Review of the occupational health and safety of Britain's ethnic minorities

Prepared by **University of Warwick** for the
Health and Safety Executive 2004

RESEARCH REPORT 221

HSE
Health & Safety Executive

Review of the occupational health and safety of Britain's ethnic minorities

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This report sets out an evidence-based review on work-related health and safety issues relating to black and minority ethnic groups. Data included available statistical materials and a systematic review of published research and practice-based reports.

UK South Asians are generally under-represented within the most hazardous occupational groups. They have lower accident rates overall, while Black Caribbean workers rates are similar to the general population; Bangladeshi and Chinese workers report lowest workplace injury rates

UK South Asian people exhibit higher levels of limiting long-term illness (LLI) and self reported poor health than the general population while Black Africans and Chinese report lower levels. Ethnic minority workers with LLI are more likely than whites to withdraw from the workforce, or to experience lower wage rates.

Some of these findings conflict with evidence of differentials from USA, Europe and Australasia, but there is a dearth of effective primary research or reliable monitoring data from UK sources.

There remains a need to improve monitoring and data collection relating to black and ethnic minority populations and migrant workers. Suggestions are made relating to workshops on occupational health promotion programmes for ethnic minorities, and ethnic minority health and safety 'Beacon' sites.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.

HSE BOOKS

First published 2004

ISBN 0 7176 2842 6

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EXECUTIVE SUMMARY

This report presents the findings of a study commissioned by the Health and Safety Executive (HSE) to provide an expert evidence-based review and assessment of:

- whether certain ethnic minority groups in Britain are disproportionately affected by work-related health and safety, outcomes, issues or activities.

It is recognised that a diverse population requires diverse responses. Following the implementation of the Race Relations Amendment Act 2000, there has been a statutory duty laid upon all NHS agencies to 'have due regard to the need to eliminate unlawful discrimination', and to make explicit consideration of the implications for racial equality of every action or policy. This report aims to enable the HSE to better ensure that the needs of workers from a range of ethnic minority backgrounds are met.

The study used two main sources of information. The first were existing databases, including data from 28 successive quarters of the Labour Force Survey (LFS) covering the period Spring 1994 to Winter 2000; the Health Survey for England (1999); and the UK Census (2001 and 1991). The second was a review of the published and grey literature on workplace injuries and accidents and work-related ill health which identified a total of nearly 600 published papers covering the period 1975 - 2003, 140 of which were considered relevant to the study.

The main points emerging from the study are presented below, followed by the main recommendations.

1. In terms of the general <u>UK ethnic minority population</u>, it is reported that:

1.1 the UK ethnic minority population is sizeable (8%), and concentrated in specific geographical areas;

1.2 this population is more youthful in age structure and therefore ethnic minorities will rise as a proportion of the working population, and as a proportion of older people in the workforce well into the 21st century;

1.3 the two main population groups are South Asian and Black (equally divided between Black Caribbeans and Black Africans);

1.4 data indicate that UK South Asian are generally under-represented in terms of employment within the most hazardous occupational groups and Black Caribbeans and Black Others are closer to the majority White population; this may be indicative of the fact that South Asian are more risk averse in their employment choice, or that they are excluded from certain occupations;

1.5 for people born abroad, the longer a person resides in the UK, the greater the likelihood of employment in the more hazardous occupations;

1.6 other survey data also indicate that South Asian have lower accident rates overall, and may be more risk averse in their general behaviour, whereas Black Caribbeans have accident rates similar to those of the general population;

1.7 some literature is available from London and Glasgow that provides limited supporting evidence of lower accident rates in the UK South Asian population. There is no literature on other UK ethnic minority groups;

1.8 because data on other ethnic population groups such as refugees/ asylum seekers and migrant workers were not available, we are not able to discuss work-related health and safety issues for these groups, although clearly migrant labour from other parts of the EU and eastern Europe is becoming increasingly important in areas such as agriculture and construction.

2. In terms of <u>workplace accidents as a whole</u>, there is evidence that:

2.1 UK workplace injury rates are lower for South Asian from the LFS data. Bangladeshi and Chinese workers report the lowest workplace injury rates, Black Caribbeans report rates similar to the white population;

2.2 although trends over time could not be analysed, the longer a person has been in residence in the UK the higher the rate of reported workplace injuries;

2.3 both these patterns are possibly linked to UK ethnic minority employment in lower risk occupations;

2.4 much US literature on occupation and workplace injuries considers ethnicity as a potentially confounding factor (along with age and gender) when comparing accident rates in different employment sectors;

2.5 where US studies do consider ethnic minorities *per se*, somewhat higher injury rates are reported for non-Whites, with narrowing of racial differences over time (greater for males than females);

2.6 there is some literature from New Zealand providing evidence of higher work-related fatal injury rates in the Maori population, although this may be due to differences in employment pattern;

2.7 the international literature is male dominated, with very little on female workers or gender differences.

3. In terms of the workplace accidents <u>in particular occupational groups</u>, it would appear that:

3.1 after controlling for a range of personal, job, and workplace characteristics, LFS data still indicate that Indians and Pakistanis are less likely than white workers to report that they had experienced a workplace accident during the previous 12 months;

3.2 although a slightly lower accident rate is reported by Black Caribbeans, a higher rate by Black Others, and the Chinese rate is lower than that of the white population, none of these are statistically significant differences;

3.3 if length of residency in the UK is considered, people born abroad are less likely to report workplace injuries in the LFS, but this difference reduces over time with no significant difference in overall 12 month accidental workplace injury rate after 10 years residence;

3.4 these patterns may be indicative of safer behaviour by South Asian in a particular occupational group. Alternatively, they may raise concerns about the quality of LFS information collected with under-reporting of their injuries by ethnic minority respondents;

3.5 further analysis of LFS data could find no evidence of differences in this pattern of reported injuries in occupational sub-groups that might be expected to differ in their likelihood of under-reporting;

3.6 these sub-groups included proxy responses (more likely for ethnic minorities); different sized establishments; public vs private sector (where injury reporting 'culture' may differ); and geographical areas (high ethnic minority concentration vs low, where any cultural pressure may be different);

3.7 the lower estimated risk of workplace injury remained for South Asian when all these sub-groups were examined, but this could still be the result of a general under-reporting of workplace injuries among all South Asian respondents;

3.8 there is very little UK literature to confirm these analyses. One study of accidents in an automobile plant found no difference in reported mean accident rates for South Asian and African Caribbean after adjustment for other factors such as age, type of job, and duration of service;

3.9 there is also very limited evidence from the US literature of ethnic minorities being at decreased risk of occupation and workplace injuries e.g. in the army for knee injury;

3.10 the US literature does however demonstrate increased risk of assault, harassment and homicide among ethnic minority workers in particular occupations, and also more negative social interactions on the job. Similar evidence is available for UK ethnic minorities from analyses of the British Crime Survey data by ethnicity.

3.11 the evidence base on immigrants and injuries or accidents at work (mostly from France) is limited; some studies report higher rates of injury and others lower rates, but rates are not systematically corrected for occupation;

3.12 research in New Zealand and Australia has identified lack of language and poor communication as possible factors for higher workplace injury rates for ethnic minorities or migrant workers, and for poorer treatment outcomes following injury.

4. In terms of UK ethnic minorities and general ill health within the working age population, it would appear that:

4.1 UK South Asian (in particular Bangladeshis and Pakistanis) in the age range 16-64 exhibit higher levels of limiting long-term illness (LLI) and self reported poor health, as identified from the UK Census;

4.2 levels of LLI and self reported poor health are particularly high for South Asian aged 50-64;

4.3 Black Caribbeans report the next highest levels of LLI and self reported poor health, after South Asian groups;

4.4 Black Africans and Chinese report lower levels i.e. better health, than the White population.

5. In terms of the UK ethnic minority workforce, <u>limiting long term illness and continued employment</u>, it would appear that:

5.1 South Asian males (in particular Bangladeshis) and Black Caribbean males are much less likely to remain in employment if they have a limiting long-term illness, as identified from UK data;

5.2 for females, this effect is even more extreme for South Asian with LLI; these women are less likely to remain in employment and Bangladeshi women with a disability actually appear to leave the workforce;

5.3 for Black Caribbean women with LLI, employment levels are similar to those of the White female population;

5.4 for individuals with a disability who remain in work, the differential drop in hourly pay rate (indicative of de-skilling) is greatest for Bangladeshi males and Chinese males and females; levels cannot be estimated for Bangladeshi females;

5.5 there is no UK literature on the subject so, it is unclear why these differential patterns exist, but it may be indicative of discrimination;

5.6 international literature from the USA and Hong Kong indicates lower incidence of awards of compensation and disability benefits due to workplace injuries for ethnic minorities. If applicable in the UK, this may possibly be a factor influencing continued employment with a limiting long-term illness;

5.7 it is thus unclear why certain ethnic groups in the UK are much less likely to remain in employment if they have a limiting long-term illness, and why those who remain in work with a disability are likely to earn a lower hourly wage rate.

6. In terms of the evidence from the <u>literature on ethnic minorities and work-related ill health</u>, we found that:

6.1 this is an *under-researched area in the UK*, with most papers from the USA. The evidence from other countries may not be generalisable to a UK setting because of the differences in ethnic minority groups and working contexts.

6.2 Research findings on ***musculoskeletal disorders*** (the most common form of work-related ill health in the UK) are mixed, with a few studies identifying a significant influence of ethnicity.

6.3 In terms of **w*orkplace stress,*** several US studies indicate that ethnic minorities experience a more negative work environment in terms of criticism, bias, and sexual harassment that can lead to stress.

6.4 The largest number of papers identified were on work-related ***breathing and lung problems***. Some evidence exists of ethnic variations in respiratory disease and cancer in workers (e.g. miners, foundry workers, rubber processers, fur workers, and grain workers) exposed to dust and other materials, after controlling for gender, age, and smoking differences.

6.5 US literature indicates that race/ethnicity is a major-effect variable for work-related ***hearing problems***, with ethnic status a significant predictor of hearing protection use.

6.6 Research findings on ***heart disease/ circulatory system disease*** are not consistent, although some studies identify a significant influence of ethnicity (e.g. smelter workers, rubber workers and fur workers).

6.7 In terms of ***skin problems*** there is limited evidence from USA studies of lower rates of dermatitis for Black American workers.

6.8 There is evidence (including some from the UK) of ethnic differences in work-related ***infectious diseases*** such as TB and hepatitis B or C, including drug-resistant TB in migrant and seasonal farm workers.

6.9 Finally, ***work place exposure*** studies identify higher blood lead concentration among ethnic minorities in lead industry workers, possibly due to eating with fingers.

6.10 ***Occupational health promotion programmes and safety training***: The few articles on occupational health programmes identified in this brief review were all from the USA. These indicate the existence of major issues for ethnic minority populations such as lower enrolment, retention and participation of minorities as well as problems of communication. The essential features of cross-cultural programmes are discussed in only one paper identified.

7. Main recommendations:

Because the main finding from our project is a lack of UK research evidence on ethnic minority populations and work-related health and safety issues, many of our recommendations are designed to improve the evidence base available.

Although our data re-analysis indicates that the behaviour of the UK ethnic minority workforce is unlikely to disproportionately affect the successful achievement of targets for reduced work-related injuries and accidents in HSE priority areas, especially for the South Asian workforce, there remains a need to examine other data sources **and** consider ways of improving future data collection with respect to both resident black and ethnic minority populations and migrant workers in order to confirm this.

In terms of national targets for reducing the number of working days lost due to ill health and the incidence rate of cases of work related ill health, key areas for action are: collation of existing data/ evidence for key conditions/diseases where non-UK literature has identified the likelihood of raised rates of work-related ill health in ethnic minority populations; further investigation of the large differences observed in limiting long-term illness and its impact on employment status in ethnic minority populations; the need to improve the evidence base on work-related ill health in ethnic minority populations; and promotion of evidence-based good practice in terms of occupational health programmes for the ethnic minority workforce.

Specific recommendations include:

Work-Related Injury/ Accident Rates:

- That HSE commission a further study to collect evidence on work-related health and safety issues for migrant workers.

- Additional research is required to consider whether particular ethnic groups interpret differently questions relating to workplace accidents that may in turn lead to additional under-reporting among such groups.

- That HSE undertake an exploratory analysis by ethnic group/ occupation of existing Workplace Health and Safety Surveys, and an option appraisal of an ethnic booster sample in the forthcoming WHASS versus conduct of smaller in-depth surveys in specific industries.

- That a systematic examination be undertaken for HSE of the health and safety requirements of populations with language needs.

Work-Related Ill Health:

- That an analysis of existing Self-reported Work-related Illness Survey (SWI) data by ethnicity be undertaken, and a small number of questions on work-related ill health be included in the future Health Survey for England.

- That research be commissioned by the HSE/ Department for Work and Pensions to identify and explore the key issues associated with limiting long-term illness and changes in employment status for ethnic minority workers, and any possible links between previous occupation/ industry and high levels of 'chronic impaired-health' among South Asian aged 50-64.

- That a national workshop be convened to consider the possibility of collating any existing data/ evidence for key conditions/diseases where raised rates of work-related ill health are likely in ethnic minority populations.

Occupational Health Promotion:

- That the HSE commission a more detailed review and workshops on occupational health promotion programmes for ethnic minorities to promote good practice, and considers the establishment of ethnic minority health and safety 'Sentinel' or 'Beacon' sites.

CHAPTER 1
GENERAL INTRODUCTION

1.1 STUDY OVERVIEW

This report presents the findings of a study commissioned by the Health and Safety Executive (HSE) to provide an expert evidence-based review and assessment of:

- whether certain ethnic minority groups in Britain are disproportionately affected by work-related health and safety, outcomes, issues or activities.

The study had three main objectives:

1. to identify whether ethnic minority groups are disproportionately represented in high risk occupations or industries;

2. to identify whether ethnic minority groups suffer disproportionately from workplace injuries or work-related ill-health;

3. to develop and provide a clear methodology, producing an evidence base that could be independently assessed.

The study supports the Health and Safety Commission's strategic plan for 2001-2004 and in particular the HSC Strategic Plan's requirement for HSE to "pay particular attention to the needs of ethnic minorities in developing programmes". The findings of the study should enable the HSE to better ensure that the needs of workers from a range of ethnic minority backgrounds are met.

Numerous studies have attempted to estimate the impact of various factors upon the incidence of workplace injuries. The emphasis of the empirical analyses varies between studies. For example, previous analyses have considered the effects on workplace injuries of unions and consultation committees (Beaumont and Harris, 1993), incentive systems (Nichols and Armstrong, 1973, Beaumont, 1980; Wrench and Lee, 1982; Dwyer and Rafferty, 1991 Hofmann and Stetzer, 1996) and shift-working (Hood and Milazzo, 1984; Minors et al, 1986). However, in order to consider the effects of such factors upon workplace injuries, most analyses rely upon the specification and estimation of statistical models that attempt to control for other determinants of industrial accidents in order that the study hypothesis can be addressed. This level of determination tends, therefore, to exclude all factors not explicitly addressed and leads to other potential influences, such as ethnicity, being ignored.

Recent research for the UK has been based upon the cross sectional analysis of micro level data. For example, Reilly, Paci and Holl (1995) and Nichols, Dennis and Guy (1995) used data from the 1990 Workplace Industrial Relations Survey to consider respectively the effects of trade unions and establishment size on workplace injury rates at the level of the establishment. McKnight and Elias (2001) provide a detailed analysis of how the characteristics of individuals and their jobs contribute towards the risk of an industrial injury. Utilising multivariate logistic regression techniques on individual level data from the UK Labour Force Survey, McKnight and Elias (2001) find that:

- the higher risk of workplace injury observed for males is not wholly attributable to the higher risk occupations (manual jobs) in which men work. Even after adjusting for these effects males have a 20% higher risk of workplace injuries than females;
- workers aged 16 to 24 have the highest risk of experiencing a workplace injury;
- workers are most likely to suffer a workplace injury during the first 12 months of employment, particularly the first 6 months in a new job. The risk of workplace injury declines as workers gain experience and job tenure increases. The growth in the use of temporary workers on short term contracts may expose a greater proportion of workers to accidents at work;
- workers employed in small workplaces (1-10 employees) have lower injury rates than those in larger workplaces, regardless of whether or not the accident is deemed 'reportable';
- certain occupations have a high relative risk of injury. Most notably these are *skilled metal & vehicles trades and unskilled transport occupations;*
- the higher risk of workplace injury observed in the construction sector is associated with the high-risk occupations that predominate in this sector. After taking account of occupational structure, the construction sector appears no less risky than the health and social work sector.

This study reveals that, although variations are observed across a variety of personal and workplace characteristics, the dominant influence that affects the risk of suffering a workplace injury is occupation. Differences in the rates of workplace injuries that exist across industrial sectors can largely be explained by the risks associated with occupations that predominate in these sectors. This analysis however did not address the issue of ethnicity in detail. In Chapter 5, we expand upon this analysis by introducing measures of ethnicity into such statistical models.

1.2 ETHNICITY AND DESCRIPTORS USED

There are many problems in attempting to analyse data and research reports with reference to the concept of 'ethnicity' or 'ethnic groups'. Historically, and in some journals and scientific papers still, terms are used relating to traditional anthropological definitions of four major human 'races', most notably using the term 'Caucasian' (meaning 'white', Europid, or European), while others have largely fallen into disuse, especially the terms 'Negroid' (Black or African), 'Mongoloid' (Asian, Chinese or Indic), and 'Australoid'. Strictly, 'Caucasian' groups include most of the population of the Indian sub-continent, although this is rarely recognised. North American (USA and Canadian) researchers use a compilation of terms, describing people in two dimensions of 'colour'/geographical origin (Caucasian/White/European; Black/African; Pacific Islander/Asian; and 'native American' or similar) as well as a cross-cutting category of 'Hispanic' (Spanish-speaking, or of Latin American/Puerto-Rican or possibly Filipino origin) and non-Hispanic. In European countries, except the UK and the Netherlands, it is more common to refer to 'Migrants' and 'migrant minorities' and the collection of data on 'race', 'ethnicity' and religion may be illegal although birthplace (and that of parents) may still be recorded.

The concept of 'ethnicity' is complex, but recognises that people identify themselves with a social grouping on cultural grounds including language, lifestyle, religion, food and origins. The basis of 'ethnicity' is thus often a tradition of common descent or intermarriage and shared culture or history. It is essential to recognise that, in a world of migration and mixing, cultures

and societies are dynamic rather than fixed, although there may be a genetic component that may have a specific implication for health (as in respect of sensitivity to certain chemicals, such as that found in people sharing a genetic trait as Glucose 6- Dehydrogenase deficiency). The UK Race Relations Act 1976 defined a 'racial group' as 'a group of persons defined by reference to colour, race, nationality or ethnic or national origins...'. 'Ethnicity' and 'ethnic group' became more formally defined in UK law by a House of Lords decision (Mandla v Lee 1983) as relating to those with 'a long shared history and a distinct culture'. Other 'relevant' characteristics were 'a common geographic origin or descent from a small number of common ancestors; a common language; a common literature; a common religion; and being a minority within a larger community'. There was however even at that time no single agreed set of official statistics or definitions for use in data collection within the UK.

Table 1.1 Categories of ethnic group recorded in the UK Censuses of 1991 and 2001

1991	*2001*
White	White – British White – Irish White – Any other White background (please write in)
Black – Other Other – Other Other – Other Other – Other	Mixed – White/Black Caribbean Mixed – White/Black African Mixed – White/Asian Any other mixed background (please write in)
Black- Caribbean	Black or Black British: Caribbean
Black- African	Black or Black British: African
Black- Other (Please describe)	Black or Black British: Any other background (please write in)
Indian	Asian or Asian British Indian
Pakistani	Asian or Asian British Pakistani
Bangladeshi	Asian or Asian British Bangladeshi
Asian- Other (Please describe)	Asian or Asian British Any other background (please write in)
Chinese	Chinese or Other Ethnic group Chinese
Any Other Ethnic Group (Please describe).	Chinese or Other Ethnic group Any other: (please write in)

(Adapted from ONS forms: reproduced with permission)

In terms of epidemiological research otherwise, the tendency has been to rely upon the commonly recorded variable 'place of birth', normally available on death certificates. However,

this has been problematic. Even at the time of the 1991 Census, over half the population in the 'Black' categories (54% Black Caribbean, 84% Black Other, and 36% Black African) were UK-born, as were half of those giving their ethnic group as Pakistani, 42% of 'Indians' and 37% of 'Bangladeshis'. It is now estimated that less than 40% of the black and minority ethnic population can be identified by birthplace, and increasingly few by the birthplace of their parents.

For practical purposes, there is little alternative to using a selection of labels and nested categories such as the ethnic groups identified by the Office of National Statistics in the decennial UK Census. For the majority of this report, we have been forced to rely on data using the categories first used in the 1991 Census, which are different from, although related to, those recorded in the Census in 2001. The latter were not in general use before 2001, and the Labour Force Survey data accessed for this study has consistently used the 1991 census categories in the years for which data analysis was conducted. Earlier rounds of the LFS did not record ethnic origin in this format. In other parts of the report, notably in the discussion of the research literature, we have used the terms found in the papers reviewed, which inevitably reflect their countries and periods of origin, and may not relate easily to modern UK usage.

1.3 MULTI-ETHNIC POPULATION IN THE UK

In recent decades, the number of people from "minority ethnic groups" within the UK has increased substantially. The minority ethnic groups of policy interest comprise people who (unlike most European national minorities) are visibly identifiable because their skin colour is brown or black, and whose family origins lie in the countries of the "New Commonwealth": the Indian sub-continent, South-east Asia, the Caribbean and Africa south of the Sahara. Though small numbers of such people have lived in the UK for centuries, the minority population increased dramatically during the second half of the twentieth century.

The growth of the minority ethnic group population of Great Britain began in the era of mass immigration from the New Commonwealth, which lasted from the passing of the British Nationality Act in 1948 to the mid-1970s. The minority ethnic group population of England and Wales increased from 103,000 in 1951 to 415 thousand in 1961 (Eversley and Sukdeo, 1969), and to 1.2 million in 1971 (Runnymede Trust and Radical Statistics Group, 1980). The rapid growth of the minority ethnic group population has been maintained. The numerical increase was about 90 thousand per annum during the 1970s and 1980s (Shaw, 1988). Hence, the total minority population reached 2.1 million in 1981 (Labour Force Survey estimates) and was measured to be 3.1 million by the 1991 Census of Population (the first to classify the British population by ethnic group). The 1990s saw an even faster rate of growth; the 2001 Census revealed that the minority population of the UK was 4.6 million (8 per cent of the population). Figure 1.1 depicts the steady growth of the minority population and its growing share of the population of Great Britain, from 1.7 per cent in 1966/7 to over 7 per cent in 1998-2000.

Rapid minority population growth has counterbalanced the slow growth (and net emigration for much of the post-war period) of British-born white people. Walker (1977) estimated that immigration from 1951 onwards increased the total population of England and Wales by 630 thousand over the period 1951-76 and that the cumulative number of births due to immigration was 330 thousand by 1976. Coleman (1995) estimated that the population of England and Wales in 1991 was around 3 million greater than it would have been in the absence of the minority ethnic group population. Since then, growth in the white population of Great Britain has virtually stopped, and the minority population now accounts for almost all the growth in the population of Great Britain. The components of population change will now be considered in greater detail.

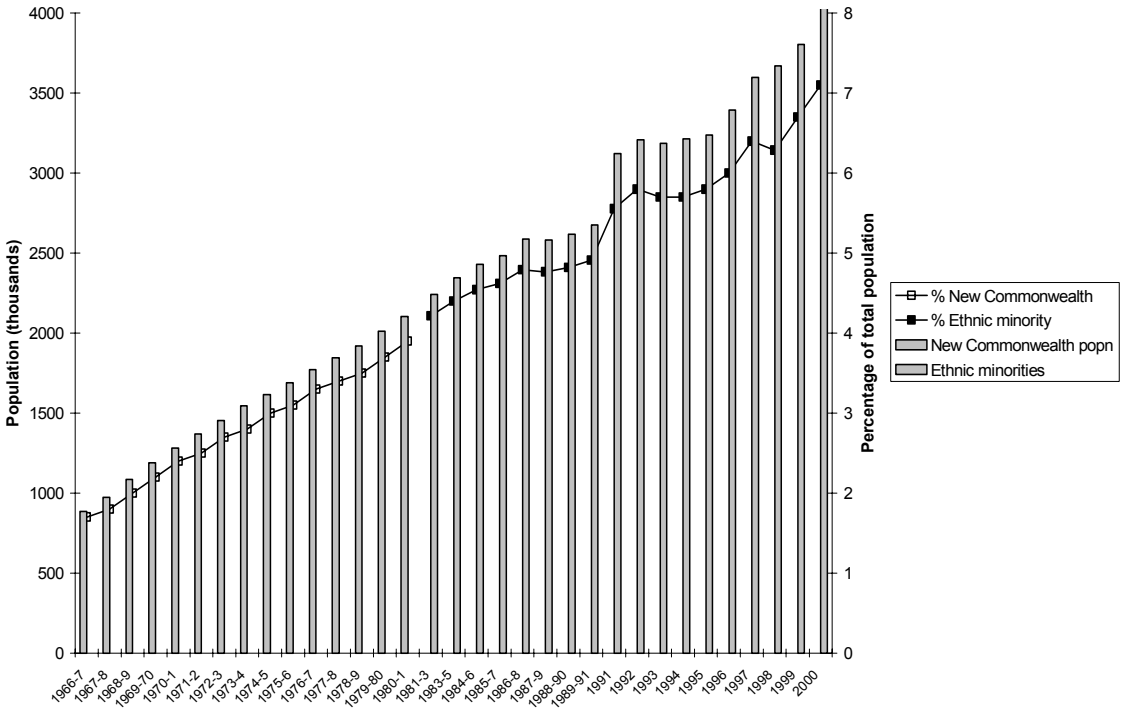

Figure 1.1 Growth in the minority population of Great Britain, 1996/7 to 2000, 2001

Source: ONS estimates to 1981, then Labour Force Survey. (2001: ONS Census data)

1.3.1 International migration and demographic change

From the end of World War 2 until the early 1980s, with the exception of the peak years of immigration at the beginning and end of the 1960s (which preceded the passing of the Immigration Acts of 1962 and 1968), the number of emigrants exceeded the numbers migrating to the UK. Immigration from the New Commonwealth started in the late 1940s and reached a peak in the late 1950s and early 1960s (Figure 1.2). Immigration from the Caribbean was largely curtailed by the Commonwealth Immigrants Act of 1962, while the Immigration Act of 1971 had a similar effect upon primary immigration from the Indian sub-continent (Salt 1996), though the migration of dependants continued. The migration of people from Pakistan and Bangladesh in search of work ended later and the migration of family members from these countries has also lasted longer than the corresponding flows from India and the Caribbean. (There is also a continuing in-flow of fiancés and newly-married spouses for some (mainly South Asian) ethnic groups.)

New flows of migrants developed during the 1980s and 1990s. Initially these flows comprised Chinese (mainly from Hong Kong) and Black-African people (many of whom arrived as students) together with students from other parts of South East Asia. This was followed by the arrival of increasing numbers of asylum-seekers (predominantly from Africa, the Middle East and countries such as Sri Lanka). The revival in net immigration from the New Commonwealth is shown in Figure 1.3, which illustrates both the doubling in the number of immigrants and the decline in the number of emigrants.

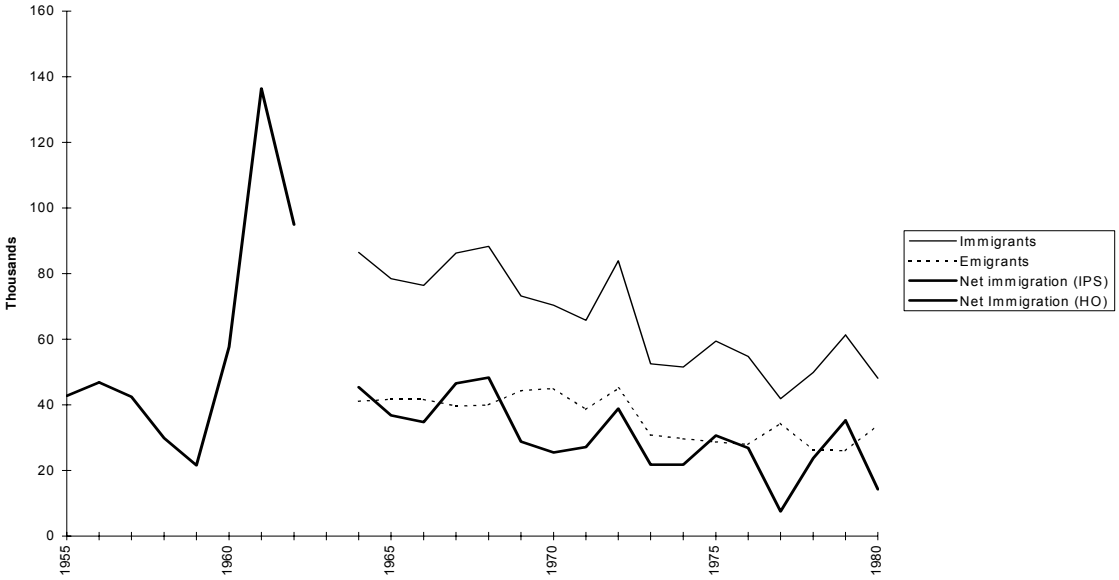

Figure 1.2 Migration from the New Commonwealth to the UK, 1955-1980

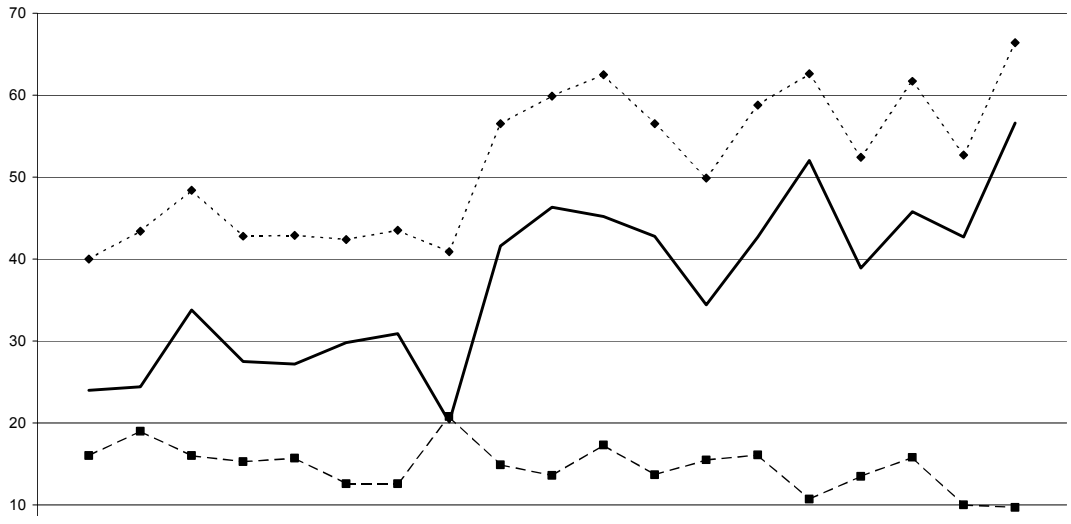

Figure 1.3 Migration to the UK from the New Commonwealth, 1981-1999

Since the early 1980s, the UK has gained population each year through net international migration. The total number of emigrants has remained fairly constant, but the annual number of immigrants has followed a rising trend, and hence the volume of net immigration has steadily increased. Annual net immigration was around 50 thousand during most of the 1980s and early 1990s, peaked at 100 thousand in the late 1980s and 1990s, but exceeded 100 thousand in the late 1990s, reaching 189 thousand in 1998-99 (this includes the substantial growth in the number of asylum-seekers entering the UK). In total, there was a net gain to the UK population of some 1.2 million people between 1981 and 1999 (Dobson and McLaughlan, 2001, 30).

There has been increased migration from both the Old and New Commonwealths and the rest of the European Union during the 1990s, but also a substantial increase in migration from the rest of the world. Figure 1.4 demonstrates that the latter has increased faster than other geographical sources of immigration during the last decade and is now the largest component of net immigration. This increase coincides with the increase in the number of asylum-seekers (experienced by all European countries), but there is clearly an economic influence on this migration flow, since the peaks in migration from the rest of the world (in the late 1980s and late 1990s) coincide with periods of very high UK economic growth. This upward trend in international migration also reflects the falling costs of international travel and increased recruitment of overseas students.

Figure 1.4 Net migration to the UK by citizenship

In the 2000-based set of population projections from the Government Accounting Office, the population of the UK is projected to reach 64.7 million in 2025. These projections assume that annual net immigration will be 135 thousand for most of this period, accounting for two-thirds of total population growth (3.4 million people). However, migration trends are very difficult to forecast, and hence projections of future population are subject to extreme uncertainty.

Different migrant ethnic groups have entered the UK at different period in time. Table 1.2 presents the percentages of all persons from each ethnic group present in the UK during 1998-2000 who entered the country before 1970, from 1970 to 1989 and from 1990 onwards,

alongside the percentage of each ethnic group born in the UK. Just over half of all people from minority ethnic groups were born in the UK. Persons of mixed parentage (Black – Mixed and Other –Mixed) are most likely to have been born in the UK, together with the Black-Other ethnic group (mainly people of Caribbean parentage who prefer to describe themselves as "Black British"). The percentage of Black people born in the UK is greater than that of the South Asian or "Chinese and Other" ethnic groups, but only just over a third of Black-African people are UK-born.

Table 1.2 Percentage born in the UK, or entering the UK in each time period, 1998-2000

Labour Force Survey ethnic group	*Born in the UK*	*Overseas*		
		pre 1970	*1970 to 1989*	*1990 onwards*
White	95.5	1.9	1.2	1.4
Minority ethnic groups	**49.5**	**13.2**	**21.3**	**16.0**
Black ethnic groups	***58.7***	***15.3***	***9.8***	***16.2***
Black - Caribbean	58.5	31.1	5.7	4.7
Black - Mixed	88.6	2.3	3.3	5.8
Black - African	35.3	4.5	20.3	39.9
Black - Other(non-mixed)	89.7	3.4	3.0	3.8
South Asian	***47.4***	***14.6***	***26.8***	***11.2***
Indian	43.8	18.5	28.5	9.2
Pakistani	53.9	11.6	21.1	13.4
Bangladeshi	44.8	7.6	34.3	13.2
Chinese & Other	***40.2***	***6.9***	***26.2***	***26.8***
Chinese	26.2	9.6	34.8	29.4
Other - Asian(non-mixed)	19.5	6.4	35.4	38.6
Other - Other(non-mixed)	32.6	4.8	30.7	32.0
Other - Mixed	72.9	7.2	9.3	10.6
All ethnic groups	**92.5**	**2.7**	**2.5**	**2.3**

Source : Labour Force Survey, average for Spring 1998 to Winter 2000/1

This table highlights the recent increase in migration to the UK, fuelled by demand for labour and the increased availability of migrant labour (stimulated by economic crises and wars in countries of origin, greater awareness of employment opportunities in the developed world and the dramatically falling cost and increasing ease of international travel). These migration flows have been focussed upon London, where increasing incomes have caused a house price boom which has made it difficult for people to migrate from other parts of the UK to take up low-paid jobs in the public sector and service sector industries. Seasonal and short-term legal migrants and people working on student visas have provided labour for employers often paying less than the national minimum wage. Unemployed people in London have been deterred from competing for these jobs by the very low wages on offer, while illegal and irregular workers accept a much poorer standard (which is hence much cheaper) of accommodation. In addition, managers in the public sector have recruited experienced workers from overseas in order to meet the performance targets set by the government for public sector services, and consequently the number of work permits issued has massively increased since 1997.

Illegal and irregular immigration has also increased greatly as unscrupulous employers in construction and agriculture have recruited such workers to jobs paid at below minimum wage. These workers and the "gangmasters" providing labour to employers seek to avoid official

regulation, and the substantial flows of short-term and seasonal workers are not counted by any official statistical exercise. Food processing and packing have recently become notorious as sectors in which these practices are extremely common.

There are few statistics on less visible minority ethnic groups such as gypsies, Roma, "showmen" or "travellers" (Irish or otherwise). Official statistical data collection exercises tend to miss people without permanent addresses and smaller ethnic groups are not reported in published output, because the numbers involved are so small that publication may involve infringement of confidentiality while comparisons based on such small numbers are not statistically significant and are therefore not published. Levels of education are low, as is health quality and people from these ethnic groups tend to be self-employed, working as contractors in construction, agriculture and dealing. The Office of the Deputy Prime Minister monitors the number of permanent and semi-permanent traveller sites and the number of caravans they can accommodate. The "traveller" population of the UK is estimated at 120,000 to 150,000 of which around 50% now live in houses (Morris and Clements 1999; Kenrick and Clark 1999). In July 2001 the DETR count showed 13,802 caravans in England, 44.9% on authorised council sites, 30.8% on authorised private sites and 24.2% on unauthorised sites elsewhere.

1.3.2 Ethnic composition of the population in 2001

The 2001 Census of Population provides the most up-to-date and comprehensive picture of the ethnic composition of the UK population. For the first time, people living in Northern Ireland were asked to record their ethnic group. The classification used by the 2001 Census (see Table 1.1) was a revised version of that used in 1991, designed to better represent people of mixed parentage, Irish people and people from Black ethnic groups.

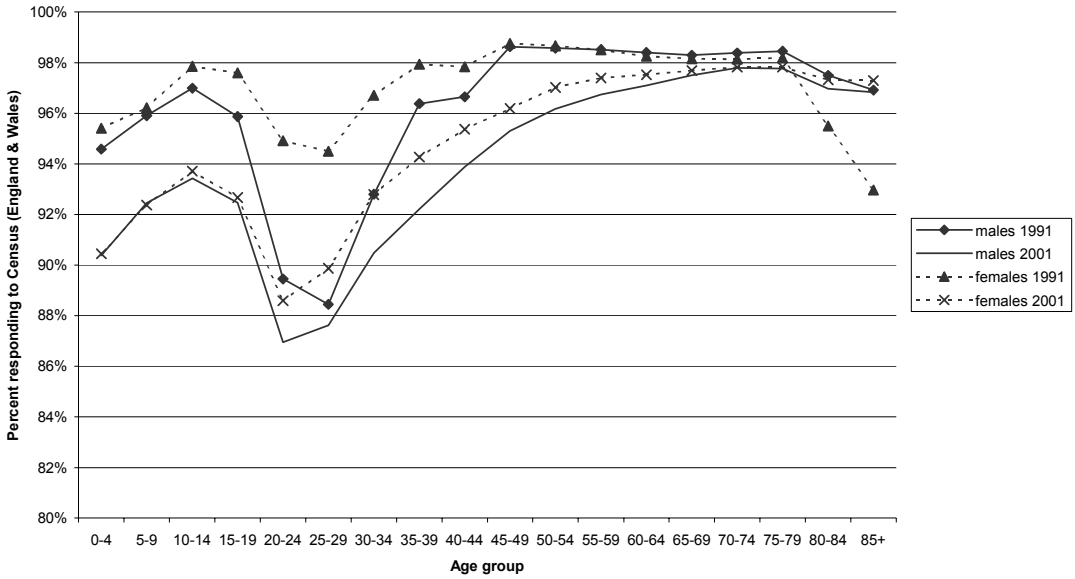

Figure 1.5 Percentage responding to the 1991 and 2001Censuses of population

No information is yet available on how successful the 2001 Census was in measuring the minority ethnic group population of the UK. The overall percentage of the population by age group and gender which responded to the Census is presented in Figure 1.5, which contrasts the response rate for 2001 with that for 1991. In 1991, on the basis of their age/sex structure, it was estimated that minority ethnic groups were slightly more likely not to respond than the white population, and that the undercount was most marked for men aged 16-34. A common experience of social surveys is that young Black men are least likely to respond (often because of high levels of residential mobility), but people from South Asian ethnic groups are often more likely than average to respond. However, the response rate declined for all age groups between 1991 and 2001, possibly because of the innovations adopted for the 2001 Census (e.g. postal return). Nevertheless, given the uncertainty surrounding other population estimates, the Census remains the best estimate of the ethnic composition of the UK population.

The breakdown of the UK population by ethnic group is presented in Table 1.3 and illustrated graphically in Figure 1.6. The total minority population in 2001 was 4.6 million (or 7.9 per cent). The largest category was South Asian people, accounting for 2 million people or 3.5 per cent of the population, half of whom were Indian. There were 1.15 million Black people, with more than half a million Black-Caribbean people. The Black African population has grown very rapidly to be almost as large as the Black Caribbean population, which is much longer established. Many of the children of Black-Caribbean parents are allocated to the Mixed parentage ethnic groups, which contain 677 thousand people, almost as many as the number of people from Chinese and Other ethnic groups.

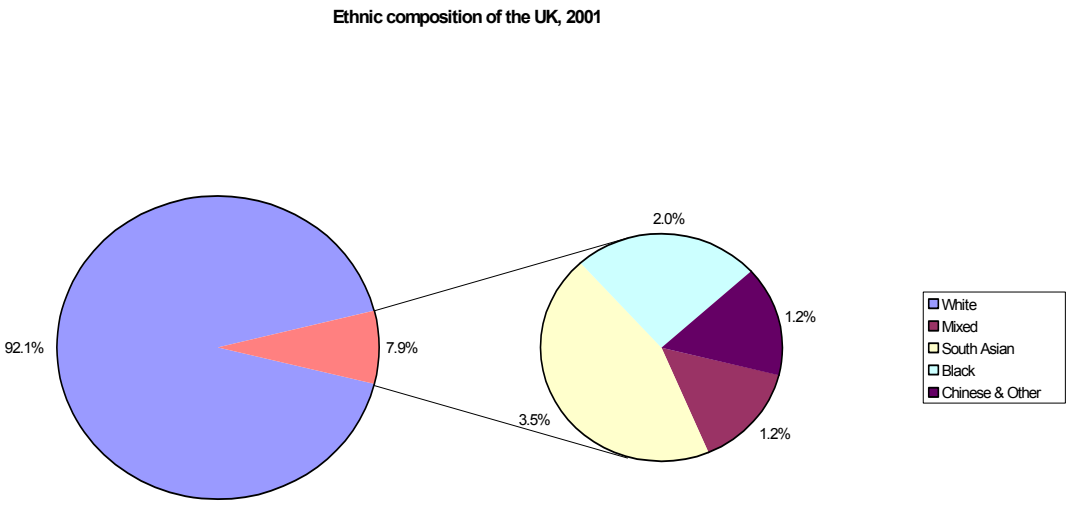

Figure 1.6 Broad ethnic breakdown of the UK population, 2001

Table 1.3 Ethnic composition of the UK, 2001

Ethnic group	*Number (000s)*	*Percent*	*Males per 1000 females*	*Mean age in years*	
				Males	*Females*
White	54153.9	92.1	944	38.2	40.9
Mixed parentage	677.1	1.2	968	20.1	21.3
South Asian	***2083.8***	***3.5***	***1008***	***28.7***	***28.7***
Indian	1053.4	1.8	990	32.0	32.4
Pakistani	747.3	1.3	1028	25.8	25.5
Bangladeshi	283	0.5	1021	24.3	23.2
Black	***1148.7***	***2.0***	***896***	***30.6***	***31.3***
Black Caribbean	565.9	1.0	864	35.4	35.8
Black African	485.3	0.8	932	26.6	27.1
Black Other	97.6	0.2	907	23.8	25.3
Chinese & Other	***725.7***	***1.2***	***974***	***30.7***	***31.8***
Chinese	247.4	0.4	929	30.7	32.2
Other Asian	247.7	0.4	1212	31.5	31.1
Other ethnic groups	230.6	0.4	808	29.7	32.1
Minority ethnic groups	***4635.3***	***7.9***	***968***	***28.2***	***28.8***
All ethnic groups	**58789.2**	**100.0**	**946**	**37.4**	**39.9**

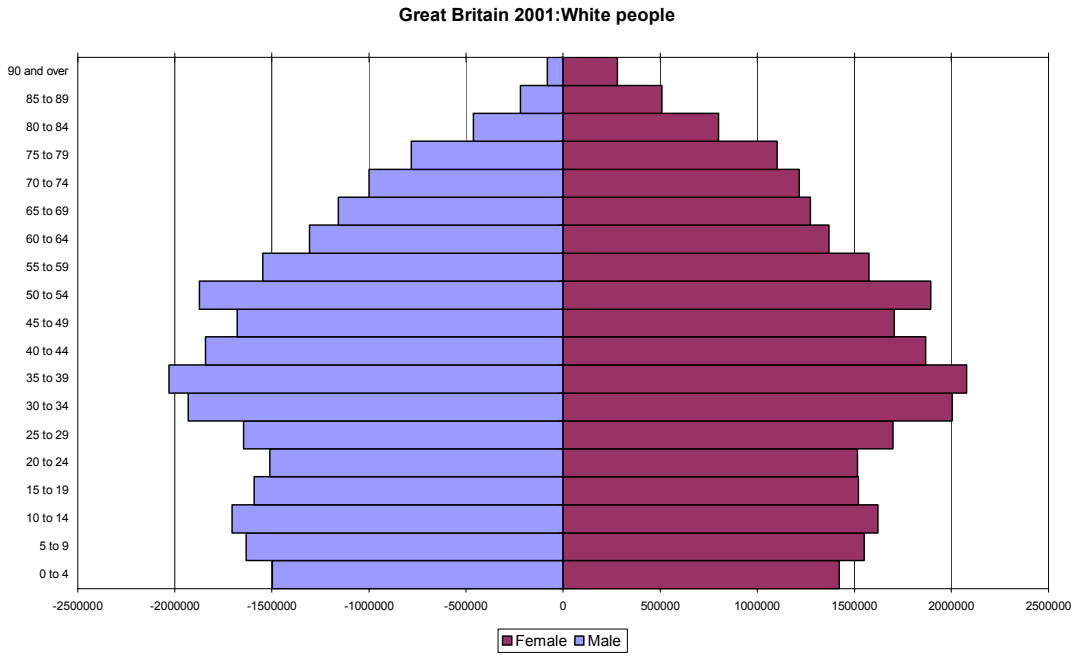

Figure 1.7 Population pyramid for Great Britain 2001: all ethnic groups

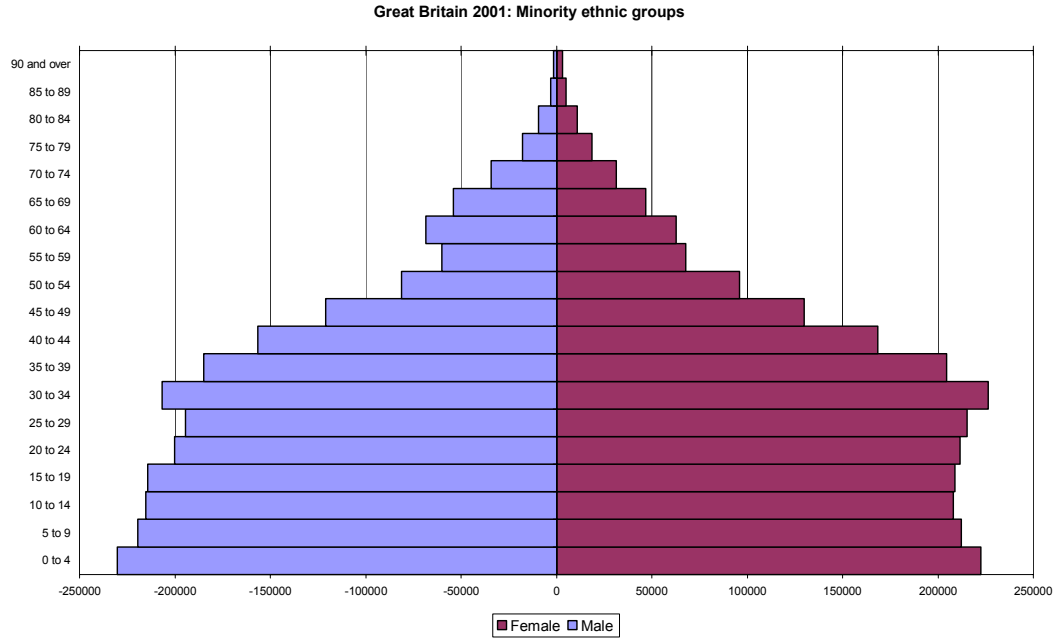

Figure 1.8 Population pyramid for Great Britain 2001: minority ethnic groups

Overall, females outnumber males, accounting for a larger share of the white population than of the population of people from minority ethnic groups. The female share of the population is greatest for Black people, especially Black-Caribbean people, and smallest in the "Other Asian" (mainly people from South-east Asia), Pakistani and Bangladeshi ethnic groups.

On average, women are 1.5 years older than men, with white women being just over 40 on average. In contrast, the mean age of people from minority ethnic groups is about ten years less, with little difference between men and women. Among minority ethnic groups, Black-Caribbean people are oldest on average, followed by Indian, Other Asian and Chinese people. At the other extreme, the mean age for people of mixed parentage is just over 20, with Pakistani and Bangladeshi people around 24 or 25 on average. The more youthful age structure of minority ethnic groups relative to white people is apparent from a comparison of Figures 1.7 and 1.8. The number of people in each 5-year age group is largest for 30-55 year olds, declining for each younger age group. This reflects the "baby booms" of the late 1940s and 1960s, and the decline in fertility thereafter. In contrast, the shape of the minority pyramid is more triangular, with children outnumbering older people, indicating that population growth will remain rapid well into the 21st century. However, the number of people of retirement age from both white and minority ethnic groups will increase substantially in the next few decades.

Data on religion was collected by the Census in England and Wales for the first time in 2001 (Table 1.4). Among people who answered the religion question, more than three-quarters declared themselves to be Christian, while 16.1 per cent professed not to have a religion. The largest minority religion was Islam, with more than 1.5 million Muslims enumerated. There were over half a million Hindus, and 329 thousand Sikhs. Overall, 6.3 per cent of those who answered the question had a religion drawn from one of the minority religions identified. Men were more likely than women to report they had no religion, were less likely to be Christian and more likely than women to be Muslim.

Table 1.4 Religious breakdown of England and Wales, 2001

	Males (000s)	*Percent with belief*	*Females (000s)*	*Percent with belief*
Christian	17442.2	74.9	19896.3	80.4
Buddhist	71.9	0.3	72.6	0.3
Hindu	278.7	1.2	273.8	1.1
Jewish	124.8	0.5	135.2	0.5
Muslim	798.6	3.4	748.0	3.0
Sikh	164.7	0.7	164.7	0.7
All other religions	72.1	0.3	78.6	0.3
No religion	4344.7	18.6	3364.6	13.6
All with religious belief	23297.5	100.0	24733.7	100.0
Religion not stated	2028.4	8.0	1982.3	7.4
ALL PEOPLE	**25326.0**		**26716.0**	

1.3.3 Geographical distribution of minority population, 2001

Migrants from the New Commonwealth who came to Britain in the 1950s and 1960s in search of work tended to settle in London, Birmingham and other industrial cities and towns of the midlands and northern England, where jobs in manufacturing industry and public sector services were readily available. Minority ethnic groups are highly concentrated geographically within the UK. The main areas of concentration are Greater London, the West Midlands, Greater Manchester, West Yorkshire and the Leicester/Nottingham corridor in the East Midlands (Table 1.5). More than a quarter of the population of Greater London is from minority ethnic groups, while a fifth of the population of the West Midlands (former) metropolitan county is from a minority ethnic group. Elsewhere, the minority share of the population only exceeds the UK average in Greater Manchester. At the other extreme, only just over 2 per cent of the populations of the Northern region of England, Wales and Scotland (and less than 1 per cent of the Northern Ireland population) are from minority ethnic groups.

Table 1.5 Minority population change by region, 1971-2001

Region, country or metropolitan county	*Population 2001 ('000s)*	*% change 1971-2001*	*Minority ethnic group population*				
			1971	*1981*	*1991*	*2001*	
			Percent	*Percent*	*Percent*	*Percent*	*Number*
South East	18386.9	12.7	4.3	7.4	9.9	13.4	2460.5
- Greater London	*7172.1*	*-0.6*	*7.9*	*14.3*	*20.2*	*28.8*	*2068.9*
East Anglia	2174.0	35.2	0.7	1.5	2.1	3.2	69.0
South West	4928.4	26.4	0.8	1.5	1.3	5.2	585.8
West Midlands	5267.3	5.3	4.1	6.4	8.2	11.3	593.0
- West Midlands MC	*2555.6*	*-7.0*	*6.8*	*10.9*	*14.6*	*20.0*	*512.4*
East Midlands	4172.2	17.6	2	3.7	4.8	6.5	271.8
Yorkshire&Humberside	4964.8	4.1	1.9	3.2	4.5	6.5	323.6
- West Yorkshire	*2079.2*	*2.7*	*3.4*	*5.9*	*8.2*	*11.4*	*236.4*
North West	6242.2	-3.1	1.3	2.7	3.9	5.9	370.7
- Greater Manchester	*2482.3*	*-7.5*	*2.1*	*3.9*	*5.9*	*8.9*	*221.8*
North	3003.0	-2.2	0.4	0.9	1.3	2.1	63.6
- Tyne & Wear	*1075.9*	*-9.6*	*0.4*	*1*	*1.8*	*3.2*	*34.0*
Wales	2903.1	9.2	0.4	0.9	1.5	2.1	61.6
Scotland	5062.0	0.2	0.4	-	1.2	2.0	101.7
Great Britain	**57103.9**	**9.0**	**2.4**	**4.2**	**5.5**	**8.1**	**4622.7**

In spite of the general tendency for people to leave the cities and move to smaller towns and rural areas, and the massive loss of jobs in the larger urban areas, people from minority ethnic groups have remained geographically concentrated into the major cities. Table 1.5 demonstrates that the share of minority ethnic groups in the main areas of settlement steadily increased between 1971 and 2001, at the same time as these regions and metropolitan counties were losing population in relative terms to the areas of more recent employment growth, notably East Anglia and South West England. Thus, the spatial separation between the white and minority ethnic groups has been maintained over this period. Since the mid-1980s, the population decline of the larger cities has been halted by the growth of the minority ethnic group population, and London's population has been increasing over this period, driven by high rates of net international migration.

Table 1.6 emphasises the regional concentration of minority ethnic groups within the UK. Greater London contains only one-eighth of the population of the UK, but nearly half the minority population (and a fifth live in Inner London). A further eighth lives in the West Midlands metropolitan county. More than two-thirds of people from Black ethnic groups live in Greater London, the bulk of the remainder living in the West Midlands metropolitan county and the South East beyond London. More than a third of South Asian people live in Greater London (a larger share of whom live in Outer London), with the second largest concentration being in the West Midlands, followed by the North West, Yorkshire and the Humber and the East Midlands.

Table 1.6 Regional distribution of ethnic groups

Government Office Region	*All people*	*All*	*White*	*Mixed*	*South Asian*	*Black*	*Chinese & Other*	*Minority ethnic groups*
ENGLAND	49138.8	83.6	82.5	95.0	96.5	98.6	92.8	96.2
NORTH EAST	2515.4	4.3	4.5	1.8	1.5	0.3	1.9	1.3
NORTH WEST	6729.8	11.4	11.7	9.2	10.3	3.6	7.6	8.1
Greater Manchester (Met County)	2482.3	4.2	4.2	4.9	6.3	2.6	3.9	4.8
YORKSHIRE & HUMBER	4964.8	8.4	8.6	6.6	10.1	3.0	4.7	7.0
West Yorkshire (Met County)	2079.2	3.5	3.4	3.7	8.3	1.8	2.4	5.1
EAST MIDLANDS	4172.2	7.1	7.2	6.4	7.5	3.4	4.4	5.9
West Midlands (Met County)	2555.6	4.3	3.8	8.1	15.6	8.3	5.3	11.1
WEST MIDLANDS	5267.3	9.0	8.6	10.8	17.5	9.1	7.0	12.8
EAST	5388.1	9.2	9.5	8.6	5.2	4.2	6.7	5.7
LONDON	7172.0	12.2	9.4	33.4	35.2	68.1	45.0	44.6
Inner London	2766.1	4.7	3.4	15.9	12.3	39.6	17.9	20.5
Outer London	4406.0	7.5	6.1	17.5	22.9	28.6	27.0	24.1
SOUTH EAST	8000.7	13.6	14.1	12.7	7.8	5.0	11.8	8.4
SOUTH WEST	4928.4	8.4	8.9	5.5	1.3	1.8	3.7	2.4
WALES	2903.0	4.9	5.2	2.6	1.1	0.6	2.0	1.3
SCOTLAND	5062.0	8.6	9.2	1.9	2.3	0.7	4.4	2.2
Great Britain	57104.0	97.1	96.9	99.5	99.9	99.9	99.2	99.7
NORTHERN IRELAND	1685.3	2.9	3.1	0.5	0.1	0.1	0.8	0.3
United Kingdom	58789.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Figure 1.9 presents the detailed local distribution of the minority population of Great Britain in 2001. This highlights the highly localised geographical distribution of people from minority ethnic groups within regions. The largest concentrations of people from minority ethnic groups occurred in Greater London, the West Midlands, the Pennine towns and the cities of the East Midlands. A

general spread of the minority population outwards into the remainder of the South East and into the Midlands and North West is apparent. However, in Wales and Scotland the minority population remains concentrated in the major cities and the minority share of the population remains very small in the areas of England outside the main axis of urbanisation stretching from London to Leeds.

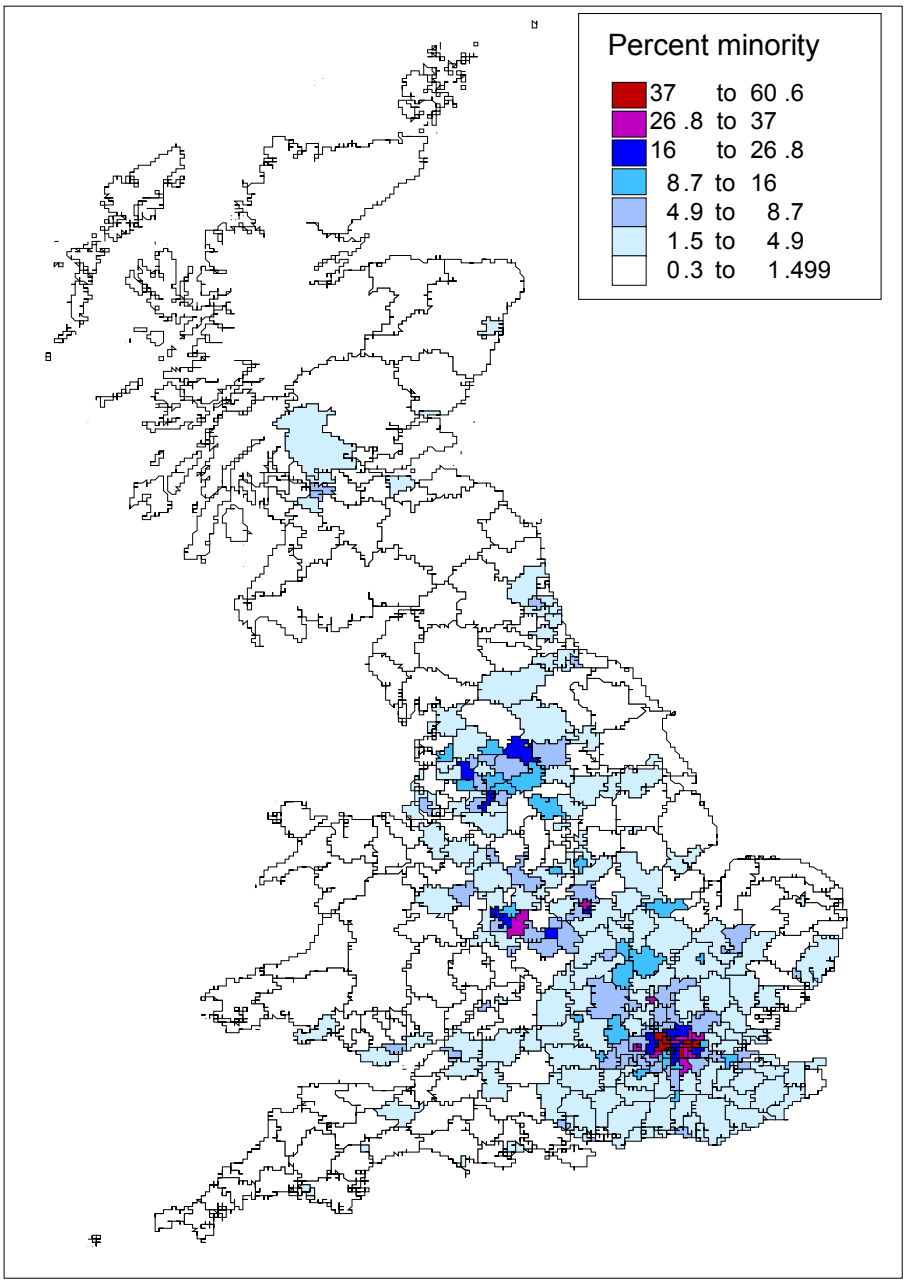

Figure 1.9 Percentage of resident population from minority ethnic groups, 2001

1.4 ECONOMIC CIRCUMSTANCES OF ETHNIC GROUPS

Table 1.7a summarises the labour market circumstances of men and women from each ethnic group aged 16 to 74 for England and Wales in 2001. Overall, white people are more likely to be economically active (in the labour market) than people from minority ethnic groups, who are twice as likely to be unemployed. Just under half of all people from minority ethnic groups aged 16 to 74

were in work, compared to over 60 per cent of white people. The economic activity and employment rates are higher for men than women, while the female unemployment rate is lower than that for men.

Among men, white British men have higher economic activity and employment rates and lower unemployment rates than men from all minority ethnic groups. Indian men have the highest economic activity rates and Chinese and Bangladeshi men the lowest. The unemployment rate is highest for Black, Pakistani and Bangladeshi men and men of mixed white/Black Caribbean ethnicity. Chinese and Indian men experience unemployment rates similar to white men.

Amongst women, Black-Caribbean women exhibit the highest economic activity rates, followed by white, Black-African, Indian, Black-Other and Chinese women. A very low percentage of Pakistani and Bangladeshi women are economically active. The unemployment rate is highest for Pakistani and Bangladeshi women, followed by Black-African and Black-Other women and lowest for Indian and Chinese women. The percentage of women in work is highest for the white, Black and Indian ethnic groups and lowest for the Bangladeshi and Pakistani ethnic groups.

Table 1.7a Economic activity by ethnic group, England and Wales 2001: aged 16-74

Ethnic group	*Males*			*Females*		
	Economic activity rate	*Unemployment rate*	*Employment rate*	*Economic activity rate*	*Unemployment rate*	*Employment rate*
White	***74.2***	***5.4***	***68.1***	***60.2***	***3.8***	***55.4***
White British	74.4	5.3	68.3	60.3	3.7	55.5
White Irish	65.6	6.7	59.9	54.4	3.9	50.7
White Other White	73.2	6.3	65.4	59.4	5.4	52.9
Mixed	***69.0***	***12.4***	***54.3***	***59.1***	***8.6***	***47.2***
White/Black Caribbean	70.6	16.3	52.8	60.4	10.9	46.6
White/Black African	69.1	13.8	52.9	57.5	9.9	45.1
White/Asian	68.7	9.5	56.5	58.5	6.5	48.4
Other Mixed	67.6	10.7	53.9	59.0	7.6	47.5
South Asian	***70.0***	***9.6***	***58.6***	***44.2***	***8.6***	***36.4***
Indian	73.6	6.2	64.7	57.4	6.1	49.7
Pakistani	66.1	13.8	52.1	28.5	14.8	20.8
Bangladeshi	64.3	15.9	48.5	25.2	16.5	16.6
Black	***69.7***	***14.9***	***53.4***	***61.7***	***9.7***	***49.8***
Black Caribbean	69.3	14.9	55.6	64.0	7.8	55.0
Black African	70.0	14.3	51.0	58.4	12.2	42.9
Other Black	70.2	18.6	51.3	62.7	11.4	49.2
Chinese & Other	***65.6***	***8.2***	***55.0***	***51.4***	***6.9***	***43.4***
Chinese	62.2	5.4	53.0	53.4	5.3	45.0
Other Asian	69.4	8.8	58.5	50.0	8.2	42.0
Other Ethnic Group	64.4	10.2	52.8	50.5	7.3	43.0
All Minority Ethnic groups	***69.0***	***11.0***	***56.2***	***51.9***	***8.7***	***42.5***
ALL PEOPLE	**73.8**	**5.8**	**67.1**	**59.5**	**4.1**	**54.3**

Note: Age range selected relates to data available from ONS National Census data. The standard tables from the 2001 Census of Population provide details of the economic activity patterns of people from minority ethnic groups aged 16 to 24 and 25 to 74 (but not for more disaggregated age groups), so the contrasting labour market experience of young people can be identified (Table 13b).

Table 1.7b Economic activity by ethnic group, England and Wales 2001: aged 16-24

Ethnic group	*Males*			*Females*		
	Economic activity rate	*Unemployment rate*	*Employment rate*	*Economic activity rate*	*Unemployment rate*	*Employment rate*
White	***70.9***	***10.0***	***63.7***	***64.5***	***6.4***	***60.3***
White British	71.7	10.1	64.5	65.1	6.4	60.9
White Irish	61.9	10.5	55.4	58.3	6.6	54.4
White Other White	49.5	9.5	44.8	52.3	6.4	49.0
Mixed	***55.3***	***18.0***	***45.4***	***52.3***	***11.3***	***46.4***
White/Black Caribbean	62.6	23.1	48.1	56.2	14.3	48.1
White/Black African	54.3	17.8	44.6	52.3	11.3	46.4
White/Asian	50.6	13.8	43.6	49.4	8.7	45.1
Other Mixed	51.0	13.9	43.9	49.9	9.2	45.3
South Asian	***51.8***	***14.8***	***44.1***	***41.9***	***12.0***	***36.8***
Indian	50.6	10.3	45.4	47.9	7.9	44.1
Pakistani	52.6	19.2	42.5	36.4	16.8	30.3
Bangladeshi	53.6	17.1	44.5	37.9	15.8	31.9
Black	***51.8***	***22.1***	***40.4***	***49.6***	***12.7***	***43.3***
Black Caribbean	60.1	26.3	44.3	56.5	13.2	49.1
Black African	43.6	15.8	36.7	42.7	11.4	37.8
Other Black	56.2	26.1	41.6	53.6	15.5	45.3
Chinese & Other	***36.7***	***11.0***	***32.7***	***34.4***	***7.2***	***31.9***
Chinese	30.1	6.5	28.2	32.3	4.6	30.8
Other Asian	46.6	11.9	41.0	38.2	9.6	34.6
Other Ethnic Group	35.3	15.6	29.8	33.9	8.3	31.1
Minority ethnic groups	***49.7***	***16.3***	***41.6***	***43.8***	***11.5***	***38.8***
ALL PEOPLE	**68.2**	**10.6**	**60.9**	**61.8**	**6.9**	**57.5**

The most notable feature of these data is that the economic activity rate is much lower for minority ethnic groups, with little difference between young people and people aged 16 to 74 from white ethnic groups. Less than half of people from minority ethnic groups aged 16 to 24 are in the labour market and only two-fifths are working (see Table 1.7b). The unemployment rate is much higher, particularly for Black-Caribbean people. The reason for lower attachment to the labour market in this age group is that people from some minority ethnic groups, in particular South Asian and Chinese people, are more likely than white young people to stay in further and higher education, and to spend longer in the education sector. In contrast to other ethnic groups, the economic activity rate for Pakistani and Bangladeshi women aged 16-24 is actually higher than that for older women, (see Table 1.7c) because women from these ethnic groups tend to withdraw from the labour market when they are in their twenties in order to take on full-time family responsibilities.

Table 1.7c Economic activity by ethnic group, England and Wales 2001: aged 25-74

Ethnic group	*Males*			*Females*		
	Economic activity rate	*Unemployment rate*	*Employment rate*	*Economic activity rate*	*Unemployment rate*	*Employment rate*
White	***74.8***	***4.6***	***71.3***	***59.5***	***3.3***	***57.5***
White British	74.8	4.6	71.4	59.5	3.2	57.6
White Irish	65.9	6.4	61.7	54.1	3.7	52.1
White Other White	78.2	5.9	73.6	60.9	5.3	57.7
Mixed	***76.2***	***10.3***	***68.3***	***62.3***	***7.6***	***57.6***
White/Black Caribbean	76.0	12.5	66.5	62.8	9.1	57.1
White/Black African	75.2	12.6	65.8	59.6	9.4	54.0
White/Asian	77.4	8.2	71.0	62.6	5.8	59.0
Other Mixed	75.4	9.6	68.1	62.9	7.0	58.4
South Asian	***76.0***	***8.5***	***69.6***	***45.0***	***7.5***	***41.6***
Indian	79.8	5.5	75.4	59.9	5.8	56.4
Pakistani	71.8	12.2	63.1	24.9	13.5	21.6
Bangladeshi	68.8	15.6	58.0	18.4	17.3	15.2
Black	***73.7***	***13.8***	***63.6***	***64.2***	***9.2***	***58.3***
Black Caribbean	70.9	13.2	61.6	65.2	7.1	60.6
Black African	77.2	14.1	66.3	62.6	12.3	54.8
Other Black	75.8	16.4	63.4	65.8	10.2	59.1
Chinese & Other	***74.8***	***7.7***	***69.0***	***55.9***	***6.8***	***52.1***
Chinese	76.5	5.3	72.5	61.0	5.5	57.6
Other Asian	75.2	8.4	68.9	52.9	8.0	48.7
Other Ethnic Group	72.5	9.5	65.7	54.0	7.2	50.1
Minority ethnic groups	***75.2***	***9.9***	***67.7***	***54.4***	***8.0***	***50.0***
ALL PEOPLE	**74.8**	**5.0**	**71.1**	**59.1**	**3.6**	**57.0**

Table 1.8 details the occupational breakdown of employment by ethnic group in the United Kingdom, using data from the 2001 Census of Population. This table for all persons obscures the tendency for occupations to be gender-specific, so that (for example) jobs in skilled manual trades are predominantly undertaken by males while sales occupations are overwhelmingly dominated by women (Owen et al. 2000). The largest SOC major groups are "managers and senior officials", "associate professional and technical occupations" and "administrative and secretarial occupations", but "elementary occupations" (unskilled) still account for nearly 3.2 million workers. The distribution of employment by occupation is broadly similar for white and minority ethnic groups. However, there are differences between minority ethnic groups, with Bangladeshis most likely to be employed in skilled trades, while manual employment is more important for Pakistani people, and Chinese and Indian people are more likely to work in managerial and professional jobs. "Managers and senior officials" will include people running their own businesses; a much higher percentage of (especially men) from South Asian and Chinese ethnic groups than white and Black people are entrepreneurs. People from Black ethnic groups tend to be more likely than other ethnic groups to work in associate professional (e.g. nursing) and administrative occupations.

Table 1.8 Occupational breakdown of employment by ethnic group, United Kingdom 2001

	All persons	*Group 1*	*Group 2*	*Group 3*	*Group 4*	*Group 5*	*Group 6*	*Group 7*	*Group 8*	*Group 9*
All persons	26575.6	3918.1	2957.0	3659.0	3536.9	3133.6	1840.8	2058.2	2299.5	3172.5
White	24900.4	3689.5	2721.7	3429.7	3315.8	2998.9	1737.5	1888.7	2154.2	2964.4
Minority ethnic groups	**1675.2**	**228.6**	**235.3**	**229.3**	**221.1**	**134.7**	**103.3**	**169.5**	**145.4**	**208.1**
Mixed	***184.1***	***24.2***	***24.2***	***31.2***	***24.8***	***14.3***	***13.6***	***18.6***	***10.4***	***22.8***
South Asian	***730.9***	***112.4***	***110.3***	***72.4***	***90.9***	***54.4***	***27.4***	***85.6***	***90.0***	***87.5***
Indian	478.5	79.7	82.5	52.1	65.7	29.9	16.4	52.2	50.3	49.8
Pakistani	190.0	25.2	22.1	15.9	18.9	13.1	8.4	25.4	35.3	25.7
Bangladeshi	62.4	7.6	5.7	4.3	6.2	11.4	2.6	8.0	4.4	12.1
Black	***462.3***	***44.5***	***51.8***	***79.6***	***74.5***	***34.4***	***47.0***	***37.8***	***30.6***	***62.0***
Black Caribbean	252.5	24.4	23.5	43.3	45.0	23.9	24.1	18.8	19.8	29.7
Black African	177.4	17.1	25.4	30.8	24.1	7.9	19.6	15.7	8.8	28.1
Other Black	32.4	3.0	2.9	5.5	5.5	2.6	3.3	3.4	2.0	4.3
Chinese & Other	***297.9***	***47.5***	***48.9***	***46.2***	***30.9***	***31.5***	***15.2***	***27.5***	***14.3***	***35.8***
Chinese	104.8	17.6	18.7	13.0	9.7	19.3	2.6	9.0	2.5	12.4
Other Asian	100.8	16.0	17.1	14.9	12.3	6.1	4.8	11.8	7.5	10.6
Other	92.2	14.0	13.1	18.3	8.9	6.2	7.9	6.7	4.3	12.9

Source: Census of Population

Titles of SOC Major Groups are 1: Managers and Senior Officials, 2: Professional Occupations, 3: Associate Professional and Technical Occupations, 4: Administrative and Secretarial Occupations, 5: Skilled Trades Occupations, 6: Personal Service Occupations, 7: Sales and Customer Service Occupations, 8: Process, Plant and Machine Operatives, 9: Elementary Occupations.

1.5 ETHNICITY AND HSE PRIORITY AREAS

In the document *Revitalising Health and Safety Strategy Statement* (DETR 2000), the government set out national targets for health and safety. This 10-year strategy seeks significant improvements in workplace health and safety by, for the first time, setting a number of over-arching targets for Great Britain. These targets are to reduce working days lost per 100 thousand workers from work related injury and ill-health by 30%, to reduce the rate of fatal and major injury accidents by 10% and to reduce the incidence rate of cases of work related ill-health by 20%. The Health and Safety Commission has identified 8 priority areas for contributing to the delivery of the RHS targets. These focus on sectors or hazards where improvements are vital if the targets are to be met: (sectors) construction, agriculture, and the health services, and (hazards) falls from height, workplace transport, stress, musculoskeletal disorders and slips and trips.

The analysis of Elias *et al*. (2001) indicated that it is the occupation of employment that has the dominant influence upon the risk of workplace injury. While the general level of economic activity will have some effect upon the incidence rate of workplace injuries, changes in workplace injury rates over time are most likely to be driven by changes in the occupational composition of employment. The effects of real improvements in health and safety upon workplace injury rates could be offset by a growth of employment in occupations that are

associated with an increased risk of workplace injury. Alternatively, more favourable shifts in the occupational composition of employment could lead to reductions in workplace injury rates. In the context of the present study it is important to consider whether these projected changes in employment are likely to be of particular significance to the occupational health and safety of Britain's ethnic minority population.

To consider these issues we utilize projections of employment taken from the *Projections of Occupations and Qualifications 2000-2001* (CE/IER, 2001). A variety of detailed employment projections are available by gender, occupation and industry sector. Due to the importance of occupation in contributing towards the risk of workplace injury, we focus upon employment projections that incorporate a high level of occupational detail. Specifically, the projections provide a forecast of employment at the Sub-Major Group level of SOC90 (see CE/IER, 2001, pp63). Due to this high level of occupational detail, the projections are not able to simultaneously allow for changes in employment across other dimensions such as industry or gender.

Occupational projections are presented in Table 1.9. Considering these projections in the context of HSC priority areas, it is projected that there will be a large growth in employment between 1999 and 2010 in occupations that relate to the Health Care Sector. Employment among Health Professionals is projected to increase by 40%, while employment in Personal Service Occupations is projected to increase by 35%. While Personal Service Occupations cover a variety of jobs, the growth in employment within health related occupations is regarded as being the underlying cause of employment growth in this area. Health care jobs falling within this area of employment includes nursing auxiliaries, ward assistants, ambulance staff and care assistants. In contrast, employment in those occupations that relate to the Agricultural Sector is projected to decline between 1999 and 2010. Employment within Managers/Proprietors in Agriculture and Services is projected to decline by 18%. Employment in Other Occupations in Agriculture, Forestry and Fishing (comprising general agricultural workers and fisherman) is projected to decline by 38% between 1999 and 2010. Only a small growth in employment within Skilled Construction Trades is projected over the period of analysis.

The employment projections therefore support the view that the HSC is correct to prioritize the Health Care Sector in order to meet over-arching targets for Health and Safety. High rates of projected growth in occupations within this sector indicate that any real improvements in health and safety should contribute to reductions in rates of workplace injury and occupational ill health. However, it is unlikely that real improvements in safety within the construction or agriculture sectors will lead to significant reductions in the overall rate of workplace injuries and ill-health, due to the small and declining incidence of employment in these sectors.

In terms of the occupational health and safety of ethnic minorities, Table 1.9 also indicates that occupations within the Health Care sector are associated with a relatively high incidence of workers from ethnic minority backgrounds and workers who were born outside of the UK. For example, information from the LFS indicates that during the period 1993 to 2000, 17% of those employed as Health Professionals and 7% of those employed as Health Associate Professionals (encompassing occupations such as state registered nurses, midwives, physiotherapists and medical technicians) were ethnic minorities. This is compared to a population average of 4.8%. It is not clear that the projected growth in jobs available within the Health Care sector will be filled by workers who have the same ethnic composition as that demonstrated within the LFS for the period 1993-2000. For example, many Black Caribbean immigrants who filled jobs within the Health Care sector during the 1950s and 1960s would have been approaching retirement age during the 1990s. However, continued measures to recruit health care workers

from abroad indicates that the prioritization of this sector by the HSC will remain of particular pertinence to the health and safety of ethnic minorities and immigrant workers.

Table 1.9 Occupational projections and ethnicity 1999-2010

Sub-Major Groups of 1990 Standard Occupational Classification	*Projected Employment (thousands)*				*Ethnicity (1993-2000)*[1]	
	1999	*2005*	*2010*	*% growth 1999-2000*	*% Non White*	*% Born Outside UK*
1.1 Corporate managers and administrators	3156	3361	3593	13.8%	3.2%	7.6%
1.2 Managers/proprietors in agriculture and services	1507	1364	1236	-18.0%	6.7%	10.5%
2.1 Science and engineering professionals	741	806	890	20.1%	4.4%	8.6%
2.2 Health professionals	232	283	323	39.2%	16.7%	25.9%
2.3 Teaching professionals	1077	1157	1243	15.4%	2.9%	8.9%
2.4 Other professional occupations	751	910	1091	45.3%	6.5%	11.0%
3.1 Science and engineering associate professionals	666	694	726	9.0%	4.2%	7.5%
3.2 Health associate professionals	692	729	751	8.5%	6.9%	11.4%
3.3 Other associate professional occupations	1366	1617	1874	37.2%	4.7%	8.9%
4.1 Clerical occupations	2979	3071	3126	4.9%	5.4%	6.1%
4.2 Secretarial occupations	1073	1023	960	-10.5%	4.2%	6.9%
5.1 Skilled construction trades	595	619	617	3.7%	2.0%	4.2%
5.2 Skilled engineering trades	1008	952	921	-8.6%	2.7%	4.4%
5.3 Other skilled trades	1684	1545	1453	-13.7%	3.5%	5.9%
6.1 Protective service occupations	423	478	517	22.2%	4.3%	6.0%
6.2 Personal service occupations	2449	2913	3308	35.1%	5.4%	9.3%
7.1 Buyers, brokers and sales representatives	452	438	432	-4.4%	2.8%	5.3%
7.2 Other sales occupations	1545	1663	1741	12.7%	6.5%	6.2%
8.1 Industrial plant and machine operators, assemblers	1528	1480	1464	-4.2%	5.9%	7.1%
8.2 Drivers and mobile machine operators	1026	1034	1061	3.4%	4.8%	6.2%
9.1 Other occupations in agriculture, forestry and fishing	124	96	77	-37.9%	2.2%	5.0%
9.2 Other elementary occupations	1767	1637	1520	-14.0%	5.1%	7.0%
All occupations	26841	27868	28924	7.8%	4.8%	7.6%

Source of Projections: IER (2002).

1. Prevalence of ethnicity derived from Labour Force Survey, 1993 to 2000

CHAPTER 2
THE INCIDENCE OF WORKPLACE INJURIES AND ILL HEALTH: VIEWS FROM THE LABOUR FORCE SURVEY AND THE CENSUS

2.1 ETHNICITY AND LONG TERM ILLNESS IN WORKING AGE POPULATION

This section presents the results of statistical analyses assessing whether ethnic minority groups of working age are disproportionately at risk of a long term illness that might limit their participation in full-time employment or influence their work performance. The principal source of reliable information on the circumstances of the minority ethnic population of the UK, other than the two major sample surveys of Modood et al. 1997, (the Policy Studies Institute's 'Fourth National Study") and the Health Survey for England 1999 (Department of Health 2001), is the national decennial Census. In 1991, this included a simple question on 'ethnic group', and in 2001 a more sophisticated set of ethnic origin categories was offered along with a question on religion (see Table 1.1). The Census has also routinely asked a question on 'limiting long-term illness' (LLI) although, as with the 'ethnic question', the precise wording and coding of replies have varied slightly between Censuses; the definition of 'limiting illness' is not related to the cause of any reduced activity levels so cannot directly be linked to occupation. In the 2001 Census a question on the individual's health over the previous 12 months was added. Although these differences create some difficulties, results from different time periods can be compared.

2.1.1 1991 Census Data

Overall levels of limiting long-term illness identified in the Census data have generally been found to correlate with increased age in populations. It has also previously been observed that overall LLI levels are higher in most black and minority ethnic groups than in the general population. This differs from the pattern that might be expected based on the relative youthfulness of these population groups (Owen 1993).

For the purposes of this report we undertook a more detailed analysis of the 1991 Census data on long-term illness, concentrating on the working age population and undertaking analyses by ethnic group and geographical region. Tables A3.1 and A3.2 in Annex 3 present the results. For the South Asian population as a whole, the LLI rate was lower than for the working age population; this is presumably linked to a lower average age due to the effects of migration.

For the working age population, the main findings are that comparable populations still exhibit major ethnic differences in reported levels of limiting long-term illness. This implies that LLI will have a differential impact in terms of restricting work activity during their working lives for certain ethnic minority groups. The lowest LLI rates are observed in the Chinese working age population and the highest in Bangladeshi/ Irish/ Pakistani population groups. As would be expected, LLI rates increase progressively with age for all ethnic groups. But the increase observed from middle age to 60-64 is far higher among South Asian minorities; with the highest rate reported for Bangladeshis aged 60-64, followed by Pakistanis. We also identified gender differentials, for the overall working age population, as well as in the older age groups, particularly for the Pakistani, Bangladeshi and Irish populations, with males reporting higher LLI rates than their female counterparts. The two former ethnic groups have the lowest labour-market participation among females of all ethnic groups (see Section 2.2). The male-female gap in LLI rate becomes wider in the older working age population, being largest (by 15 percentage points) in favour of males for Bangladeshis aged 60-64.

Although regional variations were observable, the overall patterns remained the same across the major ethnic groups (except for the Black-African and Bangladeshi minority groups, which form the smallest populations in most areas). Therefore, any explanation for these observed differences in the health of the working age populations must be related to ethnicity rather than to local labour markets and geographical variations in settlement patterns.

2.1.2 Comparison of Limiting Long-term Illness Levels of 2001 with 1991

A comparison of LLI levels in the 2001 and 1991 Censuses was also undertaken (see Table 2.1 and Figure 2.1). This reveals a substantial increase in reported LLI in England and Wales over this period. Overall, the proportion of the population reporting a long-term health problem or disability that limits their daily activity, including work, has increased from 12.3% in 1991 to 18.2% in 2001. For the working age population (16-64), this figure was 14.3% in 2001, compared to 8.9% in 1991 (an increase of 60.4%). The prevalence of LLI is also much higher for people in the older working age group 50-64 (26.6% in 2001 vs 20.1% in 1991). Thus, it would appear that the health of the working age population has deteriorated over the last ten years. However, it may appear surprising that increases in LLI rate are reported across the board (gender, age as well as ethnic group) in the 2001 Census. This raises the question of whether the observed increase is real or a data artefact; other possible reasons might include a change in people's perception of their health or an increased desire for entitlement to social security benefits.

Table 2.1 and Figure 2.1 show the prevalence of LLI by age and ethnic group. Because of the change in the 2001 ethnic classification, for certain ethnic groups the comparable 1991 ethnic category is presented in parentheses; for example, the 1991 Other Ethnic group is comparable to the Mixed and Other Ethnic groups in the 2001 Census. For the working age population as a whole, most ethnic minority groups (except the Irish) report a similar prevalence of LLI to that of the British (White) population; only the Chinese report a lower rate. However, this pattern changes for the 50-64 age group (see Figure 2.1). Here, higher rates are reported for most ethnic groups (including the Irish), with particularly high rates reported by the Bangladeshi and Pakistani communities. Table 2.1 shows no marked gender differentials between 1991 and 2001 in overall LLI rates for different working age groups. However, for specific ethnic groups in the 50-64 age category (i.e. Indian, Pakistani and Black African populations), the 2001 prevalence among females is higher by 7-9 percentage points than for males. In contrast, Bangladeshi men aged 50-64 reported higher rates of LLI than their female counterparts in both 1991 and 2001.

It is also possible to examine the prevalence of limiting long-term illness reported by different ethnic minority groups in 1991 and 2001, compared to that reported by the population in England and Wales as a whole. Figures 2.2a and 2.2b show this ratio by ethnic group for all people of working age (16-64) and for those aged 50-64; Figures 2.2c and 2.2d provide data for the 50-64 age group broken down by gender. For the working age population, relative levels of LLI have remained similar between 1991 and 2001 for each of the 11 comparable ethnic groups (except for the Indian category). Thus, Irish, Pakistani, Bangladeshi and Black Caribbean people of working age have consistently reported a higher prevalence of LLI than the overall average in both 1991 and 2001. This pattern is reversed for the Other Asian, Black African, Other Black, Chinese and Other/Mixed ethnic groups. However, ethnic differences become more distinct if the analysis is limited to people in the 50-64 age group (Figure 2.2.b). In this case, all ethnic minority groups except the Chinese have reported higher levels of limiting long-term illness than the overall average in both 1991 and 2001. The Other Asian category reported a higher level in 2001 but a lower level in 1991 when compared with the overall average. When LLI levels for this age group are broken down by gender (Figures 2.2c and 2.2d), a similar pattern is visible for females in the 50-64 age group; but for males, in addition to the Chinese,

Table 2.1 Limiting long-term illness in working age and whole population by ethnic group, 1991 & 2001, England & Wales

Ethnic Groups	*LLI Rate Males*								*LLI Rate Females*							
	16-49		*50-64*		*16-64*		*All Ages*		*16-49*		*50-64*		*16-64*		*All Ages*	
	2001	*1991*	*2001*	*1991*	*2001*	*1991*	*2001*	*1991*	*2001*	*1991*	*2001*	*1991*	*2001*	*1991*	*2001*	*1991*
All Ethnic Groups	9.8	5.4	27.0	21.7	14.5	9.4	17.3	11.8	9.5	5.1	26.3	18.5	14.1	8.4	19.1	12.8
White (White+Irish)	***9.8***	***5.4***	***26.7***	***21.7***	***14.6***	***9.5***	***17.7***	***12.1***	***9.5***	***5.0***	***25.7***	***18.2***	***14.2***	***8.4***	***19.7***	***13.1***
British (White)	9.9	5.4	26.6	21.6	14.7	9.4	17.8	12.0	9.6	5.0	25.7	18.2	14.3	8.4	19.8	13.1
Irish	11.8	6.9	33.6	24.7	20.2	13.7	25.7	17.7	10.1	6.0	29.2	19.5	17.7	11.0	25.5	16.4
Other White	6.9		22.7		9.7		12.5		6.5		22.9		9.5		13.3	
Mixed	***11.1***		***31.4***		***13.1***		***10.1***		***10.2***		***31.7***		***12.3***		***9.6***	
White and Black Caribbean	12.6		33.1		14.0		10.3		11.1		35.7		12.7		9.3	
White and Black African	11.5		32.4		13.4		10.2		10.4		34.6		12.5		9.7	
White and Asian	9.9		29.0		12.0		9.5		9.6		29.0		11.9		9.4	
Other Mixed	10.7		32.5		13.3		10.7		9.5		30.8		12.1		10.2	
Asian	***9.3***	***5.9***	***36.4***	***28.8***	***13.5***	***10.3***	***13.3***	***8.6***	***10.5***	***6.0***	***43.8***	***30.5***	***15.7***	***9.5***	***14.8***	***8.0***
Indian	7.7	5.2	32.0	25.4	12.2	9.0	12.9	8.3	9.0	5.6	40.9	31.5	14.8	9.8	15.5	8.9
Pakistani	11.2	8.1	45.5	34.4	15.4	13.3	13.9	9.7	12.6	7.4	53.2	33.8	17.5	11.0	14.9	7.9
Bangladeshi	10.8	6.9	55.7	40.0	15.4	16.1	13.6	10.4	11.7	7.9	52.7	28.8	16.5	10.6	12.6	6.9
Other Asian	9.2	3.7	29.4	18.0	12.7	5.7	12.8	5.5	10.0	3.7	33.7	19.8	14.3	5.5	14.0	5.6
Black or Black British	***9.4***	***5.9***	***30.5***	***21.3***	***12.5***	***9.4***	***13.2***	***9.1***	***9.6***	***6.2***	***36.1***	***27.4***	***13.6***	***10.0***	***13.9***	***9.3***
Black Caribbean	11.1	6.1	33.4	21.4	15.4	10.9	17.6	11.1	10.7	6.1	37.8	27.7	16.0	11.3	18.1	11.3
Black African	7.2	5.2	23.8	19.2	8.9	6.8	8.4	6.9	8.0	6.4	32.0	24.6	10.4	7.8	9.3	7.3
Other Black	12.1	6.3	33.3	25.4	14.0	7.7	12.1	6.2	11.9	6.1	36.8	27.6	13.9	7.4	12.1	5.7
Chinese or Other Ethnic Group	***5.4***		***22.0***		***7.7***		***8.3***		***5.3***		***21.6***		***7.8***		***8.6***	
Chinese	3.8	2.3	19.8	15.8	6.1	4.3	7.4	4.4	4.6	2.3	20.3	15.0	6.9	3.9	8.3	4.4
Other Ethnic Group	7.3		24.6		9.6		9.4		6.0		22.8		8.5		8.9	
Mixed+Other Ethnic Group (Other)	9.9	5.5	28.6	21.7	12.0	7.7	10.0	6.7	8.7	5.8	27.5	22.8	10.9	7.8	9.4	6.8

Note: Due to changes in the ethnic classification used in 2001, comparable ethnic categories for 1991 are included in parentheses where appropriate.

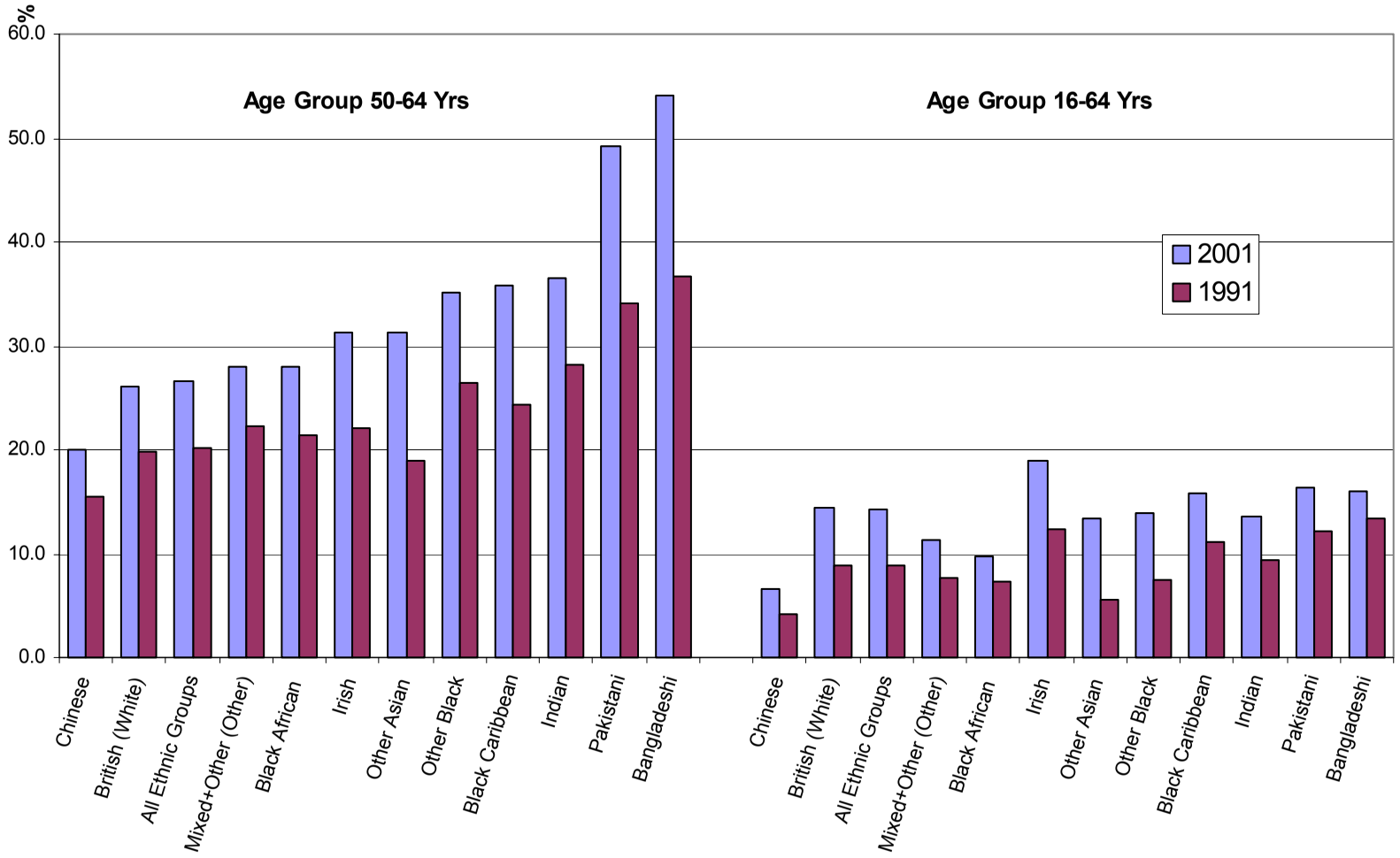

Figure 2.1 Limiting long-term illness rate by ethnic group for ages 16-64 and 50-64, 1991 and 2001, England and Wales

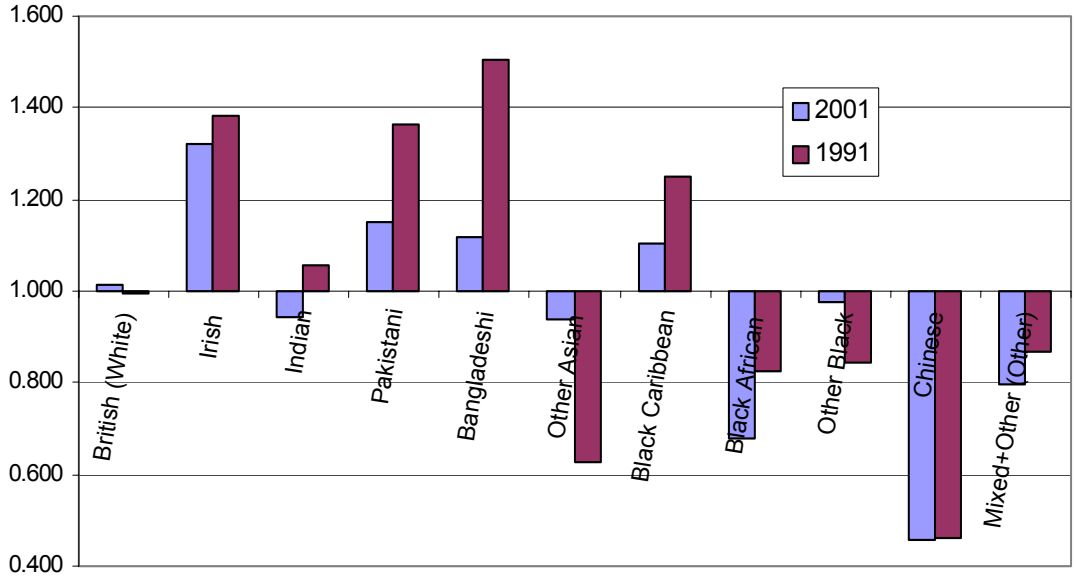

Figure 2.2a Limiting long-term illness rates relative to England and Wales (value = 1) by ethnicity – working age (16-64)

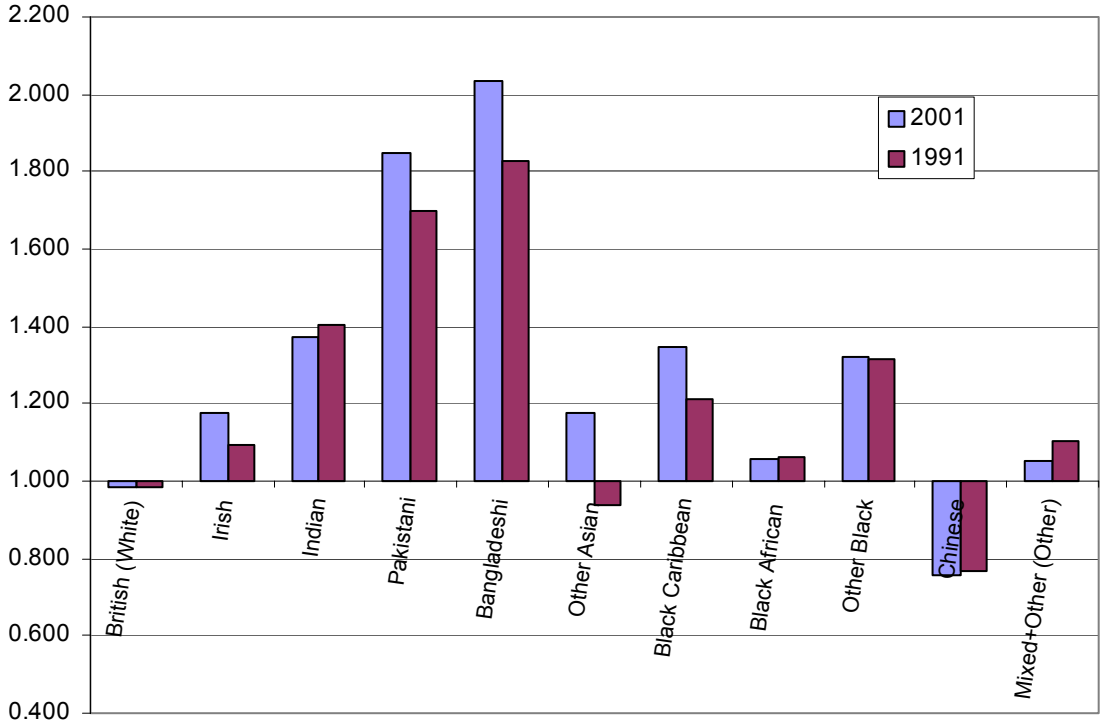

Figure 2.2b Limiting long-term illness rates relative to England and Wales (value = 1) by ethnicity – aged 50-64 years

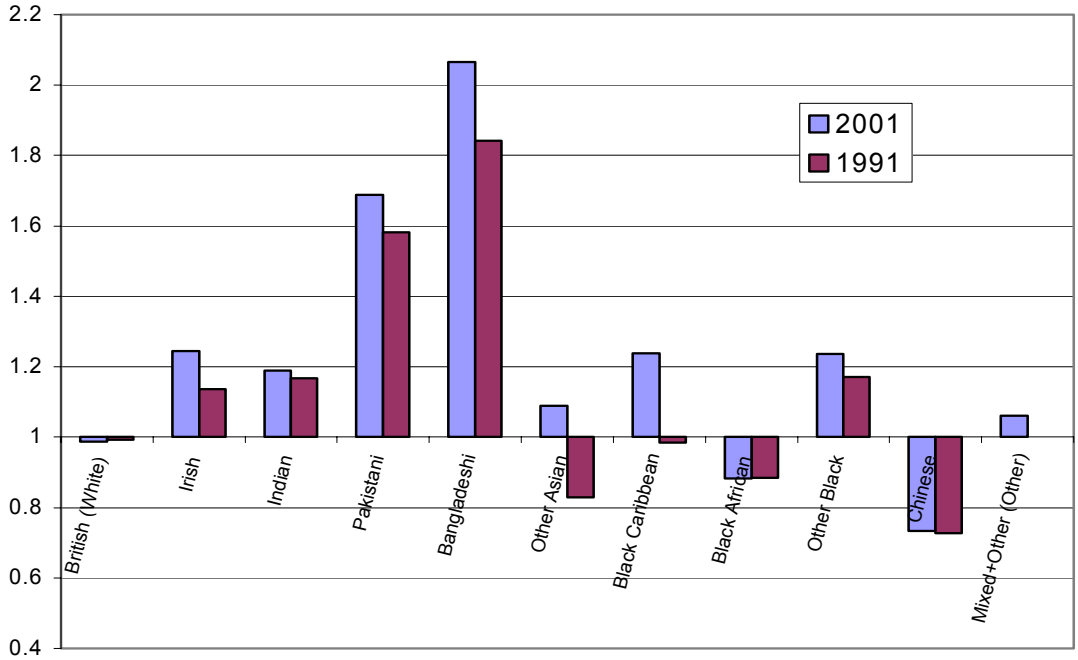

Figure 2.2c Limiting long-term illness rates relative to England and Wales (value = 1) by ethnicity – males aged 50-64 years

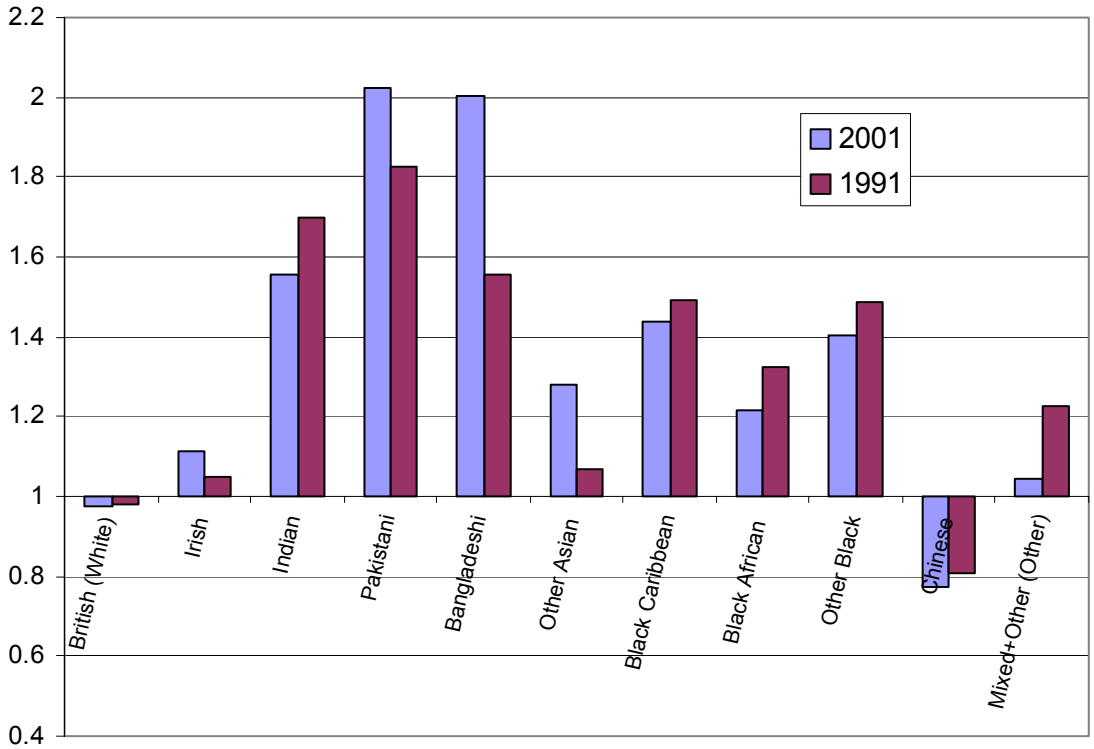

Figure 2.2d Limiting long-term illness rates relative to England and Wales (value = 1) by ethnicity – females aged 50-64 years

Black Africans (and Other Asians in 1991) also report lower levels of LLI. Overall, Bangladeshi and Pakistani men and women in this age group report consistently higher levels of limiting long-term illness, as do Indian women aged 50-64; the disparity also appears to have widened over time for the Bangladeshi and Pakistani older working age population groups.

Analysis of the additional question included in the 2001 Census enquiring about each person's general health over the previous twelve months (good, fairly good, not good) indicates that around 8% of males and females of working age (16-64) and 15% in the age group 50-64 years report that their health had been 'not good' (see Table 2.2). Once again, this figure varies depending on the ethnic group, particularly for the 50-64 age cohort. In the latter case, approximately one in four Asians report their health as 'not good', in comparison to one in five Black or Black British, one in seven British (White), and one in ten Chinese. In this same age cohort, reported rates were higher for men in the Irish and British (White) groups, whereas a higher proportion of women than men reported 'not good' health in the Indian, Pakistani and Black or Black British population groups.

Table 2.2 Percentage of people reporting 'not good' health and those with limiting long-term illness for ages 50-64 and 16-64 by sex and ethnicity, England & Wales, 2001

Ethnic Group	*Not Good Health*				*With Limiting Long-term Illness Reporting Not Good Health*			
	50-64 Years		*16-64 Years*		*50-64 Years*		*16-64 Years*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
All Ethnic Groups	**15.5**	**14.7**	**8.0**	**8.3**	**50.6**	**48.5**	**45.2**	**45.9**
White	***15.3***	***14.2***	***8.0***	***8.2***	***50.5***	***48.1***	***45.2***	***45.6***
British	15.2	14.1	8.0	8.2	50.3	47.9	45.0	45.4
Irish	21.8	18.2	13.0	11.5	58.1	53.8	54.8	52.4
Other White	13.6	13.5	5.8	6.0	51.6	49.7	45.2	45.4
Mixed	***19.4***	***19.8***	***7.4***	***8.2***	***53.5***	***53.4***	***42.8***	***46.3***
White and Black Caribbean	22.5	22.7	7.5	8.3	56.3	54.2	40.8	44.5
White and Black African	21.2	21.3	7.7	8.4	58.1	54.2	43.8	47.7
White and Asian	17.2	17.9	6.9	7.8	52.1	52.5	43.2	47.1
Other Mixed	18.9	19.4	7.7	8.3	51.3	53.5	44.1	47.0
Asian	***21.6***	***27.6***	***7.9***	***10.3***	***53.3***	***56.6***	***47.2***	***51.7***
Indian	18.3	25.2	6.9	9.4	51.0	55.4	45.5	51.0
Pakistani	28.9	36.1	9.6	12.2	57.8	61.4	50.2	54.3
Bangladeshi	34.0	32.9	9.2	10.8	55.5	54.9	47.8	49.6
Other Asian	16.7	19.6	7.2	8.9	50.4	51.4	44.6	48.3
Black or Black British	***18.5***	***21.9***	***6.8***	***8.7***	***52.7***	***52.9***	***42.0***	***46.2***
Black Caribbean	21.4	24.0	8.7	10.9	55.4	55.3	44.3	49.1
Black African	12.0	16.5	4.5	5.8	44.2	45.6	37.6	40.5
Other Black	19.8	23.0	7.6	9.5	52.8	53.9	41.6	46.0
Chinese or Other Ethnic Group	***12.1***	***12.0***	***4.5***	***4.9***	***47.0***	***46.0***	***41.4***	***42.0***
Chinese	10.3	10.3	3.2	4.1	42.6	40.8	36.3	37.3
Other Ethnic Group	14.2	13.7	5.9	5.7	51.2	50.4	45.1	45.5

Note: The Census question asked individuals to classify their general health over the last 12 months as 'good',, 'fairly good' or 'not good'.

As might be expected, there was a strong association between responses to the question on health and that on limiting long-term illness. About four-fifths of working age people who reported their health as 'not good' also had a limiting long-term illness. Conversely, under half

(46%) of those with LLI of working age (16-64) and 50% in the 50-64 age group also reported that their health had been 'not good' (see Table 2.2). It is likely that individuals who report both have a more persistent disability ('chronic impairment') that may limit their continued participation in full-time employment. Table 2.2 shows that ethnic differences in prevalence of chronic impairment are particularly evident in the 50-64 age group. For this age group, levels for males vary from 42.6% for Chinese to 58.1% for Irish, and for females from 40.8% for Chinese to 61.4% for Pakistani women.

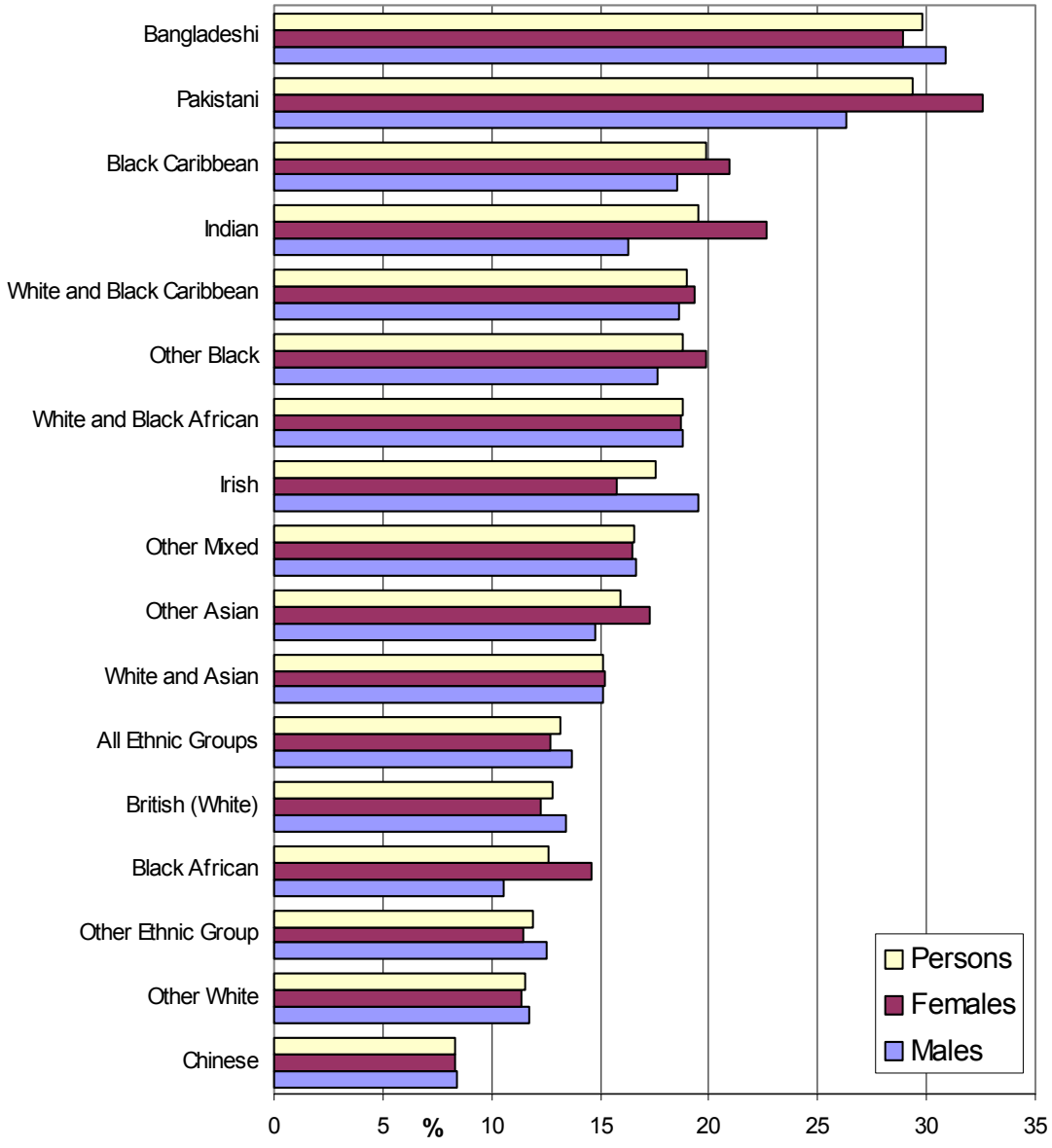

Figure 2.3 Chronic impaired health population (aged 50-64) by ethnicity, 2001

In conclusion, the analyses above indicate that specific ethnic minority groups report a higher level of LLI in the working age population compared to the national average, especially for the 50-64 age group. Furthermore, the proportion of the workforce aged 50-64 years with 'chronic impaired health' is particularly high for the Bangladeshi and Pakistani populations (see Figure 2.3). The existence of this vulnerable group must raise serious concerns for policy makers in terms of the health of the UK older working population.

2.2 ETHNICITY AND DISABILITY AND EFFECTS ON EMPLOYMENT & WAGES

This section presents the results of further analyses using data from the Labour Force Survey (LFS) to assess any connection between ethnicity, reported limiting long-term illness (LLI), and ethnic minority population employment and wage rates. The LFS is a large, nationally representative, household-based survey of persons living at private addresses (and other non-institutional housing) in the United Kingdom. The quarterly LFS, available from Spring 1992, covers a sample of approximately 60,000 households and provides information on individuals' jobs and personal characteristics.

The previous section demonstrated differences in the health/ disability of the working age population in different ethnic groups. If wage rates and the marginal returns for working are reduced among minority ethnic employees with a disability, this may influence the value of remaining in employment. Hence, the overall pattern of disability in the *employed* workforce may in its turn be distorted. Given the small size of ethnic sample reporting LLI, LFS data for 1996 through 2001 were pooled together. Over this 6 year period, on average one out of seven people of working age reported LLI. The prevalence of LLI is higher in older versus younger age groups (Table 2.3). Irrespective of gender and age groups, the LLI rate was highest for the Bangladeshi population; followed by those of Pakistani origin. Overall, 3 out of 4 older Bangladeshis (50-64 males or 50-59 females) reported LLI. In contrast, the prevalence of LLI was lowest in the Chinese population.

Table 2.3 Percentage of working age population reporting limiting disability by ethnic groups, pooled LFS data of 1996 to 2001

Ethnic Group	*Males*			*Females*		
	16-49	*50-64*	*16-64*	*16-49*	*50-59*	*16-59*
White	10.0	24.8	15.2	10.7	23.8	14.1
Black-Caribbean	8.6	34.9	15.8	11.2	33.9	14.8
Black-African	8.5	23.5	10.9	9.3	28.7	11.1
Black-Other	8.2	15.0	9.0	13.2	22.5	14.2
Indian	10.0	38.4	17.0	12.3	41.0	17.0
Pakistani	17.7	45.4	22.8	18.9	42.4	21.3
Bangladeshi	24.4	73.5	33.9	19.8	77.8	28.1
Chinese	5.9	25.5	10.4	3.4	15.3	5.5
Other	12.7	26.6	15.5	12.0	30.0	14.4
All	10.1	25.1	15.3	10.7	24.1	14.2

It is likely that differences in prevalence and severity of LLI will have some effect on employment status; once LLI becomes more severe individuals may have to curtail their working hours or even leave their job. Table 2.4 shows the activity status of the whole working age population and those who report LLI, for males and females in different ethnic groups. Overall, 84.1% of all working age males in the sample were employed (with a large majority of these as full time employees); the percentage varied from 84.4 for White males to 75.4 for South Asian males (the lowest level observed was for Bangladeshis - 53.9%). Within these figures, the percentage of males with LLI who continued in full time work was much smaller (29.6% overall); also, the proportion engaged as full time employees was significantly lower for South Asians (17.1%) than their White counterparts (30.1%). Interestingly, the gap between White and South Asian self-employed was found to be much smaller among those reporting LLI, compared with all males.

Table 2.4 Activity status of working age population (general and reporting limiting disability) by ethnic groups

Ethnic Group	*All Males*						*Males with Disability*					
	Employed				*Unemployed*	*Inactive*	*Employed*				*Unemployed*	*Inactive*
	Full time	*Part time*	*Self employed*	*All working*			*Full time*	*Part time*	*Self employed*	*All working*		
White	***66.7***	***2.7***	***15.0***	***84.4***	***4.0***	***11.6***	***30.1***	***3.2***	***9.2***	***42.4***	***6.2***	***51.4***
Black	***61.5***	***6.0***	***12.6***	***80.1***	***8.4***	***11.5***	***24.2***	***7.2***	***9.0***	***40.4***	***12.3***	***47.3***
Black-Caribbean	61.5	4.0	9.1	74.6	10.0	15.5	21.0	3.5	2.1	26.6	12.6	60.8
Black-African	58.3	8.1	16.7	83.1	7.3	9.6	28.1	11.7	19.4	59.2	7.8	33.0
Black-Other	70.2	5.5	10.7	86.4	7.2	6.4	25.8	9.7	6.4	41.9	25.8	32.3
S. Asian	***52.1***	***5.0***	***18.3***	***75.4***	***8.7***	***15.9***	***17.1***	***4.3***	***10.6***	***32.1***	***9.4***	***58.5***
Indian	60.5	3.2	18.1	81.8	5.4	12.8	24.1	3.9	11.7	39.7	5.7	54.6
Pakistani	41.2	7.5	21.2	69.9	12.6	17.5	10.7	4.7	11.2	26.5	14.4	59.1
Bangladeshi	37.4	7.5	9.1	53.9	15.7	30.3	10.5	4.7	5.8	20.9	9.3	69.8
Other	***55.7***	***5.1***	***15.2***	***76.0***	***9.6***	***14.4***	***21.9***	***5.2***	***9.9***	***37.0***	***13.5***	***49.5***
Chinese	52.5	5.0	23.5	81.0	5.4	13.6	21.7	4.3	17.4	43.5	13.0	43.5
Other	56.4	5.1	13.5	75.0	10.4	14.5	21.9	5.3	8.9	36.1	13.6	50.3
All	***66.3***	***2.8***	***15.0***	***84.1***	***4.2***	***11.7***	***29.6***	***3.3***	***9.2***	***42.1***	***6.4***	***51.5***

	All Females						*Females with Disability*					
	Employed				*Unemployed*	*Inactive*	*Employed*				*Unemployed*	*Inactive*
	Full time	*Part time*	*Self employed*	*All working*			*Full time*	*Part time*	*Self employed*	*All working*		
White	***37.1***	***31.5***	***5.6***	***74.3***	***3.0***	***22.7***	***15.8***	***18.2***	***3.7***	***37.7***	***4.0***	***58.3***
Black	***46.8***	***21.7***	***3.3***	***71.8***	***7.2***	***21.0***	***22.9***	***14.0***	***2.9***	***39.7***	***10.0***	***50.3***
Black-Caribbean	46.8	21.1	2.6	70.5	7.1	22.4	20.9	12.4	1.7	35.0	12.4	52.5
Black-African	41.8	22.3	4.3	68.4	8.3	23.4	17.9	15.1	2.8	35.8	9.4	54.7
Black-Other	56.9	22.2	3.2	82.2	5.1	12.7	35.8	16.4	6.0	58.2	4.5	37.3
S. Asian	***27.1***	***15.0***	***4.3***	***46.4***	***5.3***	***48.3***	***5.9***	***6.9***	***2.6***	***15.4***	***3.9***	***80.7***
Indian	36.3	18.0	5.6	59.9	5.4	34.7	8.8	8.1	3.7	20.7	5.4	73.9
Pakistani	14.2	11.6	2.4	28.3	5.5	66.2	3.4	7.5	0.6	11.5	2.9	85.6
Bangladeshi	5.5	5.1	1.2	11.9	4.3	83.8	0.0	0.0	2.8	2.8	0.0	97.2
Other	***33.2***	***17.6***	***5.4***	***56.2***	***5.4***	***38.4***	***12.7***	***14.5***	***3.2***	***30.5***	***3.2***	***66.4***
Chinese	35.3	16.3	10.4	62.0	3.1	35.0	16.7	16.7	5.6	38.9	0.0	61.1
Other	32.7	17.9	4.3	54.9	5.9	39.2	12.4	14.4	3.0	29.7	3.5	66.8
All	***37.1***	***30.8***	***5.6***	***73.5***	***3.2***	***23.3***	***15.6***	***17.8***	***3.7***	***37.1***	***4.0***	***58.8***

Figures 2.4a and 2.4b show work participation rates separately for males and females, for the whole population and those with LLI. For males, just under half (42.1%) of the working age population with LLI are participators. However, for the South Asian and Black Caribbean

males much greater differences are reported, compared with their White counterparts (see Figure 2.4a). The employment scenario for Bangladeshi, Pakistani and Black Caribbean with LLI is the worst (Bangladeshi males also report the lowest LLI work participation rate and the highest unemployment rate).

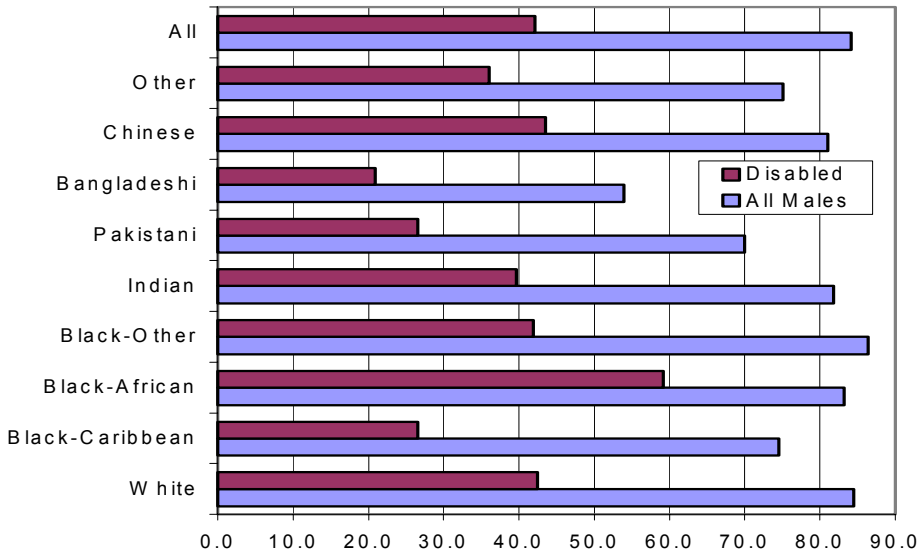

Figure 2.4a Work participation rate – all and disabled males

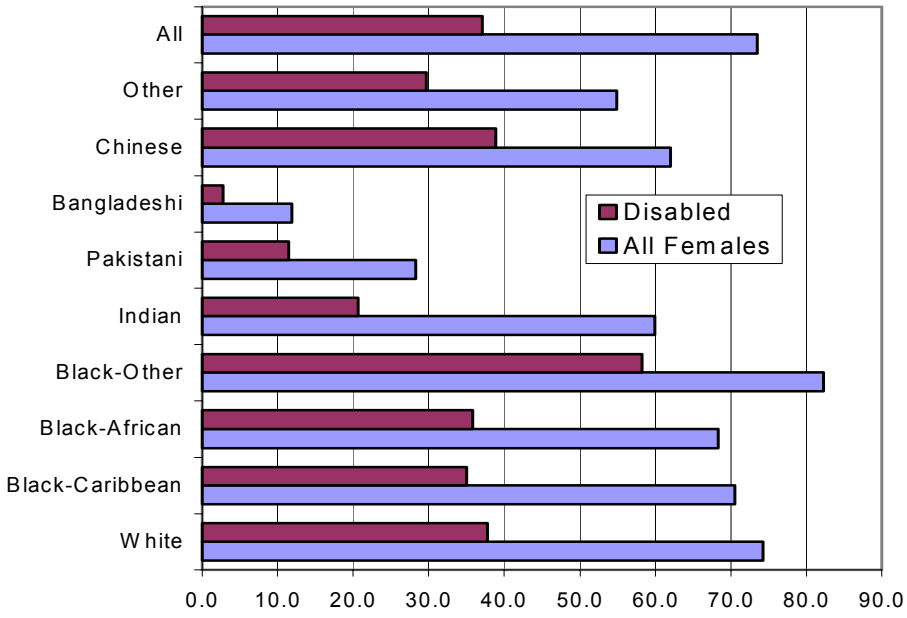

Figure 2.4b Work participation rate – all and disabled females

For women of working age 16-59, the situation is different from that of their male counterparts since a much higher percentage of women work as part-time rather than full-time employees. Furthermore, the gap between the percentage of White and South Asian women working part-time was quite wide (31.5 and 15, respectively). Even so, the pattern shown in Figure 2.4b is particularly extreme for South Asian women. The overall work participation rates for

Bangladeshi and Pakistani women are much lower (11.9% and 28.3%) when compared with their Indian (59.9%) or White (74.3%) counterparts. This presumably reflects the cultural barriers some Muslim women face in going out to work; the majority of Pakistani and Bangladeshi people belong to this religion. With LLI, the employment scenario worsens most for Bangladeshi women and secondly for Indian women. As with men, the overall work participation rate for females with LLI is just under half (37.1%). Thus, for South Asian females the impact of LLI appears to be much greater when compared with their White counterparts (see Figure 2.4b); and barring a few cases, nearly all Bangladeshi women with LLI became inactive.

In summary, the analyses presented in Tables 2.3 and 2.4 reveal that for certain ethnic minority groups, those suffering from LLI appear to be more likely to withdraw from paid employment. This effect is particularly evident in the Bangladeshi and Pakistani communities, and the impact seems to be more severe on South Asian women due to curtailment of opportunities to undertake part-time work. Differential rates of withdrawal from paid employment, or changes in employment status, may be visible through measurable differences in the effect of long-term illness upon income or wage rates among different ethnic groups.

To explore any differential consequence of disability upon earnings, an attempt was made to compare average real wage rates (£ per hour) for healthy populations and those suffering from LLI across different ethnic groups. These results are presented in Table 2.5. Overall, employees with LLI report lower wage rates than their healthy counterparts; lower by 16.8% for males and 10% for females. However, observable differences in wage rates, especially among male employees, were much higher for Bangladeshi, Pakistani and Chinese males and Chinese females.

Table 2.5 Wage rate (£ per hour) for healthy workers and those reporting limiting disability by ethnic groups

Ethnic Group	*Males*			*Females*		
	Healthy	*With limiting disability*	*% difference*	*Healthy*	*With limiting disability*	*% difference*
White	9.76	8.12	-16.8	7.05	6.35	-9.9
Black-Caribbean	8.3	7.29	-12.2	7.8	6.68	-14.4
Black-African	9.62	7.29	-24.2	7.64	6.92	-9.4
Black-Other	10.29	7.97	-22.5	8.27	7.16	-13.4
Indian	9.39	7.8	-16.9	7.23	6.06	-16.2
Pakistani	8.18	6.01	-26.5	7.42	6.53	-12.0
Bangladeshi	5.88	3.85	-34.5	8.24	NE	-
Chinese	9.67	4.49	-53.6	8.91	6.54	-26.6
Other	10.05	8.96	-10.8	7.79	6.39	-18.0
All	9.74	8.1	-16.8	7.07	6.36	-10.0

Note: NE refers to not estimated (no disability cases in the sample).

The results of a more detailed multivariate analysis of the influence of disability upon earnings is presented in the Technical Annex 8. This demonstrates that, after controlling for age, education, marital status and employment characteristics, in general, all minority ethnic male and female workers receive much lower wage rate than their White counterparts. As compared to White male workers, the wage rate was half for Bangladeshi and two-thirds for Black African men. For female workers, the wage rate was lower by one-third for Bangladeshis and by one-fifth for Black African when compared with White women. The presence of a disability reduces

the overall wage rate by 13.7% for males (13.6% Whites, 17% ethnic minorities) and a relatively lower figure of 7% for females (7.2% Whites, 3.6% ethnic minorities though not significant).

In order to explore further the observed differences in wage rate and employment activity status of ethnic minority groups with LLI, it was hoped that the study might be able to obtain some data on occupational injury compensation or disability payments under schemes operated by the Department for Work and Pensions. We were advised, however, that at present the Department does not hold, or analyse, its data classified by ethnic group categories. But, a report published in late 2003 (Molloy et al. 2003) has examined the issue of ethnicity and disability in some detail, focusing primarily on a qualitative enquiry into the experience of members of black and minority ethnic groups with a disability in seeking, or returning to, work. Although the study did not explore the circumstances or reasons for their impairments, the report does note that 'some younger Pakistani and Indian people with disabilities had felt actively discouraged from working' by their families (Molloy et al. 2003:111). This does not, however, provide an explanation for the older population in whom limiting long-term illness and chronic impairment appears to be a particular issue for the ethnic minority workforce.

2.3 DATA SOURCES FOR WORKPLACE INJURIES

We now consider the evidence on occurrence of workplace injuries in different ethnic minority groups. The two main sources of workplace injury information in Great Britain are the flow of injury reports made under the Reporting of Injury, Diseases and Dangerous Occurrences Regulations (RIDDOR) and the results of questions included in the Labour Force Survey. The Health and Safety Executive regards data from both sources as having complementary roles to play in the direction of resources, guidance of operations and the monitoring of safety performance in Great Britain, and in making comparisons with other countries.

Workplace injury data is collected by the HSE via reports made to enforcing authorities under RIDDOR. Under these regulations, employers are responsible for reporting workplace accidents where employees or self-employed sub-contractors are killed or sustain major injury or injuries that result in absence from normal work of more than three days. Employers must also report accidents where a member of the public is killed or requires hospital attention as a result of operations under the control of an employer. Not all workplace injuries have to be reported. The main exception is the non-reporting of road traffic accidents involving people travelling in the course of their work as these are covered by road traffic legislation. Workplace injury data collected by HSE under RIDDOR is held in the form of individual accident records which include the date of the accident, information about personal and workplace characteristics, how the injury occurred and the severity of the injury. Injuries are classified as fatal, major or over-3 days. Unfortunately, the RIDDOR data does not record information about ethnicity and therefore could be utilised for the purposes of the present study.

The second source of data relating to workplace injuries is the Labour Force Survey (LFS). As explained above, this is a rich data source providing information on individuals' jobs as well as their personal characteristics. It therefore served as the main source of data used for the quantitative analyses contained within this report. The LFS has been widely used as the principal Government source of current information relating to minority ethnic groups (c.f. Gott & Johnston 2002). Since 1993 a set of questions on workplace injuries, commissioned by the Health and Safety Executive, has been included in the winter quarter (December to February) of the LFS. Survey respondents are asked whether they had been injured in a work-related accident in the previous 12 months, whether any such injury was caused by a road traffic accident and how soon after the accident they were able to return to work. The information collected from these

questions can be used to compute injury rates from all work-related accidents and 'reportable' work-related accidents (non-road accidents resulting in over 3 days of absence from normal work).

2.4 DESCRIPTIVE ANALYSIS OF WORKPLACE INJURY RATES DERIVED FROM THE LFS

This section presents the results of preliminary statistical analysis from the Labour Force Survey (LFS) for the purpose of assessing whether ethnic minority groups are disproportionately at risk of incurring injuries as a result of accidents at the workplace. Quarterly Labour Force Surveys were merged in an attempt to provide meaningful sample sizes for an analysis of workplace injuries among detailed ethnic minority groups. Information was extracted from the individual data files from the Winter Quarters (Dec-Feb) of the Labour Force Surveys covering the period Winter 1993 to Winter 2000. These 8 data sets were then merged to form a single data set covering the period 1993 to 2000. The injury rates therefore represent the average annual injury rates during each of the 8-year sub-samples. For each quarter, the sample of observations was restricted to those people aged 16 and over who were in employment at the time of survey (either as an employee or self employed) and provided valid responses to questions relating to workplace injuries. Injury rates are calculated as the number of people who had a work related accident in the preceding 12 months as a proportion of all people in employment at the time of the survey. Injury rates are presented separately for all workplace injuries, workplace injuries excluding road accidents and reportable workplace injuries. Grossing factors have been applied to the data to produce population estimates of workplace injury rates.

Figures 2.5 to 2.7 present a descriptive analysis of workplace injury rates along two dimensions of ethnicity. These figures provide average accident rates and associated 95% confidence intervals. Firstly, labour market status is considered along the dimension of ethnic origin based upon Census of Population definitions. The emphasis of this question is on descent as opposed to the country in which an individual is born. The full detail available within the LFS classifies respondents as ether: White, Black – Caribbean, Black – African, Black – Other, Black – Mixed, Indian, Pakistani, Bangladeshi, Chinese, Other – Asian (non-mixed), Other – Other (non-mixed), and Other – Mixed. The second dimension along which we consider ethnicity is in terms of residency. The LFS asks respondents about their country of birth. Among those people who were not born in the UK, the LFS also asks respondents about their year of arrival in the UK. Combining this date with information about when the individual was surveyed, we then make a further distinction according to the number of years since the date of first arrival. For the purpose of the following descriptive analysis, we distinguish between those individuals who were either born in the UK, and then those who have resided in the UK for less than 1 year, between 1 and 5 years, between 6 and 10 years and those who have resided in the UK for more than 10 years.

Considering workplace injury rates by ethnicity, the all accident 12 month injury rate among white respondents is estimated as 4.4%. Excluding road accidents, this rate declines to 4.0%. Finally, this rate declines to 1.5% when only considering 'reportable' work-related accidents (non-road accidents resulting in over 3 days of absence from normal work). Focussing upon the remaining ethnic minority groups, it is observed that workplace injury rates are lower among those of Asian descent. The lowest workplace injury rates are estimated to occur among Bangladeshi and Chinese respondents. The all accident injury rates among these respondents are 1.5% and 1.8% respectively. The highest workplace injury rates for ethnic minorities are estimated to occur among Black-Other and Black-Mixed respondents. The all accident injury rates among these respondents are 5.4% and 5.5% respectively, approximately 1 percentage point higher than the rate exhibited by white respondents. This higher rate of workplace injury among these groups is also present when road accidents are excluded from the estimates.

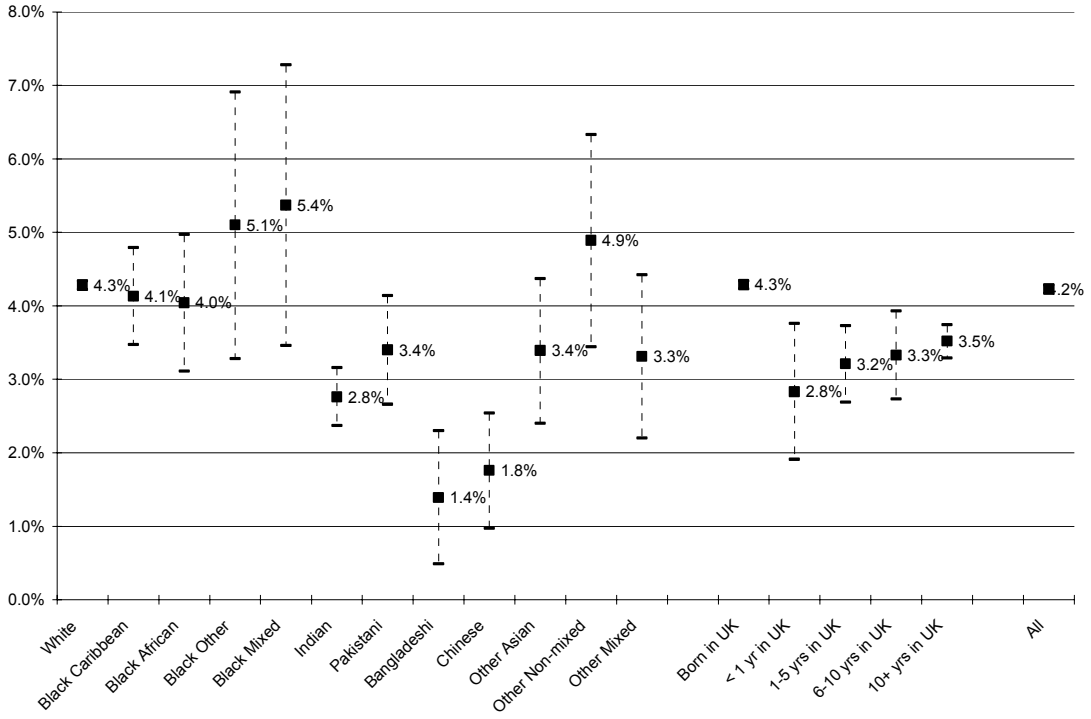

Figure 2.5 LFS workplace injury rates: all injuries

However, when only focussing upon 'reportable' work-related accidents, the rate of workplace injury is similar to that exhibited by white respondents. Finally, among the ethnic minority groups, Indians and Pakistanis take an intermediate position in terms of their workplace injury rates. The all accident injury rates among these respondents are 2.8% and 3.5% respectively. When focussing upon reportable accidents, injury rates for both these groups decline to 1.1%.

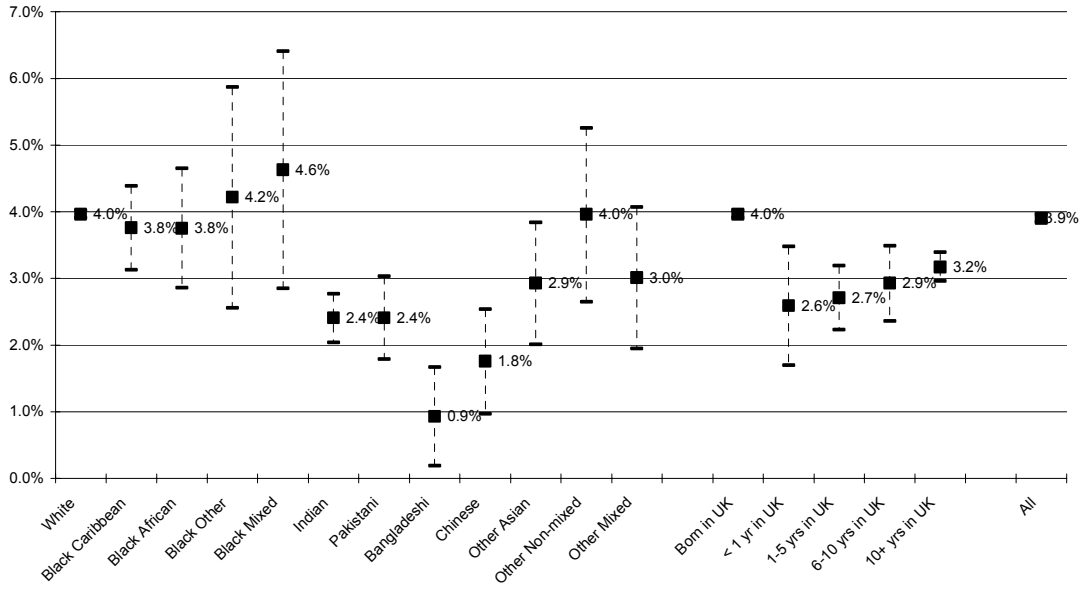

Figure 2.6 LFS Workplace Injury Rates: Excluding Road Accidents

Considering workplace injury rates by migrant status, the all accident 12 month injury rate among those respondents who were born in the UK is estimated as 4.4%. Excluding road accidents, this rate declines to 4.0%. Finally, this rate declines to 1.5% when only considering 'reportable' work-related accidents (non-road accidents resulting in over 3 days of absence from normal work). It is observed that workplace injury rates are lower among those who were born outside the UK, regardless of the length of residency. The highest workplace injury rates among migrants are estimated to occur for those who have resided in the UK for longer than 10 years. The all accident 12 month injury rate among those respondents who were not born in the UK but who have resided in the UK for longer than 10 years is estimated as 3.5%. Excluding road accidents, this rate declines to 3.2%. Finally, this rate declines to 1.3% when only considering 'reportable' work-related accidents (non-road accidents resulting in over 3 days of absence from normal work). The lowest injury rates are estimated for those who have resided in the UK for less than 1 year. However, such respondents are more likely to have had interrupted work histories during the previous 12 months and therefore would be expected to have had less exposure to workplace hazards.

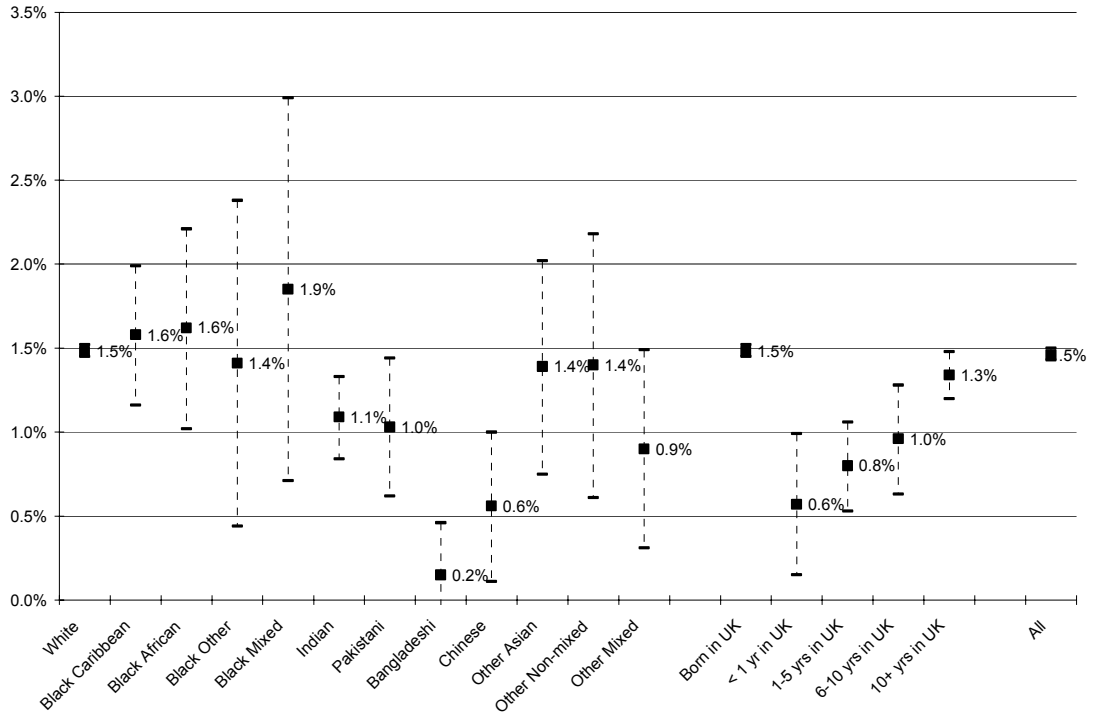

Figure 2.7 LFS workplace injury rates: reportable accidents

The descriptive analysis presented in Figures 2.5, 2.6 and 2.7 indicates that workplace injury rates for ethnic minorities are generally lower than those estimated for white people. This is with the possible exception of certain groups of black workers, for whom workplace injury rates are similar or slightly higher than those exhibited by white workers. Comparisons of workplace injury rates by migrant status do not appear to suggest that those who were born in the UK have lower rates of workplace injury than those who were born elsewhere. Indeed, regardless of length of residency in the UK, workers who were born outside the UK exhibit lower rates of workplace injury. However, it is not possible to infer from such a descriptive analysis as to whether these groups of workers are actually at an increased risk of experiencing a workplace accident compared to white workers or those who were born within the UK. Lower rates of workplace accidents amongst ethnic minorities may simply indicate the concentration of such workers within jobs that might be

expected to exhibit a lower than average risk of workplace injury. Lower aggregate rates of workplace injury among ethnic minorities or immigrants may even disguise an increased risk of workplace injury among these workers. The interaction between the occupational composition of employment and workplace injury rates among ethnic minorities and migrant workers will be discussed later.

2.5 WORKPLACE ACCIDENTS RATES FROM THE 1999 HEALTH SURVEY FOR ENGLAND

Another perspective on the accident rates among ethnic minorities was provided by the 1999 Health Survey for England. The Health Survey for England comprises a series of annual surveys covering the adult population aged 16 and over living in private households in England. All years of the Health Survey have sampled the general population, including minority ethnic groups. However, the 1999 Health Survey was designed to increase the representation of minority ethnic adults and children. While part of the sample was a general population sample that followed the same pattern as previous years, the remainder consisted of a 'boost' sample designed to provide sufficient numbers of people from ethnic minorities to examine their health in detail. Additional interviews were conducted with members of the six most populous minority ethnic groups: Black Caribbean, Indian, Pakistani, Bangladeshi, Chinese and Irish.

The remainder of this section presents results from an analysis conducted by McManus and Purdon (2001) of the 1999 Health Survey on the incidence of non-fatal accidents within ethnic minority groups. The 1999 Survey collected data on both self-reported 'major' accidents (hospital visited or doctor consulted) and 'minor' accidents (all other accidents causing pain or discomfort for more than 24 hours). By definition, fatal accidents are excluded. Accidents were defined as 'accidental events which resulted in injury or physical harm to you personally'. McManus and Purdon (2001) note that while cultural or linguistic factors in the interpretation of accident events could contribute to reported variation in rates between minority ethnic groups, it is not possible to determine whether questions have been interpreted differently.

Table 2.6 Annual accident rates per 100 adults, Health Survey for England

Standardised Ratios of Annual Accident Rates (relative to general population rate)	*Male*			*Female*		
	Minor	*Major*	*Major at Work*	*Minor*	*Major*	*Major at Work*
Black Caribbean	0.61	0.73	0.84	1.13	0.80	0.27
Indian	0.31	0.54	0.49	0.55	064	1.32
Pakistani	0.18	0.50	0.51	0.31	0.68	1.01
Bangladeshi	0.11	0.31	0.51	0.14	0.32	0.72
Chinese	0.55	0.34	0.62	0.16	0.46	0.55
Irish	1.10	0.90	0.86	1.33	0.88	0.65
General Population	1.00	1.00	1.00	1.00	1.00	1.00
General Population Rates (per 100,000)	200	19	10	120	15	3

Standardised ratios of annual accident rates relative to the general population rate are presented in Table 2.6. It can seen that among men, Bangladeshis had the lowest accident rates, with the minor rate being 11% of the general population rate and the major rate being 31% of the equivalent population rate. Black Caribbean and Irish men had accident rates fairly close to those of the general population, whereas Indian, Pakistani and Chinese men had rates between 18% and 55% of

the general population rates for minor and major accidents. Among women, Bangladeshis and Chinese exhibit the lowest minor and major accident rates. Major accident rates among Bangladeshi and Chinese women are approximately 15% of the general population rate, while rates of major accidents are 32% and 46% of the general population rate respectively. Black Caribbean and Irish women exhibit accident rates fairly close to those of the general population, whereas Indian and Pakistani women had rates between 31% and 68% of the general population rates for minor and major accidents. The Health Survey for England collected further information about the characteristics of major accidents, including whether the informant was at work at the time of the accident. Using responses to this question, rates of accident at the workplace were also derived. Among males, it is again observed that Black Caribbeans and Irish respondents exhibit workplace injury rates that are close to the rate observed among the general population. Workplace injury rates among male Indian, Pakistani and Bangladeshi respondents are approximately 50% of the population rate, while Chinese respondents exhibit rates that are approximately 60% of the population rate. For women, with the exception of Black Caribbean women who exhibit an accident rate of just 27% of the general population rate, none of the rates within the minority ethnic groups were estimated to be statistically different to the general population rate.

It is apparent that there are different overall estimates of levels of workplace injury, depending on the source used. It is less clear whether this has an effect on the internal differences, such as those between ethnic groups, although we cannot rule out the possibility of an artefact arising from the means by which data are collected. The lower rates of workplace injury reported by ethnic minorities within the Labour Force Survey do raise possible concerns about the quality of accident data collected from this source. Particular problems may arise due to the reliance upon proxy respondents in the LFS and having to recall accident events that have occurred over a 12 month period (see Chapter 5). However, the lower rates of workplace injuries reported in the Labour Force Survey among Indians, Pakistanis, Bangladeshis and Chinese appear to be supported by the 1999 Health Survey for England. In contrast to the LFS, respondents to the Health Survey for England were asked to recall the details of major accident events that they had had in the 6 months prior to the interview. In delivering the 1999 Health Survey for England, all survey materials were translated into seven languages: Hindi, Gujarati, Punjabi, Urdu, Bengali, Mandarin and Cantonese and respondents who could not carry out an interview in English were provided with an interviewer who could speak the appropriate language. Some of the more obvious methodological concerns regarding the collection of accident in the LFS do not appear to be the cause of the lower rates of workplace injury among ethnic minorities that are derived from this source.

In October 2003 the London Public Health Observatory published a report, 'Diversity Counts', on its work to gather 'Ethnic Health Intelligence' relating to London (LHO 2003). This included an analysis of data collected for a report on accidents and injuries in London ("Too high a price" - LHO website: www.lho.org.uk/hil/acc_inj.htm). While their definition included (and was dominated by) the effects of road traffic accidents, suicide, and 'domestic' accidents including fire and poisoning, these data do indicate much higher proportionate *mortality* risk ratios for those born in Ireland and 'the Rest of the World' (meaning, largely, unknown birthplace). Over half of all cases had no ethnic origin coded. Their principal conclusion was, in keeping with those of the recommendations of the Government's Accidental Injury Task Force "Measuring and Monitoring Injury Working Group", that 'ethnic monitoring should be incorporated into all injury datasets in line with the requirements of the Race Relations Amendment Act, and that Census-linked categories should be used' (LHO 2003 :30).

CHAPTER 3
LITERATURE ON ETHNICITY AND INJURIES AT WORK

3.1 INTRODUCTION

3.1.1 Literature review

The project has also undertaken a review of the published and grey literature on workplace injuries and accidents and work-related ill health. The review has identified and examined any evidence of reported differences in injury rates, diseases, or exposures; and any reports of intervention strategies to improve these.

Search strategies for electronic databases of published literature were developed using selected MeSH terms and free text terms relating to 'ethnicity and injuries and accidents' and 'ethnicity and occupational disease/illness'. The search strategy was tested and refined; articles were limited to English language publications. A Medline search using the strategy identified a total of 580 published papers published in the period 1966 - 2003. Examination of the abstracts of these papers identified 140 relevant studies from a wide range of countries. The largest number of papers were from the USA (68 studies) followed by Singapore (10 studies), New Zealand (9 studies), *8 studies from the UK*; Israel (7 studies); Canada (6 studies); France (4 studies); Australia and South Africa (2 studies each); and one study each from Central American Republic, Denmark, Estonia, Finland, Hong Kong, India, Malaysia and Sweden. Two studies were non-specific and simply refer to 'industrialised countries' and Asia; and for the remaining papers the country is unclear.

All articles have been entered on a bibliographic database and each paper has been summarised using a data extraction template (see Annex 1). This Chapter reports the findings on injuries at work and the next Chapter considers evidence on occupational ill health. Of the 140 relevant studies, relatively few papers (27) are on occupational injuries and accidents, 12 papers report on general patterns, and the remaining 101 articles consider 12 types of work-related conditions/ ill health. Fuller details of the search strategy and results are provided in the Technical Annex to this report.

3.1.2 Types of studies identified

Several studies focus on ethnicity and mortality or morbidity associated with occupational injuries, or illness due to exposure to workplace hazards, and only a few studies consider disability. Most studies have collected primary information while following different types of survey design. These studies can be classified as 'epidemiological', including use of: case-controls, prospective, retrospective, cross-sectional population surveys, and routine data, follow-up, historical records and some descriptive studies. The typology of these studies highlights: (a) differentials in rates or patterns by ethnicity; (b) post-exposure hazard consequences (e.g. chronic bronchitis, asthma and other respiratory problems, cancer, renal and other problems due to direct exposure to silica dust, pesticide and chemicals, radiation, heat, etc.); and (c) post-injury event consequences (e.g. spinal cord injury, brain problems, psycho/mental problems). Some studies have addressed the issue of working environment in terms of fatigue, stress, and also assault and homicide in the workplace and accordingly suggest safety and preventive measures. A few studies primarily raise methodological points in defining and measuring occupational health and safety issues in this area.

Most US based studies use that country's standard race/ ethnicity classification (e.g. White/Black; Hispanic/Non-Hispanic). The studies from New Zealand compare Maori with non-Maoris including European and Pacific Islanders; studies from Singapore compare Chinese with Malay or Indian; and studies from the UK compare South Asians with white British. Some studies use country of origin/ migration status or religion as one of the attributes for population diversity, but only one study used language for such stratification. Several studies compute incidence/ prevalence rates or standardised/ proportional mortality ratios (SMR/ PMR) separately by ethnic group, but most exposure related epidemiological case control studies have used ethnicity and/ or socio-economic status as one of the variables in a multivariate analysis, to *control* for variations in the outcome variable.

The 14 main areas covered by the studies identified by the literature review are listed in Table 3.1 below.

Table 3.1 Distribution of selected studies by broad topic/exposure/outcome

Occupational ill-health and injuries	***Number***
1. General Pattern - health conditions, health hazards, genetic susceptibility	12
2. Occupational Injuries and Accidents	27
3. Musculoskeletal Disorders: computer related, back pain, neck/shoulder pain	5
4. Respiratory Problems: silica dust & lung disease, asthma (isocyanate exposure), lead exposure, welders/shipyard workers & bronchitis, miners, textile/wool/fur workers & chronic bronchitis, tuberculosis, antimony (smelters), fibreglass industry, farm/rice mill workers, wood workers, asbestos exposure	20
5. Cancer: Lung cancer, digestive disorders (stomach, oesophageal, colorectal), pancreas, bladder, liver, skin cancer	25
6a. Lead exposure related: immune system, circulatory system	6
6b. Sun light, heat exposure, radiation, chemical poisoning, silica dust	7
7. Hepatitis (HAV/HBV/HCV) and HIV: Healthcare workers, nurses, dental care staff, anaesthetists	9
8. Kidney, urinary, renal diseases	3
9. Stress, inflammatory bowel disease	2
10. Diabetes, hypertension, CHD	3
11. Neurobehaviour, eye, mental diseases	2
12. Hearing, Vision impairments	4
13. Workplace social environment: assault/harassment, alcohol consumption, occupational health clinics, social work practice,	6
14. Occupational health promotion at workplace	9
All	140

3.1.3 Population/Industry/Occupation Coverage

Most studies refer to populations/ workers in a specific occupation or industry exposed to specific hazards including injury producing agents at the workplace. The class of worker varies from unskilled manual labourers to white-collar and professional workers. Occupational areas include: agriculture, forestry, fishery and rice mill workers; construction workers; textile/wool/fur workers; welders/metal fabricating/shipbuilding workers; jewellery workers; earth industry/mining workers; workers in wood and fibreglass industry, lead/battery/rubber industry, semiconductor/electronic/video-tapes industry, automobile and aerospace industry, meat plant and electric utility industry; waste water and sewage workers; drivers; army and navy staff, police and fire fighters; healthcare and dental staff, doctors and anaesthetists; and computer professionals.

3.2 SUMMARY OF FINDINGS FROM THE LITERATURE

Full details of the country/region in which the research was undertaken, type/design of the study, type of ethnic coverage, key findings, attributes of population covered, and issues highlighted by the study are presented for all 140 papers reviewed in Annex 2. The principal features emerging from the reviewed studies are summarised below, followed by a more detailed analysis of the literature on injuries at work.

3.3 EPIDEMIOLOGICAL PAPERS ON 'GENERAL PATTERNS'

Most US studies based on secondary or routine data (mainly collected/compiled by the Ministry of Labour or government agency like the Occupational Safety and Health Administration (OSHA) in the US) present evidence of differentials in the prevalence and incidence of select health conditions and their work-related consequences, including injuries among currently employed persons. However, the agencies concerned compile the annual number of cases or episodes by specific population characteristics (such as gender, age, education, occupation and ethnicity) from those establishments reporting at the time. A comparison of cases over time may therefore be misleading due to fluctuations in the number of reporting establishments within the region/country. There are also differences in the concepts and definitions used across countries. The review of evidence from these studies is therefore treated as indicative since no clear differential patterns in incidence rates by gender and ethnicity have emerged. However, a few studies have reported a narrowing of differentials between ethnic groups over time.

One US based study computed relative risks of exposure to each of six types of occupational injury and illness for Hispanic and Black workers compared to Whites (non-Hispanics). It was found that among males, Hispanics faced relative risks of exposure to all hazards adjusted for education and years of work experience of 1.33, while Blacks faced relative risks of 1.17. Among females, the adjusted relative risks were 1.19 for Hispanics and 1.31 for Blacks (Robinson 1990). Another study on health conditions of US Navy men reported that African Americans were found to be at significant increased risk for: mental disorders; diseases of the genitourinary system; diseases of the circulatory system; diseases of the digestive system; diseases of the blood and blood-forming organs; symptoms and ill-defined conditions; supplementary classifications; and diseases of the musculoskeletal system (Palinkas and Colcord 1985). Caucasians had significantly higher incidence rates for diseases of the skin and subcutaneous tissue, and accidents, poisonings and violence. Interestingly, this study indicated that the total disease incidence differential between Blacks and Caucasians had narrowed over time. It was concluded that the relationship between race and disease is mediated by several factors, including genetic predisposition, socio-economic status and cultural patterns of belief and behaviour. No single factor could account for the excess risk for all diseases among all members of a racial group.

An early US study of mortality patterns among fire fighters in Boston also revealed that the risks of health hazards had reduced over time (Musk et al. 1978). The standardised mortality ratio (SMR) was markedly reduced (less than 50) for infectious disease, diabetes, rheumatic heart disease, chronic nephritis, blood diseases and suicide. The SMR was 86 for cardiovascular deaths, 83 for neoplasm deaths, and 93 for respiratory deaths. The SMR for accidents was 135 for active fire fighters. Results suggested that the survival experience of fire fighters was strongly influenced by strict entry selection procedures, ethnic derivation, and socio-cultural attributes of membership. While excessive morbidity was demonstrated in fire fighters, there did not appear to be a strong association between occupation and cause-specific mortality.

The report entitled 'Time Lost from Work among the Currently Employed Population - United States -1968' prepared by the US Department of Health, Education, and Welfare in 1972 indicated lower days lost from work due to illness or injury for currently employed Whites than all other ethnic groups.

3.3.1 Working women

Wagener et al. (1997) have compiled information from various national surveys and secondary sources on health conditions of working women in the USA. Their report presents summary data on physical conditions and exposures, health conditions attributed to work, other health conditions that impact on work, health promotion in the workplace, and health-related benefits provided by employers. Most estimates are shown according to sex, age, race, ethnicity, educational attainment, and major occupational group. According to this study, women in the USA have about 20 percent more days lost from work than men because of activity restrictions due to acute and chronic conditions. Although the number of working days lost per person per year because of these conditions has increased slightly over the years for all workers, a gender gap continues to exist. Moreover, occupations heavily dominated by women show differing mortality profiles based on data from death certificates. The report provides proportionate mortality ratios for each cause of death among workers with a certain usual occupation as compared to the proportion of that cause among workers of all occupations, including housewives. Although mortality profiles add to knowledge of health outcomes for individuals in different occupations, they should not be viewed as necessarily related to occupational exposures. Nevertheless, the following highlights statistically significant elevated findings by race/ethnicity from the USA:

- *Among white women dieticians, motor vehicle mortality was elevated; deaths due to cancer were elevated among black women dieticians.*
- *White dental hygienists experienced elevated mortality due to cancer, particularly pancreatic and breast cancers.*
- *White health record technologists and technicians had elevated mortality due to infectious and parasitic diseases.*
- *White licensed practical nurses (LPN's) experienced elevated mortality due to diabetes and motor vehicle accidents, while black LPN's had elevated mortality due to colon cancer and suicide.*
- *Black and white secretaries, stenographers, and typists had elevated mortality due to malignant neoplasms, with breast cancer being particularly high.*
- *Information clerks and bank tellers experienced elevated mortality due to malignant neoplasms, particularly colon, pancreatic, and breast cancers.*
- *White child care workers in private households had elevated mortality due to diabetes; deaths due to pneumonia were elevated among black women workers under 65 years of age.*
- *Private household cleaners and servants had a mortality pattern similar to housewives, with low mortality for malignant neoplasms and somewhat elevated mortality due to heart disease. Diabetes was elevated among white women and cerebrovascular disease was elevated for both racial groups.*
- *Hairdressers and cosmetologists had elevated mortality due to malignant neoplasms, particularly lung cancer; white women had a high proportion of motor vehicle accidents.*
- *Black dressmakers had elevated mortality due to malignant neoplasms. Also, among black dressmakers, mortality was elevated due to chronic obstructive lung disease and to infectious and parasitic diseases.*
- *White textile sewing machine operators had elevated mortality due to diabetes and heart disease, while black operators had elevated mortality due to malignant neoplasms, particularly breast cancer. Both experience elevated mortality due to motor vehicle accidents.*

3.3.2 Preventive health services

Arnold (1996) studied the occupational health status of African-American women health care workers. Although African-American women constituted only 6.8% of the total U.S. labour force, they hold 20% of jobs in the health care industry and are disproportionately represented in those jobs that have the highest levels of workplace exposure to hazards. Given such concentration of African-American women in health care, it was suggested that primary care physicians, especially those engaged in office-based practices, should identify this target population for special need-based services as well as making them aware of the types of health issues that they are more likely to experience during their working lives.

Herbert et al. (1997) have put forward a model of clinical care linked to preventive occupational health services. This was developed at the Union Health Center (UHC), a comprehensive health care centre supported by the International Ladies Garment Workers Union serving a population of approximately 50,000 primarily minority, female garment workers in New York City. The objective was to develop a model occupational medicine programme in a union-based comprehensive health centre linking accessible clinical care with primary and secondary disease prevention efforts. Based on a need-based survey, an occupational medicine clinic was developed that integrated direct clinical care with worker and employer education and workplace hazard abatement. To assess the success of this approach, selected cases of sentinel health events were tracked and a chart review was conducted after 3 years of clinic operation. Prior to initiation of the occupational medicine programme, 64% (648) of the workers surveyed reported symptoms indicative of occupational illnesses. However, only 42 (4%) reported having been told by a physician that they had an occupational illness, and only 4 (0.4%) had filed a workers' compensation claim for an occupational disease. In the occupational medicine clinic established at the UHC, a health and safety specialist acted as a case manager, coordinating worker and employer education as well as workplace hazard abatement focused on disease prevention, ensuring that every case of occupational disease was treated as a potential sentinel health event. Work-related conditions diagnosed during the first 3 years of clinic operation included cumulative trauma disorders (141 cases), carpal tunnel syndrome (47 cases), low back disorders (33 cases), lead poisoning (20 cases), and respiratory disease (9 cases). disease prevention efforts within a US health centre setting.

3.3.3 UK studies

Williams, Bhopal and Hunt (1993) have compared the health status of South Asians (mainly Punjabis) with that of the general population in Glasgow (UK). A cross sectional survey was undertaken of 159 South Asians aged 30-40 years and 319 subjects from the general population, all aged 35 years. Body structure, lung function, pulse and blood pressure, history of physical and mental health, results of standardised questionnaires on mental health, angina and respiratory health, recent and past symptoms, history of accidents, and sickness behaviour were determined. The study found that the South Asians were shorter, broader, and more overweight (women); they had lower values for forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC), a faster pulse, and higher diastolic pressure (men). Fewer South Asian men reported accidents or digestive symptoms; fewer men wore glasses, had lost teeth, or had a long standing illness whereas more South Asian women had psychosomatic and high total symptoms (all $p < 0.01$). Women had a lower FEV1/FVC ratio ($p < 0.05$). The study concluded that the South Asians were more disadvantaged than the general population only in terms of anthropometric measures. The gender gap in health status (favouring men) in South Asians was higher than for the general population.

3.3.4 Immigrants

Contradictory evidence is provided by studies with regard to the health conditions of immigrant workers. One study in France focusing on the health of migrants in France has highlighted that immigrants belong to the lowest socio-economic status groups and are found in unskilled work or in jobs where they are constantly subjected to workplace hazards, occupational health risks and accidents (Bourdillon et al. 1991). The quality of maternal and child health care among foreign women was also found to be lower than among the French. This study identified that restrictions on the opportunities for enjoying certain social rights, administrative and financial obstacles encountered, and difficulties in communication all make it harder to meet the needs of the migrant population. Another study based on industrialised countries also reported that migrants, especially first and second generations, and ethnic minorities often have reduced entitlements in society (Bollini and Siem 1995). Not only are they exposed to poor working and living conditions, which are per se determinants of poor health, but they also have reduced access to health care for a number of political, administrative and cultural reasons which are not necessarily present for the native population. The authors argue that the higher rates of perinatal mortality and accidents/ disability observed in many migrant groups compared to the native population are linked to their lower entitlements in the receiving society. In view of the common belief that immigrants are at increased risk of injury and ill-health since they are concentrated in hazardous occupations, Courbage and Khlat (1996) examined the mortality rates and causes of death of Moroccans in France during 1979-91. They wanted to confirm the results of a previous study which had observed much lower death rates for immigrants in France than the national average, and also in specific socio-occupational categories where most immigrants belong. The authors similarly found low mortality rates for Moroccan immigrants, especially among men who had changed regions at least once within France.

3.3.5 Lack of communication and training for immigrants

A few studies have identified the lack of language, poor communication or on-the-job training as possible confounding factors for injury in the workplace (Bossley 1975; Bourdillon et al. 1991). An early New Zealand study observed a disturbingly high incidence of heavy machinery, industrial hand mutilation, involving recent Pacific Island immigrants many of whom had a poor comprehension of English. A survey of inpatients showed a proportionately greater incidence of severe injuries amongst these immigrants, and indicated that one causative factor was unsuitable selection of work (dangerous machinery), coupled with inadequate instruction in its use and safety precautions (Bossley1975). Another study identified a direct association between degree of fluency in English and better treatment outcomes for back injuries for migrant workers in Australia (Hewson, Halcrow and Brown 1987). A study of industrialised nations receiving migrants reports that one of the factors influencing poor health and living conditions of migrants is difficulty in communication (Bollini and Siem 1995).

A recent UK report prepared by the Royal Society for the Prevention of Accidents in 1996 investigated issues related to occupational health and safety needs of minority ethnic communities. The author examined whether workplace accident risks are made worse due to communication problems. While a household survey carried out in the West Midlands showed that younger employees mainly prefer communication in English, older generation Asians still prefer to use their own languages. The report indicated a need for health and safety messages to be provided in languages other than English and recommended a general guide for managers, supervisors and inspectors dealing with health and safety issues to help them understand the communication needs of multicultural and a multilingual workforce (Pawar 1996).

To sum up;

- *The 12 papers on 'general patterns' provide no consistent evidence of differentials in health conditions due to work-related hazards or injuries by gender or ethnicity, although some studies that do report differentials also report a narrowing of these over time. The latter may be due to secular trends such as reduction of risks of health hazards, improvement in technology, better safety and prevention measures, and increased awareness.*

- *There are contradictory (non-UK) findings in regard to immigrants being at increased risk of injury and ill-health due to concentration in hazardous occupations. However, a number of studies have identified the lack of language, and poor communication and on-the-job training as possible factors for workplace injury, and for poorer treatment outcomes following injury.*

- *For work-related ill health, it is concluded that the relationship with race is complex and mediated by several factors, including genetic predisposition, socio-economic status and cultural patterns of belief and behaviour.*

- *Genetic susceptibility and workplace environment: Two papers on the implications of genetic markers associated with susceptibility to harmful effects of the environment suggest that ethnic minority people at risk may need to be excluded from certain jobs/ environment(s) as discussed in Chapter 4.*

3.4 PAPERS ON 'ASSAULT AND HOMICIDES'

Several studies have indicated an increased incidence of assault and harassment as well as homicide among ethnic minority workers. Women and minority men also report more negative social interactions on the job, such as criticism, bias, and sexual harassment. A couple of studies have examined the relationship between alcohol consumption, nature of work, and other occupational factors. These analyses show that workplace problems are related to age, gender, ethnicity, work shift and departments.

Riopelle et al. (2000) describe the prevalence and correlates of physical assaults, threats of assault, and workers' perceptions of safety in selected urban employment settings in the USA. Questionnaires were mailed to a random sample of 1,763 persons working at various jobs and sites throughout Los Angeles County. Workers were asked to describe their work environments, their perceptions of personal safety at work, and physical assaults and threats they had experienced. Three percent of the respondents reported being assaulted within the previous year and 14% reported being threatened within the previous 30 days. Younger workers, more educated workers, and those who worked with clients or patients were more likely to report assaults. Approximately one third of those who reported threats or assaults described the perpetrator(s) as clients, patients, or persons in legal custody, and one third described the perpetrator(s) as co-workers or supervisors. Fifty-two percent of the workers reported being concerned about their safety at work.

Morris (1996) studied gender and ethnic differences in social constraints on and off the job among a sample of 372 police officers. Positive and negative social interactions with supervisors and coworkers, and perceptions of the work environment as well as support and resentment of the job from family and significant others, were included. As hypothesized, women and minority men reported more negative social interactions on the job, such as criticism, bias, and sexual harassment. Few differences were observed for positive social

interactions on or off the job, and where differences emerged, women and minority men reported more favorable social interactions. Findings are discussed in terms of implications for intervention, policy, and future research.

Jenkins (1996) discuss issues regarding workplace homicide by industries and occupations. There is a high incidence of homicide in the workplace and no single intervention strategy can fit in all situations. It is pointed out that interventions cannot be designed without knowledge of the demographic characteristics of victims and the distribution of workplace violence across industries and occupations. Such data are presented by gender, age, race, and geographic distribution, method of homicide, and industry and occupation.

According to a UK report prepared by the Home Office and HSE there were almost 1.3 million incidents of violence at work in England and Wales in 1999, comprising 634,000 physical assaults and 654,000 threats (the estimates were based on the 2000 British Crime Survey). In total, 604,000 workers (2.5% of working population) had experienced at least one incident in 1999, 304,000 workers had been assaulted on at least one occasion and 338,000 had been threatened (Budd 2001). The data were not analysed in terms of ethnic group. However the risk of assault at work was higher for workers in security and protective services, nurses, care workers, public transport, catering/hotels/ restaurants, teachers and other education and welfare, retail sales, management and personnel, leisure service providers and other health professionals. Full-time workers, employees with managerial responsibilities, employees in smaller organisations and the self-employed were at high risk of violence while at work. Almost a half of assaults at work and a third of threats happened after 6 p.m. suggesting increased risk of violence for those working during the late evening or night. A sixth (16%) of physical assaults at work involved offenders under the age of 16. Most incidents involving young people were against teachers and other education and welfare workers, though many were against those in the security and protective services. Victims of violence at work had a high risk of repeat victimisation that in fact had increased over time. About half (46%) of assaults at work resulted in some type of injury to the victim and in almost one in ten incidents of physical assault the victim saw a doctor as a result of the incident. Almost three-quarters of victims of violence while working said they had been emotionally affected by the incident. The most common reactions were anger, shock and fear. Those who had been threatened were particularly likely to say they felt frightened.

Another UK report on alcohol-related assault prepared by the Home Office shows that about 11% of such assaults took place in and around the workplace (highest being at the Pub - 52%). In 52% of non-alcohol related assaults attempted by an acquaintance the incident occurred at the workplace (Budd 2003).

Another report from the Home Office has analysed the 2000 British Crime Survey (BCS) in order to identify whether victims of crime believed the incident was racially motivated. The report points out that the ethnic minorities run a greater risk of crime than white people, though this largely reflects the fact that minority populations are concentrated in large cities and, in particular, in those areas where the crime rates are high for everyone. Whilst ethnic minorities do not generally face greater risks of crime than white people living in a similar area, a much greater proportion of assaults, threats and vandalism that they do experience are judged by the victim to be racially motivated. The BCS indicates that the number of racially motivated incidents has fallen between 1995 and 1999 (from 390,000 incidents to 280,000) alongside a general fall in crime. This is in sharp contrast to a fourfold increase in the number of incidents recorded by the police, which reflects more reporting by victims and better recording by the police. Respondents from ethnic minorities worry more about crime than their White counterparts. Although people from minority ethnic groups were prepared to seek help from the police, they were consistently less satisfied with the service they received than the white respondents (Clancy et al. 2001).

Similar findings were also reported by FitzGerald and Hale (1996) from earlier rounds of the BCS. They state that ethnic minorities were more likely to be victims of crimes and serious threats than whites. The proportion of all minority respondents in the BCS who had been victims of racially motivated incidents in the preceding year was four per cent for Afro-Caribbeans, five per cent for Indians and eight per cent for Pakistanis. Nearly a third of Pakistani victims said that incidents were racially motivated and this rose to 70% in the case of threats. The average figure for Indians was lower, at just under a fifth; for Afro-Caribbean victims it was 14%. Racially motivated incidents were more likely to be reported to the police by Indians than other types of crime; but both Afro-Caribbeans and Pakistanis were less inclined to report these incidents. Fear of crime was higher among the Asian groups than whites even when allowance is made for other relevant factors.

There is increasing evidence of violence and assaults on NHS staff. A survey of reported violent and abusive incidents and accidents involving staff in NHS Trusts and Health Authorities in 2001-02 indicates that workers in mental health and learning disability specialists are by far the most at risk of assault; this is followed by community health workers. However, the incidence of harassment was highest for workers in primary care trusts (http://www.doh.gov.uk/public/survey-violence-nhs0102.htm). A recent British Medical Association report on the incidence of violence against doctors also substantiates this as an issue of concern. The survey included 885 doctors of which 15.5% were from ethnic minorities. More than a third of doctors had experienced some form of violence in the workplace in the last year. Among hospital doctors, those working in A&E, psychiatry and obstetrics & gynaecology were more likely to report experience of patient violence. Around half of the respondents knew the perpetrator before the incidence took place (BMA 2003).

3.5 PAPERS ON 'OCCUPATIONAL INJURIES AND ACCIDENTS'

The literature reviewed indicates that occupational injury rates differ according to age, sex, ethnicity, occupation and industry. Socio-economic status is also a key determinant of injury. A paper by Cubbin et al. (2000) reports that blue-collar workers in the USA are at significantly increased risk of nonfatal injury. Education was unrelated to total injury morbidity, although associations were observed after stratification of outcome by severity and place of occurrence. Black persons were at increased risk from homicide, and Black and Hispanic persons were at

decreased risk of suicide and nonfatal injuries, after adjustment for socio-economic status. Injury rates in New Zealand are also reported to vary according to age, sex, ethnicity, occupation and industry. (Firth and Herbison 1990). Lacerations, strains/ sprains and foreign bodies in the eye were the most common injuries and machinery was the commonest cause of injury. Small factories had significantly higher rates for lost time injuries compared with large factories However, this study discovered serious under reporting of occupational injury to the Department of Labour. Another study has documented that work-related fatal injury rates in New Zealand are higher for Maoris than the non-Maori population (McCracken et al. 2001). Furthermore, a significant, linear decline across the years was evident for the non-Maori rates, but not for Maori rates. The authors infer that the disparity in work-related injury fatality rates between Maoris and non-Maoris is mainly due to differences in employment pattern.

Fullerton et al. (1995) have shown that of the total fatal injured cases (US, New Mexico) while on the job, 87.1% were unintentional, 10.6% homicides, and 2.3% suicides. Industries with concentration of case fatalities are construction, oil/gas and farming. The primary agents of death were motor vehicles, firearms, and falling objects. Almost all of the decedents were male; however, females were over represented among homicide deaths. Most unintentional injuries occurred in rural areas whereas most homicides and suicides occurred in urban areas. In one-fifth of cases, drug or alcohol use was evident. Thus, higher risk confounders were construction, oil/gas and farming industries, males and rural locations. Another US based study also demonstrated that women experience lower rates of occupational injury than do men in general, but subgroups are at increased risk (Weddle et al. 1993). All Hispanics were reported to be at increased risk of occupational injury, but the relative risk attributable to ethnicity for Hispanic women was nearly twice that of the corresponding relative risk suffered by working Hispanic men. It was also found that whereas, overall, women had a lower risk of assault than did men, relative risks of assault based on sex were the same in the workplace.

Robinson (1989) while examining US trends in racial inequality and exposure to work-related hazards during 1968-1986 found a dramatic narrowing of racial differences in exposure since the 1960s among males, unlike among their female counterparts. The study indicated that Black women faced approximately the same risk of occupational injury as white men.

The report by Wagener et al. (1997) shows a wide gender gap between workplace injury rates in the US work force (the rates were: 5.3% for white and 5.5% for black women; 9.7% for white and 8.9% for black men). Due to work injuries 28.2% of women and 27% of men changed their employer or activity (the percentages were marginally higher for Blacks).

3.5.1 Occupation/industry specific injuries

The literature provides evidence of higher injury fatality rates among construction workers than other general workers. Ore and Stout (1997) in the USA observed that, on average, non-white labourers had 27% greater mortality than white labourers. Agricultural, forestry and fishing were equally high injury risk industries. The mortality rate in Iowa from work-related accidents in farmers and farm labourers was found to be excessive compared with the general population. Work-related injury deaths in Alaska's fishing industry were also substantial. The majority of the decedents were Caucasian (i.e. White) men who drowned while fishing.

Baker (1987) analysed accidents at work retrospectively over a 12 month period in an automobile plant in south east England (UK). The study population was composed of Asian (22%), white (66%), and West Indian employees (12%). Crude accident rates differed among the groups, the means being Asians 1.58, whites 1.23, and West Indians 1.28. There was, however, no consistent ethnic difference after adjustment for other factors such as age, type of

job, and duration of service. Accident rates were higher in those employees who were younger, newly employed, and in production jobs. The author concludes that accident prevention programmes should be directed at those factors known to be related to accidents and not at any specific ethnic group.

3.5.2 Injuries, disability and army staff

A paper by Sulsky et al. (2000) considers the question of whether occupational injuries are responsible for more lost time from work, productivity, and working years of life than any other health condition in either civilian or military sectors. Injuries, not illnesses, are the leading cause of morbidity and mortality among U.S. Army personnel. The study examined the role of gender, race/ethnicity, and age in the odds of discharge from the Army for disabling knee injury. The authors found significant relationships between the risk of knee-related disability and age and race, with marked effect modification by gender. Non-Caucasian men and women were at lower risk than Caucasians at all ages. At most ages, Caucasian women were at higher risk than Caucasian men, and non-Caucasian women were at lower risk than non-Caucasian men. Within race/ethnicity and gender, the risks for men showed an inverted "U" shape with increasing age, and the risks for women showed a "J" shape with increasing age. The authors conclude that age, race/ethnicity, and gender interactions are important in occupational injury. Differences in risk may be related to differences in work assignments, leisure activities, physical or physiological differences or the ways in which disability compensation is granted. Bell et al. (2000) examined cases of injuries due to motor vehicle crashes in the US Army. Unadjusted analyses revealed that heavy drinking, drinking and driving, speeding, low seat belt use, younger age, minority race/ethnicity, and enlisted rank were significantly associated with motor vehicle injury, but neither smoking nor gender were. Multivariate models showed a significant trend of increasing injury risk with younger ages. Soldiers under age 21 were injured almost five times more often than those over age 40 (HR 4.89, 2.56-9.33). Also, associated with risk for hospitalisations were minority race (HR 1.78, 1.46-2.18), heaviest drinkers versus abstainers (HR 1.81, 1.11-2.94), and seat belt use of 50% or less versus 100% (HR 1.40, 1.07-1.85). The authors emphasise that programmes targeting these behaviours that meet the needs of young and minority soldiers are needed.

3.5.3 Injury and adolescents

Parker et al. (1994) have examined the nature and incidence of self-reported adolescent work injury in Minnesota, USA. The study was a cross-sectional survey of work and work injuries of 10th through 12th grade students throughout Minnesota. Injury was defined as an event that caused any of the following: loss of consciousness, seeking medical care, and/or restricting normal activities for at least 1 day. The average hours of work per week during the summer and during the school year were 30 and 16, respectively. There was no difference in hours worked between ethnic minorities and white students. The rate of reportable injuries was 12 and 13 per 100,000 hr worked for rural and urban female students whereas 16 and 20 per 100,000 hr for urban and rural male students. Ongoing medical problems were reported by 26% of the injured workers. Previous estimates of work-related injury to adolescents may have been low. The authors suggest that more studies are required to clearly define the incidence of injury among adolescents and associated risk factors.

3.5.4 Accidents and fatigue level

Hours of work, fatigue and rest can play an important role in prevention and control of accidents and injuries. Yee *et al.* (2002) explored the potential role of sleep disorders in New Zealand motor vehicle accidents. The study concluded that daytime somnolence and sleep disorders were commonly found in drivers attending the Emergency Department after an accident

resulting in injury. Lilley et al. (2002) explored the relationship of fatigue, and some of its key determinants, with accidents and injuries in a group of forestry industry workers in New Zealand. Accidents and lost-time injury were associated with length of time at work, ethnicity, and having had near-miss injury events. Fatigue was more commonly experienced at work in the forest, with 78% of workers reporting that they experienced fatigue at least "sometimes." Certain groups of workers reported long working hours, reduced sleep, compromised recovery time, and intensely paced work. Logistic regression analysis showed that recent sleep, number of breaks taken during the workday, and specific job/tasks were associated with reporting of high fatigue levels at work. Near-miss injury events were significantly more common among those reporting a high level of fatigue at work.

Wohl, Morgenstern and Kraus (1995) conducted a population-based case-control study of women in US high-risk manufacturing occupations to examine occupational injury and its association with possible risk factors inside and outside the workplace. The primary hypothesis was that women with young children are at greater risk of occupational injury than those women without owing to the responsibility and fatigue associated with raising young children. The odds of reported injury was three times greater in women with a child less than 6 years of age than in women without a young child. The study found small or zero effects for age, years of work experience, ethnicity, marital status, and shift worked. These findings indicate that factors outside the work place, such as the presence of young children at home, may increase the risk of occupational injury for women employed in manufacturing jobs.

3.5.5 Post-injury consequences (brain/head injury)

McCauley et al. (2001) considered post-concussional disorder (PCD) in the USA following mild to moderate traumatic brain injury. Their study used a syndromal approach for investigating risk factors for developing PCD, 3-months post-injury. The results indicated significant risk factors including female gender, poor social support, and elevated self-reported depressive symptoms at 1-month post-injury. Co-morbidity included concurrent diagnosis of major depressive disorder and/or posttraumatic stress disorder. Hispanics were significantly less likely to develop PCD than other racial/ethnic groups. PCD resulted more frequently from motor vehicle accidents and assaults. Levi et al. (1990) reported incidence and types of head injury trauma in northern Israel. A descriptive epidemiological study was undertaken over a 4.5-year period, including data on demographic, clinical and radiological features at the time of admission, as well as hospital care through to discharge. The crude incidence was 36.9 and 13.4 cases per 100,000 for males and females, respectively ($p< 0.01$). Age-specific incidence rates in Jews compared to other ethnic groups were reported. Falls had an incidence of 12.8 (51%), road accidents 9.0 (35.7%) and assaults 2.3 (9%) per 100,000 person-years. Other causes were accidents during work or sport and suicide.

3.5.6 Multiple injuries

The paper by Wassell *et al.* (1999) emphasises the need to consider multiple injuries in occupational cohorts, methods to account for recurrent injuries to US workers over time, and the temporary removal of workers from the 'risk set' while recuperating. In their study, the time until injury event was modelled in an occupational cohort of employees in a large power utility company where employees are susceptible to recurrent events. The injury history over a ten-year period was used to compare the hazards of specific jobs, adjusted for age when first hired, and race/ethnicity differences.

3.5.7 Under-representation/reporting of injuries

Hull, Jones and Moser (1997) have explored the factors influencing attendance rate at accident and emergency departments in East London, UK. The study examined variations in A&E department attendance rates in 105 general practices, using routine data. The mean annual age-standardised practice A&E attendance rate was 17.6 (95% CI 16.8-18.4) per 100 adult population with a range of 10.3 to 29.4. There was a negative association between the proportion of Asian population in a practice and attendance rate. Multiple regression analysis showed that 48% of the variation in attendance rates could be accounted for by six factors: percentage of households not owner occupied, percentage living in households without a car, percentage living in households lacking amenities, percentage of pensioners living alone, percentage of Asian ethnicity, and percentage living in households with a head born in the New Commonwealth and Pakistan. The authors conclude that social deprivation (including ethnicity) is strongly linked with attendance rates at A&E departments. In contrast, the organisational characteristics of general practices appear to have no bearing on the rates.

3.5.8 Injury compensation and faith, belief and practices

Cheng (1997) has explored how people respond to injuries at work among a group of hand-injured workers in Hong Kong. A focused interview with open-ended questions was employed to investigate those workers who had suffered from work-related injury over 10 years. Concerning the *perceived cause of injury*, industrial production process factors such as machine defects, piecework, limited working experience, and lack of supervision were reported to have triggered the onset of the injuries which resulted in permanent disability. At the same time, respondents also explained their injury in terms of magical-religious forces such as fate and luck, embraced in cultural beliefs that are commonly found among Chinese. Such understanding appears fatalistic but allows the individual to actively cope with misfortune. The emphasis on harmony and stability among the Chinese population also affected what action they took against the employer for negligence. It was shown that in general many respondents were bound by kuan-hsi (personal relationship) and tended to preserve the harmony between themselves and their employer. Thus, in a modern society like Hong Kong, traditional values and modern practices are complementary to each other in coping with life stresses such as disablement. Concerning risk assessment in relation to work safety, the author argues that workers' value systems and practices at the worksite should be taken into consideration.

Dembe (1995) reviewed historical records of workers' medical judgements and compensations relating to workplace injuries in the USA. Because of uncertainty about the true cause of many occupational disorders and the highly charged social environment in which medical opinions are rendered, physicians' views about malingering were often swayed by cultural, political, and economic forces. The historical record showed that a medical diagnosis of occupational malingering can reflect deep-seated cultural and social biases toward women, Jews, immigrants, and other groups representing a potential threat to the privileged social class. Efforts to eliminate fraudulent workers' compensation claims must be sensitive to the inherent ambiguities in the medical determination of work-relatedness and the potential for judgements about simulated work injuries to conceal deep-seated social biases and class prejudices.

To sum up;

- *The 27 papers on workplace injuries and accidents are concentrated on studies in a few occupations and industries (e.g. construction, agriculture, heavy machinery, drivers, army, police and fire fighters) and the literature is dominated by studies of male worker. Nevertheless, the literature suggests that injury rates differ according to age, sex, ethnicity, occupation and industry.*

- *Research from New Zealand indicates higher rates of work-related injuries for Maoris than non-Maoris and in small factories than in large factories.*

- *US literature suggests somewhat higher injury rates for Caucasian than non-Caucasian workers, but indicates greater narrowing of racial differences over time among males than among their female counterparts. Black women now face approximately the same risk of occupational injury as white men.*

- *UK literature, in contrast, presents either non-significant differences in injury rate by ethnicity or lower rates for Asians than the white population.*

- *A number of studies have identified the critical role of hours of work, fatigue etc in prevention of accidents and injuries. There is evidence that accidents and lost-time injuries are associated with length of time at work, ethnicity, and having had a near-miss injury event. Also, working women with young children are at greater risk of occupational injury than those without, presumably due to fatigue associated with raising young children.*

- *Discrimination, in terms of lower incidence of award of compensation and disability benefits due to workplace injuries is indicated for ethnic minorities in some studies.*

CHAPTER 4
LITERATURE ON ETHNICITY AND OCCUPATIONAL ILL HEALTH

4.1 INTRODUCTION

The Self-reported Work-related Illness Survey (SWI) 2001/02 provides evidence that 2.3 million individuals (5.3% of people ever employed) in the UK are suffering from work-related ill health. These include long standing as well as new cases (Jones et al. 2003). Musculoskeletal disorders (bone, joint or muscle problems) are the most commonly reported (estimated at 1,126,000 (or 2.6%) people ever employed affected); stress, depression, anxiety are the next most common with half that number affected (563,000 people); then breathing and lung problems (168,000 people); and hearing (87,000 people affected). However, analyses of the Self-reported Work-related Illness Survey contain no information on the UK ethnic minority population (HSE 2003 Occupational Health Statistics Bulletin 2002/03 September 2003). UK and international literature on various work-related disorders and illnesses is now considered in the light of their importance in the UK workforce.

4.2 MUSCULOSKELETAL DISORDERS

This condition, identified as highest prevalence in the UK SWI 2001/02, is estimated to have led to 12.3 million days off work in 2001/02. In the UK, work-related musculoskeletal disorders have a statistically higher prevalence in four out of the eight industry sectors with the highest overall self-reported work-related illness, viz agriculture, construction, health and social work, and manufacturing (HSE 2003). Based on new cases reported to The Health and Occupation Reporting Network (THOR), metal plate workers have by far the highest incidence of upper limb disorders and assembly line workers have a higher rate of spinal or back disorders.

In the literature review five studies were identified relevant to musculoskeletal disorders and ethnicity, but none were from the UK. The literature provides some evidence of ethnic differentials, including in rehabilitation and benefits.

A Canadian study of carpal tunnel syndrome among workers in a meat packaging plant identified that, although this was higher than the general population, there was no significant influence of ethnicity, age and body mass index (Gorsche et al. 1999).

In a US study, among the currently employed reporting back pain, a higher percentage of black women had back pain due to workplace accidents or repeated activities at work than white women; a similar, but less extreme, difference was observed for men. Irrespective of race, in about 1 in 4 cases the worker changed jobs, stopped working at a job, or changed work activities because of prolonged back pain problems (Wagener et al. 1997). In contrast, an Australian study of migrant workers with back injuries found that, in occupations with higher accident liabilities, the relative proportion of injuries was not related to the country of birth, although this study did identify the degree of fluency in English as a predictor of treatment outcome (Hewson, Halcrow and Brown 1987). A more recent US study of occupational low back pain has also reported that impairment ratings and temporary total disability costs are lower for African Americans than for white workers; this was found to affect their claims and benefits (Tait and Chibnall 2001).

Another US study of computer users reports that disorders of the neck, shoulder, wrist, hand or arm vary by gender, age, ethnicity and prior history (Gerr et al. 2002). Individuals aged 30 years and above had an increased risk of developing neck/shoulder symptoms and disorders and the relative risk was observed to be lower for non-white than white participants (0.7 for symptoms and 0.6 for disorders).

4.3 STRESS AND WORKPLACE SOCIAL ENVIRONMENT

In the UK, work-related stress, depression or anxiety is the second most common work-related illness and a significantly higher prevalence is found in industry sectors such as public administration, education, and health and social work (HSE 2003). None of the studies identified are from the UK and the industry sectors covered are manufacturing and transport, rather than the high risk sectors identified in the UK.

Although our literature search excluded stress as a specific search term, because of other research commissioned by the HSE, several studies were identified reporting that ethnic minorities experience more negative work environments in terms of social interactions on the job, such as criticism, bias, and sexual harassment which can lead to stress. US research on gender and cultural diversity issues in worksite stress also indicate the need for stress management programmes to enable women in general, and ethnic minority women specifically, to cope with their unique stressors (Walcott-McQuigg 1994).

Other studies examining the relationship between alcohol consumption, nature of work, and ethnicity have identified significant ethnic differences. Two US studies have examined workplace transport. One paper reports that heavy alcohol consumption among urban transit operators is related to several variables including age, ethnicity, gender and marital status (Ragland et al. 1995). A further study of urban transit operators has highlighted an association between workplace racial discrimination and some measures of alcohol consumption (Yen et al. 1999). A US study of mostly male employees in manufacturing found that problems in the workplace are associated with work-related drinking; these workplace problems were found to be related to age, gender, ethnicity, work shift and departments (Ames, Grube and Moore 1997). A further US paper reviewing published research related to women, alcohol and work emphasises the importance of interactions among ethnicity, class, employment, and alcohol consumption (Ames and Rebhun 1996).

4.4 BREATHING AND LUNG PROBLEMS

Respiratory and lung problems are work-related conditions with the third highest prevalence in SWI01/02. These disorders are estimated to have affected 168,000 people ever employed and led to 1.2 million days off work in 2001/02 (Jones et al. 2003). Respiratory conditions in the UK workforce have a statistically higher prevalence in industry sectors such as agriculture (asthma), construction (asbestosis and mesothelioma) and manufacturing (asthma). The first two of these form part of the HSC priorities programme.

The literature on ethnicity was most extensive in this area, and it included three papers from the UK. Articles covered basic respiratory problems (including asthma and chronic bronchitis), lung cancer, and exposure levels. Only a few studies examined the effect of ethnicity on relative risk. Most studies incorporated ethnicity as a descriptor of the population studied; some used multivariate analysis to obtain relative risk figures. The evidence for increased risk for ethnic minorities is mixed, depending on occupation.

The one area in which there have been a number of UK studies is that of exposure in *textile workers*. However, these studies have generally included ethnicity as a possible confounding factor, rather than focusing on differential risk. Although one study investigating respiratory ill health among wool textile workers (Europeans and Asians) found a relationship between exposure and lung function in Asian men, this was not statistically significant (Love et al. 1991). An earlier study had found more frequent respiratory symptoms in those exposed to higher concentrations of dust allowing for the effects of age, sex, smoking habit, and ethnic group (Love et al. 1988). A more recent UK study of textile workers has identified that, even after allowing for sex, age, ethnic origin, and smoking, chronic bronchitis is more prevalent in cotton workers than in those working with man-made fibre (Niven et al. 1997). A study of Indian cotton workers found a significantly higher prevalence of bronchial obstruction in asymptomatic workers with more than 10 years of exposure (Rastogi et al. 1989).

4.4.1 Respiratory and lung problems

Some research focuses on *farm workers* (HSC priority area) and ethnic differences in respiratory disorders. A Canadian study of grain workers of British, German, and Eastern European ancestry found that the British grain workers had a significantly greater prevalence of airflow obstruction than the Eastern Europeans independent of the effects of age and smoking (Horne, To and Cockcroft 1989).

Otherwise, there is limited evidence of ethnic differences in *occupational asthma*. A study from Singapore has reported a higher level in Chinese workers, with the most common causative agent being isocyanates (Kor et al. 2001). However, Diller (1987) identifies that variation in the prevalence of isocyanate asthma is not related to geographical or ethnicity factors. In another study of asthma morbidity in adults in Singapore, ethnicity was found not to be a significant predictor of asthma morbidity (Hong et al. 1994). However, in New Zealand Maoris and Pacific Islanders lose more time from work and use A&E services more than European asthmatics, relative to their asthma severity (Garrett, Mulder and Wong-Toi 1989).

Other studies report on exposure to *welding fumes* but consider ethnic differences as a confounding factor. A New Zealand study found that work-related respiratory symptoms are related both to cigarette smoking and a measure of lifetime exposure to welding fumes when a group of welders and non-welders matched for ethnicity, smoking habits, and years of work experience were compared (Bradshaw et al. 1998). A US study showed that ten years of welding in ship yard workers was associated with chronic respiratory symptoms, with baseline expiratory flows reduced slightly when compared to Caucasian-predicted values (Kilburn et al. 1989).

4.4.2 Lung diseases and cancer

The literature provides some evidence of ethnic differences in lung disease and cancer in certain occupations, particularly mining workers exposed to silica dust, *foundry workers and fur workers; contradictory results for smelter workers,* rubber workers; and no evidence for workers in the *fibreglass industry*.

There is some evidence of ethnic differences in *silica dust exposure and non-malignant disease and cancer in mining workers*, even once smoking habits are excluded as a confounding factor. One study, relating non-malignant respiratory disease to underground uranium mining and cigarette smoking in Native American, Hispanic, and non-Hispanic white miners, found that lung disease is more strongly associated with mining in Native Americans; whereas it is mostly related to cigarette smoking in Hispanic and non-Hispanic White miners (Mapel et al. 1997).

However, a more recent US study of the risk of mortality from lung cancer in miners, has found that the significant risk of mortality from lung cancer increases with cumulative exposure to silica dust in both Hispanic and non-Hispanic white miners (Rice et al. 2001). Sluis-Cremer, Harrison and Pearson (1981), who studied respiratory symptoms and lung function in black and white mining and non-mining industrial workers in South Africa and the effect of smoking habits, have demonstrated ethnic differences. A particularly high occupational mortality from oesophageal cancer has also been reported among US ethnic minority workers in occupations potentially associated with exposure to silica dust and chemical solvents or detergents (Cucino and Sonnenberg 2002).

There is also some evidence from international studies of ethnic differences in lung cancer among *foundry and smelter workers*. A study of forge, foundry, and engine (machine and assembly) plant workers in a US automobile factory, found that the risk of lung cancer was significantly higher in non-white foundry workers aged under 50 (Vena et al. 1985). Another US study of a cohort of mainly Hispanic antimony smelter workers also suggests some increased mortality from lung cancer in workers exposed to antimony when ethnic-specific lung cancer death rates are used for comparison (Schnorr et al. 1995). A study of mortality among smelter workers in lead-producing plants in Denmark also found a statistically significant increase in lung and gastric cancers in these workers, but could not rule out diet, alcohol, cigarette smoking or ethnicity as possible confounding factors (Cooper, Wong and Kheifets 1985).

Similar contradictory findings have been reported for ethnic workers is the rubber processing industry. A cohort study of Swedish rubber workers (of which one-quarter were non-Swedish citizens) has reported a significant increase in lung cancer incidence for certain immigrant groups, assumed to be due to ethnic factors (Gustavsson, Hogstedt & Holmberg 1986). In contrast, in a US study of rubber workers a higher prevalence of pulmonary disease could not be explained on the basis of smoking, age, ethnicity, or socio-economic factors, but was related to the length of exposure (Fine and Peters 1976).

However, studies of workers in the *fibreglass industry* indicate that length of exposure is the main risk factor. A US study of lung cancer or non-malignant respiratory disease among these workers identified that race, parent's ethnic background, and place of birth were not significant, but that smoking and length of employment were statistically significant predictors of the former, and smoking for the latter (Chiazze et al. 1993).

In contrast, a study of lung cancer in retired *fur workers* in the USA found that foreign-born fur dressers and eastern European-born fur workers experienced the highest mortality risks for lung and colorectal cancers, respectively (Sweeney, Walrath and Waxweiler 1985). However, a Canadian study has reported no evidence of excess mortality risks in the fur industry (Guay and Siemiatycki 1987).

Finally, a US study of lung cancer attributable to occupational exposure to well-recognised carcinogens reports that estimates of attributable risks vary according to ethnic group, smoking status and birth cohort, with higher values in non-white workers, non-smokers and among members of more recent birth cohorts (Vineis et al. 1988). US data on mortality rates for selected work-related cancers among African Americans and Latinos also indicate that African Americans have higher than expected mortality rates for cancers of the lung, nasal cavity, peritoneum and leukaemia (Loomis and Schulz 2000).

4.5 HEARING PROBLEMS

After respiratory conditions, hearing problems are the next most common cause of work-related ill health in the UK (HSE 2003). From THOR data, these have a statistically higher prevalence in two main industry sectors, extraction and utility supply, and manufacturing. In particular metal plate workers report a much higher incidence of occupational hearing loss.

The literature on ethnicity and work-related ill health in this area included no papers from the UK. There is evidence from other countries of ethnic differences, possibly linked to patterns of use of hearing protection, and of early warning of damage.

US research on male metal fabricating workers considering race/ethnicity, mean years of employment, and proportion of time worked without hearing protection indicates that race/ethnicity is the major-effect variable, and that occupational noise exposure alone cannot account for the lower rates for white vs non-white workers (Ishii and Talbott 1998). Another US study has found significant differences between black and white employees (males and females) with respect to the percentage of population exceeding the different low fence frequency combinations and potential hearing compensation cost (Royster et al. 1978). In another US study of differences in blue collar workers' use of hearing protection, ethnic status (African American) was a significant predictor of use among women but not men (Lusk, Ronis and Baer 1997). Finally, research from Singapore on workers with noise-induced deafness has found that, after adjusting for differences in ethnic group and noise exposure duration, individuals with tinnitus have consistently higher hearing thresholds (Phoon, Lee and Chia 1993). It is suggested that awareness of tinnitus may encourage workers to cooperate in company hearing conservation programmes.

4.6 HEART DISEASE/OTHER CIRCULATORY SYSTEM DISEASE

This is the next most prevalent type of self-reported work-related illness in the UK (HSE 2003). No particular occupations report significantly higher levels of these conditions although heart disease is linked to stress, where there have been reported differences. None of the studies identified on occupational coronary heart disease or raised blood pressure were from the UK. There is mixed evidence from other countries of differential risk, with some evidence of lower blood pressure risk for certain ethnic populations.

Some of the studies that concentrated primarily on work-related cancer have also reported data on coronary heart disease. For example, a study of Swedish rubber workers in Sweden that reported a significantly higher incidence of lung cancer for certain immigrant groups, also reports that mortality from coronary heart disease does not appear to be correlated positively with ethnic factors (Gustavsson, Hogstedt & Holmberg 1986). In another US study of mainly Hispanic antimony smelter workers, possibly increased mortality from nonmalignant respiratory heart disease was reported (Schnorr et al. 1995). Similarly, a Danish study of mortality among smelter workers in lead battery plants and lead-producing plants found that excess deaths from cerebrovascular disease and from hypertensive heart disease among smelter workers were in part due to the high proportion of non-white employees in the smelter populations (Cooper, Wong and Kheifets 1985).

A US study of wastewater treatment system workers, which found that migrant workers were at significantly higher cancer risk than the US white male population, also reported that foreign-born workers had a lower rate of death for arteriosclerotic heart disease (Betemps, Buncher and Clark 1994). A US study of retired fur workers which found that foreign-born workers had a

higher mortality risk for lung and colorectal cancer, did not observe a similar effect for mortality from cardiovascular disease (Sweeney, Walrath and Waxweiler 1985).

A study of male municipal employees and raised blood pressure rates reports significant effects which do not favour supervisors and clerical employees, and in addition significant differences between employees which favour black workers over white ones (Sparacino et al. 1982). Similarly, a study of prevalence and control of hypertension in a large cohort of Israeli employees in 21 industries found marked ethnic differences, with those of Western origin having the highest prevalence, and those of Asian origin, the lowest (Green and Peled 1992). Another Israeli study of employees who were screened for cardiovascular risk factors identified the highest prevalence in subjects of European origin, and those employed in the wood industries (Kristal-Boneh, Goffer and Green 1994).

4.7 EYE STRAIN/IMPAIRED VISION

Eyestrain represent a further significant source of work-related ill health in the UK, although raised prevalence is not linked to particular industry sectors (HSE 2003). Only a limited literature was found in this area, principally on impaired vision; ethnicity was considered as a confounding factor and the studies demonstrate no ethnic differences. A study of employees in the shipbuilding industry reports that exposure to moderate styrene concentrations leads to impairment of colour vision after controlling for age, ethnic origin, and social and occupational state (Fallas et al. 1992). Similarly, workers exposed to mixed solvents in a video tape manufacturing factory in Singapore showed significant differences in the prevalence of headache, poorer visual motor control and recent memory impairment than a control group of unexposed workers (matched for ethnic group, age, and years of education) (Chia et al. 1993). In another study, microelectronics workers exposed to solvent, compared with age, gender, ethnicity, and education matched controls, were found to have poorer color discrimination, visual acuity and contrast sensitivity (Broadwell et al. 1995).

4.8 SKIN PROBLEMS

Skin problems and dermatitis represent a further source of UK work-related ill health, with raised prevalence reported in community, social and personal service, and the hotel and restaurant industry sector (HSE 2003). Hair dressers and barbers in the UK report significantly higher levels of these conditions in THOR. Once again, there is limited literature in relation to ethnicity. Some papers use ethnicity to control for confounding factors, but from others there is evidence of lower risk of dermatitis for black workers. None of the papers identified were from the UK.

US data on currently employed persons indicates that exposure to substances in the workplace is similar for black and white employees, but the percentage of workers reporting skin problems (dermatitis) is much higher for white women and men (Wagener et al. 1997). A Canadian study found an increased risk of skin cancer for subjects exposed to insecticides and herbicides, petroleum products, fibreglass dust and dry cleaning agents after adjustment for age, skin and hair colour, and mother's ethnic origin (Gallagher et al. 1996). Microelectronics workers exposed to solvents were also found to report increased dermatitis as well as respiratory disease compared with age, gender, ethnicity, and education matched controls (Broadwell et al. 1995).

4.9 INFECTIOUS DISEASE

Infectious diseases, viral and bacterial, represent a further significant source of work-related ill health in the UK, with raised prevalence reported in the health and social work sector and occupations such as fishmongers and poultry workers (HSE 2003).

One area in which research evidence of ethnic differences was identified in relation to a raised risk of *tuberculosis (TB)* in healthcare and farm workers (both groups in the HSC priorities programmes). Meredith et al. (1996) also identified that the relative risk of TB is 2.4 times higher in UK health professionals, adjusted for ethnic group, sex, and age. The risk of TB was more highly elevated for workers of Indian subcontinent origin than for white workers. It has also been reported that farm workers are approximately six times more likely to develop TB than the general population of employed adults; and that migrant and seasonal farm workers are more likely to need different treatment regimes, due to higher rates of drug-resistant TB, and to require an outreach worker from the same cultural and language background (Advisory Council for the Elimination of Tuberculosis 1992).

Several studies have examined the risk of hepatitis among healthcare staff, including dental professionals. In health care workers in Central America, hepatitis B virus has been linked to ethnicity, district of residence, and age as the best predictors (Hakre et al. 1995). Similarly, in South Africa the prevalence of hepatitis B is reported to be higher in African nurses and domestic staff than in white nurses; but while Indian and white doctors are at significantly higher risk, African doctors are not (Windsor et al. 1984). A number of studies have identified other health care professions as being at higher risk of hepatitis B virus, including dentists and other dental personnel (Mori 1984); and anaesthetists, with highest rates in subjects from Asia, Africa and Eastern Europe (Chernesky, Browne and Rondi 1984). Oriental dental-care workers in Canada have been reported to have a significantly higher rate of Hepatitis B infection, with race and the number of years in practice the only significant factors in predicting infection (Noble et al. 1991).

Hepatitis C virus infection in healthcare workers in Israel has been shown to be linked to race (born in Central Asia), length of occupational exposure to blood, and history of blood transfusion (Sermoneta-Gertel et al. 2001).

In a study from Israel, occupations at risk for hepatitis A infection have been identified as being day care centre and kindergarten staff, food industry workers, teachers, physicians and dentists, and therapists and medical technicians; while sewage workers and nurses were not identified (Lerman et al. 1999). However, another study from the USA has reported that wastewater workers are at increased risk of occupationally acquired hepatitis A, possibly due to poor work practices (Weldon et al. 2000).

Another study has examined issues about HIV infection among minority health care worker and identified that inadequacy of training appears to be one of the primary reasons for high rates of needlestick injuries and exposure to blood (Askari and Alexander 1989).

4.10 OTHER WORK-RELATED CONDITIONS

The review identified some literature on other work-related conditions in ethnic minority workers. Elevated cancer levels among ethnic minority workers have been reported for bladder, stomach and leukaemia.

Cancers: Work-related cancers rates, other than lung cancer, have been reported in a number of papers. These appear to indicate ethnic differences in several cancers.

Elevated cancer mortality rates have been identified for *bladder* cancer among African American and male Latinos in several occupational groups with exposure to suspected bladder carcinogens; among Asian males in sales; and for Asian females in the personal services industry (Schulz and Loomis 2000). A US study of wastewater treatment system workers also indicates that migrant workers are at significantly higher risk than the US white male population for various cancers, including *stomach* and *leukaemia*, and diseases of the nervous system and sense organs (Betemps, Buncher and Clark 1994). A study of production workers in the USA identified that white male and black male employees have different cancer mortality rates (Ference, Chiazze and Wolf 1987). Another US study has identified differential cancer mortality risks among firefighters of different race/ethnic sub-populations (Ma et al. 1998). A study from Singapore of ethnic (Chinese) male workers identifies high levels of bowel cancer and low levels of lung and oesophagus cancer among managers and clerical workers; high lung and oesophagus rates in manual workers (e.g. bricklayers, carpenters, transport equipment operators and labourers); and high levels of skin cancer among farmers (Lee 1984). A New Zealand study of Maori *stomach* cancer rates, which have remained high, identified that occupations associated with elevated male rates were forestry workers, grain millers, brewers, and field crop workers (Dockerty et al. 1991). Finally, a US study of the high rates of *liver* cancer in Mexican-Americans has identified occupations such as plumbers and pipe fitters and textile workers as being at twofold or greater risk, but not farm workers (Suarez, Weiss and Martin 1989).

However, some studies indicate that other factors may be important, possibly length of exposure. A US study of jewelry workers identified an excess of *pancreatic* cancer in the entire group which was not explained by ethnic or other non-occupational factors (Sparks and Wegman 1980). Another US study of men employed in by-product coke plants found that, after taking into account race and age, it was men with 5 plus years exposure who had significantly elevated cancer rates (Redmond, Strobino and Cypess 1976).

4.11 WORK-RELATED EXPOSURE AND HAZARDS

Although we also aimed to identify whether ethnic minorities are disproportionately affected by hazards found within the five areas selected as HSC priorities (nuclear; railways; offshore, onshore gas; pipelines; explosives and chemical installations), we found no recent literature on these. The main literature we identified on ethnic minorities and workplace hazards was on lead exposure, heat exposure, and possible genetic susceptibility.

Lead exposure: Examination of blood lead concentration among workers in a battery manufacturing factory in Singapore has identified higher concentrations among Malay workers, possibly due to oral ingestion of lead through eating with fingers (Chia, Chia and Ong 1991). An earlier study found significant differences in the median and ulnar nerves of lead battery workers, adjusted for age, ethnic group, smoking and drinking habits (Chia et al. 1996). Another study from Singapore has found higher blood lead levels, after adjusting for the type of industry, age and duration of exposure to lead, in Malays and Indians; this is deduced to be linked to eating habits (Phoon, Lee and Ho 1990). In the USA, it has been reported that minority groups tend to be over-represented in lead industries and that high lead levels can be compounded by cultural influences (Sakamoto, Vaughan and Tobias 2001). Another study from the USA has found a highly significant association of blood lead levels with past exposure in lead-battery workers, after making allowance for job category, seniority, age, ethnicity, gender, and smoking habit (Hodgkins et al. 1991). A French study has similarly found much higher

blood lead levels in exposed workers than in controls matched according to age, sex, drinking and smoking habits, ethnic origin and drug intake (Bergeret et al. 1990).

Heat exposure: One paper reports that, in hot working conditions, the susceptibility of an individual to fluid and electrolyte disturbances cannot be predicted from age, body composition or ethnicity (Bates, Gazey and Cena 1996).

Genetic susceptibility, predictive tests and workplace environment: Two papers were identified that reviewed genetic susceptibility, working environment and occupational risk. One early US paper simply reviews various methodological approaches including adjustment for race, ethnicity, and gender (Schulte 1987). It is pointed out that better study design is needed for the simultaneous assessment of genetic and occupational risk. Another review paper discusses inherited polymorphic proteins and enzymes in different ethnic groups, whether affected individuals ought to be excluded, and whether it is scientifically and ethically justified to use these markers to 'protect' workers (Murray 1986). A study of black and white employees in the US Navy, examining a wide range of diseases, identifies the existence of subgroups within either racial group, and concludes that the relationship between race and disease is mediated by several factors, including genetic predisposition, socio-economic status and cultural patterns of belief and behaviour (Palinkas and Colcord 1985). More recently, the prevalence of a major antigen associated with systemic lupus erythematosus (SLE) was determined in the serum of uranium miners exposed to heavy quartz dust, and the study concludes that it may be indicative of higher risk of developing SLE in cohorts matched for sex, ethnicity, geographic region, and occupation (Conrad et al. 1998).

4.12 OCCUPATIONAL HEALTH PROMOTION IN THE WORKPLACE

The review identified nine papers reflecting on occupational health awareness and promotion. Such studies have examined the role of occupational health promotion programmes at worksites as well as safety training for ethnic minorities. However, these studies also highlight limitations such as lower enrolment, retention and participation of ethnic minorities as well as problems of communication, heterogeneity in socio-economic status, work habits and behaviour.

Lusk, Ronis and Baer (1997) have examined gender differences in US blue-collar workers' self-reported use of hearing protection devices (HPDs). Overall use did not differ by gender; in addition, self-efficacy and barriers to use of HPDs were the two best predictors of this behavior for both men and women. Despite the similarities in HPD use and the most important predictors of that use between men and women, predictive models differed by gender in several ways. Significant predictors of use among men also included age and value of use of HPDs. For women, ethnic status and plant site were additional significant predictors of use. Because the influences of plant site and gender on self-reported use of HPDs could not be separated in this study, the authors recommend further research to address worksite culture and assess differences by gender.

Walcott-McQuigg (1994) discuss gender and cultural diversity issues in worksite stress. By the year 2000, 85% of new entrants into the US work force were predicted to be women and minorities, increasing US work force exposure of women and minorities to occupational stress hazards. Ethnic minority women, in addition to experiencing stressors that other women experience, are exposed to stressors that are unique because of their ethnicity. The author recommends that stress management programmes to assist women to manage their stress should

include strategies that enable women in general, and ethnic minority women specifically, to cope with their unique stressors.

The workplace is an ideal setting to promote health and safety programmes. A report by Wagener et al. (1997) shows that in the US, between 1985 and 1992, the percentage of private establishments offering some type of health promotion programme increased, as did the variety of programmes offered. The most frequently offered health promotion programme was job hazard and injury (64% of worksites), followed by exercise or physical fitness (41%), smoking control (40%), stress management (37%) and alcohol/other drugs (36%). Programmes relating to smoking control, back care, exercise, high blood pressure, nutrition education, stress management, and weight control were offered more frequently in 1992 than in 1985. For all programmes the percentage of worksites offering the programme increased with size of the worksite. However, older workers, less educated and Hispanic workers were less likely to have access to such programmes.

Stange et al. (1991) describe the demographic and health characteristics of participants and non-participants in a US worksite health-promotion programme. Although worksite health-promotion programmes represent an increasingly common attempt by industry to improve the health of employees, the potential impact of programmes is limited by nonparticipation, especially among demographic subgroups and those who could most benefit from health behaviour change. The study prospectively examined the relationship of personnel data and self-reported health habits and health status to participation in the health-promotion programme. Thirty-four percent of the 505 employees enrolled in the programme. White employees were 2.47 times as likely to participate as non-whites (95% confidence interval, 1.59, 3.83). There was no difference between participants and non-participants in self-reported health status, and only slightly more positive health habits were noted among participants. Seatbelt use was 1.65 times more common among participants (1.10, 2.49). The authors conclude that it is reassuring that such programmes do not enroll only the very healthy or those with healthy habits. However, the diminished enrollment of non-white employees supports concern that health-related programmes may not equally reach all segments of the work force.

Brill et al. (1991) explored the relationship between socio-demographic characteristics and recruitment, retention, and health improvements in a worksite health promotion programme among 11830 employees in the USA. Enrolled employees (n = 3,873) were given a health screen consisting of health habit assessment, measurement of clinical variables, physical fitness testing, and a medical examination. One-third of employees were successfully recruited into the programme. Recruitment rates were virtually identical for men and women (32% and 33%, respectively), but varied across ethnic, age, and education groups. Black, younger employees, and non-college graduates were less likely to be recruited. Sixty-nine percent of the employees were retained in the programme, as defined by participation in the second screen, and women were more likely to be retained than men (71% versus 64%, respectively). Retention rates throughout the 10-week programme were higher for White and Hispanics, and were virtually identical for each age group and education level. Overall, participants in the programme showed an improvement in physical fitness and general well-being, lost weight, and smoked less. These changes were relatively consistent across the various demographic groups.

Aguirre-Molina and Molina (1990) described the health characteristics and health risks of ethnic-racial populations and the implications for planning and delivering health promotion programmes at the worksite. Special consideration was given to occupational stratification, which separated these groups from their white counterparts, thus requiring special attention. Guidelines are given for designing culturally appropriate worksite health promotion programmes.

Whitmore and Groce (1992) discuss the essential features of cross-cultural safety programmes for environmental management. For those who have responsibility for safety programmes in health facilities the primary objective is to effectively orient, train and retrain environmental service and housekeeping personnel, regardless of their individual background, so that each employee has the knowledge, skills and work habits to safely and effectively meet performance expectations. With an increasingly diverse multicultural workforce, however, there is a need to reexamine many of the assumptions of what constitutes adequate safety training for all employees. The authors examine some of the basic issues that arise when addressing a multicultural workforce. Two questions are at the heart of the discussion: (1) how does one effectively communicate with a multicultural base group, and (2) how does one know whether the communication has been effective to ensure the health and safety of employees?

Johansson and Partanen (2002) discuss the role of trade unions in workplace health promotion. Historically, workers have organized in trade unions and parties to strengthen their efforts at improving workplace health and safety, job conditions, working hours, wages, job contracts, and social security. Cooperation between workers and their organizations and professionals has been instrumental in improving regulation and legislation affecting workers' health. The authors give examples of participatory research in occupational health in Denmark and Finland. The social context of workplace health promotion, particularly the role of unions and workers' safety representatives is described in an international feasibility study. The authors advocate defending and supporting workers and their trade unions and strengthening their influence on workplace health promotion. In the face of rapid capitalist globalization, unions represent a barricade in defense of workers' health and safety. Health promoters and related professionals are encouraged to support trade unions in their efforts to promote health for workers and other less privileged groups.

Kawakami and Kogi (2001) discuss the merits of action-oriented support for occupational safety and health programmes in some developing countries in Asia. This paper reports the achievements of 3 action-oriented support programmes: the WISE programme for small enterprises, the WIND programme for farmers, and the POSITIVE programme for workers and trade unions. Special attention is paid to how the programmes have strengthened local efforts for sustainable actions in safety and health improvements. The results showed that there were significant achievements in action-oriented support programmes, including a large number of improvement examples, integration into government policies, and network support through employers' and workers' organizations. Participatory, action-oriented training tools such as action-checklists, local good example photos, and group work methods played key roles in the effective implementation of the programmes. There were a number of local efforts to extend the coverage of action-oriented support to hard-to-reach workers such as home-based workers, rural workers, and ethnic minorities. The authors conclude that action-oriented support programmes can provide local people with concrete means to promote safety and health improvements. The successful programmes commonly focused on local initiatives and were built on local wisdom and resources.

Cwikel (1992) describes the potential problems in occupational health and discusses suitable social work interventions on the basis of data obtained in a study of textile industry workers. Significant differences were observed between groups of workers (newly hired, veteran, and currently unemployed) on self-rated health, frequency of health problems that interfere in role function, smoking, and frequency of alcohol consumption. In addition, health behaviour varied by sex, age, educational achievement and ethnic origin among newly hired workers. Results indicated the need to identify target groups of workers when designing and implementing health prevention/health promotion programmes. A model of social work practice in occupational health is presented based on different types of health behaviour (preventive health behaviour,

illness behaviour, sick role behaviour and rehabilitation) and intervention modes in social work practice (individual treatment, group work, family therapy and policy and programme planning).

CHAPTER 5
WORKPLACE INJURIES AND ETHNIC MINORITIES: AN ANALYSIS OF THE LABOUR FORCE SURVEY

5.1 INTRODUCTION

In Chapter 2 we utilised merged data from the Winter Quarters of the LFS to present estimates of workplace accident rates for detailed ethnic groups. We now wish to provide a detailed overview of the labour market characteristics of ethnic minorities. In particular, the emphasis of this section is to provide a detailed analysis of the occupational composition of employment among ethnic minorities and those who were not born in the UK. By detailing the occupational composition of employment among these groups of workers, it will be possible to provide explanation as to the patterns of workplace injury rates outlined earlier.

To provide the most detailed analysis possible, we utilise data from 28 successive quarters of the LFS covering the period Spring 1994 to Winter 2000. In order to provide meaningful sample sizes for particular ethnic groups, data from successive quarters of the LFS have been averaged. Two dimensions of ethnicity are again considered. However, as the primary interest of this section is to provide detail regarding the occupational composition of employment, the classifications schemes utilised for ethnicity are less detailed that those that were utilised in the earlier discussion of injury rates. Firstly. for the purpose of the following descriptive analysis, ethnic categories have been collapsed into Black Caribbean, Black Other (encompassing Black – African, Black – Other, Black – Mixed), Asian (encompassing Indian, Pakistani, Bangladeshi, Chinese and Other – Asian) and Others. The second dimension along which we consider ethnicity is in terms of residency. Here we now distinguish between those individuals who were either born in the UK, those who have resided in the UK for less than 10 years, and those who have resided in the UK for more than 10 years.

5.2 THE OCCUPATIONAL COMPOSITION OF EMPLOYMENT AND WORKPLACE INJURIES

Elias *et al* (2001) have undertaken an analysis of workplace injuries based upon individual level data from the LFS. This study reveals that although variations are observed across a variety of personal and workplace characteristics, the dominant influence that effects the risk of suffering a workplace injury is occupation. Differences in the rates of workplace injuries that exist across industrial sectors can largely be explained by the risks associated with occupations that predominate in these sectors. In understanding differences in aggregate workplace injury rates between different ethnic groups, it is therefore important to consider differences in the occupational composition of employment between these groups.

The Standard Occupational Classification (SOC) provides a national standard for categorising occupational information. SOC forms the basis of occupational classification in a variety of national surveys that collect statistical information, including the LFS. The Major Group structure of SOC90 consists of a broad set of nine occupational categories (one-digit) that are designed to be useful in bringing together occupations that are similar in terms of qualifications, training, skills and experience commonly associated with the competent performance of work tasks. Occupation is most often determined by reference to a person's main job at a reference time. Defined as a set of tasks to be carried out by one person, jobs are primarily recognised by their associated job titles. Within SOC, jobs are classified into groups according to their skill level and skill content. The concept of 'skill' is operationalised in terms of the nature and

duration of the qualifications, training and work experience required to become competent to perform the associated tasks in a particular job.

At the time of writing, workplace injury data is available from nine quarters of the LFS for the period 1993 to 2001. However, from the Spring Quarter (March-May) of 2001, the classification of occupational information contained within the LFS moved from 1990 Standard Occupational Classification (OPCS, 1990) to the 2000 Standard Occupational Classification (ONS, 2000). There is no direct one-to-one mapping between the constituent occupational groups of SOC90 and SOC2000 in all areas of the classification. The ability to merge data across successive quarters requires occupational information to be recorded on a consistent basis. The analysis therefore does not incorporate injury data from the most recent LFS that utilise SOC2000 for the classification of occupational information. SOC has a hierarchical structure. At the most detailed level of classification, 374 unit groups (three-digit) are distinguished. Each occupation unit group is allocated to a minor group (two-digit) of which they are 77 and a major group (one digit), of which there are nine. In analysing the occupational composition of employment across different ethnic groups, the present analysis will utilise the Minor Group (two-digit) level of SOC90.

5.3 OCCUPATIONS, ETHNICITY AND WORKPLACE INJURY RATES

Table 5.1 presents occupational injury rates for the 10 most hazardous Minor Groups of SOC90. In constructing these occupational injury rates, information was extracted from the individual data files from the Winter Quarters (Dec-Feb) of the Labour Force Surveys covering the period Winter 1993 to Winter 2000. These 8 data sets were then merged to form a single data set covering the period 1993 to 2000. The injury rates therefore represent the average annual injury rates during each of the 8-year sub-samples. This is the same procedure that was utilised in the estimation of workplace injury rates for by ethnicity and migrant status presented in earlier.

These Minor Groups of SOC90 are ranked in descending order according to their workplace accident rate. For ease of exposition, we focus upon the all injury accident rate. Injury rates excluding road accidents and rates of reportable workplace injury for all SOC Minor Groups are presented in Annex 4. It should be noted that the numbering system assigned to these occupational categories reflects the hierarchical structure of SOC and not the actual number of SOC Minor Groups. For a full description of these occupational categories and the jobs that are classified to these groups, see OPCS (1990). In terms of the all workplace rate, it can be seen that the three most hazardous occupational groups are SOC Minor Group 83: Metal Making, Treating Operatives; 93: Other Transport Occupations and 61: Security Service Occupations. The 5 most hazardous occupational groups are each characterised by workplace accident rates in excess of 10%. In contrast, the three least hazardous occupational groups are SOC Minor Groups 25: Business and Financial Professionals, 35: Legal Associate Professionals and 32: Computer Analysts, Programmers.

The remaining columns of Table 5.1 present the cumulative percentage of people employed within these Minor Groups of SOC90. Full details of the occupational composition of employment (i.e. the cell percentages used to calculate these cumulative percentages are presented in Annex 5). To provide the most robust analysis possible, we utilise data from 28 successive quarters of the LFS covering the period Spring 1994 to Winter 2000. Note that in our analysis of the occupational composition of employment, we are not restricted to utilising information drawn only from the Winter Quarters of the LFS. Our figures are produced by taking averages of estimates derived from each of these quarters. The importance of taking averages from successive Quarters of the LFS is highlighted at the base of Table 5.1. It can be seen that on average, only 456 Black Caribbeans of working age and who were currently in

employment appeared within a single quarter of the LFS. This is compared to 399 Black Others, 1432 Asians and 414 Others. These unweighted samples would not be sufficient to provide robust estimates of the occupational composition of employment across detailed occupational categories.

It can be seen that among white workers, 8.6% are employed within the 10 most hazardous Minor Groups of SOC90. This is compared to 7.9% of Black Caribbeans, 6.7% of Black-Others, 5.4% of Asians and 4.6% of others who are employed in these occupations. This patterns is repeated when we consider the 20 most hazardous occupations, which are shown to constitute 20% of employment among whites, 17.7% of employment among Black Caribbeans, 12.9% of employment among Black-Others, 14.8% of employment among Asians and 9.1% of employment among Others.

It is therefore observed that ethnic minorities are generally under-represented in terms of employment within these most hazardous occupational groups. There are however a couple of exceptions to this. Most noticeable is the higher incidence of Black Caribbeans and Black Others who work within who work within Minor Group 64: Health and Related Occupations. Jobs coded to this Minor Group of SOC include nursing assistants and auxiliaries, hospital ward assistants, ambulance staff and care assistants. 5.9% of Black Caribbean workers are employed within this group of SOC, compared to 2.8% of white workers. Similarly, 5.4% of Black Other workers are employed within this group of SOC, compared to 2.7% of white workers. Employment within Minor Group 64: Health and Related Occupations is projected to increase from approximately 825 thousand to 1.4 million by 2010 (CE/IER, 2001). Growth in this occupational area may therefore disproportionately effect certain ethnic groups in terms of their exposure to risk of workplace injury.

Table 5.1 Occupations and workplace injury rates: ethnicity

Top 10 Most Hazardous SOC90 Minor Groups	*Accident Rate*	*Cumulative Employment*				
		White	*Black Caribbean*	*Black Other*	*Asian*	*Other*
83 metal making, treating operatives	11.7%	0.2%	0.2%	0.2%	0.2%	0.1%
93 other transport occupations	11.5%	0.6%	0.8%	0.5%	0.7%	0.4%
61 security etc service occupations	10.8%	2.2%	2.7%	3.2%	1.6%	1.6%
53 metal forming, welding etc trades	10.3%	3.6%	3.8%	3.5%	2.2%	1.9%
91 other manufacturing etc occupations	10.1%	3.9%	4.1%	3.6%	2.4%	2.0%
54 vehicle trades	9.9%	5.0%	5.2%	4.1%	3.0%	2.4%
94 other communication occupations	9.0%	5.9%	6.4%	5.3%	4.0%	3.6%
58 food preparation trades	8.9%	6.2%	6.6%	5.6%	4.3%	3.7%
51 metal machining, fitting etc trades	8.8%	8.2%	7.7%	6.2%	5.4%	4.5%
60 NCOs etc, armed forces	8.5%	8.6%	7.9%	6.7%	5.4%	4.6%
Top 15 most hazardous occupations	8.2%	12.8%	11.3%	7.9%	8.7%	6.1%
Top 20 most hazardous occupations	7.2%	20.0%	17.7%	12.9%	14.8%	9.1%
Average Total Employment (000s)		23981.3 (100%)	204.4 (100%)	185.4 (100%)	636.9 (100%)	189.0 (100%)
Average unweighted cases		58208	456	399	1432	414

The second dimension along which we consider the occupational composition of employment is in terms of residency. Here we now distinguish between those individuals who were either born in the UK, those who have resided in the UK for less than 10 years, and those who have resided in

the UK for more than 10 years. In Table 5.2, the Minor Groups of SOC90 are again ranked in descending order according to their workplace accident rate with the associated cumulative percentage of people employed within these Minor Groups of SOC90. Full details of the occupational composition of employment (i.e. the cell percentages used to calculate these cumulative percentages are presented in Annex 6).

Table 5.2 Occupations and workplace injury rates: migrant status

Top 10 Most Hazardous SOC90 Minor Groups	*Accident Rate*	*Cumulative Employment*		
		Born in UK	*Lived in UK <10 yrs*	*Lived in UK >10 yrs*
83 metal making, treating operatives	11.7%	0.2%	0.1%	0.1%
93 other transport occupations	11.5%	0.6%	0.3%	0.4%
61 security etc service occupations	10.8%	2.3%	1.1%	1.6%
53 metal forming, welding etc trades	10.3%	3.7%	1.4%	2.3%
91 other manufacturing etc occupations	10.1%	4.0%	1.5%	2.5%
54 vehicle trades	9.9%	5.1%	1.8%	3.2%
94 other communication occupations	9.0%	6.0%	2.3%	4.0%
58 food preparation trades	8.9%	6.3%	2.6%	4.2%
51 metal machining, fitting etc trades	8.8%	8.3%	3.1%	5.4%
60 NCOs etc, armed forces	8.5%	8.7%	4.2%	5.7%
Top 15 most hazardous occupations	8.2%	12.9%	6.4%	9.0%
Top 20 most hazardous occupations	7.2%	20.2%	9.6%	14.5%
Average total employment		23501.6 (100%)	562.9 (100%)	1351.3 (100%)
Average unweighted cases		57391	1208	3152

It can be seen that among those workers who were born in the UK, 8.7% are employed within the 10 most hazardous Minor Groups of SOC90. This is compared to 4.2% of those workers who were not born in the UK and have resided in the UK for less than 10 years. Among those workers who were not born in the UK, but who have resided in the UK for more than 10 years, 5.7% are employed within the 10 most hazardous Minor Groups of SOC90. This pattern is repeated when we consider the 20 most hazardous occupations, which are shown to constitute 20.2% of employment among those workers who were born in the UK. This is compared to 9.6% of total employment among those who have resided in the UK for less than 10 years and 14.5% of total employment among those who have resided in the UK for longer than 10 years. It is therefore demonstrated that those workers who were not born in the UK are generally under-represented in terms of employment within the most hazardous occupational groups.

This analysis of the occupational composition of employment among ethnic minorities indicates that the lower rates of workplace injury generally exhibited by these groups are related to their occupational composition of employment. Both workers from ethnic minority groups and those who were not born in the UK are under-represented in terms of their employment within the most hazardous occupational groups. However, while such patterns of employment contribute to lower aggregate injury rates among these workers, it is still not clear whether such workers are at an increased or decreased risk to experiencing a work related accident. Indeed, lower rates of workplace injury resulting from the concentration of employment in occupations that are less hazardous could actually disguise an increased risk of workplace injury experienced by ethnic minorities or migrant workers within these occupations. The research question therefore

remains as to whether, after controlling for a range of personal, job, and workplace characteristics, do ethnic minorities experience different risks of workplace injury?

5.4 THE PROBABILITY OF REPORTING WORKPLACE ACCIDENTS

The risk of a workplace injury will be related to the characteristics of the job. Previous research into the incidence of workplace injuries has shown that some individuals appear to be more likely to suffer a workplace injury. However, much of this research is unable to determine whether certain groups of individuals with high injury rates are 'accident prone' or are more likely to be employed in 'high risk' jobs. For example, Stevens (1992) argued that the higher rate of workplace injuries reported by men, as opposed to women, results from occupation specific differences and the concentration of men in occupations which have a higher risk of workplace injury. Early research into the perception of higher rates of industrial accident among 'immigrant' groups found that the 'immigrant' effect was in fact a 'dangerous job' effect (Lee & Wrench 1980, Wrench 1995).

Descriptive analysis undertaken in Chapter 2 indicated that ethnic minorities and those workers born outside the UK had a lower incidence to report that they had experienced a workplace injury during the previous 12 months. However, lower rates of workplace accidents amongst ethnic minorities may indicate either the presence of personal characteristics that may pre-dispose those from ethnic minorities to have a lower risk of suffering from work-related accidents; or the concentration of ethnic minorities within jobs that might be expected to exhibit a lower than average risk of workplace injury. Even lower rates of workplace injury among ethnic minorities or immigrants may not be indicative of a reduced risk of workplace injury among these workers. The research question therefore remains as to whether, after controlling for a range of personal, job, and workplace characteristics, ethnic minorities experience different risks of workplace injury.

5.4.1 Modelling strategy

McKnight, Elias and Wilson (2001) have used multivariate statistical techniques to 'separate out' the various influences on the risk of a workplace injury associated with employer and workplace characteristics, such as occupation, industrial sector and level of qualification, age and length of time spent in a job. For example, after adjusting for a wide variety of factors, men are still estimated to face a 35% higher risk of reportable injury compared to women. Research such as this, however, has not considered the issue of ethnicity in detail. To measure the possible affect of ethnicity upon risk of incurring a workplace injury, variables to identify particular ethnic groups have been included in population models to consider whether after controlling for other characteristics, ethnic minorities are more or less prone to experiencing an occupational injury. To identify the separate contribution of ethnicity towards the risk of a workplace injury, multivariate logistic regressions of binary dependent variables indicating whether or not a survey respondent has had a workplace injury during the previous 12 months have been undertaken. Separate models have been estimated for all workplace injuries, workplace injuries excluding road accidents and reportable workplace injuries.

Due to the low numbers of workplace injuries reported by ethnic minorities, data from each of the 8 available quarters of the LFS (Winter Quarters for 1993 to 2000) have been combined for the purpose of the multivariate analysis to assist in verifying whether any statistically significant differences exist between different ethnic groups. Results related to ethnicity and country of origin are presented in the following charts. The bars represent the relative percentage risk of reporting the occurrence of a workplace injury during the previous 12 months relative to a chosen reference category. The shaded bars represent the estimation of relationships that were

found to be statistically significant at the 5% level. Other controls in the statistical model include age, gender, region of residence, educational attainment, hours of work, size of establishment, public/private sector identifier, employment status, current employment tenure, occupation (at the level of SOC90 minor groups) and industry (50 industry categories based on SIC92).

5.4.2 Estimation results

Figures 5.1 to 5.3 present results from logistic models that incorporate variables to distinguish individuals by ethnicity and length of residence in the UK. These characteristics are shown as sets of categories, with one category excluded in each set in order to act as the reference. The first set of variables distinguishes ethnicity, with 'whites' acting as the reference category. The second set of variables distinguishes migrant status, with 'born in UK' acting as the reference category. Where the bar drops below the horizontal axis, this indicates that individuals within that category exhibit a lower probability of reporting a workplace accident compared to the reference category. Where it lies above, this indicates a higher probability of reporting a workplace injury compared to the reference category. Shaded bars indicate whether the relationship was estimated to be statistically significant at the 5% level.

In terms of ethnicity, it is estimated that Indians and Pakistanis are less likely than Whites to report that they had experienced a workplace accident during the previous 12 months. This result is estimated to be statistically significant among both Indians and Pakistanis for all accidents (respectively 31% and 43% less likely), excluding road accidents (33% and 53% less likely) and reportable accidents (26% and 48% less likely). No statistically significant differences are estimated for Black Caribbeans, Black Others (incorporating Black African, Black Other, Black Mix) or Chinese workers, although there is weak evidence to suggest that workers within the Black Others category have an increased probability of reporting a workplace accident. In terms of length of residency in the UK, it is estimated that individuals not born in the UK are less likely to report the occurrence of a workplace injury. It appears, however, that as these individuals spend longer within the UK, their propensity to report the occurrence of a workplace injury during the 12 months prior to the survey approaches that of individuals who were born in this country. This is highlighted by those workers who have resided in the UK for longer than 10 years having very similar reporting behaviour compared to those who were born within the UK.

The reduced likelihood of Asians and those born outside of the UK to report the occurrence of a workplace accident does raise concerns about the quality of information collected from such respondents. A potential source of error in the LFS is that information related to approximately one third of individuals is collected through a proxy respondent. While this information is generally regarded as being of acceptable quality, it is possible that proxy respondents may under-report the occurrence of certain events (see Dawe and Knight, 1997). This could be of particular importance for the reporting of workplace injuries that requires respondents to recall events over a 12-month period. Figures 5.4 to 5.6 therefore consider whether there is a tendency for workplace injuries to be under-reported by proxy respondents.

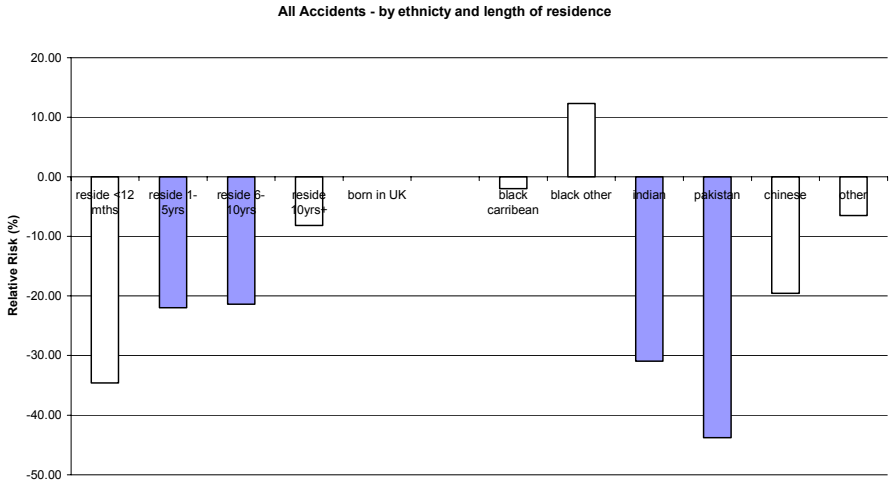

Figure 5.1 Probability of reporting an accident by ethnicity and length of residence

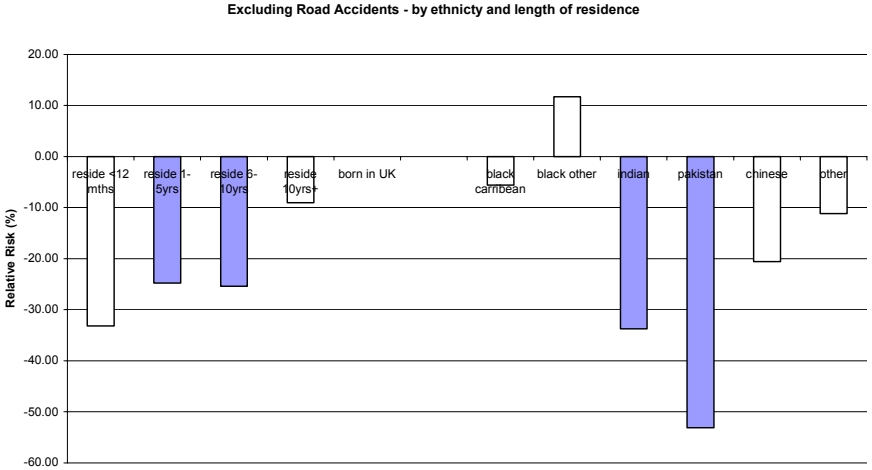

Figure 5.2 Probability of reporting an accident (excluding road accidents) by ethnicity and length of residence

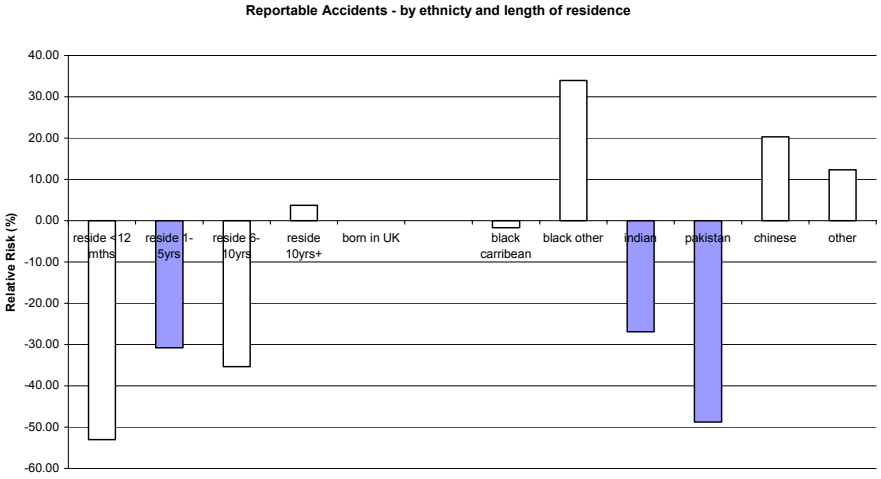

Figure 5.3 Probability of reporting a 'reportable' accident by ethnicity and length of residence

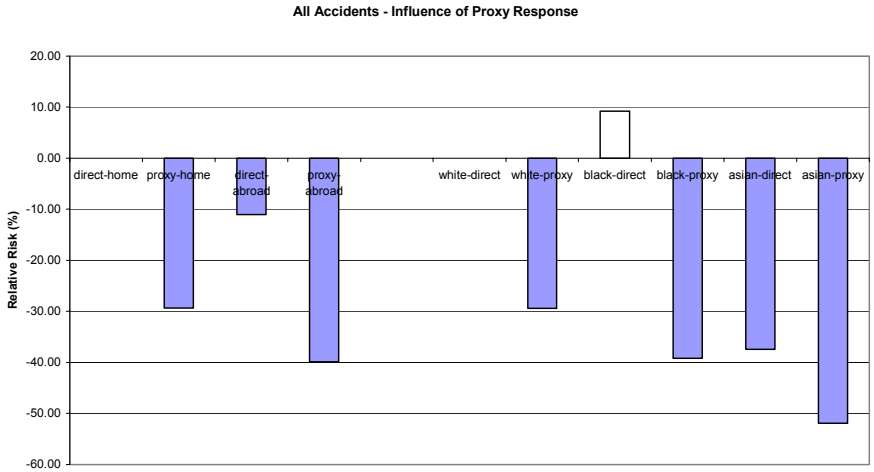

Figure 5.4 Probability of reporting an accident: effect of proxy response

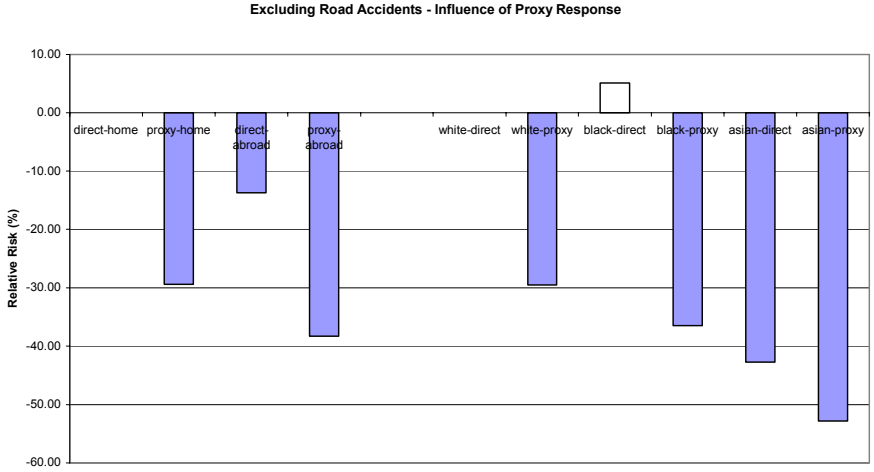

Figure 5.5 Probability of reporting an accident (excluding road accidents): effect of proxy response

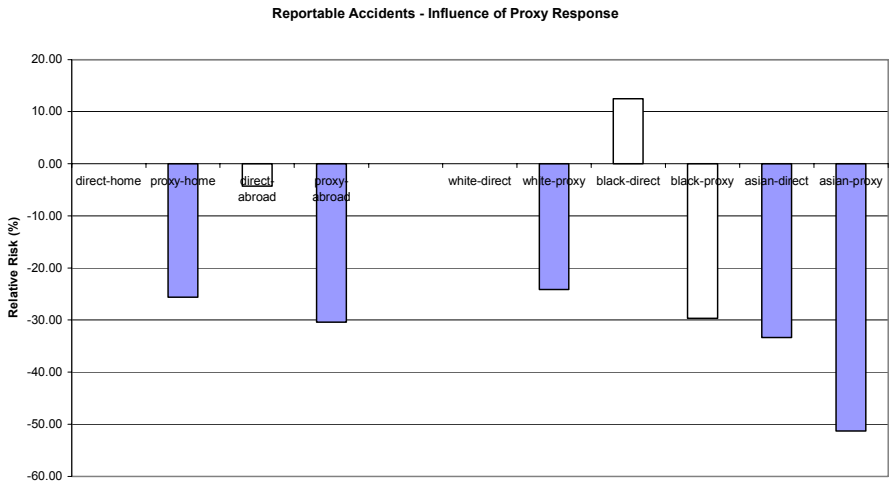

Figure 5.6 Probability of reporting a 'reportable' accident: effect of proxy response

Considering proxy response by ethnicity for all accidents, it is estimated that proxy respondents reporting on behalf of Whites are 30% less likely to report the occurrence of a workplace injury compared to Whites who respond to the LFS directly. In comparison, it is estimated that proxy respondents reporting on behalf of Black (incorporating Black Caribbeans, Black Africans and Black Others) are approximately 49% less likely to report the occurrence of a workplace injury compared to Black who respond to the LFS directly. Therefore, there is possible cause for concern regarding the quality of information collected via proxy respondents relating to workplace injuries among Black. This is particularly important given that Black Caribbeans and Black Others were estimated to have an increased probability of reporting a workplace accident compared to whites, although not significantly so (see Figure 5.1 to 5.3). Under-reporting among proxy respondents may be disguising the actual extent of any increased risk exhibited by this group.

However, this is in contrast to Asians. Considering the probability of reporting all workplace accidents, proxy respondents reporting on behalf of an Asian are only approximately 15% less likely to report the occurrence of a workplace injury compared to Asians who respond to the LFS directly. Under reporting by proxy respondents therefore does not appear to explain the reduced risk of workplace injury among Asians. Similarly, there is no evidence to suggest that injury data collected through proxy respondents on behalf individuals born outside of the UK is contributing towards the lower risk of workplace injuries estimated for this group. The relative quality of data from proxy respondents does not appear to be the cause of the lower probability of workplace injuries among Asians, or among those not originally born in the UK. However, it is important to note that the lower estimated risks of workplace injury could be the result of a general under-reporting of workplace injuries among such groups, among both proxy respondents and those who respond directly to the LFS.

Another source of potential bias in terms of the under-reporting of accidents among ethnic minority or immigrant workers may be related to establishment size. Available empirical evidence tends to support the view that larger establishments exhibit lower rates of workplace injury (e.g. Currington, 1986, Lanoie, 1992). It is suggested that this pattern is indicative of the economies of scale achieved by larger establishments in terms of expenditure on health and safety. The average cost of health and safety measures per employee will be lower in larger firms, increasing the incentive of firms to invest in these areas. Previous analysis of the LFS however indicates that the risk of injury is lower within smaller establishments with fewer than 25 employees compared to larger establishments (Elias et al, 2001). The inability to distinguish between medium and larger sized establishments within the LFS means that it has not been possible to identify effects that may be attributable to economies of scale at larger establishments (see Nichols, Dennis and Guy, 1995).

The lower probability of workers in small establishments reporting a workplace injury could be attributable to safer behaviour at small establishments, where the operation of the business would be more adversely affected by the absence of a member of staff. Alternatively, these findings may indicate that such businesses are less able to cope with unplanned periods of absence, encouraging a faster return to work following a workplace injury. Finally, small firms may be characterised by a lack of awareness among both employees and employers regarding health and safety responsibilities. Whilst the lack of regulatory control at such workplaces may have adverse level upon actual workplace safety, workers in such establishments may have a lower propensity to report workplace accidents. The relationship between establishment size and workplace injuries may differ further when focussing upon ethnic minorities or migrant workers as such workers may be more likely to work in family run businesses. This may have an affect both upon workplace behaviour and upon how such workers may respond to questions regarding workplace injuries. Figures 5.7 to 5.9 therefore consider the relationship between establishment size and the probability of reporting a workplace accident among different ethnic groups and by migrant status.

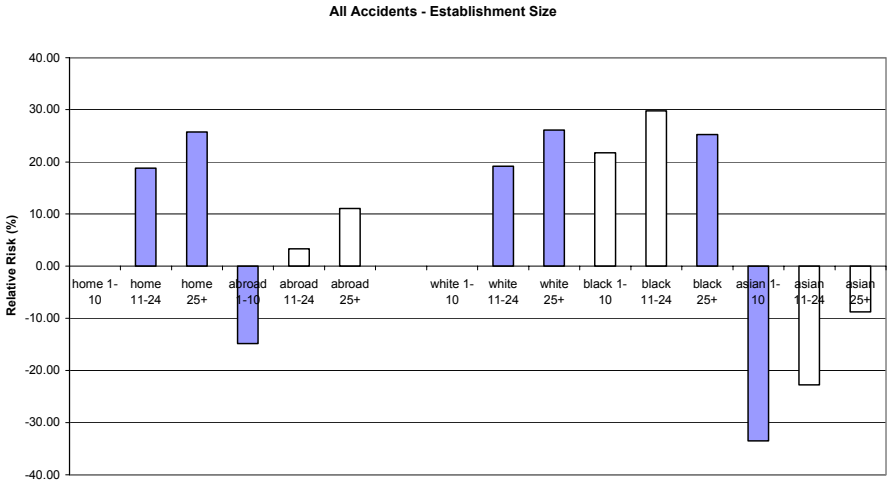

Figure 5.7 Probability of reporting an accident: effect of establishment size

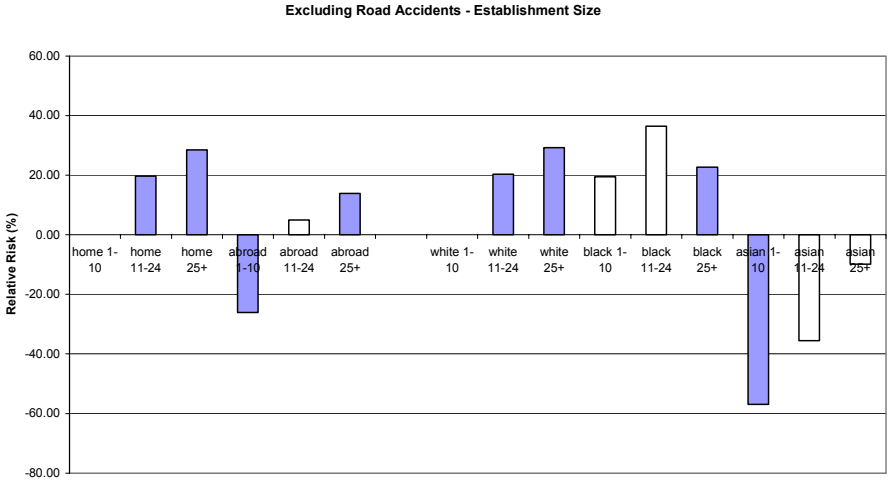

Figure 5.8 Probability of reporting an accident (excluding road accidents): effect of establishment size

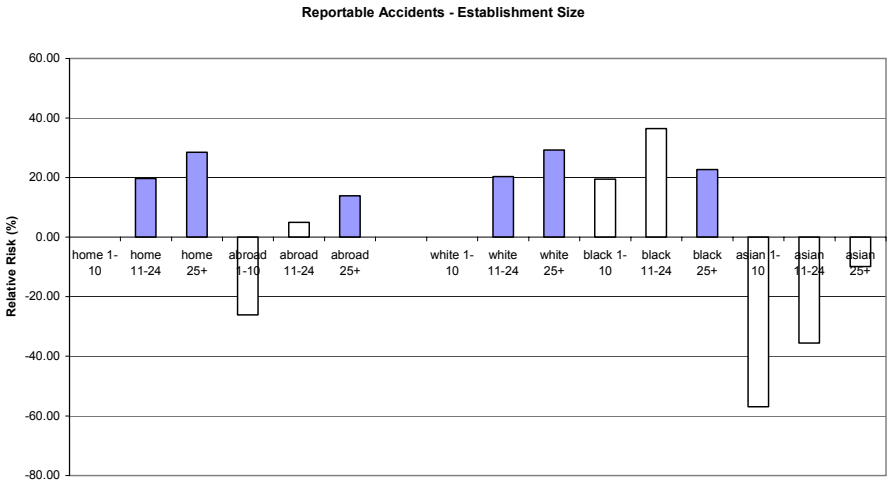

Figure 5.9 Probability of reporting a ‘reportable’ accident: effect of establishment size

A common theme emerges across these figures, with workers at smaller establishments having a lower probability of reporting a workplace injury. Considering all workplace accidents (see Figure 5.7), it can be seen that among those born in the UK, workers in establishments with 11-24 employees are 19% more likely to report a workplace accident compared to those in establishments with 1-10 employees. UK born workers in establishments with 25 or more employees are 26% more likely to report a workplace accident compared to the reference category. Considering those workers born outside the UK, workers in establishments with 11-24 employees are 18% more likely to report a workplace accident compared to those born outside the UK and working in establishments with 1-10 employees. Immigrant workers in establishments with 25 or more employees were also 26% more likely to report a workplace accident compared to those born outside the UK and working in establishments with 1-10 employees. A similar pattern emerges when excluding road accidents and for reportable accidents. The lower probability of workers who were born outside of the UK reporting a workplace accident is observed across all establishment sizes and is not due to a disproportionately lower probability of reporting within establishments of a particular size.

Considering different ethnic groups, it is observed across all accident types that White and Asian workers at smaller establishments have a lower probability of reporting a workplace injuries. The lower probability of Asian workers reporting a workplace accident is observed across all establishment sizes and is not due to a disproportionately lower probability of reporting within establishments of a particular size. The positive relationship between establishment size and the probability of an individual reporting a workplace accident is however not observed among Black survey respondents. Although not statistically significant, Black workers in establishments with 1 to 10 employees are estimated to have a 20% higher probability of reporting a workplace accident compared to White workers at establishments of similar size. The lower probability of reporting an accident within that is observed among white workers and Asian workers in smaller establishments does not emerge among black workers. The lower likelihood of ethnic minorities reporting a workplace injury does not appear to be attributable to a disproportionately lower probability of reporting a workplace injury among ethnic minorities and migrant workers employed within small establishments.

We next consider the issue of under-reporting by making the distinction between those people employed in the public and private sector. Utilising data from the LFS and having controlled for a variety of personal, establishment and job related characteristics, Elias *et al* (2001) estimate that workers in the public sector have approximately a 30% lower probability of experiencing a reportable workplace injury. This finding could be due to otherwise unobserved differences in the characteristics of those employed in the public and private sector that makes these workers differ in their susceptibility to experiencing a workplace injury. This finding could also be due to public sector workers taking more time off work as the result of a workplace injury. Alternatively, public sector workers may be more likely to report accidents because of the presence organisational regulations that are clear in identifying what constitutes a workplace injury and which encourage the reporting of these accidents. While information collected about workplace injuries in the LFS is not dependant upon whether an injury was actually reported under RIDDOR, the effect of higher reporting levels in the public sector may spill over into responses to the LFS. Figures 5.10 to 5.12 therefore consider the probability of reporting a workplace accident among different ethnic groups and by migrant status according to whether these workers are employed in the public or private sector.

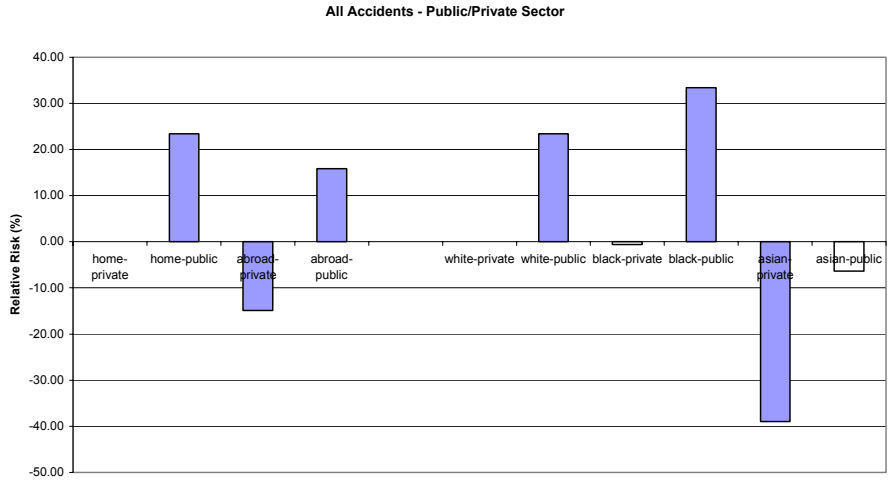

Figure 5.10 Probability of reporting an accident: distinguishing the public/private sector

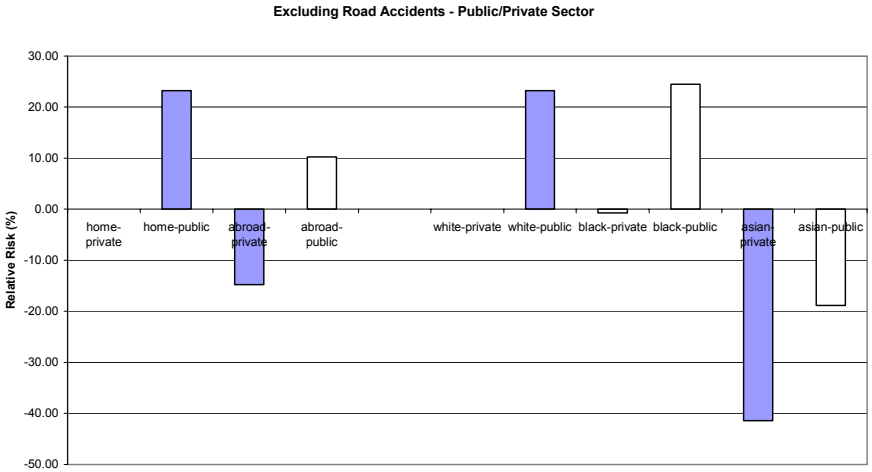

Figure 5.11 Probability of reporting an accident (excluding road accidents): distinguishing the public/private sector

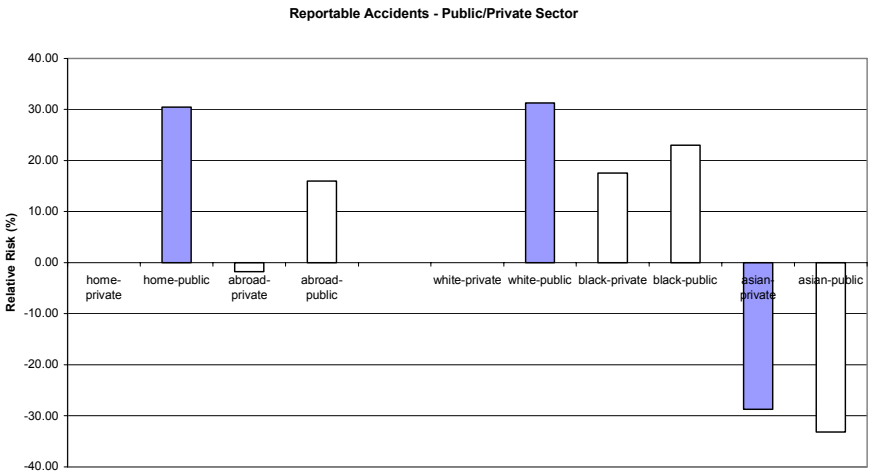

Figure 5.12 Probability of reporting a 'reportable' accident: distinguishing the public/private sector

Considering the results for all accidents presented in Figure 5.10, it can be seen that among those born in the UK, workers in private sector establishments are 23% less likely to report a workplace accident compared to those in the public sector. Considering those workers born outside the UK, workers in private sector establishments are 31% less likely to report a workplace accident compared to those born outside the UK and working in the public sector. This wider difference among migrant workers however does not emerge when excluding road accidents and for reportable accidents. The results do not appear to be indicative differences in reporting levels among migrant workers in public and private sector establishments.

The patterns are less clear when we consider the relationship between ethnicity and the probability of reporting a workplace injury by sector. Considering all workplace injuries, white public sector workers are estimated to be 23% more likely to report a workplace injury than private sector workers. Black public sector workers are estimated to be 34% more likely to report a workplace injury compared to Black private sector workers. Similarly, Asian public sector workers are estimated to be 32% more likely to report a workplace injury compared to Asian private sector employees. However, these wider difference among ethnic minorities do not emerge when excluding road accidents and for reportable accidents only. When excluding road accidents, the difference in the probability of reporting a workplace injury between public and private sector employees is almost identical among white, Black and Asian workers. The increased probability of white public sector workers incurring a reportable workplace injury (32% more likely) is not observed among Black and Asian workers.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

This chapter provides an overall assessment of the various types of evidence we have identified on ethnicity and work-related health and safety issues. In particular, our review set out to assess whether ethnic minority groups in the UK are disproportionately affected by any work-related health and safety issues, and also how the HSE might address any areas that emerge.

We present below an overview of the main findings from our work, with the key findings from re-analysis of LFS and other data sources and our literature review drawn together for ethnic minority populations in the two separate areas of (i) work-related injury or accident rates and (ii) work-related ill health. Recommendations are made on the basis of all sources of evidence, when appropriate. Where possible, findings are also related to the HSC priorities programmes and, to a lesser extent, the key hazard areas selected as HSC priorities.

THE SIZE, LOCATION AND ETHNIC DIVERSITY OF THE UK POPULATION

The total UK ethnic minority population is relatively large and rising. In the 2001 Census it was 4.6 million, or 7.9%, having risen from a figure of 5.5% in 1991 and 4.2% in 1981. The South Asian group accounts for 2 million people. There are 1.15 million 'Black' people; nearly half a million are 'Black Africans', and nearly 0.6 million are from the more established 'Black-Caribbean' population. The black and minority ethnic population is principally located in England (83.6 per cent). Most of our main findings relate to the South Asian group.

The minority ethnic population is more youthful in age structure than the white population. This means that population growth will remain rapid over the coming years. It also means that the proportion of the working population from these different ethnic backgrounds will increase, as will the proportion of older ethnic minority people in the workforce. Several issues that emerge from our review relate, in particular, to the older ethnic minority workforce.

The four main areas of high ethnic concentration are Greater London, the West Midlands Metropolitan County, West Yorkshire, and Greater Manchester. London contains nearly half the minority population (with a fifth in Inner London) and one eighth live in the West Midlands Metropolitan County.

Our analysis of Labour Force Survey (LFS) data shows that UK South Asian are less likely to work in high risk occupations and are disproportionately represented in lower risk occupations or industries. It is unclear whether this effect is linked to risk aversion or exclusion from certain occupations e.g. police. No such effect is apparent for the Black Caribbean population. The main exception to this rule is the high number of Black Caribbeans (and 'Black Other') in health and related occupations; 5.9% of Black Caribbean workers are employed within this group, compared to 2.8% of white workers. Employment in this sector is also projected to increase from approximately 0.8 million to 1.4 million by 2010. This will disproportionately affect any health and safety issues identified for ethnic groups in this sector.

Most data sources we used focus on more 'easy to reach' minority ethnic groups. We have therefore found it more *difficult to gather information on groups such as seasonal or migrant workers*, since they are likely to be excluded from datasets such as LFS because of the way in which the data is collected, and they may not have been surveyed by the 2001 census. Other groups in the population such *asylum seekers* (who have restricted working rights) are also difficult to access data on. The present report therefore is therefore **not able to say anything substantive about work-related health and safety issues for such populations**, although

clearly the former will become increasingly important as the economy encourages more migrant workers, and industries such as agriculture and construction become increasingly dependent on migrant labour, especially from other parts of the EU and eastern Europe.

Migrant Workers

Recommendation 1: Because we were unable in this project to provide any analysis of data on work-related health and safety issues for migrant workers, we would recommend that HSE commission a further study to collect evidence on this particular population.

DISCUSSION OF WORK-RELATED INJURY OR ACCIDENT RATES AND ETHNIC MINORITIES

6.1 GENERAL ACCIDENT PATTERNS FOR ADULT ETHNIC MINORITIES (HEALTH SURVEY FOR ENGLAND)

There is evidence from the grey literature of a lower accident rate overall in South Asian populations. The 1999 Health Survey for England, for example, shows that both in terms of self reported 'major' accidents (hospital visited or doctor consulted) and 'minor' accidents (all other accidents causing pain or discomfort for more than 24 hours), Bangladeshis men report the lowest accident rates. Indian, Pakistani and Chinese men also report lower rates than the general population rate. However, Black Caribbean men's accident rates are fairly close to those of the general population. Similarly, Black Caribbean women have accident rates equivalent to the general population, but South Asian women have much lower rates. It appears therefore that certain population groups such as south Asian may be more risk averse in terms of their personal behaviour, or may under-report accidents.

UK literature

There is very limited UK literature to confirm these accident patterns. But two papers were identified that offer some support for the lower South Asian accident rates reported in the Health Survey for England. A study of variations in A&E department attendance rates in GP practices in East London offers some evidence of lower accident rates for Asian populations (Hull, Jones and Moser 1997). Similarly, an examination of the health status of South Asian (mainly Punjabis) in Glasgow identified that fewer South Asian men reported accidents (Williams, Bhopal and Hunt 1993).

There is no literature on other UK ethnic groups such as African Caribbeans.

6.2 INJURY OR ACCIDENT PATTERNS AT WORK FOR ETHNIC MINORITIES (LABOUR FORCE SURVEY)

From our analysis of LFS data there is evidence that the reported workplace injury rate is lower for South Asian. This is not unexpected, since the dominant influence that affects the risk of suffering a workplace injury is occupation, and the South Asian population is employed in lower risk occupations (see section 6.1). The lowest workplace injury rates are estimated to occur among Bangladeshis (1.4%),Chinese (1.8%), Indians (2.8%) and Pakistanis (3.4%) compared to 4.3% among white respondents. The highest workplace injury rates for ethnic minorities are estimated to occur among 'Black-Other' (5.1%) and 'Black-Mixed' (5.4%) respondents. Black Caribbeans and

Black Africans exhibit workplace injury rates that are similar to the white population. Measures of dispersion indicate that workplace injury rates estimated for Indians, Pakistanis, Bangladeshis and Chinese are statistically significant and cannot be attributed to sampling variability.

6.3 INTERNATIONAL LITERATURE ON INJURY OR ACCIDENT PATTERNS AT WORK FOR ETHNIC MINORITIES

The general literature on occupation and workplace injuries is principally from the USA, and mostly based on analysis of secondary or routine data. In many of these studies, ethnicity is used as a demographic descriptor (along with age and gender) and the focus is on accident rates in different employment sectors, rather than on the ethnic population *per se*. The literature is male dominated, with very little on female workers or gender differences. The fact that most analyses do not consider multiple injuries in cohorts or the temporary removal of workers from the 'risk set' while recuperating is also thought to be a major shortcoming (Wassell *et al.* 1999).

In general, the international literature does not provide any support for *lower* accident rates in ethnic minority populations. Where US analyses do focus on ethnicity, early findings suggest somewhat lower injury rates for the white population. For example, a report on days lost from work due to illness or injury in the US indicated fewer days lost for currently employed whites than all other ethnic groups (US Department of Health, Education, and Welfare 1972). Early research into the mortality pattern among fire fighters in Boston also reported a narrowing of differentials between ethnic groups over time (Musk et al. 1978). Other US analyses indicate that there has been a greater narrowing of racial differences over time among males than among their female counterparts. Black women now face approximately the same risk of occupational injury as white men. Other US research demonstrates that Hispanics are at increased risk of occupational injury, with Hispanic women having nearly twice the risk of working Hispanic men (Weddle et al. 1993).

There is also some literature from New Zealand which provides evidence of higher fatality rates in the resident minority ethnic population. Work-related fatal injury rates are reported to be higher for the Maori population and, although the rates for non-Maoris have declined with time, this is not true for Maori rates (McCracken et al. 2001). The authors infer that this disparity is mainly due to differences in employment pattern.

6.4 UK ETHNIC MINORITIES AND INJURIES OR ACCIDENTS IN PARTICULAR OCCUPATIONAL GROUPS

In the UK, the fact that South Asian are employed in less hazardous occupations will clearly contribute to their reported lower overall injury rate at work, but they may still be more at risk of injury within particular occupations. Thus, the overall lower rate of workplace injury among ethnic minorities that we observe may mask an increased risk of workplace injury among these workers in certain occupations.

Multivariate techniques were therefore used to identify the influence of ethnicity upon the probability of reporting a workplace injury, after controlling for a range of other personal, job, and workplace characteristics. From these models, it is estimated that, even once other factors are taken into account, Indians and Pakistanis are significantly less likely than white workers to report that they have experienced a workplace accident during the previous 12 months; the smaller Bangladeshi population was not distinguished in these analyses. No statistically significant differences were identified for Black Caribbeans although a slightly lower rate was

observed; or for 'Black Others' (incorporating 'Black African', 'Black Other', 'Black Mixed') who exhibited a higher rate; or Chinese whose rate was lower than that of the white population.

Although it was not possible to use the LFS data to examine trends over time, an analysis based on length of residency for ethnic minorities does show that there is increased likelihood of employment in more hazardous occupations with increased length of residency. However, workplace injury rates continue to rise the longer a person has been in residence in the UK, even after these are corrected for demographics and occupation, with no significant difference in overall 12 month accidental workplace injury rate after 10 years residence. This observed trend may either be due to less safe behaviour with time, improved behaviour in reporting of accidents, or differences in the composition of the ethnic population which has been in residence for more than 10 years (and its safety profile). It may also be linked to the poorer health of the older ethnic minority workforce and changes in continued employment full-time (see section 6.8).

Analyses of the LFS have therefore revealed that some groups of ethnic minorities appear less likely to report the occurrence of a workplace injury. It is not clear whether this is due to under-reporting or safer behaviour on the part of such workers. Patterns of occupational choice appear to indicate that ethnic minorities are less likely to select employment within more hazardous occupations. This may indicate increased levels of risk aversion among such groups. However, regardless of the interpretation of this finding, it remains the case that the occupation of employment has the dominant influence upon the risk of an individual experiencing a workplace injury. In meeting national targets for health and safety, the HSE has identified construction, agriculture and health services as sectors where improvements are vital if targets are to be met. The prioritisation of agriculture and the health services sectors by the HSC is likely to be of particular pertinence to the health and safety of ethnic minorities and immigrant workers.

6.5 UK SOUTH ASIAN - SAFER BEHAVIOUR OR UNDER-REPORTING?

The reduced likelihood of South Asian groups such as Indians and Pakistanis reporting the occurrence of a workplace accident may be indicative of safer behaviour among these populations. The occupational analysis has revealed that these groups do not appear to work in more hazardous jobs. Alternatively, these findings may raise concerns about the quality of information collected from such respondents. Further analyses *could not identify any evidence to support the presence of disproportionate levels of under-reporting by ethnic minorities*, even allowing for differences in rates of use of proxy LFS respondents, employment within smaller establishments, or employment in organisations with a supportive culture for reporting accidents (e.g. the public sector). This cannot however exclude the possibility of general under-reporting of workplace injuries among South Asian groups.

Proxy respondents

Under reporting by proxy respondents does not appear to offer an explanation for the observed reduced risk of workplace injury among Asians, although it may mean that other groups such as 'Black Others' who are calculated to have a (non significant) increased probability of workplace accidents compared to the white population, may in fact exhibit statistically significant differences. Similarly, there is no evidence to suggest that injury data collected through proxy respondents on behalf of individuals born outside of the UK is contributing towards the lower risk of workplace injuries estimated for this group. However, it is important to note that the lower estimated risks of workplace injury could still be the result of a general under-reporting of workplace injuries among ethnic groups, among both proxy respondents and those who respond directly to the LFS.

Establishment size

The lower likelihood of South Asian reporting a workplace injury does not appear to be attributable to such groups being employed within smaller establishments. Empirical evidence tends to suggest that larger establishments exhibit lower workplace injury rates, although previous analysis of the LFS has also indicated that the risk of injury is lower within very small establishments with fewer than 25 employees. However, a lower probability of South Asian workers reporting a workplace accident was found to be present for all establishment sizes, although it was only statistically significant for smaller (1-10 employee) establishments. In contrast, we found no observable pattern with establishment size for Black respondents, although Black workers in establishments with 1 to 10 employees were estimated to have a 20% higher probability (not statistically significant) of reporting a workplace accident compared to White workers. For Asian workers who were born outside the UK, there is a similar lower probability of reporting a workplace accident observed across all establishment sizes.

The lower probability of a workplace injury being reported by South Asian workers in very small establishments (1-10 employees) may be influenced by the fact that such workers are more likely to be working in family run businesses.

Supportive work culture

It may be that in certain organisational cultures workers are more likely to report accidents. For example, in the public sector the presence of organisational rules about what constitutes a workplace injury and associated regulations might encourage the reporting of accidents. We found that both workers born abroad, and those born in the UK, are significantly less likely to report a workplace accident if employed in private sector establishments, compared to those working in the public sector. In absolute terms however, the level of accidents reported by those born abroad is lower in both the public and private sector.

Similarly, Black, Asian and white employees are all more likely to report a workplace injury if they are public sector workers than if they are private sector workers. However, if *reportable* workplace injuries alone are examined, Asian workers in the public sector are no longer more likely to report workplace injuries than their peers in the private sector.

6.6 LITERATURE ON ETHNIC MINORITIES AND INJURIES OR ACCIDENTS AT WORK

There is very little UK literature in this area. A retrospective analysis of accidents at work over a 12 month period in an automobile plant in south east England reported mean accident rates of 1.58 for Asians, 1.23 for White workers, and 1.28 for West Indians (Baker 1987). However, there was no difference after adjustment for other factors such as age, type of job, and duration of service.

The majority of published studies identified are from the USA. In general, US research indicates that injury rates differ according to age, sex, socio-economic status, ethnicity, occupation and industry, with indications of increased rates for ethnic minorities. Only two US papers were identified reporting that ethnic minorities are at *reduced risk* of workplace injury. In a US study of discharge from the Army for disabling knee injury, non-white men and women were found to be at *lower risk* than white employees at all ages, although the authors conclude that this may be related to differences in work/ leisure activities or the ways in which disability compensation is granted (Sulsky et al. 2000). In another US study, after adjustment for socio-economic status, Black and Hispanic blue-collar workers were found to be at *decreased risk* of

suicide and nonfatal injuries, but Black Americans were at increased risk from homicide compared with the White majority blue-collar worker population (Cubbin et al. 2000).

Workplace assaults/homicides

Several US studies have indicated an increasing incidence of assault and harassment as well as homicide among ethnic minority workers (Riopelle et al. 2000; Morris 1996; Jenkins 1996). Women and minority men also report more negative social interactions on the job, such as criticism, bias, and sexual harassment. No similar literature was available for UK ethnic minorities. The recent BMA survey of NHS staff did not distinguish ethnic minority groups (British Medical Association 2003). However, the British Crime Survey indicates that ethnic minorities are more likely to be victims of crimes and serious threats than the white population, and that risk of assault at work is higher for workers in security, health, social care, public transport and restaurants (FitzGerald and Hale 1996; Clancy et al. 2001, Budd 2003).

Immigrants and injuries at work

There is limited literature on immigrants and injuries or accidents at work. Two French studies were identified that indicate immigrants are at increased risk of injury and ill-health due to concentration in hazardous occupations (Bourdillon et al. 1991; Bollini and Siem 1995). In contrast, another study of Moroccans in France identified lower death rates for immigrants than the national average, and also in specific occupational categories where most immigrants work (Courbage & Khlat 1996).

Hours of work and fatigue

Our review also identified some literature on ethnicity, workplace accident patterns, and hours of work and fatigue. For example, research on forestry industry workers in New Zealand has identified that accidents and injuries are associated with ethnicity and long working hours (Lilley et al. 2002). In contrast, a US study of women in high-risk manufacturing occupations found that occupational injury was most significantly related to having a child less than 6 years of age and not associated with ethnicity or work-related fatigue/shift worked (Wohl, Morgenstern and Kraus 1995).

Language and communication

A number of studies have identified the lack of language and poor communication and on-the-job training as possible factors for higher workplace injury rates for ethnic minorities, and for poorer treatment outcomes following injury. A New Zealand study reports a high incidence of heavy machinery, industrial hand mutilation for recent Pacific Island immigrants many of whom had poor comprehension of English, with inadequate instruction identified as a causative factor (Bossley 1975). Another Australian study has identified a direct association between the degree of fluency in English and better treatment outcomes for back injuries for migrant workers (Hewson, Halcrow and Brown 1987).

Work-Related Injury/ Accident Rates and Ethnic Minorities:

Recommendation 2: We conclude that the health and safety of ethnic population groups will be best served by the continued focus of the HSE upon Priority Programme Areas selected to meet national targets for improvements in Health and Safety. Additional research is however required to determine whether the lower risk of workplace injury estimated for particular ethnic groups from both the Health Survey for England and the Labour Force Survey is a real effect or is a result of different reporting patterns.

Recommendation 3: We would recommend that the HSE commission an exploratory analysis by ethnic group/ occupation of the three existing Workplace Health and Safety Surveys (WHASS). An option appraisal to compare the costs and benefits of an ethnic booster sample in the forthcoming WHASS versus conduct of smaller in-depth surveys in specific industries should be included. Also, since cultural differences in interpretation of questions in the Labour Force Survey and the Health Survey for England (e.g. in terms of what constitutes an accident) cannot be excluded as a possible reason for the ethnic differences observed in reported accident rates, a small qualitative study should be undertaken to examine the framing of these questions.

Recommendation 4: We would recommend that a systematic examination be undertaken of the health and safety requirements of population groups who have difficulty reading or understanding/ speaking English. A mapping exercise should also be undertaken to look at ways of improving routine collection of information on ethnic minority groups, to include language needs.

DISCUSSION OF ETHNIC MINORITIES AND WORK-RELATED ILL HEALTH

6.7 UK POPULATION OF WORKING AGE: ETHNIC DIVERSITY, GENERAL HEALTH AND LONG TERM ILLNESS

Based on the 1991 Census, it is evident that the pattern of long-term illness in the UK working age population varies depending on the ethnic group. The prevalence of reported long-term illness was higher in South Asian groups and it also increased more rapidly with age than for the majority white population.

The 2001 Census shows an overall large increase, compared with 1991 figures, in the proportion of the population reporting a long term illness, health problem or disability. For the working age populations (16-64) as a whole, only five groups report a lower prevalence of long-term illness than the population average as a whole in both 1991 and 2001; Chinese, 'Other Asian', 'Black African', 'Black Others', and 'Other/Mixed' ethnic groups. However, if the older age group (50-64) is examined then only the Chinese continue to report lower levels. By far the highest relative levels of long-term illness are found in Bangladeshi and Pakistani populations in both 1991 and 2001, with a marked increased differential in 2001. When the figures for older men and women aged 50-64 are examined separately, the long term illness rates in these two groups are found to have increased more markedly for women than for men, particularly Bangladeshi women.

From the 2001 Census also, individuals' general health over the previous 12 months indicates that a much higher proportion of Bangladeshis and Pakistanis are in poor health; the figure for

Black Caribbeans is slightly more elevated, and for Chinese it is much lower, than that reported by the white population.

If the 50 plus working age group who report they have a long-term limiting illness **and** also indicate that their health has been 'not good' over the previous 12 months ('chronic impaired-health' group) are considered, then the Bangladeshi and Pakistani populations are found to exhibit nearly three times the level of chronic impaired-health as that reported by the white majority population.

6.8 UK WORKFORCE: ETHNIC DIVERSITY, LIMITING LONG TERM ILLNESS AND CONTINUED EMPLOYMENT

The effect of limiting long-term illness (LLI) on employability was examined using Labour Force Survey data, pooled from 1996 to 2001. Our analysis shows that South Asian males are far less likely to remain in employment with a limiting long-term illness, especially those in the Bangladeshi and Pakistani populations, than white or Black Caribbean males. For women, an even sharper differential is observed for South Asian, particularly for Bangladeshi women where virtually all women with a disability appear to leave the workforce. Our analyses indicate therefore that for South Asian (and particularly women) the presence of a LLI leads to a much greater likelihood that a person will cease to be employed full-time.

Furthermore, South Asian in the workforce with a limiting long-term illness who continue to work are more likely to undergo a change in work status or de-skilling. The net impact of disability on wage rates (£ per hour) was examined as a proxy for work status. The overall impact of disability on wage rates was greatest for Chinese (males and females); Bangladeshis (males, females leave workforce); and male Pakistanis; while Black Caribbeans showed little effect. Thus there appears to be evidence of disproportionate de-skilling for Chinese and South Asian populations who remain in work with a LLI i.e. in terms of reduced hourly rate. This may either be linked to the type of employment in which these individuals were originally engaged, the types of limiting long-term illness from which they suffer, or institutional racism in terms of how their employer accommodates their disability within the workplace.

In conclusion the observed higher levels of impaired health among certain ethnic minority groups (particularly South Asian) of working age, reported in section 6.7, appears to mean that more individuals are likely to have withdrawn entirely from the workforce due to ill health; and those remaining in work are less likely to be in full-time work and they are more likely to have suffered a drop in hourly wage rates.

The overall effect, **in terms of the population in work**, is that we are likely to be dealing with a healthier south Asian workforce, compared with the working age Asian population overall. Fewer employees with a limiting long-term illness will continue to work once disabled in some way, and those who do continue to work are more likely to work part-time and therefore be exposed for fewer hours per week to the risk of injury or (further) work-related ill health in a particular occupation. However, it is unclear whether workers with a LLI are likely to exhibit higher workplace accident rates, which might offer a partial explanation for the lower workplace accident rates reported in the LFS. For Black Caribbeans there is no evidence of a similar effect.

International literature: differences in compensation claims

The observed differences in continued employment with a limiting long-term illness may be due to differences in the award of disability benefits or, if an accident is involved, compensation.

The literature review provides some evidence of a lower incidence of awards of compensation and disability benefits due to workplace injuries for ethnic minorities, possibly indicative of discrimination. However, none of this literature is UK based.

For example, a review of US historical records of workers' medical judgements and compensations relating to workplace injuries showed that a medical diagnosis of occupational malingering might reflect deep-seated cultural and social biases toward women, Jews, and immigrants (Dembe 1995). Similarly, a study of approximately 1,000 primarily minority, female garment workers in New York City identified lower compensation claims (Herbert et al. 1997). Similarly, a study of non-malignant respiratory disease in Native American, Hispanic, and non-Hispanic white uranium miners found that although mining is more strongly associated with lung disease in Native Americans, they were less likely to meet spirometry criteria for compensation, with 24% excluded (Mapel et al. 1997). However, in some settings cultural factors may also come into play. For example, in Hong Kong a study of hand-injured Chinese workers with permanent disability found that fate and luck were used by individuals to explain the injury (Cheng 1997). This affected what action workers took against their employer for negligence. Many respondents were bound by kuan-hsi (personal relationship) and tended to preserve the harmony between themselves and their employer.

International literature on ethnic minorities and rehabilitation after injuries or accidents at work

It may be that the patterns observed are also due to differences in rehabilitation for injuries or work related health conditions. An Australian study of migrant workers with back injuries has identified the degree of fluency in English as a predictor of treatment outcome (Hewson, Halcrow and Brown 1987). However, in the USA, McCauley et al. (2001) examining mild to moderate traumatic brain injury resulting from motor vehicle accidents and assaults found that Hispanics were significantly less likely to develop post-concussional disorder than other racial/ethnic groups.

6.9 LITERATURE ON ETHNIC MINORITIES AND WORK-RELATED ILL HEALTH

The issue of ethnic minorities and work-related ill health appears to be a *generally under-researched area in the UK*; very few articles were from the UK. Furthermore, the UK studies focus exclusively on the South Asian community, so there is no evidence for other groups such as African Caribbeans or Chinese.

The literature identified is mainly from the USA, with some papers from Singapore, New Zealand, Denmark, France, Israel, Australia and Canada. The evidence from these countries *may not be generalisable to a UK setting* because of the differences in ethnic minority groups and working contexts.

The Self-reported Work-related Illness Survey (SWI) in 2001/02 indicated that 2.3 million UK individuals were suffering from work-related ill health. However, published analyses of SWI provide no information on ethnic minority populations (HSE 2003). The international literature does provide some evidence on ethnic minority groups and work-related illnesses, including those identified as most common in the UK workforce.

Musculoskeletal disorders represent the most common form of work-related ill health in the UK. Our literature review identified only five relevant papers. None were from the UK. A Canadian study of factory workers found no significant influence of ethnicity on wrist disorders, and an Australian study of migrant workers with back injuries found no influence of country of

birth. The remaining studies from the US provide limited evidence of ethnic differentials (including in rehabilitation and benefits), although findings are not consistent.

Workplace stress is the second most common UK work-related illness. Although stress was excluded as a specific search term, because of the separate research commissioned by the HSE in this area, several US studies report that ethnic minorities experience a more negative work environment in terms of criticism, bias, and sexual harassment that can lead to stress. Some studies also demonstrate a relationship between work-related drinking, ethnicity, and problems in the workplace. None of the papers we identified were from the UK.

Breathing and lung problems constitute the third most important form of work-related ill health reported in the UK. The largest number of papers on ethnicity were found in this area, including three from the UK. In terms of *respiratory disease*, none of the studies reported that differences in occupational asthma are related to ethnic origin. A Canadian study of grain workers of different ancestry identified that British workers had a significantly greater prevalence of airflow obstruction than Eastern Europeans, independent of the effects of age and smoking. US studies also indicate that lung disease is more strongly associated with exposure for Native American miners. Three UK studies (using ethnicity as a controlling factor) report more frequent symptoms in textile workers exposed to higher concentrations of dust, once differences in ethnic origin, gender, age, and smoking habits are excluded.

In terms of *cancer*, US studies report higher global rates of lung cancer for African Americans exposed to well-recognised carcinogens; non-white foundry workers; eastern European-born fur workers; and oesophageal cancer for non-white miners. Research from Denmark also indicates that lung cancer incidence is higher for certain immigrant groups in the rubber processing industry.

Hearing problems are the next most common UK work-related disability. No UK papers were identified. However, US articles indicate that race/ethnicity is a major-effect variable, with ethnic status also a significant predictor of hearing protection use.

Heart disease/ circulatory system disease is the next most prevalent type of self-reported work-related illness in the UK. No UK literature was identified on the subject. Higher rates of coronary heart disease have been reported for non-white smelter workers in Danish lead battery plants and US Hispanic antimony smelter workers. Other studies report no differences for rubber workers in Denmark and US fur workers. However, lower rates of heart disease are reported for foreign-born workers in US wastewater treatment. Lower raised blood pressure rates are also reported for US black male municipal employees over whites, and employees of Western origin in various Israeli industries.

Vision defects, including associated head aches and eye strain, are the next most common cause of work-related ill health. Three studies were identified that reported impaired vision in employees in the shipbuilding industry, microelectronics factories, and a video tape manufacturing factory. None of these were from the UK, and all only considered ethnicity as a confounding factor.

Skin problems and dermatitis are a further source of work-related ill health in the UK. A US study reports fewer white than black workers with skin problems.

Infectious diseases, viral and bacterial, represent a further significant source of work-related ill health in the UK, with raised prevalence reported in the health and social work sector and occupations such as fishmongers and poultry workers (HSE 2003).

Infectious diseases represent a further significant source of work-related ill health in the UK. Migrant and seasonal farm workers are reported to be more likely to have drug-resistant TB. A UK study identified a 2.4 raised relative risk of TB in UK health professionals, adjusted for ethnic group, sex, and age. Several non-UK studies also consider hepatitis. A raised risk of hepatitis B has been reported for certain ethnic groups (e.g. African nurses in South Africa; Asian, African and Eastern Europe anaesthetists; and oriental dental-care workers in Canada). The risk of hepatitis C is also reported to be raised in central Asian healthcare workers in Israel. HIV infection has also been reported to be higher among minority health care worker.

Work place exposure studies report on lead and heat exposure. Higher blood lead concentration are reported among Malays and Indians in battery manufacturing factories in Singapore, linked to oral ingestion of lead through eating with fingers. US studies also report high blood lead levels in minority group lead industry workers. However, the literature indicates that susceptibility of individuals to heat exposure cannot be predicted from ethnicity.

Work-Related Ill Health and Ethnic Minorities:

Recommendation 5: We would recommend that thought be given to the inclusion of a small number of questions on work-related ill health in future rounds of the Health Survey for England. In 1999 and 2004 this included a booster sample of ethnic minorities. Consideration should also be given by the HSE to an analysis of the Self-reported Work-related Illness Survey (SWI) data by ethnicity, to include those currently employed and people who have ever worked.

Recommendation 6: We would recommend that qualitative research be commissioned by the HSE/ Department for Work and Pensions to identify and explore the key issues associated with limiting long-term illness and changes in employment status for ethnic workers, particularly Bangladeshi women, as well as any differences in the award of disability benefits or, if an accident is involved, compensation. We would also suggest that an additional study examine the high levels of long-term illness/ 'chronic impaired-health' among South Asian aged 50-64 and any possible links to previous occupation/ industry. Finally, we are aware that the Department for Work and Pensions has no data on pensions and ethnicity, and would recommend that they consider the feasibility of starting to collect this.

Recommendation 7: The lack of published research evidence on UK ethnic minorities and work-related ill health is a major gap. We recommend that a national workshop be convened to consider the possibility of collating any existing data/ evidence for key conditions/diseases where non-UK literature has identified the likelihood of raised rates of work-related ill health in ethnic minority populations, and of developing further research in these areas. The possibility of trades unions or employers associations sponsoring some initial studies in specific occupational/ industry sectors should be explored.

6.10 LITERATURE ON ETHNIC MINORITIES AND OCCUPATIONAL HEALTH PROMOTION

A key area in which literature was identified is that of occupational health promotion programmes and safety training in the workplace. These papers are from the US and provide evidence of lower enrolment, retention and participation of ethnic minorities, as well as problems of communication.

A US study found that white employees were more likely to participate in occupational health promotion programmes than non-white workers raising concerns that programmes may not equally reach all segments of the work force; there was no difference in self-reported health status, and only slightly more positive health habits, among those who participated and those who did not (Stange et al. 1991). Another US study of recruitment, retention, and health improvements in a worksite health promotion programme reports that recruitment rates vary across ethnic groups, with black workers less likely than white and Hispanic ones to be recruited and retained in the programme, although the impact on those who participate is relatively consistent across the various demographic groups (Brill et al. 1991).

The essential features of a cross-cultural safety programme are discussed in other papers, including how to communicate effectively with a multicultural group and how to identify whether communication has been effective (Whitmore and Groce 1992). A further US paper presents guidelines for designing culturally appropriate worksite health promotion programmes, including occupational stratification that separates ethnic-racial groups from their white counterparts (Aguirre-Molina and Molina 1990). In another US study, ethnic status was a significant predictor of hearing protection use among women, suggesting that gender and ethnicity should be addressed to increase use of hearing protection (Lusk, Ronis and Baer 1997). US research on cultural diversity and workplace stress also indicates the need for stress management programmes to enable ethnic minority women to cope (Walcott-McQuigg 1994). A study from Israel of textile industry workers indicates that occupational health problems (suitable for social work intervention) vary by ethnic origin, as well as sex, age, and educational achievement; as a result the author recommends identifying target groups of workers when designing and implementing health prevention/health promotion programmes (Cwikel 1992). A further paper describes occupational health and safety action-oriented programmes in Asia, incorporating use of training tools and group work methods, and extended coverage to include home-based workers, rural workers, and ethnic minorities (Kawakami and Kogi 2001). Finally, the advocacy role of trade unions on behalf of less privileged groups in workplace health promotion is discussed in one paper, providing examples from Denmark and Finland (Johansson and Partanen 2002).

Ethnic Minorities and Occupational Health Promotion:

Recommendation 8: We would recommend that the HSE commission a more detailed review focusing on occupational health promotion programmes and safety training for ethnic minorities, followed by a workshop to be run for practitioners to promote good practice. Consideration should also be given to the establishment of ethnic minority health and safety 'Sentinel' or 'Beacon' sites.

CONCLUSIONS

The Health and Safety Commission's strategic plan for 2001-2004 includes the twin goals of reducing injury rates and work related ill health, and consequent days lost from work; and improving the working environment. These goals have been quantified in a number of national targets as follows:

- to reduce the number of working days lost per 100,000 from work related injury and ill health by 15% by 2004 (and by 30% by 2010);

- to reduce the incidence of fatal and major injury accidents by 5% by 2004 (and by 10% by 2010);
- to reduce the incidence rate of cases of work related ill health by 10% by 2004 (and by 20% by 2010).

In addition to these goals, the HSC Strategic Plan also includes the requirement for HSE to "pay particular attention to the needs of ethnic minorities in developing programmes". This is supported by the Race Relations Amendment Act (2000) which requires all public bodies to take account of the needs of the population they serve; and Human Rights legislation which makes similar demands.

From the evidence presented in this report, it is evident that there are a number of areas in relation to the ethnic working population that require a proactive response from the HSE and other agencies. These actions are important because the proportion of the working population from different ethnic backgrounds is predicted to increase, as is the proportion of older ethnic minority people in the workforce.

Our re-analysis of LFS data indicates that the behaviour of the UK ethnic minority workforce is unlikely to disproportionately affect the successful achievement of targets for reduced work-related injuries and accidents in HSE priority areas, with the South Asian workforce in particular appearing to exhibit significantly lower rates already. However, there remains a need to examine other data sources **and** consider ways of improving future data collection in order to confirm this for resident black and ethnic minority populations. Furthermore, effort is needed to collate information on migrant workers since this is currently lacking.

In terms of national targets for reducing the number of working days lost due to ill health and the incidence rate of cases of work related ill health, the main finding from our project is the singular lack of UK research evidence on ethnic minority populations and the incidence of specific work-related diseases/conditions in different occupational areas. There is an urgent need to consider the possibility of collating any existing data/ evidence for key conditions/diseases where non-UK literature has identified the likelihood of raised rates of work-related ill health in ethnic minority populations. Two other key areas requiring further investigation and/or action are: the observed differential patterns in limiting long-term illness and changes in employment status for ethnic workers and, linked to this, possible differences in the award of disability benefits or compensation; and the high levels of 'chronic impaired-health' among South Asian aged 50-64 and any possible links to previous occupation/ industry. There is also the potential to improve the evidence on work-related ill health in ethnic populations through including questions on work-related ill health in the future Health Survey for England, analysing the Self-reported Work-related Illness Survey data by ethnicity, and by encouraging the Department for Work and Pensions to collect data on pensions and ethnicity.

Finally, there is a need to improve the evidence base on ethnic minorities and occupational health promotion programmes, and to promote good practice in this area.

Review of the Occupational Health and Safety of Britain's Ethnic Minorities

Technical Annex

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ANNEX 1

LITERATURE ON ETHNICITY AND OCCUPATIONAL ILL HEALTH

The following appendix presents a detailed report on the findings of scientific articles located during our systematic review. These are presented under clinical headings which may be related to disease entities as classified by the International Classification of Diseases (ICD). The findings of these papers have also been re-presented following the Key Themes identified as HSE priorities, in Chapter 4. They are given here in more detail in this format, for the benefit of those responsible for health care provision.

A1.1 MUSCULOSKELETAL DISORDERS

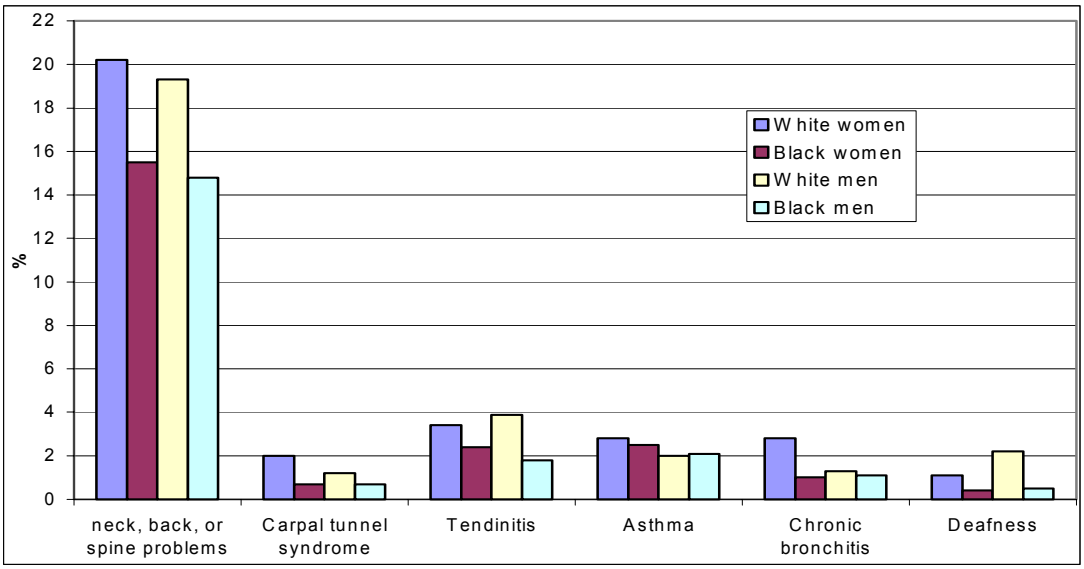
Five papers refer to musculoskeletal disorders. These studies report no variations in risk factors for musculoskeletal disorders and back pain by ethnicity or country of birth among production and office workers. Conditions include disorders of the neck, shoulder, wrist, hand or arm.

The study in USA identified neck or shoulder (N/S) and hand or arm (H/A) musculoskeletal symptoms (MSS) and disorders (MSD) common among computer users which in fact varied by gender, age, ethnicity and prior history of N/S (Gerr et al. 2002). In Singapore, 3.9% of workers reporting aches or pains in back, neck or upper limbs and 1.8% had work-related complaints. A higher proportion of males reporting back complaints whereas complaints for hands/wrists and arms/forearms higher for females. Of the affected 82.3% were employed, 60.3% being production workers, compared to 33.3% professional/office workers and 6.4% service workers (Chan and Ho 1998). Workers in meat packaging plant in Canada also reported higher prevalence and incidence of Carpal tunnel syndrome (CTS) than the general population, however, with no significant influence of ethnicity, age and body mass index (Gorsche et al. 1999). The study in Australia observed that the prevalence of migrant workers with back injuries was found to be similar to that in the occupations with higher accident liabilities. The relative proportion of musculoligamentous injuries and the more objectively confirmable back injuries was not related to the country of birth. Better predictors of treatment outcome were: the time that had elapsed between the injury and admission to the Centre; whether the referral was direct or indirect after the previous treatment; and the degree of fluency in English (Hewson, Halcrow and Brown 1987).

The report prepared by Wagener et al. (1997) shows that the currently employed women were more likely to report repeated trouble with neck, back, or spine (19.5 percent compared with 18.7 percent for men). Also a higher number of currently employed women than men had prolonged hand and wrist discomfort that was not due to an injury. About 60 percent of these workers had hand and wrist discomfort for 2 years or more, with about 1 in 10 reporting that they had the discomfort for more than 10 years. In about 1 in 10 cases, the worker changed jobs, stopped working at a job, or changed work activities because of the prolonged hand and wrist discomfort.

Similarly, among the currently employed reporting back pain, 35.5 percent of white women and 50.5 per cent of black women associated back pain due to workplace accidents or repeated activities at workplace; the respective percentages for white men and black men were 56.3 and 65.9. Irrespective of race, in about 1 in 4 cases the worker changed jobs, stopped working at a job, or changed work activities because of prolonged back pain problem.

Figure A1.1: Select occupational ill-health conditions among currently employed, US 1998



The paper by Tait and Chibnall (2001) examined medical and psychosocial factors associated with work injury management decisions and claims relative to patients with occupational low back pain in the USA. They found that the temporary total disability costs and impairment ratings were recorded lower for African Americans than for Caucasians, which finally affected their claims and benefits. The paper remarked further on the implications for work injury management and disability determination, as well as future research.

According to a HSE report on self-reported work-related illness, an estimated 2.4 million people (5.3% of ever employed) in Great Britain in 2001-02 were suffering from an illness that was caused or made worse by their current or past work. In terms of people employed in the last 12 months there were 2.2% of new cases of work-related illnesses. An estimated 32.9 million working days were lost in 2001-02 through illness caused or made worse by work. Musculoskeletal disorders followed by stress, depression and anxiety were far the most commonly reported work-related illnesses. Almost half of musculoskeletal disorder cases were related to back pain; about one-third related to pain in upper limbs or neck and nearly one-fifth to pain in lower limbs. Other important disease categories were breathing and lung problems; hearing problems, heart disease or other problems of circulatory system; headache and/or eyestrain; and skin problems. Occupations with above average illness rates included protective service occupations; health and social welfare associate professionals; skilled construction and building trades and teaching and research professionals. Industries with above average illness rates included public administration and defence; agriculture, hunting, forestry and fishing; construction; education, health and social work and transport, storage and communication (Jones et al. 2003). The illness rate increased with age and was higher for males than for females; for self-employed than for employees and for full-time workers than part-timers. However, the stress, depression and anxiety rates were higher among employees especially in higher status jobs and the incidence was almost 50% higher for females than for males.

A1. 2 STRESS AND WORKPLACE SOCIAL ENVIRONMENT

Yen et al. (1999) examined an association between occupational stress and alcohol consumption by evaluating workplace racial discrimination in a sample of urban transit operators in the USA. During 1993-1995, after undergoing a medical exam, 1,542 transit operators completed an interview. Operators who reported discrimination in at least one situation, out of a possible four, were more likely to have had negative life consequences as a result of drinking (adjusted OR = 1.97; 95% CI, 1.20-3.83) and were more likely to be classified as having an alcohol disorder (OR = 1.56 [0.96-2.54]), compared to those who reported no instances of workplace discrimination. Results adjusted simultaneously for age, sex, race/ethnicity, education, income, marital status, and seniority. There was no association between workplace discrimination and heavy drinking or drinks per month. The study indicated an association between workplace racial discrimination and some measures of alcohol consumption.

Ames, Grube and Moore (1997) presented the relationship of drinking and hangovers to workplace problems in a manufacturing industry. The data came from a survey of 832 hourly employees (88% male) and from ethnographic research in the plant. The study asked the employees how much they drank prior to and during working hours and how frequently they had been hangover at work. Respondents were also asked about their overall alcohol consumption and their experience of various problems in the workplace. Bivariate analyses indicated that overall drinking, heavy drinking outside of work, drinking at or just before work and coming to work hangover were related to the overall number of work problems experienced by respondents, and to specific problems such as conflicts with supervisors and falling asleep on the job. Multivariate analyses revealed that workplace drinking and coming to work hangover predicted work-related problems even when usual drinking patterns, heavy drinking and significant job characteristics and background variables were controlled. Overall drinking and heavy drinking outside the workplace did not predict workplace problems in the multivariate analyses. The analyses show that workplace problems were also related to age, gender, ethnicity, work shift and departments. The study implied that the work-related drinking and hangovers at work are related to problems within the workplace and may lead to lowered productivity and morale.

Ragland et al. (1995) explored occupational and non-occupational correlates of alcohol consumption using data from a 1983-1985 cross-sectional study of urban transit operators. A total of 1.853 operators underwent a medical examination for driver's license renewal (including information on age, ethnicity, gender and education). Of these operators, 1,448 completed a questionnaire about occupational (e.g., time of shift, job stressors) and non-occupational (e.g., personality, life stressors) factors. From either the medical examination or the questionnaire, weekly alcohol consumption was available for 1,820 operators. Variables related to alcohol consumption in previous studies, or theoretically linked to consumption, were analyzed in relation to heavy (15 or more drinks/week) and average weekly consumption. Heavy and average consumption were both related to several non-occupational variables, including demographic (age, ethnicity, gender, marital status), personality (depression, anger expression), and life stress variables (i.e., life events). Heavy and average consumption were also related to several occupational variables, including job history (number of years driving, specific worksite) and job stressors. Neither measure was related to subjective job content (job demand, decision latitude). Variability in consumption by demographic factors among this population reflects that generally seen in the society as a whole. However, occupational factors may influence consumption, since consumption was strongly related to (a) specific worksite and time of shift and (b) reported job stressors. For clarifying the exact influence of occupational and worksite factors on alcohol consumption will depend on the convergence of findings from different research designs (e.g., cross-sectional, longitudinal, ethnographic).

Ames and Rebhun (1996) explored issues related to women, alcohol and work. Economic shift toward industrial and service jobs coupled with the increasing presence of women in the workplace has revolutionized women's domestic and public roles and these changes have impacted their drinking behaviour. In addition, in a multicultural society like the United States, subcultures, ethnic groups, socioeconomic classes, and even job categories have their own sets of gendered drinking norms. Patterns of alcohol use among women can be better understood with consideration of intricate interactions among gender, ethnicity, class, employment, and alcohol consumption. This study reviewed literature about ethnic, class, occupational, and gender influences on women's workplace-related drinking. The report highlighted both the complexity of the phenomenon and the inconsistent, incomplete nature of existing information, as well as pointed out directions for future research.

A1.3 RESPIRATORY PROBLEMS

Numerous occupation-based exposure studies indicate the higher risk of respiratory problems (including lung diseases, asthma and chronic bronchitis) among workers directly exposed to silica dust, fumes and gases and other air pollutants. These studies conclude that the length and intensity of exposure, nature of interaction between host and the agent, and smoking behaviour are the key factors rather than ethnicity alone or socio-economic status. No significant influence of ethnicity is evident from UK literature on chronic bronchitis among textile workers

Occupational Asthma: Kor et al. (2001) described occupational asthma in more prevalent among males in Singapore. There were 53% cases of Chinese, 24% Malays, 16% Indians and 7% of other ethnic origins. The mean age at diagnosis was 35.8 years and the mean duration of exposure prior to onset of symptoms was 34.9 months. The most common causative agent was isocyanates (31%) followed by solder flux (13%) and welding fumes (9%). 14.4% of workers were assessed to have permanent disability under the Workmen's Compensation Act. The study concluded that despite occupational asthma is a condition associated with disability in the workplace, it is continued to be largely under-reported. Hong et al. (1994) discussed lifestyle and behavioural risk factors associated with asthma morbidity in adults in Singapore. The study covered concerning risk factors including ethnicity, clinical atopic status (current rhinitis/eczema), smoking, occupation, keeping of pets, rugs and carpets, use of brooms, burning of mosquito coils or incense, and outdoor air pollution, as well as the patient's knowledge of asthma care. The significant predictors of asthma morbidity were keeping of either pets or rugs/carpets and high-risk occupations. A multiplicity of interacting factors and behavioural responses appear to influence the effects of allergens and other environmental precipitants on asthma morbidity. Diller (1987) presented facts and fallacies involved in the epidemiology of isocyanate asthma. Observed incidence varies by the intensity of isocyanate exposure, criteria for diagnosis, mode of calculation, sensitising capacity of different isocyanates, individual predisposition and confounding factors (adjuvants). Though there is not much variation in the prevalence by geographical or ethnicity factors, work places at risk are those with isocyanate concentrations above 20 ppb. Garrett, Mulder and Wong-Toi (1989) discussed reasons for racial differences in A & E attendance rates for asthma in New Zealand. Europeans reported more daytime symptoms of asthma and were on more medications than Pacific Islanders, with Maoris intermediate. Relative to the perceived severity of their asthma, both Maoris and Pacific Islanders lost more time from work or school and used hospital services more than European asthmatics using A & E. The increased use of A & E by Maori and Pacific Island asthmatics seemed not attributable to the intrinsic severity of their asthma and was better explained by ethnic, socio-economic and sociocultural factors. Pacific Islanders had less self management skills and, like Maoris, were less likely to be on prophylactic medications relative to oral bronchodilator use and these factors likely contributed to their increased morbidity.

Respiratory disorders and farm workers: Horne, To and Cockcroft (1989) presented ethnic differences in the prevalence of pulmonary airflow obstruction among grain workers in Canada. WHO data suggest that British males over 45 have a higher death rate from chronic bronchitis, emphysema, and asthma combined than do other Europeans. Although widely supposed that this is due to particularly unfavourable environmental factors in the British Isles, as well as a higher rate of tobacco consumption, ethnicity itself may be a significant factor in determining risk of obstructive airways disease. While examining airflow obstruction among grain workers of British, German, and Eastern European ancestry, the study found that the British grain workers had a significantly greater prevalence of airflow obstruction than the Eastern Europeans. The study concluded that ethnic origin made a significant contribution to the estimation of risk of airflow obstruction among grain workers independent of the effects of age and smoking. Lim et al. (1984) carried out the study to determine the health effects of rice husk dusts in Malaysian rice millers after controlling for age, sex, ethnic group, and agricultural work background. Clinical, haematological, and radiological findings suggest that a distinct clinical syndrome seems to be associated with exposure to rice husk dust. This included acute and chronic irritant effects affecting the eyes, skin, and upper respiratory tract; allergic responses such as nasal catarrh, tightness of chest, asthma, and eosinophilia; and radiological opacities in the chest, probably representing early silicosis or extrinsic allergic alveolitis.

Chronic bronchitis and textile workers: Niven et al. (1997) examined chronic bronchitis among textile workers in UK. A large population of textile workers was investigated to determine whether such exposure was also associated with chronic bronchitis once other possible aetiological factors had been accounted for. Current and lifetime exposure to dust was estimated by personal and work area sampling, and the use of records of retrospective dust levels previously measured over the preceding 10 years among textile workers. A control group of workers exposed to man-made fibre textiles was identified. The comparative prevalence of chronic bronchitis in the two populations was assessed, allowing for sex, age, smoking habit, and ethnic origin. Two case referent studies were also performed; cases of chronic bronchitis were separately matched with controls from the cotton and control populations to determine the effect of the symptomatic state on lung function. After controlling for smoking (pack years), workers in a cotton environment were significantly more likely to suffer from chronic bronchitis specially in workers over 45 years of age (odds ratio 2.51; CI 1.3 - 4.9); $p < 0.01$). Regression analysis of all possible influencing parameters showed that cumulative exposure to cotton dust was significantly associated with chronic bronchitis after the effects of age, sex, smoking, and ethnic group were accounted for ($p < 0.0005$). The study concluded that chronic bronchitis was more prevalent in cotton workers than in those working with man-made fibre and exposure was additive to the effect of smoking. The diagnosis of chronic bronchitis was associated with a small but significant decrement in lung function.

Love et al. (1991) presented the characteristics of respiratory ill health of wool textile workers in UK. The relations of lung function and chest radiographic appearances with exposure to inspirable dust were examined for workers categorised into three large sex and ethnic groups (European men, Asian men, and Asian women). Profusions of small opacities of 0/1 on the ILO scale, or greater, were present in only 6% of the population, and were not positively associated with current exposure to wool mill dust, or duration of exposure. In general, statistically significant relations between exposure and lung function indices were not found, with the exception of an inverse relation between the forced expiratory volume/forced vital capacity ratio and dust concentration in European women. A suggestive but not statistically significant inverse relation between FVC and current dust concentration was seen in Asian men. Substantial differences were found between mills in mean values of lung function variables after adjustment for other factors but these were not apparently related to the differences in dust concentrations between these mills. Dyeworkers and wool scourers (mostly European men in relatively dust

free jobs) on average experienced an FEV1 251 ml lower than other workers when age, height, smoking habits, and occupational factors had been taken into account.

In an earlier study Love et al. (1988) discussed the respiratory and allergic symptoms in wool textile workers in UK. The epidemiological study covered 2153 workers including 385 Urdu speaking workers from Pakistan whose English was not fluent. Symptoms investigated included cough and phlegm, wheezing and chest tightness, breathlessness and its variability, rhinitis, conjunctivitis, chills, nosebleeds, and chest illnesses. Additional questions were asked, where appropriate, about the times of day, days of the week, seasons, and places that the symptoms were worse or better than normal. An environmental survey was carried out at each mill, which included 629 measurements of inspirable dust, enabling estimates to be made of the airborne concentrations of inspirable dust usually experienced by each member of the workforce under current conditions. Overall symptom prevalences were: persistent cough and phlegm, 9%; wheeze, 31%; breathlessness on walking with others on level ground, 10%; persistent rhinitis, 18%; persistent conjunctivitis, 10%; persistent chills, 2%; ten or more nosebleeds a year, 2%; and three or more chest illnesses in past three years, 5%. After allowing for the effects of age, sex, smoking habit, and ethnic group, cough and phlegm, wheeze, breathlessness, rhinitis, conjunctivitis, and nosebleeds were found to be more frequent in those exposed to higher than to lower concentrations of dust. In some experiencing high concentrations (blenders and carpet yarn backwinders) cough and phlegm, wheeze, rhinitis, and conjunctivitis were related to the years worked in such jobs. Relative risks of each symptom in relation to inspirable dust concentrations were calculated by means of a logistic regression analysis. At concentrations of 10 mg/m3, the current UK standard for nuisance dusts, the risk of cough and phlegm relative to that of an unexposed worker was 1.37, that of wheeze 1.40, breathlessness 1.48, rhinitis 1.24, and conjunctivitis 1.70. Since some of these symptoms may be associated with functional impairment of the lungs, further studies of selected workers are being carried out to estimate the functional effects of exposure to dust in wool textile mills.

Rastogi et al. (1989) presented the prevalence of ventilatory obstruction in textile workers exposed to cotton dust in India. The study was conducted in a cotton spinning mill to assess the prevalence of respiratory impairment in 189 asymptomatic workers and 133 byssinotics drawn from various sections of the plant exposed to airborne cotton dust in the work environment. Eighty-four healthy controls belonging to the same socio-economic status and ethnic group having never been exposed to cotton dust or any other pollutant was also studied for the purpose of comparison. Of the 189 asymptomatic workers, 13 (6.8%) suffered from bronchial obstruction whereas only 2 (2.3%) among the control showed obstructive pulmonary impairment. The byssinotics showed a significantly higher prevalence (15.7%) of bronchial obstruction than that (6.8%) observed among the asymptomatic cotton workers (P less than 0.005). Byssinotics (grade II) showed significantly higher prevalence (31.5%) of bronchial obstruction than that (9.4%) observed in acute byssinotics (grade I). The effect of smoking on the prevalence of bronchial obstruction in the asymptomatic and byssinotics was quite discernible as smokers showed significantly higher prevalence than that observed among the non-smokers (P less than 0.05). The asymptomatic cotton workers and those with different grades of byssinosis having more than 10 years of exposure showed significantly higher prevalence of bronchial obstruction than that observed in the group with less than 10 years of exposure (P less than 0.005). The healthy cotton workers and byssinotics engaged in the preparatory section (card, blow, and waste plant rooms) showed an insignificant higher prevalence of bronchial obstruction (11.3 and 24.4%, respectively) than among those who worked in the spinning, reeling, and winding sections of the mill. The mechanism responsible for causing ventilatory obstruction in the textile workers were discussed.

Respiratory symptoms and welders: Bradshaw et al. (1998) studied chronic bronchitis, work related respiratory symptoms, and pulmonary function in welders in New Zealand. Forced

expiratory volume in one second (FEV1), forced vital capacity (FVC), and peak expiratory flow (PEF) were measured before the start of the shift. There were no significant differences in ethnicity, smoking habits, or years of work experience between welders and non-welders. Symptoms of chronic bronchitis were more common in current welders (11.3%) than in non-welders (5.0%). Of those workers with a cumulative exposure index to welding fume 10 years or more, 16.7% reported symptoms of chronic bronchitis compared with 4.7% of those with a cumulative exposure index < 4 years (OR 4.1, 0.90 - 17.6). Multivariate analysis identified a high proportion of time spent welding in confined spaces as the main risk factor for reporting the symptoms (OR 2.8, 1.0 - 8.3). The study has documented a high prevalence of symptoms of chronic bronchitis and other work related respiratory symptoms in current welders. Also, workers with chronic bronchitis had reduced PEF and FEV/FVC compared with those without chronic bronchitis. These symptoms related both to cigarette smoking and a measure of lifetime exposure to welding fume. Kilburn et al. (1989) examined respiratory symptoms and functional impairment from acute exposure to welding gases and fumes. Ten years of welding was associated with chronic bronchitis in 23.3% of non-smokers compared to 3.3% in male controls, shortness of breath in 31.5% of non-smokers compared to 1.5% in controls, and chest pain or heaviness in 38.4% compared to 4.4% in controls. Men who welded aluminium but had never smoked had more frequent wheezing, chest tightness, phlegm, feverishness and fatigue than those welding mild (black) or stainless steel. There were no significant cross-shift effects from welding exposure on measurements of pulmonary function. Although baseline expiratory flows were reduced slightly when compared to Caucasian-predicted values, ethnic specific comparisons for the largest subgroup showed only that FEF25-75 was reduced to 92.9 percentage of predicted values. Diffusing capacities for carbon monoxide were significantly reduced as compared to referents. The pulmonary function values of 25 current smokers were indistinguishable from the 41 who had never smoked, which probably reflects their low consumption of cigarettes.

Respiratory morbidity and rubber processing industry: Fine and Peters (1976) studied respiratory morbidity in rubber processing workers. Respiratory questionnaires and pulmonary function tests were administered to men exposed to dust in the processing area in three rubber tire manufacturing plants as well as to controls. Compared with the controls, the processing workers had a higher prevalence of chronic productive cough. Overall, the processing group showed a decrease in the ratio of FEV to FVC. The processing workers with more than ten years of exposure showed a significant decrease in the ratio of FEV1.0/FVC, the FEV1.0, the residual FEV1.0, and the flow rates at 50% and 25% of the forced vital capacity. None of the pulmonary function effects could be solely explained on the basis of smoking, age, ethnic, or socio-economic factors: all were related to the length of exposure. Based on these results the study concluded that exposure in the processing area produces pulmonary disease.

Respiratory disease mortality and fibreglass industry: Chiazze et al. (1993) undertook a case-control study of malignant and non-malignant respiratory disease among employees of the Fiberglas Ohio plant in the USA. The aim was to determine the extent to which exposures to substances in the plant environment, to non-workplace factors, or to a combination may play a part in the risk of mortality from respiratory disease among workers in this plant. A historical environmental reconstruction of the plant was undertaken to characterise the exposure profile for workers in this plant from its beginnings in 1934 to the end of 1987. The exposure profile provided estimates of cumulative exposure to respirable fibres, fine fibres, asbestos, talc, formaldehyde, silica, and asphalt fumes. Information on employment characteristics (duration of employment, year of hire, age at first hire) obtained from the employer. An interview survey used to obtained information on demographic characteristics (date of birth, race, education, marital state, parent's ethnic background, and place of birth), lifetime residence, occupational and smoking histories, hobbies, and personal and family medical history. Matched, unadjusted odds ratios were used to assess the association between lung cancer or non-malignant

respiratory disease and the cumulative exposure history, demographic characteristics, and employment variables. Only the smoking variables and employment characteristics (year of hire and age at first hire) were statistically significant for lung cancer. For non-malignant respiratory disease, only the smoking variables were statistically significant in the univariate analysis.

Asbestos workers: Fournier-Massey, Wong and Hall (1984) studied retired and former asbestos workers in Hawaii. They represented the main ethnic groups - Caucasian, Chinese, Filipino, Hawaiian and part-Hawaiian, and Japanese - on Oahu. Most subjects had had significant exposure to asbestos in a shipyard, and 83% were current non-smokers (160 had never smoked, and 111 were ex-smokers for ten years or more). Taking age and ethnicity into account, the group had more chronic respiratory and gastrointestinal problems than the comparable male population of Oahu in 1979, but fewer such problems than active shipyard workers elsewhere. These problems related primarily to current smoking status and secondarily to the length of asbestos exposure. The findings are compared to those of other shipyards, and support the hypothesis that the biological effects of asbestos exposure are generally mild in Hawaii.

A1.4 CANCER

Cancer (25 papers): A number of exposure studies have shown differential mortality rates for work-related cancers among production workers engaged in different industries. Some of these studies have also observed differential mortality rates by ethnicity for specific cancers. Apart from length and intensity of exposure at workplace, these studies conclude that ethnicity, diet, alcohol, and cigarette smoking cannot be ruled out as possible confounding etiologic factors for cancer deaths.

Work-related Cancers: Loomis and Schulz (2000) presented mortality rates of six work-related cancers among African Americans and Latinos. Proportionate mortality ratios (PMRs) and standardised mortality rate ratios (SRRs) for ages 20-64 years were computed for cancers of the lung, nasal cavity, pleura, and peritoneum, malignant melanoma and leukaemia. PMRs was generally low for both groups, but African Americans had higher than expected mortality rates for leukaemia and cancers of the lung, nasal cavity, and peritoneum. Industry-specific analyses indicate excess leukaemia among African American men in the rubber industry (PMR 2.08, 1.29 - 3.35), Latino men in textile (PMR 2. 31, 0.81 - 5.13) and wood industries (PMR 2.03, 0.81 - 5.13), and Latino women in the chemical industry (PMR 2.18, 0.59 - 8.10), among other findings. Excess cancer of the pleura and peritoneum was observed among workers with a variety of usual occupations, consistent with widespread exposure to asbestos.

Lee (1984) estimated cancer incidence in Singapore by occupational groups. It was confined to Chinese males aged 35-64 for the period 1968-1977. Due to the lack of relevant population data, relative risks were based on the Standardised Relative Proportional Risk (SRPR), standardised for age, dialect group and place of birth. Managers and clerical workers seem to have high SRPRs for cancer of the large bowel, but low SRPRs for cancer of the lung and oesophagus. High SRPRs for lung and oesophagus are seen in some groups of manual workers (e.g., bricklayers, carpenters, transport equipment operators and labourers not otherwise specified). There is also a high SRPR for skin cancer among farmers.

Gustavsson, Hogstedt and Holmberg (1986) studied mortality and incidence of cancer among Swedish rubber workers in Sweden during 1952-1981. No significant risk excesses were detected when the cohort was analyzed without consideration of employment time or latency period. However, the mortality from coronary heart disease and the incidence of lung cancer were increased when the study period was limited to greater than or equal 40 years since first employment. The standardized mortality ratio for coronary heart disease correlated positively

with employment duration. The mortality from asthma, bronchitis, and emphysema was non-significantly increased. The incidence of bladder cancer was increased among individuals with heavy and long-term exposure in the weighing and mixing departments. Twenty-five percent of the individuals in the cohort were not Swedish citizens at the time of employment, and an analysis of the mortality and cancer incidence in this group showed a markedly increased of lung cancer incidence for certain immigrant groups, probably mainly due to ethnic factors. The study suggested that ethnic factors must be considered in the analysis of occupational groups when a high proportion of the workers are immigrants.

Ference, Chiazze and Wolf (1987) presented a cohort mortality study of production workers employed between 1955 and 1961 at four plants of the Allied Corporation. The study was undertaken to determine whether mortality patterns in production facilities were similar to those of a separately studied group of research laboratory personnel working with similar materials. White male production workers from all plants combined experienced lower mortality for all causes of death combined than would be expected on the basis of the US population. Cancer of the rectum was significantly elevated among white males and cancer of the stomach was significantly elevated among black males at one plant. There were significant deficits among all white males for nonmalignant digestive system diseases and all external causes of death.

Lung cancer: Rice et al. (2001) used various exposure-response models to estimate the risk of mortality from lung cancer due to occupational exposure to respirable crystalline silica dust. Data from a cohort mortality study of 2342 white male California diatomaceous earth mining and processing workers exposed to crystalline silica dust (mainly cristobalite) were analysed with potential confounding factors as the effects of time since first observation, calendar time, age, and Hispanic ethnicity. Lifetime risks of lung cancer were estimated up to age 85 with an actuarial approach that accounted for competing causes of death. Exposure to respirable crystalline silica dust was a significant predictor ($p<0.05$) in nearly all of the models evaluated. For those who died of lung cancer the linear relative rate model predicted rate ratios for mortality from lung cancer of about 1.6 for the mean cumulative exposure to respirable silica compared with no exposure. The excess lifetime risk (to age 85) of mortality from lung cancer for white men exposed for 45 years and with a 10 year lag period at the current Occupational Safety and Health Administration (OSHA) standard of about 0.05 mg/m(3) for respirable cristobalite dust was 19/1000. There was a significant risk of mortality from lung cancer that increased with cumulative exposure to respirable crystalline silica dust. The study inferred from the predicted number of deaths from lung cancer that current occupational health standards may not be adequately protecting workers from the risk of lung cancer.

Vineis et al. (1988) examined lung cancer attributable to well-known and suspected lung carcinogens. The studies were conducted in areas heterogeneous in terms of industrial activities. The percentage of lung cancers attributable to occupations entailing potential exposure to well-recognized carcinogens ranged, by study area, from 3 to 17%. The further inclusion of occupational groups with suspect carcinogenic exposures changed these estimates very little. Exclusion of data derived from next-of-kin interviews influenced the estimates of attributable risks, but not in a systematic fashion. The estimates also varied according to ethnic group, smoking status and birth cohort, with higher values in non-whites, non-smokers and among members of more recent birth cohorts.

Schnorr et al. (1995) studied lung cancer mortality in a cohort of antimony smelter workers in the USA. This mortality study of 1,014 men employed between 1937 and 1971 were mainly of Spanish origin (n = 928). Hispanics are known to smoke at much lower rates than non-Hispanics, and their lung cancer and heart disease mortality is generally low. When ethnic-specific Texas lung cancer death rates were used for comparison, mortality from lung cancer among antimony workers was elevated (SMR 1.39, 1.01-1.88), and also observed a significant

positive trend in mortality with duration of employment. When ischaemic heart disease death rates from three different Spanish-surnamed populations were used for comparison, the rate ratios for mortality from ischaemic heart disease were 0.91 (90% CI 0.84-1.09), 1.22 (90% CI 0.78-1.89), and 1.49 (90% CI 0.84-2.63). Pneumoconiosis/ other lung disease death rates for Spanish-surnamed men were unavailable and so calculation of rate ratios used white males as a comparison population (SMR 1.22; 90% CI 0.80-1.80). The data suggest some increased mortality from lung cancer and perhaps nonmalignant respiratory heart disease in workers exposed to antimony.

Cooper, Wong and Kheifets (1985) studied mortality among employees of lead battery plants and lead-producing plants in Denmark during 1947-1980. There were 1 718 deaths in the first cohort and 621 in the second. Mortality from all causes combined was significantly greater than expected in each cohort, the standardized mortality ratio (SMR) being 107 and 113, respectively. Among the battery plant workers the greater than expected mortality rate resulted in large part from a significant number of excess deaths from malignant neoplasms (SMR 113), other hypertensive disease (mainly renal) (SMR 320), chronic nephritis (SMR 222), and a group of ill-defined conditions (SMR 355). Among the lead production workers the pattern was similar, with a significant number of excess deaths from other hypertensive disease (SMR 475), hypertensive heart disease (SMR 203), chronic nephritis (SMR 265), and ill-defined conditions (SMR 214). There was also a significant excess of deaths from external causes (SMR 143). The SMR for total malignancies was 113, but this value was not significantly elevated at the 5% level. In neither cohort were deaths from cerebrovascular disease in significant excess, the SMR being 93 and 132, respectively. A proportionate mortality analysis showed that the excess deaths from cerebrovascular disease and from hypertensive heart disease among smelter workers were in part due to the high proportion of nonwhites in the smelter populations. The stomach, liver, and lungs were the sites responsible for most excess cancer deaths in both cohorts, but the elevated SMR values were statistically significant only for gastric and lung cancers in battery plant workers. There were no excess deaths from malignancies of the kidney, brain, or lymphopoietic system in either cohort. It is impossible to relate the observed mortality to levels of lead exposure; because of meager quantitative information prior to 1960. It is known that past exposures had been very high. Ethnicity, diet, alcohol, and cigarette smoking could not be ruled out as possible confounding etiologic factors for the cancer deaths.

Vena et al. (1985) conducted a proportionate mortality ratio (PMR) study using data on workers of an automobile factory composed of forge, foundry, and engine (machine and assembly) plants. Ninety four percent of the death certificates were obtained for all active and non-active workers who died during the period 1 January 1970 to 31 December 1979. Observed numbers of deaths were compared with expected numbers based on the general population. There was close agreement between the number of observed and expected deaths by either standard of comparison among white auto workers in the forge and foundry plants. Valid analyses of cause specific mortality among non-whites could be conducted for the foundry plant only. Although there was raised PMR for deaths due to diseases of the circulatory system, none of the other cause specific PMRs was significant. Although based on small numbers, the risk of cancer of the lung was significantly high in non-whites under age 50 in the foundry (PMR = 2.6; $p< 0.05$). The cause specific PMRs for whites in the engine plant were statistically significant for malignant neoplasms (1.2) and all external causes (0.62).

Lung cancer & Fur workers: Sweeney, Walrath and Waxweiler (1985) examined mortality among retired fur workers in the USA. Workplace exposures of fur workers varied with job category. Dyers were exposed to oxidative dyes used in commercial hair dyes; dressers and service workers were exposed to tanning chemicals. In a comparison with the general population, no significant increases in mortality were observed among the fur dyers. Among fur dressers, mortality from all malignant neoplasms (SMR 151) and lung cancer (SMR 232) was

significantly elevated, as was mortality from cardiovascular disease (SMR 126) among fur service workers. When examined by ethnic origin, the elevated SMR values and directly age-adjusted rate ratios suggested that foreign-born fur dressers and eastern European-born fur workers experienced the highest risks for lung and colorectal cancers, respectively. The data support previous findings of increased mortality from colorectal cancer in the foreign-born population of the United States and suggest a possible occupational etiology for the observed lung cancer excess.

Guay and Siemiatycki (1987) carried out a historic cohort mortality study among two groups of male workers in the Montreal fur industry: 263 dressers and dyers and 599 fur garment manufacturers, followed up from 1966 to 1981. The first group was exposed to a very wide variety of chemicals used in tanning, cleaning, and dyeing fur, including substances considered to be carcinogenic and/or mutagenic. The second group was exposed to residue from the dressing and dyeing stage and to respirable fur dust. The mean age of the workers was 43.2 years and the mean number of years since first employment 14.1. Observed deaths were compared with the general population. Standardized mortality ratios (SMRs) for the manufacturers were significantly low, probably because of the ethnic composition of the cohort and a healthy worker effect. SMRs for the dressers and dyers were also low, but not as low as for the manufacturers. When attention was restricted to the French Canadians in the cohort, the observed deaths were close to the expected; there was a noteworthy excess of colorectal cancer for dressers and dyers. Apart from this suggestive evidence, the results did not indicate any excess mortality risks in the fur industry.

Oesophageal cancer and silica dust: Cucino and Sonnenberg (2002) presented occupational mortality from squamous cell carcinoma of the oesophagus in the United States during 1991-1996. Mortality from oesophageal cancer by occupation or industry was expressed as standardised proportional mortality ratio (PMR), adjusted by age, gender, and ethnicity. Mortality was particularly high among nonwhites and men. The industrial and the occupational distributions shared a similar pattern. Mortality from oesophageal squamous cell carcinoma occurred more frequently among subjects exposed to silica dust, such as brick masons and stone masons, concrete and terrazzo finishers, roofers, and construction labourers. It was also high in such industries as unspecified machinery or manufacturing and such occupations as unspecified material handlers, janitors, or cleaners. It was low in industries and occupations associated with agriculture, clergy, work in religious organisations, and textiles. In conclusion, mortality from oesophageal squamous cell carcinoma appeared to be low in occupations associated with less consumption of alcohol and tobacco. It was high among occupations potentially associated with exposure to silica dust and chemical solvents or detergents.

Occupational bladder cancer: Schulz and Loomis (2000) examined occupational bladder cancer mortality among racial and ethnic minorities in the United States for 1985-1992. Mortality of specific racial/ethnic/occupational groups was compared separately with workers in the specific occupation and with members of the specific racial/ethnic group. The study identified elevated bladder cancer mortality among African American males and females and Latino males in several occupational groups with exposure to suspected bladder carcinogens as well as among Asian males in sales (PMR = 2. 13) and Asian females in the personal services industry (PMR = 5.25).

Cancer and fire fighters: Ma et al. (1998) presented race-specific cancer mortality in US fire fighters during 1984-1993 in terms of mortality odds ratio (MOR). The overall cancer mortality was slightly elevated among white firefighters (MOR = 1.1), but the increase in overall cancer mortality among black firefighters was not significant (MOR = 1.2). Only prostate cancer risk was elevated in both groups (whites: MOR = 1.2, blacks: MOR = 1.9). Among white firefighters, elevated site-specific cancer mortality risks were found for the following cancer

sites: lip (MOR = 5.9), pancreas (MOR = 1.2), soft tissue sarcoma (MOR = 1.6), melanoma (MOR = 1.4), kidney and renal pelvis (MOR = 1.3), non-Hodgkin's lymphoma (MOR = 1.4), and Hodgkin's disease (MOR = 2.4; 95% CI = 1.4-4.1). It also observed a slightly elevated risk for bronchus and lung cancer (MOR = 1.1). Among black firefighters, excess risks were found for cancers of the brain and central nervous system (MOR = 6.9), colon (MOR = 2.1), and nasopharynx (MOR = 7.6). The paper suggested the need for further studies to confirm the existence of differential cancer mortality risks among firefighters of different race/ethnic sub-populations.

Skin cancer and chemical exposure: Gallagher et al. (1996) examined the role of non-sunlight-related risk factors for squamous cell carcinoma (SCC) and basal cell carcinoma (BCC) of the skin through population-based case-control study among males in Canada. In total, 180 SCC and 226 BCC cases and 406 randomly selected male controls, frequency matched by 5-year age groups to the cases, were interviewed by trained personnel using a standardized etiological questionnaire. After adjustment for age, skin and hair colour, mother's ethnic origin, and sunlight exposure, elevated risks for SCC were seen in subjects exposed to insecticides (OR, highest tertile, 2.8, 1.4-5.6), herbicides (OR, highest tertile, 3.9, 2.2-6.9), and fungicides and seed treatments (OR, highest tertile, 2.4, 1.4-4.0), as well petroleum products, grease, and several other exposures. Elevated risks of BCC were seen in subjects exposed to fiberglass dust (OR, 2.0, 1.0-3.9) and dry cleaning agents (OR, 4.6, 1.1-19.7). Prior non-diagnostic X-ray treatment for skin conditions increased risk of both cancers. Although solar UV radiation is known to be the major environmental exposure causing non-melanocytic skin cancer, results of this study suggest that non-solar factors may also be important.

Cancer Mortality and Wastewater treatment workers: Betemps, Buncher and Clark (1994) undertook proportional mortality analysis of wastewater treatment system workers at risk for cancers and diseases affecting the neurological and digestive systems by birth place. The migrant worker group was significantly higher than the US white male population for cancer of the stomach, leukemia, and all lymphopoietic cancers. Migrant workers also had an elevated ratio for all diseases of the nervous system and sense organs. No cases of amyotrophic lateral sclerosis were found. The American-born workers had an elevated rate of death for arteriosclerotic heart disease compared with the US white male population. The study suggested that place of birth may present a confounding factor when evaluating exposures in employee groups.

Stomach cancer and agricultural workers: Dockerty et al. (1991) studied stomach cancer in New Zealand by ethnicity. Age-standardized mortality and incidence rates have declined over the past four decades, as in other countries. Rates have been consistently higher for men, and for Maori. A cancer registry-based case-control study of 1016 male stomach cancer cases and 19,042 male controls with other cancers was also conducted, to evaluate the relationships between stomach cancer and specific occupations. Adjustment was made for age, ethnicity, socioeconomic level, and smoking status. When 22 occupational groups were examined, adjusted odds ratios (ORs) and 95% confidence intervals (95% Cls) were elevated above unity for only forestry workers (OR 1.83, 1.01-3.32); and three subgroups: grain millers and related workers; brewers, wine and beverage makers; and field crop workers. Men who had ever smoked cigarettes were found to have an increased stomach cancer risk compared to those who had never smoked (adjusted OR 1.36, 1.15-1.60).

Upper respiratory and digestive tract cancers: Haguenoer et al. (1990) conducted a case-control study to investigate occupational risk factors for upper respiratory and digestive tract cancers (nose, lips, buccal cavity, pharynx, and larynx) in the north of France. Two hundred and eighty three cases of histologically confirmed cancer in men treated were included in the study. Two controls per case who did not have cancer were matched for sex, age, ethnic group, area of

residence, and smoking and alcohol drinking history. All subjects were questioned about occupations in which they had worked for at least 15 years. Significant associations were found between wood work and nasal cancer and farming and lip cancer. Pharyngeal cancer was associated with the textile industry and the building industry. Coal miners showed a threefold excess risk for cancer of the lip, buccal cavity and larynx.

Stomach and pancreas cancer and Exposure to Metalworking fluids and abrasives: Silverstein et al. (1988) studied stomach cancer among bearing plant workers exposed to metalworking fluids and abrasives. Cause of death and work histories were determined for 1,766 bearing plant workers who died between Jan 1, 1950 and June 30, 1982. Mortality odds ratios (SMOR) and proportional mortality ratios (PMR) revealed significant excesses of gastrointestinal malignancies. The proportional mortality excess for stomach cancer among white men was greatest among those with more than 10 years' exposure in the major grinding group. The SMOR by logistic regression for stomach cancer among white men was 2.3 (P = .02) for 25 years' grinding experience. For cancer of the pancreas among white men, there were significant associations with both machining and grinding jobs in straight oil. The study confirms previous evidence that grinding operations using water-based cutting fluids increase the risk for stomach cancer and provides moderate evidence that exposures to straight oil-cutting fluids increase the risk for cancer of the pancreas. There were indications, meriting further investigation, that non-malignant liver disease is associated with cutting fluid exposures and that lung cancer is associated with oil smoke from operations such as forging or heat treating.

Liver Cancer: Suarez, Weiss and Martin (1989) conducted a case-control study of primary liver cancer and occupation to determine if the high risk of liver cancer in Mexican-Americans can be explained by farm worker exposures to pesticides. The association of liver cancer with the petroleum and chemical industry and with other potentially high-risk occupations was also examined. Controls were randomly selected from other causes of deaths among males excluding all neoplasms, liver and gallbladder diseases, infectious hepatitis, and alcoholism, and were frequency matched to cases by age, race, ethnicity, and year of death. Risk for farm workers based on age, race, and ethnicity-adjusted odds ratios (ORs) was not excessive but was larger than the risk for farmers. Excess risk in the petroleum and chemical manufacturing industries was confined to oil refinery workers. Other occupations with twofold risk or greater were plumbers and pipe fitters; butchers and meat cutters; textile workers; cooks; and longshoremen.

Sparks and Wegman (1980) undertook a proportional mortality analysis of jewelry workers in the USA. The study consisted of 931 males who died between 1956 and 1975. An excess proportion of pancreas cancer was found in the entire group (16/9; $p < 0.05$) and was not explained by ethnic or other non-occupational factors. Job titles were specific enough to identify a subset of polishers and findings for this job category were compared to those for all other categories. Excesses of stomach cancer (odds ratio 4.4; $p < 0.01$) and stomach ulcer (odds ratio 5.0, $p < 0.01$) were found, but for each the observed number of deaths was small.

Fraumeni (1975) reviewed cancers of the pancreas and biliary tract internationally. Pancreatic carcinoma is common in western countries, although 2 Polynesian groups (New Zealand Maoris and native Hawaiians) have the highest rates internationally. In the United States the disease is rising in frequency, predominating in males and in blacks. The rates are elevated in urban areas, but geographic analysis uncovered no clustering of contiguous counties except in southern Louisiana. The origin of pancreatic cancer is obscure, but a twofold increased risk has been documented for cigarette smokers and diabetic patients. Alcohol, occupational agents, and dietary fat have been suspected, but not proven to be risk factors. Except for the rare hereditary form of pancreatitis, there are few clues to genetic predisposition. In contrast, the reported incidence of biliary tract cancer is highest in Latin American populations and American Indians. The tumor predominates in females around the world, except for Chinese and Japanese who show a male excess. In the United States the rates are higher in whites than blacks, and clusters

of high-risk counties have been found in the north central region, the southwest, and Appalachia. The distribution of biliary tumors parallels that of cholesterol gallstones, the major risk factor for biliary cancer. Insights into biliary carcinogenesis depend upon clarification of lithogenic influences, such as pregnancy, obesity, and hyperlipoproteinemia, exogenous estrogens, familial tendencies, and ethnic-geographic factors that may reflect dietary habits. Noncalculous risk factors for biliary cancer include ulcerative colitis, clonorchiasis, Gardner's syndrome, and probably certain industrial exposures. Within the biliary tract, tumors of the gallbladder and bile duct show epidemiological distinctions. In contrast to gallbladder cancer, bile duct neoplasms predominate in males; they are less often associated with stones and more often with other risk factors. In some respects, bile duct and pancreatic tumors are alike. The male predominance of both tumors, an association between cholecystectomy and pancreatic cancer, and other considerations have prompted the notion that the same biliary carcinogens may affect the bile duct, ampulla of Vater, or, by reflux, the pancreatic duct. Various epidemiological and interdisciplinary approaches are needed to further clarify the origins of biliary tract and pancreatic cancers, but nutritional studies hold special promise in laying the groundwork for prevention of these tumors.

Redmond, Strobino and Cypess (1976) presented the site-specific cancer mortality, 1953-1966, for men employed in by-product coke plants in the USA. Approximate relative risks, which take into account race, age, and calendar years of follow-up, have been calculated for various work areas of the coke plant. Men with five or more years at the coke ovens have an excess risk of dying from lung cancer and kidney cancer. Cancers of the digestive system are significantly elevated in non-oven workers. Cancers of two sites, the colon and pancreas, account for the total excess in cancers of the digestive system. Cancers of the buccal cavity and pharynx appear high in non-oven workers, although the number of deaths involved is small.

Effect of confounding factors on occupational cancer: Siemiatycki et al. (1988) studied the effect of inclusion or exclusion of three variables - smoking, ethnic group, and socio-economic status - on estimates of odds ratios (OR) between 25 occupations and three types of cancer - lung, bladder, and stomach. Of the 75 associations studied, only one OR was distorted by more than 40% when comparing unadjusted with adjusted estimates; three were distorted by between 30% and 40%; four others by between 20% and 30%. Of the eight associations that were distorted by more than 20%, seven involved lung cancer and one involved bladder cancer; none involved stomach cancer. An additional analysis was carried out on the 25 lung cancer-occupation associations to determine whether the nature of the stratification on smoking (i.e., whether crude or precise categories were used) gave different OR estimates. The differences in ORs induced by different parameterisations of the smoking variable were relatively small. Our results support the view that relative risks between lung cancer and occupation in excess of 1.4 are unlikely to be artefacts due to uncontrolled confounding. For bladder and stomach cancer, the corresponding cut point may be as low as 1.2. In studies of occupation and cancer, uncontrolled confounding due to smoking and social class may not be as serious a threat to the integrity of results as is sometimes feared.

Blot and Fraumeni (1976) demonstrated geographic patterns of lung cancer. A survey of lung cancer mortality by county in the United States, 1950-1969, revealed excessive rates among males in counties where paper, chemical, petroleum, and transportation industries were located. Such industrial correlations were not attributed to urbanization, socioeconomic factors, or other manufacturing operations, and may account for part of the high risk of lung cancer previously reported in Southern US coastal counties.

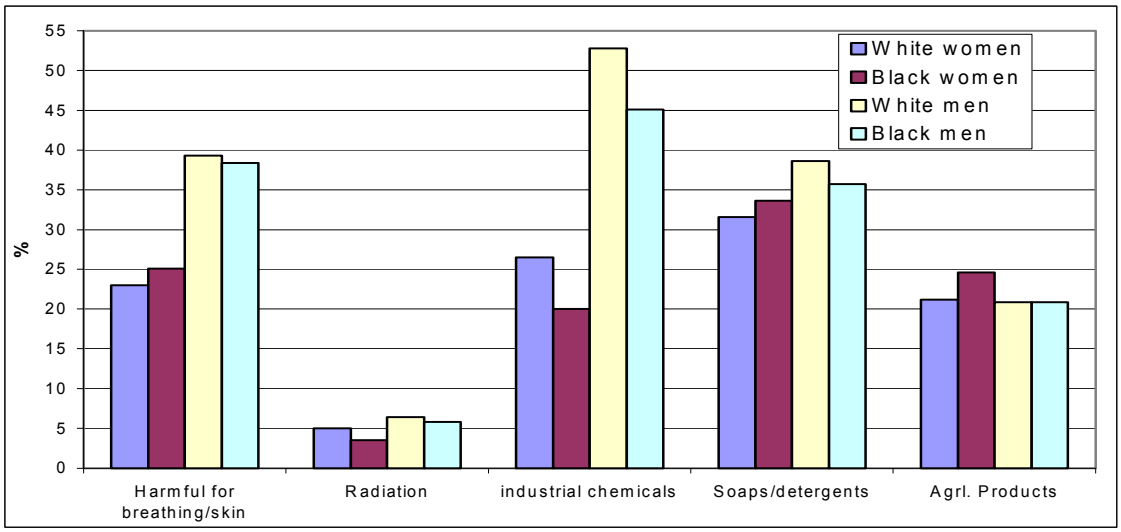
A1.5 EXPOSURE RELATED – LEAD, DUST, CHEMICALS, SUN LIGHT, HEAT AND RADIATION

Exposure (13 papers): Some studies have examined intermediate outcomes (diagnostic or clinical) rather than disease outcomes among workers exposed to lead, dust, chemicals, sun light, heat and radiation. High blood lead levels were found among workers in a lead battery manufacturing factory in Singapore. It is suggested that the higher levels among Malay and Indian workers could be due to eating habits (i.e. eating with fingers). A couple of studies have found higher mortality and morbidity due to pesticide and chemical poisoning among non-white workers. Although the level of heat tolerance varies from individual to individual, no significant association has been found between loss of body fluids and ethnicity in Australia.

Exposure related epidemiological studies (case control, retrospective, prospective, etc.) have considered ethnic profile of the population in three ways: (a) most studies used ethnicity classification to design the study by defining the control group or referent population; (b) some studies used it further in the multivariate analysis to obtain adjusted Odds ratios or Relative Risk ratios; and (c) only a few studies extended their analysis to identify the effect of ethnicity on Odds ratios or Relative Risk ratios or estimated these ratios separately for each ethnic category. Therefore, the main objective of measuring a specific outcome by ethnic groups was evident in only few studies.

The US data on currently employed persons suggest that 23% of women and 39.1% of men reported exposure to substances at workplace believed to be harmful if breathed or on skin. The respective percentages for exposure to radiation were much smaller (4.8 and 6.3). Further, in regard to information about hands and arms exposed to various agents at workplace 25.6% of women and 51.7% men reported exposure to industrial chemicals, 31.8% women and 38.3% men to soaps and detergents, and 21.6% women and 20.9% men to agricultural products (Wagener et al. 1997). The percentages were marginally lower for Blacks than for White. However, wide racial-gender differences were noticed in the percentages of workers reporting skin problems (Dermatitis) -13.7 and 8.4 for White and Black women; 11.7 and 5.8 for White and Black men.

Figure A1.2: Exposure to harmful agents at workplace, US 1992



Lung disease, silica dust and mining workers: Park et al. (2002) studied mortality from lung disease and onset of radiographic silicosis, arising from occupational exposure to respirable crystalline silica dust among earth mining and processing workers. Data were analysed with Poisson regression methods with internal and external adjustments for potential confounding by calendar time, age, smoking, Hispanic ethnicity, and time since first observation. The study concluded that the Current occupational health standards for crystalline silica permit risks of lung disease other than cancer far in excess of what is usually considered acceptable by the Occupational Safety and Health Administration (a lifetime risk of less than one in a thousand deaths). Mapel et al. (1997) study investigated the relationship of non-malignant respiratory disease to underground uranium mining and to cigarette smoking in Native American, Hispanic, and non-Hispanic White miners and also evaluated the criteria for compensation of ethnic minorities. The results suggest that the uranium mining is more strongly associated with obstructive lung disease and radiographic pneumoconiosis in Native Americans than in Hispanics and non-Hispanic Whites. Obstructive lung disease in Hispanic and non-Hispanic White miners is mostly related to cigarette smoking. Current compensation criteria excluded 24% of Native Americans who, by ethnic-specific standards, had restrictive lung disease and 4.8% who had obstructive lung disease. Native Americans have the highest prevalence of radiographic pneumoconiosis, but are less likely to meet spirometry criteria for compensation. Sluis-Cremer, Harrison and Pearson (1981) studied respiratory symptoms and lung function in black and white mining and non-mining industrial workers in South Africa. A number of chronic respiratory diseases for Whites and Blacks are compared, and the effect of smoking habits in the two ethnic groups is reported. The results are discussed in the light of other reports on ethnic differences in the literature.

Blood lead levels: Chia et al. (1996) examined cumulative blood lead levels and nerve conduction parameters among 72 workers in a lead battery manufacturing factory and 82 referents in Singapore. The aim of the study was (a) correlating the nerve conduction parameters of the median and ulnar nerves of the dominant forearms with the blood cumulative lead-years (BPbCum) results; (b) determining a "no effect' cumulative dose of lead on the peripheral nerves. The mean BPb for the exposed and referent were 36.9 micrograms/100ml and 10.5 micrograms/100ml, respectively. The mean BPbCum was 136.8 (range = 6.7-1087.0) micrograms-year/100ml. Significant differences were found in the adjusted (for age, ethnical groups, smoking and drinking habits by ANCOVA) means median sensory conduction velocity, motor conduction velocity, distal latency and amplitude between the exposed and referent groups. But for the ulnar nerve only, distal latency was significantly different. With the BPbCum groups, dose response relations are noted in both the nerve conduction parameters of the median and ulnar nerves. There were no significant differences for the ulnar and median nerves conduction parameters between BPbCum < 40 micrograms-year/100ml group and referent. The study indicates that a maintained blood lead level of less than 40micrograms/100ml for one year may not have significant effects on the median and ulnar nerves.

Chia, Chia and Ong (1991) examined ethnic differences in blood lead concentration among workers in a battery manufacturing factory in Singapore. The mean adjusted (for environmental lead levels, age, exposure duration and stick-years of smoking by analysis of covariance) blood lead level of the Malays was 34.8 micrograms/dl as compared to 22.4 micrograms/dl for the Chinese. This difference was significant ($p< 0.02$). Oral ingestion of lead, through eating of food with hands contaminated by lead compound, among the Malay workers was suggested as a possible cause for the difference in the mean blood lead levels. It suggested preventive measures to overcome the problem.

Hodgkins et al. (1991) examined the influence of high past lead-in-air exposures on the lead-in-blood levels of lead-acid battery workers with continuing exposure. The study followed 132 lead-acid battery workers in two plants over 30 months during 1983-85 with frequent air lead and blood lead determinations. Both plants converted to more modern, expanded-metal battery manufacturing technologies around 1978 with associated reductions in mean air lead exposures from greater than 100 to less than 30 micrograms/m3. In multiple regression analyses including consideration of job category, seniority, age, ethnicity, gender, and smoking habit as covariates, there was a highly significant association of blood lead in micrograms/dL with air lead in micrograms/m3 (partial R2 = .20, p< .0001) among the 68 workers in plant B but no association (P = .91) in plant A. Restriction of the regression analysis to those 44 workers in plant B with less than or equal to 22 years of seniority yielded the most significant air lead-blood lead association (partial R2 = .36, p< .0001). Among the remaining 24 workers in plant B, seniority, but not air lead, had a significant positive association with blood lead. Despite very stable air lead levels over the 30-month study, 51 workers in plant A with more than 20 years' seniority had a mean decline of 0.04 microgram/dL in mean blood lead over the study period, whereas the 13 workers in plant A with less than or equal to 20 years' seniority had a mean increase of 7.6 microgram/dL.

Bergeret et al. (1990) studied Neutrophil functions in 38 lead-exposed workers compared to 34 controls. Both groups were matched according to age, sex, drinking and smoking habits, ethnic origin and drug intake. Blood lead levels were found to be seven times higher in exposed workers than in controls. Phagocytosis assayed by chemiluminescence was found to be slightly but not significantly altered in exposed workers. In contrast, chemotaxis using the agarose technique was significantly depressed. These results are in agreement with previous in-vitro findings, which suggest further assessment of clinical consequences.

Phoon, Lee and Ho (1990) studied biological monitoring of workers exposed to inorganic lead in Singapore. The WHO recommended health-based limit level for lead absorption at 40 micrograms/dL for adult male workers was taken to divide the factories into "higher risk" and "lower risk" ones. The former category included factories manufacturing PVC and lead storage batteries, with the highest level of 79.6 micrograms/dL found in PVC manufacture. Of the 3 main races in Singapore, the Chinese have the lowest blood lead levels after adjusting for the type of industry, age and duration of exposure to lead. Age was correlated with the duration of lead exposure. The higher blood lead levels in Malays and Indians may have been contributed to by eating habits (i.e. eating with hands). The higher prevalence of smoking among Malays may also be contributory. The results in this study, while reassuring that no worker was found with blood lead above 80 micrograms/dL, also indicated that workers in some factories were still exposed to a health risk.

Sakamoto, Vaughan and Tobias (2001) explored occupational health surveillance strategies for an ethnically diverse Asian employee population in the USA. Lead toxicity may be a result of acute or chronic exposure and can affect the haematopoietic, nervous, renal, and reproductive systems. Minority groups tend to be over-represented in lead industries. Further, an increase in high lead levels can be compounded by cultural influences. Education must be geared toward the specific employee populations. Successful programs require assistance from all team members - occupational health nurse, safety engineer, industrial hygienist, and environmental engineer. The study suggested that the occupational health nurses play an important role in implementation of medical/health surveillance programmes by scheduling regular blood testing, monitoring results, and educating employees.

Occupational Sunlight exposure: A case-control study by van Wijngaarden and Savitz (2001) examined occupational sunlight exposure and death from non-Hodgkin lymphoma (NHL) and NHL subtypes among 188 cases and 1880 controls selected from a cohort of 138,905 male

electric utility workers. Exposure was classified according to work history linked to indices of cumulative sunlight exposure. Odds ratios were derived from conditional logistic regression models and were conditioned on the matching factors birth year and ethnicity. Mortality from NHL and intermediate/high-grade lymphomas was not related to cumulative sunlight exposure, with odds ratios around the null. For low-grade lymphomas, a dose-response gradient was observed for exposure in the past 12 to 21 years, but this result seemed to be sensitive to cut points for categorization of cumulative exposure. These data do not provide evidence for an association between occupational sunlight exposure and mortality from NHL or NHL subtypes.

Heat exposure: Bates, Gazey and Cena (1996) presented factors affecting heat illness when working in conditions of thermal stress in Australia. In hot working conditions, high sweat rates with excessive loss of body fluids may result in dehydration and electrolyte imbalance. It is well established that dehydration and/or electrolyte disturbances will impair work performance, and, if prolonged or severe, can pose a serious risk to health. The lesser condition of hypohydration is undoubtedly widespread in the workplace, and may be indirectly responsible for less than optimal performance and workplace accidents. With the aid of a new sweat collection method, fluid and electrolyte loss from a population of male workers with varying fitness and body composition has been documented. This has provided the basis for prescribing guidelines of fluid replacement when working in the heat. In addition, the minimum duration of heat exposure required to trigger heat acclimatisation was sought using sweat sodium as an indicator. The ability to predict the susceptibility of an individual to fluid and electrolyte disturbances cannot be made from age, body composition, ethnicity or VO2max, although a high VO2max appears to enhance heat tolerance. Sodium loss in sweat varies greatly and is not significantly related to sweat rate. Acclimatization results in a significant decrease in sweat sodium and increased sweat rate during summer compared with winter. This advantageous physiological adaptation requires a minimum of 9 h of heat exposure to initiate.

Beaumont et al. (1995) attempted a historical cohort investigation of spontaneous abortion in the Semiconductor industry. The study covered those female employees who had worked for at least 6 months and aged between 18 and 44 years during 1986-89. It included all fabrication-room (fab) employees and an approximately equal number of nonfabrication (nonfab) employees, in a total sample of 7,269. Telephone interviews with 6,088 women (84%) identified 904 eligible pregnancies and 113 SABs. Exposure classification was based on questionnaire and industrial hygiene assessments of tasks the women performed during the first trimester of pregnancy. Using logistic regression to control for age, smoking, ethnicity, education, income, year of pregnancy, and stress, we found a higher risk of SAB in fab employees than in nonfab employees (15.0% of fab pregnancies ended in SAB vs. 10.4% of nonfab pregnancies, adjusted relative risk (RR = 1.43, 0.95-2.09). Analysis of fab work groups showed that the highest relative risk was in masking employees (17.5% SAB rate, adjusted RR = 1.78, 1.17-2.62 in comparison with nonfab employees). Within masking, the highest risk was found in etching-related process employees (22.2% SAB rate, adjusted RR = 2.08, 1.27-3.19 in comparison to nonfab employees).

Radiation: Tekkel et al. (1997) examined radiation effects on Estonia male workers aged 20-39 years who were sent to Chernobyl to assist in the cleanup activities after the reactor accident. A cohort of 4,833 cleanup workers was assembled based on multiple and independent sources of information. Information obtained from 3,704 responses to a detailed questionnaire indicated that 63% of the workers were sent to Chernobyl in 1986; 54% were of Estonian and 35% of Russian ethnicity; 72% were married, and 1,164 of their 5,392 children were conceived after the Chernobyl disaster. The workers were less educated than their counterparts in the general population of Estonia, and only 8.5% had attended university. Based on doses entered in worker records, the mean dose was 11 cGy, with only 1.4% over 25 cGy. Nearly 85% of the workers were sent as part of military training activities, and more than half spent in excess of 3 months

in the Chernobyl area. Thirty-six percent of the workers reported having worked within the immediate vicinity of the accident site; 11.5% worked on the roofs near the damaged reactor, clearing the highly radioactive debris. The most commonly performed task was the removal and burial of topsoil (55% of the workers). Potassium iodide was given to over 18% of the men. The study design also incorporates biological indicators of exposure based on the glycophorin; a mutational assay of red blood cells and chromosome translocation analyses of lymphocytes; record linkage with national cancer registry and mortality registry files to determine cancer incidence and cause-specific mortality; thyroid screening examinations with ultrasound and fine-needle biopsy; and cryopreserved white blood cells and plasma for future molecular studies.

Pesticide and Chemical Poisoning: Klein-Schwartz and Smith (1997) undertook a comprehensive analysis of morbidity and mortality from poisoning by agricultural and horticultural chemicals in the United States. It included descriptive analysis of national mortality data, National Hospital Discharge Survey data, and American Association of Poison Control Centers national data for 1985 through 1990. There were 341 fatalities from agricultural and horticultural chemicals over the 6-year period, of which 64% were suicides, 28% were unintentional, and 8% were of undetermined intent. There were 25,418 hospitalizations; 78% were reported to be unintentional. Both deaths and hospitalizations occurred more frequently in males, and rates were higher in nonwhites than in whites. There were 338,170 poison exposures reported to poison centers for fungicides, herbicides, pesticides/ insecticides, and rodenticides. Life-threatening manifestations or long-term sequelae occurred in 782 cases, and 97 deaths were reported. Pesticides and insecticides accounted for 72% of the poison center cases and 63% of the fatalities. Although they accounted for only 8% of poison exposures, herbicide deaths were disproportionately high (25%). Poisonings with agricultural and horticultural chemicals are an important public health problem. Prevention efforts need to incorporate the fact that many serious cases, such as paraquat poisonings, are suicidal in nature.

Morgan, Lin and Saikaly (1980) presented morbidity and mortality in workers occupationally exposed to pesticides. Utilizing cause-of-death information and responses to questionnaires addressed to survivors, mortalities and health impairments in a cohort of workers occupationally exposed to pesticides were compared to occurrences in workers not pesticide exposed, over the period 1971-1977. Seventy-two percent of 2,620 pesticide-exposed workers, and 75% of 1,049 "controls", recruited in 1971-73, were accounted for either by returned questionnaire or mortality. Disease incidence rates were studied in relation to broadly defined occupational subclasses, and to serum concentrations of organochlorine pesticides (OCl) measured at the time of recruitment. Death by accidental trauma was unusually frequent among pesticide applicators. Mortalities from cancer and arteriosclerosis were not detectably different from those observed in the controls. Among survivors, dermatitis and skin cancer were unusually common in structural pest-control operators. Internal cancer was no more frequent in the intensively pesticide-exposed workers than in the controls, but it appeared to occur at an unusually high rate in workers characterized as "possibly pesticide-exposed". There were apparent associations between high serum pesticide OCl levels measured in 1971-73 and the subsequent appearance of hypertension, arteriosclerotic cardiovascular disease, and possibly diabetes. This could imply a causal role of any of the pesticidal and other environmental stresses to which these workers were exposed.

Conrad et al. (1998) investigated the prevalence of the 16/6 idiotype (genetic sub-group) (16/6 Id), a major cross reactive idiotype of anti-DNA antibodies involved in the pathogenesis of experimental lupus, in subjects with an exogenous risk for the development of systemic lupus erythematosus (SLE). The titer of 16/6 Id was determined by ELISA in sera of uranium miners exposed to heavy quartz dust: 15 developed definite and 12 probable SLE, 34 had clinical symptoms, and 27 had only serological signs (medium to high titer anti-dsDNA antibodies) of

possible connective tissue disease (CTD) development. The prevalence of 16/6 Id was higher in all groups compared to healthy blood donors. It was 18.5% in miners with SLE (definite and probable) and 22.2-26.5% in miners with clinical and/or serological signs for developing CTD. All 16/6 Id positive miners were positive for anti-dsDNA antibodies and other autoantibodies associated with CTD. The prevalence of 16/6 Id in anti-dsDNA positive miners correlated slightly with CTD/SLE symptoms: 55.6% in patients with SLE, 47.4% in miners with possible CTD/SLE, and 22.2% in miners without CTD symptoms. Further, at short term follow-up, disease progressed in 2 miners of the 16/6 Id positive, but not in 16/6 Id negative miners. The study concluded that the detection of 16/6 Id in miners exposed to quartz dust may indicate a higher risk for development of SLE, warranting further studies of the role of 16/6 Id in the development of SLE in a cohort with the same sex, ethnicity, geographic region, and occupation.

A1.6 HEARING AND VISION IMPAIRMENTS

Ishii and Talbott (1998) studied race/ethnicity differences in the prevalence of noise-induced hearing loss. This retrospective study covered 216 white and 70 non-white male metal fabricating workers. Significant variables associated with race/ethnicity were mean years of employment and proportion of time worked without hearing protection. Among whites, the permanent threshold average for 1, 2, 3 and 5 kHz was 25.99 dB, compared with 17.71 dB in non-whites ($P < 0.01$). Backwards stepwise regression indicated that race/ethnicity, after being adjusted for years of employment, was the major-effect variable. The results of this study suggest that occupational noise exposure alone does not alone account for the racial hearing differences.

Phoon, Lee and Chia (1993) studied the prevalence and characteristics of tinnitus in 647 noise-exposed workers who had been notified as cases of noise-induced deafness. Of these 151 workers (23.3 per cent) had tinnitus. The tinnitus was bilateral in 42.4 per cent of cases, and of high frequency in 44.4 per cent. In 23.8 per cent it was associated with other symptoms. About 30 per cent of those with tinnitus complained that it interfered with daily activities like telephone conversation and sleep. The workers with tinnitus had consistently higher hearing thresholds at both high and low frequencies than with those having no tinnitus. This finding remained even after adjusting for differences in sex, age and ethnic group composition and in the noise exposure duration. Workers are often told that noise exposure causes deafness, but little is mentioned about tinnitus. Awareness of the possible occurrence of tinnitus may encourage workers to cooperate more actively in a company hearing conservation programme.

Fallas et al. (1992) investigated impairment of colour vision exposed to styrene among 60 men aged 20 to 56 years (mean 29.5) employed in the shipbuilding. Exposure was due to the handling of glass reinforced polyester materials. The study was cross sectional and the workers were compared with a control group matched for age, social and occupational state, and ethnic origin. During the study, the mean atmospheric exposure to styrene was 24.3 ppm. Mean urinary elimination was 230 mg/g creatinine for mandelic acid and 57.4 mg/g creatinine for phenylglyoxylic acid. The Farnsworth 100 hue test showed no significant differences between the exposed and control groups for error scores. A significant difference was found, however, for the number of subjects with errors axis in the red-green, or blue-yellow ranges, or both, which was larger among the exposed workers (32/60 v 20/60 for the controls ($p < 0.05$)). Psychometric tests were also conducted, using the WHO neurobehavioural core test battery. Of the seven tests it included, anomalies were only found for the aiming test. These results suggest that exposure to moderate styrene concentrations of the order of 25 ppm can lead to impairment of colour vision.

Royster et al. (1978) examined issues related to potential hearing compensation cost by race and sex. A large general industrial population (n = 10,000) was analyzed using different low fences (15 bB HTL to 35 dB HTL) with the high fence held constant at 93 dB HTL. Three different audiometric test frequency combinations considered were: HTL.5,1,2 kHz, HTL.5,1,2,3 kHz and HTL1,2,3 kHz. The data was analyzed for the total population and for four sub-populations - black males, black females, white males and white females. The findings indicate that significant differences exist between the groupings with respect to the potential hearing compensation cost and percentage of population exceeding the different low fence frequency combinations.

A1.7 DIABETES, HYPERTENSION, CHD

Three papers dealing with diabetes, hypertension and CHD have noticed marked ethnic differences in hypertension rates (lower for ethnic minorities) and diabetes control (poorer for ethnic minorities).

Metcalf et al. (1993) examined the prevalence of microalbuminuria in a mixed, ethnic population and investigated the extent to which ethnic variation in microalbuminuria can be explained by abnormal glucose metabolism, obesity, hypertension, hypertriglyceridemia, and life-style factors. Urinary albumin concentrations were measured in 5467 middle-aged Maori, Pacific Islander, and European workers who participated in a health-screening survey of 46 New Zealand companies. Participants provided a first-voided, morning urine sample; had a 75-g oral glucose tolerance test; had weight, height, and blood pressure measured; and completed a self-administered questionnaire about past medical history and sociodemographic status. A significantly higher prevalence of microalbuminuria was found in individuals with new cases of diabetes mellitus (24.1%), in cases of diabetes mellitus previously diagnosed (20.6%), and in those with impaired glucose tolerance (16.1%) compared with non-diabetic individuals (4.0%). Moreover, in the general population, a piecewise linear relationship was detected between albuminuria and plasma glucose with significant changes of slope corresponding with 2 h plasma glucose concentrations (95% confidence interval) of 6.7 (6.4-7.0) and 9.2 (8.6-9.8) mM, respectively. After adjusting for sex, obesity, hypertension, hypertriglyceridemia, cigarette smoking, and heavy alcohol consumption in a multivariate model, glycaemia was the most significant determinant of urinary albumin concentrations in all three ethnic groups. However, blood glucose concentrations did not completely explain the higher relative risk (95% confidence interval) of microalbuminuria in Maori (5.97; 4.48-7.78) and Pacific Islander (5.33; 4.13-6.87) workers compared with European workers. Of the variables investigated, hyperglycemia was the most important factor explaining the high prevalence of microalbuminuria in Maori and Pacific Islander workers compared with the European workers. However, only 14.9% of the variation in urinary albumin concentrations was found in our multivariate model, quite likely there would be effects of excluded factors such as diet and coexisting renal diseases.

Green and Peled (1992) presented prevalence and control of hypertension in a large cohort of occupationally active Israelis. Between 1985 and 1987, blood pressures were measured and interview data obtained on awareness and treatment of hypertension in a sample of 3677 male and 1573 female employees in 21 Israeli industries. In the age group 35-64 years, the age-standardized prevalence of hypertension (greater than or equal to 160/95 mm Hg or treated) using the same standard population as the WHO MONICA Study was 17.1% for men and 16.1% for women. The prevalence for men was somewhat below the median country compared with the MONICA centres, whereas for women it was closer to the median. Marked ethnic differences were evident, with those of Western origin having the highest prevalence, and those of Asian origin, the lowest. Of the hypertensives, 35.6% of the men and 33.3% of the women

were unaware of their condition. Among men aware, 82.8% were receiving treatment and 59.8% of them were under control; the corresponding percentages for women were 86.2% and 72.8%. Older people were more likely to be aware of their hypertension and receiving treatment. Beta-blockers and diuretics were the predominant drugs of choice.

Sparacino et al. (1982) investigated blood pressure of male municipal employees to explore the effects of job status. Repeated measurements of resting blood pressure and heart rate were obtained at the worksite for a sample of 441 male municipal employees ranging widely in age (M = 41 yr.), job level, and education. As a result of unusually high diastolic values (M = 91), over-all uncontrolled hypertension rates were very high (33% of the men exceeding 160 systolic or 95 diastolic including those on medication). Higher rates were obtained for blue collar as opposed to white collar employees and for those plant workers in the Division of Water as opposed to Sewerage and Drainage. Net of age, weight, smoking, education, and anti-hypertensive medication use, higher systolic and diastolic mean values were obtained for supervisors who were primarily employed as foremen and clerical personnel. Inter-plant differences in blood pressure were also found for primarily blue collar Sewers and Drains employees, though whites' and blacks' values were nearly identical. Comparisons with national blood pressure data indicate significant effects for level of job and education which again disfavored supervisors and clerical employees and in addition men who had more education. Whites' and blacks' blood pressures deviated significantly from expected values, the differences favouring blacks. Social psychological mechanisms which may mediate these effects were discussed.

A1.8 INFECTIONS: TUBERCULOSIS, HEPATITIS A, B OR C AND HIV

Two papers discussed risk of tuberculosis in farm workers and healthcare staff. UK study implies that TB remains a hazard for healthcare workers and highlights the importance of occupational health monitoring and protection of workers. Nine papers have pointed out the danger and higher risks of Hepatitis A, B and C and HIV infection among healthcare staff including dental professionals and anesthetists. The incidence is reported to be higher for women, to increase with years of medical service, to be higher among nurses and non-professional staff than among physicians, and to differ significantly among ethnic groups. Waste water and sewage workers are also identified as a further high-risk group for hepatitis infection.

Tuberculosis in healthcare staff and farm workers: Meredith et al. (1996) explored whether healthcare workers in England and Wales are at increased risk of tuberculosis and what is the level of drug resistance in the population. Comparison of notification rates by occupation obtained from national tuberculosis notification surveys in 1988 and 1993, with denominators from the 1991 census. It covered people with notified tuberculosis in professional and associate professional occupations from the two surveys. Rates of notified tuberculosis in health professionals (mainly doctors) and health associate professionals (mainly nurses) compared with rates in other professional and associate professional occupations, adjusted for ethnic group, sex, and age. The crude notification rate in healthcare workers was 11.8 per 100,000 per year compared with 3.3 per 100,000 per year in other professional and associate professional occupations; rate ratios were higher (range 1.7 to 3.2) in all ethnic groups. The relative risk adjusted for ethnic group, sex, and age was 2.4 (CI 2.0 to 3.0), slightly higher for health professionals (2.7 (1.9 to 3.8)) than for associate professionals (2.0 (1.5 to 2.6)). No multiple drug resistant strains of tuberculosis were identified in healthcare workers. The study concluded that better detection and notification of cases of tuberculosis in healthcare workers may account for some of the apparent increased risk, but these findings imply that tuberculosis remains a hazard for healthcare workers and highlight the importance of ensuring that occupational health

monitoring and protection workers are not neglected. Advisory Council for the Elimination of Tuberculosis (1992) observed that the farm workers are approximately six times more likely to develop tuberculosis (TB) than the general population of employed adults. It submitted detailed recommended on the prevention and control of tuberculosis in migrant farm workers so as to assist healthcare providers serving migrant and seasonal farm workers. It also emphasised the importance of drug-resistant TB and flexibility in consideration of altered treatment regimes due to higher rates of resistance observed in ethnic and social groups comprising much of the migrant farm workers. It suggested that the patients should be placed on directly observed therapy given by a well-trained, outreach worker from the same cultural and language background as the patients.

Healthcare Staff: Sermoneta-Gertel et al. (2001) assessed Hepatitis c virus (HCV) infection in employees of a large university hospital in Israel. Of all 5,444 eligible employees (18-65 years old) 4,287 (79%) participated in the survey. Sera were tested for antibodies to HCV (anti-HCV) using a third-generation enzyme immunoassay. A third-generation strip immunoblot assay was used for confirmation. Participants were interviewed regarding their occupational history, and they completed a self-administered questionnaire covering history of non-occupational exposure to blood and country of birth. Anti-HCV was found in 0.9% of employees, ranging from 0.1% among those born in Israel to 5.7% among those born in Central Asia. After age, gender, social status, country of birth, and history of blood transfusion were controlled for in a logistic regression, occupational exposure to blood > or = 10 years was significantly associated with the presence of antibodies (OR, 2.6; P<.01). Presence of anti-HCV also was associated with country of birth (range: Israel OR, 1; West OR, 3.8 [P<.1]; Central Asia OR, 48.6 [P<.0001]) and history of blood transfusion (OR, 2.7; P<.01). No significant associations were found between anti-HCV and age, gender, social status, history of tattoo, acupuncture, current occupation, department, exposure to blood in current occupation, adherence to safety precautions, or history of percutaneous injury. The association with length of exposure was stronger (OR, 3.6; P<.01) when the same logistic regression was run excluding the outlier ethnic group of Central Asia.

Lerman et al. (1999) undertook the study to identify occupations at risk for hepatitis A (HAV) infection and to determine their relative risk. In this nationwide historical prospective study, the relative risk of HAV among different occupations in Israel was determined according to the HAV incidence in different occupations during 1993-94 compared with the incidence in two standard populations. After age, gender, ethnicity, and time of immigration to Israel were controlled for, certain occupations showed a significant increased risk of hepatitis A: yeshiva students (standardized incidence ratio (SIR) = 9.98, 99% CI: 7.55, 13.18), day care center and kindergarten staff (SIR = 5.47, 99% CI: 3.50, 8.57), food industry workers (SIR = 5.41, 99% CI: 1.92, 15.25), teachers (SIR = 4.02, 99% CI: 2.92, 5.48), physicians and dentists (SIR = 3.77, 99% CI: 1.78, 8.14), and therapists and medical technicians (SIR = 3.75, 99% CI: 1.75, 8.14). Sewage workers and nurses did not show any significantly increased risk. The results were validated by comparison with an additional standard population.

Hakre et al. (1995) estimated the prevalence of hepatitis B virus (HBV) among health care workers in Belize, Central America. Of the 330 workers tested, 94 (29%) were positive for antibody to HBV core antigen (anti-HBc) and three (1%) had HBV surface antigen. The presence of anti-HBc increased significantly with age from 12% in those 18-24 years old to 52% in those > or = 50 years old. The rate was 17% of 48 men compared with 30% of 282 women (P = 0.05). Rates increased with years of medical service and were higher among nurses (69 of 228; 30%) and nonprofessional staff (15 of 44; 34%) than among physicians (0 of 20). The presence of anti-HBc also differed significantly among ethnic groups: Mestizo, 4%; Creole, 33% and Garifuna, 57%. Rates differed by district ranging from 3% in a northern district (mostly Mestizo) to 67% in a southern district (mostly Garifuna). Parental exposure to hepatitis B through needle stick injuries and blood transfusions was not associated with anti-HBc.

Multiple logistic regression analysis confirmed ethnicity, district of residence, and age as the best predictors of anti-HBc in health care workers. Cost analysis suggests that because of regional differences in exposure, testing of health care workers for anti-HBc in the Belize and Stann Creek districts in southern Belize before hepatitis B immunization would result in vaccine program cost savings.

Askari and Alexander (1989) studied AIDS issues among the minority health care worker. Large groups of health care workers, many of whom are among ethnic minorities with potential for occupational exposure to HIV/HBV, are generally underserved in training on prevention of occupational transmission of the viruses. The inadequacy of training for indirect client care personnel appears to be one of the primary reasons for high rates of needlestick injuries and exposure to blood. Training in appropriate infection control techniques can help reduce the uneasiness and fear among health care workers over occupationally-related HIV/HBV transmission.

Windsor et al. (1984) presented prevalence of hepatitis B in nurses and domestic staff in South Africa. Results obtained in two sero-epidemiologic surveys of hospital personnel in Durban were collated to yield information on 423 nurses and 141 domestic staff. The prevalence of antibodies to HBV was 14.9 per cent in 101 white nurses, 52.5 per cent in 322 African nurses and 51.8 per cent in 141 African domestics. This represents a greater than eight times increase for white nurses and a 50 per cent increase for African nurses and domestics over that seen in the equivalent blood donor groups ($p< 0.001$ in each case). Antibody prevalence increased with age for all three staff groups, as did the number of individuals exhibiting a marker pattern (HBcAb greater than HBsAb) suggestive of persisting infection. No white nurses but 14 (4.3 per cent) African nurses and 17 (12.1 per cent) African domestics were HBsAg positive, the antigenaemia in domestics representing a significant increase ($p< 0.001$) over the 4.0 per cent seen in female African blood donors. Six of the nurses and two of the domestics were also HBeAg positive. African nurses in adult medical wards showed greatest exposure (57 per cent) closely followed by nurses working in outpatient departments (54 per cent) and as theatre staff (52 per cent). Lower exposure rates (40 per cent) were seen in pediatric and renal unit nurses. This contrasts with results obtained for doctors in the two surveys which indicated that while Indian and white doctors are at significantly higher risk in the African hospital, African doctors are not, and that doctors working in surgical and renal departments are at higher risk than doctors on adult medical wards.

Dental professionals: Noble et al. (1991) studied Hepatitis B and HIV infections in dental professionals in Canada. In a survey carried out in 1987 and 1988 in Vancouver British Columbia, 704 dental professionals filled out an anonymous questionnaire and submitted a blood sample. Of those not immunized, 11% had infection with Hepatitis B, with dentists having a rate of 18%, significantly higher than other dental workers. Two carriers of HBsAg were detected and no individuals showed evidence of HIV infection. There were no differences in infection rates by the specific infection control practices. Oriental dental-care workers had a significantly higher rate of infection than other races surveyed. In a multivariate model, race and the number of years in practice were the only significant factors in predicting infection. The use of gloves did not show a protective effect, although a threefold protection rate for gloves is the smallest difference that could be reliably detected. The immunization rate with Hepatitis B vaccine averaged 46%, with fewer dentists being immunized than hygienists. Seroconversion rates were lower in older individuals. Dental professionals had a high risk of Hepatitis B and had not been adequately immunized. Reliance on gloves for operator protection appears to be inadequate.

Mori (1984) presented the status of viral hepatitis among dentists and other dental personnel. Viral hepatitis is a major public health problem, occurring endemically in all areas of the world. The prevalence of the disease is influenced by numerous factors which may be able to modulate its onset. Study of the epidemiology of viral hepatitis in different geographical, ethnic, social and genetic groups as well as immunological and individual factors has contributed much to our understanding of the disease. Hepatitis viruses are classified into A (infectious hepatitis), B (serum hepatitis) and non-A, non-B. The transmission of hepatitis B virus (HBV) is a potential hazard in dental practice. A number of reports suggest a significantly higher incidence of hepatitis among dentists than in the general population and also higher rates of hepatitis in certain specialists, especially oral surgeons, periodontists and endodontists, than in general dentists. Vectors of infection with HBV in dental practice are blood, saliva and nasopharyngeal secretions. The incidence of hepatitis B in dental practitioners is influenced by the exposure to infection, the type of practice, the number of years of professional experience, and antibody response. HBV may be spread by dentists and dental students, by dental auxiliaries and by other personnel closely associated with clinical practice, who are antigen positive carriers but have no clinical symptoms. Therefore, dentists and their staff should know well the risk of infection from their patients, the risk of cross-infection between patients, and the risk of infecting each other.

Chernesky, Browne and Rondi (1984) estimated Hepatitis B virus antibody prevalence in anaesthetists in Canada. The prevalence of antibodies to hepatitis B virus (anti HBs or anti HBc) was 16.9 per cent in a group of anaesthetists, compared to 3.7 per cent in volunteer blood donors and 5.6 per cent of patients without hepatic infections. Professional risk factors such as treating a hepatitis B patient or working in a hospital laboratory, haemodialysis, an intensive care unit, or in oncology, did not correlate with antibody prevalence. Personal risk factors such as a history of a family member with hepatitis, or of receiving blood transfusion in the past were also not associated. A greater number of anaesthetists with a history of hepatitis in the past had antibodies, than those with no history (p less than 0.05). The country of origin may have been a contributing factor to antibody prevalence as highest positivity rates were found in subjects from Asia, Africa and Eastern Europe. Results of testing in 1978 and 1982 revealed that 37 per cent of immune subjects possessed only anti HBc and at least one person positive for both markers on the first occasion was only anti HBc positive later. Laboratory testing, risk factors, and immunization for HBV should be examined in greater detail in larger populations of health care workers.

Wastewater workers: Weldon et al. (2000) estimated the prevalence of antibody to hepatitis A virus (HAV) in drinking water workers and wastewater workers in the USA from 1996 to 1997. A total of 359 wastewater and 89 drinking water workers participated in the study. Anti-HAV positivity was 28.4% for wastewater and 23.6% for drinking water workers. After adjustment for age, educational attainment, and Hispanic ethnicity, the odds ratio for the association between anti-HAV positivity and wastewater industry employment was 2.0 (95% CI: 1.0 to 3.8). Among wastewater workers, never eating in a lunchroom, 8 or more years in the wastewater industry, never wearing face protection, and skin contact with sewage at least once per day were all significantly associated with anti-HAV positivity in a model that adjusted for age and educational attainment. Wastewater workers in this study had a higher prevalence of anti-HAV than drinking water workers, which suggested that wastewater workers may have been at increased risk of occupationally acquired hepatitis A. Work practices that expose workers to wastewater may increase their risk.

A1.9 INFLAMMATORY BOWEL DISEASE

Cucino and Sonnenberg (2001) presented occupational mortality from inflammatory bowel disease (IBD) in the United States during 1991-1996. The numbers of deaths from Crohn's disease and ulcerative colitis were retrieved from the computerized 1991-1996 data files of the National Center for Health Statistics. Deaths were grouped by gender, ethnicity, disease type, occupation, and industry. Mortality by occupation and industry were expressed as proportional mortality ratio (PMR), adjusted for gender and ethnicity. Between 1991 and 1996, 2399 subjects died from Crohn's disease and 2419 subjects died from ulcerative colitis. Significant correlations were found between the PMR values of ulcerative colitis and Crohn's disease regarding their distribution by occupation, $r = 0.36$ and $p < 0.05$, as well as by industry, $r = 0.37$, $p < 0.01$. IBD mortality by occupation was significantly reduced among farmers (PMR: 70, 95% CI: 42-97), mining machine operators (31, 95% CI: 0-74), and labourers (71. 95% CI: 45-98). A non-significant increase was found among sales persons (117, 95% CI: 95-139) and secretaries (122, 95% CI: 83-161). IBD mortality by industry was significantly reduced in agricultural production of livestock (39, 95% CI: 1-78), mining (46, 95% CI: 9-83), grocery stores (55, 95% CI: 17-94), and work in private households (64, 95% CI: 30-97). A non-significant increase was found in food production (128, 95% CI: 74-182), investment and insurance business (137, 95% CI: 77-198), and administration (122, 95% CI: 81-163). IBD mortality is low in occupations associated with manual work and farming and relatively high in sedentary occupations associated with indoor work. Crohn's disease and ulcerative colitis show a similar distribution.

A1.10 KIDNEY, URINARY, RENAL DISEASES

Kristal-Boneh, Goffer and Green (1994) examined the prevalence of urolithiasis (i.e. kidney stones) in 5574 men and women employees in 21 industrial plants in Israel who were screened for cardiovascular risk factors between 1985 and 1987. Among the data gathered were previous physician diagnosis of urolithiasis and ergonomic and demographic data. Urolithiasis was much more frequent in men than in women (age-adjusted prevalence of 4.5% in men and 1.2% in women, $p< .0001$). Older subjects had higher prevalence than young subjects. There were ethnic differences, and the highest prevalence was in subjects of European origin. Of the occupational factors, only industrial sector was related to prevalence of urolithiasis particularly among employees in wood industries ($p < .05$). The study concluded that to determine the cause and magnitude of the association of wood industries with increased prevalence of urolithiasis, ergonomic and chemical factors should be investigated.

Harrington et al. (1989) studied the relationship between exposure to occupational organic solvents and diseases of the kidney - particularly malignancy and glomerulonephritis. Two case referent studies were undertaken in the West Midlands to investigate these possibilities. In the case of renal cancer 54 live cases of biopsy proved adenocarcinoma of the kidney were compared with an equal number of community based healthy referents matched for age, sex, place of residence, and socioeconomic and ethnic grouping. For glomerulonephritis, 50 biopsy proved cases were matched in the same manner with 50 referents. Fourteen other patients were also reviewed who, on biopsy, proved not to have glomerulonephritis. For both sets of cases and their referents each individual was interviewed and a detailed account obtained of medical history and environmental exposures. Exposure to solvents was assessed independently and "blind" in a semi-quantitative way by an experienced occupational hygienist. Past exposure was estimated for 10 different solvent types and 17 material types. No relation was found between exposure to solvents and renal cancer or glomerulonephritis. In the case of renal cancer the numbers studied only precluded a fourfold excess risk. For glomerulonephritis, the study, although methodologically superior to most other published studies and of similar size, was of similar power to the renal cancer investigation.

Chan et al. (1987) investigated the degree of leptospirosis risk in 80 sewer and 120 public cleansing workers in Singapore. They were interviewed and their serum samples tested for the presence of leptospiral antibodies by the sensitised erythrocyte lysis (SEL) test. Another 100 control subjects matched by sex, age and ethnic group were similarly studied. The study subjects had higher seroprevalence than the controls - over six times higher for SEL titres of greater than 1:100 and over 1.5 times for titres of greater than 1:25. The highest seroprevalence was found in workers cleaning wet markets and food centres. There was no significant correlation between the prevalence of positive titres and symptom prevalence or hospitalisation. Five of the study subjects (all sewer workers) gave a history of jaundice.

A1.11 NEUROBEHAVIOURAL, EYE, MENTAL DISEASES

Broadwell et al. (1995) undertook neurobehavioral assessment of solvent-exposed microelectronics workers. Twenty-five workers, five currently and 20 formerly involved in the manufacture of hybrid microcircuits, underwent clinical evaluations at the request of a management-union committee concerned about chronic solvent exposures in a research and development laboratory. A battery of neurobehavioral tests was administered to compare the solvent-exposed group with 32 age, gender, ethnicity, and education matched controls. The tests included: MMPI-I, hand grip strength, tactile sensitivity, dexterity, color discrimination, visual acuity and contrast sensitivity, and tests selected from the computerized Neurobehavioral Evaluation System (NES2). Clinical narratives and retrospective exposure assessments in the study group suggested chronic low-level exposure to solvents, with intermittent acute excursions. Work-related diagnoses included upper respiratory mucosal irritation and sinusitis (44%), lower respiratory reactive airway disease (12%), and dermatitis (5%). Three workers (12%) had findings consistent with a solvent-induced encephalopathy. Significant differences (after Bonferroni correction) were found between the two groups on 5 of 11 NES sub-tests: symptom scale, mood scale, finger tapping, simple reaction time, and symbol-digit substitution. Differences also reached significance for overall vibration sensitivity thresholds, visual contrast sensitivity, and grip strength. The MMPI average clinical scale elevation was significantly higher in the exposed group than controls. These results support an association between chronic low-dose solvent exposure and measurable neurobehavioral changes.

Chia et al. (1993) studied neurobehavioural effects on workers in a video tape manufacturing factory in Singapore. The workers were exposed to mixed solvents consisting of methyl ethyl ketone (MEK), cyclohexanone (CHE), tetrahydrofuran (THF), and toluene (TOL). Nineteen exposed workers out of the workforce of forty-five were studied. Twenty-six workers (with no exposure) matched for ethnic group, age, and years of education served as controls. Eight-hour personal environmental samples were analyzed for the 19 workers along with symptom questionnaires, clinical examinations, and neurobehavioural tests including the Santa Ana Dexterity, Finger Tapping, Digit Span, and Visual Reproduction tests. The mean TWA concentrations for MEK, THF, CHE, and TOL were all below the current American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLV). However, the total solvents concentration index exceeds unity in one of the work areas. Significant differences were observed for prevalence of headache, and eyes and nose irritation among the exposed workers. There were also significant differences for the Santa Ana test for both-hands, Digit Span test and Visual Reproduction test. However, no dose-effect relation between behavioral scores and airborne solvent exposure was noted. The study suggested that solvent-exposed workers in video tape manufacturing plants may have poorer visual motor control and recent memory impairment (visual and verbal) than unexposed workers. Dermal absorption of solvents may have played a role in these results by increasing workers exposure.

ANNEX 2
SUMMARY OF SELECT ARTICLES ON OCCUPATIONAL INJURIES / DISEASE / ILL-HEALTH FOR LITERATURE REVIEW

Study Focus (General/ Occupation/ Industry/ Condition Specific) (author)	Country of Study	Publication year	Study Type (epidemiological, routine data, population survey, prospective, over time/ cross-section)	Ethnic groups/ Migration Status	Key findings/conclusions	Attributes/ Remarks	Issues
I. General Pattern							
Work-related Health Conditions and injuries **(Park et al. 1993)**	US	1993	National Health Survey	Race/ethnicity	It presents national estimates of prevalence and incidence of selected health conditions and their work-related consequences among currently employed persons 18 years of age and over by ethnicity. The major health conditions presented include back pain; hand discomfort; dermatitis; eye, nose, and throat irritation; and work injuries. Also presented are estimates of the distribution of workers on selected physical activities and exposures at work.	Gender, age, education, occupation groups	Policy
General - differentials **(Murray 2003)**	US	2003	Routine data	Race/ethnicity	Reviews the evidence about workers of colour and occupational injuries and disease. Patterns of employment in the U.S. workforce according to education, gender, and race/ethnicity are discussed, and how these patterns might cause disproportionate exposure leading to disproportionate disease and injury. Methodological issues are explored that have hampered research about occupational health disparities	Education, sex, occupation	methodological, policy, future research work
Health of South Asians **(Williams, Bhopal and Hunt 1993)**	UK, Glasgow	1993	Cross-sectional survey	South Asian/General population	The study found relatively fewer accidents and long term illnesses among South Asians. South Asians were consistently disadvantaged only in terms of anthropometric measures. Otherwise, the many differences were balanced, with disadvantage being	sex	

					concentrated only among South Asian women. The health gap between sexes in South Asians seems higher than in the general population. The findings show patterns of health in the fourth decade of life which are consistent with patterns of hospital admission and mortality documented in the published reports.	
Exposure to Occupational Hazards **(Robinson 1990)**	US, California	1989	Routine data, 1986	Hispanics/ Blacks/ non-Hispanic whites	Relative risks of exposure to each of six types of occupational injuries and illnesses for Hispanic and Black workers compared to Whites who are not Hispanic were calculated. Among males, Hispanics faced relative risks of exposure to all hazards adjusted for education and years of work experience of 1.33, while Blacks faced relative risks of 1.17. Among females, adjusted relative risks were 1.19 for Hispanics and 1.31 for Blacks.	
Health risks among Males -Navy **(Palinkas and Colcord 1985)**	US	1985	Hospitalisation records, 1974-79	Black/ Caucasian	Results indicated that total disease incidence among Black males has declined in the past decade, with a reduction in total first hospitalisations from 1652 per 10,000 men in 1974 to 1088 per 10,000 men in 1979. Total incidence rates for Caucasian males in the same period declined from 1347 per 10,000 men to 1100 per 10,000 men. However, Blacks were found to be at significant risk for: mental disorders; diseases of the genitourinary system; diseases of the circulatory system; diseases of the digestive system; diseases of the blood and blood-forming organs; symptoms and ill-defined conditions; supplementary classifications; and diseases of the musculoskeletal system. Caucasians had significant higher incidence rates for diseases of the skin and subcutaneous tissue, and accidents, poisonings and violence. The populations of Blacks and Caucasians in the Navy are not uniform with respect to disease incidence. There exist numerous subgroups within either racial group, defined on the basis of certain demographic and social characteristics, which are at risk for particular diseases. The relationship between race	Demographic, socio-economic

					and disease is mediated by several factors, including genetic predisposition, socio-economic status and cultural patterns of belief and behaviour. No single factor can account for the excess risk for all diseases among all members of either racial group.		
Mortality by cause - Fire fighters **(Musk et al. 1978)**	US, Boston	1978	Death certificates of 2470 deceased firefighters	ethnicity	The standardised mortality ratio (SMR) was markedly reduced (less than 50) for infectious disease, diabetes, rheumatic heart disease, chronic nephritis, blood diseases and suicide. The SMR was 86 for cardiovascular deaths, 83 for neoplastic deaths, and 93 for respiratory deaths. The SMR for accidents was 135 for active firefighters. The results suggest that the survival experience of firefighters is strongly influenced by strict entry selection procedures, ethnic derivation, and sociocultural attributes of membership. While excessive morbidity has been demonstrated in firefighters, there does not appear to be a strong association between occupation and cause-specific mortality.		
Health - Immigrants-Hazards at Work place **(Bourdillon et al. 1991)**	France	1991	Descriptive	Immigrants/ Natives	In France, 8% of the population are foreigners. They come from the lowest socio-economic level. Foreign workers are found in unskilled work and in jobs where they are constantly subjected to hazards of the workplace, occupational health risks and accidents. The quality of maternal and child health care among foreign women is lower than among the French. Foreign children are hospitalized more often and for longer than French children. Restrictions on the opportunities for enjoying certain social rights, administrative and financial obstacles encountered and difficulties in communication all make it harder to meet the needs of this section of the population.		Social policy
Health conditions - Working Women **(Wagener et al. 1997)**	US	1997	Various National Surveys, secondary data, descriptive	Race/ethnicity	Summary data on physical conditions and exposures, health conditions attributed to work, other health conditions that impact on work, health promotion in the	Gender, age, education, major	Awareness, policy

					workplace, and health-related benefits provided by employers.	occupations	
Women's health - Healthcare industry **(Arnold 1996)**	US	1996	Descriptive, secondary data	African-American	African-American women constitute only 6.8% of the total U.S. labor force, they hold 20% of the jobs in the health care industry and are disproportionately represented in those jobs that have the highest levels of workplace exposure to hazards.		Need for special service provision
Occupational Health Clinic - Preventive services **(Herbert et al. 1997)**	US	1997	Pre- and Post evaluation of occupational medicine clinic survey of female garment workers	??	Prior to initiation of the occupational medicine clinic, 64% of the workers surveyed reported symptoms indicative of occupational illnesses. Only 4% reported having been told by a physician that they had an occupational illness. The pilot project represents a new model for effective integration of clinical care and occupational disease prevention efforts within a primary care center.		Identification of occupational illness, Strategies for better service provision
Genetics and Occupational risks **(Schulte 1987)**	US	1987	Descriptive, research bias, Review	Race/ethnicity	Medical and epidemiological literature has been surveyed and the methods for assessing genetic and occupational risks have been identified and critiqued. Five major methodologic approaches have been identified: (1) adjustment for race, ethnicity, and sex; (2) case studies of occupational disease in genetically susceptible workers; (3) cross-sectional evaluations of the prevalence of disease among genetically differentiated groups; (4) case-control studies of the association of genetic characteristics and disease; and (5) family studies of disease aggregations. These approaches, in part, allow for controlling genetic factors or identifying susceptible genes or phenotype markers that may differentiate occupational populations according to risk. In many studies, the methods used were not very powerful for detecting gene-occupation interactions thus need for a better study design for the simultaneous assessment of genetic and occupational risk.		Methodological issues
Genetic susceptibility to risks at workplace	??	1986	Descriptive, review	Ethnicity	A number of inherited polymorphic proteins and enzymes have recently been identified in different		Safety strategies

(Murray 1986)					ethnic groups. Certain biochemical markers appear to be associated with susceptibility to harmful effects of the environment. It reviews the potential for using these markers to determine whether affected persons ought to be excluded from certain jobs or from the environment(s) of specific settings in the workplace. It also identifies the criteria to be used before it is scientifically and ethically justified to use these markers to "protect" workers and/or persons from harm by not allowing them to work in a specific setting or with specific agents to which they have been deemed to be at special risk for injury.		
II. Occupational Injuries and Accidents							
Fatal & Non-fatal injury in Working Age **(Cubbin *et al.* 2000)**	US	2000	Population survey	Race/ethnicity	The effects of Socioeconomic status (SES) varied substantially by cause of injury mortality and indicator of SES. In the multivariate models, blue-collar workers were at significantly increased odds of nonfatal injury. Education was unrelated to total injury morbidity, although associations were observed after stratification of the outcome by severity and place of occurrence. Black persons were at increased risk for homicide, and Black and Hispanic persons were at decreased risk for suicide and nonfatal injuries, after adjustment for SES.	Socio-economic status, severity, place of occurrence	Determinants for policy interventions
Occupational Injuries **(Firth and Herbison 1990)**	NZ, Dunedin	1990	Hospital records - A&E attendance	ethnicity	The overall injury rate being 15.8/1000 workers. The injury rate varied according to age, sex, ethnicity, occupation and industry. Laceration, strain/sprain and foreign body in the eye were the most common injuries and machinery was the commonest cause of injury. Small factories had significantly higher rates for lost time injuries compared with large factories. Serious under reporting of occupational injury to the Department of Labour was identified.		Under-reporting
Fatal Work-related Injury differentials **(McCracken *et al.* 2001)**	NZ	2001	Death certificates, 1985-94	Maori/non-Maori	Incidence higher for Maori and consistently declined over time. An overall disparity exists between Maori and non-Maori, which is probably due to differences in employment pattern.		differential in employment status

Mortality by Causes - Immigrants **(Courbage and Khlat 1996)**	France	1996	Descriptive	Immigrants - Moroccans	Study showed that the death rates of immigrants in France were surprisingly low: they were not only better than the national average, but far better than the rates specific to the socio-occupational categories the immigrants belonged to. Low mortality of Moroccans specially among those who had regional mobility at least once within France.		
Mortality, Accidents, Disability - Immigrants **(Bollini and Siem 1995)**	Industrialised countries	1995	Descriptive, cross-countries	Migrants and ethnic minorities	Migrants, especially first and second generations, and ethnic minorities often have reduced entitlements in receiving societies. Not only are they exposed to poor working and living conditions, which are per se determinants of poor health, but they also have reduced access to health care for a number of political, administrative and cultural reasons which are not necessarily present for the native population. The paper argues that the higher rates of perinatal mortality and accidents/disability observed in many migrant groups compared to the native population are linked to their lower entitlements in the receiving societies.		Policy, advocacy, inequality
Mortality-Occupational Injury **(Fullerton *et al.* 1995)**	US, New Mexico	1995	Retrospective review of medical reports, 1980-91	ethnicity	The study recorded 613 cases of fatally injured while on the job - 87.1% were unintentional, 10.6% homicides, and 2.3% suicides. Industries with the most fatalities were construction (11.8%), oil/gas (10.6%), and farming (8.6%). The primary agents of death were motor vehicles (41.7%), firearms (10.1%), and falling objects (10.0%). Almost all (95.6%) of the decedents were male. However, females were over represented among homicide deaths. Most unintentional injuries occurred in rural areas (69.1%), whereas most homicides (73.4%) and suicides (71.4%) occurred in urban areas. Drug or alcohol use was evident in 19.4% of cases. Higher risk industry were construction, oil/gas and farming, among males and in rural areas	Gender, location, drug, alcohol, industry	Policy
Simulated Occupational Injuries **(Dembe 1995)**	US	1998	Historical -descriptive evidence	Immigrants, Jews	The historical record shows that a medical diagnosis of occupational malingering can reflect deep-seated cultural and social biases toward women, Jews,	Social class	advocacy

					immigrants, and other groups representing a potential threat to the privileged social class. Current efforts to eliminate fraudulent workers' compensation claims must be sensitive to the inherent ambiguities in the medical determination of work-relatedness and the potential for judgements about simulated work injuries to conceal deep-seated social biases and class prejudices.		
Working Women - Hispanic -Injuries and Assault **(Weddle *et al.* 1993)**	US, Washington DC	1993	Medical records of 2572 injury patients	Hispanic	All Hispanics were at increased risk of occupational injury, but the relative risk attributable to ethnicity for Hispanic women (3.83) was nearly twice that of the corresponding relative risk suffered by working Hispanic men (2.07). It was also found that whereas, overall, women had a lower risk of assault than did men, relative risks of assault based on sex were the same in the workplace.		
Falls & Consequence **(Ellis and Trent 2001)**	US California	2001	Hospital discharge study	Race/ethnicity	Rates per 100 000 for same level hospitalized fall injuries for whites (161) were distinctively higher than for blacks (64), Hispanics (43), and Asian/Pacific Islanders (35). Whites were more likely to have a fracture diagnosis and to be discharged to long term care rather than home, suggesting a poorer outcome or greater severity. Prevention, particularly aimed at whites, has potential to improve health and save treatment costs.		Preventive strategies, treatment cost-saving, Workers?
Recurrent injury events - power utility co. **(Wassell *et al.* 1999)**	US	1999	History of injury events records for 10 years	Race/ethnicity	The injury history over a ten-year period is used to compare the hazards of specific jobs, adjusted for age when first hired, and race/ethnicity differences		Safety measures
Fatal injuries - Construction workers **(Ore and Stout 1997)**	US	1997	Death data, 1980-92	Race/ethnicity	On average, nonwhite laborers had 27% greater mortality than white laborers.	Gender	Prevention
Drivers - MV accidents-sleep disorder/fatigue **(Yee *et al.* 2002)**	NZ	2002	Prospective follow-up, 120	Asian/Pacific	Sleepiness score and accident relationship explored. Daytime somnolence and sleep disorders were commonly found in drivers attending the Emergency Department after accidents resulting in injury. Driver fatigue and sleep disorders should be considered as a potential contributing factor in New Zealand MVAs.	age	Strategies for improvement

Forest Workers - sleep disorder/fatigue **(Lilley et al. 2002)**	NZ	2002	Pop survey, n=367	Ethnicity	Fatigue was found to be commonly experienced at work in the forest, with 78% of workers reporting that they experienced fatigue at least "sometimes." Certain groups of workers reported long working hours, reduced sleep, compromised recovery time, and intensely paced work. Logistic regression analysis showed that recent sleep, number of breaks taken during the workday, and specific job/tasks were associated with reporting of high fatigue levels at work. Near-miss injury events were significantly more common among those reporting a high level of fatigue at work. Accidents and lost-time injury were associated with length of time at work, ethnicity, and having had near-miss injury events The results indicate the need for further examination of shift and workload management among forestry workers, as well as a role for improving industry awareness about the causes and consequences of fatigue.		Working environment
Brain injury- Depressive disorder **(McCauley et al. 2001)**	US	2001	Screening, 3 months post injury	Race/ethnicity	Hispanic were less likely to develop post-concussional disorder (PCD) than other racial/ethnic groups. The head trauma requirement was waived in order to determine specificity of symptoms to traumatic brain injury. Associated risk factors were female gender, poor social support, and elevated self-reported depressive symptoms at 1-month post injury. Comorbidities included concurrent diagnosis of major depressive disorder and/or posttraumatic stress disorder. PCD resulted more frequently from motor vehicle accidents and assaults. Screening tests for PCD risk factors/comorbidities performed shortly after injury coupled with appropriate referrals for psycho-educational interventions and support groups may avoid prolonged loss of productivity and poor perceived quality of life in these patients.	Type of event	Workers? Consequence
Army Discharge - Knee injury **(Sulsky et al. 2000)**	US	2000	Case-control study, 1980-95, 860 women & 1005 men	Race/ethnicity	Study found relations between the risk of knee-related disability and age and race, with marked effect modification by gender. Non-Caucasian men and	Age, sex	Work environment, compensation

					women were at lower risk than Caucasians at all ages. At most ages, Caucasian women were at higher risk than Caucasian men, and non-Caucasian women were at lower risk than non-Caucasian men. Age, race/ethnicity, and gender interactions are important in occupational injury. Differences in risk may be related to differences in work assignments, leisure activities, physical or physiological differences, or the ways in which disability compensation is granted		
Army Personnel -MV accidents **(Bell et al. 2000)**	US	2000	Behavioural follow-up study for 6 years of 99981 Army personnel	Race/ethnicity	Multivariate analysis showed a significant trend of increasing injury risk with younger ages. Soldiers under age 21 were injured almost five times more often than those over age 40. Also associated with risk for hospitalisations were minority race, heaviest drinkers versus abstainers, and seat belt use of 50% or less versus 100%. Although non-significant, there was evidence of an age-drinking interaction where the difference in injury risk between those older and those younger than 21 was greatest at low alcohol consumption levels. Modifiable risk factors associated with motor vehicle injuries include heavy drinking and low seat belt use. Programmes targeting these behaviours that meet the needs of young and minority soldiers are needed.	age	Prevention, safety interventions
Attendance at A&E **(Hull, Jones and Moser 1997)**	UK, East London	1997	Practice-based Study, routine data from Family Health Services Authority	ethnicity	Regression analysis showed that 48% of the variation in attendance rates could be accounted for by six factors: percentage of households not owner occupied, percentage living in households without a car, percentage living in households lacking amenities, percentage of pensioners living alone, percentage of Asian ethnicity, and percentage living in households with a head born in the New Commonwealth and Pakistan. Social deprivation is strongly linked with attendance rates at accident and emergency departments in East London. In contrast, the organisational characteristics of general practices appear to have no	Deprivation indicators	Strengthening service provision Workers? Injury?

					bearing on the rates. Both purchasers and providers need to take account of these findings when planning accident and emergency provision.		
Hand-injured Workers - compensation **(Cheng 1997)**	Hong Kong	1997	Qualitative, Prospective	Chinese/others	Concerning the perceived cause of the injury, the industrial production process such as machine defects, piecework, limited working experience, and lack of supervision triggered the onset of the injuries which resulted in permanent disability. At the same time, respondents explained their injury in terms of magical-religious forces such as fate and luck. This kind of understanding is embraced in cultural beliefs that are commonly found among Chinese. Such understandings appear fatalistic but allow the individual to actively cope with such misfortune. The emphasis on harmony and stability among Chinese also affected what action they took against the employer for negligence. It was shown that in general many respondents were bound by kuan-hsi (personal relationship) and tended to preserve the harmony between themselves and their employer. Concerning risk assessment in relation to work safety, workers' value systems and practices on the shop floor should be taken into consideration.		Coping strategies with disablements, work safety, Consequence
Aerospace Female Workers **(Wohl, Morgenstern and Kraus 1995)**	US	1995	Case-control study	ethnicity	The odds of reported injury was 2.9 times greater in women with a child less than 6 years of age than in women without children less than age 6. Other predictors of injury were a history of previous injury and a body mass index greater than or equal to 25. Age, years of work experience, total number of children at home, ethnicity, marital status, and shift work had very little or no effects. These findings indicate that factors outside the work place, such as the presence of young children at home, may increase the risk of occupational injury for women employed in manufacturing jobs.	Age,	Intervention, work environment
Adolescent work-related injury **(Parker et al 1994)**	US, Minnesota	1994	Cross-sectional survey, 3051 students of 10-12th grade	ethnicity	Injury was defined as an event which caused any of the following: loss of consciousness, seeking medical care, and/or restricting normal activities for at least 1 day.		Further research on risk factors

					The average hours of work per week during the summer and during the school year were 30 and 16, respectively. There was no difference in hours worked between ethnic minorities and white students. The rate of reportable injuries was 12 and 13 per 100,000 hr worked for rural and urban females, 16 and 20 per 100,000 hr for urban and rural males. Ongoing medical problems were reported by 26% of the injured workers. Previous estimates of work-related injury to adolescents may have been low.		
Fishing Industry-Fatal Injury **(Schnitzer, Landen and Russell 1994)**	US, Alaska	1993	Death certificates, 1980-88, 45000 population	Caucasian/ others	The 5-year average annual fishing-related fatality rate was 414.6 per 100,000 fishermen. The majority of the decedents were Caucasian men who drowned while fishing. The study emphasises that fishing is a dangerous industry in Alaska and demonstrates the benefit of using multiple data sources to identify fishing-related deaths in the state.		Policy, Safety
Head Injury **(Levi et al. 1990)**	Israel	1990	Epidemiological based on Hospital and screening records over a 4.5 years period with a referral base of 1,200,000 residents, Neurosurgical evaluations and treatments to 1,370 patients	Jews/ Other ethnic groups	The database consists of demographic, clinical and radiological features at the time of admission, as well as the hospital course through discharge. The crude incidence rate was 25.2 cases per 100,000 person-years (similar to that of three neurosurgical units in Scotland). Age adjustment showed almost twice this rate at the two extremes of age and a smaller elevation in early adulthood. The crude incidence was 36.9 for males and 13.4 for females. Age-specific incidence rates in Jews compared to other ethnic groups were reported. Falls had an incidence of 12.8 (51%), road accidents 9.0 (35.7%) and assaults 2.3 (9%) per 100,000 person-years. Other causes were accidents during work or sport and suicide. The rate of brain pathology as revealed by computerised tomography steadily increased from 19% in childhood to 71% in the elderly with a mean of 41.8%. A similar increasing trend with age was found in the rate of intracranial mass lesions (mean 28.3%), impaired consciousness (30.4%) and mortality (13%).	Sex, age	

Hazards at workplace-Exposure **(Robinson 1990)**	US, California	1989	California 1986 data	Hispanics/ Blacks/ non-Hispanic whites	Relative risks of exposure to each of six types of occupational injuries and illnesses for Hispanic and Black workers compared to Whites who are not Hispanic. Among males, Hispanics faced relative risks of exposure to all hazards adjusted for education and years of work experience of 1.33, while Blacks faced relative risks of 1.17. Among females, adjusted relative risks were 1.19 for Hispanics and 1.31 for Blacks.	Education, work experience	
Accidents at Workplace - automobile Industry **(Baker 1987)**	UK	1987	Retrospective, 4482 employees in a car engine machining and assembly plant	Asian/White/ West Indians	The study population was composed of Asian (22%), white (66%), and West Indian employees (12%). The crude accident rates differed among the groups - for Asians 1.58, white 1.23, and West Indians 1.28. There was, however, no consistent ethnic difference after adjustment for other factors such as age, type of job, and duration of service. Accident rates were higher in those employees who were younger, newly employed, and in production jobs. The findings of this research imply that accident prevention programmes should be directed to those factors known to relate to accidents and not to any specific ethnic group.		Accident prevention programmes irrespective of ethnic classification
Mortality - Farmers/Farm labourers-Chemical Exposure - Injuries & Respiratory problems **(Burmeister and Morgan 1982)**	US, Iowa	1982	Death certificates, 1971-78	ethnicity	White California males aged 20-64 dying 1959-61 indicated unusually high mortality rates in farm labourers from respiratory diseases and accidents. Whereas agricultural workers of Iowa from 1971 through 1978 reported only higher mortality from work-related accidents and not the respiratory disease deaths when compared with the general population. The reason for high respiratory disease mortality in California remains unknown. The two worker populations differ with respect to ethnic background, socioeconomic status, mobility and accessibility of medical care. Worker exposures to agricultural chemicals and to dust are substantial in both regions, but are qualitatively different.	Socio-economic mobility	
Migrants-Hand injuries **(Bossley 1975)**	NZ	1975		Pacific Island Immigrants	There is a disturbingly high incidence of heavy machinery, industrial hand mutilation, involving recent		Safety measures at workplace,

					Pacific Island immigrants many of whom have a poor comprehension of English. High rate of severe injuries amongst these immigrants indicates that one causative factor is unsuitable selection of works for this dangerous machinery, coupled with inadequate instruction in its use and safety precautions.		communication
Hazards at Workplace **(Robinson 1989)**	??	1989	Records, 1968-86	ethnicity	For male workers, there has been a dramatic narrowing of racial differences in exposure since the 1960s. For female workers, no such narrowing of racial differences has occurred. Black women now face approximately the same risk of occupational injury as white men.		
III. Musculoskeletal Disorders							
Computer users-musculoskeletal disorders **(Gerr et al. 2002)**	US	2002	Prospective study of 632 users, 3 years follow-up	Race/ethnicity	Neck or shoulder (N/S) and hand or arm (H/A) musculoskeletal symptoms (MSS) and disorders (MSD) common among computer users; varied by gender, age, ethnicity and prior history of N/S	Gender, age, and prior history of N/S	Prevention
Carpal tunnel syndrome (CTS) - Meat packing **(Gorsche et al. 1999)**	Canada	1999	Follow up of 665 workers	ethnicity	Prevalence and incidence of CTS in this workforce were higher than in the general population with no significant association with ethnicity, age, and body mass index.	Gender, age BMI	
Work injury - back pain **(Tait and Chibnall 2001)**	US	2001	retrospective review of 132 patients	Race/ethnicity	Injury claims showed that ethnicity and litigation status were associated with work injury management. Temporary total disability costs and impairment ratings were lower for African Americans than for Caucasians, but only in the absence of legal representation		Injury management
Musculoskeletal complaints **(Chan and Ho 1998)**	Singapore	1998	Sample survey, doctors and patients	??	3.9% of workers reporting aches or pains in back, neck or upper limbs and 1.8% had work-related complaints. A higher proportion of males reported back pain; complaints for hands/wrists and arms/forearms were higher for females. 82.3% of the affected were employed, 60.3% being production workers, compared to 33.3% professional/office workers and 6.4% service workers.		Conforming to previous findings
Back pain **(Hewson, Halcrow and Brown 1987)**	Australia	1987	Routine data review for last 10 years from Rehabilitation centre records	Country of birth/ ethnicity	The prevalence of migrant workers with back injuries was found to be similar to that in the occupations with higher accident liabilities in the surrounding municipalities. The relative proportion of	Time elapsed	Methodological issues, compensation

					musculoligamentous injuries and the more objectively confirmable back injuries was not related to the country of birth. Better predictors of treatment outcome were: the time that had elapsed between the injury and admission to the Centre; whether the referral was direct or indirect after the previous treatment; and the degree of fluency in English. It is concluded that the stereotypes that describe migrant workers as accident-prone or malingerers cannot be supported and that the vulnerability of migrant workers to the "accident-victim syndrome" can be accounted for without reference to ethnic characteristics.		
IV. Respiratory Problems							
Exposure - silica dust and lung disease - earth industry **(Park et al. 2002)**	US, California	2002	Cohort study of exposed workers	ethnicity	Current occupational health standards for crystalline silica permit risks of lung disease far in excess than acceptable by the Occupational Safety and Health Administration	Age, smoking, time since exposure	Safety measures
Occupational Asthma **(Kor et al. 2001)**	Singapore	2001	Referrals to Lung Clinic, 90 cases	Chinese/ Malays/ Indians	Occupational asthma is a condition associated with disability in the workplace and may still be largely under-reported. The most common causative agent is isocyanates.	Gender, age	Under-reporting
Asthma **(Hong et al. 1994)**	Singapore	1994	Survey of 787 asthmatic patients	Ethnicity	Significant predictors of asthma morbidity were keeping of either pets or rugs/carpets and high-risk occupations. A multiplicity of interacting factors and behavioural responses appear to influence the effects of allergens and other environmental precipitants on asthma morbidity.		
Asthma- Isocyanate exposure **(Diller 1987)**	??	1987	Descriptive, research bias	??	Isocyanate asthma incidence varies between 0 and 25%. Reasons for differences in observed incidence are intensity of isocyanate exposure, criteria for diagnosis, mode of calculation, sensitizing capacity of different isocyanates, individual predisposition and confounding factors (adjuvants). There is no geographical or ethnical prevalence. Workplaces at risk are those with isocyanate concentrations above 20 ppb.		Methodological issues

Asthma - A&E attendance **(Garrett, Mulder and Wong-Toi 1989)**	NZ	1989	Hospital records	Maoris/ European/ Pacific Islanders	Higher reporting of daytime symptom and on medications for Europeans, intermediate for Maoris, lower for Pacific Islanders. Relative to the perceived severity of their asthma, both Maoris and Pacific Islanders lost more time from work or school and used hospital services more than European asthmatics using A & E. The increased use of A & E by Maori and Pacific Island asthmatics seemed not attributable to the intrinsic severity of their asthma and was better explained by ethnic, socioeconomic and sociocultural factors. Pacific Islanders had less self management skills and, like Maoris, were less likely to be on prophylactic medications relative to oral bronchodilator use and these factors likely contributed to their increased morbidity.	Socio-economic	Service use, training
Respiratory disease - Miners **(Mapel et al. 1997)**	US	1997	1359 miners	Race/ethnicity	Native American miners have more nonmalignant respiratory disease from underground uranium mining, and less disease from smoking, than the other groups, but are less likely to receive compensation for mining-related disease.		Compensation by ethnicity
Respiratory Symptoms - Mining and Non-mining workers **(Sluis-Cremer, Harrison and Pearson 1981)**	South Africa	1981	Survey of workers	White/Blacks	Data for Whites and Blacks are compared, and the effect of smoking habits in the two ethnic groups is reported. The results are discussed in the light of other reports on ethnic differences in the literature.		
Tuberculosis - Healthcare workers **(Meredith et al. 1996)**	UK	1996	National tuberculosis notification surveys, 1988 & 1993	Ethnicity	The rate in healthcare workers was more than thrice that for other professional and associate professional occupations; rate ratios were higher in all ethnic groups.	Gender, age	occupational health monitoring need
Tuberculosis - Farm workers **(Advisory Council for the Elimination of Tuberculosis 1992)**	??	1992	Descriptive, secondary data	Migration status	Farm workers are approximately six times more likely to develop tuberculosis (TB) than the general population of employed adults. Drug-resistant TB is an important consideration, it requires altered treatment regimes due to higher rates of resistance in ethnic and social groups comprising much of the migrant farm workers. Patients should be monitored carefully for compliance, treatment response, and toxicity.		Treatment regimes, effective monitoring, service delivery

Respiratory problems - Grain workers **(Horne, To and Cockcroft 1989)**	Canada	1989	Clinical data	British/ German/ Eastern European	It showed that the British grain workers had a significantly greater prevalence of airflow obstruction than the Eastern Europeans. We also found that ethnic origin made a significant contribution to the estimation of risk of airflow obstruction among grain workers independent of the effects of age and smoking.
Respiratory diseases- Rice mill workers **(Lim et al. 1984)**	Malaysia	1984	Clinical examinations of 122 male Malay workers from three rice mills, with 42 controls of similar age, sex, ethnic group, and agricultural work background	Ethnicity	Clinical, haematological, and radiological findings suggest that a distinct clinical syndrome seems to be associated with exposure to rice husk dust. This include acute and chronic irritant effects affecting the eyes, skin, and upper respiratory tract; allergic responses such as nasal catarrh, tightness of chest, asthma, and eosinophilia; and radiological opacities in the chest, probably representing early silicosis or extrinsic allergic alveolitis.
Respiratory diseases - Fibreglass industry **(Chiazze et al. 1993)**	US	1993	Case-control study, exposure profile of workers 1934-87	Race/ethnicity	ORs were used to assess the association between lung cancer or non-malignant respiratory disease and the cumulative exposure history, demographic characteristics, and employment variables. Only the smoking variables and employment characteristics were statistically significant for lung cancer. For non-malignant respiratory disease, only the smoking variables were statistically significant.
Respiratory disease - textile workers **(Niven et al. 1997)**	UK	1997	Epidemiological study, Clinical examinations of 2991 workers with a control group exposed to man-made fibre textiles	ethnicity	Chronic bronchitis is more prevalent in workers of cotton than man-made fiber textiles and exposure is additive to the effect of smoking. The diagnosis of chronic bronchitis is associated with a small but significant decrement in lung function.
Respiratory diseases - Wool textile workers **(Love et al. 1991)**	UK, West Yorkshire	1991	Screening data, 634 workers	European men/ Asian men/ Asian women	Exposures to inspirable dust had been measured at time spent in current job, and in the industry were used as surrogates for lifetime cumulative exposures. Chest radiographs showed profusions of small opacities were present in only 6% of the population, and were not positively associated with current exposure to wool mill dust, or duration of exposure. In general, statistically

					significant relations between exposure and lung function indices were not found, with the exception of an inverse relation between the forced expiratory volume/forced vital capacity ratio and dust concentration in European women.	
Respiratory and allergic symptoms - Wool textile workers **(Love et al. 1988)**	UK, West Yorkshire	1988	Epidemiological study of 2153 workers in 15 mills	Ethnicity	After controlling for age, sex, smoking habit and ethnic group, cough and phlegm, wheeze, breathlessness, rhinitis, conjunctivitis, and nosebleeds were more frequent in those exposed to higher dust concentrations. In some experiencing high concentrations (blenders and carpet yarn backwinders) cough and phlegm, wheeze, rhinitis, and conjunctivitis were related to the years worked in such jobs. Relative risks of each symptom in relation to inspirable dust concentrations were also calculated. The risk of cough and phlegm relative to that of an unexposed worker was 1.37, that of wheeze 1.40, breathlessness 1.48, rhinitis 1.24, and conjunctivitis 1.70. Since some of these symptoms may be associated with functional impairment of the lungs, follow up studies are being carried out to estimate the functional effects of exposure to dust.	
Respiratory diseases - Cotton Textile workers **(Rastogi et al. 1989)**	India	1989	Epidemiological study of 189 asymptomatic workers, 133 byssinotics, 84 healthy non-exposed controls	??	Of the 6.8% of asymptomatic workers suffered from bronchial obstruction whereas 2.3% among the control showed obstructive pulmonary impairment. The byssinotics showed a significantly higher prevalence of bronchial obstruction. Length of exposure was also contributory factor. The mechanism responsible for causing ventilatory obstruction in the textile workers is discussed.	
Respiratory - Welders **(Bradshaw et al. 1998)**	NZ	1998	Follow up 62 current welders and 75 non-welders	ethnicity	High prevalence of symptoms of chronic bronchitis and other work related respiratory symptoms in current welders; no significant differences in ethnicity, smoking habits, or years of work experience.	
Respiratory diseases - exposure to welding gases & fumes -Shipyard	US	1989	Clinical tests of 145 welders and control groups	Ethnicity	Ten years of welding was associated with chronic bronchitis in 23.3% of nonsmokers compared to 3.3% in male controls, shortness of breath in 31.5% of	Preventive measures

workers **(Kilburn et al. 1989)**					nonsmokers compared to 1.5% in controls, and chest pain or heaviness in 38.4% compared to 4.4% in controls. Men who welded aluminum but had never smoked had more frequent wheezing, chest tightness, phlegm, feverishness and fatigue than those welding mild (black) or stainless steel. Diffusing capacities for carbon monoxide were significantly reduced as compared to referents.	
Respiratory problems - Former Asbestos workers **(Fournier-Massey, Wong and Hall 1984)**	US, Hawaii	1984	Survey of 1,401 male workers	Caucasian/ Chinese/ Filipino, Hawaiian and part-Hawaiian, and Japanese	Most subjects had significant exposure to asbestos in a shipyard and 83% were current nonsmokers. Taking age and ethnicity into account, this group had more chronic respiratory and gastrointestinal problems than the comparable male population, but fewer such problems than active shipyard workers elsewhere. These problems related primarily to current smoking status and secondarily to the length of asbestos exposure. Health care was available, but former workers used it less than retirees, despite having more symptoms. Very few abnormalities were reported by the subjects on their chest X-rays, pulmonary function tests, and sputum cytology performed elsewhere. These findings are compared to those of other shipyards, and support the hypothesis that the biological effects of asbestos exposure are found to be mild.	Age
Respiratory diseases - Rubber workers **(Fine and Peters 1976)**	??	1976	Clinical data, 65 rubber processing men and 189 controls	Ethnicity??	Compared with the controls, the processing workers had a higher prevalence of chronic productive cough. The processing workers with more than ten years of exposure showed a significant decrease in the ratio. None of the pulmonary function effects could be solely explained on the basis of smoking, age, ethnic, or socioeconomic factors: all were related to the length of exposure. Thus, exposure in the processing area produces pulmonary disease.	

V. Cancer						
Cancer by Occupation **(Lee 1984)**	Singapore	1984	Cancer registry data, 1968-77	Chinese/Birth place	Cancer incidence worked for Chinese males aged 35-64. Due to the lack of relevant population data, relative risks were based on the Standardised Relative Proportional Risk (SRPR), standardised for age, dialect group and place of birth. Managers and clerical workers seem to have high SRPRs for cancer of the large bowel, but low SRPRs for cancer of the lung and oesophagus. High SRPRs for lung and oesophagus are seen in some groups of manual workers (e.g., bricklayers, carpenters, transport equipment operators and labourers not otherwise specified). There is also a high SRPR for skin cancer among farmers.	
Cancer mortality - Production workers **(Ference, Chiazze and Wolf 1987)**	US	1987	Cohort mortality study of production workers at four plants employed between 1955 and 1961	Race/ethnicity	White male production workers experienced lower mortality for all causes of death when compared with the US population. Cancer of the rectum was significantly elevated among white males and cancer of stomach was significantly elevated among black males at one plant. There were significant deficits among all white males for nonmalignant digestive system diseases and all external causes of death.	
Occupational Cancer confounding factors **(Siemiatycki et al. 1988)**	Canada	1988	Descriptive, research bias	Ethnicity	Determine the effect of inclusion or exclusion of three variables--smoking, ethnic group, and socioeconomic status--on estimates of odds ratios (OR) between 25 occupations and three types of cancer--lung, bladder, and stomach. Of the 75 associations studied, only one OR was distorted by more than 40% when comparing unadjusted with adjusted estimates; three were distorted by between 30% and 40%; four others by between 20% and 30%. Of the eight associations which were distorted by more than 20%, seven involved lung cancer and one involved bladder cancer; none involved stomach cancer. Overall, in studies of occupation and cancer, uncontrolled confounding due to smoking and social class may not be as serious a threat to the integrity of results as is sometimes feared.	Methodological issues, socioeconomic confounding factors

Cancer - rubber workers **(Gustavsson, Hogstedt and Holmberg 1986)**	Sweden	1986	Mortality (1952 to 1981) and incidence (1959 to 1980) of cancer among 8,734 workers from two Swedish rubber manufacturing companies.	Swedish/non-Swedish citizens	Mortality from coronary heart disease and the incidence of lung cancer were increased when the study period was limited to greater than or equal 40 years since first employment. The standardized mortality ratio for coronary heart disease correlated positively with employment duration. The mortality from asthma, bronchitis, and emphysema was nonsignificantly increased. The incidence of bladder cancer was increased among individuals with heavy and long-term exposure in the weighing and mixing departments. Twenty-five percent of the individuals in the cohort were not Swedish citizens at the time of employment, and an analysis of the mortality and cancer incidence in this group showed a markedly increased lung cancer incidence for certain immigrant groups, probably due to ethnic factors.		Methodological issues
Mortality (esophageal squamous cell carcinoma) - Silica dust Exposure **(Cucino and Sonnenberg 2002)**	US	2002	Death data, 63717 subjects 1991-96	ethnicity	Mortality rate from esophageal squamous cell carcinoma lower in occupations associated with less consumption of alcohol and tobacco; higher among occupations potentially associated with exposure to silica dust and chemical solvents or detergents.	Gender, age	exploration
Work related Cancers **(Loomis and Schulz 2000)**	US	2000	Death data, 1985-92	African American/ Latino	African Americans had higher than expected mortality rates for leukemia and cancers of the lung, nasal cavity, and peritoneum. Excess leukemia among African American men in the rubber industry, Latino men in textile and wood industries and Latino women in the chemical industry. Excess cancer of the pleura and peritoneum was observed among workers in those occupations with widespread exposure to asbestos.	gender	Need for Surveillance data base
Exposure - silica dust and lung disease - earth industry **(Rice et al. 2001)**	US	2001	Cohort mortality study of 2342 White male workers	Hispanic/Non-Hispanic	Significant risk of mortality from lung cancer that increased with cumulative exposure to respirable crystalline silica dust; suggesting inadequacy of current occupational health standards in protecting workers from the risk of lung cancer.	Age	Safety measures
Occupational bladder cancer mortality	US	2000	Death records, 1985-92	Race/ethnicity	Elevated bladder cancer mortality among African American males and females and Latino males in		

(Schulz and Loomis 2000)					several occupational groups with exposure to suspected bladder carcinogens as well as among Asian males in sales and Asian females in the personal services industry.	
Cancer mortality - firefighters **(Ma et al. 1998)**	US	1998	Death data, 1984-93	Race/ethnicity	The overall cancer mortality was slightly elevated among white than black firefighters. Only prostate cancer risk was elevated in both groups (whites: 1.2, blacks: 1.9). Among white firefighters, it observed a slightly elevated risk for bronchus and lung cancer (1.1) and for black firefighters, excess risks were found for cancers of the brain and central nervous system (6.9), colon (2.1), and nasopharynx (7.6).	Future research
Skin cancer - Chemical exposures **(Gallagher et al. 1996)**	Canada	1996	Case-control study	ethnicity	After adjustment for age, skin and hair colour, mother's ethnic origin, and sunlight exposure, elevated risks for squamous cell carcinoma (SCC) were seen in subjects exposed to insecticides, herbicides, and fungicides and seed treatments, as well petroleum products, grease, and several other exposures. Elevated risks of basal cell carcinoma (BCC) were seen in subjects exposed to fiberglass dust and dry cleaning agents.	Exploration of non-sunlight-related risks
Mortality - Wastewater treatment workers **(Betemps, Buncher and Clark 1994)**	US	1994	Cohort study	Migration status	Migrant workers were having significantly higher than the US white male population for cancer of the stomach, leukemia, and all lymphopoietic cancers. They also had an elevated ratio for all diseases of the nervous system and sense organs. American-born workers had an elevated rate of death for arteriosclerotic heart disease compared with the US white male population.	
Stomach Cancer - Agricultural workers **(Dockerty et al. 1991)**	NZ	1991	Case-control study of 1016 male stomach cancer cases and 19,042 male controls with other cancers	Maori/others	Though Cancer Rates have been consistently higher for men, and for Maori, the relationships between stomach cancer and specific occupations varied. After adjusting for age, ethnicity, socioeconomic level, and smoking status and when 22 occupational groups were examined, adjusted odds ratios were elevated for forestry workers and three subgroups - grain millers and related workers; brewers, wine and beverage makers; and field crop workers.	

Cancers -Respiratory and Digestive **(Haguenoer et al. 1990)**	France	1990	Case-control study, 283 treated cases, with controls matched for sex, age, ethnic group, area of residence, and smoking and alcohol drinking history, 1983	Ethnicity	Significant associations were found between wood work and nasal cancer and farming and lip cancer. Pharyngeal cancer was associated with the textile industry and the building industry. Coal miners showed a threefold excess risk for cancer of the lip, buccal cavity, and larynx.	
Stomach Cancer Mortality-Exposure to Metalworking fluids and abrasives **(Silverstein et al. 1988)**	US	1988	Death data, 1766 bearing plant workers 1950-82	Race/ethnicity	Mortality ratios revealed significant excesses of gastrointestinal malignancies. The proportional mortality excess for stomach cancer among white men was greatest among those with more than 10 years' exposure in the major grinding group. For cancer of the pancreas among white men, there were significant associations with both machining and grinding jobs in straight oil. These findings could not be explained by confounding due to the ethnic background of the decedents. This study confirms previous evidence that grinding operations using water-based cutting fluids increase the risk for stomach cancer and provides moderate evidence that exposures to straight oil-cutting fluids increase the risk for cancer of the pancreas.	Conformity
Liver cancer mortality **(Suarez, Weiss and Martin 1989)**	US, Texas	1989	Case-control study, 1742 deaths due to liver cancer in men , 1969-80 with controls	Race/ethnicity	Risk for farmworkers based on age, race, and ethnicity-adjusted odds ratios (ORs) was not excessive but larger than the risk for farmers. Excess risk in the petroleum and chemical manufacturing industries was confined to oil refinery workers. Other occupations with twofold risk or greater were plumbers and pipefitters, butchers and meat cutters, textile workers, cooks, and longshoremen.	
Lung Cancer - Geographical pattern **(Blot and Fraumeni 1976)**	US	1976	Survey, 1950-69	??	Excessive rates among males in counties where paper, chemical, petroleum, and transportation industries are located.	
Lung cancers and carcinogens **(Vineis et al. 1988)**	US	1988	5 case-control studies of 2,973 male cases and 3,210 controls	Race/ethnicity	The percentage of lung cancers attributable to occupations entailing potential exposure to well-recognized carcinogens ranged from 3 to 17%. The	

					estimates varied according to ethnic group, smoking status and birth cohort, with higher values in non-whites, non-smokers and among members of more recent birth cohorts.	
Lung cancer mortality - exposure- antimony smelter workers **(Schnorr et al. 1995)**	US, Texas	1995	Clinical records, 1014 men employed during 1937-71	Hispanic/Non-Hispanic	The data suggest some increased mortality from lung cancer and perhaps nonmalignant respiratory heart disease in workers exposed to antimony.	Future research
Mortality - Lead exposure battery workers **(Cooper, Wong and Kheifets 1985)**	Denmark	1985	Two cohorts of male lead workers, 4 519 battery plant workers and 2 300 lead production workers, 1946-80	Ethnicity	Mortality from all causes combined was significantly greater than the expected levels. Among the battery plant workers excess mortality rate due to malignant neoplasms, other hypertensive disease (mainly renal), chronic nephritis, and a group of ill-defined conditions. Among the lead production workers the pattern was similar, with a significant number of excess deaths from other hypertensive disease, hypertensive heart disease, chronic nephritis, and ill-defined conditions. There was also a significant excess of deaths from external causes. The excess deaths from cerebrovascular disease and from hypertensive heart disease among smelter workers were in part due to the high proportion of nonwhites in the smelter populations. The stomach, liver, and lungs were the sites responsible for most excess cancer deaths in both cohorts, but the elevated SMRs were statistically significant only for gastric and lung cancers in battery plant workers. There were no excess deaths from malignancies of the kidney, brain, or lymphopoietic system in either cohort. Ethnicity, diet, alcohol, and cigarette smoking could not be ruled out as possible confounding etiologic factors for the cancer deaths.	
Mortality - Fur industry **(Guay and Siemiatycki 1987)**	Canada	1987	Historic cohort mortality study of male workers: 263 dressers and dyers (exposed to chemicals used in tanning, cleaning, and	ethnicity	Standardized mortality ratios (SMRs) for the manufacturers were significantly lower probably due to ethnic composition of the cohort and a healthy worker effect. SMRs for the dressers and dyers were also low, but not as low as for the manufacturers. For the French Canadians in cohort, the observed deaths were close to	

			dyeing fur) and 599 fur garment manufacturers (exposed to residue from the dressing and dyeing stage and to respirable fur dust), 1966-81		the expected; there was a noteworthy excess of colorectal cancer for dressers and dyers. Apart from this weak suggestive evidence, the results did not indicate any excess mortality risks in the fur industry. The results were limited due to small number deaths occurred in the cohort.	
Mortality - Lung and Colorectal Cancers - Fur workers **(Sweeney, Walrath and Waxweiler 1985)**	US	1985	Retrospective cohort study 807 retired fur workers, 1952-77	Country of birth	In a comparison with general population, no significant increases in mortality were observed among the fur dyers. Among fur dressers, mortality from all malignant neoplasms and lung cancer was significantly elevated, as was mortality from cardiovascular disease among fur service workers. When examined by ethnic origin, the elevated SMR values and directly age-adjusted rate ratios suggested that foreign-born fur dressers and eastern European-born fur workers experienced the highest risks for lung and colorectal cancers, respectively. The data support previous findings of increased mortality from colorectal cancer in the foreign-born population of the United States and suggest a possible occupational etiology for excess lung cancer rate.	Conformity
Mortality-Automobile industry **(Vena et al. 1985)**	US	1985	Death data, 1970-79	Race/ethnicity	Close agreement between the observed and expected deaths among white autoworkers in the forge and foundry plants. Valid analyses of cause specific mortality among non-whites could be conducted for the foundry plant only - higher death rates due to diseases of the circulatory system. Although based on small numbers, the risk of cancer of the lung was significantly high in non-whites under age 50 in the foundry. The cause specific PMRs for whites in the engine plant were statistically significant for malignant neoplasms.	
Mortality -Pancreas cancer- Jewellery workers **(Sparks and Wegman 1980)**	US	1980	Death data of 931 males, 1956-75	??	An excess proportion of pancreas cancer was found in the entire group and was not explained by ethnic or other non-occupational factors. Excess of stomach cancer and stomach ulcer were found among polishers.	

					Possible important exposures in the jewelry industry are reviewed.	
Cancers of Pancreas and Biliary tract **(Fraumeni 1975)**	US	1975	Descriptive, Review	Ethnicity??	Rising incidence among males, blacks, living in urban areas. Twofold increased risk for smokers and diabetic patients. Alcohol, occupational agents, and dietary fat have been suspected risk factors. In contrast, the incidence of biliary tract cancer is highest in Latin American populations and American Indians; predominates in females and in whites.	Need for nutrition-based studies for further exploration of risk factors
Cancer - Coke by-product workers **(Redmond, Strobino and Cypess 1976)**	US	1976	Death records of men employed, 1953-66	??	Men with five or more years at the coke ovens have an excess risk of dying from lung cancer and kidney cancer. Cancers of the digestive system are significantly elevated in nonoven workers. Cancers of two sites, the colon and pancreas, account for the total excess in cancers of the digestive system. 3. Cancers of the buccal cavity and pharynx appear high in nonoven workers, although the number of deaths involved is small. This clearly indicates the need to consider nonoven as well as oven workers when evaluating cancer hazards in the coke plant.	
VIa. Exposure Related – Lead						
Lead exposure **(Chia et al. 1996)**	Singapore	1996	Epidemiological, 72 exposed and 82 referents	Ethnicity	Significant differences were found in the adjusted (for age, ethnical groups, smoking and drinking habits) means median sensory conduction velocity, motor conduction velocity, distal latency and amplitude between the exposed and referent groups.	Methodological, measuring toxicity level
Lead exposure -Battery manufacturing **(Chia, Chia and Ong 1991)**	Singapore	1991	Epidemiological study	Chinese/ Malays	Mean blood lead levels adjusted (for environmental lead levels, age, exposure duration and stick-years of smoking by analysis of covariance) were higher for Malays. Oral ingestion of lead, through eating of food with hands contaminated by lead compound, among the Malay workers was a possible cause.	Preventive measures
Lead exposure -Battery manufacturing **(Hodgkins et al. 1991)**	US	1991	Epidemiological study, follow up of 132 workers for 30 months in 2 plants, 1983-85	ethnicity	Relationship between air lead levels and blood lead levels in lead-acid battery workers Multiple regression analyses including consideration of job category, seniority, age, ethnicity, gender, and smoking habit as	

					covariates, suggests highly significant association of blood lead with air lead.		
Neutrophil functions in lead-exposed workers **(Bergeret et al. 1990)**	France	1990	Clinical data 38 exposed workers and 34 controls; both groups were matched according to age, sex, drinking and smoking habits, ethnic origin and drug intake.	Ethnicity	Blood lead levels were found to be seven times higher in exposed workers than in controls. Phagocytosis assayed by chemiluminescence was found to be slightly but not significantly altered in exposed workers. In contrast, chemotaxis was significantly depressed. These results are in agreement with previous in-vitro findings.		Conformity, Future research
Lead exposure **(Phoon, Lee and Ho 1990)**	Singapore	1990	Clinical tests of workers exposed to inorganic lead, 1987 (PVC and battery factories)	Chinese/ Malay/ Indian	Chinese have the lowest blood lead levels after adjusting for the type of industry, age and duration of exposure to lead. Age was correlated with the duration of lead exposure. The higher blood lead levels in Malays and Indians may have been contributed to by eating habits (eating with hands). The higher prevalence of smoking among Malays may also be a contributory factor.		Preventive measures
Health Surveillance -Lead industry **(Sakamoto, Vaughan and Tobias 2001)**	US	2001	Descriptive	??	Minority groups tend to be overrepresented in lead industries. Role of occupational health nurses critical in implementation of medical/health surveillance programs by scheduling regular blood testing, monitoring results, and educating employees.		Strategies
VIb. Exposure Related - Sun light, Heat, Radiation, Chemical poisoning, Dust							
Occupational Sunlight exposure - Electric utility workers **(van Wijngaarden and Savitz 2001)**	US	2001	Case-control study from a cohort of 138905 male electric utility workers	ethnicity	No evidence for an association between occupational sunlight exposure and mortality from non-Hodgkin lymphoma (NHL) or NHL subtypes.	age	
Heat Exposure - Thermal Stress **(Bates, Gazey and Cena 1996)**	Australia	1996	Descriptive	Ethnicity	Factors affecting heat illness during hot working conditions-excessive loss of body fluids. Dehydration, sweat, sodium loss, heat tolerance relationships were studied	Age, body composition	Safety guidelines, work environment
Risk of Spontaneous Abortion (SAB) - Semi conductor industry	US	1995	Epidemiological cohort study	ethnicity	High risk of SAB in fabrication employees was found after controlling for age, smoking, ethnicity, education, income, year of pregnancy, and stress. Analysis of	Age, education, income	

(Beaumont et al. 1995)					fabrication work groups showed that the highest relative risk was in masking employees particularly involved in etching-related process.		
Radiation Effect-Chernobyl cleanup workers **(Tekkel et al. 1997)**	Estonia	1997	Epidemiological, pop survey of 3704, screening	Estonian/ Russian	Nearly 85% of the workers were sent as part of military training activities, and more than half spent in excess of 3 months in the Chernobyl area. Thirty-six percent of the workers reported having worked within the immediate vicinity of the accident site; 11.5% worked on the roofs near the damaged reactor, clearing the highly radioactive debris. A mutational assay of red blood cells and chromosome translocation analyses of lymphocytes; record linkage with national cancer registry and mortality registry files to determine cancer incidence and cause-specific mortality; thyroid screening examinations with ultrasound and fine-needle biopsy; and cryopreserved white blood cells and plasma for future molecular studies.		Exposure
Mortality and Morbidity - Agrl. Chemical poisoning **(Klein-Schwartz and Smith 1997)**	US	1997	Hospital Discharge survey data, 1985-90	Whites/non-Whites	Mortality and morbidity due to poison exposures higher among non-Whites, Males. Poisonings with agricultural and horticultural chemicals are an important public health problem. Prevention efforts need to incorporate the fact that many serious cases, such as paraquat poisonings, are suicidal in nature.	sex	Public health prevention measures
Pesticide Exposure-Mortality and Morbidity **(Morgan, Lin and Saikaly 1980)**	??	1980	Follow up survey of 2620 exposed and 1049 controls	???	Disease incidence rates were studied in relation to broadly defined occupational subclasses, and to serum concentrations of organochlorine pesticides (OCl) measured at the time of recruitment. Death by accidental trauma was unusually frequent among pesticide applicators. Mortalities from cancer and arteriosclerosis were not detectably different from those observed in the controls. Among survivors, dermatitis and skin cancer were unusually common in structural pest-control operators. Internal cancer was no more frequent in the intensively pesticide-exposed workers than in the controls, but it appeared to occur at an unusually high rate in workers characterised as		

					"possibly pesticide-exposed". There were apparent associations between high serum pesticide OCl levels measured in 1971-73 and the subsequent appearance of hypertension, arteriosclerotic cardiovascular disease, and possibly diabetes.		
Silica dust exposure - Miners **(Conrad et al. 1998)**	Israel	1998	Epidemiological study	??	Miners exposed to quartz dust may indicate a higher risk for development of systemic lupus erythematosus.		Future research
VII. Hepatitis A, B or C Virus and HIV							
Hepatitis C Virus (HCV)-Exposure-Hospital Staff **(Sermoneta-Gertel et al. 2001)**	Israel	2001	Seroprevalence survey of all 5444 employees of one tertiary hospital	Country of birth	Hospital work does not seem to constitute a major risk factor for HCV infection. A higher prevalence of anti-HCV among employees with longer versus shorter lengths of occupational exposure may be due to a cumulative effect of exposure over the years.	Gender, age, social status	
Hepatitis A Virus (HAV)-Exposure **(Lerman et al. 1999)**	Israel	1999	Prospective study, 1993-94	ethnicity	After controlling for age, gender, ethnicity, and time of immigration, few occupations showed increased risk of hepatitis A: yeshiva students, day care centre & kindergarten staff, food industry workers, teachers, physicians and dentists, and therapists and medical technicians. Sewage workers and nurses did not show any significantly increased risk.	Gender, age	Vaccination programme
Hepatitis B Virus-Healthcare workers **(Hakre et al. 1995)**	Central America	1995	Seroprevalence survey of 330 workers	Mestizo/ Creole/ Garifuna	The rate was higher for women; increased with years of medical service and higher among nurses and nonprofessional staff than among physicians. The presence of anti-HBc also differed significantly among ethnic groups.	Gender, age	Screening vs. Immunisation
AIDS/HBV- Healthcare workers **(Askari and Alexander 1989)**	??	1989	Descriptive	Ethnicity??	Large groups of health care workers, several from ethnic minorities with potential for occupational exposure to HIV/HBV, are generally underserved in training on prevention of occupational transmission of the viruses. The inadequacy of training for indirect client care personnel appears to be one of the primary reasons for high rates of needlestick injuries and exposure to blood. Training in appropriate infection control techniques can help reduce such risks.		Training needs and preventive measures

Hepatitis B - Healthcare workers **(Windsor et al. 1984)**	South Africa	1984	Two sero-epidemiological surveys of hospital personnel (423 nurses and 141 domestic staff)	White/ African/ Indian	The prevalence of antibodies to HBV was 14.9 per cent in 101 white nurses, 52.5 per cent in 322 African nurses and 51.8 per cent in 141 African domestics. This represents a greater than eight times increase for white nurses and a 50 per cent increase for African nurses and domestics over that seen in the equivalent blood donor groups. Antibody prevalence increased with age for all three staff groups, as did the number of individuals exhibiting a marker pattern suggestive of persisting infection. African nurses in adult medical wards showed greatest exposure followed by nurses working in outpatient departments and as theatre staff. Lower exposure rates were seen in pediatric and renal unit nurses. This contrasts with results obtained for doctors in the two surveys which indicated that while Indian and white doctors are at significantly higher risk, African doctors are not, and that doctors working in surgical and renal departments are at higher risk than doctors on adult medical wards.	
Hepatitis B - dental care workers **(Noble et al. 1991)**	Canada	1991	Survey of 704 dental professionals, 1987-88	ethnicity	11% had infection with Hepatitis B, with dentists having a rate of 18%, significantly higher than other dental workers. There were no differences in infection rates by the specific infection control practices. Oriental dental-care workers had a significantly higher rate of infection than other races. In a multivariate model, race and the number of years in practice were the only significant factors in predicting infection. The use of gloves did not show a protective effect, although a threefold protection rate for gloves is the smallest difference that could be reliably detected.	Safety practices
Viral Hepatitis - Dental personnel **(Mori 1984)**	??	1984	Descriptive, review	Ethnicity??	A number of reports suggest a significantly higher incidence of hepatitis among dentists than in the general population and also higher rates of hepatitis in certain specialists, especially oral surgeons, periodontists and endodontists, than in general dentists. The incidence HBV in dental practitioners is influenced by the	Advocacy, Safety measures

					exposure to infection, the type of practice, the number of years of professional experience and antibody response. HBV may be spread by dentists and dental students, by dental auxiliaries and by other personnel closely associated with clinical practice, who are antigen positive carriers but have no clinical symptoms. Dental staff should know well the risk of infection from their patients, the risk of cross-infection between patients, and the risk of infecting each other.		
Hepatitis B - anesthetists **(Chernesky, Browne and Rondi 1984)**	Canada	1984	Clinical data	Country of origin	The prevalence of antibodies to HBVwas 16.9% among anesthetists, compared to 3.7% in volunteer blood donors and 5.6% of patients without hepatic infections. Professional risk factors such as treating a hepatitis B patient or working in a hospital laboratory, haemodialysis, an intensive care unit, or in oncology, did not correlate with antibody prevalence. Personal risk factors such as a history of a family member with hepatitis, or of receiving blood transfusion in the past were also not associated. A greater number of anesthetists with a history of hepatitis in the past had antibodies, than those with no history. The country of origin may have been a contributing factor to antibody prevalence as highest positivity rates were found in subjects from Asia, Africa and Eastern Europe.		Need for larger population based study
Hepatitis A Virus (HAV)-Exposure-Wastewater workers **(Weldon et al. 2000)**	US, Texas	2000	359 wastewater and 89 drinking water workers	Hispanic ethnicity	A higher prevalence of anti-HAV than drinking water workers, which suggested that wastewater workers may have been at increased risk of occupationally acquired hepatitis A.	Age, education	Prevention
VIII. Kidney, Urinary, Renal diseases							
Urolithiasis **(Kristal-Boneh, Goffer and Green 1994)**	Israel	1994	Screening data of 5574 employees in 21 industrial plants, 1985-87	European origin	Urolithiasis was much more frequent in men than in women; in older than in younger subjects, and the highest prevalence was in subjects of European origin. Of the occupational factors, it was more frequent among employees in wood industries.	Gender	Future research
Renal Disease-Organic solvent exposure	UK, West Midlands	1989	Clinical data from two studies, 54 live cases	Ethnicity	No relation was found between exposure to solvents and renal cancer or glomerulonephritis. In the case of renal		

(Harrington et al. 1989)			compared with healthy referents, 50 biopsy cases matched with 50 referents		cancer the numbers studied only precluded a fourfold excess risk. For glomerulonephritis, the study, although methodologically superior to most other published studies and of similar size, was of similar power to the renal cancer investigation.		
Leptospirosis risk -Sewer workers **(Chan et al. 1987)**	Singapore	1987	Screening data, 80 sewer and 120 public cleansing workers; 100 controls matched by sex, age and ethnic group	Ethnicity	The study subjects had higher seroprevalence than the controls; the highest seroprevalence was found in workers cleaning wet markets and food centres. There was no significant correlation between the prevalence of positive titres and symptom prevalence or hospitalisation. Five of the study subjects (all sewer workers) gave a history of jaundice.		
IX. Stress/Inflammatory bowl disease							
Inflammatory bowel disease (IBD) by industry **(Cucino and Sonnenberg 2001)**	US	2001	Death records, 1991-96	ethnicity	IBD mortality is low in occupations associated with manual work and farming and relatively high in sedentary occupations associated with indoor work	Gender, occupation, industry	Exploration
Occupational Stress and alcohol consumption **(Yen et al. 1999)**	US	1999	Survey of 1542 transit operators, 1993-95	Race/ethnicity	Those reporting discrimination in at least 1out of 4 situations were more likely to have had negative life consequences as a result of drinking and were more likely to be classified as having an alcohol disorder when compared to those with no instances of workplace discrimination.	Gender, age, education, income, marital status	
X. Diabetes, Hypertension, CHD							
Microalbuminuria **(Metcalf et al. 1993)**	NZ	1993	Health-Screening survey 5467 middle aged workers in 46 Companies	Maori/ Pacific Islander/ European	A significantly higher prevalence of microalbuminuria was found in diabetes mellitus individuals. After adjusting for sex, obesity, hypertension, hypertriglyceridemia, cigarette smoking, and heavy alcohol consumption in a multivariate model, glycemia was the most significant determinant of urinary albumin concentrations in all three ethnic groups; high prevalence of microalbuminuria in Maori and Pacific Islanders compared with the European workers.		
Hypertension **(Green and Peled 1992)**	Israel	1992	Health survey of 3677 male and 1573 female	Western/Asian	The prevalence for men was somewhat below the national median whereas for women it was closer to the	Gender, age	

			workers in 21 industries, 1985-87		median. Marked ethnic differences were evident, with those of Western origin having the highest prevalence, and those of Asian origin, the lowest. One-third of hypertensives were unaware of their condition.
BP and Job status **(Sparacino et al. 1982)**	??	1982	Survey of 441 male municipal employees	White/Blacks	Overall uncontrolled hypertension rates were very high; higher rates were obtained for blue collar as opposed to white collar employees and for those plant workers in the Division of Water as opposed to Sewerage and Drainage. Net of age, weight, smoking, education, and anti-hypertensive medication use, higher systolic and diastolic mean values were obtained for supervisors who were primarily employed as foremen and clerical personnel. Inter-plant differences in BP were also found for blue collar Sewers and Drains employees. Comparisons with national BP data indicate significant effects for level of job and education which again disfavored supervisors and clerical employees and who had more education. Whites' and blacks' BPs deviated significantly, the differences favouring blacks. Social psychological mechanisms which may mediate these effects were discussed.
XI. Neurobehavioural, Eye, Mental diseases					
Neurobehavioural - Exposure - Microelectronics workers **(Broadwell et al. 1995)**	US	1995	Epidemiological study, 25 solvent-exposed and 32 controls matched by age, gender, ethnicity, and education	ethnicity	The results support an association between chronic low-dose solvent exposure and measurable neurobehavioral changes.
Neurobehavioural - Exposure - Video tape manufacturing workers **(Chia et al. 1993)**	Singapore	1993	Epidemiological study, 19 solvent-exposed and 26 non-exposed workers	??	Solvent-exposed workers in video tape manufacturing plants may have poorer visual motor control and recent memory impairment (visual and verbal) than unexposed workers. Dermal absorption of solvents may have played a role in these results by increasing workers exposure.

XII. Hearing, Vision Impairments						
Noise-induced hearing loss - metal fabricating workers **(Ishii and Talbott 1998)**	US	1998	Retrospective study, 216 white and 70 non-white males	Race/ethnicity	Major effect variable was years of employment than race/ethnicity	
Tinnitus - Noise exposed workers **(Phoon, Lee and Chia 1993)**	Singapore	1993	Clinical data, 647 workers notifying noise-induced deafness	ethnicity??	About 30 per cent of those with tinnitus complained that it interfered with daily activities like telephone conversation and sleep. The workers with tinnitus had consistently higher hearing thresholds at both high and low frequencies than those with no tinnitus even after adjusting for differences in sex, age and ethnicity and in the noise exposure duration.	Awareness, Preventive measures
Vision Impairment - Exposure to Styrene **(Fallas et al. 1992)**	France	1992	60 men in Ship building industry	??	A significant difference was found, for the number of subjects with errors axis in the red-green, or blue-yellow ranges, or both, which was larger among the exposed workers than for the controls. The results suggest that exposure to moderate styrene concentrations of the order of 25 ppm can lead to impairment of colour vision.	
Hearing Compensation Cost **(Royster et al. 1978)**	??	1978	Data base of 10000 industrial population	Whites/Blacks	Significant differences exist between the groupings (white and black males and females) with respect to the potential hearing compensation cost and percent of a population exceeding the different low fence frequency combinations.	
XIII. Workplace Social Environment						
Assault -Public Service workplace **(Riopelle et al. 2000)**	US, Los Angles	2000	Sample survey of 1763 workers	Race/ethnicity	Younger, more educated workers, and those who worked with clients or patients were more likely to report assaults. Those who reported threats or assaults mainly described the perpetrator(s) as clients, patients, or persons in legal custody or as co-workers/supervisors.	Safety measures
Harassment at workplace - Police officers **(Morris 1996)**	US	1997	Survey of 372 police officers	Race/ethnicity	As hypothesized, women and minority men reported more negative social interactions on the job, such as criticism, bias, and sexual harassment. Few differences	Future interventions

					were observed for positive social interactions on or off the job		
Workplace Homicide **(Jenkins 1996)**	US	1996	Descriptive		Homicide is to blame. There is a high incidence of homicide at workplace (20 deaths each week) and no single intervention strategy can fit in all situations. It is pointed out that interventions cannot be designed without knowledge of the demographic characteristics of victims and the distribution of workplace violence across industries and occupations. Such data are presented by gender, age, race, geographic distribution, method of homicide, and industry and occupation.	Gender, age, industry, occupation	Need based interventions
Workplace problems and alcoholism **(Ames, Grube and Moore 1997)**	US	1997	Random Survey of 832 hourly employees	ethnicity	Overall drinking, heavy drinking outside of work, drinking at or just before work and coming to work hangover were related to the overall number of work problems experienced by respondents, and to specific problems such as conflicts with supervisors and falling asleep on the job. The analyses show that workplace problems were also related to age, gender, ethnicity, work shift and departments.	Gender, age	Work environment/ culture
Alcohol consumption correlates **(Ragland et al. 1995)**	US	1995	Survey of 1853 transit operators, 1983-85	Race/ethnicity	Occupational factors influence alcohol consumption, since it was strongly related to (a) specific worksite and time of shift and (b) reported job stressors. However, their exact influence would depend on the convergence of findings from different research designs (e.g., cross-sectional, longitudinal, ethnographic).	Gender, age, marital status	Future research
Women's Workplace drinking - literature review **(Ames and Rebhun 1996)**	US	1996	Descriptive	Race/ethnicity	Review shows the complexity of the phenomenon and the inconsistent, incomplete nature of existing information, as well as pointing out directions for future research. It begins with a general discussion of women and workplace drinking.		Under-reporting, methodological
XIV. Occupational Health Promotion at Workplace							
Health promotion-use of Hearing Protection Devices (HPD) **(Lusk, Ronis and Baer 1997)**	US	1997	Survey	Race/ethnicity	No gender differentials, however, significant predictors of use among men included age and value of use of HPDs. For women, ethnic status and plant site were additional significant predictors of use.	Gender, age	Effective interventions

Worksite stress - women **(Walcott-McQuigg 1994)**	??	1994	Descriptive	Ethnicity	Women and minorities are more exposed to occupational stress hazards; could be unique because of their ethnicity. Stress management programs should include strategies specifically addressed to ethnic minority women.	Stress management
Worksite health promotion programmes **(Stange et al. 1991)**	US	1991	Health survey of 505 enrolled employees	Race/ethnicity	Of the enrolled in the health-promotion program, Whites were 2.5 times as likely to participate as nonwhites. The study results are reassuring that such programs do not enroll only the very healthy or those with healthy habits. However, the diminished enrollment of nonwhite employees supports concern that health-related programs may not equally reach all segments of the work force.	Equity in enrolment
Worksite health promotion programmes **(Brill et al. 1991)**	US	1991	Health survey of 3873 enrolled employees	Race/ethnicity	Recruitment rates were virtually identical for men and women but varied across ethnic, age, and education groups. Blacks, younger employees, and noncollege graduates were less likely to be recruited. Retention rates throughout the 10-week program were higher for whites and Hispanics, and were virtually identical for each age group and education level. The program showed an improvement in physical fitness and general well-being, lost weight, and smoked less and the changes were relatively consistent across socio-demographic groups.	Health promotion
Worksite health promotion programmes **(Aguirre-Molina and Molina 1990)**	US	1990	Descriptive	Race/ethnicity	It describes the health characteristics and health risks of ethnic-racial populations and the implications for planning and delivering health promotion programs at the worksite. Special attention by occupational stratification, which separates these groups from their white counterparts. Guidelines for designing culturally appropriate worksite health promotion programs.	Health promotion guidelines
Safety Training by ethnic groups **(Whitmore and Groce 1992)**	??	1992	Descriptive	ethnicity??	It examines some of the basic issues relating to knowledge, skills and work habits regarding safety when addressing a multicultural workforce. Two questions addressed are: how does one effectively communicate with a multicultural base group, and	Safety programmes

					whether the communication has been effective to ensure health and safety of employees?		
Workplace health promotion **(Johansson and Partanen 2002)**	??	2002	Descriptive	ethnicity	The study emphasises the role of trade unions in health promotion		advocacy
Health promotion action programmes **(Kawakami and Kogi 2001)**	Asia	2001	Review of 3 action-oriented support programmes	ethnicity	Action-oriented support programmes provided local people with concrete means to promote safety and health improvements. The successful programs commonly focused on local initiatives and were built on local wisdom and resources	Gender, work type	Advocacy
Social work interventions **(Cwikel 1992)**	Israel	1992	Survey of textile industry workers	??	Health behaviors varied by sex, age, educational achievement and ethnic origin among newly hired workers. A model of social work practice in occupational health is presented based on different types of health behavior (preventive health behavior, illness behavior, sick role behavior and rehabilitation) and intervention modes in social work practice (individual treatment, group work, family therapy and policy and program planning).		Need for awareness, prevention programmes

ANNEX 3
INCIDENCE OF LONG TERM ILLNESS AMONG WORKING AGE POPULATION, 1991

Table A3.1: Percentage of working age population (aged 16-64) reporting long term illness by ethnicity and region, 1991

	Great Britain	England	North	Yorks	Trent	East Anglia	North West Thames	North East Thames	South East Thames	South West Thames	Wessex	Oxford	South West	West Mids	Mersey	North West	Wales	Scotland
All ethnic groups																		
Males	9.5	9.1	13.2	9.7	10.4	7.5	6.9	8.6	8.2	6.2	7.3	6.0	8.5	9.6	12.0	11.8	14.6	10.9
Females	8.6	8.2	10.8	8.5	9.1	7.0	6.8	8.1	7.6	6.1	6.8	5.9	7.4	8.7	10.2	10.6	12.2	10.0
White																		
Males	9.5	9.1	13.3	9.6	10.4	7.5	6.6	8.4	8.2	6.2	7.3	5.9	8.5	9.4	12.1	11.7	14.6	10.9
Females	8.5	8.1	10.9	8.4	9.0	7.0	6.4	7.9	7.5	6.0	6.8	5.8	7.3	8.5	10.3	10.6	12.3	10.1
Black - Caribbean																		
Males	10.9	10.8	15.0	12.1	12.5	7.4	10.4	10.6	10.6	8.6	8.1	7.9	11.5	11.9	16.1	15.5	16.5	14.6
Females	11.3	11.3	14.0	12.2	13.7	9.9	11.0	11.5	11.1	9.6	8.6	8.8	13.1	11.9	13.9	13.5	12.9	10.9
Black - African																		
Males	6.8	6.7	11.1	13.6	18.2	5.3	6.1	5.3	5.3	5.8	14.3	7.4	10.8	13.9	16.2	12.0	13.8	7.7
Females	7.9	7.8	15.0	19.4	20.5	5.6	7.2	6.6	6.1	6.7	18.9	12.1	18.6	16.3	12.8	12.9	11.0	12.9
Black - other																		
Males	7.7	7.6	9.7	8.1	7.9	3.8	6.9	7.7	8.3	6.9	8.0	5.2	7.9	7.8	11.5	9.6	12.7	8.1
Females	7.4	7.3	8.5	6.8	7.1	5.4	7.4	7.8	7.1	5.9	7.1	6.2	9.3	6.8	9.9	8.8	11.3	7.3
Indian																		
Males	9.0	9.0	9.3	9.9	9.7	7.8	8.2	9.7	8.4	6.5	7.1	6.4	7.6	9.7	7.1	13.1	10.2	8.4
Females	9.8	9.8	8.9	10.2	10.8	8.3	9.3	10.3	9.0	8.2	8.0	7.4	7.9	10.8	6.3	12.1	7.6	8.4

Table A3.1 (contd): Percentage of working age population (aged 16-64) reporting long term illness by ethnicity and region, 1991

	Great Britain	England	North	Yorks	Trent	East Anglia	North West Thames	North East Thames	South East Thames	South West Thames	Wessex	Oxford	South West	West Mids	Mersey	North West	Wales	Scotland
Pakistani																		
Males	13.2	13.3	12.7	14.9	13.8	11.9	10.2	12.1	10.8	8.5	12.9	10.3	10.0	13.9	10.8	16.8	13.1	11.6
Females	11.0	11.0	9.7	10.8	10.2	8.8	9.7	11.3	9.8	8.9	10.6	9.5	9.6	12.0	10.0	12.5	10.7	10.8
Bangladeshi																		
Males	16.0	16.1	10.8	18.0	13.4	12.3	16.3	17.2	12.0	8.9	9.4	8.9	7.2	19.8	14.4	20.3	13.9	6.0
Females	10.5	10.6	7.8	11.3	9.3	9.7	10.4	11.1	9.0	7.0	6.7	8.1	10.5	12.9	10.6	9.8	9.1	4.9
Chinese																		
Males	4.3	4.3	4.9	3.8	4.0	3.5	3.0	4.5	5.4	3.4	4.2	2.6	3.9	4.4	8.4	4.9	5.0	4.4
Females	4.0	3.9	4.9	4.1	4.3	3.0	3.0	4.1	4.5	3.2	4.3	3.3	3.8	4.3	6.2	4.2	3.7	4.6
Other - Asian																		
Males	5.6	5.7	3.7	7.0	6.9	5.9	4.6	6.8	7.0	4.1	5.1	4.2	4.4	8.6	6.6	7.9	4.0	3.8
Females	5.5	5.6	2.8	5.8	7.1	4.4	5.3	6.6	6.2	3.8	4.2	4.6	4.3	8.2	3.5	7.5	3.7	3.7
Other - other																		
Males	7.6	7.6	7.5	6.7	8.7	5.8	7.4	8.5	8.1	6.5	6.5	5.0	7.5	9.1	9.6	8.2	10.2	4.9
Females	7.7	7.7	7.6	6.3	8.3	6.2	7.8	8.9	8.0	7.0	6.6	5.1	7.9	7.8	7.9	8.4	10.2	5.7
Persons born in Ireland																		
Males	13.7	13.5	15.8	16.0	15.9	10.4	10.7	13.9	13.6	8.5	10.1	9.2	12.0	17.2	18.1	19.3	19.6	13.8
Females	11.0	11.0	13.1	12.6	12.1	8.8	8.9	11.4	10.8	7.9	9.2	8.1	9.0	13.7	13.7	15.8	13.4	10.9

Table A3.2: Age specific long term illness rate (%) among working age population by ethnicity and region, 1991

Ethnic groups	Sex	Age Groups										Working Age (16-64)	All
		16-19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64		
All ethnic groups	Males	2.9	3.6	4.1	4.8	5.9	7.3	9.7	14.5	21.5	30.9	9.5	11.8
	Females	2.8	3.3	3.7	4.4	5.4	7.0	9.8	14.4	19.4	22.7	8.6	12.9
White	Males	2.9	3.6	4.1	4.8	5.9	7.2	9.6	14.3	21.3	30.8	9.5	12.0
	Females	2.8	3.3	3.7	4.3	5.3	6.9	9.6	14.0	19.0	22.5	8.5	13.1
Black – Caribbean	Males	4.3	5.2	5.7	5.4	6.2	8.3	10.6	14.6	21.1	30.6	10.9	11.1
	Females	3.4	4.3	4.7	4.9	6.2	9.1	14.5	21.1	30.9	33.8	11.3	11.3
Black - African	Males	6.8	5.8	4.2	3.8	4.7	6.7	8.9	13.8	20.2	31.9	6.8	6.9
	Females	6.0	5.4	4.6	5.4	7.4	9.8	14.5	20.4	28.4	32.1	7.9	7.4
Black - other	Males	4.0	5.6	6.5	5.9	7.5	10.6	12.0	18.0	26.1	37.6	7.7	6.2
	Females	3.9	4.7	5.8	6.2	8.1	11.1	16.9	22.4	31.3	30.5	7.4	5.7
Indian	Males	2.6	2.9	3.3	4.3	5.8	8.5	11.9	17.5	26.5	37.4	9.0	8.3
	Females	2.2	2.6	3.4	4.2	6.5	9.7	15.2	24.9	35.1	38.2	9.8	8.9
Pakistani	Males	3.9	4.8	5.2	7.1	11.4	14.4	19.5	27.7	35.5	45.1	13.2	9.6
	Females	3.7	4.3	4.7	6.4	9.6	14.7	20.1	29.0	36.0	40.7	11.0	7.9
Bangladeshi	Males	3.0	3.5	5.7	6.7	11.1	12.3	21.6	33.3	43.1	47.8	16.0	10.4
	Females	2.9	3.9	5.2	7.3	11.9	16.2	19.1	26.3	31.5	32.9	10.5	6.9
Chinese	Males	1.8	1.6	1.7	1.9	2.3	3.2	6.0	9.5	16.0	27.2	4.3	4.4
	Females	1.1	1.4	1.7	2.0	2.1	3.7	6.6	10.3	16.8	21.3	4.0	4.4
Other groups - Asian	Males	2.0	2.4	2.7	2.7	3.8	4.7	8.2	12.4	20.8	28.5	5.6	5.4
	Females	2.0	2.0	2.4	2.7	3.8	5.1	9.0	14.4	22.7	28.4	5.5	5.5
Other groups - other	Males	3.6	4.4	4.4	4.9	6.0	8.1	10.6	15.1	21.1	31.9	7.6	6.6
	Females	3.3	4.2	4.5	5.4	6.4	9.0	12.9	18.6	24.3	27.7	7.7	6.8
Persons born in Ireland	Males	3.4	2.8	3.0	4.6	6.6	8.9	12.1	16.9	24.5	34.1	13.7	17.8
	Females	3.2	2.4	2.6	3.8	5.3	7.6	11.0	15.5	20.4	22.9	11.0	16.6

ANNEX 4
OCCUPATIONAL ACCIDENT RATES (1993-2000)

Rank	SOC90 Minor Group	Accident Rates		
		All Workplace Accident	Excluding Road Accidents	Reportable Workplace Accidents
1	83 metal making, treating operatives	11.7%	11.4%	4.9%
2	93 other transport occupations	11.5%	10.7%	5.4%
3	61 security etc service occupations	10.8%	9.4%	3.4%
4	53 metal forming, welding etc trades	10.3%	9.9%	3.7%
5	91 other manufacturing etc occupations	10.1%	9.9%	3.8%
6	54 vehicle trades	9.9%	9.5%	3.6%
7	94 other communication occupations	9.0%	7.5%	3.1%
8	58 food preparation trades	8.9%	8.7%	3.6%
9	51 metal machining, fitting etc trades	8.8%	8.4%	2.9%
10	60 NCOs etc, armed forces	8.5%	8.2%	3.3%
11	82 chemicals, paper etc operatives	8.5%	8.2%	3.5%
12	57 woodworking trades	8.4%	8.3%	3.3%
13	92 other construction occupations	8.4%	8.2%	4.0%
14	89 plant & machine operatives nes	8.2%	8.0%	3.3%
15	84 metal working operatives	8.2%	8.1%	3.0%
16	80 food, drink, tobacco operatives	8.2%	8.1%	3.8%
17	87 road transport operatives	8.1%	6.3%	3.0%
18	88 other transport, machine operatives	7.9%	7.7%	3.6%
19	90 other farming related occupations	7.6%	7.2%	2.9%
20	50 construction trades	7.2%	6.8%	2.8%
21	81 textiles, tannery operatives	7.1%	6.9%	2.4%
22	44 stores, despatch clerks & keepers	7.0%	6.9%	3.1%
23	59 other craft, related trades nes	6.8%	6.3%	2.5%
24	99 other occupations nes	6.7%	6.6%	3.6%
25	52 electrical, electronic trades	6.7%	6.0%	2.2%
26	64 health and related occupations	6.6%	6.2%	3.2%
27	16 managers in farming, horticulture etc	6.3%	6.1%	2.1%
28	85 assemblers, lineworkers	6.1%	6.0%	2.5%
29	86 other routine operatives	5.6%	5.5%	2.4%
30	63 travel attendants etc occupations	5.4%	4.8%	1.8%
31	73 mobile salespersons & agents	5.4%	4.4%	1.9%
32	67 domestic staff etc	5.3%	5.1%	1.7%
33	15 protective service officers	5.1%	4.6%	1.9%
34	56 printing and related trades	5.0%	4.9%	1.9%
35	62 catering occupations	4.9%	4.7%	1.3%
36	29 professional occupations nes	4.6%	4.1%	1.2%
37	30 scientific technicians	4.5%	4.3%	1.3%
38	34 health associate professionals	4.5%	4.1%	1.4%
39	95 other sales, service occupations	4.4%	4.3%	1.7%
40	37 welfare etc associate professionals	4.1%	3.7%	1.4%
41	69 personal service occupations nes	3.9%	3.8%	1.3%
42	14 managers in transport and storing	3.8%	3.6%	1.3%
43	33 ship, aircraft officers & controllers	3.6%	3.6%	2.4%
44	55 textiles, garments etc trades	3.5%	3.5%	1.3%
45	38 artistic, sports etc professionals	3.3%	3.0%	1.1%

46	17 managers etc service industry	3.2%	2.9%	0.9%
47	11 prod managers – manufacturing etc	3.1%	2.9%	0.8%
48	72 sales, check-out assistants	3.1%	3.0%	1.1%
49	39 prof, technical occupations nes	3.0%	2.1%	0.8%
50	71 sales representatives	2.7%	1.8%	0.6%
51	23 teaching professionals	2.6%	2.4%	0.5%
52	65 childcare and related occupations	2.5%	2.4%	0.8%
53	22 health professionals	2.5%	2.3%	0.4%
54	21 engineers and technologists	2.5%	2.2%	0.6%
55	49 clerical, secretarial occupations nes	2.4%	2.1%	0.8%
56	27 librarians etc professionals	2.4%	2.1%	0.4%
57	79 sales occupations nes	2.4%	2.0%	0.5%
58	19 managers, administrators nes	2.3%	2.0%	0.4%
59	26 architects, town planners, surveyors	2.1%	1.8%	0.4%
60	43 clerks nes	1.9%	1.7%	0.5%
61	70 buyers, brokers agents etc	1.8%	1.2%	0.2%
62	31 draughtspersons, surveyors etc	1.8%	1.5%	0.3%
63	40 administrative staff in government	1.7%	1.5%	0.4%
64	20 natural scientists	1.7%	1.6%	0.2%
65	66 hairdressers, beauticians etc	1.7%	1.4%	0.5%
66	46 receptionist, telephonists etc	1.6%	1.4%	0.4%
67	42 filing and record clerks	1.6%	1.6%	0.6%
68	41 numerical clerks and cashiers	1.5%	1.4%	0.5%
69	12 specialist managers	1.5%	1.1%	0.3%
70	36 business, finance associate profs	1.4%	1.2%	0.3%
71	13 financial & office managers etc	1.3%	1.1%	0.4%
72	10 gen managers – government, large orgs	1.3%	1.2%	0.3%
73	24 legal professionals	1.3%	1.0%	0.1%
74	45 secretarial etc personnel	1.2%	1.1%	0.4%
75	32 computer analysts, programmers	1.2%	1.0%	0.3%
76	35 legal associate professionals	1.1%	1.1%	0.2%
77	25 business & financial professionals	0.7%	0.6%	0.2%

ANNEX 5
OCCUPATION COMPOSITION OF EMPLOYMENT (1994-2000): BY ETHNICITY

SOC90 Minor Group	White	Black Caribbean	Black Other	Asian	Other	Total
10 gen managers - government, large orgs	1.1%	0.9%	1.1%	0.7%	1.1%	1.0%
11 prod managers - manufacturing etc	2.0%	0.8%	0.6%	1.2%	1.2%	1.9%
12 specialist managers	4.2%	2.3%	2.5%	2.8%	4.9%	4.2%
13 financial & office managers etc	2.0%	1.9%	1.4%	1.6%	2.3%	2.0%
14 managers in transport and storing	0.7%	0.5%	0.7%	0.5%	0.4%	0.7%
15 protective service officers	0.2%	0.0%	0.1%	0.0%	0.1%	0.2%
16 managers in farming, horticulture etc	0.6%	0.0%	0.0%	0.0%	0.0%	0.6%
17 managers etc service industry	4.1%	2.5%	2.9%	9.5%	6.1%	4.2%
19 managers, administrators nes	1.0%	1.0%	0.8%	0.6%	1.2%	1.0%
20 natural scientists	0.5%	0.2%	0.4%	0.6%	0.8%	0.5%
21 engineers and technologists	2.2%	0.9%	1.5%	2.3%	2.8%	2.2%
22 health professionals	0.7%	0.2%	2.2%	3.9%	3.6%	0.8%
23 teaching professionals	4.2%	2.1%	2.8%	2.2%	4.1%	4.2%
24 legal professionals	0.5%	0.4%	0.6%	0.7%	0.5%	0.5%
25 business & financial professionals	1.2%	1.1%	1.6%	2.0%	2.3%	1.2%
26 architects, town planners, surveyors	0.5%	0.1%	0.2%	0.2%	0.1%	0.4%
27 librarians etc professionals	0.1%	0.0%	0.1%	0.1%	0.2%	0.1%
29 professional occupations nes	0.6%	2.3%	1.5%	0.7%	0.8%	0.7%
30 scientific technicians	1.0%	0.8%	1.0%	0.7%	1.0%	1.0%
31 draughtspersons, surveyors etc	0.4%	0.2%	0.1%	0.1%	0.2%	0.4%
32 computer analysts, programmers	1.0%	0.9%	1.2%	1.6%	1.7%	1.0%
33 ship, aircraft officers & controllers	0.2%	0.0%	0.1%	0.0%	0.1%	0.1%
34 health associate professionals	2.7%	6.2%	5.8%	2.0%	4.6%	2.8%
35 legal associate professionals	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%
36 business, finance associate profs	1.3%	1.0%	1.1%	1.0%	1.2%	1.3%
37 welfare etc associate professionals	0.8%	2.8%	1.7%	0.8%	0.7%	0.8%
38 artistic, sports etc professionals	1.6%	1.5%	1.9%	0.9%	2.2%	1.6%
39 prof, technical occupations nes	1.0%	1.0%	0.9%	0.7%	0.8%	1.0%
40 administrative staff in government	1.4%	3.1%	2.7%	1.4%	1.7%	1.4%
41 numerical clerks and cashiers	3.9%	3.5%	3.4%	4.6%	4.0%	3.9%
42 filing and record clerks	1.3%	1.1%	1.6%	1.1%	0.8%	1.3%
43 clerks nes	2.6%	3.0%	2.7%	2.4%	2.2%	2.6%
44 stores, despatch clerks & keepers	1.6%	1.3%	1.5%	1.5%	1.5%	1.6%
45 secretarial etc personnel	2.7%	3.5%	2.6%	1.2%	2.4%	2.6%
46 receptionist, telephonists etc	1.2%	1.5%	0.9%	0.9%	1.1%	1.2%
49 clerical, secretarial occupations nes	0.6%	0.8%	0.8%	0.6%	0.5%	0.6%
50 construction trades	2.2%	1.6%	0.6%	0.5%	0.5%	2.2%
51 metal machining, fitting etc trades	2.0%	1.1%	0.6%	1.1%	0.8%	1.9%
52 electrical, electronic trades	1.9%	2.6%	1.5%	1.4%	1.2%	1.9%
53 metal forming, welding etc trades	1.4%	1.1%	0.3%	0.6%	0.3%	1.3%
54 vehicle trades	1.1%	1.1%	0.5%	0.6%	0.4%	1.1%
55 textiles, garments etc trades	0.8%	1.0%	0.7%	3.8%	0.9%	0.9%
56 printing and related trades	0.5%	0.3%	0.3%	0.3%	0.2%	0.5%

57 woodworking trades	1.2%	0.8%	0.3%	0.6%	0.2%	1.1%
58 food preparation trades	0.3%	0.2%	0.3%	0.3%	0.1%	0.3%
59 other craft, related trades nes	1.2%	0.6%	0.5%	0.3%	0.2%	1.1%
60 NCOs etc, armed forces	0.4%	0.2%	0.5%	0.0%	0.1%	0.4%
61 security etc service occupations	1.6%	1.9%	2.7%	0.9%	1.2%	1.6%
62 catering occupations	2.3%	2.2%	3.4%	4.8%	4.9%	2.4%
63 travel attendants etc occupations	0.2%	0.3%	0.5%	0.2%	0.4%	0.2%
64 health and related occupations	2.8%	5.9%	5.4%	0.8%	2.8%	2.8%
65 childcare and related occupations	2.1%	2.7%	1.6%	1.2%	1.6%	2.1%
66 hairdressers, beauticians etc	0.6%	0.3%	0.6%	0.2%	0.8%	0.6%
67 domestic staff etc	0.5%	0.8%	0.9%	0.4%	0.7%	0.5%
69 personal service occupations nes	0.3%	0.7%	0.5%	0.2%	0.3%	0.3%
70 buyers, brokers agents etc	0.3%	0.1%	0.4%	0.3%	0.3%	0.3%
71 sales representatives	1.4%	0.7%	0.6%	0.8%	0.9%	1.4%
72 sales, check-out assistants	5.6%	4.7%	7.2%	9.1%	7.5%	5.7%
73 mobile salespersons & agents	0.4%	0.2%	0.3%	0.6%	0.3%	0.4%
79 sales occupations nes	0.4%	0.6%	0.3%	0.3%	0.4%	0.4%
80 food, drink, tobacco operatives	0.6%	0.6%	0.5%	1.1%	0.4%	0.6%
81 textiles, tannery operatives	0.1%	0.2%	0.0%	0.7%	0.0%	0.1%
82 chemicals, paper etc operatives	0.8%	0.5%	0.2%	0.9%	0.4%	0.8%
83 metal making, treating operatives	0.2%	0.2%	0.2%	0.2%	0.1%	0.2%
84 metal working operatives	0.5%	0.8%	0.3%	1.1%	0.2%	0.5%
85 assemblers, lineworkers	0.9%	1.5%	0.4%	1.7%	0.7%	0.9%
86 other routine operatives	1.4%	1.3%	1.3%	3.3%	1.0%	1.4%
87 road transport operatives	2.8%	3.4%	3.3%	3.8%	1.8%	2.8%
88 other transport, machine operatives	0.9%	0.8%	0.5%	0.6%	0.2%	0.9%
89 plant & machine operatives nes	1.1%	0.9%	0.3%	0.6%	0.5%	1.1%
90 other farming related occupations	0.7%	0.0%	0.1%	0.1%	0.1%	0.7%
91 other manufacturing etc occupations	0.3%	0.3%	0.1%	0.2%	0.1%	0.3%
92 other construction occupations	0.6%	0.4%	0.1%	0.1%	0.2%	0.6%
93 other transport occupations	0.4%	0.6%	0.3%	0.5%	0.3%	0.4%
94 other communication occupations	0.9%	1.2%	1.2%	1.0%	1.2%	0.9%
95 other sales, service occupations	4.5%	6.0%	9.5%	3.4%	6.0%	4.5%
99 other occupations nes	0.4%	0.3%	0.4%	0.3%	0.2%	0.4%
Population weighted	**23981272**	**204424**	**185385**	**636905**	**188948**	**25196934**
Population unweighted	**58208**	**456**	**399**	**1432**	**414**	**60908**

ANNEX 6
OCCUPATION COMPOSITION OF EMPLOYMENT (1994-2000): BY MIGRANT STATUS

SOC90 Minor Group	Born in UK	Lived in UK less than 10 years	Lived in UK more than 10 yrs
10 gen managers - government, large orgs	1.0%	1.1%	1.2%
11 prod managers - manufacturing etc	1.9%	1.4%	1.6%
12 specialist managers	4.1%	6.5%	4.6%
13 financial & office managers etc	2.0%	1.8%	2.0%
14 managers in transport and storing	0.8%	0.4%	0.5%
15 protective service officers	0.2%	0.3%	0.2%
16 managers in farming, horticulture etc	0.6%	0.1%	0.2%
17 managers etc service industry	4.1%	3.9%	7.4%
19 managers, administrators nes	1.0%	0.8%	1.1%
20 natural scientists	0.5%	1.5%	0.7%
21 engineers and technologists	2.1%	2.8%	2.3%
22 health professionals	0.6%	4.2%	2.2%
23 teaching professionals	4.1%	4.5%	5.1%
24 legal professionals	0.4%	0.6%	0.6%
25 business & financial professionals	1.1%	2.1%	1.8%
26 architects, town planners, surveyors	0.4%	0.4%	0.4%
27 librarians etc professionals	0.1%	0.1%	0.1%
29 professional occupations nes	0.6%	1.0%	0.9%
30 scientific technicians	1.0%	0.8%	0.9%
31 draughtspersons, surveyors etc	0.4%	0.2%	0.2%
32 computer analysts, programmers	0.9%	1.9%	1.2%
33 ship, aircraft officers & controllers	0.1%	0.2%	0.2%
34 health associate professionals	2.7%	3.4%	4.7%
35 legal associate professionals	0.1%	0.1%	0.1%
36 business, finance associate profs	1.2%	1.7%	1.0%
37 welfare etc associate professionals	0.8%	0.5%	1.1%
38 artistic, sports etc professionals	1.5%	2.8%	2.2%
39 prof, technical occupations nes	1.0%	0.8%	0.9%
40 administrative staff in government	1.5%	0.6%	1.3%
41 numerical clerks and cashiers	4.0%	3.2%	3.6%
42 filing and record clerks	1.3%	1.1%	1.1%
43 clerks nes	2.6%	2.2%	2.0%
44 stores, despatch clerks & keepers	1.6%	1.0%	1.2%
45 secretarial etc personnel	2.6%	2.3%	2.5%
46 receptionist, telephonists etc	1.2%	0.9%	0.9%
49 clerical, secretarial occupations nes	0.6%	0.5%	0.4%
50 construction trades	2.3%	0.5%	1.3%
51 metal machining, fitting etc trades	2.0%	0.5%	1.2%
52 electrical, electronic trades	2.0%	1.0%	1.4%
53 metal forming, welding etc trades	1.4%	0.3%	0.7%
54 vehicle trades	1.1%	0.3%	0.7%
55 textiles, garments etc trades	0.8%	2.0%	1.8%
56 printing and related trades	0.5%	0.1%	0.3%
57 woodworking trades	1.2%	0.6%	0.8%
58 food preparation trades	0.3%	0.3%	0.2%
59 other craft, related trades nes	1.2%	0.3%	0.6%

60 NCOs etc, armed forces	0.4%	1.1%	0.3%
61 security etc service occupations	1.7%	0.8%	1.2%
62 catering occupations	2.2%	6.8%	3.4%
63 travel attendants etc occupations	0.2%	0.5%	0.3%
64 health and related occupations	2.8%	2.3%	2.7%
65 childcare and related occupations	2.1%	2.7%	1.7%
66 hairdressers, beauticians etc	0.6%	0.4%	0.4%
67 domestic staff etc	0.5%	0.8%	0.6%
69 personal service occupations nes	0.4%	0.3%	0.2%
70 buyers, brokers agents etc	0.3%	0.2%	0.4%
71 sales representatives	1.4%	0.9%	0.9%
72 sales, check-out assistants	5.8%	5.2%	4.3%
73 mobile salespersons & agents	0.4%	0.2%	0.4%
79 sales occupations nes	0.4%	0.3%	0.2%
80 food, drink, tobacco operatives	0.6%	0.6%	0.6%
81 textiles, tannery operatives	0.1%	0.2%	0.3%
82 chemicals, paper etc operatives	0.8%	0.5%	0.6%
83 metal making, treating operatives	0.2%	0.1%	0.1%
84 metal working operatives	0.5%	0.3%	0.6%
85 assemblers, lineworkers	0.9%	0.4%	1.1%
86 other routine operatives	1.4%	1.7%	1.6%
87 road transport operatives	2.8%	1.6%	2.7%
88 other transport, machine operatives	0.9%	0.3%	0.7%
89 plant & machine operatives nes	1.1%	0.4%	0.8%
90 other farming related occupations	0.7%	0.2%	0.2%
91 other manufacturing etc occupations	0.3%	0.1%	0.2%
92 other construction occupations	0.6%	0.4%	0.5%
93 other transport occupations	0.4%	0.2%	0.3%
94 other communication occupations	0.9%	0.5%	0.8%
95 other sales, service occupations	4.5%	6.2%	4.2%
99 other occupations nes	0.4%	0.3%	0.3%
Population weighted	**23501589**	**562845**	**1351262**
Population unweighted	**57391**	**1208**	**3152**

ANNEX 7
LITERATURE SEARCH HISTORY

Work-related accidents and ill –health

Medical aspects

An initial simple search was performed on Medline (1966-April 2003):

Ethnicity and accidents

1	ethnic$.mp. [mp = ti, ab, rw, sh]	42900
2	accident$.mp. [mp = ti, ab, rw, sh]	79256
3	1 and 2	357

Some more targeted strategies were developed on specific topics eg RSI, but all references retrieved in the individual searches had already appeared in the 357 above.

Further searches were conducted in May on Medline (1966 – May 2003):

Ethnicity, work and health

1	ethnic$.mp.	[mp = ti, ab, rw, sh]	42982
2	work$.mp.	[mp = ti, ab, rw, sh]	36889
3	health$.mp.	[mp = ti, ab, rw, sh]	812479
4	Great Britain.mp.	[mp = ti, ab, rw, sh]	11307
5	1 and 2 and 3 and 4		45

Work related ill health and ethnicity

1	(work adj related),mp. [mp = ti, ab, rw, sh]	3634
2	((ill adj health) or Illness$ or disease$).mp. [mp = ti, ab, rw, sh]	1322636
3	ethnic$.mp. [mp = ti, ab, rw, sh]	42982
4	1 and 2 and 3	10

These two relatively simple strategies did not retrieve any more significant articles than had previously been found in the earlier search.

A much more complicated strategy was therefore explored.

Search History Results

1	attitude to health.mp.[mp=n,ab,rw,sh]	37514
2	cultural diversity.mp. [mp=ti, ab, rw, sh]	5134
3	cultural characteristics.mp. [mp=ti, ab, rw, sh]	6440
4	ethnic groups.mp. [mp=ti, ab, rw, sh]	28635
5	minority groups.mp. [mp=ti, ab, rw, sh]	6145
6	occupational diseases.mp. [mp=ti, ab, rw, sh}	51903
7	occupational health.mp. [mp=ti, ab, rw, sh]	12606
8	chronic disease.mp. [mp=ti, ab, rw, sh]	143714
9	pain.mp. [mp=ti, ab, rw, sh]	191951
10	arthritis.mp. [mp=ti, ab, rw, sh]	72921
11	hypertension.mp. [mp=ti, ab, rw, sh]	188247
12	respiratory tract diseases.mp. [mp=ti, ab, rw, sh]	12400
13	neoplasms.mp. mp=	16086
14	diabetes mellitus.mp. [mp=ti, ab, rw, sh]	97872
15	2 or 3 or 4 or 5	43400
16	6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	867871
17	15 and 16	3244
18	17 not 8	2841
19	limit 18 to English language	2679
20	limit 19 to human [Limit not valid in: Pre-MEDLINE; records were retained]	2594
21	limit 20 to (adolescent <13 to 18 years> or adult <19 to 44 years> or middle age <45 to 64 years» [Limit not valid in: Pre-MEDLINE; records were retained]	1627
22	work$.mp. [mp=ti, ab, rw, sh]	36889
23	21 and 22	131

This strategy was again rejected as the final 131 items were not especially useful in the current context. The three searches immediately above are representative of a number of approaches tried to extract pertinent articles.

Finally a very simple strategy was used with the following results:

Database: Pre-MEDLINE, MEDLINE (1966 - May 2003)
Search Strategy:

1	occupational diseases.mp. [mp=ti, ab, rw, sh]	(51903)
2	occupational health.mp. [mp=ti, ab, rw, sh]	(12606)
3	ethnic$.mp. [mp=ti, ab, rw, sh]	(42982)
4	1 or 2	(62091)
5	3 and 4	(235)
6	limit 5 to english language	(224)

This strategy resulted in a higher number of useful items than previous searches. Introducing the term "Great Britain" reduced the hits to 5 so this was not included in the final strategy.

The two main searches together (ethnicity and accidents/ill-health) gave a total of 581 hits, although there were some duplicates.

Searches were also conducted on MedWebPlus and the HMIC database (covers King's Fund, DH and HELMIS) but these did not produce any additional useful material.

Occupational health aspects

A number of databases in the area of occupational health were searched -
Haz-map and IP online produced no further useful references.

OSH reference databases were also investigated. These consisted of a number of different files including OSHLINE with NIOSHTIC/NIOSHTIC-2, HSELINE, and Canadiana. Only basic details are given as search results as these resources are subscription based. Also searchable from this location is CISILO which deals with occupational accidents and diseases, but again, unfortunately this was only available on subscription so could not be checked.

MHIDAS (Major hazard incident data service) also charged a fee to search and RILOSH (Ryerson International Labour occupational safety and health Index) had restricted access, so neither of these were available to the researchers.

OSH.net, a subject gateway to a wealth of American safety and health resources yielded no results of interest.

OSHWEB which lists resources by industry/company was also investigated, but regrettably had no search box through which to seek information.

A number of other web sites were viewed in an effort to track down grey literature. These included ROSPA, IPRU (Injury Prevention Research Unit), NOHSC (Australia) and NSC(America) but no additional material was retrieved.

From all the material found, 140 items were selected for further investigation.

ANNEX 8
EFFECT OF DISABILITY ON EARNINGS – MULTIVARIATE ANALYSIS

To examine the impact of disability on wage rate, an OLS regression model was undertaken. The dependent variable considered was the hourly real wage rate in log form. The Independent variables include personal attributes (such as age, age squared, terminal education age, whether has a partner, whether having limiting long-term disability and ethnicity), employment characteristics (such as whether working in the public sector, size of establishment and whether engaged in manual work - either as skilled, semi-skilled or unskilled worker), region and survey year. The results are presented for three groups - (a) all, (b) White, and (c) Black and Minority Ethnic (BME) - and separately for males and females (see Tables A8.1 and A8.2). The main findings of the regression analysis are discussed below:

- As expected, there is a positive but non-linear relationship between wage rate and age in all the regression results. Similarly, age at terminal education is also positively related. The influence of age and terminal education age on wage rate was smaller for BME group than for White group particularly among males. Thus there are smaller returns to skill (measured through education and age/experience) for BME group than for Whites

- Interestingly, having a partner increases the wage rate by 4.3% for males and in contrast decreases by 1.2% for females. Thus the overall effect of marital status on wages is that the marriage for men is rewarded, while for women it is penalised. However, the coefficient was not significant for BME group for both males and females.

- Working in public sector was not an attractive proposition for males particularly for Whites that had received 4 to 5% lower wages than their private sector counterparts. In contrast, BME males received 5.3% higher wages in the public than in the private sector. However, females working in the public sector irrespective of ethnicity have received more than 11% higher wages than those in the private sector.

- In all the regressions the influence of the size of establishment was found to be progressive on wage rate. For females the rise in wage rate with establishment size was higher for White than for BME group whereas it was other way round for males. Overall, the females working in establishment with under 11 employees received 20.4% lower wage rate than those working in establishment with 50 and more employees; the corresponding figure for males was 27.2%.

- Manual skilled, semi-skilled or unskilled workers were worse paid by 31% for both White males and females but the figure for BME males and females ranged between 38 and 39 percent. This reflects on less racial discrimination in non-manual work.

- As expected the wage rate is higher in the most recent survey years than the previous ones and in London (Inner and Outer) and Rest of South East regions. For males the wage rate was higher by 18-22% and for females 13-31% when compared with Tyne & Wear region.

- More importantly, all ethnic minority males and females have received much lower wage rate than the White people. Despite controlling for all characteristics included in the model, Bangladeshi men had received 51.5% lower wage rate than their white counterparts. This was followed by Black African (33.1%), Pakistani (31%), Chinese (25.9%) and Indian

(22.8%) men. The scenario is somewhat different for females - wage rate was lower by 32.5% for Bangladeshi, 18.6% for Black African and 15.9% for Indian women when compared with White women. The disability effects of reducing the overall wage rate by 13.7% for males (13.6% for White and 17% for BME) and relatively a lower figure of 7% for females (7.2% for White and 3.6% for BME but not significant).

The specification described above assumes that the effect of disability is the same for all ethnic groups. We have also attempted interaction of disability with ethnic group to capture the effect of disability whilst assuming that it differs across ethnic groups. However, in none of ethnic group the interaction term was found to be significant; as a result we did not present these estimates. Also, in regression results for females the ethnic group 7 (Bangladeshi) was dropped because there were apparently no women with disability and for comparison a minuscule cases were dropped from BME males regression as well.

Table A8.1: Determinants of Wage Rate for White, Black and Minority Ethnic and All Employee Males Aged 16-64, LFS 1996-2001: OLS Estimates

Independent variable	All Males		White Males		BME Males	
	Coefficient	Significance level	Coefficient	Significance level	Coefficient	Significance level
Age	0.0619	0.0000	0.0631	0.0000	0.0320	0.0000
Age Squared	-0.0007	0.0000	-0.0007	0.0000	-0.0003	0.0010
Terminal education age	0.0486	0.0000	0.0491	0.0000	0.0359	0.0000
Having a partner (None)	0.0426	0.0000	0.0441	0.0000	0.0110	0.7560
Having limiting disability (None)	-0.1378	0.0000	-0.1367	0.0000	-0.1690	0.0000
Working in Public sector (Private)	-0.0464	0.0000	-0.0506	0.0000	0.0528	0.0160
Establishment size (50+)						
Missing	-0.0711	0.0000	-0.0730	0.0000	-0.0151	0.8090
1--10	-0.2719	0.0000	-0.2677	0.0000	-0.3687	0.0000
11--19	-0.1658	0.0000	-0.1635	0.0000	-0.2254	0.0000
20--24	-0.1371	0.0000	-0.1340	0.0000	-0.2223	0.0000
25--49	-0.1086	0.0000	-0.1088	0.0000	-0.0786	0.0180
Whether manual work	-0.3169	0.0000	-0.3141	0.0000	-0.3826	0.0000
Ethnic Group (1. White)						
2. Black-Caribbean	-0.1295	0.0000			0.0965	0.0710
3. Black-African	-0.3101	0.0000			-0.0642	0.2410
4. Black-Other	-0.1260	0.0000			0.0797	0.1930
5. Indian	-0.2273	0.0000			0.0371	0.4670
6. Pakistani	-0.3076	0.0000			-0.0423	0.4390
7. Bangladeshi	-0.5334	0.0000			-0.1848	0.0100
8. Chinese	-0.2702	0.0000			(dropped)	
9. Other	-0.1811	0.0000			0.0751	0.1510
Survey year (1996)						
1997	0.0306	0.0000	0.0302	0.0000	0.0437	0.1470
1998	0.0713	0.0000	0.0714	0.0000	0.0600	0.0490
1999	0.1068	0.0000	0.1073	0.0000	0.0819	0.0080
2000	0.1450	0.0000	0.1442	0.0000	0.1623	0.0000
2001	-0.0111	0.0420	-0.0111	0.0450	0.0056	0.8820
Region (1. Tyne & Wear)						
2. Rest of Northern Region	0.0342	0.0090	0.0352	0.0070	-0.1108	0.4860
3. South Yorkshire	0.0002	0.9880	-0.0013	0.9260	0.0335	0.8180
4. West Yorkshire	0.0175	0.1780	0.0194	0.1360	-0.0494	0.7030
5. Rest of Yorkshire & Humberside	0.0330	0.0150	0.0322	0.0180	0.1683	0.3440
6. East Midlands	0.0328	0.0060	0.0329	0.0060	0.0061	0.9620
7. East Anglia	0.0417	0.0010	0.0403	0.0020	0.1030	0.4730
8. Inner London	0.2150	0.0000	0.2354	0.0000	0.1074	0.3910
9. Outer London	0.2193	0.0000	0.2223	0.0000	0.1759	0.1580
10. Rest of South East	0.1742	0.0000	0.1731	0.0000	0.1911	0.1280
11. South West	0.0423	0.0000	0.0409	0.0000	0.1566	0.2390
12. West Midlands (Metropolitan)	0.0524	0.0000	0.0520	0.0000	0.0255	0.8400
13. Rest of West Midlands	0.0475	0.0000	0.0460	0.0000	0.1185	0.3790
14. Greater Manchester	0.0279	0.0300	0.0304	0.0180	-0.0651	0.6230
15. Merseyside	0.0304	0.0420	0.0309	0.0390	-0.0384	0.8180
16. Rest of North West	0.0508	0.0000	0.0526	0.0000	-0.0590	0.6680
17. Wales	0.0165	0.1910	0.0166	0.1890	0.0117	0.9370
18. Strathclyde	0.0419	0.0010	0.0427	0.0010	0.0147	0.9210
19. Rest of Scotland	0.0523	0.0000	0.0523	0.0000	0.0577	0.7050
20. Northern Ireland	-0.0840	0.0000	-0.0836	0.0000	-0.0028	0.9920
Constant term	0.0314	0.3250	-0.0007	0.9820	0.5852	0.0080
R-Squared	0.3364		0.3362		0.3572	
No. of observations	81664		78771		2893	

Table A8.2: Determinants of Wage Rate for White, Black and Minority Ethnic and All Employee Females Aged 16-64, LFS 1996-2001: OLS Estimates

Independent variable	All Females		White Females		BME Females	
	Coefficient	Significance level	Coefficient	Significance level	Coefficient	Significance level
Age	0.0223	0.0000	0.0220	0.0000	0.0297	0.0000
Age Squared	-0.0002	0.0000	-0.0002	0.0000	-0.0003	0.0010
Terminal education age	0.0658	0.0000	0.0676	0.0000	0.0313	0.0000
Having a partner (None)	-0.0125	0.0010	-0.0142	0.0000	0.0285	0.1960
Having limiting disability (None)	-0.0673	0.0000	-0.0676	0.0000	-0.0711	0.0190
Working in Public sector (Private)	0.1166	0.0000	0.1151	0.0000	0.1227	0.0000
Establishment size (50+)						
Missing	-0.1120	0.0000	-0.1138	0.0000	-0.0833	0.1590
1--10	-0.2037	0.0000	-0.2060	0.0000	-0.1328	0.0000
11--19	-0.1134	0.0000	-0.1151	0.0000	-0.0760	0.0140
20--24	-0.0876	0.0000	-0.0907	0.0000	-0.0095	0.8240
25--49	-0.0657	0.0000	-0.0687	0.0000	0.0109	0.6910
Whether manual work	-0.3135	0.0000	-0.3100	0.0000	-0.3852	0.0000
Ethnic Group (1. White)						
2. Black-Caribbean	-0.0133	0.4100			-0.0253	0.5450
3. Black-African	-0.1890	0.0000			-0.1609	0.0000
4. Black-Other	-0.0455	0.0510			-0.0761	0.1140
5. Indian	-0.1422	0.0000			-0.1285	0.0020
6. Pakistani	-0.1169	0.0000			-0.1154	0.0220
7. Bangladeshi	-0.3347	0.0000			-0.2564	0.0130
8. Chinese	-0.0297	0.4030			(dropped)	
9. Other	-0.1097	0.0000			-0.0858	0.0380
Survey year (1996)						
1997	0.0277	0.0000	0.0287	0.0000	0.0067	0.8060
1998	0.0739	0.0000	0.0731	0.0000	0.0895	0.0010
1999	0.1221	0.0000	0.1228	0.0000	0.0964	0.0000
2000	0.1673	0.0000	0.1666	0.0000	0.1790	0.0000
2001	0.0725	0.0000	0.0703	0.0000	0.1329	0.0000
Region (1. Tyne & Wear)						
2. Rest of Northern Region	-0.0043	0.7290	-0.0058	0.6420	0.3241	0.1140
3. South Yorkshire	-0.0054	0.6920	-0.0071	0.6020	0.0538	0.7700
4. West Yorkshire	0.0437	0.0000	0.0439	0.0000	0.0145	0.9340
5. Rest of Yorkshire & Humberside	-0.0054	0.6760	-0.0070	0.5930	0.1625	0.4110
6. East Midlands	0.0211	0.0640	0.0196	0.0850	0.0390	0.8220
7. East Anglia	0.0165	0.1830	0.0153	0.2150	0.0674	0.7100
8. Inner London	0.3140	0.0000	0.3290	0.0000	0.2784	0.1030
9. Outer London	0.2541	0.0000	0.2565	0.0000	0.2449	0.1510
10. Rest of South East	0.1256	0.0000	0.1229	0.0000	0.1884	0.2710
11. South West	0.0109	0.3320	0.0094	0.3990	0.0295	0.8670
12. West Midlands (Metropolitan)	0.0453	0.0000	0.0416	0.0010	0.0800	0.6420
13. Rest of West Midlands	0.0144	0.2250	0.0133	0.2630	0.0466	0.7970
14. Greater Manchester	0.0563	0.0000	0.0554	0.0000	0.0672	0.7020
15. Merseyside	0.0511	0.0000	0.0508	0.0000	0.0138	0.9440
16. Rest of North West	0.0294	0.0160	0.0275	0.0240	0.1026	0.5770
17. Wales	-0.0064	0.5960	-0.0067	0.5780	-0.0606	0.7410
18. Strathclyde	0.0646	0.0000	0.0637	0.0000	0.1514	0.4320
19. Rest of Scotland	0.0441	0.0000	0.0428	0.0000	0.0894	0.6370
20. Northern Ireland	-0.0064	0.6290	-0.0079	0.5490	-0.0058	0.9820
Constant term	0.0523	0.1110	0.0298	0.3710	0.4813	0.0500
R-Squared	0.3511		0.3535		0.3174	
No. of observations	84785		81775		3010	

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Printed and published by the Health and Safety Executive
C1.10 04/04

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ISBN 0-7176-2842-6

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