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Insomnia and its Predictors in the Transition from Adolescence to Adulthood - A Longitudinal Study in a General Population

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Hilde Rovik Gabrielsen

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Insomnia and its Predictors in the Transition from Adolescence to Adulthood - A Longitudinal Study in a General Population

Hilde Rovik Gabrielsen [a]; Børge Sivertsen [a]; Ståle Pallesen [b c]; Bente Wold [d]

[a] Department of Clinical Psychology, University of Bergen, Norway;

[b] Department of Psychosocial Science, University of Bergen, Bergen, Norway;

[c] Norwegian Competence Center for Sleep Disorders, Bergen, Norway;

[d] Research Centre for Health Promotion, University of Bergen, Norway

Hilde.Gabrielsen@student.uib.no; Børge.Sivertsen@psykp.uib.no;

Staale.Pallesen@psysp.uib.no; Bente.Wold@iuh.uib.no

Abstract

This study investigated the course of insomnia from young adolescence to adulthood, and identified early predictors of adult insomnia. Data on sleep, health, and lifestyle factors were collected in 1242 individuals at four time points from at age 13 years to 30 years, in a Norwegian general sample. There was a high stability of sleep problems: of participants with DSM-IV defined insomnia at age 30, 58%, 29%, and 39% also reported sleep problems at age 23, 15 and 13, respectively. Poor health during adolescence was the strongest predictor of adult insomnia, and the strongest individual predictors were pain, poor perceived health, diffuse symptoms, and previous sleep problems. We conclude that insomnia is persistent over time from young adolescence to adulthood, and that several health factors during adolescence predict insomnia at age 30.

Sammendrag

Denne studien har undersøkt insomni fra ungdomsalder til voksenalder, og identifisert tidlige prediktorer på insomni hos voksne. Data om søvn, helse og livsstils faktorer ble innhentet fra 1242 individer på fire tidspunkt fra de var 13 år til de ble 30 års, i den norske normalbefolkningen. Det ble funnet en høy stabilitet av søvnvansker: av deltagere med DSM-IV identifisert insomni ved 30 år, hadde henholdsvis 58%, 29% og 39% også rapporterte søvnvansker i 23, 15 og 13 års alderen. Dårlig helse som ungdom var den sterkeste prediktoren for insomni hos voksne, og de sterkeste individuelle prediktorene var smerte, dårlig subjektiv helse, diffuse symptomer og tidligere søvn vansker. Vi konkluderer med at insomni er vedvarende over tid fra tidlig ungdomsalder til voksenalder, og at flere helse faktorer i ungdomsalderen predikerer insomni ved 30 år.

Insomnia is the most prevalent of all sleep disorders, with nearly one third reporting insomnia symptoms in the general population (Buysse, Germain, & Moul, 2005; Morin, LeBlanc, Daley, Gregorie, & Mèrette, 2006; Morin, Savard, Ouellet, & Daley, 2003; Ohayon, 2002) A diagnosis of insomnia is less common but several studies have shown that approximately 10% of the adult population in Western societies suffer from chronic insomnia (Ohayon, 2002; Pallesen et al., 2001), as specified in DSM-IV (American Psychiatric Association, 1994). Insomnia has been linked to increased use of health care resources (Sivertsen, Krokstad, Mykletun, & Øverland, in press), and the direct cost of insomnia has been estimated to account for 13.9 billion dollars annually in the US (Walsh, 2004). Insomnia have also been linked to higher rates of absenteeism (Lèger, Guilleminault, Bader, Lèvy, & Paillard, 2002), more accidents (Lèger, Massuel, & Metlaine, 2006), and have been shown to predict sick leave (Sivertsen, Overland, Bjorvatn, Mæland, & Mykletun, 2009a) and permanent work disability (Sivertsen et al., 2009b), making the indirect costs of insomnia substantial.

Insomnia symptoms are commonly reported in the major phases of life (Kahn et al., 1989; Kenaita et al., 2007; Morgan, 2003; Sutton, Moldofsky, & Badley, 2001) but less is known about insomnia in the context of transition between life-phases. However, sleep problems have been shown to decrease from childhood (age four) to mid-adolescence at 13-15 years of age (Gregory & O´Connor, 2002). In contrast, studies on adult or elderly samples have generally shown that sleep problems increase with advancing age, especially as persons reach 65 years (Kim, Uchiyama, Okawa, Liu, & Ogihara, 2000; Morgan, 2003; Åkerstedt et al., 2002). A general finding is that insomnia is more common in females, especially after onset of menses (Johnson, Roth, Schultz, & Breslau, 2006b; Zhang & Wing, 2006).

Adolescence is typically a time in life where individuals start making their own choices regarding diet, exercise, and use of social drugs such as tobacco and alcohol. Previous studies

have shown that insomnia is related to unhealthy lifestyle factors, including frequent use of tobacco and alcohol, obesity, and doing no habitual exercises (Johnson & Breslau, 2001; Kim et al., 2000; Landis & Parker, 2007; Ohida et al., 2004). Insomnia has also been linked with a range of adverse consequences and medical conditions including reduced quality of life (Zammit, Weiner, Damato, Sillup, & McMillan, 1999), impaired immune functioning (Savard, Laroche, Simard, Ivers, & Morin, 2003), current and subsequent affective disorder (Franzen & Buysse, 2008; Neckelmann, Mykletun, & Dahl, 2007), as well as chronic pain, heart disease, high blood pressure, neurological diseases, migraine, and cancer (Call-Schmidt & Richardson, 2003; Phillips & Mannino, 2005; Rhee, 2000; Taylor et al., 2007). These correlates with insomnia may reflect different kinds of relationships, with sleep difficulties potentially representing both symptoms and consequences. Alternatively, the link between insomnia and different health variables may be reflected through common third variables, typically co-occuring with medical and psychiatric conditions. The relationship between anxiety, depression, and insomnia has recently received increased attention, as it has been demonstrated that insomnia can be both a predictor and a consequence of anxiety and depression (Jansson-Frojmark & Lindblom, 2008; Morphy, Dunn, Lewis, Boardman, & Croft, 2007).

Few longitudinal studies have explored predictors of insomnia across life-phases. However, one study demonstrated the long-term impact of life-stress on sleep by noting that family conflict during childhood predicted insomnia in late adolescence (Gregory, Caspi, Moffitt, & Poulton, 2006). One study showed that depression symptoms and cigarette smoking in adolescence predicted incidence and persistence of insomnia in young adults (Patten, Choi, Gillin, & Pierce, 2000). It is generally known that several health and lifestyle behaviours established in adolescence may last for decades, and impact adult health and health related outcomes. Hence, since no previous longitudinal study has investigated the

relationship between health and lifestyle factors in adolescents and subsequent insomnia in adulthood we therefore conducted a longitudinal study following participants from 13 to 30 years of age. The study aims were 1) examine the course of insomnia from young adolescence to adulthood, and 2) to identify potential early predictors of adult insomnia.

METHODS

Participants and Procedure

The data used in this study originates from the Norwegian Longitudinal Health Behaviour Study (NLHB). The NLHB is a prospective, 17-year longitudinal, two-generation study that has its focus on health behaviour, lifestyle, and self-reported health among a community sample of adolescents and their parents. A community sample of 1242 (46 % females) Norwegian adolescents participated in a longitudinal study with waves at 13 (N = 887, 45 % females), 15 (N = 933, 45 % females), 23 (N = 625, 51 % females), and 30 years (N = 533, 53 % females). Data from waves at 14, 16, 18, 19, and 21 years of age were excluded from the present study, as sleep was not measured in these waves. Only data from the adolescents were included in the present study. All participants with valid responses on at least two of the variables of interest at minimum two points of time were included in the present study.

Instruments

The Bergen Insomnia Scale (BIS) (Pallesen et al., 2008) was used to assess insomnia at the final follow-up when the participants were 30 years old. The BIS consists of six items based on the inclusion criteria of insomnia in DSM-IV, the first four items corresponding to criteria A (nightly symptoms), and the last two to criteria B (impaired daytime functioning). Each item is scored on an eight-point scale (range 0-7) representing how many days per week during the last month one had experienced the specific symptom sleep described by different

items. Participants were defined as having “insomnia symptoms” if meeting criteria A only, and “insomnia” if in addition meeting criteria B in the DSM-IV. The BIS has previously yielded alphas of .79, .87 and .80 in a student, community and patient sample, respectively (Pallesen et al., 2008) Sleep problems at the previous waves (at ages 13, 15, and 23 years) were measured using a single item scored on a four-point likert-scale. In the present study “sleep problems” were defined as reporting difficulties falling asleep at least 1-3 evenings a week “often” or “always”, whereas good sleepers were defined by reporting these symptoms “seldom” or “never”.

“Pain” was measured by four items (headache, stomachache, backache, and pain in arms or legs. An index comprising more “diffuse symptoms” was based on six items: dizziness, feeling sick, bad appetite, colds or soar throat, weakness, and diarrhoea. The variables pain and diffuse symptoms were calculated the same way: on each item the participants were asked how often during the last three months (“very often”, “seldom”, or “never”) they had experienced a specific type of pain or symptom. All item categories were recoded so that high scores indicated more pain or diffuse symptoms, and continuous sum-scores (range 4-12 for pain and 7-21 for diffuse symptoms) were calculated for each wave.

Depressive symptoms were assessed by a seven-item inventory developed by Alsaker & Olweus (Alsaker, 1992). The items were formulated like statements, concerning different aspects of depression and the participants were asked how much they agreed with the statement on a six-point likert-scale ranging from “does not apply at all” to “applies exactly”. All the item categories were recorded so that a high score indicated a more depressed mood. A continuous sum-score (range 7-42) was used for each year.

Poor perceived health was measured by a single item regarding health quality compared to others at the same age scored on a five-point likert-scale ranging from “very good” to “very poor”. Frequency of exercise, was measured by a single item (“Outside school

hours, how often do you do sports or exercise until you are out of breath or sweaty?"), scored on a seven-point likert-scale: ranging from "every day" to "never". Alcohol consumption was measured by a single item regarding frequency of drinking alcohol the last three months scored on a nine-point likert-scale: ranging from "not tasted last 3 months" to "6-7 times a week". Smoking was measured on a singe item ("How often do you smoke?") scored on a four-point likert-scale: "never", "less than once a month", "every week", or "every day". Body mass index (BMI; kg/m^2) was calculated based on self-reported height and weight (kg).

Statistical Analysis

SPSS version 16 for Mac (SPSS Inc, Chigaco, Illinois) was used for all statistical analyses. Independent sample t-tests and Pearson Chi-Square tests were used to examine differences between participants with sleep problems/insomnia and good sleepers. Gender differences in prevalence and new occurrence of sleep problems at 13, 15, and 23 years and insomnia at 30 years were explored using Pearsons Chi-Square tests. Unadjusted logistic regression analyses were performed to identify predictors (at ages 13 to 23 years) and associations (30 years) of adult insomnia. Insomnia (insomnia vs. good sleepers) at 30 years was used as the dependent variable, while the independent variables entered into the equation included previous sleep problems, pain (in addition to the single pain items: headache, stomachache, backache, and pain in arms or legs), diffuse symptoms, depression, poor perceived health, little or no exercise, high BMI, smoking, and alcohol consumption. Unadjusted logistic regression analyses were also used to identify adolescent predictors of adult insomnia, excluding participants with sleep problems at the given waves.

RESULTS

Prevalence of Adolescent Sleep Problems and Adult Insomnia

The frequency, of self-reported sleep problems at 13, 15, and 23 years of age were 5.7 %, 8.1%, and 8.7%, respectively. In comparison the Bergen Insomnia Scale (administered at 30 years of age) indicated that 35.9% had insomnia at 30 years of age, while 26.1% had insomnia symptom. A gender difference emerged with age, 6.0% of the females reported sleep problems at age 13, whereas 11.3% reported sleep problems at age 23, while the prevalence of sleep problems in males during the same period remained stable at 5-6% (X^2=5.72, *df*=1, *P*< .05). Similarly, at age 30, more woman than men fulfilled the criteria for insomnia The most substantial increase in sleep problems for both sexes appeared between 23 and 30 years, but the overweight of sleep problems in adult females did not increase at the same rate as in adolescence. However females had more severe insomnia (42% vs. 28%: X^2=12.93, *df*=2, *P*< .001).

Chronicity of Adolescent Sleep Problems and Adult Insomnia

As detailed in figure 1, there was a high correspondence between adult insomnia categories and sleep problems in adolescence and young adulthood. Among those with insomnia at 30 years, 58% had sleep problems at 23 years, 29% at 15 years, and 39% at 13 years. There was a tendency that more females than men with insomnia at 30 years also reported sleep problems at 13 (61% vs. 10%), 15 (37% vs. 10%) and 23 years (64% vs. 45%), although only the gender difference at age 13 was significant (X^2=1.03, *df*=2, *P* < .01).

[Insert figure 1 here]

Correlates of Sleep Problems and Insomnia

Table 1 presents differences (measured simultaneously) between good sleepers and participants with sleep problems at 13, 15, and 23 years and good sleepers versus insomniacs at 30 years on physical and mental health, and lifestyle. In sum, participants with sleep problems at ages 15 and 23 and insomnia at age 30 reported worse physical and mental health on all factors compared with good sleepers. In adolescents aged 13, only depression and headache was significantly worse among the poor sleepers (see Table 1 for details).

[Insert table 1 here]

Predictors of Insomnia

Logistic regression analyses demonstrated that in the transition from adolescence to adulthood, pain, diffuse symptoms, and poor perceived health were the strongest risk factors of insomnia at 30 years. In addition, sleep problems and depression in young adulthood also increased the risk of insomnia at 30 years (see Table 2). The number of significant predictors increased with age, from two significant predictors at 13 years to five at 23 years of age. The odds ratio (OR) for the significant variables also increased with age, with e.g. poor perceived health at 23 increasing the risk of insomnia at 30 years more than poor subjective health at 15 years of age. Smoking was the only variable not significantly related to insomnia at 30 years in any of the previous waves. Among the pain items, headache and stomachache were the strongest predictors, but the OR of all four items at 23 years was significant. Interestingly, only sleep problems at 23 years predicted insomnia at 30 years of age.

[Insert table 2 here]

Predictors of New Occurrence Insomnia

Logistic regression analyses of good sleepers at 13, 15, and 23 years of age but who suffered from insomnia at 30 (table 3) greatly reduced both the number of significant predictors and the OR of those predictors. Pain, diffuse symptoms, and poor perceived health were the most important predictors, but also depression significantly predicted new occurrence of insomnia. Headache and stomachache had the highest OR of the pain predictors at age 23, followed by backache and pain in arms or legs which were among the five most important predictors.

[Insert table 3 here]

DISCUSSION

To the best of our knowledge, this is the first longitudinal study of insomnia following the transition from adolescence to adulthood. We found a high degree of stability of sleep problems. In general, both physical and mental health problems at 13 or 15 years significantly predicted insomnia at 30 years, of which pain, diffuse symptoms, poor perceived health, and previous sleep problems were the strongest predictors. Depression also had a significant but small predictive value for insomnia at 30 years of age.

The Chronicity of Insomnia

In the present study, 58% with adult insomnia also had sleep problems seven years earlier, 29% had sleep problems thirteen years earlier, and 39% fifteen years earlier. The chronicity of insomnia was relatively high compared to the two previous studies based on prospective data on adolescents. Roberts (2008) reported a chronicity rate of 22.8% after one year, while Patten (2000) noted a 21% rate four years later. Still, our rates are comparable to rates found in adults after three and ten years (Janson, Lindberg, Gislaon, Elmasry, & Boman, 2001; Morin et al., 2009). In adults, the chronicity rate has been reported within a range of

1.3% 11 years later to 69% at 12 months follow-up (Janson et al., 2001; Morphy et al., 2007; Neckelmann et al., 2007). Persistence of insomnia has previously been reported to be associated with older age (Morphy et al., 2007). Thus, our data challenge this notion showing that sleep problems generally are persistent even across several years from adolescence to adulthood.

Gender Differences in Prevalence and Chronicity of Insomnia

The prevalence of sleep problems in females increased from 6% in adolescence (13 years) to 11.3% in young adulthood (23 years). The most substantial increase however took place in adulthood (from 23 to 30 years), with 65.5% of the females having insomnia symptoms or insomnia at 30 years. In comparison 5-6% of the males reported sleep problems in adolescence or young adulthood, and 58.0% of the males had adult insomnia symptoms or insomnia at 30 years. A meta-analysis investigating insomnia have showed that insomnia is more common in females and that this difference increase with age, in addition to insomnia tending to be more chronic in females (Zhang & Wing, 2006). The present study confirms these findings, but also shows that the gender difference is most apparent adolescence and young adulthood, when the prevalence of sleep problems in males is relatively low, and becomes less distinct in adulthood when both genders show an increase in prevalence. However, we did find insomnia to be more common in females, indicating that although insomnia and insomnia symptoms were common in both sexes, females had more severe insomnia than men. Furthermore more females than men with insomnia at 30 years also had sleep problems at 23, 15, and 13 years, indicating that insomnia may be more chronic in females.

Physical- and Mental Health, and Insomnia

In the current study sleep problems seven years earlier predicted insomnia at 30 years, whereas sleep problems at 13 or 15 years did not. Previous studies have shown that prior

insomnia increased the risk of adult insomnia in the range of one month to ten years later (Janson et al., 2001; Klink, Quan, Kalterborn, & Lebowitz, 1992; LeBlanc et al., 2007).

In the present study participants with sleep problems at 15, 23, or 30 years reported significantly worse perceived health, than good sleepers. Poor perceived health at 15 and 23 years also independently increased the risk of insomnia as well as new occurrence insomnia at 30 years. These findings extend on previous cross-sectional studies showing that health dissatisfaction is associated with insomnia in both adolescents and adults (Kim et al., 2000; Liu, Uchiyama, Okawa, & Kurita, 2000; Sutton et al., 2001). Poor physical health has also been shown to predict insomnia (Liu et al., 2000; Morgan, 2003). The present study extends the existing base of knowledge about the relationship between poor perceived health and insomnia by showing not only that adult poor perceived health is associated with adult insomnia, but also that adolescent poor perceived health predicted both adult insomnia and new occurrence of adult insomnia.

In the present study adolescents and young adults with sleep problems at 15 and 23 years, and adults with insomnia at 30 years independently reported more headache, stomachache, backache, pain in arms or legs, and overall pain than good sleepers at the same ages. Moreover, pain in adolescence or young adulthood also predicted insomnia and new occurrence insomnia seven, thirteen and seventeen years later. These associations between insomnia and pain are consistent with earlier findings (Su, Huang, & Chou, 2004; Sutton et al., 2001). .However, no prior studies have looked at the relationship between pain and sleep problems over such length of time, but the finding that pain predicted insomnia and new occurrence insomnia as long as seventeen and thirteen years later, is consistent with studies showing that pain increase the risk of developing insomnia one year later (Morphy et al., 2007). Also, Morphy et al. (2007) concluded that insomnia, pain, depression, and anxiety was interwined based on the finding that pain, depression, and anxiety increased the risk of

insomnia one years later, and that insomnia likewise increased the risk of widespread pain, depression, and anxiety one year later. When looking more closely at the different pain areas, the most important link between pain and insomnia, in the present study, was that of headache and stomachache and to a lesser degree backache and pain in arms and legs, although all pain variables significantly increased the risk insomnia at lest seven years later. Several studies has previously established a close relationship between headache and insomnia (Alberti, Mazzotta, Gallinella, & Sarchielli, 2005; Rhee, 2000), and one study even concluded that good sleep protects against early morning headache and migraine attacks (Alstadhaug, Salvesen, & Bekkelund, 2007). The headache and stomachache associated with insomnia might have been related to anxiety, as anxiety have been known to cause tension in the muscles in the neck and stomach area (Gureje et al., 2008). Headache and stomachache could in other words have been bodily expressions of anxiety, which is known to be closely associated with insomnia, and which often precedes it (Jansson-Frojmark & Lindblom, 2008; Johnson, Roth, & Breslau, 2006a) .

Our findings showed that individuals with sleep problems at 15, 23, or 30 years had more diffuse symptoms than good sleepers at the same ages, and that diffuse symptoms at the three first waves independently predicted insomnia and new occurrence insomnia at age 30. No previous longitudinal study has, to our knowledge, investigated whether diffuse symptoms such as dizziness, diarrhoea, feeling sick, weakness, colds or soar throat, or bad appetite may predict insomnia over time. Still, insomnia has been known to be associated with stress (Kim et al., 2000; Sutton et al., 2001) and to have an impact on immune functioning (Savard et al., 2003), and an association between diffuse symptoms and insomnia are reasonable as some diffuse symptoms can be due to a temporarily reduction of the immune system and/or long-term stress.

In the present study participants with sleep problems at any wave reported more depression than good sleepers at the same waves. Depression at 23 years increased the risk of insomnia and new occurrence insomnia at 30 years. Depression at 13 years was a small, but significant predictor of new occurrence insomnia at 30 years. The relationship between depression and insomnia is well established in both adolescents and adults, and our findings supported this notion (Roane & Taylor, 2008; Roberts, Roberts, & Chen, 2001). However, the causal relationship between depression and insomnia has however been a bit more blurry with several studies indicating that depression may occur as a consequence of insomnia. Others have argued that depression predicts insomnia, or that there is a bidirectional relationship between the two entities (Jansson & Linton, 2006; Jansson-Frojmark & Lindblom, 2008; Johnson et al., 2006a; Morgan, 2003; Phillips & Mannino, 2005). Previous studies have demonstrated that insomnia could predict depression one to three years later (Riemann & Voderholzer, 2003), but not eleven years later (Neckelmann et al., 2007). Our finding, that depression predicted new occurrence insomnia seven and seventeen years later, in combination with earlier findings that insomnia predicted depression support the presence of a bidirectional relationship between insomnia and depression. Due to this being the first longitudinal study of insomnia over seventeen years, it has been hard to compare our results with those of earlier studies. However, Phillips and Mannino's (2005) finding that depressive symptoms predicted adult insomnia five to seven years later, and Patten et al.`s (2000) study showing that depressive symptoms predicted the development of insomnia four years later in young adults, are in line with our finding that adolescent depression predicted the development of adult insomnia seven and seventeen years later.

Lifestyle Factors and Insomnia

In the current study adolescents with sleep problems at 15 years and adults with insomnia at 30 years exercised less and had a higher BMI than good sleepers at the same

ages, although there were no significant differences in levels of exercise and weight at ages 13 and 23 years. Little or no exercise and high BMI were independently associated with insomnia at 30 years, but adolescent limited exercise or high BMI had no effect on adult sleep. We did however not have data making it possible to investigate whether high BMI predicted insomnia seven years later or not. Physical exercise is one of several non-pharmalogical treatments of sleep disorders suggested by the American Sleep Disorders Association (Hauri, 1993). As exercise can promote or disrupt sleep depending on the type of exercise, its intensity, duration and time of day, moderate exercise in the late afternoon are usually recommended (Driver & Taylor, 2000; Santos, Tufik, & De Mello, 2007). A review article concluded that exercise increased the total sleep time, although the effect was moderate, and suggested that exercise might have especially positive effects on the sleep of insomniacs compared to good sleepers (Driver & Taylor, 2000). This is fortunate considering that previous studies have shown that lack of physical activity was linked to sleep problems (Liu et al., 2000; Morgan, 2003; Åkerstedt et al., 2002). Youngstedt & Freelove-Charton (2005) also reviewed the literature on sleep and exercise and suggested that the apparent link between exercise and good sleep on one side and lack of exercise and sleep problems on the other side might be due to unaccounted factors such as exposure to bright sunlight during outdoor exercise promoting sleep by circadian phase-shifting effects and antidepressant effects, and the social element of the exercise rather than the exercise in it self.

Like lack of habitual exercise, obesity has frequently been linked to insomnia (Janson et al., 2001; Åkerstedt et al., 2002) although some has failed to find such an association (Sutton et al., 2001). Obesity in adolescence and adulthood has been associated with shorter sleep durations (Beebe et al., 2007; Bjorvatn et al., 2007) and adolescent obesity have been associated with lighter sleep and less deep sleep (Landis & Parker, 2007). Our finding that high BMI was associated with insomnia in adults is thus consistent with previous findings.

Participants with sleep problems at age 15 consumed more alcohol and smoked more tobacco than fifteen year olds without sleep problems. Adults with insomnia at 30 years reported less alcohol consumption than adult good sleepers. There were no significant differences between participants with and without sleep problems in frequency of smoking at 13, 23, and 30 years or alcohol consumption at 23 years or age. Adult alcohol consumption was positively associated with insomnia at 30 years, but adolescent alcohol consumption did not predict insomnia at 30 years. Smoking was the only lifestyle variable investigated not associated with adult insomnia, and like the other health variables smoking did not predict insomnia at age 30 years. Our finding, that smoking only was associated with sleep problems in adolescence (15 years), and not in adulthood (23 or 30 years) was unexpected, as previous studies have demonstrated that both smoking and alcohol consumption are associated with sleep problems in adolescents and adults (Kenaita et al., 2007; Riedel, Durrence, Lichstein, Taylor, & Bush, 2004; Tynjälä, Kannas, Levalahti, & Valimaa, 1999). Patten (2000) even found a dose-response relationship between cigarette smoking and insomnia, with smoking predicting both new occurrence and persistence of insomnia four years later. Alcohol is known to have a negative impact on sleep quality because it increases bodily activation when it leaves the bloodstream after its initial sedative effect has worn out (Heider & Wolland, 2005). As the sedative effect does increase the likelihood of falling asleep, self-medication of sleep onset problems with alcohol have however been reported as common (Morin, LeBlanc, Daley, Gregorie, & Mèrette, 2006). As the current level of alcohol consumption in the present study was low, this finding could be seen in light of Skogen et al.'s (submitted) finding that a moderate level of alcohol consumption is associated with good mental health, while both total abstinence and high levels of alcohol were associated with poor mental health. Smoking increases the bodily activation by the nicotine stimulating cholinergic

neurotransmission, and are linked to sleep onset latency, sleep fragmentation, and increased daytime sleepiness (Jaehne, Loessi, Bàrkai, Riemann, & Hornyak, in press).

None of the lifestyle factors predicted insomnia at any time, implying that lack of exercise, high BMI, smoking, or alcohol consumption during adolescence and young adulthood in it self is not a risk factor for developing insomnia at 30 years of age if having a history as a good sleeper. It is plausible that a several unhealthy elements combined would have predicted adult insomnia diagnosis, even if they did not do so separately.

In sum, adolescents and adults with sleep problems or insomnia reported more physical-and mental health problems and poorer lifestyle than good sleepers at the same ages, with the exception of alcohol consumption at the last two waves. The health factors were the most important predictors of insomnia and new occurrence insomnia at 30 years. As this study have only looked at the effects of poor health and lifestyle on future insomnia, it is yet uncertain whether this is part of an interwined or bidirectional relationship, with insomnia possibly influencing future poor health and lifestyle.

Strengths and Limitations

A major strength of this study was the longitudinal design, enabling us to investigate and compare factors associated with persistence and new occurrence insomnia over a course of seventeen years. Although there have been longitudinal studies investigating insomnia, none of the studies identified studied such a wide range of mental and physical health aspects over such a length of time in a general population using DSM-IV criteria for insomnia. The large sample size was another important strength of this study, enhancing the generalizability of the findings and ensuring sufficient statistical power.

Important limitations of the current study was the use of a single item to discriminate between individuals with and without sleep problems at the three first waves, and the Bergen Insomnia Scale was used to separate good sleepers from insomniacs only at the fourth wave.

This makes it difficult to compare prevalence rates of sleep problems/insomnia at 13, 15, and 23 years of age with the corresponding prevalence rate at 30 years. As Morin et al. (2009) have pointed out, a limitation with longitudinal studies where sleep problems were reported over several years have been the unclearness about whether they had persisted continuously or were interrupted by periods of remission. Also all data were based on self-report only. Furthermore, as our definition of insomnia in the fourth wave was based on the DSM-IV inclusion criteria only, the occurrence of false positives, such as participants with sleep problems due to another sleep disorder, mental disorder, substance or medical condition being falsely attributed to insomnia, cannot be ruled out. The daytime impairments reported by our respondents may for example be a symptom of other conditions such as sleep apnea rather than being primary insomnia. As the present study followed a great number of participants over a course of seventeen years, there was as expected a large dropout, and care should be taken when generalizing the results to the entire population. Furthermore, factors such as anxiety and stress that would have been interesting in a longitudinal study of insomnia were not included in the different waves of the study.

Conclusion

In conclusion, this study shows a high degree of stability of sleep problems. Several health factors during adolescent and young adulthood independently predict both insomnia and new occurrence of insomnia at age 30, the most important being pain, diffuse symptoms, poor perceived health, and previous sleep problems.

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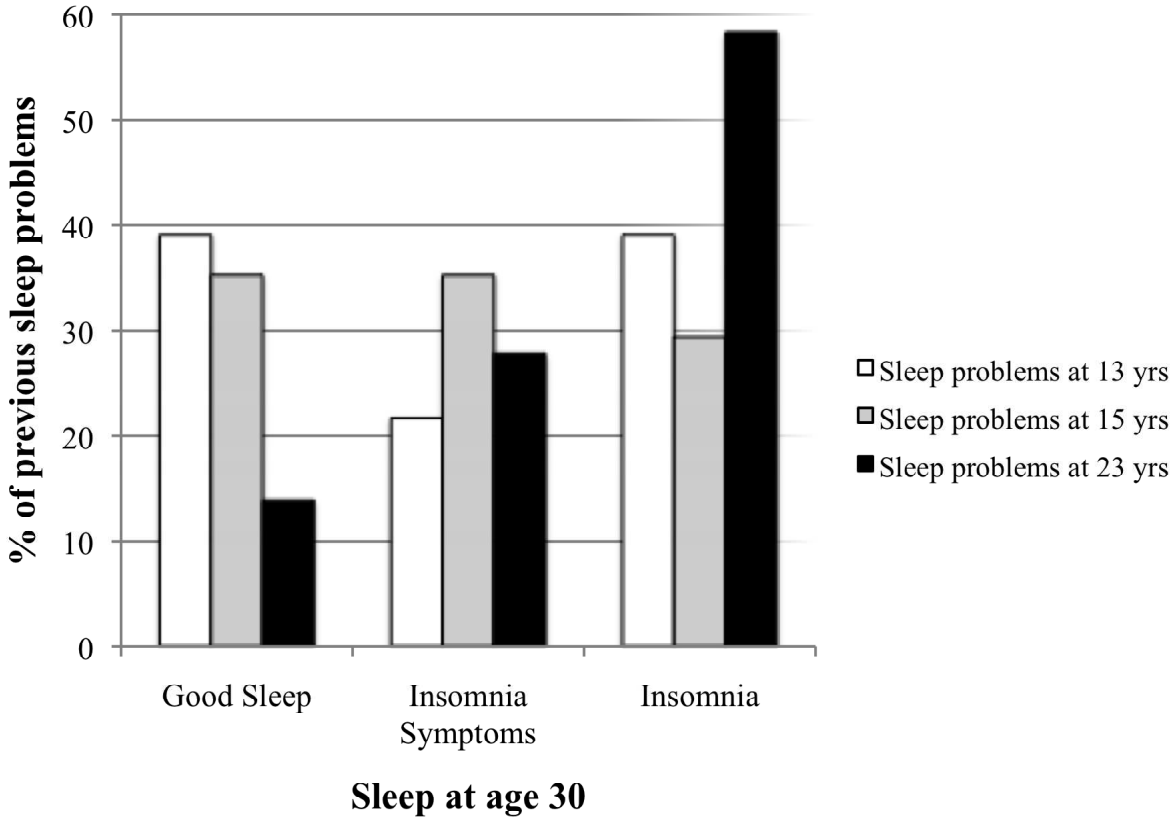

Figure 1. Correspondence between insomnia categories at 30 years of age and sleep problems at 13, 15, and 23 years.

Table 1

Associations of Sleep Problems/Insomnia at 13, 15, 23, and 30 Years of age.

Variable	Sleep problems at 13 yrs		Sleep problems at 15 yrs		Sleep problems at 23 yrs		Insomnia at 30 yrs	
	Yes	No	Yes	No	Yes	No	Diag.	No diag.
Pain	6.80	6.30	7.22***	6.01	7.07***	5.58	6.30***	5.13
Headache	1.80*	1.54	1.90***	1.45	1.87***	1.42	1.68***	1.30
Stomachache	1.60	1.59	1.71**	1.46	1.80***	1.38	1.48***	1.18
Backache	1.63	1.53	1.82**	1.59	1.87***	1.55	1.70***	1.43
Pain in arms or legs	1.77	1.63	1.81***	1.53	1,54**	1.23	1.46***	1.22
Diffuse symptoms	9.63	8.77	10.18***	8.55	10.55***	8.26	9.06***	7.37
Depression	18.38*	15.48	23.35***	15.98	21.74***	12.46	14.36***	10.27
Poor perceived health	2.47	2.24	2.48***	2.07	2.67***	2.22	2.44***	1.95
Little or no exercise	3.37	2.92	3.74**	3.09	4.30	4.00	4.20*	3.88
High BMI	18.85	18.22	20.72*	20.10	/	/	25.12*	24.17
Smoking	1.34	1.19	2.21**	1.71	2.43	2.23	1.82	1.72
Alcohol consumption	/	/	2.99**	2.29	3.96	4.15	3.52***	4.22

Mean (M) values are reported. "/" means that data were not collected. Single pain items have been indented and written in italic.

* P < .05, ** P < .01, and *** P < .001 (based on independent sample t-tests).

Table 2

Predictors of Adult Insomnia at 30 Years

Variable	13 yrs		15 yrs		23 yrs		30 yrs	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sleep problems	1.09	.77-1.56	1.28	.93-1.80	2.54***	1.74-3.71	/	/
Pain	1.21**	1.05-1.40	1.25***	1.10-1.43	1.61***	1.35-1.91	1.74***	1.48-2.05
Headache	1.65**	1.14-2.40	1.75**	1.25-2.44	2.22***	1.53-3.23	2.53***	1.81-3.54
Stomachache	1.71**	1.14-2.58	1.41	.99-2.02	2.14***	1.44-3.18	3.97***	2.00-4.68
Backache	1.29	.89-1.86	1.30	.96-1.77	1.74**	1.23-2.47	2.00***	1.44-2.78
Pain in arms or legs	1.19	.82-1.70	1.32	.95-1.84	2.59***	1.60-4.19	2.18***	1.50-3.17
Diffuse symptoms	1.17*	1.03-1.33	1.22***	1.09-1.36	1.44***	1.26-1.64	1.77***	1.53-2.05
Depression	1.04(*)	.99-1.08	1.03	.99-1.06	1.14***	1.09-1.20	1.16***	1.10-1.22
Poor perceived health	1.25	.89-1.74	1.37*	1.02-1.83	2.04***	1.47-2.84	2.59***	1.90-3.54
Little or no exercise	1.17	.98-1.40	1.15	.99-1.33	1.14	.99-1.32	1.16*	1.01-1.32
High BMI	1.02	.92-1.13	1.03	.95-1.11	/	/	1.07*	1.01-1.13
Smoking	1.35	.92-1.92	1.05	.87-1.28	1.04	.88-1.22	1.07	.91-1.26
Alcohol consumption	/	/	.99	.87-1.12	1.05	.90-1.22	.80***	.71-.89

"/" means that data were not collected. Single pain items have been indented and written in italic.

(*) P = .05, * P < .05, ** P < .01, and *** P < .001

Table 3

Predictors of New Occurrence Adult Insomnia

(Participants Reporting Good Sleep at 13, 15, and 23 Years of age, but Suffering From Insomnia at 30 Years)

Variables	13 yrs		15 yrs		23 yrs	
	OR	95% CI	OR	95% CI	OR	95% CI
Pain	1.23**	1.05-1.44	1.29***	1.11-1.49	1.57***	1.30-1.88
Headache	1.75**	1.16-2.62	1.78**	1.22-2.60	2.02***	1.34-3.06
Stomachache	1.83**	1.17-2.85	1.54*	1.05-2.27	2.08***	1.37-3.15
Backache	1.15	.77-1.71	1.39*	1.00-1.94	1.72**	1.19-2.48
Pain in arms or legs	1.27	.86-1.88	1.33	.94-1.89	2.75***	1.63-4-63
Diffuse symptoms	1.18*	1.02-1.36	1.22***	1.08-1.38	1.36***	1.18-1.57
Depression	1.05*	1.01-1.10	1.03	.99-1.06	1.17***	1.11-1.24
Poor perceived health	1.35	.93-1.94	1.40*	1.03-1.91	1.86***	1.33-2.62
Little or no exercise	1.07	.85-1.33	1.15	.98-1.34	1.12	.97-1.31
High BMI	.97	.86-1.10	1.03	.95-1.12	/	/
Smoking	1.47	.90-2.39	1.07	.87-1.32	1.04	.88-1.23
Alcohol consumption	/	/	1.01	.88-1.17	.99	.86-1.14

"/" means that data were not collected. Single pain items have been indented and written in italic.

* P < .05, ** P < .01, and *** P < .001