



Trends in sleeping difficulty among adolescents in five Nordic countries 2002–2014

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Abstract

Sleep has been found to be an important factor in adolescents' mental and physical health. The aim of the present study was to examine trends in sleep difficulty (i.e., difficulty falling asleep more often than once a week) in the Nordic countries among 11- to 15-year-olds. We analysed Nordic data from the Health Behaviour in School-aged Children study (HBSC), which is conducted every four years, looking specifically at trends in sleep difficulty over a 12-year period from 2002 to 2014. The participants were aged 11 to 15 years. The total number of participants across these years was 113,447. A large percentage (17% to 31% in 2014) of adolescents in the Nordic countries experience sleep difficulty, and these difficulties increased from 2002 to 2014 in Denmark, Finland, Iceland, and Sweden. Only in Norway was there a decrease, mainly due to a reduction in sleep difficulty among 11-year-old boys and girls from 2010 to 2014. Sleep difficulty among boys and girls are prevalent and generally on the rise in the Nordic countries with the exception of Norway.

Keywords

sleep difficulty, adolescents, Nordic countries

Introduction

Adolescence is a period of intense biological, psychological and social change in the life of the individual. Factors that affect these changes may influence adolescents' mental and physical health, as well as their future health. Sleep appears to be of pivotal importance in mental and physical health for maintaining and restoring function, especially during periods of brain maturation (Dahl & Lewin, 2002). Brain development (Telzer, Goldenberg, Fuligni, Lieberman, & Gálvan, 2015) may be a key underlying factor behind the effects of sleep on our future mental health (i.e., depression; see Lovato & Gradisar, 2014) and our ability to function in daily life (e.g., academic and work performance). Research by Telzer et al. (2015) suggested, for the first time, that variations in adolescent sleep may have a long term effect on the brain's white matter, which in turn affects cognitive processing. This potential link between sleep problems and brain development suggests that sleep problems are not a confounding factor, but rather a causal factor in the relationship between sleep, brain development, and psychological outcomes.

Thus, unsurprisingly, fewer hours of sleep have been found to have a negative impact on adolescent health (Hirshkowitz et al., 2015). In a large sample of adolescents, reduced weekday sleep has been linked to hopelessness, suicide ideation, suicide attempts, and drug use (tobacco, alcohol, and marijuana), whereas nine hours of sleep was shown to offer protection (Winsler, Deutsch, Vorona, Payne, & Szklo-Coxe, 2015). The consequences of sleep problems in adolescents may be prevalent, severe and wide-ranging, impacting their academic function, as well as physical and psychological health (e.g., Wong et al., 2013). Sleep problems have been associated with reduced alertness (Short, Gradisar, Lack, & Wright, 2013), increased risk of accidents (Pizza et al., 2010), and depression (Bauducco, Flink, Jansson-Fröjmark, & Linton, 2016; Short et al., 2013). Furthermore, different types of sleep problems (e.g., quality, duration, interruption, difficulty falling asleep) are not limited to adolescents but may extend beyond adolescence into adulthood, thus continuously contributing to worsening mental and physical health. Among older adolescents (e.g., university students), a lower level of sleep quality has been associated with depression, anxiety, stress (Zochil & Thorsteinsson, 2018), and fatigue (Valpiani, Brown, Thorsteinsson, & Hine, 2011). Therefore, examining sleep trends in adolescents is a major public health issue.

In relation to academic performance, sleep problems may contribute to negative mood (e.g., anxiety, depression, and fatigue) that may in turn affect school-related outcomes. Lack of sleep has been associated with teachers' reports of aggression and social problems among students (Aronen, Paavonen, Fjällberg, Soininen, & Törrönen, 2000). A meta-analysis by Dewald, Meijer, Oort, Kerkhof, and Bögels (2010) examined the effects of different sleep issues (i.e., sleepiness, sleep quality, and sleep duration) suggesting that increased issues with sleep impaired school performance with somewhat stronger effects for boys and younger students. Hysing, Harvey, Linton, Askeland, and Sivertsen (2016) also reported adverse effects on school performance associated with sleep difficulties (e.g., short sleep duration) after adjusting for socioeconomic status. In a Swedish longitudinal study (Bauducco, Tillfors, Özdemir, Flink, & Linton, 2015), symptoms of insomnia predicted school absenteeism one year later, over and above known risk factors for absenteeism. Adolescents reporting severe symptoms of insomnia were almost three times more likely to report problematic absenteeism one year later than adolescents reporting no or low symptoms.

It is possible that findings such as these may be partly explained by a reported association between sleep restriction and increased feelings of anxiety, hostility, confusion, irrita-

bility, and fatigue as well as diminished emotion regulation (Baum et al., 2014) and shorter sleep duration being associated with higher symptom load such as irritability and nervousness (Nuutinen et al., 2014).

The negative effects of sleep problems in adolescents seem to be extensive and prevalent. Findings from a large US sample of year 10 and 12 students suggest that a large proportion (>80%) of students do not get adequate sleep (Winsler et al., 2015). Currently, we have limited information on sleep trends in the Nordic nations. A Norwegian Health Behaviour in School-aged Children (HBSC) study indicated a rising trend in the prevalence of sleep-onset difficulties among 11- to 15-year-olds between 1985 and 2005 (Pallesen et al., 2008). In Finland, Kronholm et al. (2015) reported an increase in the prevalence of insomnia symptoms and tiredness among adolescents from the mid-1990s to the end of the first decade of the 21st century. Insomnia symptoms and tiredness were associated with reduced academic performance, with insomnia symptoms and tiredness being more common among girls. Changes in sleep habits between 1985 and 2013 in 11- to 15-year-olds in Sweden (Norell-Clarke & Hagquist, 2017) suggest that, over time, more students had later bed-times. These trends are informative, but more extensive examinations of trends are needed, examining more recent data. Therefore, the present trend analysis is intended to aid our understanding when it comes to the development of sleep difficulties among adolescents in five Nordic countries. Increasing our understanding of a potentially strong causal factor – sleep – in mental health is important in itself, but also for decision making in relation to health care spending, in justifying the development of sleep intervention programs, and for policy making.

Aims

The present study examined trends in sleep difficulty (i.e., difficulty falling asleep more often than once a week) for boys and girls aged 11 to 15 years over a 12-year period from 2002 to 2014 in five Nordic countries.

Method

Participants

The present study used data gathered in five countries (i.e., Denmark, Finland, Iceland, Norway, and Sweden) coordinated by the HBSC project. The HBSC is a WHO collaborative international survey and a cross-national initiative (HBSC, 2016). The 19 samples were drawn in 2002 (Iceland not included), 2006, 2010, and 2014 from three different age groups at 11, 13 and 15 years of age, with the sample size ranging from 3,422 to 11,119; see Table 1.

Table 1. Number of participants by country and year of survey

Country	2002	2006	2010	2014
Denmark	4,672	5,741	4,330	3,891
Finland	5,388	5,249	6,723	5,925
Iceland	NA	9,540	11,119	10,602
Norway	5,023	4,711	4,342	3,422
Sweden	3,926	4,415	6,718	7,700

The survey method was based on national cluster sampling from school classes, except in Iceland, where the whole population was targeted for the ages in question.

Measures

Questions on demographics used were gender (boys and girls), survey year (2002, 2006, 2010, and 2014), country (Denmark, Finland, Iceland, Norway, Sweden), and age group (11, 13, and 15). The question on sleep difficulty was taken from a list of eight subjective health complaints over the last six months that have been included in the HBSC study, and employed the HBSC Symptom Checklist (Ravens-Sieberer et al., 2008). Before the list of the eight complaints came the question, “In the last 6 months: how often have you had the following ...?” followed by eight complaint items, one of which was “difficulties in getting to sleep”. This question was answered on a five-point scale, “about every day”, “more than once a week”, “about every week”, “about every month”, and “rarely or never”. For the purposes of the present study, we grouped the participants into two groups: (1) those with sleep difficulties (i.e., “about every day” or “more than once a week”) and (2) those without sleep difficulties (i.e., “about every week”, “about every month”, and “rarely or never”). This approach was based on that taken by Pallesen et al. (2008), enabling us to (a) focus on those who are considered to have a sleep difficulty in comparison with those who are not, and (b) compare our findings with those of studies such as the one by Pallesen et al. (2008).

Procedure

The data gathered in the present study were sampled following the respective international and national guidelines, with all data being anonymous. The data were gathered during school hours with enough physical space between students to secure anonymity. Additionally, students were informed that their answers would be anonymous. The same standard questions were employed across countries – however, individual countries were able to add specific questionnaire packages; see Currie, Gabhainn, Godeau, and Committee (2009) for more information on the general HBSC survey methodology.

Statistical Analysis

Trends in sleeping difficulty among adolescents in five Nordic countries between 2002–2014 were analysed with binomial logistic regression analyses. The design effect relating to clustering of respondents within school classes, study weights and stratification were modelled using the survey package in R developed for analysing complex survey data (Lumley, 2017; R Core Team, 2013). In HBSC studies, school classes are the primary sampling unit and the survey round is used as a stratification variable. Logistic regression models, accounting for the design effect of the unique sampling procedure of the HBSC, were used to explore trends in sleep difficulty, survey year, gender, age, and country. The data analysis procedure was based on the methodological recommendations by Schnohr et al. (2015).

A test for higher-order interactions using adjusted Wald F-tests was performed in order to test for significant interactions between gender, age, country, and survey year. A saturated model with all factors interacting was first explored; then, using a backward stepwise method, all non-significant interactions that did not improve on the model fit were removed to fit the final model accounting for any significant interactions. A country by survey year interaction is recommended when performing trend analysis (Schnohr et al., 2015). The final model with the best fit included two-way interactions between: age and

gender, age and survey year, survey year and country; and a three-way interaction between age, survey year, and country.

Marginal effects at each level of the model predictors were computed from the design adjusted binomial logistic regression model (i.e., predicted values were calculated separately by gender, age, country, and survey year), and are presented in the results section.

Results

Descriptive Results

Table 2 and Figure 1 present the trends in sleep difficulty (i.e., more than once a week or every day) among adolescents in the different Nordic countries. There was a marked difference in the development among adolescents in these countries. While sleep difficulty decreased in Sweden from 2002 to 2006, it increased in the other four nations. Sleep difficulty trends were mostly stable from 2006 to 2010; however, from 2010 to 2014, they increased by 10 percentage points in Sweden and 5 percentage points in Iceland, but were reduced by 5 percentage points in Norway.

Table 2. Prevalence (%) of more-than-weekly sleep difficulty, in the Nordic countries, by survey year (95% CI)

Country	2002	2006	2010	2014
Denmark	20 (19–21)	23 (21–25)	25 (24–27)	26 (24–27)
Finland	15 (14–16)	17 (16–18)	17 (15–18)	19 (18–20)
Iceland	–	20 (20–21)	22 (21–23)	27 (26–27)
Norway	19 (17–20)	20 (19–22)	22 (21–23)	17 (16–19)
Sweden	25 (23–26)	21 (20–23)	21 (20–23)	31 (30–32)

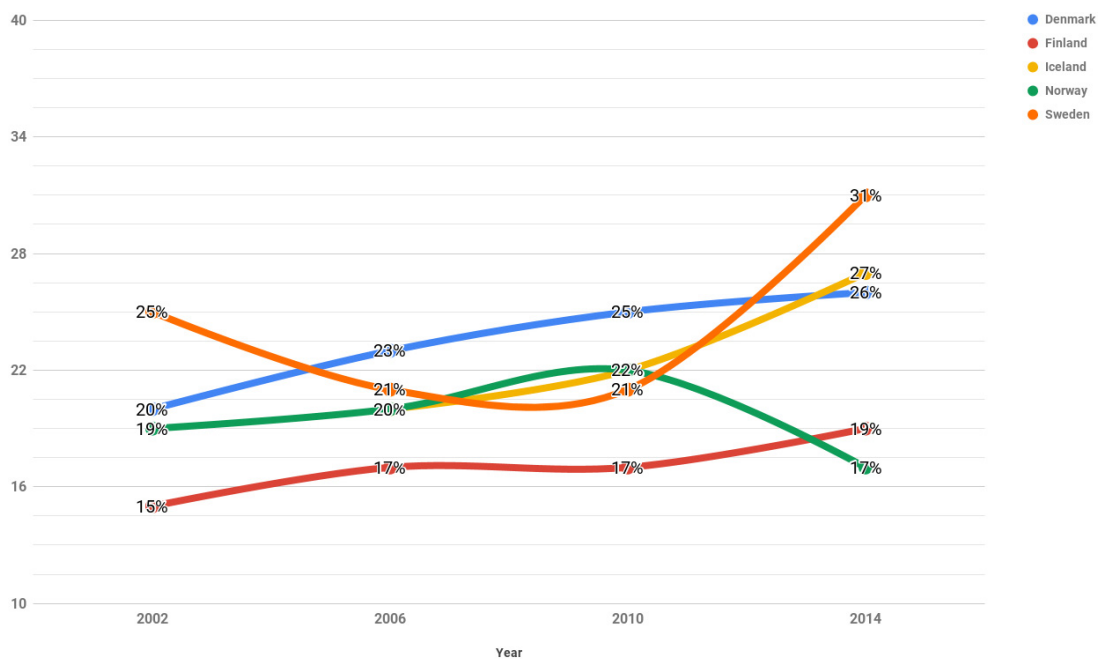


Figure 1. Sleep difficulty, prevalence (%) of more than weekly sleep difficulties, by country and year.

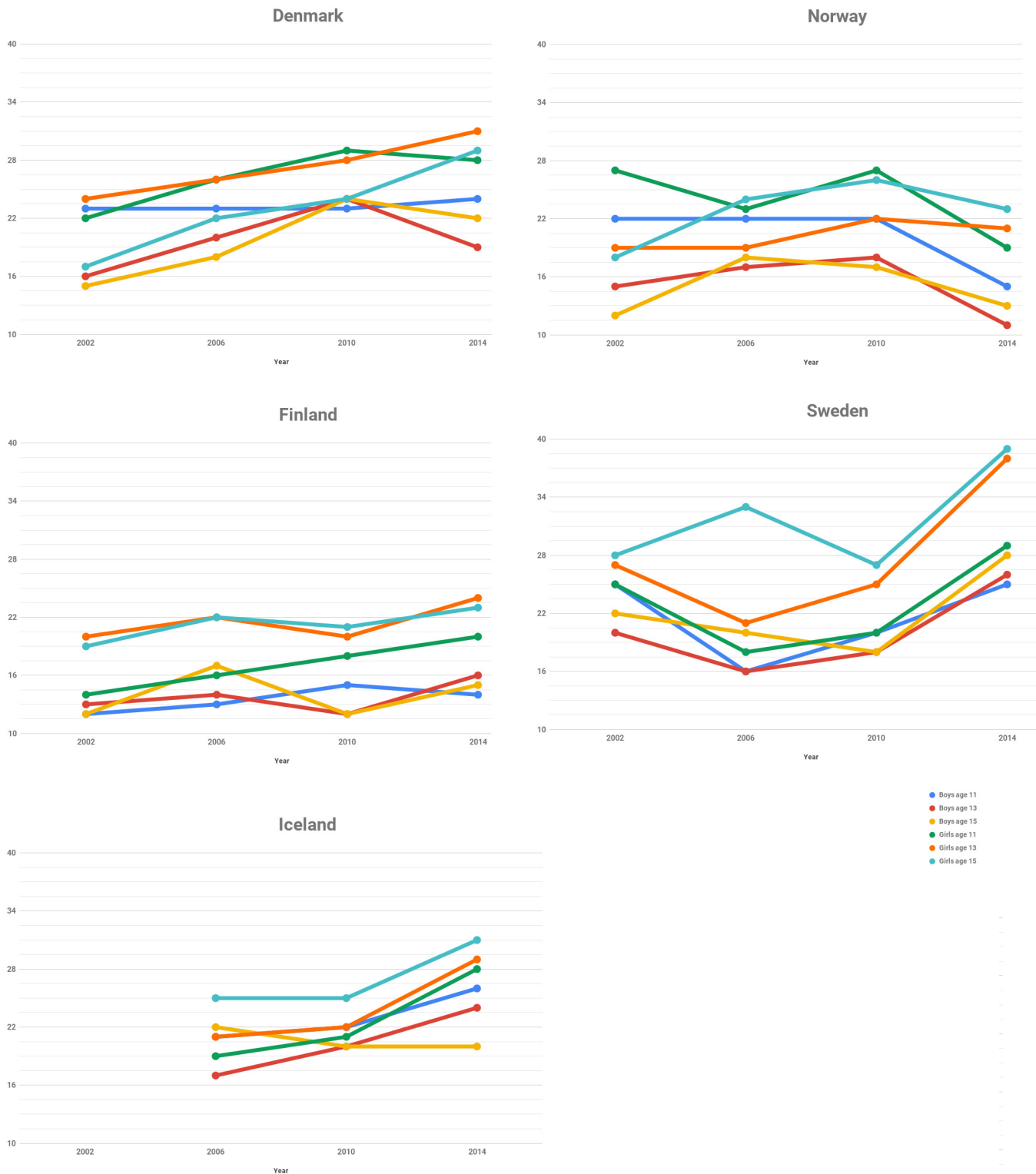


Figure 2. Sleep difficulty, prevalence (%) of more than weekly sleep difficulties, by age and gender by year, grouped by country.

Regression Analyses

Results of the logistic regression analyses showed that sleep difficulty increased among adolescents in the Nordic countries from 2002–2014, equating to about a 5% increase of *more than weekly sleep difficulties* among adolescents. However, this increase needed to be further examined as it depended on an interaction between age, country, and survey year; see Figure 2.

In 2002, 11-year-olds had the highest prevalence of sleep difficulty in the Nordic countries, and girls experienced significantly more sleep difficulty than boys did. There was a two-way interaction between age and gender (Wald $F(2, 3203) = 38.49, p < .001$), indicating that while 11-year-olds had similar (and the highest) levels of sleep difficulty, older adolescent girls had the most sleep difficulty in 2002 compared to older boys.

There were several changes in sleep difficulty among adolescents between 2002 and 2014. First, there was a two-way interaction between age and survey year (Wald $F(2, 3203) = 4.62, p < .01$) indicating that 15-year-olds had a steeper increase in sleep difficulty from 2002 to 2014. Second, there was a two-way interaction between country and survey year (Wald $F(4, 3203) = 13.83, p < .001$) suggesting different trends in the prevalence of sleep difficulty over the years across the Nordic countries. The marginal effect measures for each country indicate no significant change in the prevalence of more than weekly sleep difficulty in Denmark. Finland and Sweden both showed a small increase, while Iceland had the biggest increase across survey years. Norway was the only country that showed a small decreasing trend. Comparing the results from 2002 with 2014, the countries with the highest prevalence in absolute terms were Iceland, Sweden, and Denmark, while Norway and Finland had significantly lower rates of sleep difficulty among adolescents. Currently, Finland still has the lowest prevalence of sleep difficulty, while Norway now has the second lowest rate. Iceland has had the biggest change based on trend over survey years, thus showing a substantial increase across years.

There was a significant three-way interaction between age, country, and survey time (Wald $F(8, 3203) = 4.73, p < .001$) suggesting that the effect of change over time depends on both age and country, concerning sleep difficulty among adolescents. The regression analysis showed that there were some different tendencies in the different countries in regard to age categories. 11-year-olds in Norway showed a substantial decrease over time. As the 11-year-olds had the most sleep difficulty in 2002, this might explain why Norwegian 11-year-olds have such a different comparative profile. Other age groups in the five Nordic countries showed stable or increased sleep difficulty between 2002 and 2014.

Discussion

The analyses in the present study showed that sleep difficulty (i.e., more than once a week or every day) in the Nordic countries were common, with about one in every five adolescents being affected. Furthermore, sleep difficulty increased from 2002 to 2014 by about 5%. The only country that showed a decrease was Norway. Being young and a girl increased the risk of sleep difficulty. These findings are worrying given the potential causal link between sleep problems and brain development (Telzer et al., 2015), suggesting that sleep problems are on the rise and potentially leading to a future impact on mental health in adolescents and young adults. However, given that psychological interventions can be applied to various different sleep problems (e.g., Blake, Sheeber, Youssef, Raniti, & Allen, 2017; Bonnar et al., 2015) there is great potential for parents, schools, policy makers, and health care professionals to act to reduce sleep problems and the impact they may have.

There were also some notable differences between countries in absolute terms in 2002. Denmark, Norway, and Sweden had significantly higher rates of adolescent sleep difficulty than Iceland¹ and Finland. There were also indications of different country profiles when it

1. Icelandic estimates from 2002 are based on predicted values.

came to age. In 2002, a greater prevalence of sleep difficulty among younger adolescents was especially evident in Denmark and Norway, while the other countries had much less variance between age categories. Then looking at the trend from 2002 to 2014, there are worrying increases in sleep difficulty in Denmark, Iceland, and Sweden, while Finland has a smaller increase and Norway has a reduction.

To try to understand these differences in sleep difficulties, we considered cultural differences among these five nations. School start times may explain parts of these findings, with school starting 8:00 in Denmark, Iceland, and Sweden, between 8:00 and 9:00 in Norway, and between 8:00 and 9:45 in Finland. Thus, the countries that enable flexible start times seem to be doing better. Looking at the Human Development index (United Nations Development Programme, 2016) does not help explain this differences since it shows that of the five nations, Finland is ranked 23rd, Sweden 14th, Iceland 9th, Denmark 5th, and Norway 1st.

Our findings were consistent with previous findings. A previous study examining Norwegian HBSC data from 1983 to 2005 (Pallesen et al., 2008) reported a higher prevalence of sleep-onset difficulties among 11-year-old students compared to 13- and 15-year-old students. Girls were more likely to report difficulties than boys were. Trend analysis showed that prevalence of sleep-onset difficulties increased significantly from 1983 to 2005 for boys and girls across all age groups. Other studies have also shown a decrease in the proportion of children and adolescents who slept the recommended number of hours for their age (Hirshkowitz et al., 2015; Winsler et al., 2015). However, they reported that boys were more likely than girls to sleep less than the recommended time. This apparent inconsistency in findings may be a result of differences in the assessment of sleep problems. Sleep problems in our study was assessed in relation to “difficulties in getting to sleep” and not sleep duration.

Recommendations for sleep and sleep hygiene among adolescents (note Bauducco et al., 2016) need to be informed by research findings (e.g., Bonnar et al., 2015), thus they need to detail not only sleep duration but also screen time, such as how long before sleep should screens be turned off and recommended use of blue light reduction on smart phones. School authorities in the Nordic countries may also want to examine the relevance of research into school start times (Gariépy et al., 2017; Owens et al., 2010) in Nordic countries.

Limitations

Sleep problems were measured based on difficulty in getting to sleep. Additional measurements, such as quality of sleep, sleep duration, and sleep interruption, could provide a more complete picture of these problems than we were able to present in the present study (see Dewald et al., 2010). Future trend analysis will be able to take advantage of the more comprehensive list of items included in the most recent wave of the HBSC study. Another limitation was the use of self-reported rather than an objective approach to assess sleep problems. Studies have indicated that self-reports of sleep problems tend to underestimate the problem (Arora, Broglia, Pushpakumar, Lodhi, & Taheri, 2013). The actual number of Nordic adolescents with sleep difficulty is therefore likely to exceed the estimation in the present study. Assessment of sleep problems through self-report measures may not be ideal compared with more objective assessments, such as via actigraphy or sleep diaries (Arora et al., 2013). However, items used in large population-based surveys, such as in the HBSC, have been found to be reliable (Haugland & Wold, 2001). Furthermore, self-reports are probably the only assessment possible from a logistic point of view as well as the most cost-effective and with the lowest dropout rate. Future studies need to keep monitoring trends in sleep problems and incorporate an assessment of factors that may potentially affect sleep problems, such as screen time (see Hale & Guan, 2015) and exercise.

Conclusion

About one in every five children is affected by sleep difficulty in the Nordic countries of Denmark, Finland, Iceland, Norway, and Sweden. Sleep difficulties are on the rise in all of these countries, with the exception of Norway, where there has been a decrease from 2010 to 2014 among 11-year-old children. Sleep difficulty trends need to be acted on through school and government policy to help reduce sleep problems among adolescents.

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