Insomnia and its relationship to health-care utilization, work absenteeism, productivity and accidents

M. Daley[a,b], C.M. Morin[a,b,*], M. Leblanc[a,b], J.P. Grégoire[c,d], J. Savard[a,e], L. Baillargeon[f]

[a] École de Psychologie, Université Laval, Pavillon F.A.S., Quebec, Canada G1K 0A6

[b] Centre d'étude des troubles du sommeil, Centre de recherche Université Laval-Robert Giffard, Quebec, Canada

[c] Faculté de pharmacie, Université Laval, Quebec, Canada

[d] Unité de recherche en santé des populations de l'Université Laval, Centre de recherche du CHA-Hôpital du Saint-Sacrement, Quebec, Canada

[e] Centre de recherche en cancérologie de l'Université Laval, Quebec, Canada

[f] Unité de médecine familiale, Pavillon CHUL, Université Laval, Quebec, Canada

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Correspondence: École de psychologie, Université Laval, Pavillon F.A.S., Quebec, Canada G1K 0A6. Tel. : +1 418 656 3275; fax : +1 418 656 5152.

Email address : cmorin@psy.ulaval.ca

Abstract

Background and purpose: To document and provide a micro analysis of the relationship between insomnia and health problems, health-care use, absenteeism, productivity and accidents.

Participants and methods: A population-based sample of 953 French-speaking adults from Québec, Canada. Participants were categorized as having insomnia syndrome (SYND) or insomnia symptoms (SYMPT) or as good sleepers (GS). They completed questionnaires on sleep, health, use of health-care services and products, accidents, work absences and reduced work productivity. Data were also obtained from the Québec-government-administered health insurance board on selected variables (e.g., consultations with health-care professionals, diagnoses).

Results: There were significantly more individuals in the SYND group relative to the GS group reporting at least one chronic health problem (83% vs. 53%; OR: 2.78) and who had consulted a health-care professional in the past year (81% vs. 60%; OR: 2.8). There were also higher proportions of individuals in the SYND group than in the GS group who had used prescription medications (57% vs. 30.7%; OR: 2.8), most notably to treat insomnia, mood and anxiety disorders, or who had used over-the-counter products (75.6% vs. 62.0%; OR: 1.8) and alcohol as a sleep aid (17.8% vs. 3.9%; OR: 4.6). In terms of daytime function, 25.0% of the SYND had been absent from work relative to 17.1% of GS (OR: 1.7), 40.6% reported having experienced reduced productivity compared to 12.3% of GS (OR: 4.8) and non-motor-vehicle accidents occurred at higher rates in the SYND group (12.5% vs. 6.4% for GS; OR: 2.4). No differences were found for hospitalisations or motor-vehicle accidents. Most of the associations remained significant even after controlling for psychiatric comorbidity. Rates for the SYMPT group were situated between SYND and GS on all major dependent variables. Furthermore, insomnia and fatigue were perceived as contributing significantly to accidents, absences and decreased work productivity, regardless of insomnia status.

Conclusions: This study indicates that insomnia is associated with significant morbidity in terms of health problems and health-care utilization, work absenteeism and reduced productivity, and risk of non-motor-vehicle accidents. Future studies should evaluate whether treating insomnia can reverse this morbidity.

***Key words*:** Insomnia; Health-care utilization; Morbidity; Absenteeism; Productivity; Accidents

Introduction

Insomnia is the most prevalent of all sleep disorders. Epidemiological research indicates that occasional sleep problems occur in approximately one-third of the population, with between 6% and 10% meeting diagnostic criteria for insomnia syndrome [1–4]. The impact of insomnia is far-reaching, yet most studies examine only one dimension of this impact. For example, several studies suggest that individuals with insomnia use health-care services more frequently than good sleepers, even after controlling for higher rates of depression, anxiety and medical illnesses [1,5,6]. It is estimated that between 5% and 36% of individuals with insomnia have at some time consulted a physician specifically for their sleep problem, while 27–55% have discussed it with a physician in the course of a consultation for another problem [7–9]. While the majority of these consultations are with a general practitioner, little is known about consultations with other types of health-care professionals. Higher consultation rates in people with insomnia may be partly due to the fact that they suffer from a greater number of comorbid physical and/or psychological health complaints [1,10–15]. Research also reveals higher hospitalisation rates in individuals with insomnia [5,16,17], although the specific contribution of insomnia to hospitalisation is poorly understood.

People with insomnia often use prescription medications or over-the-counter (OTC) products or alcohol to manage their sleep difficulties [18,19]. There are wide variations, however, across studies which may reflect cultural or economic variations in the samples studied (e.g., attitudinal, health-care system) or differences in research methodology (e.g., time frame). Furthermore, little is known about utilization of these different products as sleep aids as a function of insomnia severity.

Insomnia can have a negative impact on various aspects of daytime functioning, including work performance. Several cross-sectional studies of working-age adults have found a link between poor sleep and absenteeism, reduced work capacity/productivity, and low levels of work satisfaction and performance [20–24]. Schweitzer et al. [25] estimated that individuals reporting poor sleep miss at least five more days of work per year than good sleepers, while Leigh [26] reported monthly absence rates 1.4 times higher in poor sleepers than in workers with no sleep difficulties. The specific causes of these absences are not clear. A recent study [27] suggests that depressive, behavioral and other complaints that may accompany insomnia explain work absenteeism, and not insomnia *per se*. These results raise an important issue concerning the specific role of insomnia relative to other comorbid problems in accounting for work absenteeism.

Fatigue, combined with other cognitive difficulties associated with insomnia (e.g., poor attention), can lead to serious consequences when individuals are carrying out tasks such as driving. Individuals with sleep problems have been found to be three to four times more likely than good sleepers to experience a motor-vehicle or other serious accident [25,28,29]. Similarly, decision making errors and on-the-job accidents are also more frequent in individuals with sleep problems [16,25]. Interpreting such results is complicated by the fact that the largest proportions of sleep disorder related accidents occur for people suffering from sleep disorders other than insomnia (i.e., sleep apnea), which are usually not considered separately from insomnia. As a result, the relationship between insomnia alone and accident rates is not clear.

The objective of this study was to examine the relationship between insomnia and health, health-care use, and two aspects of daytime function: work function and accidents. A conservative definition of insomnia was used, with a distinction made between individuals with an insomnia disorder and those with subsyndromal insomnia. Sub-types of health problems, consultations and medications/products were examined, as was the *perceived* contributing role of insomnia to health-care services/products use, absences, reduced productivity and accidents.

Methods

This research was part of a larger epidemiological study documenting the prevalence, risk factors, and natural history of insomnia. Preliminary findings about the prevalence and psychological correlates of insomnia have been reported elsewhere [3]. The study was approved by the Laval University's research ethics committee.

Participant selection and screening

Participants were selected from the province of Québec for an initial telephone-administered sleep survey. They were chosen using a stratified probabilistic selection procedure based on the last Canadian census, combined with a random digit selection method. A professional polling agency was responsible for administering the telephone survey. Once households were selected and contacted, the Kish selection method was employed to identify which household member would be interviewed [30]. The only inclusion criteria for the telephone interview were being over 18 years of age and being able to speak French (for more information regarding the methodology of the original telephone phone survey, see Morin et al. [3]). Of 5991 calls placed, 2001 French-speaking respondents agreed to complete the initial telephone survey (34% response rate; see Fig. 1). Of these respondents, 1467 accepted to continue with a longitudinal extension of the study (73% participation rate), which entailed completing questionnaires sent out by mail. In order to obtain a sample most representative of the population as possible, only people having previously received a diagnosis for a sleep disorder other than insomnia (7.2%) were excluded from the next phase, thus reducing the sample to 1362. Previously diagnosed sleep disorders that disqualified individuals from participating included restless legs syndrome, sleep apnea, narcolepsy, hypersomnia or periodic limb movements. Of the 1362 questionnaires sent out, 997 (73%) were returned. When necessary, participants received one mailed reminder and up to eight telephone calls in the weeks following the mailing of the questionnaires. Upon return of each completed questionnaire, participants received a financial compensation of $25.00 Cdn. Further verification of questionnaire responses for the presence of other sleep disorders led to the exclusion of 44 additional individuals, thus reducing the sample to 953. Five more participants were excluded at the data analysis stage due to missing data, leaving a total final sample.

Procedure

Sleep status groups

Participants were classified into three groups according to an algorithm based on a combination of insomnia diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders [31], the International Classification of Diseases, 10th Edition [32] and the use of sleep-promoting products (prescribed and over-the-counter). Responses from the Insomnia Severity Index [33], the Pittsburgh Sleep Quality Index [34] and questions on sleep-promoting medication utilization were used to evaluate the presence or absence of each criterion.

The three sleep status groups were defined as follows: *Insomnia syndrome:* Participants in this group met diagnostic criteria for insomnia. They were dissatisfied with their sleep (i.e., dissatisfied (3) or very dissatisfied (4) on a 0–4 scale) and presented symptoms of initial, maintenance or late insomnia at least three nights per week for a minimum duration of one month. Psychological distress or daytime impairment related to sleep difficulties was also reported by those individuals (i.e., much (3) or very much (4) on 0–4 scales). Finally, if prescribed medication was used as a sleep-promoting agent at least three nights per week, participants were automatically classified in the insomnia syndrome group whether or not they presented symptoms of initial, maintenance or late insomnia. *Insomnia symptoms:* Participants in this group presented symptoms of initial, maintenance or late insomnia at least three nights per week, without fulfilling all the diagnostic criteria of an insomnia syndrome (i.e., they could be satisfied with their sleep, not report distress or daytime consequences, or their sleep difficulties could have been present for less than one month). Also included in this group were individuals dissatisfied with their sleep quality but without symptoms of initial, maintenance or late insomnia. Last, participants using prescribed medication to promote sleep less than three nights per week or over-the-counter medication at least one night per week were automatically classified into this group. *Good sleepers:* These participants were satisfied with their sleep (i.e., very satisfied (0), satisfied (1), or neutral (2) on a 0–4 scale), did not report symptoms of initial, maintenance or late insomnia, and did not use prescribed or over-the-counter medication as a sleep-promoting agent.

Measures

Several questionnaires were used in the larger study but only those directly relevant to the present paper are described here. The first two are insomnia questionnaires which were used to classify participants in one of the three insomnia status groups.

The Insomnia Severity Index

The Insomnia Severity Index [33] is a seven-item questionnaire used to provide a subjective index of sleep impairment based on (a) severity of sleep-onset, sleep maintenance and early awakening problems; (b) satisfaction with the current sleep pattern; (c) perceived interference of sleeping difficulties with daily functioning; (d) noticeability of impairment attributed to the sleep problem; and (e) degree of distress caused by the sleep problem. Items are evaluated according to a 5-point Likert scale (0 = not at all, 4 = extremely) with total scores ranging from 0 to 28. This tool has been shown to have adequate psychometric properties [34].

Pittsburgh Sleep Quality Index

This questionnaire is composed of 19 items designed to assess sleep quality and disturbances over a one month interval. Four open-ended questions are followed by closed questions that are rated on a 4-point Likert scale. Scores for seven components of sleep are derived: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The total score can range from 0 to 21 and is obtained by adding up the seven component scores. The PSQI has been shown to have a diagnostic sensitivity of 89.6% and a specificity of 86.5%.

Health-care service use and insomnia impact questionnaire

An in-house questionnaire was developed to obtain information on chronic health problems (a more specific measure than ICD-9 illness diagnoses obtained from the RAMQ is described below), health-care service and product utilisation, use of alcohol as a sleep aid, hospitalisations, productivity, absenteeism and accidents (motor-vehicle and other types). Although this assessment instrument has yet to be formally validated, key questions are similar to those used in the NIMH Epidemiological Catchment Area Survey [1] and other research [6]. Participants were asked to report the frequency of consultations with all types of health-care practitioners for the previous three months as well as whether insomnia was a reason for seeking consultation (main reason, secondary reason, not a reason). Participants were also asked to provide detailed information on the number and types of all products (prescription, over-the-counter, herbal/natural, alcohol) consumed in the previous 3 months, the dosage (where appropriate) and the health problem for which the product was consumed. Similarly detailed information was requested regarding hospitalisations occurring in the previous 6 months (frequency, reason for hospitalisation, length of stay, diagnoses, interventions). Prescription medication names provided by participants were coded according to the 23 major categories identified in the American Hospital Formulary Service (AHFS) [36] and, where necessary, using the self-report specification regarding the particular ailment being treated. Over-the-counter medications were coded according to categories identified by the Non-prescription Drug Manufacturers Association of Canada (NDMAC) [37] as being the most frequently used products. Self-reported health problems were coded using the eighteen major diagnostic categories set forth in the ICD-9 and used by the *Régie de l'assurance maladie de Québec* (RAMQ).

Participants were also asked to report the number of hours absent from work in the past three months as well as periods of reduced productivity experienced during the same time frame (for remunerated work or other activities). Rather than rely on a dichotomous response that could inflate productivity loss estimates, we tried to nuance our measurement by asking participants to estimate *by what proportion* they thought their productivity had diminished (e.g., 10%, 50% and 90%). For questions related to absences and productivity, participants reported on the cause that was perceived to have most strongly motivated these events (e.g., illness, appointment, insomnia, etc.), along with the perceived strength of the link with insomnia and/or insomnia's consequences (e.g., fatigue, reduced concentration). This was evaluated using a scale of 1–10, which was later transformed to a scale of 0–9 to allow for the lowest number ("0") to represent zero when used in analysis as a multiplier.

Motor-vehicle and other accidents (such as work-related accidents and falls) that occurred in the previous 6 months were also reported, along with a subjective assessment of the link between insomnia or its consequences and the event. The recall period for all questions was the 3 months prior to questionnaire completion, except in the case of hospitalisations and accidents where a longer recall period of 6 months was used (see Drummond et al. [38] for a discussion of optimal reference periods). Finally, demographic data were obtained, including age, gender, race, income, education, and marital status.

Régie de l'assurance maladie de Québec and MedEcho

Data were obtained from two provincial government health-care databases for all 953 participants. The RAMQ is the provincial government-administered provider of health-care services. Québec residents receive coverage for visits to certain health-care professionals (i.e., general practitioners and medical specialists), with some individuals receiving additional assistance if they meet certain conditions (e.g., invalidity, economic hard ship, senior citizens). This database provided information about RAMQ-covered consultations for the study's participants. Data were available according to type of health-care professional consulted. In addition, the RAMQ provided data on diagnoses received. Primary diagnoses were used and coded according to the eighteen ICD-9 categories (infectious parasitic, neo-plasms, endocrine/metabolism/immune, blood, mental disorder, nervous system/sensory organs, circulatory, respiratory, digestive, genitourinary, pregnancy, skin and tissue, skin/muscle/conjunctive tissue, congenital, perinatal, signs and symptoms, supplementary, and other). These data served as an objective complement to the self-report data on chronic illnesses, providing additional information on broader illness categories. While data on prescription medication use are also available from this source, they are limited to a small subset of the population with the special conditions mentioned above who are actually reimbursed for these medications. For this reason, prescription medication data derived from the RAMQ database were not used in the present analyses.

A separate database (*MedEcho*) maintained by the Ministry of Health and Social Services provided hospitalisation data (date, length of stay, principal and secondary diagnoses).

Statistical Analyses

Insomnia status was considered an independent variable in all statistical analyses. The dependent variables derived from the *RAMQ* and *MedEcho* databases and the health care service use and insomnia impact questionnaire included (a) types and frequency of consultations with 13 categories of health-care professionals; (b) types of self-reported chronic health problems (15 categories evaluated); (c) diagnoses received during RAMQ-reimbursed health professional consultations (18 major categories and four sub-categories of mental disorders assessed); (d) types and frequency of prescription medication use (21 sub-categories assessed); (e) types and frequency of over-the-counter products used (20 categories assessed); (f) types and frequency of alcohol used to manage sleep difficulties; (g) frequency, duration and reasons for hospitalisations;

(h) frequency and reasons for self-reported work absences; (i) frequency and reasons for self-reported reduced productivity; and (j) frequency of accidents (motor-vehicle and other types of accidents) and the role of insomnia in those accidents.

Cross-tabulations were run to test for differences in proportions of the sample reporting having experienced the dichotomous dependent variables of interest: had or had not (a) consulted, (b) used prescription medications, (c) used over-the-counter medications, (d) used alcohol as a sleep aid, (e) been hospitalised, (f) been absent from work, (g) experienced reduced productivity, (h) been in a motor-vehicle or other type of accident. Odd ratios were calculated to determine the relative likelihood that such events would occur given membership to the insomnia syndrome group relative to the ‘‘good sleepers” group. Associated 95% confidence intervals (CI) were calculated. Analysis of variance (ANOVA) was used to com- pare means for all continuous quantitative data across insomnia groups with Games–Howell non-parametric tests applied for post hoc analyses.

All data were entered twice and cross-checked for errors. Missing data were scrutinized to verify for bias. The Statistical Package for Social Sciences software (SPSS; version 11.5) was used to conduct all analyses.

Results

Sociodemographic and clinical characteristics of sample

The mean age of participants was 43.7 years (SD = 14.0, range = 18–83) with no significant group differences. Females comprised 60.0% of the sample. The majority of participants were married (58.1%) and worked day shifts (76.4%) at full-time jobs (55.9%). A third (33.7%) had college or professional diplomas, while 27.3% held a university degree. No significant group differences were found for measures of marital status, education, income, or work schedule.

Sleep status

Five participants could not be classified in any of the three sleep status groups because of missing data. Of the 948 remaining participants, 493 (51.7%) were classified as good sleepers, 308 (32.3%) as having insomnia symptoms, and 147 (15.4%) as having an insomnia syndrome. Of the last group, 20 individuals did not fulfill all of the insomnia diagnostic criteria but used prescribed sleep medication for at least three nights per week.

Health status: RAMQ diagnoses and self-reported chronic health problems

Significant group differences were detected for two diagnostic categories obtained from the RAMQ: mental disorders and disorders of the bone, muscle or conjunctive tissue. In the SYND group, 17.7% had received a diagnosis for a mental disorder (predominantly anxiety and mood disorders), compared to 4.5% of SYMPT and 10.2% of GS, $v^2(2, N = 407) = 9.7$, $p < .01$. Of all the participants having received a diagnosis of Anxiety Disorder, 55.4% were in the SYND group, 24.5% in the SYMPT group, and 20.1% in the GS group, respectively, $v^2(2, N = 407) = 10.40$, $p < .005$. Of those having received a diagnosis of Dysthymic Disorder, 56.7% were in the SYND group, 27.2% in the SYMPT group and 16.5% in the GS group respectively, $v^2(2, N = 407) = 11.39$, $p < .005$. Finally, of all the participants having received a diagnosis of Depressive Disorder, 59.3% were in the SYND group, 26.3% in the SYMPT group, and 14.4% in the GS group respectively, $v^2(2, N = 407) = 13.7$, $p < .005$.

As for disorders of the bone, muscle or conjunctive tissue, 20.3% of the SYND group had received a diagnosis, as compared to 12.9% of SYMPT and 9.2% of GS, $v^2(2, N = 407) = 6.32$, $p < .05$. The survey data showed the SYND group to have significantly higher rates of chronic illness (82.7%) as compared to SYMPT (60.4%) and GS (53.2%; see Table 1). SYND participants were almost five times more likely to report at least one chronic health problem relative to GS (see Table 2). Chronic health problem categories associated more frequently with insomnia syndrome were arthritis, ulcers, chronic pain, sinusitis, headache/migraine, and hypertension. No significant differences were found for diabetes, allergies, asthma or the category ‘‘other,’’ and too few observations were present to assess cancer, bronchitis/emphysema, epilepsy, heart disease and stroke. The total number of different chronic health problems was tallied per participant and means were compared across groups; an omnibus test revealed a significant difference, with the mean number of self-reported chronic health problems for SYND, SYMPT and GS groups as follows: 1.69, 1.08, and .81, respectively, $F(2, 809) = 30.76$, $p < .001$. All pairwise comparisons were found to be significant ($p < .001$).

Health-care utilisation: consultations, prescriptions/OTC product and alcohol use

Participants in the SYND group were more likely to have consulted a health-care professional (according to both self-reports and objective RAMQ data) and taken prescription or over-the-counter medications than participants in the other two groups (Table 1). The relation- ship in each of these analyses was linear, with scores in the SYMPT group higher than scores in the GS group and scores in the SYND group higher than both of the other two groups. Differences were present on a global level as well as for analysis of sub-categories of professionals consulted, prescription medications and OTC products used. Table 3 shows that of the *RAMQ*-reimbursed health-care professionals, more participants in the SYND group had consulted general practitioners, psychiatrists and other specialists than participants in the other two groups. Self-report also revealed higher consultation rates of social workers, psychologists, pharmacists, acupuncturists, homeopaths and massage therapists.

One-way ANOVA was used to compare the *frequency* of all types of consultations combined over the 3-month reference period. The SYND group had been consulted more often ($M = 5.13$ times, SD = 7.18) than the SYMPT group ($M = 2.65$, SD = 3.65) or the GS group ($M = 2.13$, SD = 3.87), $F(2, 928) = 24.52$, $p < .000$. RAMQ-reimbursed consultations over the 3-month period were individually compared; group differences were found for the frequency of visits to general practitioners and psychiatrists. The mean number of general practitioner visits for the three subgroups during the 3-month reference period was 3.08 for SYND (SD = 5.19), 1.84 for SYMPT (SD = 2.73), and 1.69 for GS (SD = 2.13; $F(2, 406) = 5.78$, $p < .003$), while the average number of visits to psychiatrists was 0.13 for the SYND group (SD = 0.56), 0.02 for the SYMPT group (SD = 0.17), and 0.01 for the GS group (SD = 0.07), $F(2, 406) = 6.03$, $p < .003$. Comparing groups across the use of all 13 professional consultation categories also revealed consultation of a greater *variety* of professionals in the SYND group ($M = 1.92$, SD = 1.48) compared to the SYMPT group ($M = 1.30$ (SD = 1.15) and the GS group ($M = 1.06$, SD = 1.09), $F(2, 920) = 28.92$, $p < .005$.

Self-report data on prescription medication use revealed that more participants in the SYND group had used medications for mood, anxiety and insomnia problems in the past 3 months than individuals in the SYMPT and GS groups (Table 4). Differences were also identified for medications prescribed for disorders of the bone/muscle/conjunctive tissue, infectious/parasitic diseases and the ICD-9 category ‘‘signs and symptoms.” No differences were identified for use of prescription medications in the 16 remaining ICD-9 categories. The total number of different prescription medications consumed per person per 3-month period was also significantly different across groups: SYND = 1.27 (SD = 1.05), SYMPT = 0.86 (SD = 1.40), GS = 0.69 (SD = 1.04); $F(2, 920) = 19.68$, $p < .001$.

Similarly, a greater number of different OTC products was consumed by the SYND group over the 3-month period than the other groups (SYND = 1.27 (SD = 1.05), SYMPT = 1.16 (SD = 1.1), and GS = 0.99 (SD = 1.04; $F(2, 920) = 4.61$, $p < .01$). Two types of OTC products were used more frequently by the SYND group than by the other groups: products to treat backache and insomnia. While cell sizes were too small to draw conclusions about backache product use, this was not the case for OTC products for insomnia. Of the SYND group, 9.9% had taken such products compared to 4.7% of the SYMPT group and 1.0% of the GS group, v2(2, $N = 931$) = 26.82, $p < .001$.

Alcohol used as sleep aid

Of the entire sample, 8% had consumed alcohol to promote sleep in the previous 3 months. Of the SYND group, 17.8% had used alcohol as a sleep aid, compared to 10.5% of the SYMPT group and 3.9% of the GS group (see Table 1). Participants with insomnia syndrome were over four times more at risk of using alcohol to manage their sleep compared to good sleepers.

Hospitalisations

About four percent (4.2%) of the overall sample had been hospitalised in the past 6 months (*RAMQ* data). No significant group differences were found in the percentage of participants having been hospitalised, the reasons for hospitalisation, or the total number of diagnoses received during hospitalisation (cell sizes were too small to be interpretable).

Absenteeism

Of the total sample, 20.3% reported having been absent from paid work at least once in the past 3 months (see Table 1). SYND participants were more at risk of being absent from work (OR: 1.74) than good sleepers and had a significantly higher number of total hours missed from paid work; participants in the SYND group missed an average of 19.94 hours (SD = 68.98) of paid work in the previous 3 months, compared to 14.29 h (SD = 65.62) for the SYMPT group and 5.94 h (SD = 39.13) for the GS group, $F(2, 933) = 3.46$, $p < .05$ (see Table 5).

Subjective explanations for the absences that were investigated included health of the participant, health of a significant other, leave of absence, appointments, fatigue, and ‘‘other reasons” (single category). Health was reported by 75.6% of all participants to be the main cause of their absences, with no group differences present. The overall rate of reporting fatigue as the primary reason for absences was 18.5%, with, once again, no group differences detected. Participants also reported on the perceived link between insomnia (or its consequences) and their work-related absences in terms of a percentage. The strongest link was found for the SYND group (43.8%) as compared to the SYND group (22.0%) and the GS group (11.6%), $F(2, 141) = 10.0$, $p < .001$.

These percentages were used to derive the proportion of the total time absent from work that can be attributable to insomnia (see Table 5). Analysis after this adjustment indicated that participants in the SYND were absent 8.7 h per 3-month period because of their insomnia. This was significantly higher than both SYMPT and GS participants (3.1 h and 0.69 h, respectively.)

Reduced productivity

Nineteen percent (18.9%) of the sample reported having experienced a reduction in their productivity levels in the prior 3 months, with the largest proportions being in the SYND group (40.6%), compared to 19.9% of the SYMPT group and

12.3% of the GS group (see Table 1).

Table 6 presents possible explanatory factors for reduced productivity that were investigated (health, fatigue, stress, preoccupations, decreased motivation/interest, other, or a mixture of reasons either including or not including fatigue). The most frequently cited reasons, regardless of insomnia status, were fatigue (45.5%) and a mixture of reasons that included fatigue (17.9%), stress (11.7%), and the participant's health (11.9%). Participants with SYND were significantly more likely to report fatigue as the main reason for their reduced productivity (55.6%) relative to the SYND (46.7%) and GS groups (35.0%), $F(2, 174) = 3.80$, $p < .05$. No differences were found for the remaining six categories.

The number of hours of reported lost productivity is displayed in Table 5 along with the absenteeism data. Participants in the SYND group reported significantly more hours of lost productivity in the past 3 months (97.72 h) than participants in the SYMP group (32.6 h) or GS group (20.05 h; $F(2, 921) = 18.03$, $p < .001$). These numbers were obtained after having adjusted for the estimated percentage drop in productivity for each reported episode (see Section 2). Of those participants who responded ‘‘yes” to the question regarding whether insomnia or its consequences had played a role in their productivity difficulties, SYND participants rated the extent of that contribution at 56.4%, SYMPT participants at 37.9%, and good sleepers at 27.6%, $F(2, 120) = 13.16$, $p < .001$.

These figures were used to determine the relative contribution of insomnia to overall lost productivity. Participants in the SYND group had 54.1 h of lost productivity due to insomnia, while participants in the SYMPT and GS groups had 13.2 and 5.4 h, respectively.

Accidents

Thirty-three people in the sample (3.6%) reported having had an automobile accident in the previous 6 months (see Table 1). No significant between-group differences were observed in the rates of automobile accidents having occurred during this reference period. However, 23.5%, or eight participants, having had an automobile accident reported that insomnia or its consequences had played a role in the event, with no group differences being present.

Significant differences were detected for other types of accidents as a function of insomnia status (see Table 1). Seventy-five participants (8.5%) had experienced other types of accidents during the reference period. The proportions were significantly different across groups: 12.5% of participants with SYND, 10.2% of participants with SYMPT, and 6.4% of GS. Individuals in the SYND group were almost twice as likely to have experienced other types of accident compared to good sleepers (*OR*: 2.43). About 39% of participants, regardless of insomnia status, stated that insomnia or it consequences played a role in the event. There was no effect, however, of insomnia status on the belief that there existed a link between the sleep difficulty and the accident. Finally, while no group differences were revealed regarding the *strength* of the perceived link (scale of 0–10) between insomnia and the accident, the link was rated to be quite high for all groups: SYND = 5.5, SYMPT = 7.2, GS = 6.00.

Role of psychiatric comorbidity

To examine the potential impact of comorbid psychiatric disorders on health-care use and work functions, some of the above analyses were repeated for subgroups of individuals with and without psychiatric comorbidity. The main criterion used to determine the probable presence of psychiatric comorbidity was a total score greater than 20 on the Beck Depression Inventory [39] and/or a total score greater than 52 on the State-Trait Anxiety Inventory [40]. These cut-off scores indicate the presence of moderate to severe symptoms of depression and anxiety, respectively. Although self-report measures cannot replace a formal diagnostic interview to make a psychiatric diagnosis, they are used in the present study in an exploratory manner to identify potential cases with psychiatric comorbidity. Using these criteria, we found that psychiatric comorbidity was present for 8.4% of GS, 14.8% of SYMP, and 36.1% for SYND. When comparisons were repeated for subgroups of individuals without psychiatric comorbidity all comparisons (SYND vs. GS), except for absences from work, remained significant: consultations (survey; OR 3.09), consultations (RAMQ; OR: 1.82), presence of chronic health problems (OR: 2.09), use of prescribed medications (OR: 2.91), use of OTC medications (OR: 2.41), and productivity (OR: 3.82) (see Table 1).

Discussion

This study found a linear relationship between insomnia and rates of self-reported chronic health problems, health-care utilization, work absenteeism, decreased productivity, and non-motor-vehicle accidents. The results also showed that insomnia is associated with increased use of prescription medications, over-the-counter products and alcohol. Individuals with insomnia consulted health-care professionals more frequently than good sleepers, with mental health professionals being consulted at particularly high rates. Likewise, most of the prescribed drugs taken by individuals in the insomnia syndrome group were psychotropic products, including hypnotic medications and medications for the treatment of mood or anxiety problems. This latter finding is consistent with previous reports of higher rates of comorbid physical and psychological disorders, notably depression and anxiety, among individuals with insomnia relative to controls without insomnia complaints.

Important associations between insomnia and work function were identified in the present study. Participants with insomnia syndrome were almost two times more at risk of reporting work absences and almost five times more at risk of reporting lost productivity. Only a few other studies have examined the link between insomnia and work performance. [21–23,25,26] While Leigh [26] found monthly absence rates 1.4 times higher in people with insomnia compared to good sleepers, this study found insomnia syndrome to be associated with 3-month absence rates just over two times higher than for good sleepers and an over 12-fold increase in number of hours missed due to sleep difficulties. Our study probed participants' perceptions regarding the reasons for these absences and the most frequently reported reason across all participants was health problems, followed by fatigue.

Participants with insomnia syndrome were almost five times more likely than good sleepers to experience reduced productivity. They reported losing five times as many hours of productivity as a whole and almost ten times as many hours due solely to their insomnia problems. Fatigue was the most frequently cited perceived cause of productivity problems, regardless of insomnia status, with reports of fatigue most marked in the syndrome group. It is not clear the extent to which the association between fatigue and work performance identified in this study is insomnia-induced and to what extent the fatigue is associated with other factors such as comorbid illness and stress. This should be investigated in further research as the relationship between insomnia, absences and reduced productivity presents significant economic implications.

This study examined the *relative* contribution of insomnia to decreased work function. The subjective strength of the link between insomnia and absences was 25.7% for all three groups combined, but this link was four times higher in the syndrome group than in the good sleepers group. The average perceived link between reduced productivity and insomnia in the syndrome group was 40.7%. Interestingly, even good sleepers and individuals with subsyndromal insomnia reported important insomnia-related work deficits. This information is useful as it allows the estimation of the number of hours of work absences perceived to result from insomnia rather than attributing all the responsibility to insomnia alone. It is well documented, however, that individuals with insomnia tend to overestimate the severity of their sleep difficulties [41] and, to some extent, amplify the perceived consequences of insomnia on daytime functioning [42]. Such errors in attribution may also occur when individuals are asked to estimate the contribution of insomnia to their reduced productivity. While this may have contributed to a possible inflation of estimates, this is the first study to examine the contribution of insomnia relative to other factors and it is believed to provide fairly conservative estimates.

While there were no group differences for motor-vehicle accident rates, which may be due to a low base rate of accidents, almost a quarter of individuals who had been involved in such an accident, regardless of sleep status, reported that insomnia or its consequences had been the main cause of their accident. This interesting finding warrants further investigation. Future research measuring other variables such as distance travelled before the accident, the responsibility of the driver in the accident, the time the accident occurred, and whether insomnia was treated or not would help clarify this issue.

This study makes a contribution to the literature in several ways. First, it provides a global portrait of insomnia morbidity using a single population-based sample, rather than combining data from different studies using different methodologies and insomnia definitions. The use of objective data from the *RAMQ* and their concordance with subjective reports strengthens confidence in the results. Other strengths include the use of a conservative and operationalized definition of insomnia, making an important differentiation between an insomnia disorder and subsyndromal insomnia based on DSM-IV and ICSD criteria. The use of three comparison groups rather than the two typical groups (insomnia vs. no insomnia) allowed for the detection of a linear relationship that was present for most analyses. Analyses of sub-types of health-care professionals consulted, as well as consultation motives, medication sub-types and prescription purposes allowed for a more nuanced understanding of health-care use.

These contributions are counterbalanced by several limitations. First, the study may suffer from a selection bias. While the initial sample completing telephone interviews was representative of the Canadian population, more women volunteered for the current study, likely reflecting the fact that more women suffer from insomnia than men. Thus, some group differences may be inflated, given that women tend to use the health-care system more than men. Second, the questionnaire measuring health-care use and productivity is subject to the same limitations of most self-report measures in terms of reporting bias and recall difficulties. As some individuals with insomnia may overestimate the impact of their sleep difficulties on daytime function, it is plausible that participants' assessment of the role of insomnia in work absences, productivity and accidents was exaggerated. Future research should consider using recently published instruments such as the Work Limitations Questionnaire [43] and the Stanford Presenteeism Scale [44]. A final limitation of this study relates to the issue of comorbidity. The lack of formal diagnostic interviews to establish the presence or absence of medical and psychiatric comorbid disorders precludes a clear interpretation of the relationship of insomnia and the increased use of health-care services and work absenteeism and reduced productivity. Future studies will need to more systematically evaluate the unique contribution of insomnia to these different domains relative to other comorbid medical and psychiatric conditions.

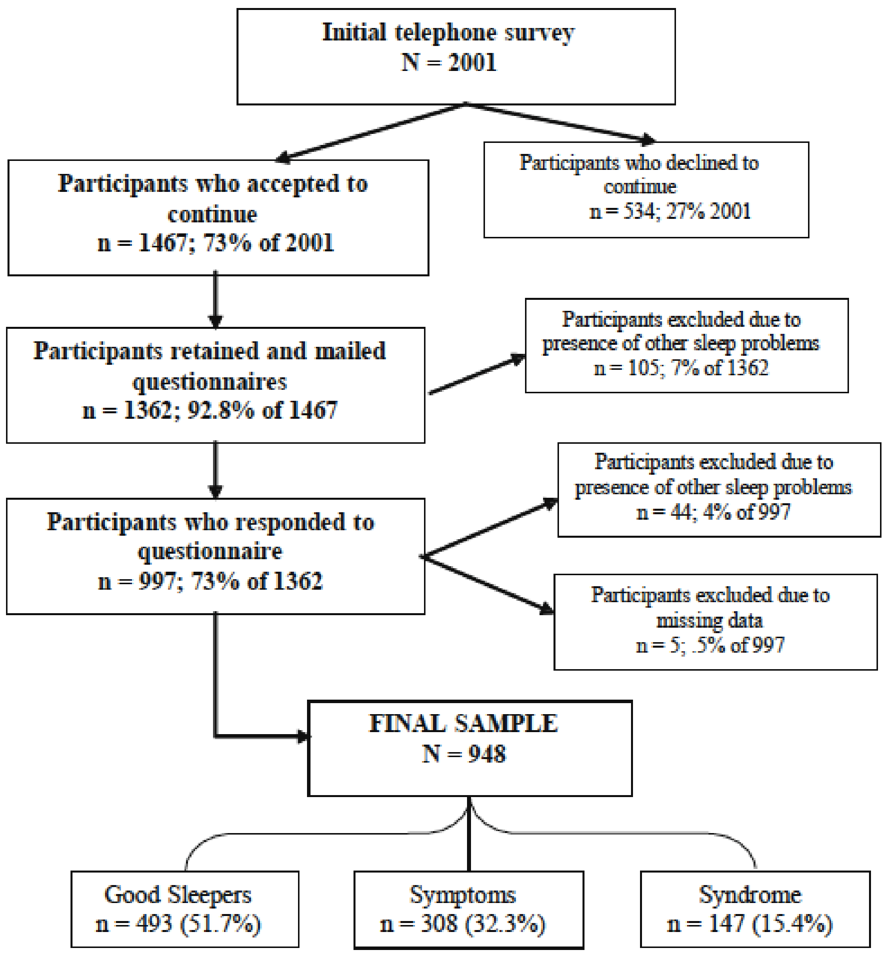

Fig. 1. Flow chart of sample formation.

Table 1
Cross-tabulations for proportions of "yes" responses on dichotomous dependent variables (reference period = 3 months)

Dependent variables	Good sleepers ($n = 493$) % (n)	Symptoms ($n = 308$) % (n)	Syndrome ($n = 147$) % (n)	Total ($n = 948$) % (n)	v^2 (df = 2)	p	All comparisons		OR[b] (no comorbidity)
							OR (SYND vs. GS)	95% CI	
Consultations (all-survey)	60.5 (296)	69.7 (207)	81.5 (110)	66.6 (613)	22.80	.000	2.87	1.77–4.34	3.09
RAMQ consultations	39.9 (195)	43.9 (133)	56.8 (79)	43.7 (407)	12.65	.002	1.99	1.25–2.63	1.82
Hospitalisations (RAMQ)[a]	3.3 (16)	4.7 (14)	6.7 (9)	4.2 (39)	3.26	.196			
Chronic health problems	53.2 (262)	60.4 (186)	82.7 (122)	59.0 (828)	30.97	.000	2.38	2.88–8.46	2.09
Prescription medications	30.7 (150)	43.4 (129)	57.0 (77)	38.7 (356)	35.23	.000	3.00	1.90–4.05	2.91
OTC products	62.0 (303)	64.0 (190)	75.6 (102)	64.6 (595)	8.62	.013	1.90	1.16–2.67	2.42
Alcohol	3.9 (19)	10.5 (31)	17.8 (24)	8.1 (74)	30.99	.000	4.57	2.46–8.48	
Absences	17.1 (67)	24.0 (53)	25.0 (24)	20.3 (144)	6.57	.049	1.74	1.03–2.94	1.36
Productivity	12.3 (59)	19.9 (58)	40.6 (54)	18.9 (171)	54.53	.000	4.58	3.12–7.37	3.82
Accidents (motor-vehicle)[a]	3.7 (18)	3.4 (10)	3.7 (5)	3.6 (33)	0.07	.979			
Accidents (other)[a]	6.4 (30)	10.2 (29)	12.5 (16)	8.5 (75)	6.28	.043	2.43	1.51–3.89	

[a] Reference period = past 6 months. Significance tests are one-tailed. Missing data represented less than 5% of the sample. OR and CI not calculated for non-significant comparisons.
[b] OR adjusted for psychiatric comorbidity for selected dependent variables.

Table 2
Self-report percentages of participants with various chronic health problems

Health problems	Good sleepers ($n = 493$) % (n)	Symptoms ($n = 308$) % (n)	Syndrome ($n = 147$) % (n)	Total ($n = 948$) % (n)	v^2	p	OR (SYND vs. GS)	95% CI
Any problem at all	53.2 (256)	60.4 (136)	82.7 (86)	59.0 (478)	30.97	.001	4.93	2.88–8.46
Arthritis	5.6 (27)	9.3 (21)	26.0 (27)	9.3 (75)	42.14	.000	3.88	2.17–6.92
Ulcers	1.2 (6)	4.9 (11)	8.7 (9)	3.2 (26)	17.92	.000		
Chronic pain	13.3 (64)	14.2 (32)	26.0 (27)	15.2 (123)	10.86	.004	3.28	1.97–5.47
Sinusitis	3.1 (15)	5.3 (12)	9.6 (10)	4.6 (37)	8.70	.013		
Headaches/migraine	11.0 (53)	13.3 (30)	21.2 (22)	13.0 (105)	7.82	.020	3.44	1.93–6.14
Hypertension	7.3 (35)	11.1 (25)	15.4 (16)	9.4 (76)	7.71	.020	2.46	1.33–4.54
Bronchitis/emphys.	0.4 (2)	3.1 (7)	3.8 (4)	1.6 (13)	10.85	.004	11.26	2.15–58.87
Diabetes	2.5 (12)	3.1 (7)	4.8 (5)	3.0 (24)	1.62	.446	4.57	1.68–12.48
Allergies	16.4 (79)	17.3[a] (39)	21.2 (22)	17.3 (140)	1.34	.512		
Asthma	7.3 (35)	7.1 (16)	10.6 (11)	7.7 (62)	1.45	.480		
Epilepsy	0.0 (0)	0.4 (1)	0.0 (0)	0.1 (1)	2.60	.272		
Heart disease	0.6 (3)	4.4 (10)	4.8 (5)	2.2 (18)	13.97	.001		
Cancer	0.6 (3)	1.3 (3)	1.9 (2)	1.0 (8)	1.86	.395		
Stroke	-.0 (0)	0.0 (0)	1.0 (1)	0.1 (1)	6.80	.033		
Other	11.6 (56)	12.9 (29)	14.4 (15)	12.3 (100)	0.70	.706	2.76	1.62–4.71

Note. [a]When the v^2 statistic is not significant or the higher percentage across groups is found in a group other than the syndrome group, the *OR* is not calculated. Percentages may not add to 100% due to rounding. Significance tests are two-tailed.

Table 3
Cross-tabulations for proportions of respondents having consulted various health-care providers (reference period = past 3 months)

Professional	Good sleepers ($n = 493$) % (n)	Symptoms ($n = 295$) % (n)	Syndrome ($n = 153$) % (n)	Total ($N = 948$) % (n)	v^2 (df = 2)	p	OR (SYND vs. GS)	95% CI
RAMQ-reimbursed practitioners								
All combined	39.9 (195)	43.9 (133)	56.8 (79)	43.7% (407)[a]	12.66	.004	1.82	1.25–2.63
General practitioners	31.7 (155)	35.0 (106)	48.2 (67)	35.2% (328)	12.93	.002	1.88	1.30–2.74
Psychiatrists	0.2 (1)	0.3 (1)	2.9 (4)	0.6% (6)	12.77	.002	13.92	1.54–25.49
Other specialists	18.2 (89)	22.8 (69)	30.9 (43)	21.6% (201)	10.74	.006	1.85	1.22–2.80
Non-reimbursed practitioners (survey)								
Social worker	.8% (4)	1.3 (4)	5.9 (8)	1.7% (16)	16.56	.000	11.09	2.96–41.53
Psychologist	2.5 (12)	3.7 (11)	14.1 (19)	4.6% (42)	33.56	.000	5.30	2.59–10.86
Pharmacist	20.0 (98)	30.3 (90)	36.3 (49)	25.7% (237)	19.42	.000	2.27	1.52–3.41
Acupuncturist	.2 (1)	1.0 (3)	3.7 (5)	1.0% (9)	13.39	.003	9.00	1.73–46.85
Massage therapist	9.8% (48)	5.1 (15)	12.6 (17)	8.7% (80)	8.33	.011		
Homeopath	.8 (4)	1.7 (5)	3.7 (5)	1.5% (14)	5.96	.052	5.41	1.51–19.45
Physiotherapist	3.5 (17)	2.0 (6)	8.1 (11)	3.7% (34)	9.94	.140	2.01	1.01–4.45
Nurse	4.3% (21)	6.4% (19)	7.4 (10)	5.4% (50)	2.8	.402		
Other	7.0 (34)	6.1 (18)	6.7 (9)	6.6% (61)	0.24	.464		
Chiropractor	5.3 (26)	5.4 (16)	5.9% (8)	5.4% (50)	0.08	.809		

Note. [a]This number represents the total percentage of the sample having consulted a member of that health profession. OR and CI not calculated for non-significant comparisons.

Table 4
Cross-tabulations for proportions of participants reporting having used different types of prescription medications in the past three months

Category	Good sleepers ($N = 493$) (%, n)	Symptoms ($n = 305$) (%, n)	Syndrome ($n = 147$) (%, n)	Total ($n = 948$) (%, n)	v^2 (df=2)	p	OR (SYND vs. GS)	95% CI
Overall	31.7 (159)	41.9 (117)	56.3 (81)	38.6 (357)	30.40	0.000	2.77	1.90 – 4.05
Mood	1.6 (8)	2.0 (6)	7.7 (11)	2.7 (25)	16.52	0.000	4.96	1.96 – 12.59
Anxiety	1.8 (9)	4.7 (14)	15.5 (22)	4.8 (45)	44.66	0.000	6.92	3.41 – 14.05
Insomnia	1.0 (5)	2.3 (7)	15.5 (22)	3.7 (34)	67.69	0.000	13.67	5.40 – 34.58
Bone/Musc/ Conj. Tissue	5.5 (27)	5.7 (17)	12.0 (17)	6.6 (61)	8.05	0.018	2.12	1.13 – 3.97
Infectious/parasitic	0.4 (3)	2.3 (6)	2.1 (3)	1.3 (12)	6.35	0.042	6.94	1.26 – 38.30
Signs and symptoms	1.8 (9)	3.7 (11)	5.6 (8)	3.0 (28)	6.12	0.047		
Digestive	2.0 (10)	4.3 (13)	2.8 (4)	2.9 (27)	3.51	0.173		
Supplementary	0.6 (3)	1.3 (4)	0.0 (0)	0.8 (7)	2.58	0.275		
Neoplasms (cancer)	0.0 (0)	0.3 (1)	0.7 (1)	0.2 (2)	2.84	0.242		
Genitourinary	4.7 (23)	6.0 (18)	9.2 (13)	5.8 (54)	4.05	0.132		
Respiratory	4.2 (22)	5.4 (16)	2.8 (4)	4.5 (42)	1.44	0.488		
Endocrine/metabolism	4.9 (24)	7.7 (23)	7.0 (10)	6.1 (57)	2.77	0.253		
Skin and tissue	1.4 (7)	1.3 (4)	0.7 (1)	1.3 (12)	0.46	0.794		
Circulatory	10.0 (49)	12.7 (38)	9.9 (14)	10.8 (101)	1.58	0.454		
Nervous system/ sense organs	2.0 (10)	2.3 (7)	4.2 (6)	2.5 (23)	2.21	0.331		
Injuries/side effects	0.6 (3)	0.7 (2)	1.4 (2)	0.8 (7)	0.98	0.614		
Blood	0.6 (3)	0.3 (1)	0.7 (1)	0.5 (5)	0.36	0.837		
Other	0.6 (3)	0.7 (2)	1.4 (2)	0.8 (7)	0.98	0.614		
Pregnancy	N/A							
Congenital	N/A							
Perinatal	N/A							

Note. Significance tests are two-tailed. Percentages may not add up to 100 due to rounding. Odds ratios are not provided for non-significant test statistics.

Table 5
Mean hours lost to absences and reduced productivity: three-month data (N = 948)

	Absenteeism			Reduced productivity		
	Good sleepers ($n = 493$)	Symptoms ($n = 308$)	Syndrome ($n = 147$)	Good sleepers ($n = 493$)	Symptoms ($n = 308$)	Syndrome ($n = 147$)
3-Month						
# of hours (M; SD)	5.94_a (39.13)	14.29_b (65.62)	19.94_c (68.98)	20.05_a (96.31)	32.66_b (106.45)	97.72_c (241.87)
95% CI	2.46–9.41	6.19–22.38	9.47–26.92	11.47–28.62	20.60–44.71	56.23–139.20
% loss due to insomnia	$11.58\%_a$	$22.03\%_b$	$43.75\%_c$	$27.65\%_a$	$37.93\%_b$	$56.41\%_c$
Hours lost due to insomnia (M)	0.69	3.14	8.72	5.36	13.18	54.15

Note. Means with different subscripts differ significantly from each other using Games–Howell post hoc tests.

Table 6
Primary attribution of decreased work productivity ($N = 948$)

Reason (total %)	Good sleepers ($n = 493$) %	Symptoms ($n = 308$) %	Syndrome ($n = 147$) %	v^2
Physical health (11.90)	10.28	11.78	13.74	0.48
Fatigue (45.47)	35.0	46.49	55.60	3.83^*
Stress (11.71)	14.17	11.35	7.46	1.80
Preoccupations (0.76)	1.67	0.57	0.0	0.64
Decreased motivation/interest (4.28)	4.17	5.17	3.51	1.20
Multiple + fatigue (17.86)	18.89	13.65	21.05	1.44
Other + multiple w/o fatigue (6.57)	10.00	6.90	2.63	0.21

* $p < .05$.

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