Perceived sleep quality and its precursors in adolescents

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SUMMARY
This study investigated perceived sleep quality among 11-, 13- and 15-year-old Finnish adolescents (n = 4187). Additionally, associations of selected behavioural, social and psychological factors with subjective sleep quality were examined among 15-year-olds. This study is part of an international, WHO-co-ordinated survey of school children’s health and lifestyle (the HBSC Study). In Finland, research data represented the whole country. The data were collected during March–May 1994. Pupils responded anonymously to a standardized questionnaire during a class period. About every 10th adolescent felt that their sleep quality was at most satisfactory, about 30% of pupils had had difficulties in falling asleep and almost every fifth adolescent reported nocturnal awakenings every week. Thus, a large proportion of pupils in every classroom has a weakened ability to concentrate on school work or other activities. Among 15-year-old boys, a good home atmosphere was the most important contributing factor to good perceived sleep quality. A health-promotive lifestyle (good sleep hygiene and infrequent use of addictive substances) and good self-perception also had significant correlation with good perceived sleep quality. In 15-year-old girls, a good home atmosphere, good self-perception and health-promotive habits played an equally important role in associations with subjective sleep quality. Physical activity in leisure time had minor but significant correlation with perceived sleep quality among girls. In both sexes, perceived home atmosphere had a significant association with all the factors that had correlated significantly with subjective sleep quality. Results indicate that a good home atmosphere, a health-promotive lifestyle and good self-perception are important constituents of good sleep among 15-year-olds. Good and refreshing sleep is one of the constituents for general well-being among adolescents. That is why these issues provide a challenge for health promotion and health education.

Key words: adolescents; health behaviour; health promotion; perceived sleep quality

INTRODUCTION
Sleep quality is an important indicator of children’s and adolescents’ health and well-being. Poor perceived sleep quality is associated with poor reported health, poor physical fitness and numerous psychosomatic symptoms. Sleep difficulties and poor sleep quality may also be signs of stress factors in living environment or indicators of a health-compromising lifestyle. (Price et al., 1978; Rimpelä and Rimpelä, 1983; Weydahl, 1991a; Mahon, 1994, 1995; King et al., 1996; Pilcher et al., 1997; Vignau et al., 1997).

Few studies have sleep quality as the focus of major interest in normal adolescent populations (Price et al., 1978; Kirmil-Gray et al., 1984; Levy et al., 1986; Hawkins and Shaw, 1992; Andrade et al., 1993; Manni et al., 1997; Vignau et al., 1997). A need for a large-scale study on this issue has been expressed in earlier studies (Price et al., 1978; Kirmil-Gray et al., 1984; Levy et al., 1986; Zammit, 1988; Lexcen and Hicks, 1993; Tynjälä and Kannas, 1993; see also Hyypä, 1991). Studying perceived sleep quality in normal populations
will help us to determine if we need to be concerned about sleep quality in younger age groups (Price et al., 1978).

Perceived sleep quality is described in many studies as difficulty in falling asleep, sleep onset latency, difficulty in maintaining sleep, awakenings at night, calmness of sleep, premature final morning awakening, how refreshed a person feels after sleep and a person’s own view of sleep quality (Monroe, 1967; Price et al., 1978; Healey et al., 1981; Lugaresi et al., 1983; Kirmil-Gray et al., 1984; Levy et al., 1986; Strauch and Meier, 1988; Andrade et al., 1993; Lecsen and Hicks, 1993; Tynjälä et al., 1993; Tynjälä and Kannas, 1993; Åkerstedt et al., 1994; Saarenpää-Heikkilä et al., 1995). On the basis of these indicators, persons are often grouped as, e.g. poor sleepers, occasional poor sleepers and good sleepers. In these studies, the proportion of adolescents with no sleep problems has varied between 40% and 70%, whereas about 10% have been categorized as poor sleepers with chronic and severe sleep disturbances.

Investigations of the above-mentioned indicators of sleep quality among adolescents have revealed that the majority of adolescents sleep well or very well (Andrade et al., 1993; Tynjälä, 1993; Tynjälä and Kannas, 1993). Under 10% of adolescents have reported difficulties in falling asleep or nocturnal awakenings every or almost every night (Morrison et al., 1992; Andrade et al., 1993; Tynjälä, 1993; Saarenpää-Heikkilä et al., 1995; see also Aro et al., 1987). Differences in the indicators of subjective sleep quality between age groups have been for the most part not significant (Tynjälä and Kannas, 1993; see also Strauch and Meier, 1988; Saarenpää-Heikkilä et al., 1995). Moreover, sex differences have been rare or have not existed (Fischer and Wilson, 1987; Strauch and Meier, 1988; Hawkins and Shaw, 1992; Tynjälä, 1993; Tynjälä and Kannas, 1993; Yarcheski and Mahon, 1994; Saarenpää-Heikkilä et al., 1995). However, in some studies girls have reported more sleep difficulties than boys (e.g. Rimpelä and Rimpelä, 1983; Kirmil-Gray et al., 1984; Aro et al., 1987; King et al., 1996; Vignau et al., 1997).

There are many studies that provide evidence that poor sleep quality is associated, among other things, with problems in social relationships, problems with handling troubles, problems at school, disturbances in sleeping environment and psychological states, e.g. anxiety, depression, tension and worry (Price et al., 1978; Kahn et al., 1989; Weydahl, 1991a; Mahon, 1994, 1995; Pilcher et al., 1997; Vignau et al., 1997). Positive self-esteem or self-concept is more typical of persons with good sleep quality (e.g. Price et al., 1978; Healey et al., 1981; Kirmil-Gray et al., 1984; see also Hyppä et al., 1991).

Unhealthy behaviours tend to cluster (Lecsen and Hicks, 1993; Aarø et al., 1995), and therefore it is important to also study sleep quality from the viewpoint of adolescents’ lifestyle. Studies have indicated that frequent smoking, heavy use of alcohol and frequent use of coffee or caffeinated beverages are associated with poor perceived sleep quality (e.g. Price et al., 1978; Rimpelä and Rimpelä, 1983; Hallman et al., 1992; Rahkonen et al., 1992; Lecsen and Hicks, 1993; Phillips and Danner, 1995; Vignau et al., 1997). Physical activity has been found to have positive effects and lack of physical activity negative effects on subjective sleep quality (Price et al., 1978; Shapiro et al., 1984; see also Weydahl, 1991b). Sleeping habits, e.g. late and irregular bedtime, short sleeping time, large sleeping time differences between the week and weekend, and long daytime naps are associated with poor perceived sleep quality (Kirmil-Gray et al., 1984; Carskadon, 1990; Ferber, 1990; see also Rimpelä and Rimpelä, 1983).

The first research task in the present study was to describe the self-reports of 11-, 13- and 15-year-old Finnish boys and girls on how well they sleep (how often they have difficulties in falling asleep, how often they wake up at night and how well in general they sleep). The second research task was to investigate what factors, e.g. self-perception, social relationships, addictive behaviour, sleep hygiene and physical activity, are associated with perceived sleep quality in 15-year-old Finns.

METHODS

This study is part of an international, WHO-co-ordinated survey of school children’s health behaviour—the HBSC Study—which describes the perceived health and lifestyle of 11-, 13- and 15-year-old adolescents from a health promotion viewpoint.

In Finland, the Institute for Educational Research in Jyväskylä was responsible for the sampling procedure. Samples were chosen from the Finnish school register by using a special sampling program. The sample frame was the
number of Finnish-speaking pupils in each class level. This computer program picked the schools using cluster sampling in such a way that the size of schools was taken into consideration (probability proportional to size of school—PPS). Within the school, the class was randomly selected. In only a few cases was more than one class per school selected in the sample. The strata of schools were based on province division. The other basis of stratum was the division between urban and rural communes. In summary, the research data represented the Finnish-speaking part of the country well (94% of the whole population) in the 11-, 13- and 15-year age groups (Tynjälä and Törmäkangas, 1995).

In Finland the age groups represent pupils in the 5th, 7th and 9th grades of the compulsory comprehensive school. Pupils responded anonymously to a standardized questionnaire during a class period with a teacher overseeing the process. Data were collected in March–May 1994. The final sample of the cleaned (Aarø et al., 1994) data consisted of 4187 pupils, 869 of which were 11-year-old boys (mean age was 11 years and 9 months), 631 were 13-year-old boys (mean age 13 years and 10 months) and 576 were 15-year-old boys (mean age 15 years and 9 months); respective figures for girls were 845 (mean age 11 years and 9 months), 648 (mean age 13 years and 9 months) and 618 (mean age 15 years and 9 months). All 206 schools included in the sample participated in the survey. Of all the pupils in the sample, 93% responded to the questionnaire. Non-responses, 7% of the sample, consisted of pupils absent from school on the data collection day. The data have been described in more detail elsewhere (Tynjälä and Törmäkangas, 1995; King et al., 1996).

Perceived sleep quality was measured by inquiring how well adolescents sleep in general, how often they have difficulties in falling asleep and how often they wake up during the night. The internal consistency of the sum index of these variables was tested using Cronbach’s Alpha, and it was 0.66. Frequency distributions of these variables were analysed by pupil’s sex and age using cross-tabulations and Chi-square test. A more detailed description of these questions and variables is presented in Appendix 1.

The associations between perceived sleep quality and 28 variables were investigated among 15-year-olds. These 28 variables were selected on the basis of earlier studies. After investigating the correlation structure and using information from earlier studies (e.g. Tynjälä et al., 1997), these variables were thought to formulate the following factors: sleep hygiene (bedtime during school week, regularity of bedtime, sleep time during school week); addictive behaviour (cigarettes per week, times being drunk, frequency of beer drinking); leisure time physical activity (frequency and time spent on physical activity per week, activity in sport club); sedentary behaviour (hours of watching TV, hours of watching VCR, number of evenings a week spent with friends); self-perception (index of self-esteem [Cronbach’s Alpha was 0.83; the index was a modification of Rosenberg, 1985; see also Lintunen et al., 1995], feeling of self-confidence, feeling of helplessness); index of problems at school (six items, Cronbach’s Alpha was 0.68); social relationships (feelings of loneliness, perceived home atmosphere, number of close friends, index of the perceived importance to family members and close friends—six items with Cronbach’s Alpha = 0.46); class and school atmosphere (encouragement by teachers, how interested teachers were in pupils, did pupils enjoy being together in the class, how friendly and helpful pupils felt the other pupils were in the class, frequency of being bullied, how safe pupils felt at school); attitude toward school and school work (opinion about going to school, opinion of how good he/she is in school, opinion of how well he/she knows what kind of things he/she is good at in school).

Among 15-year-old boys and girls, factors’ correlation structure was analysed using structural equation models within the framework of LISREL (version 8.12a). The polychoric correlations needed in LISREL were calculated using PRELIS [version 2.12a] (Jöreskog and Sörbom, 1993). These analyses were carried out separately for boys and girls. The LISREL analyses were performed using the generally weighted least squares (WLS) estimation method because the analyses were based on polychoric correlations. In addition, the variables were not multinormally distributed and the data comprised mostly variables with an ordinal scale. The analyses simultaneously included both the confirmatory factor analysis and structural equation modelling. The equivalence of the regression coefficients was statistically tested with nested models that are based on sequential Chi-square tests. If the Chi-square test was not significant, the regression coefficients were equal. In the reverse case, the coefficients were not equal.
RESULTS

**Perceived sleep quality in 11-, 13- and 15-year-olds**

Most adolescents slept well. About 60% felt that they slept very well and every third rather well. There were only slight sex or age group differences in general sleep quality (Table 1). Every other adolescent had rarely or never experienced difficulties in falling asleep during the 6 months preceding the survey. However, about 30% had had difficulties in initiating sleep at least once a week and 5% almost every night. There were no age group differences and only a small \( p = 0.027 \) sex group difference in the youngest age group where the problem was slightly more typical among boys. Over 60% of the pupils did not report awakenings at night during the 6 months preceding the survey, but almost 20% had had nocturnal awakenings every week. There were no age group differences among girls in nightly awakenings; among boys they seemed to decrease with age (Table 2).

**Perceived sleep quality and its correlates among 15-year-olds**

Structural equation models were used to describe associations of selected behaviourial, social and personal factors with perceived sleep quality. The models include only those variables and factors that were accepted for the final statistical models, which may be characterized more as of an inter-relationship type than explanatory type. The analyses were executed separately for boys and girls. The factor structure is described in Appendix 1. The polychoric correlation coefficients of the variables that were the basis for the final models are presented in Appendices 2 and 3. Factors’ correlation structure used in the final
models is presented in Appendix 4. Only graphically simplified versions of the structural equation models are presented in this report: comprehensive graphical presentations of the models are available from the author.

A model for boys
Among boys, home atmosphere, self-perception and health habits (second order factor composed of sleep hygiene factor and addictive behaviour factor) explained 22% of the variance in perceived sleep quality. Subjective sleep quality together with home atmosphere explained 11% of the variance of self-perception and 14% of the variance of health habits. The second order factor, health habits, was formulated in the structural equation model, because the first order factors—sleep hygiene and addictive behaviour—correlated strongly with each other (r = 0.53). This correlation was higher than their correlation with the sleep quality factor (r = 0.24 and 0.22). Home atmosphere, self-perception and health habits were not equally important in associations with subjective sleep quality ($\chi^2 = 6.760$, d.f. = 2, $p = 0.034$), but self-perception and health habits were equally important ($\chi^2 = 0.090$, d.f. = 1, NS). It follows that home atmosphere was the most significant element concerning subjective sleep quality. For the factor model with health habits factor, but without structural equations, the $\chi^2$ value was 59.096 (d.f. = 49, $p = 0.153$). Tests for the equivalence of sleep hygiene factor and addictive behaviour factor in this second order factor were done against this model: these two factors were equally important ($\chi^2 = 14.162$, d.f. = 1, $p < 0.001$—test of equivalence of residuals of the factors). Based on the previous Chi-square test, it follows that the sleep hygiene factor was more important than the addictive behaviour factor in this second order factor. Reliability of the variables ($R^2$) used in the model varied from 0.51 to 0.82. According to the goodness-of-fit statistics of the model, the fit to the data was good. The goodness of the statistical model is presented in Figure 1.

A model for girls
Among girls, home atmosphere, self-perception, health habits (second order factor composed of sleep hygiene factor and addictive behaviour factor) and leisure time physical activity explained 30% of the variance of perceived sleep quality. Subjective sleep quality together with home atmosphere and leisure time physical activity explained 27% of the variance of self-perception. Perceived sleep quality, home atmosphere and self-perception explained 8% of the variance of leisure time physical activity. In addition, subjective sleep quality and home atmosphere explained 29% of the variance of health habits. Self-perception and leisure time physical activity also had a significant inter-relationship with each other. Regarding the association of home atmosphere, self-perception, health habits and leisure time physical activity with perceived sleep quality, the investigation of the equality of the regression coefficients revealed that the coefficients were not of equal importance ($\chi^2 = 9.290$, d.f. = 3, $p = 0.002$). However, the first three were equally important ($\chi^2 = 0.140$, d.f. = 2, NS). It follows that leisure time physical activity proved to be the least important in associations with subjective sleep quality (Figure 2).

The second order factor, health habits, was formulated in the structural equation model, because the first order factors—sleep hygiene and addictive behaviour—correlated with each other (r = 0.33). This correlation was higher than the correlation between addictive behaviour factor and sleep quality factor (r = 0.25). The correlation between sleep hygiene factor and sleep quality factor was 0.36. For the factor model with health habits factor, but without structural equations, the $\chi^2$ value was 109.421 (d.f. = 77, $p = 0.009$). Tests for the equivalence of the sleep hygiene factor and addictive behaviour factor were performed against this model, and they revealed that these two factors were equally important in this second order factor ($\chi^2 = 0.801$, d.f. = 1, NS—test of equivalence of residuals of the factors, Figure 2).

The reliability of the variables ($R^2$) used in the model varied from 0.50 to 0.96. In a few cases, residuals of variables correlated positively with each other. This indicates that the correlation structure of the variables was quite complicated (see Appendix 3). According to the goodness-of-fit statistics of the model, the fit to the data was not as good as in the boys’ model. The Chi-square value was relatively high and its $p$ value significant. However, the normed fit index (NFI) was very high (0.97) and the number of cases ($n$) was greater than the critical number of cases (CN). These indicated that the large sample size ($n = 551$) had had an effect on the Chi-square value and that conclusions about the goodness
Fig. 1: Factors associated with perceived sleep quality among 15-year-old boys: structural equation model. Variables are presented in boxes, factors in ellipses; the $R^2$ value above each factor describes how much of the variance of that factor could be explained by the other factors (or variables); small arrows outside boxes or ellipses describe residuals (actual numbers were intentionally dropped from the figure); the rest of the abbreviations are described below the figure.

of the statistical model should not be made on the basis of the Chi-square test. All the other parameters of goodness of the model were statistically adequate (Figure 2).

**DISCUSSION**

Åkerstedt *et al.* (1994) concluded in their study that the index of sleep quality should include the following measures: sleep quality; calmness of sleep; easiness of falling asleep; sleeping throughout the night; and refreshness after sleep. They also concluded that sleep quality is mainly a question of sleep continuity. The questions about sleep quality used in this study covered most of these criteria. Adolescents' own perceptions indicated that about every tenth person felt that their sleep quality was at most satisfactory. About 30% of pupils had also had difficulties in falling asleep and almost every fifth adolescent reported nocturnal awakenings every week. These prevalences were relatively high. According to other studies (e.g. Tynjälä *et al.*, 1997), at least every third pupil was tired on almost every school morning or felt tired more often than once a week. It may be concluded that a large proportion of pupils in every classroom has a weakened ability to concentrate on school work or other activities. Results on prevalences gained in this study are in line with earlier studies (e.g. Andrade *et al.*, 1993; Tynjälä, 1993; Saarenpää-Heikkilä *et al.*, 1995), but prevalences cannot, however, be directly compared with each other because of, e.g. differences in operationalizations of sleep variables. Among 15-year-old boys, home atmosphere seemed to be a very important element in relation to perceived sleep quality.
Among girls of the same age, self-perception, health habits and home atmosphere were equally important in associations with subjective sleep quality.

Interpretation of models

The association between self-esteem or self-image and sleep quality indicators has also been reported in many earlier studies (e.g. Price et al., 1978; Kirmil-Gray et al., 1984; Turtle et al., 1996). In this study, the associations between home atmosphere, pupils' self-perception and perceived sleep quality indicated that good relationships at home form an important ground for positive self-perception and health-promotive habits which all correlated with good subjective sleep quality. The results support the idea that family support in general has salutary effects on adolescents' psychological well-being (Reicher, 1993; Vilhjalmsson, 1994). The results in this study are in line with the finding that poor sleepers are less satisfied in their relationships with their parents (Healey et al., 1981). Adolescents' complaints of poor sleep may even be regarded as a possibly meaningful and sensitive sign of severe family or personal disruption. Not only family relations but also parents' health status reflects perceived sleep quality. If adolescents, especially girls, are worried about their parents' health and well-being, it may manifest itself as poor perceived sleep quality (Vignau et al., 1997).

Physical activity was a significant factor only among girls. This finding is not in concordance with the results obtained by Weydahl (1991a). This may result from differences in questions concerning subjective sleep quality and physical activity. Among boys, health habits—composed of sleep hygiene and addictive behaviour—and self-perception were equally important, but not
as important as home atmosphere in associations with subjective sleep quality. Sleep hygiene and addictive behaviour correlated strongly with each other among boys, but this correlation was also significant in girls. This association has been found in earlier studies in Finland and elsewhere among adolescents (e.g. Rimpelä and Rimpelä, 1983; Tynjälä et al., 1993, 1997). One purpose of this study was to investigate how latent behavioural and other factors are associated with subjective sleep quality. In many earlier studies, the focus has been on the relationships between single manifest (observable) variables and perceived sleep quality, therefore direct comparisons with earlier studies cannot be made. However, it can be concluded that the results of this study support earlier studies, e.g. frequent use of addictive substances (drinking and smoking in this study) had a negative effect on perceived sleep quality (e.g. Lexcen and Hicks, 1993; Phillips and Danner, 1995; Vignau et al., 1997). This seems to be typical in adolescent years, but these associations have been weak or did not exist in the adult population (Palmer et al., 1980; Urponen et al., 1988; Vuori et al., 1988).

This study focused on the associations of selected behavioural, social and psychological factors with adolescents’ perceived sleep quality. Exclusion of many relevant indicators of subjective health was done intentionally to emphasize the main interest, subjective sleep quality. Initially, the variables in the models were selected on the basis of earlier studies. During the formulation of structural equation models, many originally significant variables—one the basis of initial correlations with the indicators of subjective sleep quality variables—were dropped from the models. Exclusions of these variables were made on a statistical basis: if the variable was no longer significant in the model it was dropped out. As a result, the models describe the associations rather efficiently. The home atmosphere variable in the statistical models could be described as a natural ‘background’ factor because it is an important ground for all later developments in children and adolescents. Home atmosphere also seemed to have a great impact on adolescents' self-perception and health habits in general. Manni et al. (1997) found in their study that gender was an important factor in associations with chronic poor sleep. There were more females than males among poor sleepers in their study. However, in this study models were compiled separately for both sexes. The models resemble each other but the weights of different elements are not the same.

The question of missing data arises when using many variables in the analyses. This was the case in the structural equation models in 15-year-olds. A comparison of respondents who were included in the models (no missing data in any of the variables in the model) against those respondents who had missing data in one or more variables (they were automatically excluded from the models) revealed only one difference between the groups: the ‘excluded’ group—17% of boys and 10% of girls—went to bed later than the group included in the models. No other significant differences were found. It may be concluded that the results of the structural equation models represent the whole 15-year-old study group adequately well.

Future research challenges
In future research, the role of family relationships, social support in the family, the health status of parents and siblings and their associations with adolescents’ sleep and subjective health in general should be covered in more detail, not only in cross-sectional studies but also in follow-up studies (e.g. Välimaa et al., 1993; Vilhjalmsson, 1994; Vignau et al., 1997). In this study, only one question measured family relationships, but even that proved to be of great importance concerning adolescents’ subjective sleep quality. Good family relationships probably have a ‘protective’ effect in relation to adolescents’ health and in a broader sense to their well-being (see Nestmann and Hurrelmann, 1994). Aro (1988) indicated in her study that children from both divorced and discordant families reported more distress symptoms, more abundant use and in boys more delinquent acts than children from intact families. Also, severe illness of a family member was highly associated with a higher number of symptoms, and with the greatest increase in symptoms in both sexes. The effect of life events involving illness or loss was greater in boys than girls (Aro, 1988; see also Rutter, 1985). The results gained in this study emphasize the importance of family relationships to adolescents’ health and well-being. An interesting future topic would be to investigate which matters constitute a good night’s sleep from a wider perspective (Zammit, 1988).

Few studies have investigated the association between sleep variables and perceived health status in adolescence. The results of these studies
have been somewhat contradictory. On one hand, studies have suggested that sleep quality correlates more strongly than sleep quantity with health (Pilcher et al., 1997). On the other hand, in some studies sleep disturbance is associated with perceived health status only in middle adolescence (15–17-year-olds), but not in the early (12–14-year-olds) or late phase of adolescence (18–21-year-olds) [Yarcheski and Mahon, 1994; Mahon, 1995]. Thus, further research is required to clarify the association between sleep and perceived health in adolescence.

According to Mahon (1995), better subjective measures of sleep for adolescents are needed: an effort should be made to develop reliable and valid measures of the experience of sleep during adolescent development. Nurses and other health care professionals should routinely collect data on adolescents’ alcohol and drug use because they have been known or thought to influence sleep (e.g. Lexcen and Hicks, 1993; Phillips and Danner, 1995; Tynjälä et al., 1997). Health care professionals should create a knowledge base regarding the extent to which sleep contributes to the health and well-being of adolescents (Mahon, 1995).

Some practical considerations

What kind of practical considerations should be made in school health education, school health care staff training and parent counselling? Mahon (1995) suggests the following issues to be discussed to promote good sleep in adolescence: pupils should sleep in quiet, comfortable and well-ventilated rooms. They should avoid excessive expenditure of energy in the evening hours immediately preceding sleep, and if needed, pupils should be instructed in the use of relaxation techniques.

Poor sleep quality, poor sleep hygiene, frequent use of alcohol, regular smoking and poor self-perception identified in this study provide an important challenge to health promotion among school children. Although adolescents’ sleep quality is clearly related to home atmosphere, the role of the school is also important. In order to deal with these sleep-related problems that affect children’s health, issues about sleep and rest need to be included in the health education curriculum in schools. Intensive cooperation and a good functioning network between school and home will also be needed to foster dialogue between teachers, school nurses and parents.

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REFERENCES


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**APPENDIX 1. FACTOR STRUCTURES USED IN THE FINAL MODELS AMONG 15-YEAR-OLDS**

<table>
<thead>
<tr>
<th>Factor (F), variable (V)</th>
<th>Questions and their alternatives in parentheses</th>
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<tr>
<td><strong>Perceived sleep quality (F)</strong></td>
<td>How well do you usually sleep? (very well, quite well, satisfactorily, quite badly, very badly). How often do you have difficulties in falling asleep? (almost daily, more than once a week, about once a week, about once a month, rarely or never). How often do you wake up during the night? (almost daily, more than once a week, about once a week, about once a month, rarely or never).</td>
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<td><strong>Home atmosphere (V, F)</strong></td>
<td>What kind of atmosphere do you have in your home? (very good, quite good, neither good nor bad, quite bad, very bad).</td>
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<td><strong>Sleep hygiene (F)</strong></td>
<td>Do you usually go to bed at a certain time? (very regularly, quite regularly, quite irregularly, very irregularly). When do you usually go to bed if you have to go to school the next morning? (alternatives ranged from no later than 9 pm to 2 am or later in half hour intervals).</td>
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<td><strong>Self-perception (F)</strong></td>
<td>Do you feel helpless? (always, often, sometimes, rarely, never). Do you feel confident in yourself? (always, often, sometimes, rarely, never). Index of self-esteem was formulated from the following statements: I feel that I am as capable and skilful as any other person; I think that I have plenty of good qualities; I often feel that I am a failure; I can manage things as well as any other person; I feel that I am all right; I am satisfied with myself; I sometimes feel totally useless; I sometimes think I am no good at all (strongly agree, partly agree, partly disagree, strongly disagree).</td>
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<td><strong>Addictive behaviour (F)</strong></td>
<td>How many cigarettes do you usually smoke in a week? Have you ever had so much alcohol that you were really drunk? (no, never; yes, once; yes, two–three times; yes, four–10 times; yes, more than 10 times). How do you drink beer? (every day, every week, every month, less than once a month, never).</td>
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<td><strong>Leisure time physical activity (F)</strong></td>
<td>Outside school hours: How often do you usually exercise in your free time so much that you get out of breath or sweat? (every day, every–six times a week, two–three times once a week, once a week, once a month, less than once a month, never). Outside school hours: How many hours do you usually exercise in your free time so much that you get out of breath or sweat? (None, about 30 min, about 1 h, about 2–3 h, about 4–6 h, 7 h or more). Are you member of a sports club? (no; yes, but I don’t participate in exercises; yes, and I am training in a sports club). This variable was dichotomized afterwards: the first two categories were combined.</td>
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*Home atmosphere factor was composed of home atmosphere variable.*
APPENDIX 2. POLYCHORIC CORRELATION COEFFICIENTS AMONG 15-YEAR-OLD BOYS  
\((n = 484)\)

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<td>(1) Wake up during night → seldom</td>
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<td>(2) Difficulty in falling asleep → seldom</td>
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<td>(3) How well do you sleep in general → well</td>
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<tr>
<td>(4) Bedtime during school week → early</td>
<td>0.02</td>
<td>0.18</td>
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</tr>
<tr>
<td>(5) Regularity of bedtime → regular</td>
<td>0.12</td>
<td>0.07</td>
<td>0.19</td>
<td>0.46</td>
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<tr>
<td>(6) Cigarettes a week → none</td>
<td>0.06</td>
<td>0.17</td>
<td>0.05</td>
<td>0.38</td>
<td>0.24</td>
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<tr>
<td>(7) Times being drunk → never</td>
<td>0.08</td>
<td>0.19</td>
<td>0.06</td>
<td>0.33</td>
<td>0.29</td>
<td>0.71</td>
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</tr>
<tr>
<td>(8) Drinking beer → never</td>
<td>0.08</td>
<td>0.17</td>
<td>0.06</td>
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<td>0.26</td>
<td>0.66</td>
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<tr>
<td>(9) Feeling of helplessness → never</td>
<td>0.28</td>
<td>0.20</td>
<td>0.17</td>
<td>-0.07</td>
<td>0.01</td>
<td>-0.10</td>
<td>-0.04</td>
<td>-0.09</td>
<td>1.00</td>
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</tr>
<tr>
<td>(10) Feeling of self-confidence → always</td>
<td>0.23</td>
<td>0.11</td>
<td>0.17</td>
<td>-0.08</td>
<td>0.11</td>
<td>-0.10</td>
<td>-0.04</td>
<td>-0.09</td>
<td>0.58</td>
<td>1.00</td>
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</tr>
<tr>
<td>(11) Self-esteem → good</td>
<td>0.12</td>
<td>0.17</td>
<td>0.17</td>
<td>0.06</td>
<td>0.16</td>
<td>0.12</td>
<td>0.10</td>
<td>0.04</td>
<td>0.49</td>
<td>0.54</td>
<td>1.00</td>
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<tr>
<td>(12) Home atmosphere → good</td>
<td>0.37</td>
<td>0.25</td>
<td>0.28</td>
<td>0.08</td>
<td>0.27</td>
<td>0.11</td>
<td>0.21</td>
<td>0.15</td>
<td>0.22</td>
<td>0.27</td>
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APPENDIX 3. POLYCHORIC CORRELATION COEFFICIENTS AMONG 15-YEAR-OLD GIRLS  
\((n = 551)\)

<table>
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<th>(1)</th>
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<th>(11)</th>
<th>(12)</th>
<th>(13)</th>
<th>(14)</th>
<th>(15)</th>
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<tbody>
<tr>
<td>(1) Wake up during night → seldom</td>
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<tr>
<td>(2) Difficulty in falling asleep → seldom</td>
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<td>1.00</td>
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<tr>
<td>(3) How well do you sleep in general → well</td>
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</tr>
<tr>
<td>(4) Bedtime during school week → early</td>
<td>0.04</td>
<td>0.18</td>
<td>0.06</td>
<td>1.00</td>
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<tr>
<td>(5) Regularity of bedtime → regular</td>
<td>0.16</td>
<td>0.37</td>
<td>0.30</td>
<td>0.59</td>
<td>1.00</td>
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</tr>
<tr>
<td>(6) Cigarettes a week → none</td>
<td>0.17</td>
<td>0.20</td>
<td>0.18</td>
<td>0.21</td>
<td>0.28</td>
<td>1.00</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(7) Times being drunk → never</td>
<td>0.09</td>
<td>0.15</td>
<td>0.06</td>
<td>0.19</td>
<td>0.19</td>
<td>0.66</td>
<td>1.00</td>
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</tr>
<tr>
<td>(8) Drinking beer → never</td>
<td>-0.03</td>
<td>0.13</td>
<td>0.05</td>
<td>0.09</td>
<td>0.22</td>
<td>0.59</td>
<td>0.75</td>
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<tr>
<td>(9) Physical activity (times) → almost daily</td>
<td>0.03</td>
<td>0.09</td>
<td>0.16</td>
<td>0.02</td>
<td>-0.02</td>
<td>0.08</td>
<td>0.04</td>
<td>0.05</td>
<td>1.00</td>
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<tr>
<td>(10) Physical activity (h) → many hours a week</td>
<td>0.18</td>
<td>0.10</td>
<td>0.16</td>
<td>0.04</td>
<td>0.06</td>
<td>0.21</td>
<td>0.05</td>
<td>0.05</td>
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<tr>
<td>(11) Activity in sport club → active</td>
<td>0.25</td>
<td>0.05</td>
<td>0.19</td>
<td>-0.04</td>
<td>-0.07</td>
<td>0.17</td>
<td>-0.04</td>
<td>0.00</td>
<td>0.59</td>
<td>0.71</td>
<td>1.00</td>
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<tr>
<td>(12) Feeling of helplessness → never</td>
<td>0.27</td>
<td>0.32</td>
<td>0.31</td>
<td>-0.05</td>
<td>0.06</td>
<td>0.01</td>
<td>-0.04</td>
<td>-0.06</td>
<td>0.05</td>
<td>0.09</td>
<td>0.05</td>
<td>1.00</td>
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<tr>
<td>(13) Feeling of self-confidence → always</td>
<td>0.29</td>
<td>0.29</td>
<td>0.30</td>
<td>-0.02</td>
<td>0.02</td>
<td>0.05</td>
<td>-0.02</td>
<td>-0.05</td>
<td>0.12</td>
<td>0.16</td>
<td>0.01</td>
<td>0.53</td>
<td>1.00</td>
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<tr>
<td>(14) Self-esteem → good</td>
<td>0.30</td>
<td>0.28</td>
<td>0.29</td>
<td>0.05</td>
<td>0.13</td>
<td>0.21</td>
<td>0.05</td>
<td>0.00</td>
<td>0.14</td>
<td>0.24</td>
<td>0.17</td>
<td>0.57</td>
<td>0.64</td>
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<tr>
<td>(15) Home atmosphere → good</td>
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<td>0.29</td>
<td>0.43</td>
<td>0.10</td>
<td>0.19</td>
<td>0.21</td>
<td>0.24</td>
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<td>0.17</td>
<td>0.06</td>
<td>0.17</td>
<td>0.29</td>
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APPENDIX 4. CORRELATIONS OF FACTORS AND HOME ATMOSPHERE VARIABLE IN THE FINAL MODELS. BOYS' CORRELATIONS IN THE UPPER TRIANGLE AND GIRLS' CORRELATIONS IN THE LOWER TRIANGLE

<table>
<thead>
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<tbody>
<tr>
<td>(1) Perceived sleep quality → good</td>
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<td>0.316</td>
<td>0.404</td>
<td>0.308</td>
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<td>(2) Physical activity → active</td>
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<td>(3) Self-perception → good</td>
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<td>0.258</td>
<td>1.000</td>
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<td>(4) Home atmosphere → good</td>
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<td>0.208</td>
<td>0.420</td>
<td>1.000</td>
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<tr>
<td>(5) Health habits → healthy</td>
<td>0.519</td>
<td>0.139</td>
<td>0.119</td>
<td>0.435</td>
<td>1.000</td>
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