valid cases. 532 hospital controls individually matched for age, district and date. Death certificates and available medical records were screened to ensure consistency of diagnosis of asthma.
Outcome measure: Death from asthma.
Results: The median age was 53 (IQR 40–59) for cases and 53 (IQR 40–58) for controls; 60% and 63% respectively were female. Cases had more chronic lung disease, obesity and an earlier age of onset, but similar evidence of atopy and family history of asthma. Although attendance at out-patients and previous asthma admissions were comparable for cases and controls, fewer general practice contacts in the last year, and greater length of time from last practice contact to index date were associated with higher risk of death. Also associated were: lower prescription of oral steroids and antibiotics by practices in the final three months, lack of PEFR recording in the last year, repeated non-attendance for asthma care, mention of a home nebuliser, home oxygen and wheelchair. Cases had significantly more domiciliary visits particularly for respiratory illness. Reporting of A&E attendance to practices was poor.
Conclusions: Higher risk of asthma death was associated with aspects of medical care amenable to change. Despite similar use of hospitals, there was under-use of primary care. Practices should be encouraged to continue a proactive approach to the management of severe asthmatic patients.

182 ASTHMA AND SOCIAL CLASS—THE EVIDENCE FROM NATIONAL DATASETS

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Background: Reports on inequalities in asthma are inconsistent. Social class, based on occupation, is one of the most widely available social indicators. It can be used to reflect a range of factors (such as income, culture and educational attainment) that could affect the occurrence and severity of disease and its medical care.
Methods: Social class differentials in GP consultations for asthma, prevalence of asthma or its symptoms and male asthma mortality were studied (adjusting for age) using the Morbidity Statistics from General Practice 1991–2, the Health Survey for England 1995–97 and ONS mortality statistics 1991–93 respectively.
Results: Slightly more adults from manual than non-manual classes consult GPs for asthma (RR=1.2) and they consult slightly more often (RR=1.1), independently of current smoking habit. There is no class gradient in the prevalence of asthma though there is a clear trend ($p<0.0001$) in the prevalence of wheeze in adults with an OR (adjusted for smoking) of 1.7 for severe wheeze in class V compared to class I. There is also a trend in the proportion of wheeze diagnosed as asthma ($p<0.001$) with those in class I more likely to be diagnosed. In those who have never smoked, 44% more wheezers in class I are labelled asthmatics than in class V ($p=0.03$). The greatest class differentials are for mortality. The SMR for asthma in 20-64 year old men in class V was 229 compared to 51 for class I.
Conclusions: There is little class difference in prevalence or in GP consultations for asthma overall, but there is a 70% excess of severe asthma symptoms and a fivefold increase in asthma mortality for class V compared to class I. Though severe asthma may affect choice of occupation the larger differentials in severity and mortality could also be due to class differences in medical care.

183 DOES AMBIENT NITROGEN DIOXIDE CAUSE ACUTE EXACERBATIONS OF DISEASE?

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Objectives: To determine whether nitrogen dioxide (NO_2) is causally related to mortality and/or morbidity.
Background: UK, European and WHO air quality guidelines include objectives for NO_2, although reviews have all concluded that there is little evidence that ambient NO_2 has acute effects of health.
Design: Systematic literature review of abstracts and papers up to the end of 2000, adhering to WHO guidelines, using the search term nitrogen dioxide exploded / all subheadings in four electronic databases.
Main outcome measure: Examination of published evidence using Bradford Hill's viewpoints.
Results: Most epidemiological studies of NO_2 have been published since the reviews were written. There is a positive association in most time-series studies between daily or hourly NO_2 and total and cardiovascular mortality; emergency hospital admissions for ischaemic heart diseases, acute myocardial infarction, chronic obstructive pulmonary disease (especially in people =65) and asthma (in children and adults); and more minor exacerbations of obstructive airways diseases. The association with total mortality is probably due to confounding by other pollutants. For the other associations, specificity, temporality, coherence, biological gradient and strength of association are strongly supportive of causality, including results from two- or multi-pollutant models. There is reasonable consistency, when the low power of many small studies are considered, and biological plausibility. The threshold of effect differs between epidemiological and most experimental studies but individuals at greatest risk (with pre-existing cardiorespiratory disease) are seldom involved in chamber studies. It is unknown by how much deaths are brought forward by NO_2 and whether admissions are additional or earlier than they otherwise would have been.
Conclusion: Ambient NO_2 is probably causally related to cardiovascular deaths and to emergency hospital admissions for ischaemic heart disease, acute myocardial infarction, chronic obstructive pulmonary disease in older people and asthma at all ages.

184 MORTALITY AND TEMPERATURE IN SOFIA AND LONDON

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Background: Both hot and cold temperatures have been associated with increased mortality, independently of seasonal trends. We examine associations between mortality and temperature in two European capitals - Sofia and London.
Methods: Four years of daily deaths, air pollution and weather data were collected. Using generalised additive models, associations between mortality and temperature were analysed controlling for season, day of week, public holiday, and particulates. Temperature was entered as the average of the daily maxima over the previous week. Linear splines represented 'hot' and 'cold' effects.
Preliminary results: Sofia and London had similar mean daily maximum temperatures of 15.6 and 15.2 degrees respectively. However, the range was -9 to 37 in Sofia, versus -1 to 34 in London, and minimum temperatures reached -17 in Sofia against -6 in London. Initial associations were seen with cold in both cities, mortality declining as temperature rose, with a slight upturn again above about 25 degrees. After controlling for confounders, the cold effect in Sofia flattened, leaving an estimated rate increase of 0.04% (95% CI -0.14 to 0.21) per extra degree below 20, whereas in London there remained a significant rate increase of 0.49% (0.39 to 0.58). Heat effects were seen in both cities, with a rate increase of 1.49% (0.66 to 2.32) for every degree above 25 in Sofia, and of 0.99% (0.24 to 1.76) in London.
Conclusions: Strong associations were revealed between mortality and heat, particularly in Sofia. The association with low temperatures found in London was not found in Sofia, where people, lifestyles and/or facilities (e.g. housing) are perhaps adapted to more extreme cold.

185 REDUCTION IN BOTH SEASONAL MORTALITY AND LONGER TERM MORTALITY TRENDS FOLLOWING RESTRICTIONS ON THE SULPHUR CONTENT OF FUEL OIL IN HONG KONG

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Background: Evidence on health benefits from air quality interventions is scarce. In 1990 Hong Kong Government restrictions on the sulphur content of industrial fuel led to an immediate fall in ambient SO_2 levels by up to 80% and SO_4 in RSP by 35% in industrial areas. No comparable changes occurred in the other criteria pollutants NO_2, total RSP and O_3.
Results: There was a marked effect on the seasonal mortality pattern in the following twelve months with reduction in the amplitude of the seasonal cycle. This was significant in the 65+ and all ages groups for

all causes, respiratory mortality and cardiovascular mortality. During 13 to 24 months following the intervention the winter mortality showed a higher peak than expected; during 25–60 months post-intervention it returned to patterns expected from models derived from the whole of the period of study 1985–1995. There was no change in the seasonal pattern of mortality from neoplasms. The slope in the annual trend in mortality declined with a turning point approximating to the mid-year of the intervention for all causes (all age groups), respiratory (all age groups) and cardiovascular (65+ and all ages groups) mortality. The observed effect of the intervention in this population of approximately 6 million, for changes in the increase in life expectancy for all ages, was equivalent to a total of 579,000 in males and 334,000 in females, person-years of life gained over the two years following the intervention.
Conclusion: Products of combustion from sulphur rich fuels have a specific and independent effect on mortality including respiratory and cardiovascular deaths. The Hong Kong air quality improvement through the use of low sulphur fuels is the first direct evidence that control of a single pollutant of this type is associated with both immediate and longer term health benefits at all ages.

186 PARALLEL ANALYSES OF INDIVIDUAL AND ECOLOGICAL DATA ON RESIDENTIAL RADON AND LUNG CANCER IN SOUTH WEST ENGLAND

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Background: Individual based case-control studies support a positive association between residential radon exposure and lung cancer risk. However, several ecological studies have shown a strong negative association.
Methods: Data were available from a case-control study of residential radon based on 982 lung cancer cases and 1486 population controls. All subjects were aged less than 75 and were long-term residents of Devon and Cornwall. Two concurrent analyses were performed, the first based on individual data and the second on data aggregated at the district level.
Results: Analyses based on individual data were consistent with a positive association after adjusting for age, sex, smoking and social class. However, analyses based on aggregated data in the two counties were contradictory. The unadjusted odds ratios (OR) associated with a 100 Bqm^{-3} increase in radon exposure were 1.46 (95% CI 0.89, 2.38) in Cornwall and 0.36 (0.16, 0.82) in Devon. Adjustment for age, sex, smoking and social class reduced this discrepancy only slightly and additional adjustment for urban/rural status was required to produce similar results in the two counties (adjusted ORs: 1.40 (0.80, 2.45) and 1.32 (0.42, 4.34) in Cornwall and Devon respectively). Although important in the aggregated analyses, the urban/rural variable had no impact on the analyses based on individual data.
Conclusions: These results confirm that ecological studies, particularly those of weak associations, may be misleading even after accounting for major risk factors. In this example, additional adjustment was required at the aggregated level for a variable not seen to be important at the individual level. Most of the methods that have been recommended for overcoming the limitations of ecological studies would not have proved useful in identifying this variable in practise.

Diabetes

187 OVERALL AND CARDIOVASCULAR MORTALITY IN PEOPLE WITH DIABETES IN ENGLAND AND WALES

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Aims: To assess overall and cardiovascular mortality in people with type 1 and type 2 diabetes in England and Wales.
Methods: The General Practice Research Database (GPRD) covering about 400 practices and 4.5 million people in England and Wales was used for the analysis. Mortality (overall and cardiovascular) during 1992–2000 in a cohort of 5807 type 1 and 32061 type 2 diabetes patients was compared with mortality in controls with no record of diabetes matched for age, sex and general practice, controlling for age, sex, body mass index (BMI), smoking and hypertension. Cox proportional hazards survival regression was used for the analysis. Absolute risks and survival curves were derived by age and gender for mortality in type 1 and type 2 diabetes.
Results: Hazard ratios (HR) for overall mortality from type 1 diabetes were more than double in men than in controls (HR2.8, p<.001, 95% confidence interval (CI) 2.4–3.3), and 4-fold greater in women (HR4.4, p<.001, 95% CI 3.6–5.4). For type 2 diabetes HRs were 2.2 in men (p<.001, 95% CI 2.1–2.3) and 2.8 in women (p<.001, 95% CI 2.6–3.0). Mortality risks increased significantly with smoking, rising BMI and hypertension. In all age groups, mortality was greater for men than women, although the increase in mortality associated with both types of diabetes was greater for women than men. Data will also be presented on the incidence of and mortality from coronary heart disease and stroke in people with type 1 and type 2 diabetes.
Comments: The strengths of this study are its large size and use of non-diabetic controls (rather than the general population, as in most other studies) to estimate excess mortality in people with diabetes. The results show that, compared to people without diabetes, the overall risk of death is tripled in type 1 and doubled in type 2 diabetes.

188 LIFESTYLE DETERMINANTS OF INSULIN RESISTANCE: THE CORK AND KERRY DIABETES AND HEART DISEASE STUDY

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Objective: To study the role of potentially modifiable environmental factors (general and central obesity, physical activity, cigarette smoking and alcohol intake) in the development of insulin resistance.
Methods: Cross sectional study involving 1018 men and women aged 50 to 69 years sampled from 17 general practice list in the South of Ireland. The overall response rate was 69%. Insulin resistance was estimated on the basis of fasting glucose and insulin, using the glucose homeostasis model (HOMA scores). Data on lifestyle and anthropometric measures were obtained using standard questionnaires.
Results: Body mass index and waist hip ratio were positively and significantly associated with HOMA scores independent of each other and of age and sex, partial correlation, r =0.47 (BMI) and r=0.15 (W/H ratio), both p=0.001. In analyses adjusted for age and sex, physical activity levels were significantly and inversely associated with HOMA score. This association remained significant on further adjustment for waist hip ratio but not BMI. There was a weak positive association, of borderline significance between cigarette smoking and HOMA score in age and sex adjusted analyses, which became non-significant on adjustment for either waist hip ratio or BMI. There was a U-shaped relationship between alcohol intake and HOMA scores with lowest levels in light drinkers (less than 18 units a week). This trend was accentuated on adjustment for age, sex and waist hip ratio, but attenuated (non-significant) on adjustment for BMI.
Conclusion: These results highlight the role of lifestyle risk factors in the development of insulin resistance. The effects of lifestyle variables appears to be mediated largely via the extent of obesity (BMI) rather than the distribution of obesity (waist/hip ratio). The relationship between alcohol intake and insulin resistance is similar to that between alcohol intake and coronary heart disease.

189 DIABETES AND COGNITIVE FUNCTION IN THE CAERPHILLY STUDY

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Background: Evidence is gathering of an association between diabetes mellitus and cognitive function. Of interest is whether the association is a direct or indirect effect of diabetes.
Method: 2205 men aged 55–69 years who were eligible for inclusion into the third phase of the Caerphilly study were assessed for diabetes, blood glucose and cognitive function, along with other risk factors as