Epidemiology of Insomnia: a Longitudinal Study in a UK Population

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Study Objectives: To investigate the incidence, persistence, and consequences of insomnia and their associations with psychological health and pain.

Design: A population based, longitudinal, cohort study using postal questionnaires at baseline and 12-month follow-up. Sleep problems in the past month were assessed using 4 questions: insomnia was defined as having at least 1 of the sleep problems "on most nights." Questions about psychological health, presence of pain at different sites, and demographic details were included in the questionnaire.

Setting: Five general practices in Staffordshire, UK.

Participants: The questionnaire was mailed to a random sample of 4885 adults aged 18 years and over registered with these practices. There were 2662 questionnaires returned.

Results: Of the responders, 2363 completed all 4 sleep questions at baseline: 870 (37%) had insomnia and 1493 (63%) did not have insomnia. Of those without insomnia at baseline, the incidence of insomnia at 12 months was 15%, and this was significantly associated with baseline anxiety, depression, and pain. Of those who did have insomnia at baseline, 69% had insomnia at 12-month follow-up; persistence of insomnia was significantly associated with older age. Insomnia at baseline was significantly associated with incidence of anxiety, depression, and widespread pain at 12-month follow-up.

Conclusions: Insomnia is common and often persistent. Older people appear more vulnerable to persistent symptoms. Our results provide evidence that the common problems of insomnia, pain, and psychological distress are intertwined and suggest that combined approaches to treatment may be needed to reduce the onset and persistence of these problems in the community.

Keywords: Epidemiology, incidence, longitudinal studies, prevalence, sleep initiation and maintenance disorders

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INTRODUCTION

INSOMNIA IS COMMON AND INCLUDES SYMPTOMS SUCH AS DIFFICULTY FALLING ASLEEP OR STAYING ASLEEP, EARLY MORNING WAKENING, AND SLEEP dissatisfaction, as well as daytime consequences such as tiredness.[1] Studies of general-population samples have found the prevalence of insomnia to range between 10% and 48%.[2,3] Much of this variation in prevalence may be explained by the use of different definitions of insomnia in these studies.[1]

Insomnia can have important consequences for sufferers and may impact on health, work, and quality of life. Such associations include the development of depression,[2] increased use of health care services[4,5] and a higher risk of motor vehicle accidents.[6] In addition, studies looking at the relationship between insomnia and work have found associations with absenteeism, decreased concentration, impaired work performance and work related accidents.[5,7]

Cross-sectional studies of insomnia have consistently found female sex,[1,2,8] mental health problems,[2,4,9,10] and physical health problems[11-14] to be associated with an increased prevalence. A link between increasing age and insomnia has been reported,[1,4] although this finding is not consistent.[8,15,16] A small number of epidemiologic studies have looked at the relationship between pain and insomnia.[15,17]

Although there are numerous cross-sectional studies investigating prevalence of insomnia in the USA[11,18-20] and Europe,[3,4,16,21-25] including the UK,[9] less is known about the onset and natural history of insomnia. Many of these studies have highlighted factors associated with prevalent insomnia, and it is not clear what is cause and effect or whether the factors are linked with the onset or persistence of the problem. Longitudinal studies can help to unravel these associations.

The aims of this study were to investigate the incidence and persistence of insomnia and factors associated with these, and insomnia as a risk factor for anxiety, depression, and pain, in a longitudinal study of an adult, UK, general-population sample.

MATERIALS AND METHODS

Study Population and Design

A postal survey of a population aged 18 years and over was carried out using a self-completion questionnaire. The primary focus of the study was on headache, but the survey contained a wide range of questions, including items addressing sleep problems.[26] The adult population registered with 5 general practices in the UK, covering a mix of urban and rural areas, provided the sampling frame. One thousand patients were randomly selected from each practice register. More than 95% of people in the UK are registered with a general practitioner (regardless of whether they consult or not), and practice registers provide a convenient frame for sampling the local population. Doctors from the practices checked the selected patients for exclusions. One hundred and fifteen patients were excluded, the majority because they had died or left the practice (because they moved) in the 6 weeks between obtaining the sample and conducting the mailing, and a small proportion because they were in the hospital at the time

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This was not an industry supported study. Drs. Morphy, Dunn, Lewis, Boardman, and Croft have reported no financial conflicts of interest.

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of the survey or were suffering from serious mental illness. This meant that 4885 questionnaires were sent out at baseline. Ethical approval for the study was obtained from the Local Research Ethics Committee.

Data were collected using self-completion questionnaires, mailed with a study information leaflet, a letter from the general practice, and a form requesting consent to further involvement in the study. Reminders were sent to nonrespondents at 2 and 5 weeks.[26] The baseline questionnaire was mailed in April 2000, and a follow-up questionnaire (repeating the same questions) was sent 1 year later to those people who responded to the first questionnaire and who consented to further involvement.[27] Further details of the survey have been reported elsewhere.[26-28]

Questionnaire

The questionnaire included sections on general health, demographics, and headache. It included the Hospital Anxiety and Depression Scale as a measure of anxiety and depression[29]; this instrument has been validated and shown to be useful in identifying depression and anxiety in general-population samples.[30,31] The Hospital Anxiety and Depression Scale was scored according to a preassigned classification of "noncase" (score 0-7), "possible case" (score 8-10), and "probable case" (score 11 and over) for the separate dimensions of anxiety and depression, as specified by the authors.[29] A blank body manikin (with front and back views) asking participants to shade areas of any aches or pains lasting for 1 day or more in the previous month was used to identify number of pain areas (ranging from 0 to 7). This was classified according to criteria of Macfarlane[32] with the addition of the head area. Due to the underlying ordinal nature of the scale and the fact that subgroup analyses will result in small frequency counts in certain cells, number of pain area categories were grouped as 0, 1, 2 to 3, and 4 to 7. The reliability of questions on headache, bodily pain, anxiety, depression, and sleep problem was examined as part of the wider study; they were found to be reliable for use in the general population.[33]

Questions about employment status and occupation (own and partner) were used to determine social class. Social class was grouped as I—professional, II—managerial and technical, IIIN—nonmanual skilled, IIIM—manual skilled, IV—partly skilled, and V—unskilled. Groups I to IIIN were then classed as nonmanual and IIIM to V as manual.[34,35]

There were 4 questions relating to sleep, based on work by Jenkins et al.[36] These were: "Over the last month did you: (a) have trouble falling asleep, (b) wake up several times per night, (c) have trouble staying asleep, and (d) wake up after your usual amount of sleep feeling tired and worn out?" There were 3 possible responses to each question—"not at all," "on some nights," and "on most nights." Our main definition of insomnia was based on respondents answering 1 or more questions "on most nights." Since expert opinion differs regarding the classification of insomnia, particularly relating to the issue of nonrestorative sleep, we also carried out a sensitivity analysis of our data in relation to 2 other plausible definitions of insomnia. The first reclassification was based on having problems "on most nights" according to 1 or more of the nighttime symptoms only (trouble falling asleep and/or wake up several times per night and/or trouble staying asleep), ie, excluding the daytime symptom (wake up feeling tired and worn out). The second reclassification defined insomnia as endorsing 1 or more of the 3 nighttime symptoms "on most nights" and the daytime symptom "on most nights."

Analysis

Three separate analytical approaches were carried out to investigate the associations with insomnia. The first analysis (incidence analysis) estimated the incidence and risk factors for the development of insomnia and included participants who responded to both the baseline and 1-year follow-up questionnaires and who had no insomnia at baseline. The second analysis (persistence analysis) investigated the frequency of persistent insomnia at follow-up and the factors predicting the persistence of insomnia. This analysis included respondents who reported having insomnia at baseline and who completed the 1-year follow-up. For the incidence and persistence analyses, the associations between insomnia at 1-year follow-up and demographic and general health variables at baseline were examined. The third analysis (consequence analysis) investigated whether the presence of insomnia at baseline was a risk factor for developing anxiety, depression, or pain at follow-up. This involved 3 subgroup analyses: the first based on respondents with no anxiety ("noncase" or "possible case") at baseline, with anxiety ("probable" case) or no anxiety at 12-month follow-up as the outcome; the second on respondents with no depression ("noncase" or "possible case") at baseline, with depression ("probable" case) or no depression at 12-month follow-up as the outcome; the third on respondents with no "widespread pain" (defined as fewer than 4 regions of pain) at baseline, with "widespread pain" (4 or more regions of pain) or no "widespread pain" at 12-month follow-up as the outcome.

Associations were measured by risk ratios (RRs). Firstly, univariate analyses were carried out to investigate the crude associations between outcomes and individual baseline risk factors. Secondly, multivariate analyses were carried out to evaluate the independent effects on outcome of risk factors adjusted for covariates. The multivariate estimation was carried out using Cox regression (applying a constant risk period[37]). Associations with age are shown in terms of RRs per incremental "unit" change of 10 years. Statistical significance is given at the 5% probability level (2 tails). All analyses were carried out using SPSS 12.0 (SPSS, Inc., Chicago, IL) and Confidence Interval Analysis (version 2.0.0. University of Southampton School of Medicine, Southampton, UK).

RESULTS

Response

A total of 2662 completed questionnaires were returned at baseline, giving an adjusted response of 56% following adjustment for deaths and incorrect addresses occurring or ascertained after mailing. Response was higher in women than men (61% versus 51%, respectively) and higher in older than younger groups (65% in the over 65 years age group compared to 43% in the 18- to 35-year age group). Only questionnaires in which all the questions related to sleep were answered were used in the analysis. There were 299 questionnaires with missing data on 1 or more of the sleep questions, meaning that 2363 respondents were included in the cohort for this study. The median age of the sample was 50 years (range 18 to 98 years), and 55% of the sample were women.

Of the respondents to the baseline survey, 84% consented to receiving another questionnaire. Eighty-four people had left the

Table 1—Characteristics of Responders at Baseline and 12-Month Follow-up

	Baseline (n = 2662)	Follow-up (n = 1589)
Age, y	51.7 (17.5)	52.3 (16.3)
Sex		
Men	1175 (44.1)	697 (43.9)
Women	1487 (55.9)	892 (56.1)
Social class		
Nonmanual	1451 (59.9)	953 (63.9)
Manual	972 (40.1)	539 (36.1)
Anxiety		
Noncase	1525 (60.4)	921 (61.2)
Possible case	515 (20.4)	289 (19.2)
Probable case	483 (19.1)	295 (19.6)
Depression		
Noncase	1984 (79.4)	1225 (80.2)
Possible case	316 (12.6)	185 (12.1)
Probable case	200 (8.0)	117 (7.7)
Pain areas		
0	758 (28.5)	162 (10.2)
1	348 (13.1)	440 (27.7)
2-3	693 (26.0)	392 (24.7)
4-7	863 (32.4)	595 (37.4)
Sleep questions		
Trouble falling asleep		
None	953 (37.8)	582 (38.3)
Some nights	1259 (50.0)	758 (49.9)
Most nights	306 (12.2)	180 (11.8)
Wake up several times at night		
None	575 (23.0)	306 (20.4)
Some nights	1249 (50.2)	795 (52.9)
Most nights	664 (26.7)	401 (26.7)
Trouble staying asleep		
None	897 (40.0)	480 (32.8)
Some nights	1101 (45.4)	729 (49.9)
Most nights	427 (17.6)	253 (17.3)
Wake up tired and worn out		
None	696 (30.0)	428 (28.6)
Some nights	1307 (52.4)	803 (53.7)
Most nights	491 (19.7)	265 (17.7)
Insomnia (main definition)[a]		
No	1493 (63.2)	933 (65.2)
Yes	870 (36.8)	498 (34.8)

Data are presented as numbers (percentages), except age, which is mean ± SD. Numbers do not always add to the marginal totals (2662 at baseline; 1589 at follow up) due to some missing data.

[a]"Trouble falling asleep" (most nights) and/or "Wake up several times at night" (most nights) and/or "Have trouble falling asleep" (most nights) and/or "Wake up tired and worn out" (most nights).

practice or died during follow-up; therefore 2141 questionnaires were mailed at 1 year and 1589 were returned, giving a response to follow-up of 74%. There was little difference in response to follow-up between those with and without insomnia at baseline.

Characteristics of responders to the baseline and 12-month questionnaires are presented in Table 1. The prevalence of insomnia at baseline was 36.8% (95% confidence interval 34.9, 38.8). Table 1 summarizes the individual responses to the 4 sleep questions. The least common symptom at baseline was "trouble staying asleep," to which 40% answered "not at all." The most common symptom was "wake up several times at night," which affected 27% of respondents "on most nights" at baseline and 12 months.

Incidence Analysis

Among the 859 respondents who were included in the incidence analysis (ie, those with no insomnia at baseline who responded to the sleep questions at follow-up), 125 were classified with insomnia at 1 year, an incidence of 14.6% (95% confidence interval 12.2, 16.9). Table 2 shows the associations between baseline demographic and general health factors and the incidence of insomnia at 12 months. Age, sex, and social status were not significantly associated with incidence of insomnia. However, depression and anxiety were associated with a significant increase in the development of insomnia in both unadjusted and multivariate analyses. Incidence of insomnia also increased with the number of pain areas reported at baseline. Depression was the strongest independent predictor of developing insomnia, with probable cases of depression having 3 times the risk of developing insomnia compared with noncases.

Persistence Analysis

The persistence analysis included 483 respondents: those who were classified as having insomnia at baseline who also responded to the sleep questions at 12 months. Of these, 334 continued to report insomnia at follow-up, giving a persistence estimate of 69.2% (95% confidence interval 65.0, 73.3). Table 3 shows the associations between baseline demographic and general health factors and the persistence of insomnia at 12 months. The only baseline factor significantly related to the persistence of insomnia was age. After adjusting for the other variables, we estimated that each 10-year increase in age was associated with an elevated risk of 1.1 of having persistent insomnia. Given that persistence affected about 70% and that the mean age of our study population was approximately 50, our estimated RR of 1.1 would imply that someone aged 60 with baseline insomnia was likely to have a 7% greater absolute risk (1.1×70%) of having persistent pain at follow-up, compared with someone aged 50; the absolute risk difference is approximately 15% (1.1×1.1×70%) for 70- compared with 50-year-olds.

Consequences Analysis

Results relating to the 3 consequences analyses are shown in Table 4. Insomnia at baseline was significantly associated with incidence of anxiety, depression, and "widespread pain" at 12 months. The associations were statistically significant both before and after adjustment for baseline covariates. After adjustment, insomnia at baseline was associated with nearly 3 times the risk of developing depression and more than 2 times the risk of developing anxiety at 12-month follow-up.

Sensitivity Analysis

Patterns of association, when the 2 alternative definitions of insomnia were applied, showed broad similarities with the main analyses above, although some became weaker or lost statistical significance.

The prevalence of 1 or more sleep problems "on most nights" across the 3 nighttime symptoms was 30.4% (719/2363); incidence was 13.3% (126/949), and persistence 67.9% (267/393).

Table 2—Incidence of Insomnia at 12-Month Follow-up

	Insomnia[a] No. (%)	No insomnia[a] No. (%)	Unadjusted RR (95% CI)	Adjusted RR[b] (95% CI)
Subgroup totals[c]	125 (14.6)	734 (85.4)	-	-
Age	-	-	1.06 (0.95, 1.20)[d]	1.06 (0.94, 1.20)[d]
Sex				
Men[e]	53 (12.8)	360 (87.2)	1.00	1.00
Women	72 (16.1)	374 (83.9)	1.26 (0.88, 1.79)	1.25 (0.85, 1.82)
Social class				
Nonmanual[e]	80 (14.3)	481 (85.7)	1.00	1.00
Manual	41 (15.7)	220 (84.3)	1.10 (0.76, 1.61)	1.15 (0.78, 1.68)
Anxiety				
Noncase[e]	64 (10.2)	557 (89.7)	1.00	1.00
Possible case	26 (20.0)	104 (80.0)	2.42 (1.61, 3.64)	2.13 (1.36, 3.31)
Probable case	33 (38.8)	52 (61.2)	3.16 (1.98, 5.05)	2.43 (1.39, 4.24)
Depression				
Noncase[e]	88 (11.4)	682 (88.6)	1.00	1.00
Possible case	22 (41.5)	31 (58.5)	1.73 (0.99, 3.02)	1.04 (0.55, 1.97)
Probable case	13 (56.5)	10 (43.5)	5.74 (2.90, 11.4)	3.21 (1.49, 6.91)
Pain areas				
0[e]	25 (8.9)	255 (91.1)	1.00	1.00
1	17 (12.2)	122 (87.8)	1.37 (0.74, 2.54)	1.30 (0.70, 2.42)
2-3	38 (16.3)	195 (83.7)	1.83 (1.10, 3.03)	1.67 (0.99, 2.80)
4-7	45 (21.7)	162 (78.3)	2.44 (1.49, 3.97)	1.71 (1.02, 2.87)

CI refers to confidence interval.
[a]Insomnia defined as: "Trouble falling asleep" (most nights) and/or "Wake up several times at night" (most nights) and/or "Have trouble falling asleep" (most nights) and/or "Wake up tired and worn out" (most nights).
[b]Risk ratios (RR) adjusted for age, sex, social class, anxiety, depression, pain areas.
[c]Subgroup totals denote the number of respondents with insomnia and the number of respondents without insomnia at follow-up among those who did not have insomnia at baseline. Numbers may not add up to the subgroup totals due to some missing data.
[d]Risk ratios relate to "unit" increases in age of 10 years.
[e]Reference category for calculation of risk ratios.

After adjustment, incident insomnia was significantly associated with increased age (RR = 1.18); female sex (RR = 1.50); "possible" anxiety (RR = 2.17); "probable" anxiety (RR = 2.09); "probable depression" (RR = 2.77); 2 to 3 pain areas (RR = 1.97), and 4 to 7 pain areas (RR = 2.01). After adjustment, persistent insomnia was significantly associated with increased age (RR = 1.10). Insomnia was significantly associated with incident depression (RR = 2.19) and "widespread pain" (RR = 1.56) and linked with incident anxiety but not significantly (RR = 1.54).

The prevalence for the stricter definition of any nighttime symptom "on most nights" plus the daytime symptom of feeling tired and worn out "on most nights" was 13.2% (313/2363); incidence was 6.8% (80/1176), and persistence 54.8% (91/166). After adjustment, incident insomnia was significantly associated with female sex (RR = 1.98); "probable" anxiety (RR = 2.31); "probable depression" (RR = 4.58), and 4 to 7 pain areas (RR = 2.24). After adjustment, persistent insomnia was not significantly associated with any factor, though age had a similar point estimate as in the main analysis (RR = 1.10). Insomnia was significantly associated with incident depression (RR = 2.57) but showed little association with incident anxiety (RR = 1.17) and "widespread pain" (RR = 1.18).

DISCUSSION

Our findings confirm that insomnia is common in the adult UK general population, with a prevalence of 37%. We have shown that much of this insomnia is persistent, with over two thirds (69%) of sufferers at baseline also reporting symptoms a year later. The incidence of insomnia is 15% in this population and is associated with preexisting anxiety, depression, and pain as reported at baseline. In contrast, the persistence of insomnia was significantly associated only with older age. We have also provided evidence that insomnia is a risk factor for the subsequent onset of anxiety, depression, and pain.

A major strength of this study is the longitudinal design, enabling us to investigate and compare the factors associated with incidence, persistence, and consequences of insomnia over the course of 1 year. Numerous studies have looked at the prevalence and cross-sectional associations of insomnia. However, such studies are not able to separate factors that influence the development or persistence of insomnia or to investigate insomnia as a risk factor for other conditions. Although there are longitudinal studies investigating insomnia,[2,13,38] none of the studies identified had compared factors related to the incidence of insomnia with those related to persistence in a general adult population. The population basis (rural and urban areas) and large sample size are also important strengths of this study and enhance the generalizability of the findings. In addition, factors such as pain and psychological status were measured using instruments validated for use in the general population.

Comparing occurrence figures between studies is difficult. The main reasons relate to differences in definitions of insomnia, differences in survey methodologies, and also the variation in length

Table 3—Persistence of Insomnia at 12-Month Follow-up

	Insomnia[a] No. (%)	No insomnia[a] No. (%)	Unadjusted RR (95% CI)	Adjusted RR[b] (95% CI)
Subgroup totals[c]	334 (69.2)	149 (30.8)	-	-
Age	-	-	1.09 (1.03, 1.17)[d]	1.10 (1.03, 1.18)[d]
Sex				
Men[d]	117 (65.0)	63 (35.0)	1.00	1.00
Women	217 (71.6)	86 (28.4)	1.10 (0.88, 1.38)	1.13 (0.89, 1.43)
Social class				
Nonmanual[e]	193 (67.2)	94 (32.8)	1.00	1.00
Manual	129 (71.7)	51 (28.3)	1.07 (0.85, 1.33)	1.06 (0.84, 1.33)
Anxiety				
Noncase[e]	116 (65.9)	60 (34.1)	1.00	1.00
Possible case	94 (69.6)	41 (30.4)	1.06 (0.81, 1.39)	1.05 (0.79, 1.40)
Probable case	120 (74.1)	42 (25.9)	1.12 (0.87, 1.45)	1.12 (0.81, 1.53)
Depression				
Noncase[e]	193 (64.3)	107 (35.7)	1.00	1.00
Possible case	79 (77.5)	23 (22.5)	1.20 (0.93, 1.56)	1.11 (0.82, 1.48)
Probable case	55 (77.5)	16 (22.5)	1.20 (0.89, 1.63)	1.08 (0.75, 1.54)
Pain areas				
0[e]	52 (64.2)	29 (35.8)	1.00	1.00
1	24 (66.7)	12 (33.3)	1.04 (0.64, 1.68)	1.02 (0.62, 1.68)
2-3	74 (66.1)	38 (33.9)	1.03 (0.72, 1.47)	1.04 (0.71, 1.51)
4-7	184 (72.4)	70 (27.6)	1.13 (0.83, 1.54)	1.09 (0.78, 1.51)

[a]Insomnia defined as "Trouble falling asleep" (most nights) and/or "Wake up several times at night" (most nights) and/or "Have trouble falling asleep" (most nights) and/or "Wake up tired and worn out" (most nights).
[b]Risk ratios adjusted for age, sex, social class, anxiety, depression, pain areas.
[c]Subgroup totals denote the number of respondents with insomnia and the number of respondents without insomnia at follow-up among those who did have insomnia at baseline. Numbers may not add up to the subgroup totals due to some missing data.
[d]Risk ratios relate to "unit" increases in age of 10 years.
[e]Reference category for calculation of risk ratios.

Table 4—Consequences of Insomnia at 12-Month Follow-up

	Problem[a] at follow up			
Insomnia[b] at baseline	Yes No. (%)	No No. (%)	Unadjusted RR (95% CI)	Adjusted RR[c] (95% CI)
Anxiety[a]				
No[d]	47 (6.0%)	737 (94.0%)	1.00	1.00
Yes	54 (16.7%)	270 (83.4%)	2.78 (1.88, 4.11)	2.28 (1.43, 3.64)
Depression[a]				
No[d]	17 (2.0%)	850 (98.0%)	1.00	1.00
Yes	35 (8.4%)	384 (91.7%)	4.26 (2.39, 7.60)	2.71 (1.37, 5.37)
Widespread pain[a]				
No[d]	127 (18.2%)	569 (81.8%)	1.00	1.00
Yes	71 (28.3%)	180 (71.7%)	1.55 (1.16, 2.07)	1.45 (1.03, 2.03)

[a]Problem at follow-up refers to incident anxiety, depression or widespread pain. Anxiety and depression were based on the classification of "probable case" (no anxiety and no depression being based on "noncase" and "possible case" criteria). Widespread pain was denoted by pain in four or more regions of the manikin (no widespread pain is denoted by none to 3 areas of pain). In each of the 3 analyses the denominator figures are those with no problem at baseline.
[b]Insomnia defined as "Trouble falling asleep" (most nights) and/or "Wake up several times at night" (most nights) and/or "Have trouble falling asleep" (most nights) and/or "Wake up tired and worn out" (most nights).
[c]Risk ratios adjusted for age, sex, social class, anxiety (except when anxiety is the problem of interest), depression (except when depression is the problem of interest), pain areas (except when widespread pain is the problem of interest).
[d]Reference category for calculation of risk ratios.

of follow-up in longitudinal studies. Studies have reported similar prevalence estimates to our main definition.[4,8,11] However, studies with stricter criteria for defining insomnia tend to report lower prevalence and incidence figures. For example, a study by Ford and Kamarow,[2] which used a stricter definition than our main definition, reported a prevalence of 10.0% and an incidence of 6.2% (compared with 36.8% and 14.6% in our study). Similarly, our conservative definition (requiring both a nighttime and a daytime symptom) gave lower prevalence and incidence estimates of 13.2% and 6.8%, respectively. There is some debate as to whether the symptom "wake up tired and worn out" may be a symptom of other conditions such as sleep apnea rather than being truly

insomnia.[39] This item was included within our principal definition of insomnia, as recommended by the authors of the questionnaire that we employed. Excluding this daytime symptom, while maintaining the criterion of sleep problems on most nights for at least 1 of the 3 nighttime symptoms, the prevalence, incidence, and persistence estimates were little changed: 30.4%, 13.3%, and 67.9%, respectively. Furthermore, the different definitions of insomnia did not greatly influence the statistical associations. The main difference occurred when the daytime symptom "wake up feeling tired and worn out" on most nights was made mandatory to the classification of insomnia, resulting in a reduction in the risk of developing anxiety and pain among persons with insomnia.

Older people were more likely than younger people to have persistent insomnia. There is a complex association between age and insomnia. Some studies have found a clear relationship between increasing age and insomnia,[4,11,23] but other studies have found no association.[9,16] Palleson et al[24] found that early morning wakening and difficulty maintaining sleep were more common in the older age group, whereas daytime impairment was less common in this age group. However, associations between increasing age and the persistence of insomnia were consistent across the 3 separate definitions of insomnia considered in our study.

There have only been a small number of studies investigating the relationship between pain and insomnia in general population samples. A study by Ohayon[17] looked at the association between chronic pain (6 months' duration or longer) at different sites and insomnia and found a strong relationship between insomnia and chronic pain. A study from Canada also found that pain was significantly associated with insomnia.[15] Our study found that reporting of 4 or more pain areas was a significant risk factor for the subsequent incidence of insomnia independent of depression and anxiety. There was a higher incidence of insomnia as the number of reported pain areas increased. Also, insomnia was shown to be a risk factor for the subsequent development of pain.

Psychological health problems, such as anxiety and depression, have been consistently linked with insomnia in a number of population studies.[2,4,13,20] The findings of Foley et al,[13] based on a 3-year longitudinal study of 6800 adults aged 65 years and older reported that depression was linked with the incidence and retention of insomnia. In our study, both anxiety and depression at baseline were significantly linked with incidence, but not persistence, of insomnia. Moreover, our study also provides evidence indicating that insomnia is a significant risk factor for the subsequent onset of anxiety and depression.

One potential limitation of this study is the baseline response of 56%, giving potential for bias. In order to investigate this, an age-sex standardized prevalence figure was calculated and was very similar to our crude estimate (standardized estimate 36.4%, crude estimate 36.8%). Furthermore, there was little evidence of response bias when comparing those who replied early to the questionnaire and those who replied only after a reminder. Although unknown biases in baseline response may affect the accuracy of the prevalence figure, the estimates of associations among other baseline factors and prevalence, incidence, and persistence of insomnia are unlikely to be affected. In terms of bias in follow-up, there were few baseline differences between respondents and nonrespondents to the 12-month questionnaire. A second potential limitation is that our prevalence figure relates to 1 population district in the UK. This area is socioeconomically more deprived than average for the UK and has a relatively small ethnic minority population. However, these differences are not substantial and are unlikely to greatly affect the generalizability of the findings, particularly the prospective associations.

Prevalence is useful in highlighting the size of a problem, and insomnia is clearly common. Although not all persons reporting insomnia will regard it as a problem, there is evidence from family practice settings that a high proportion of consulters have insomnia symptoms.[40] Further research would be needed to clarify the benefits of identifying and dealing with the problem, but the strong links among insomnia and anxiety, depression, and pain suggest its possible involvement in a range of presenting problems.

Cross-sectional prevalence studies cannot disentangle cause and effect, but it is likely that some cases of insomnia result from other longstanding conditions. Our results confirm this for depression in particular, but anxiety and pain were also significant predictors of incident insomnia. Evaluation of the population attributable proportions based on our adjusted estimates of RR, estimate that 21% of incident insomnia is statistically linked with prior anxiety, 19% with the prior presence of 4 or more areas of pain, and 10% with depression; the percentage attributable to depression is less (despite a stronger association) because there were relatively few respondents with "probable" depression. However the relationships are 2 way, given our findings that insomnia predisposes to the onset of depression, anxiety, and pain, and this indicates complex cycles of cause and effect in the development of these chronic problems. Our study suggests that effective treatment of the individual problems when they first present has the potential to substantially reduce the onset and persistence of multiple morbidity in the general population. This represents a challenge for public health and primary care to identify strategies for both treatment and prevention of insomnia. With increasing reluctance to use sedative medication, self-help and psychological approaches offer alternative models of care. Interventions targeted at persons at higher risk may help reduce long-term problems, particularly among older people.

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