Insomnia symptoms in older adults: associated factors and gender differences.

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Abstract

Objectives

The aim of this study was to examine the factors associated with insomnia in community-dwelling elderly as a function of the nature and number of insomnia symptoms (IS) e.g . difficulty with initiating sleep (DIS), difficulty with maintaining sleep (DMS) and early morning awakening (EMA).

Methods

IS were assessed in a sample of 2673 men and 3213 women aged 65 years and over. The participants were administered standardized questionnaires regarding the frequency of IS and other sleep characteristics (snoring, nightmares, sleeping medication, sleepiness) as well as various socio-demographic, behavioral and clinical variables, and measures of physical and mental health.

Results

More than 70% of men and women reported at least one IS, DMS being the most prevalent symptom in both men and women. Women reported more frequently two or three IS whereas men reported more often only one IS. Multivariate regression analyses stratified by gender showed that men and women shared numerous factors associated with IS, sleeping medication, nightmares, sleepiness, chronic diseases, and depression being independently associated with two or three IS. For both sexes, age was associated with only one IS in all age categories. Loud snoring was strongly associated with increased DMS in men only. High body mass index increased the risk for DIS in men but tended to decrease it in women. In women, hormonal replacement therapy, Mediterranean diet, caffeine and alcohol intake had a protective effect.

Conclusion

Our data suggest that women may have specific predisposition factors of multiple IS which may involve both behavioral and hormonal factors. Identification and treatment of these risk factors may form the basis of an intervention program for reduction of insomnia symptoms in the elderly..

MESH Keywords Age Factors ; Aged ; Aged, 80 and over ; Female ; France ; epidemiology ; Humans ; Male ; Prevalence ; Risk Factors ; Self Report ; Sex Characteristics ; Sex Factors ; Sleep Initiation and Maintenance Disorders ; diagnosis ; epidemiology

INTRODUCTION

Insomnia is very common among older persons with prevalence estimates varying from 20 to 48 % (1 –4). Insomnia is a clinically heterogeneous disorder diagnosed by reference to subjective evaluation of sleep quality. The principal insomnia symptoms (IS) are difficulty in initiating sleep (DIS), difficulty in maintaining sleep (DMS) and early morning awakening (EMA). IS are frequently associated with sleepiness, daytime fatigue and psychotropic medication use and can have deleterious consequences on health and everyday functioning. However, little is known about which IS risk factors operate in elderly subjects and which symptoms should be the principal target of intervention strategies, as the rare studies already performed mainly focused on global IS without considering symptom profiles.

Previous epidemiological studies have suggested that the aging process per se is not responsible for higher prevalence of insomnia in the elderly although this has not been evaluated in the oldest old (5 , 6). In addition, whereas a higher prevalence rate has been reported in women (Ganguli et al. , 1996; Su et al. , 2004), the reasons for gender differences in insomnia prevalence have not been examined in detail

especially in the elderly. The main hypotheses which have been explored up to now have focused on socio-demographic differences (notably separation, widowhood and occupation (Li et al. , 2002)), higher rate of depression (7 , 8) or bias of declaration (9 –11) and classification (12).

Moreover, given that insomnia is a heterogeneous condition composed of several symptoms it can be assumed that the number of symptoms, i.e . the number of types of insomnia complaints expressed, is higher among women than men which could partly explain the higher prevalence reported among women. We thus performed both types of analyses considering on one hand the number of symptoms and on the other hand isolated symptoms, when subjects presented with only one insomnia complaint.

Distinct behavioural characteristics and physiological differences have rarely been investigated. Polysomnographic studies have reported sex differences in sleep physiology in clinical populations, with men showing less conserved slow wave sleep than women (13 – 20). At the present time only one study has been performed in an elderly population which also reported sex differences (Redline et al. , 2004). However, it did not take into account the hormonal status of post-menopausal women whose estrogen levels are even lower than elderly men of the same age when not treated with hormonal replacement therapy (HRT). Given that HRT is an effective treatment for sleep complaints in menopausal women even in the absence of vasomotor symptoms (Polo-Kantola et al. , 1998), it seems likely that estrogen levels play a role in IS or at least modulate their expression.

Hence, at the present time the main characteristics and risk factors for insomnia in the elderly remain largely unknown notably due to heterogeneity in study design and sampling (notably in age, sex ratio, co-morbidity, community vs. clinical samples), small sample size, and limited sleep characteristics and other covariate adjustment. Lastly, whereas several previous studies have controlled for sex, few studies have performed gender stratified analyses.

The present study aimed to examine the frequency of IS in the elderly and the factors associated with IS in a large community-based elderly population, which permitted the examination of a range of sleep profiles and extensive adjustment for confounding factors, e.g. socio-demographic, clinical, and behavioral variables which may contribute to insomnia. Analysis of gender-differences was also considered.

METHODS

Participants

Subjects were recruited as part of a multi-site cohort study of community-dwelling persons aged 65 years and over randomly selected from the electoral rolls of three French cities (Bordeaux, Dijon and Montpellier) between 1999 and 2001 (3C Study). The study design has been described elsewhere (21). The study protocol was approved by the Ethics Committee of the University-Hospital of Bicêtre (France) and written informed consent was obtained from each participant. A total of 9294 subjects, 3650 men and 5644 women were included in the study. Data were collected during a face to face interview using a standardized questionnaire by trained psychologists or nurses. Diagnoses of dementia and other neurological disorders were made by 3C study clinical investigators according to DSM-IV criteria (22) and were further validated by a national panel of neurologists independently of the 3C investigators.

Sleep complaint measures

Sleep complaints were assessed by a self-report questionnaire which evaluates the frequency (never, rarely, regularly or frequently) of (1) having difficulty in initiating sleep (DIS), (2) waking up several times during the night (DMS), (3) waking up too early in the morning without being able to fall asleep again (EMA). IS was defined as reporting regularly or frequently at least one symptom (DIS, DMS, or EMA). Other information related to sleep was also recorded including taking medication for sleep problems and duration of use (in years), or reporting regularly or frequently being excessively sleepy during the day, having nightmares, or snoring loudly.

Socio-demographic and clinical variables

A standardized health interview covered socio-demographic factors and current state of health, including gender, age, marital status, education, and body mass index (BMI). Detailed medical questionnaires (with additional information where necessary from general practitioners) were used to obtain information on history of vascular disease including angina pectoris, arrhythmia, lower limb arteritis, heart failure, myocardial infarction, coronary surgery, stroke, and hypertension (resting blood pressure ≥160/95 mm Hg or treated); if subjects presented with at least one of these symptoms they were considered as having history of vascular disease. Other illnesses including asthma, diabetes (fasting glucose ≥7.0 mmol/l or reported treatment), hypercholesterolemia (total cholesterol ≥ 6.2 mmol/l or reported treatment) and thyroid problems were also considered. Participants were classified as having chronic disease if they suffered from one, or two or more, of these illnesses. Depressive symptomatology was assessed with the Center for Epidemiological Studies-Depression Scale (CES-D) with a 16 cut-off point (23). For women, information was also obtained regarding the type of menopause (i.e. , natural, surgical or following treatment such as chemotherapy) as well as use of HRT.

A life-style questionnaire was used to obtain information on current smoking status, alcohol intake, consumption of coffee and tea. Dietary intake was assessed by a questionnaire covering the following foods: dairy products, meat (and poultry), fish, eggs, cereals (including bread and starches), raw fruit, raw and dried vegetables, classified as low intake: never or less than once a week; moderate intake: once to 3 times a week, and high intake: 4 to 7 times a week. Mediterranean diet is characterized by high intake of vegetables, legumes, fruits and cereals; high intake of unsaturated fatty acids mostly in the form of olive oil, but low intake of saturated fatty acids; a moderately high intake of fish; a low to moderate intake of dairy products (mostly cheese or yogurt); a low intake of meat and poultry; and a regular but moderate amount of alcohol primarily in the form of wine and generally during a meal (24). A value of 0 or 1 in relation to frequency was assigned to the 11 components of the Mediterranean diet. Subjects reporting more than seven components (highest quartile) were considered has having Mediterranean diet.

Statistical analysis

Men and women were found to differ on most exposure variables. In order to examine separate patterns of risk, gender stratified analyses were undertaken. Univariate logistic regressions were used to determine differences in socio-demographic and clinical characteristics between men and women. Associations between the outcome variable, i.e. , number of IS (0, 1, 2 or 3) and socio-demographic and clinical variables were tested using a multinomial logistic regression model adjusting for all significant associations between socio-demographic, clinical variables at the univariate level with a p-value < 0.10. Results were presented as odds-ratios (OR) and their 95 % confidence intervals (CI). In the subgroup of subjects reporting only one IS (isolated IS), multivariate logistic regressions were used for each IS to model the relationship between IS and associated variables at $p < 0.10$. Significance level was set at $p<0.05$. The statistical analysis was carried out using SAS software (version 9.1).

RESULTS

Participant characteristics

Of the 9294 participants initially recruited in the 3C Study, 217 diagnosed with dementia were excluded, 2308 had not fully completed the sleep questionnaire, and 883 had missing data for confounding variables. The remaining 5886 participants (54.59 % of women) were included in the analysis. Compared with the analyzed sample, the subjects not included were significantly ($p<0.0001$) more often women, older, widowed or separated, depressed, with low education level, more likely to have more than one chronic disease, drank less frequently alcohol and coffee, adhered less often to a Mediterranean diet, and for women were less likely to use or to have used HRT.

Gender differences and sleep characteristics

Men and women were found to differ on most socio-demographic, behavioral, clinical, and sleep characteristics (Table 1). Compared to men, women were younger and more often widowed or divorced, with a lower education level, drank less alcohol and coffee, and adhered less often to a Mediterranean diet. Women also were less often overweight, had less chronic diseases, and were more likely to be depressed.

Regarding sleep characteristics, women reported more frequently use of sleep medication and for longer periods (median [IQR] was 8 years [2–16] versus 5 years [2–15] in men, Mann-Whitney Test $z=-4.23$, $p<0.0001$). Benzodiazepine was most frequently reported among the users (by 51.62 % of men and 60.58 % of women), followed by 'Z-drug' hypnotic use (24.86 % of men and 24.97 % of women), antidepressant (7.84 % of men and 7.75 % of women), antihistaminic compound (6.49 % of men and 7.63 % of women), and 8.38 % of men and 9.48 % of women reported herbals/botanicals use. In addition, women more frequently experienced nightmares, and had less often loud snoring and daytime sleepiness.

Women reported more IS than men (75% vs. 70%, $p=0.0001$) with additional gender differences in patterns of complaint distribution. Women reported significantly more frequently two or three IS while men reported more often only one. Globally, DMS (isolated or associated with DIS and EMA) was reported with similar frequency in men (62.86%) and women (62.25%) while women reported more often overall DIS (42.42% vs . 21.33% in men) or EMA (38.77 vs . 30.01% in men). DIS associated with DMS or with EMA was reported more frequently by women, and DMS associated with EMA was reported more often by men. More specifically, examining the subgroup of subjects presenting with only one IS, DMS was the most frequently reported by both sexes but more often in men than in women whereas DIS was more frequent in women than in men. EMA was equally reported by both men and women.

Risk factors associated with the number of IS

We evaluated the risks of reporting one, two, or three IS using multivariate multinomial logistic regression models stratified by gender and adjusted for socio-demographic, behavioral, clinical and sleep variables described above (Table 2). For men and women, depressive symptomatology, sleepiness and nightmares were significantly associated with one, two, or three IS, whereas sleep medication and having two or more chronic diseases were associated with two or three IS. For both sexes, age was associated with one IS in all age categories

whereas no significant association was observed with three IS. Comparable strength of association (in terms of OR values) was observed for men and women. In women only, high BMI, high alcohol intake and HRT were protective for two or three IS and Mediterranean diet for one, two or these IS. In men only, loud snoring was associated with only one IS and no protective factors were observed. For both sexes, marital status, coffee intake or type of menopause for women was not significantly associated with IS (data not shown).

Factors associated with one IS complaint

In order to specify each IS complaint, we evaluated the risks of reporting only one IS using multivariate logistic regression models stratified on gender and adjusted for socio-demographic, clinical and sleep variables (Table 3). For both men and women, age, sleepiness and nightmares were significantly associated with increased risk of DMS whereas sleep medication was independently associated with increased risk of DIS. Depression scores and BMI showed different associations in men and women: higher depression scores were associated with higher risk of EMA in men and with higher risk of DIS in women. An opposite association was observed for high BMI, which was associated with a higher risk of DIS in men and marginally protective in women. Loud snoring was associated with risk of DMS in men only. In women only, coffee drinking and Mediterranean diet were marginally protective for DMS and no variables were significantly associated with EMA.

DISCUSSION

Distribution of IS in the elderly general population

In our study, IS were found to be highly prevalent, more than 70 % of elderly reporting at least one IS. Similar result was reported in another study with 69% of subjects reporting at least one IS (25). In our study the prevalence was higher in women than in men (75% vs. 70%, χ^2 test=18.48, df=1, $p<0.0001$). As already reported, DMS was the most frequent IS (1 , 4 , 26 –30) and we further observed a comparable prevalence in men and women. As an isolated symptom it was independently associated with age in both men and women. With aging, sleep fragmentation is the main component of insomnia. Numerous factors are involved in sleep fragmentation and responsible for neurobiological and behavioral sleep pattern changes with aging, such as hormonal changes (20 , 31), alteration of homeostatic process (32 , 33), circadian rhythmicity (34), low physical activity and less light exposure(35), sleep apnea (36). All of them could result in an increased brain vulnerability to various arousal stimuli explaining that in elderly DMS is the most prevalent IS whatever the gender.

Factors associated with IS and gender differences

Most factors, e.g. , age, sleep medication, nightmares, sleepiness, chronic diseases, and depression were independently associated with the presence of IS (1 , 4 , 6). We did not observe significant gender differences regarding the strength of these associations. Interestingly, DIS is more prevalent in women than in men and isolated DIS is principally associated with sleep medication; it might be suggested that long sleep latency is less tolerated than other IS in older persons thus leading to higher treatment rates. This may explain the higher prevalence of DIS in women, already reported in other studies (29 , 37 –40) and also the longer duration of sleep medication intake in older women.

Women more frequently reported two or three IS compared to men who tend to commonly experience a single symptom. To our knowledge, this is the first time that gender differences with regard to the number of IS are reported in the elderly general population. These gender variations could be the consequence of differences in the nature or intensity of exposure to risk factors, or in the susceptibility to the same risk factors. They could result from cultural, social, behavioral or adaptive differences. In our study, depression is independently associated with isolated IS, with differences in symptom expression, DIS in women and EMA in men. Some depressive symptoms are different in men and in women: women are more prone to ruminate than men (41). It is known that poor sleepers are more prone than good sleepers to ruminate about daytime symptoms and their consequences of their chronic sleep difficulties (42 , 43). Ruminative thoughts, worries and anxiety are responsible for difficulties in falling asleep especially in women (4 , 42 –44). Otherwise it has been shown (45) that the symptoms of terminal insomnia are strongly associated with polysomnographic features (reduced REM, sleep latency) of endogenous depression. It might be possible that in elderly men, depression and sleepiness, associated with terminal insomnia, are the expression of endogenous depression. Polysomnographic recordings will be required to test this hypothesis.

In our study we found opposite effects of high BMI; increasing the risk for isolated DIS in men but marginally decreasing it in women. Biological differences, especially hormonal factors, could be involved in this gender difference. Obesity during the climacteric is a key factor associated with an increase in estrogen exposure. After the menopause, mesenchymal cells of adipose tissue become the main source of estrogen via testosterone aromatization. Therefore, in the post-reproductive years, the extent of female estrogenization is mainly determined by adiposity(46). Interestingly, we found that current long-term HRT use (mean duration was 10 years) was also independently protective for IS in women confirming the beneficial effect of HRT on IS in women (47 –49).

In women some lifestyle factors (moderate alcohol, and coffee intake and adherence to a Mediterranean diet) have a protective effect for having two or three IS or isolated DMS. Caffeine and alcohol intake have been related to a common sensation-seeking or behavioral or

socialization component in healthy adults. Elderly women might also be more aware than men of the deleterious effect of alcohol or coffee on IS (50 , 51), and thus reduce their intake in an attempt to reduce their symptoms.

The protective role of the Mediterranean diet could be related to a reduction in cardiovascular disease which are also risk factors for insomnia (52), however, the effect still persisted when adjusting for vascular disease. To our knowledge the protective role of the Mediterranean diet on IS has not been reported elsewhere.

In men specifically, snoring was associated with isolated DMS. A male predominance of snoring is observed in all epidemiological studies. Associated with obesity, snoring is a marker of sleep apnea (53 , 54). It has been shown that a quarter of adults over 65 have sleep apnea and 40 to 50 % of patients with sleep apnea have IS (36). It thus appears that sleep breathing disorders might be associated with IS more frequently in older than in younger subjects.

Finally, no factors were independently associated with isolated EMA in women. However, considering the low number of subjects reporting this IS, this may result from a lack of statistical power.

Limitations and strengths

This study has several limitations. The data relating to some of the covariates were self-reported and may thus be subject to recall bias with participants with sleep disorders responding more negatively to questions about health. However, associations remained even in adjusted analyses, thus suggesting that any bias did not have a substantial influence on the results. There is also the potential for bias in this analysis due to the fact that excluded persons potentially appeared at higher risk for IS so that the associations could be underestimated.

Our study has a number of strengths. The analysis was based on a large multi-centre population study of people aged 65 years and over and therefore the results may be relevant to the broader community of older persons. We could also specify each IS to evaluate risk factors related to isolated or combined IS. The size of our sample also enabled evaluating gender differences while controlling for a large number of covariates, particularly measures of physical health, sleep disorders (sleep treatment, snoring, sleepiness and nightmares), socio-demographic factors, behavioral habits, and depressive components.

CONCLUSION

Complaints of IS are common in the elderly general population, with more than 70% of men and women in our study reporting IS with a significantly higher prevalence in women than in men. Women more frequently experience two or three symptoms whereas men more frequently complain of only one symptom. As insomnia is frequently determined by a cut-off point on a scale, this could explain why the prevalence rates are often reported to be higher in women. Factors associated with IS are very similar for men and women, including sleep medication, nightmares, sleepiness, chronic disease and depression. In women, however, we observed that life style factors (adherence to a Mediterranean diet and moderate coffee and/or alcohol intake) may have a protective effect, suggesting possible behavioral modulation. The protective effects of HRT use and of high BMI also suggest a specific female predisposition which may involve hormonal factors. The results of this study suggest possible intervention strategies for improving sleep quality in elderly persons with insomnia through intervention at the level of specific symptoms.

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Footnotes:

No Disclosures to Report

References:

- 1 . Foley DJ , Monjan AA , Brown SL . Sleep complaints among elderly persons: an epidemiologic study of three communities . Sleep . 1995 ; 18 : 425 - 432
- 2 . Vitiello MV . Sleep disorders and aging: understanding the causes . J Gerontol A Biol Sci Med Sci . 1997 ; 52 : M189 - 191
- 3 . Newman AB , Enright PL , Manolio TA . Sleep disturbance, psychosocial correlates, and cardiovascular disease in 5201 older adults: the Cardiovascular Health Study . J Am Geriatr Soc . 1997 ; 45 : 1 - 7

- 4 . Maggi S , Langlois JA , Minicuci N . Sleep complaints in community-dwelling older persons: prevalence, associated factors, and reported causes . J Am Geriatr Soc . 1998 ; 46 : 161 - 168
- 5 . Ohayon MM , Zulley J , Guilleminault C . How age and daytime activities are related to insomnia in the general population: consequences for older people . J Am Geriatr Soc . 2001 ; 49 : 360 - 366
- 6 . Stewart R , Besset A , Bebbington P . Insomnia comorbidity and impact and hypnotic use by age group in a national survey population aged 16 to 74 years . Sleep . 2006 ; 29 : 1391 - 1397
- 7 . Lindberg E , Janson C , Gislason T . Sleep disturbances in a young adult population: can gender differences be explained by differences in psychological status? . Sleep . 1997 ; 20 : 381 - 387
- 8 . Piccinelli M , Wilkinson G . Gender differences in depression . Critical review Br J Psychiatry . 2000 ; 177 : 486 - 492
- 9 . Ford DE , Kamerow DB . Epidemiologic study of sleep disturbances and psychiatric disorders. An opportunity for prevention? . JAMA . 1989 ; 262 : 1479 - 1484
- 10 . Li RH , Wing YK , Ho SC . Gender differences in insomnia—a study in the Hong Kong Chinese population . Journal Psychosom Res . 2002 ; 53 : 601 - 609
- 11 . Zhang B , Wing Y-K . Sex differences in insomnia: a meta-analysis . Sleep . 2006 ; 29 : 85 - 93
- 12 . Reyner LA , Horne JA . Gender- and age-related differences in sleep determined by home- recorded sleep logs and actimetry from 400 adults . Sleep . 1995 ; 18 : 127 - 134
- 13 . Buysse DJ , Reynolds CF 3rd , Monk TH . Quantification of subjective sleep quality in healthy elderly men and women using the Pittsburgh Sleep Quality Index (PSQI) . Sleep . 1991 ; 14 : 331 - 338
- 14 . Fukuda N , Honma H , Kohsaka M . Gender difference of slow wave sleep in middle aged and elderly subjects . Psychiatry Clin Neurosci . 1999 ; 53 : 151 - 153
- 15 . Ganguli M , Reynolds CF , Gilby JE . Prevalence and persistence of sleep complaints in a rural older community sample: the MoVIES project . J Am Geriatr Soc . 1996 ; 44 : 778 - 784
- 16 . Hume KI , Van F , Watson A . A field study of age and gender differences in habitual adult sleep . J Sleep Res . 1998 ; 7 : 85 - 94
- 17 . Monk TH , Reynolds CF 3rd , Machen MA . Daily social rhythms in the elderly and their relation to objectively recorded sleep . Sleep . 1992 ; 15 : 322 - 329
- 18 . Redline S , Kirchner HL , Quan SF . The effects of age, sex, ethnicity, and sleep-disordered breathing on sleep architecture . Arch Intern Med . 2004 ; 164 : 406 - 418
- 19 . Su TP , Huang SR , Chou P . Prevalence and risk factors of insomnia in community-dwelling Chinese elderly: a Taiwanese urban area survey . Aust N Z J Psychiatry . 2004 ; 38 : 706 - 713
- 20 . Van Cauter E , Leproult R , Plat L . Age-related changes in slow wave sleep and REM sleep and relationship with growth hormone and cortisol levels in healthy men . Jama . 2000 ; 284 : 861 - 868
- 21 . The 3 C Study Group . Vascular factors and risk of dementia: design of the Three-City Study and baseline characteristics of the study population . Neuroepidemiology . 2003 ; 22 : 316 - 325
- 22 . American Psychiatric Association . Diagnostic and Statistical Manual of Mental Disorders (DSM IV) . Washington, DC American Psychiatric Association ; 1994 ;
- 23 . Radloff LS . The CES-D Scale: a self-report depression scale for research in the general population . Applied Psychological Measurement . 1977 ; 1 : 385 - 401
- 24 . Trichopoulou A , Costacou T , Bamia C . Adherence to a Mediterranean diet and survival in a Greek population . N Engl J Med . 2003 ; 348 : 2599 - 2608
- 25 . Reid KJ , Martinovich Z , Finkel S . Sleep: a marker of physical and mental health in the elderly . Am J Geriatr Psychiatry . 2006 ; 14 : 860 - 866
- 26 . Gislason T , Reynisdottir H , Kristbjarnarson H . Sleep habits and sleep disturbances among the elderly--an epidemiological survey . J Intern Med . 1993 ; 234 : 31 - 39
- 27 . Blazer DG , Hays JC , Foley DJ . Sleep complaints in older adults: a racial comparison . J Gerontol A Biol Sci Med Sci . 1995 ; 50 : M280 - 284
- 28 . Babar SI , Enright PL , Boyle P . Sleep disturbances and their correlates in elderly Japanese American men residing in Hawaii . J Gerontol A Biol Sci Med Sci . 2000 ; 55 : M406 - 411
- 29 . Schubert CR , Cruickshanks KJ , Dalton DS . Prevalence of sleep problems and quality of life in an older population . Sleep . 2002 ; 25 : 889 - 893
- 30 . Rocha FL , Uchoa E , Guerra HL . Prevalence of sleep complaints and associated factors in community-dwelling older people in Brazil: the Bambui Health and Ageing Study (BHAS) . Sleep Med . 2002 ; 3 : 231 - 238
- 31 . Vgontzas AN , Zoumakis M , Bixler EO . Impaired nighttime sleep in healthy old versus young adults is associated with elevated plasma interleukin-6 and cortisol levels: physiologic and therapeutic implications . J Clin Endocrinol Metab . 2003 ; 88 : 2087 - 2095
- 32 . Gaudreau H , Morettini J , Lavoie HB . Effects of a 25-h sleep deprivation on daytime sleep in the middle-aged . Neurobiol Aging . 2001 ; 22 : 461 - 468
- 33 . Landolt HP , Dijk DJ , Achermann P . Effect of age on the sleep EEG: slow-wave activity and spindle frequency activity in young and middle-aged men . Brain Res . 1996 ; 738 : 205 - 212
- 34 . Duffy JF , Dijk DJ , Klerman EB . Later endogenous circadian temperature nadir relative to an earlier wake time in older people . Am J Physiol . 1998 ; 275 : R1478 - 1487
- 35 . Bliwise DL . Editor: Kreiger MH , Roth T , Dement WC . Normal aging . Principles and pratice in sleep medicine . Philadelphia Elsevier Saunders ; 2005 ; 24 - 38
- 36 . Young T , Shahar E , Nieto FJ . Predictors of sleep-disordered breathing in community-dwelling adults: the Sleep Heart Health Study . Arch Intern Med . 2002 ; 162 : 893 - 900
- 37 . Rediehs MH , Reis JS , Creason NS . Sleep in old age: focus on gender differences . Sleep . 1990 ; 13 : 410 - 424
- 38 . Middelkoop HA , Smilde-van den Doel DA , Neven AK . Subjective sleep characteristics of 1,485 males and females aged 50–93: effects of sex and age, and factors related to self-evaluated quality of sleep . J Gerontol A Biol Sci Med Sci . 1996 ; 51 : M108 - 115
- 39 . Liu X , Liu L . Sleep habits and insomnia in a sample of elderly persons in China . Sleep . 2005 ; 28 : 1579 - 1587
- 40 . Quan SF , Katz R , Olson J . Factors associated with incidence and persistence of symptoms of disturbed sleep in an elderly cohort: the Cardiovascular Health Study . Am J Med Sci . 2005 ; 329 : 163 - 172
- 41 . Nolen-Hoeksema S , Larson J , Grayson C . Explaining the gender difference in depressive symptoms . J Pers Soc Psychol . 1999 ; 77 : 1061 - 1072
- 42 . Thomsen DK , Mehlsen MY , Christensen S . Rumination-relationship with negative mood and sleep quality . Personality and Individual Differences . 2003 ; 34 : 1293 - 1301
- 43 . Carney CE , Edinger JD , Meyer B . Symptom-focused rumination and sleep disturbance . Behav Sleep Med . 2006 ; 4 : 228 - 241
- 44 . Nolen-Hoeksema S , Parker LE , Larson J . Ruminative coping with depressed mood following loss . J Pers Soc Psychol . 1994 ; 67 : 92 - 104
- 45 . Giles DE , Roffwarg HP , Schlesser MA . Which endogenous depressive symptoms relate to REM latency reduction? . Biol Psychiatry . 1986 ; 21 : 473 - 482
- 46 . Ancelin ML , Ritchie K . Lifelong endocrine fluctuations and related cognitive disorders . Curr Pharm Des . 2005 ; 11 : 4229 - 4252
- 47 . Thomson J , Oswald I . Effect of oestrogen on the sleep, mood, and anxiety of menopausal women . Br Med J . 1977 ; 2 : 1317 - 1319
- 48 . Scharf MB , McDannold MD , Stover R . Effects of estrogen replacement therapy on rates of cyclic alternating patterns and hot-flush events during sleep in postmenopausal women: a pilot study . Clin Ther . 1997 ; 19 : 304 - 311
- 49 . Polo-Kantola P , Erkkola R , Helenius H . When does estrogen replacement therapy improve sleep quality? . Am J Obstet Gynecol . 1998 ; 178 : 1002 - 1009
- 50 . Brower KJ . Insomnia, alcoholism and relapse . Sleep Med Rev . 2003 ; 7 : 523 - 539
- 51 . Roehrs T , Roth T . Caffeine: sleep and daytime sleepiness . Sleep Med Rev . 2008 ; 12 : 153 - 162
- 52 . Katz DA , McHorney CA . Clinical correlates of insomnia in patients with chronic illness . Arch Intern Med . 1998 ; 158 : 1099 - 1107
- 53 . Hoffstein V . Snoring and upper airways resistance . 4 Philadelphia Elsevier Saunders ; 2005 ;
- 54 . Aloia MS , Arnedt JT , Smith L . Examining the construct of depression in obstructive sleep apnea syndrome . Sleep Med . 2005 ; 6 : 115 - 121

Table 1
Description of the sample

	MEN		WOMEN				
	N=2673		N=3213				
	n	**%**	**n**	**%**	**χ^2**	**df**	**p-value**
Center							
Bordeaux	460	17.21	454	14.13	11.06	2	0.004
Dijon	1427	53.39	1806	56.21			
Montpellier	786	29.41	953	29.66			
Age (years)							
65–69	771	28.84	1012	31.50	7.68	3	0.053
70–74	948	35.47	1051	32.71			
75–79	644	24.09	800	24.90			
80+	310	11.60	350	10.89			
Widowed or divorced	368	13.77	1226	38.16	439.55	1	<0.0001
Education							
High	762	28.51	467	14.53	174.49	2	<0.0001
Medium	1359	50.84	2006	62.43			
Low	552	20.65	740	23.03			
BMI (kg/m^2)							
<25	1008	37.71	1750	54.47	205.51	2	<0.0001
25–29	1340	50.13	1035	32.21			
>30	325	12.16	428	13.32			
Alcohol intake							
0–12 g/day	1058	39.58	2588	80.55	1138.61	2	<0.0001
13–36 g/day	1114	41.68	572	17.80			
>36 g/day	501	18.74	53	1.65			
Coffee drink > 2 cups/day	750	28.06	715	22.25	26.30	1	<0.0001
Mediterranean diet	1584	59.26	1649	51.32	37.12	1	<0.0001
Menopause							
Normal		.	2586	80.49			
Surgical		.	262	8.15			
Medical treatment		.	365	11.36			
Hormone Replacement Therapy (HRT)							
Never		.	2162	67.29			
Past		.	541	16.84			
Current		.	510	15.87			
CES-D ≥ 16	368	13.77	903	28.10	177.15	1	<0.0001
Chronic diseases							
0	455	17.02	593	18.46	8.25	2	0.016

1	874	32.70	1125	35.01			
≥2	1344	50.28	1495	46.53			
Sleep medication	370	13.84	865	26.92	150.56	1	<0.0001
Loud snoring	474	17.73	278	8.65	107.96	1	<0.0001
Sleepiness	581	21.74	407	12.67	85.91	1	<0.0001
Nightmares	95	3.55	197	6.13	20.56	1	<0.0001
Number of symptoms							
0	791	29.59	860	26.77	190.49	3	<0.0001
1	1006	37.64	838	26.08			
2	582	21.77	774	24.09			
3	294	11.00	741	23.06			
Composite symptom index* :							
None	791	29.59	860	26.77	340.71	7	<0.0001
DIS only	53	1.98	150	4.67			
DMS only	832	31.13	578	17.99			
EMA only	121	4.53	110	3.42			
DIS + DMS	195	7.30	379	11.80			
DIS + EMA	28	1.05	93	2.89			
EMA + DMS	359	13.43	302	9.40			
DIS + EMA + DMA	294	11.00	741	23.06			

* corresponding to either isolated or associated symptoms

Table 2

Gender-stratified multivariate multinomial logistic regression: Adjusted OR, confidence intervals and significance levels of having 1, 2 or 3 IS.

	Men						Women					
	Wald χ^2	**df**	**Overall p**	**1 versus 0**	**2 versus 0**	**3 versus 0**	**Wald χ^2**	**df**	**Overall p**	**1 versus 0**	**2 versus 0**	**3 versus 0**
Age (years)												
65–69	27.46	9	0.001	1	1	1	17.33	9	0.044	1	1	1
70–74				1.47 [1.16–1.86]	1.10 [0.83–1.46]	1.24 [0.86–1.78]				1.25 [0.98–1.59]	0.96 [0.75–1.24]	1.12 [0.86–1.46]
75–79				1.63 [1.25–2.12]	1.08 [0.79–1.47]	1.26 [0.84–1.88]				1.39 [1.06–1.83]	1.27 [0.96–1.67]	1.01 [0.75–1.37]
80+				2.18 [1.53–3.10]	1.61 [1.07–2.41]	1.42 [0.84–2.40]				1.52 [1.06–2.18]	1.13 [0.77–1.65]	1.34 [0.91–1.98]
Education												
High							16.75	6	0.010	1	1	1
Medium										0.73 [0.55–0.96]	0.83 [0.61–1.12]	0.81 [0.59–1.12]
Low										0.78 [0.56–1.09]	1.18 [0.83–1.68]	1.14 [0.79–1.65]
BMI (kg/m^2)												
<25							23.03	6	0.0008	1	1	1
25–29										1.03 [0.83–1.28]	0.92 [0.73–1.15]	1.19 [0.94–1.50]
≥30										0.92 [0.68–1.24]	0.71 [0.52–0.98]	0.55 [0.39–0.78]
Alcohol intake												
<12							18.53	6	0.005	1	1	1
12–36 g/day										1.13 [0.88–1.46]	1.31 [1.01–1.71]	0.96 [0.72–1.28]
>36 g/day										0.73 [0.38–1.43]	0.37 [0.16–0.86]	0.22 [0.09–0.58]
Mediterranean diet, Yes vs No	4.52	3	0.21	1.16 [0.95–1.42]	0.95 [0.75–1.20]	0.93 [0.69–1.26]	6.22	3	0.10	0.80 [0.66–0.98]	0.81 [0.66–0.99]	0.80 [0.64–1.00]
Current HRT, Yes vs No							5.80	3	0.12	0.95 [0.72–1.24]	0.76 [0.57–1.02]	0.73 [0.54–0.99]
CES-D ≥ 16 Yes vs No	37.19	3	<0.0001	1.44 [1.04–2.01]	2.04 [1.42–2.91]	3.44 [2.26–5.22]	53.55	3	<0.0001	1.33 [1.04–1.69]	1.84 [1.45–2.35]	2.43 [1.89–3.13]
Chronic diseases												
0	11.78	6	0.067	1	1	1	17.01	6	0.009	1	1	1
1				1.16 [0.88–1.52]	1.61 [1.13–2.27]	1.50 [0.95–2.39]				1.09 [0.83–1.42]	1.04 [0.78–1.38]	1.46 [1.06–2.00]
2+				1.15 [0.88–1.49]	1.58 [1.13–2.20]	1.73 [1.12–2.67]				1.20 [0.92–1.57]	1.35 [1.02–1.79]	1.82 [1.33–2.49]
Sleep treatment, Yes vs No	51.65	3	<0.0001	1.12 [0.80–1.56]	2.25 [1.60–3.15]	3.13 [2.12–4.63]	73.32	3	<0.0001	1.22 [0.95–1.58]	1.96 [1.53–2.51]	2.67 [2.07–3.44]
Loud snoring, Yes vs No	6.36	3	0.095	1.38 [1.06–1.79]	1.25 [0.92–1.69]	1.09 [0.74–1.60]						
Sleepiness, Yes vs No	80.83	3	<0.0001	2.36 [1.75–3.18]	4.04 [2.95–5.53]	3.52 [2.44–5.10]	15.98	3	0.001	1.68 [1.17–2.42]	1.91 [1.34–2.74]	2.02 [1.40–2.91]
Nightmares, Yes vs No	24.17	3	<0.0001	2.91 [1.18–7.17]	6.27 [2.57–15.28]	7.31 [2.84–18.80]	29.88	3	<0.0001	1.99 [1.08–3.67]	2.97 [1.67–5.30]	4.28 [2.42–7.55]

Center is not shown.

Table 3

Multivariate logistic regression: OR adjusted, confidence intervals and significance levels of isolated symptoms.

3a – In men

	DIS				DMS				EMA			
	Wald χ^2	**df**	**OR [95%CI]**	**p-value***	**Wald χ^2**	**df**	**OR [95%CI]**	**p-value***	**Wald χ^2**	**df**	**OR [95%CI]**	**p-value***
Age (years)												
65–69	2.42	3	1	0.49	28.16	3	1	<0.0001	6.45	3	1	0.092
70–74			1.06 [0.52–2.17]				1.52 [1.19–1.96]				1.76 [1.08–2.86]	
75–79			0.82 [0.35–1.93]				1.76 [1.34–2.32]				1.08 [0.60–1.95]	
80+			1.83 [0.70–4.80]				2.36 [1.64–3.40]				1.56 [0.75–3.29]	
BMI												
<25	6.67	2	1	0.036								
25–29			1.00 [0.51–1.96]									
≥30			2.70 [1.15–6.34]									
CES-D ≥16, Yes vs No	1.38	1	1.65 [0.72–3.80]	0.24	1.53	1	1.25 [0.88–1.77]	0.22	3.74	1	1.90 [0.99–3.64]	0.053
Sleep treatment, Yes vs No	16.93	1	4.46 [2.19–9.10]	<0.0001					2.77	1	1.69 [0.91–3.12]	0.096
Loud snoring, Yes vs No					6.26	1	1.43 [1.08–1.88]	0.012	2.36	1	1.50 [0.89–2.51]	0.125
Sleepiness, Yes vs No	1.20	1	1.56 [0.70–3.47]	0.27	27.68	1	2.30 [1.69–3.14]	<0.0001	12.37	1	2.55 [1.51–4.29]	0.0004
Nightmares, Yes vs No	1.64	1	3.46 [0.52–23.17]	0.20	5.56	1	3.08 [1.21–7.83]	0.018				

3b – In women

	DIS				DMS			
	Wald χ^2	**df**	**OR [95%CI]**	**p-value***	**Wald χ^2**	**df**	**OR [95%CI]**	**p-value***
Age (years)								
65–69	1.20	3	1	0.75	13.77	3	1	0.003
70–74			1.21 [0.78–1.89]				1.28 [0.98–1.67]	
75–79			0.96 [0.58–1.61]				1.59 [1.19–2.12]	
80+			0.94 [0.47–1.85]				1.78 [1.21–2.60]	
BMI								
<25	3.09	2	1	0.21				
25–29			0.91 [0.61–1.37]					
≥30			0.57 [0.30–1.07]					
Coffee > 2 cups/day, Yes vs No					3.51	1	0.78 [0.60–1.01]	0.061
Mediterranean diet, Yes vs No	0.48	1	0.87 [0.60–1.28]	0.49	3.08	1	0.82 [0.66–1.02]	0.079
CES-D≥16, Yes vs No	12.55	1	2.10 [1.39–3.16]	0.0004	0.49	1	1.10 [0.84–1.45]	0.48
Sleep treatment, Yes vs No	34.69	1	3.41 [2.27–5.14]	<0.0001				
Sleepiness, Yes vs No					12.88	1	2.01 [1.37–2.94]	0.0003
Nightmares, Yes vs No	1.13	1	1.71 [0.63–4.63]	0.29	7.44	1	2.44 [1.29–4.63]	0.006

* p-value (for variables with more than two categories, the p-value of the test for trend is given). EMA is not shown in women since all variables are not significant. Center not shown.