

Gender and socio-economic patterning of self-reported sleep problems in Britain

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Abstract

Sleep is fundamental to health and well-being, yet relatively little research attention has been paid to sleep quality. This paper addresses how socio-economic circumstances and gender are associated with sleep problems. We examine (i) socio-economic status (SES) patterning of reported sleep problems, (ii) whether SES differences in sleep problems can be explained by socio-demographic characteristics, smoking, worries, health and depression, and (iii) gender differences in sleep problems, addressing the relative contribution of SES, smoking, worries, health and depression in explaining these differences. Logistic regression is used to analyse the British *Psychiatric Morbidity Survey 2000*, which interviewed 8578 men and women aged 16 to 74. Strong independent associations are found between sleep problems and four measures of SES: household income, educational qualifications, living in rented housing and not being in paid employment. Income differences in sleep problems were attenuated and no longer significant when health and other characteristics were adjusted. In contrast, the higher odds of poor sleep among the unemployment and those with low education remained significant following adjustment. Women reported significantly poorer sleep than men, as did the divorced and widowed. Gender differences in sleep problems were halved following adjustment for socio-economic characteristics, suggesting that inequalities in socio-economic circumstances play a major part in accounting for gender differences in sleep problems. We conclude that disadvantaged socio-economic characteristics are associated with sleep problems, and that disrupted sleep is potentially one of the mechanisms through which low SES is linked to poor health.

Introduction

Social scientists have paid relatively little attention to quality of sleep, nor have they assessed whether social factors mediate gender differences in sleep quality. This paper examines the British *Psychiatric Morbidity Survey* (Singleton, Bumpstead, O'Brien, Lee & Meltzer, 2001) to better understand gender differences in sleep, and the socio-economic patterning of sleep problems.

It is well-known in sleep research that women report higher levels of sleep complaints than men (Groeger, Zilstra & Dijk, 2004; Landis & Lent, 2006; Sekine, Chandola, Martikainen, Marmot & Kagamimori, 2006; Zhang & Wing, 2006). A meta-analysis of 29 published studies concluded that the overall risk ratio of insomnia was 1.41 for women compared to men (Zhang & Wing, 2006). Biological or physiological sex differences are often identified as explanations for women's higher levels of disturbed sleep (Chen, Kawachi, Subramanian, Acevedo-Garcia & Lee, 2005; Dzaja, Arber, Hislop, Kerkhofs, Kopp, Pollmacher et al., 2005; Manber & Armitage, 1999), and psychological explanations are also prevalent (Lindberg, Janson, Gislason, Bjornsson, Hetta & Boman, 1997). Women have higher levels of depression and anxiety, and research shows that individuals suffering from psychiatric disorders, such as depression and anxiety, have poorer quality sleep (Piccinelli & Wilkinson, 2000; Ustun, 2000). However, sex differences in sleep quality remain after removing the effects of women's higher rates of psychiatric morbidity (Lindberg et al., 1997; Zhang & Wing, 2006).

Studies of sex differences in sleep less frequently consider sociological explanations. Chen et al. (2005: 488) conclude that 'In contrast with explanations emphasising sex differences in biology and prior psychiatric illnesses, the sociological perspective has not been well investigated in the existing literature.' They found that the sex difference in sleep disturbance was reduced after controlling for women's social roles (using marital status, employment status, and number of children under 15 as a proxy for childcare responsibilities). However, women's sleep quality still remained significantly poorer than men's, suggesting the need for research on gender differences using more extensive measures of social roles and socio-economic status (SES). Sekine et al. (2006) found that the gender difference in reported sleep quality

among Japanese civil servants could be entirely explained by gender differences in work characteristics, domestic roles and family-work conflicts. However, it remains unclear whether gender differences can be explained by socio-economic, work and family characteristics among nationally representative population samples.

Epidemiological studies of sleep quality have primarily focused on socio-demographic variables, namely gender, age and marital status (Leger, Guilleminault, Dreyfus, Delahaye & Paillard, 2000; Lichstein, Durrence, Riedel, Taylor & Bush, 2004; Ohayon, Caulet & Guilleminault, 1997; Ohayon 2002). Although, sleep researchers have begun to analyse whether socio-economic circumstances are linked to sleep quality, they rarely examine multiple socio-economic variables. Research has found poor sleep quality associated with lower educational qualifications (Gilles, Lichstein, Scarinci, Heith Durrence, Taylor, Bush et al., 2005; Kietjna, Wojtyniak, Rymaszewska & Stokwiszewski, 2003; Hartz et al; 2007; Moore et al., 2002; Stewart, Besset, Bebbington, Brugha, Lindesay, Jenkins et al., 2006), unemployment (Hartz et al., 2007; Paine, Gander, Harris, & Reid, 2004; Rocha, Guerra, Fernanda & Lima-Costa, 2002), and low income (Hartz et al., 2007; Lauderdale et al., 2007; Hall, Bromberger & Matthews, 1999). These studies have not systematically examined the independent effects of a range of socio-economic variables, nor whether the patterning of SES with sleep quality is mediated by other variables.

As noted by Rocha et al. (2002), it is important to assess whether these SES relationships with sleep quality are confounded by poor health among those with lower SES. Poor physical and mental health is associated with disrupted sleep. A major reason for poorer sleep quality with increasing age is because of chronic ill-health causing pain and discomfort at night, resulting in sleep complaints and disorders (Davidson, MacLean, Brundage & Schulze, 2002; Stewart et al., 2006; Vitiello, Moe & Prinz, 2002), and research has consistently found strong associations between depression and poor sleep quality (Hartz et al, 2007; Lindberg et al., 1997).

Research questions

Researchers have rarely analysed how a diverse range of measures of socio-economic circumstances, such as education, income, housing conditions and employment status,

are related to sleep quality, and whether independent effects of SES remain after adjusting for socio-demographic variables, poor health and depression. It is well-known that women report poorer sleep than men, but researchers have hitherto not addressed to what extent women's more disadvantaged socio-economic status mediates gender differences in sleep quality.

This paper analyses nationally representative British data to answer the following research questions:

- (1) What is the patterning of four measures of socio-economic status with self-reported sleep problems?
- (2) Can the patterning of different socio-economic characteristics with sleep problems be explained by socio-demographic characteristics, smoking, worries, poor health and depression?
- (3) Given the known gender difference in sleep problems, what is the relative contribution of socio-economic characteristics, compared with smoking, worries, poor health and depression, in explaining this gender difference?

Materials and Methods

The paper analyses a British nationally representative cross-sectional interview survey: the 2000 *Psychiatric Morbidity Survey* (Singleton et al., 2001). Home interviews (averaging 1½ hours) were conducted with 8,580 people aged 16-74. A representative sample of addresses was selected from the Postcode Address File with one household member aged 16-74 randomly selected for interview from each sample household. The response rate of 69.5% is high, considering the length and complexity of the interview (Singleton et al, 2001; Stewart et al., 2006). The maximum age is 74 years, therefore our findings cannot be generalised to older people above this age.

Sleep Problems

Sleep problems were measured as part of the revised version of the Clinical Interview Schedule (CIS-R) (Lewis, Pelosi, Araya & Dunn, 1992). Respondents were asked: 'In the past month, have you been having problems with trying to get to sleep or with getting back to sleep if you woke up or were woken up?' Those answering 'Yes',

were asked: ‘On how many of the past seven nights did you have problems with your sleep?’ Three response categories were provided: *None; 1 to 3 nights; 4 nights or more*. The paper analyses a dichotomous variable of reporting sleep problems on 4 or more nights per week (versus less often) as an indicator of frequently experienced sleep difficulties.

Socio-demographic and socio-economic characteristics

The socio-demographic variables analysed are sex, age groups (*16-24, 25-34, 35-44, 45-54, 55-64, 65-74*), marital status (*married/cohabiting, never married, widowed, divorced/separated*) and number of children living in the household (coded as *None, 1, 2, 3 or more*).

The *Psychiatric Morbidity Survey* includes extensive questions on socio-economic characteristics, allowing comparison of four measures of SES: highest educational qualifications, employment status, housing tenure and household income.

Highest educational qualifications were coded into 4 ordinal categories: *Degree level or higher qualifications; Teaching, technical or professional qualifications and A levels* (national examinations taken at 18 and required for university entry); *GCSE/O levels* (national examinations taken at 16) and *Other qualifications* (largely secretarial, trade, apprenticeship or other lower qualifications); and *No educational qualifications*.

Employment status was self-reported as *Full-time employed, Part-time employed, Unemployed* (looking for work in last 4 weeks) or *Economically inactive* (coded from main reason not working in last 4 weeks as retirement, full-time student, household duties, or disability/long-term sick).

Housing tenure is coded as *Owns accommodation; Rents from Public Housing* (Local Authority or Housing Association); *Rents from other sources*, primarily private renting. Housing tenure in Britain provides an indicator of socio-economic disadvantage, since public (or welfare) housing rented from the Local Authority or Housing Associations often represents poor quality housing located in more deprived neighbourhoods.

Household income is measured by the sum of personal gross income from all sources for each household member, equivalised using the McClements Scale (Dept of Work and Pensions, 2002) to take into account differences in number of adults and children

in the household. In this way it is valid to compare ‘equivalised household income’ for different respondents irrespective of their household size or structure. Income was coded into 5 income ranges: the lowest category (<£150 per week) comprises 20% of the whole sample, and the highest (>£750 per week) comprises 12%.

Measures of other variables

Smoking was categorised as *Never smoked*, *Ex-smoker* and *Current smoker*.

Alcohol consumption was measured by asking respondents: ‘How often had alcohol in the past year?’ with response categories of *Never*, *Monthly*, *2-4 times a month*, *2-3 times a week*, and *4 or more times a week*.

Self-reported data about *worries* (in general), *worries about health*, and *depression* were obtained using the CIS-R symptom scores (Lewis et al., 1992). For each of these measures, interviewees were asked if they had experienced 4 different symptoms in the last 7 days. In each case, this was scored as *None*, *Medium* (1 symptom reported), and *High* (2 or more symptoms reported).

Self-rated (or self-assessed) health is used extensively in research on determinants of health, and is a good predictor of mortality and general health (Ferraro & Farmer, 1999; Idler & Benyamini, 1997). Self-rated health was measured by asking: ‘How is your health in general? Would you say your health is Excellent, Very Good, Good, Fair or Poor?’ These were recoded into *Very good* (representing excellent or very good), *Good* and *Poor* (representing fair or poor).

Number of chronic illnesses was measured by asking; ‘Do you have any long-standing illnesses, disability or infirmity? By long-standing I mean anything that has troubled you over a period of time or that is likely to affect you over a period of time.’

Respondents self-reporting ‘Yes’, were asked ‘What is the matter with you?’ and each health problem mentioned was recorded. The total number of long-standing health problems self-reported were summed, and recoded as *None*, *1,2, 3 or more*.

Statistical analysis

The proportions of men and women reporting sleep problems on 4 or more nights a week are analysed for each of the above variables, with chi-squared probability values reported (Tables 1-2). Hierarchical logistic regression models are presented to examine the three research questions addressed in the paper.

Statistical analyses were performed using SPSS (version 13, SPSS, Inc., Chicago, IL). Statistical tests used .05 (2 tailed) significance levels. To allow both the strength and precision of the relationships to be better assessed, results are presented as odds ratios (OR) with their associated 95% confidence intervals (CI). Checks were performed to ensure that there was no significant multicollinearity between the variables in the models; Tolerance, Variance Inflation Factors and Condition Indices were all within an acceptable range. Nagelkerke's Pseudo R² is presented to give an indication of the variance explained by each model.

Results

Sex differences in sleep quality – bivariate analyses

We first examine the proportion of men and women reporting sleep problems on 4 or more nights per week in relation to socio-demographic, socio-economic, health and other variables. More women (20%) than men (14%) report sleep problems on 4 or more nights per week (Table 1). A significant relationship with age is found for women but not for men. The highest proportion of women reporting sleep problems are age 45-54 (24%) with a modest decline above this age. The divorced/separated report the worst sleep among both women (27%) and men (26%), followed by the widowed (26% women, 21% men).

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Table 1 about here
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Significant associations with sleep problems are found for each measure of socio-economic status among both women and men, with strong linear gradients for educational qualifications and household income. Only 10% in the highest income group report poor sleep compared with 25% in the lowest income group, and only 12% who have a degree report sleep problems compared with 22% with no qualifications. The unemployed (22%) and the economically inactive (25%) are more likely than the full-time employed (12%) to report sleep problems. Nearly twice as many Local Authority (public) housing residents report sleep problems (26%) than those owning their home (15%). The pattern of socio-economic differentials in sleep quality is comparable for both men and women.

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Table 2 about here
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Smokers report higher levels of sleep problems (22%) than non-smokers and ex-smokers (15%), Table 2. A higher proportion of respondents who ‘never’ drink alcohol report sleep problems (23%), with the lowest proportions among those drinking 2-3 times per week (15%). However, alcohol consumption was not statistically significant in the hierarchical logistic regression analysis (Model 4), therefore alcohol is not included in the multivariate analyses (Table 3). As expected, there are strong linear associations of sleep problems with self-reported health and number of chronic illnesses (Table 2). Men and women who report more worries, health worries, and depression are much more likely to report poor sleep.

Socio-economic differences in reported sleep problems

Logistic regression is used to examine the effects of four socio-economic status variables (income, housing tenure, employment status, education) on reported sleep problems. Figure 1 shows the odds ratios of sleep problems for each socio-economic variable following adjustment for sex and age (10 year groups), contrasted with the ‘fully-adjusted’ model, which also adjusts for marital status, number of children, the other 3 socio-economic variables, smoking, worries, depression and the health variables.

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Figure 1 about here
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In each case, individuals with disadvantaged socio-economic status (SES) report more sleep problems than those living in more advantaged circumstances (following age-adjustment). There is a strong linear gradient of household equivalised income with sleep quality (Figure 1a). Those with an income of <£150 per week have an ‘age-adjusted’ odds ratio (OR) for sleep problems of 2.94 (CI:2.33-3.72) compared with the highest income group of >£750 per week (OR=1.0). However, once the model is ‘fully-adjusted’ by controlling for all other variables, there is no significant association of income with sleep problems. Regarding housing tenure, those living in

public housing have an age-adjusted OR of 2.08 (CI:1.82-2.38) of sleep problems compared to OR=1.62 (CI:1.32-1.98) for living in private rental accommodation and owner occupiers (OR=1.0) (Figure 1b). There is no longer a statistically significant association between housing tenure and sleep problems, once the model is fully-adjusted for other variables.

The age-adjusted model for employment status shows a high OR of sleep problems among the unemployed (OR=2.25, CI:1.65-3.07) and the economically inactive (OR=2.65, CI:2.27-3.09) (Figure 1c). After fully adjusting for other socio-demographic and socio-economic variables, smoking, worries, health and depression, a statistically significant odds of sleep problems remains for both the unemployed (OR=1.55) and the economically inactive (OR=1.43).

The linear gradient of sleep problems with highest educational qualifications shows that individuals with no qualifications have an age-adjusted OR=1.97 (CI:1.60-2.41) compared to those with a degree (OR=1.00, Figure 1d). This gradient reduces after fully-adjusting for other variables, but a significantly higher OR of sleep problems remains for those with no qualifications and with lower qualifications (OR=1.32).

This section has shown strong associations of four separate SES variables with poor quality sleep. For educational qualifications and employment status, statistically significant differences remain after adjusting for all SES variables, socio-demographic variables, smoking, worries, and health variables.

Mediation of SES patterning of sleep problems

We now address our second research question of whether other variables mediate the association between SES variables and sleep problems using hierarchical logistic regression models (Table 3, n=8240). The order of variables entered into the models reflects an *a priori* judgement of the primary causal ordering between variables. Age and sex are prior variables (Model 1), followed by inclusion of marital status and number of children in Model 2. The primary direction of causation assumes that SES has an effect on smoking, worries, health and depression, therefore the four SES characteristics (income, education, housing tenure, employment status) are included in

Model 3. Smoking and worries are assumed to be causally prior to health status and included in Model 4, with the health variables and depression included in Model 5.

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Table 3 about here
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The independent effects of each of the four socio-economic characteristics on sleep problems are shown in Model 3 after adjusting for age, marital status, number of children and the other three socio-economic variables. The four SES variables each has a statistically significant independent association with sleep problems, demonstrating in each case that the more socially disadvantaged report poorer sleep (even after adjusting for the other 3 SES measures).

Worries and smoking (adjusted in Model 4) and the health variables (Model 5) are mediators of the relationship between each SES measure and poor sleep quality. Low income has a significant effect on sleep quality independent of the other 3 SES variables, but this becomes non-significant after adjusting for smoking and worries (Model 4). The high odds of reported poor sleep among residents of public housing in Model 3 becomes partially attenuated after adjusting for smoking and worries. This suggests that a reason for sleep problems among people living on low incomes and in public rented housing is because of increased stress and worries associated with their disadvantaged living circumstances. The relationships between living in rented housing and sleep problems are further attenuated and become non-significant after adjusting for health and depression (Model 5), suggesting that people living in rented housing are more likely to have poor physical and mental health, which contributes to explaining their poorer sleep.

Being unemployed or economically inactive is associated with sleep problems (Model 3). The odds ratio for the unemployed reduces slightly following adjustment for worries and smoking, but remains unchanged following adjustment for the health variables (including depression). This contrasts with the economically inactive, where substantial attenuation in the OR only occurs following adjustment for health variables (Model 5), but not in model 4 following adjustment for worries and

smoking. Following full adjustment in Model 5, the unemployed and economically inactive retain significantly elevated odds of sleep problems.

Educational qualifications are linked to reported sleep problems with significantly higher odds ratios for respondents with no qualifications. However, these associations with sleep problems become *greater* in Model 4 after adjusting for smoking and worries, and remain significant following adjustment for health variables, indicating that education is independently associated with sleep problems, which cannot be explained by other factors.

The overall predictive power of the models can be assessed by comparing the change in LogLikelihood ratios and the Nagelkerke R square (or 'pseudo' R square). Age and gender have little predictive power ($R^2=.017$), which increases only marginally with the addition of marital status and number of children (Model 2). The four socio-economic status characteristics increase the R^2 from .03 to .075, indicating the relatively greater predictive power of SES than socio-demographic factors in relation to sleep problems. The addition of worries and smoking in Model 4 substantially increases explained variance in sleep problems from 7.5% to 16.4%. A large increase in explained variance also occurred when health variables were added in Model 5 ($R^2=.24$).

Gender differences in sleep problems

Our third research question examines the relative contribution of SES, smoking, worries, self-reported health and depression in mediating gender differences in sleep problems.

Women report more sleep problems than men (OR=1.49) after adjusting for age (Model 1, Table 3). The OR falls to 1.42 when marital status and number of children are included in Model 2. When the four SES indicators are included in Model 3, there is a much larger reduction in the gender difference (OR=1.23) suggesting that half of the greater sleep problems of women can be explained by their more disadvantaged socio-economic circumstances than men. The odds ratio falls further when smoking and worries are included in Model 4 (OR=1.17). However, adjustment for the three health variables and depression does *not* moderate the gender difference, which in fact

increases (OR=1.27). This suggests that the higher level of sleep problems among women than men is not due to women being more likely than men to have poor self-assessed health, more chronic illnesses or depression. Therefore, our findings suggest that a substantial part of the gender difference in sleep problems is linked to women's more disadvantaged socio-economic circumstances.

Discussion

This analysis of a British nationally representative survey of over 8,000 men and women aged 16-74 has demonstrated strong linkages between disadvantaged socio-economic circumstances and sleep problems. Low educational qualifications, low household income, living in public rented housing and not being in paid work are all independently associated with reported sleep problems. A linear gradient is found between sleep problems and both household income and highest educational qualifications.

In relation to our second research question, the association between sleep problems and both household income and housing tenure is fully mediated by differences in other SES characteristics, smoking, worries, health and depression. However, the unemployed, economically inactive, and those with low educational qualifications, report significantly poorer sleep even after adjusting for the full range of other potential mediators.

We show a comparable gender difference in poor sleep to that identified in other studies (Zhang & Wing, 2006). Regarding our third research question, this gender difference is halved after adjustment for SES, indicating that a major reason for women's greater level of sleep problems relates to their more disadvantaged socio-economic circumstances. This partially confirms Sekine et al. (2006) who found the gender difference in sleep quality among Japanese civil servants could be entirely explained by gender differences in work conditions, domestic roles and family-work conflicts. Our findings, and those of Sekine et al., therefore cast doubt on the importance of a physiological basis for the sex difference in reported sleep quality, while supporting explanations associated with gender, in particular the differential social roles and socio-economic characteristics of men and women.

Worries are implicated in the gender difference in sleep problems. Women's sleep is more likely to be disturbed by worries, particularly associated with their gender role as mothers or wives, and their concern for the well-being of family members (Hislop & Arber, 2003a; Arber, Hislop, Bote & Meadows, 2007). Previous sleep research has tended to view 'worries' as a mark of anxiety or psychological problems, rather than embedded within social roles and responsibilities. Worries and concerns represent an important predictor of sleep problems, but retain an independent effect after controlling for health and depression. In addition, our analysis suggests that differences in health status between men and women do *not* explain the gender difference in sleep problems. Indeed, the gender difference becomes greater after adjusting for health variables and depression (Model 5).

Our research supports other studies that have found poorer sleep quality among those with low educational qualifications (Kietjna et al., 2003; Moore et al., 2002; Rocha et al., 2002; Stewart et al., 2006), who are not working (Paine et al., 2004; Rocha et al., 2002), and with low income (Lauderdale et al., 2006; Friedman, Love, Rosenkranz, Urry, Davidson, Singer et al., 2007). However, our study goes beyond existing research in two ways. First, by using representative national data to simultaneously consider the independent effects of four SES variables (income, education, employment status, housing tenure). Second, it addresses previous observations (Rocha et al., 2002) that the higher prevalence of insomnia among individuals with low education, not working and with low income may be confounded by poor physical and mental health, through examining models containing health measures and depression.

We consider the *relative importance* of different sets of factors in leading to sleep disruption. 'Worries' were confounded with socio-economic characteristics; the relationships between sleep problems and living on a low income or living in rented housing were partially mediated through worries and concerns. After adjusting for smoking, worries, health and depression, a significant independent association still remained between sleep problems and both low education and not being in paid work. Lack of employment is linked to sleep problems in two ways; for the unemployed,

primarily through its intrinsic relationship with worries, while for the economically inactive, primarily because of their poorer health status.

Explaining the SES gradient in sleep quality

Several types of mechanisms may underlie the patterning found in this paper between low SES and reported sleep problems:

- (i) *Structural disadvantage.* Living in adverse material circumstances leads to direct effects on sleep quality. In crowded living environments, family members may disturb each other's sleep. Low SES is associated with living in smaller, poorer quality housing, e.g. with fewer and more shared bedrooms, and greater likelihood of having to sleep 'on the sofa' in the event of snoring or other partner disturbance (Venn, 2007). Poor quality housing, e.g. in flats with insubstantial walls may result in night-time disturbance through noise from neighbours, which is unlikely in more salubrious areas of detached housing. Low SES is also associated with living in disadvantaged neighbourhoods (Paine et al., 2004) and areas with greater problems of noise, crime, anti-social behaviour, safety and security, which may directly compromise sleep quality.
- (ii) *Psychological distress associated with structural disadvantage.* Low SES, particularly being unemployed, living in poor housing, living in disadvantaged neighbourhoods, lacking access to transportation, and living on a low income, are likely to lead to greater levels of worries, anxieties, and psychological distress, which in turn impact on sleep problems. Coping with these adverse social circumstances may have direct physiological consequences affecting blood pressure, stress hormones and emotional wellbeing, all of which are associated with sleep quality. There are therefore indirect effects of SES on sleep quality through the mediating factors of worries, psychological distress and emotional wellbeing.
- (iii) *Lifestyle – individual behaviours.* Low SES is linked to individual lifestyle behaviours (such as smoking, alcohol consumption and exercise), which may in turn adversely affect sleep quality. However, our analyses found no association between alcohol consumption and sleep (in the multivariate models), and only modest links between smoking and sleep problems.

- (iv) *Education and knowledge of sleep promoting strategies.* Higher educational level may be associated with greater knowledge about sleep hygiene practices and more awareness of the strategies that can be used to improve sleep. The more educated may also be more proactive in their attempts to use various personalised strategies to enhance their sleep quality (Hislop & Arber, 2003b), as well as having greater recognition of the importance of sleep for health and well-being (e.g. through reading media articles or the internet).

Our analyses lend support to a combination of explanations (i), (ii) and (iv). There is less support for individual lifestyle factors (explanation iii) as a mediator between low SES and poor sleep quality. Explanations (i) and (ii) are relevant for interpreting the links between sleep problems and income and housing. Explanation (ii) which links low SES through psychological stress to compromised sleep, has some support, since variations in sleep problems with income, housing and unemployment are moderated by the inclusion of worries in Model 4. Within our study, educational qualifications continue to have a significant relationship with sleep quality in Model 5 even after adjustment for health, worries, and other SES variables. Explanation (iv) is relevant in accounting for this education-sleep linkage.

SES, sleep problems and health

Although our data (in Model 5) show a strong association between poor health and sleep problems, it is not possible to make a clear assessment of the direction of causation between ill-health and sleep quality from this cross-sectional survey.

It is well-known that poor health status and associated pain lead to disturbed and poor quality sleep (Davidson et al., 2002; Spiegel, Leproult & Van Cauter, 1999; Vitiello et al., 2002). However, increasing evidence from prospective studies shows that disrupted sleep and short sleep duration (under 6.5 hours) are implicated in higher levels of diabetes, obesity, hypertension and mortality (Ayas, White, Al-Delaimy, Manson, Stamfer, Speizer et al, 2003; Ferrie, Shipley, Cappuccio, Brunner, Miller, Kumari et al., 2007; Gangwisch, Heymsfield, Boden-Albala, Buijs, Kreier, Pickering et al., 2007; Patel, Ayas, Malhotra et al., 2004; Tamakoshi & Ohno, 2004; Yaggi, Araujo & McKinlay, 2006). Experimental laboratory research has also shown that chronic sleep deprivation (restricted to 4 hours of sleep for 6 nights) results in

significant changes in carbohydrate metabolism, decreased glucose tolerance, elevated evening cortisol levels and increased sympathetic activity, indicating that sleep loss can increase 'allostatic load', facilitating the development of chronic conditions, such as obesity, diabetes and hypertension (Spiegel et al., 1999; Van Cauter & Spiegel, 1999). While our research confirms strong associations between sleep problems and self-assessed health, health worries, number of chronic illnesses and depression, longitudinal studies are required to clarify the predominant directions of causality.

A large corpus of research shows that low SES is strongly related to morbidity, mortality and biological risk factors (Backlund, Sorlie & Johnson, 1999; Banks, Marmot, Oldfield & Smith, 2006; Braveman, Cubbin, Egerter, Chideya, Marchi, Metzler, 2005; Fritzell & Lundberg, 2007; Seeman, Merkin, Crimmins, Koretz, Charette & Karlamangla, 2008; Shishehbor, Litaker, Pothier & Lauer, 2006).

Extensive research on health inequalities has clearly demonstrated that the primary direction of causality is that of 'social causation' with strong effects of low SES on ill-health, and only modest support for 'reverse causation', 'social drift' or 'social selection' in which poor health is implicated in low SES (Backlund et al., 1999; Davey-Smith, 2003; Fritzell & Lundberg, 2007).

Some researchers (Friedman et al., 2007; Hall et al., 1999; Patel et al., 2006; Van Cauter & Spiegel, 1999) have argued that part of the mechanism underlying research findings that link low SES to poor health may be through the intermediary pathway of poor sleep quality. Our findings would lend support to this linkage, but in order to assess this hypothesis, prospective studies are required to identify the magnitude of relationships and directions of causation among the three sets of variables - socio-economic status, health and sleep quality.

Conclusions

There are strong independent associations between multiple measures of socio-economic disadvantage and sleep problems, namely low income, low educational qualifications, living in public housing and not being in paid work. Disadvantaged SES is associated with increased sleep problems, which is likely to be through the intermediary mechanisms of psychological stress, worries, and poor health. However,

the independent associations between sleep problems and both low education and not being in paid work could not be explained by other factors.

A large part of the well-known gender difference in reported sleep problems is mediated by the more disadvantaged SES of women, casting doubt on the primacy of physiological explanations of this gender difference. A substantial proportion of the higher reported sleep problems of the divorced and widowed can also be accounted for by their more disadvantaged SES. In turn, SES is shown to impact on psychological distress and worries, which form part of the mechanism through which disadvantaged SES impacts on sleep problems.

Our findings that people with more disadvantaged SES report greater sleep problems needs further consideration by health researchers. First, it is important to undertake detailed research to identify what factors associated with low SES are causally implicated in sleep problems in order to identify the nature of the underlying causal mechanisms. Second, there is a need for prospective studies which examine a wide range of SES variables, measures of health status, and quality of sleep in order to better assess the causal ordering between SES, health and sleep quality. Third, clinical sleep researchers acknowledge the importance of including controls for sex, age and health status of subjects within sleep studies. However, invalid conclusions may be drawn in experimental research if treatment and control groups vary in their SES composition. When conducting laboratory and community-based trials related to sleep, our findings suggest that it may be relevant to control (or match) for educational level, income or other measures of SES, or randomise in order to naturally control for SES.

Research on health inequalities has hitherto paid scant attention to the social patterning of disrupted sleep. Our research has shown strong linkages both between socio-economic variables and sleep quality and between health variables and sleep quality. This suggests that disrupted sleep may potentially be one of the mechanisms through which low socio-economic status leads to increased morbidity and mortality.

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Table 1. Proportion reporting poor sleep on 4 or more nights a week by demographic and socio-economic variables by gender, age 16-74

	Men		Women		Total	
	%	n=	%	N=	%	n=
All	14.2	3852	19.7	4727	17.2	8578
Age						
16-24	10.9	385	15.9	409	13.5	794
25-34	12.9	711	15.7	972	14.6	1683
35-44	13.2	823	17.5	1024	15.6	1847
45-54	15.1	747	24.2	798	19.8	1545
55-64	16.7	646	22.0	796	19.6	1442
65-74	15.4	539	22.9	728	19.7	1267
p=	0.091		0.000		0.000	
Marital Status						
Married	12.5	2356	18.0	2739	15.5	5095
Single	12.4	937	15.8	849	14.0	1786
Widowed	21.4	131	25.9	432	24.9	563
Divorced/Separated	25.5	427	27.2	707	26.5	1134
p=	0.000		0.000		0.000	
Number of children						
No children	15.2	2816	20.4	3096	17.9	5912
1 child	13.2	440	19.1	650	16.7	1090
2 children	9.3	454	18.5	701	14.9	1155
3+ children	13.5	141	16.4	280	15.4	421
p=	0.008		0.303		0.055	
Highest Educational Qualifications						
Degree	9.4	662	14.7	577	11.9	1239
Professional, A Level	10.7	857	17.2	886	14.0	1743
GCSE or equivalent	15.2	1248	17.9	1719	16.8	2967
No qualifications	18.7	1047	25.1	1517	22.5	2564
p=	0.000		0.000		0.000	
Employment Status						
Working full time	10.2	2353	14.5	1463	11.8	3816
Working part time	11.6	285	16.0	1168	15.1	1453
Unemployed	20.5	146	24.6	114	22.3	260
Economically inactive	23.1	1031	25.5	1954	24.7	2985
p=	0.000		0.000		0.000	
Household Equivalised Income per week £						
<£150	24.9	574	25.7	1082	25.4	1656
£150<300	16.7	930	19.8	1361	18.5	2291
£300<500	11.2	976	18.2	1060	14.8	2036
£500<750	10.0	661	16.8	588	13.2	1249
£750 or more	9.2	564	11.9	463	10.4	1027
p=	0.000		0.000		0.000	
Housing Tenure						
Owned	11.2	2778	17.7	3283	14.7	6061
Rented - Private sources	17.8	371	19.7	407	18.8	778
Rented - Local Authority/Housing Association	24.7	655	26.5	1002	25.8	1657
p=	0.000		0.000		0.000	

Source: *Psychiatric Morbidity Survey, 2000* (authors' analysis)

Table 2. Proportion reporting poor sleep on 4 or more nights a week by smoking, worries and health variables by gender, age 16-74

	Men		Women		Total	
	%	n=	%	n=	%	n=
Cigarette Smoking						
Smoker	19.0	1162	24.4	1402	22.0	2564
Ex Smoker	12.0	1808	18.3	1938	15.3	3746
Never Smoked	12.3	877	16.8	1383	15.0	2260
p=	0.000		0.000		0.000	
Alcohol in past year						
Never	19.6	341	25.1	677	23.3	1018
Monthly	16.6	447	21.8	1014	20.2	1461
Two to four times a month	13.2	827	17.9	1212	16.0	2039
Two to three times a week	12.5	1362	17.0	1195	14.6	2557
Four or more times a week	14.3	855	18.8	606	16.2	1461
p=	0.006		0.000		0.000	
Self-reported Health						
Very Good or Excellent	7.0	2111	12.3	2473	9.8	4584
Good	13.4	972	20.4	1253	17.3	2225
Fair or poor	35.1	767	37.4	999	36.4	1766
p=	0.000		0.000		0.000	
Health worries						
No	10.0	3228	15.3	3909	12.9	7137
Medium	28.4	342	33.7	466	31.4	808
High	45.6	281	49.7	352	47.9	633
p=	0.000		0.000		0.000	
Depression						
No	9.2	3119	13.5	3630	11.5	6749
Medium	28.9	311	32.0	516	30.8	827
High	40.6	421	47.7	581	44.7	1002
p=	0.000		0.000		0.000	
Number of chronic illnesses						
0	8.3	2108	12.7	2442	10.7	4550
1	16.7	1099	21.4	1296	19.2	2395
2	22.0	381	28.7	575	26.0	956
3 or more	40.0	260	44.0	411	42.5	671
p=	0.000		0.000		0.000	

Source: *Psychiatric Morbidity Survey 2000* (authors' analysis)

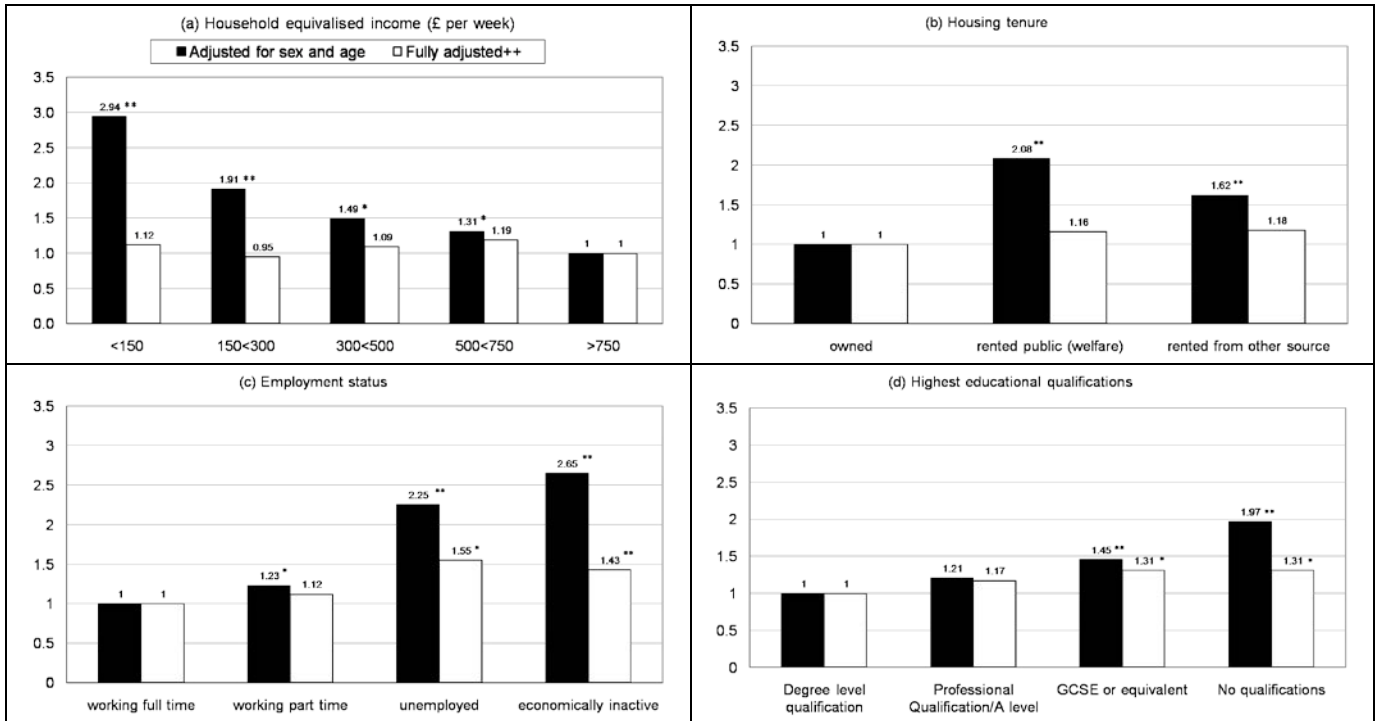
**Table 3. Odds ratios of reported sleep problems on 4 or more nights per week
(n=8240)**

	Model 1 Age + Sex		Model 2 Demographic		Model 3 Socio-economic		Model 4 Worries/smoking		Model 5 Health	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex										
Male	1.00		1.00		1.00		1.00		1.00	
Female	1.49**	1.33-1.68	1.42**	1.26-1.60	1.23**	1.08-1.40	1.17*	1.02-1.33	1.27**	1.11-1.46
Age										
16-24	1.00		1.00		1.00		1.00		1.00	
25-34	1.06	0.83-1.36	1.02	0.79-1.33	1.24	0.94-1.62	1.21	0.91-1.60	1.03	0.78-1.37
35-44	1.17	0.92-1.49	1.07	0.82-1.40	1.36*	1.03-1.79	1.35*	1.01-1.79	1.01	0.75-1.36
45-54	1.60**	1.26-2.04	1.39*	1.05-1.83	1.56**	1.17-2.08	1.65**	1.23-2.22	1.21	0.89-1.66
55-64	1.51**	1.18-1.94	1.28	0.95-1.71	1.06	0.78-1.44	1.36	0.98-1.86	1.06	0.76-1.49
65-74	1.56**	1.22-2.01	1.30	0.96-1.76	0.81	0.58-1.12	1.25	0.88-1.76	1.09	0.76-1.57
Marital status										
Married/cohabiting			1.00		1.00		1.00		1.00	
Single			1.00	0.83-1.20	0.82*	0.68-1.00	0.86	0.70-1.05	0.86	0.70-1.06
Widowed			1.52**	1.21-1.92	1.26	1.00-1.59	1.23	0.97-1.58	1.21	0.94-1.60
Divorced/Separated			1.86**	1.58-2.17	1.43**	1.20-1.69	1.35**	1.13-1.61	1.27**	1.05-1.53
Children in home										
None			1.00		1.00		1.00		1.00	
1			1.03	0.85-1.25	0.92	0.75-1.12	0.94	0.76-1.16	1.05	0.85-1.31
2			0.92	0.75-1.13	0.77*	0.62-0.96	0.80	0.64-1.00	0.99	0.78-1.25
3 or more			0.88	0.66-1.20	0.58**	0.42-0.79	0.59**	0.43-0.82	0.80	0.57-1.12
Household Income										
<£150 per week					1.47**	1.11-1.95	1.32	0.99-1.77	1.12	0.82-1.51
£150<300 per wk					1.28	0.99-1.66	1.19	0.91-1.56	0.95	0.72-1.26
£300<500 per wk					1.26	0.98-1.61	1.24	0.96-1.60	1.09	0.84-1.42
£500<750 per wk					1.25	0.96-1.63	1.24	0.94-1.62	1.19	0.90-1.57
>£750 per week					1.00		1.00		1.00	
Housing Tenure										
Owned					1.00		1.00		1.00	
Rented-private					1.35**	1.10-1.67	1.22	0.98-1.52	1.19	0.94-1.50
Rented-public					1.43**	1.22-1.68	1.32**	1.11-1.56	1.16	0.97-1.38
Employment										
Full-time					1.00		1.00		1.00	
Part-time					1.18	0.97-1.43	1.18	0.97-1.44	1.12	0.91-1.38
Unemployed					1.65**	1.18-2.32	1.58*	1.10-2.24	1.55*	1.07-2.24
Inactive					2.14**	1.79-2.56	2.06**	1.71-2.48	1.43**	1.17-1.74
Educational Qualifications										
Degree					1.00		1.00		1.00	
Prof, tech, A Level					1.11	0.88-1.40	1.16	0.92-1.47	1.17	0.91-1.50
GCSE or equiv.					1.24	1.00-1.54	1.33*	1.06-1.66	1.31*	1.04-1.65
No qual.					1.36*	1.07-1.71	1.46**	1.15-1.86	1.31*	1.02-1.69
Cigarette smoking										
No							1.00		1.00	
Ex-Smoker							0.98	0.83-1.14	1.00	0.84-1.17
Smoker							1.24*	1.04-1.46	1.13	0.95-1.35
Worries										
No							1.00		1.00	
Medium							2.09**	1.77-2.47	1.62**	1.36-1.93
High							4.67**	4.05-5.39	2.34**	1.98-2.76
Subjective Health										
Very good									1.00	
Good									1.23**	1.04-1.45
Poor									1.76**	1.45-2.13
Health worries										
No									1.00	
Medium									1.66**	1.37-2.00
High									2.11**	1.72-2.60
No. of Chronic Illnesses										
0									1.00	
1									1.26**	1.07-1.48
2									1.40**	1.12-1.73
3 or more									2.04**	1.60-2.60
Depression										
No									1.00	
Medium									1.86**	1.54-2.25
High									2.48**	2.07-2.98
-2 Log likelihood	7481.59		7415.25		7186.16		6711.49		6268.64	

Δdf	6	6	12	4	9
Nagelkerke R Square	.017	0.030	0.075	0.164	0.242

* $p < .05$, ** $p < .01$ Source: *Psychiatric Morbidity Survey, 2000* (authors' analysis)

Figure 1. Odds ratios of sleep problems on 4 or more nights per week by 4 socio-economic status variables (n=8240)



++Fully adjusted for sex, age (10 year age groups), marital status, number of children, income, housing tenure, employment status, education, smoking, worries, subjective health, number of chronic illnesses, health worries, depression; *p<.05 **p<.01;

Source: *Psychiatric Morbidity Survey, 2000*, (authors' analysis)

