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PHYSICAL ACTIVITY AND SLEEP AS FACTORS FOR A HEALTHY LIFESTYLE IN ADOLESCENTS

ABSTRACT

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The numbering of the tables and figures does not correspond to that in the dissertation.

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ABBREVIATIONS:

BMI – Body Mass Index;

COVID – 19 - Coronavirus disease 2019;

FA – Physical activity

KM/H – kilometer / hour;

MET - Metabolic equivalent of task

UNICEF - United National Children“s Fund;

WHO – World health organization;

Introduction

The world today hosts the largest cohort of adolescents aged 10-19. Approximately 1.2 billion children of this age group constitute 16% of the global human population, with an expected increase in the size of this proportion in the future. The development of an individual passes through several phases. The newborn is dependent on their parents to fulfill almost every need. During childhood, a successful child may briefly separate from them, seeking social contact with peers or adults. The subsequent transitional phase of adolescence, shaping the personality, must bring the process of growth and maturation to its logical conclusion. The young person must leave their parents and become a mature and responsible individual who can successfully integrate into the relevant social group, transcending the dependence of childhood.

Adolescence aims to prepare the adolescent physically, mentally, and socially for their functioning as an adult. This stage of the life cycle spans ages 11 to 18. It is characterized biologically by physical development, including changes in sexual organs and morphological characteristics such as height, weight, and muscle mass, as well as changes in thinking, acquisition of solid knowledge, and reasoning skills. The formation, during this stage, of skills for conscious decision-making and a healthy lifestyle will have a positive impact on life and health in the subsequent stages of individual existence.

To succeed, adolescents must accumulate knowledge and shape their character, values, and perspectives. In this way, the child should take their place as a responsible member of society. Parents play a key role in guiding their child's potential in a certain direction. Imposing certain behavioral restrictions, such behavior may be characterized as destructive, as they replace the diversity of childhood with a strongly narrowed reality. On the other hand, if parents do not take such actions, it would mean the child remains a "perpetual child," which is morally unacceptable.

In addition to separating from the family environment, a change accompanying this stage of life is the change in the circle of friends. If up to this point it has been determined by the school environment and the influence of parents, then with the "leaving" of home, the youth independently choose their environment. Changing the circle of friends is a sign that they are seeking an environment to fit in until they discover themselves.

A change in worldview is also observed. Adolescents begin to form their own views and opinions, forming a worldview influenced by multiple factors and subject to multiple changes during puberty. These tasks, facing the development of personality, are not easy to control and can lead to emotional and psychological problems, intrapersonal and interpersonal conflicts, aggression, and depression. The opinion of peers, their appearance, and the desire to resemble their peers play a significant role for them to be accepted as part of society. This also happens within the school environment, where the school, besides being a place for education, also becomes an environment for shaping personality. With regard to sexual maturation, interest in the opposite sex also develops.

An essential prerequisite for the normal course of all these processes accompanying adolescence is optimal physical activity together with appropriate sleep hygiene. Their role in the normal physiological processes, their positive role in building mental health, as well as in shaping the value system of children, is indisputable. Optimal

final development of the musculoskeletal system, muscle mass building, efficient functioning of the cardiovascular and respiratory system, are unthinkable without appropriate sleep and physical exertion. Although the benefits of adequate quality and quantity of sleep and physical activity are painfully well known, there is a global trend towards decreasing levels of activity on one hand, and on the other hand, virtual means of socialization have an additional negative effect on the quality of sleep in adolescents.

Lack of activity and insufficient effective sleep are leading risk factors for a number of chronic diseases. For example, according to WHO data for the period 2020-2030, nearly 500 million of the world's population would develop cardiopulmonary diseases, diabetes, obesity, and other socially significant diseases due to lack of physical activity. These conditions will be the cause of 10% of premature mortality and losses of about 27 billion US dollars annually. At the same time, about 80-85% of children are not engaged in physical activities with the intensity and duration recommended by the WHO.

The duration and quality of sleep are factors with proven effects on the health, mood, behavior, and cognitive abilities of adolescents. Sleep problems can negatively affect quality of life, cause anxiety and depressive states, overweight and obesity, limited socialization, low academic achievement, and increased risk of developing deviant behavior and substance use disorders. These conditions and diseases are preventable, and appropriate physical activity and sleep hygiene in adolescents can be essential tools for this purpose. In our country, problems with sleep and physical activity are considered separately, with a lack of data on the combined impact of the two factors, which emphasizes the need to build policies and programs that encourage adolescents to be physically active and to develop sustainable behavioral habits leading to lifelong good health. The need for such parallel analysis of issues related to physical activity and sleep hygiene in adolescents motivates the conduct of this dissertation research.

AIM, OBJECTIVES AND METHODOLOGY OF THE RESEARCH

AIM

The aim of the present dissertation work is to establish the significance and interrelationship of factors influencing physical activity and sleep hygiene and their role as components of a healthy lifestyle among students aged between 10 and 19 years in the territory of the Republic of Bulgaria.

OBJECTIVES

To accomplish the objective, the following research tasks are established:

TASK 1: Investigate the level of physical activity in different periods of adolescence.

TASK 2: Examine the influence of certain socio-demographic and motivational factors on physical activity.

TASK 3: Characterize sleep patterns in different age groups of adolescents.

TASK 4: Explore the impact of certain socio-demographic and behavioral factors on sleep among adolescents.

TASK 5: Determine the relationship between physical activity and sleep quality as primary components of a healthy lifestyle among adolescents.

TASK 6: Develop a methodological guide for promoting adolescent health through physical activity and sleep hygiene, intended for health professionals in school health offices.

WORKING HYPOTHESES

In the dissertation work, the following operational **scientific hypotheses** will be tested:

1. The physical activity of adolescents varies across different age periods of adolescence.
2. Physical activity is influenced by gender, place of residence, and the socio-economic status of the family.
3. With increasing age and academic commitments of adolescents, the quantity of sleep decreases and its quality deteriorates.

4. The most significant factor limiting the quantity of sleep among adolescents is social media usage.
5. High levels of physical activity increase the duration of sleep among adolescents.

METHODOLOGY

Object and Subject of the Study:

The object of the current scientific research is the healthy lifestyle of adolescents.

The subject of the dissertation work is physical activity and sleep as components of a healthy lifestyle among adolescents.

Research Methodology:

Design, Time, and Place of the Study:

A cross-sectional social-medical study was conducted from November 2021 to January 2023. The study included students aged 10-19 from 12 secondary schools (SOUs) and 3 primary schools (POUs) located in the Central South and Southwest regions of Bulgaria, selected for convenience. The schools were chosen with the aim of ensuring representation of the adolescent population from areas with different sizes and lifestyles, in order to present characteristics and factors typical of the entire adolescent group in the Republic of Bulgaria.

The essential collection of primary information was preceded by a pilot study conducted from November 2021 to June 2022, where questionnaires were provided to 50 students permanently residing in Bulgaria. The pilot study assisted in the compilation of the final questionnaire, based on which the current research was conducted.

The collection of primary information from the study participants was carried out from September 2022 to January 2023. Due to the COVID-19 pandemic and the epidemic control measures in place in the country, it was decided that the information would be collected online through the completion of a questionnaire (Google Form), accessible once through a provided active link. Permission for the surveys was obtained from the directors of the respective schools, following the established procedures by the Regional Inspectorates of Education. Prior permission from the parents of all participants was obtained through detailed presentation of the purpose of the study and the questionnaire sections to the parental community during parent meetings.

Studied Subjects:

The study group of adolescents consisted of 565 participants aged between 10 and 19 years. The main socio-demographic characteristics of the group are presented in Table 2. Quantitative demographic characteristics are represented by mean value ± standard deviation, and qualitative characteristics are presented by number and relative share of the respective category (%).

For the distribution of participants by age, a classification of periods of adolescence was used as follows: early adolescence 10-14 years old; middle adolescence – 15-17 years old; late adolescence – 18-19 years old. The socio-economic status of the children's families was determined based on the monthly incomes of a family member. In classifying individuals into the four categories based on the monthly income of a family member, current information from the National Statistical Institute regarding the minimum wage and average monthly income in the country (data for 2022) was used, with families categorized as having minimum income – below 710 BGN/member, average – 711-1399 BGN/member, high – above 1400 BGN/member, and families with irregular incomes.

Table. 2. Main demographic and social characteristics of the studied group of students

Indication	**Number (relative share in %), mean±std. dogs.**
Average age in years	14.64 ± 2.34
Sex	
Women	362 (64,1%)
Men	203 (35,9%)
BMI	20.16 ± 3.41
Occupation	
Capital	300 (53,1%)
District city	153 (27,1%)
Small town	75 (13,3%)
Village	37 (6,5%)
Family	n = 543

Nuclear - parents and children	472 (83,5%)
Incomplete – one parent with child/children	70 (12,4%)
Incomplete - one parent with child/children	1 (0,2%)
Socio-economic status of the family	
High incomes	134 (23,7%)
Average incomes	397 (70,3%)
Minimum income	30 (5,3%)
Intermittent income	4 (0,7%)

The table illustrates that within the studied group, children aged 10-14 years constitute 311 individuals (55%), while the age group of 15-17 years comprises 153 individuals (27.1%), and those in late adolescence account for 101 individuals (17.9%). Among the participants in the study, girls predominate, numbering 362 (64.1%). More than half, specifically 300 (53.1%) children, reside in the capital city.

The majority of the children grow up in nuclear families (parents and children), totaling 472 individuals (83.5%). Approximately two-thirds of the children demonstrate excellent academic performance, with 353 students (62.5%) achieving this level. Additionally, 153 students (26.1%) attain a very good level of performance, while 36 (6.4%) achieve a satisfactory level. The remaining children report receiving varied grades without categorizing themselves by average performance.

The methodology for data registration involved the utilization of a questionnaire-based approach to gather primary information. An online survey method was employed, providing participants with an active link to access the questionnaire. The survey was conducted at participants' convenience, allowing sufficient time for responses to ensure comprehensive data collection across all aspects of inquiry.

The survey instrument comprised 74 questions structured into several sections:

1. Demographic and social information regarding the participants - encompassing 7 questions.
2. Information pertaining to the intensity and duration of physical activity - consisting of 7 questions.

3. Factors influencing motivation for physical activity - encompassing 25 questions.
4. Characteristics of the quantity and quality of sleep - including 10 questions.
5. Factors influencing the quantity and quality of sleep - comprising 12 questions.
6. Effects of sleep disturbances on daily activities of children and academic performance - consisting of 13 questions.

Physical activity was assessed through subjective (questionnaires, diaries, etc.) or objective (motion sensors, heart rate monitors) methods. The present study utilized questions from the International Physical Activity Questionnaire - Short Form (IPAQ-short form), a globally recognized instrument for assessing physical activity. The questionnaire items were structured to gather information on physical activity across varying levels of energy expenditure, i.e., low, moderate, and high intensity. Questions regarding physical activity were open-ended, querying participants about their physical activity over the past seven days preceding questionnaire completion. Duration in minutes and frequency in days for the three types of physical activity by intensity level were evaluated.

The results concerning participants' physical activity levels were determined based on Metabolic Equivalent of Task (MET), where 1 MET represents the energy expenditure rate while sitting at rest, equivalent to 3.5 milliliters of oxygen consumption per kilogram of body weight per minute. The abbreviations METs and MET-minutes were utilized. Walking at a normal pace was equated to 3.3 METs, moderate physical activity to 4.0 METs, and high-intensity activity to 8.0 METs. Each activity, based on its category (low, moderate, and high), was multiplied by its corresponding coefficient (METs), the number of days, and the number of minutes. The total sum of the three types of activities determined the MET-minutes/week, representing the cumulative metabolic equivalent for the entire week.

The formula for calculating each activity is as follows: (METs) * (number of minutes per day) * (number of days per week).

For example, if an individual reported allocating 30 minutes for walking, 30 minutes for moderate physical activity, and 30 minutes for high-intensity exercise on each of 5 days, their total metabolic equivalent would be calculated as follows:

Total MET-minutes/week = 3.3 * 30 * 5 (walking) + 4.0 * 30 * 5 (moderate activity) + 8.0 * 30 * 5 (high intensity) = 2295 MET-minutes/week.

The final level of physical activity was determined as low, moderate, or high based on the following evaluation criteria:

1. **Low physical activity** was identified in individuals who either had no physical activity or whose activity did not meet the criteria for moderate or high physical activity.
2. **Moderate physical activity** corresponded to meeting at least one of the following three criteria: i) 3 or more days of high-intensity physical activity for at least 20 minutes daily, ii) 5 or more days of moderate-intensity physical activity and/or walking for at least 30 minutes daily, iii) 5 or more days of any combination of the three types of activity with a total metabolic equivalent of at least 600 MET-minutes/week.
3. To be classified as engaging in **high physical activity** (active exercisers), individuals needed to meet at least one of the following two criteria: i) Engaging in high-intensity physical activity on at least 3 days in the preceding week with a total metabolic equivalent of at least 1500 MET-minutes/week, ii) Engaging in all types of activities at an intensity level for 7 or more days with a total metabolic equivalent of at least 3000 MET-minutes/ week.

The utilization of questionnaires presents a facile method for application among large population groups, thus serving as a primary tool for assessing physical activity in extensive epidemiological studies. Simultaneously, this method may lead to an overestimation of physical activity due to the subjective assessment of data reported by respondents. Consequently, some research teams rely on various activity-monitoring devices that track energy expenditure during specific activities, thereby potentially augmenting recorded activity levels. In the current study, consideration was given to the fact that physical activity is a behavioral factor influenced to some extent by the developmental environment and cultural characteristics of the country. The internationally validated tool employed for determining physical activity is based on individuals' self-assessment of the intensity of their physical activities. It has been utilized in large-scale observational studies and was developed by the World Health

Organization (WHO) as part of an approach to monitor risk factors for chronic diseases across more than 120 countries worldwide. Limitations associated with its application are linked to the subjective evaluation by respondents, as well as meteorological conditions during the week queried of the children, as some activities may vary based on weather characteristics and the corresponding season. Furthermore, during the survey period, some schools were under quarantine due to COVID-19, potentially resulting in reduced physical activity levels among children.

The motivation for physical activity among adolescents was examined using the psychometric instrument called the Behavioral Regulation in Exercise Questionnaire - Version 3 (BREQ-3). This questionnaire constitutes a multidimensional tool comprising 24 statements, forming 6 subscales. The theoretical underpinnings of the instrument lie in Deci and Ryan's Self-Determination Theory. Self-determination refers to the extent to which individuals autonomously direct their behavior through internal forces, performing actions willingly and out of personal desire, rather than being influenced by external factors that mandate action.

The BREQ-3 facilitates the determination of various types of motivation for engaging in physical activity. The subscales measure four distinct forms of external motivation, based on their relative degree of autonomy, ranging from controlled forms of regulation (external and introjected regulation) to autonomously driven regulation (identified and integrated regulation). The other two scales assess amotivation and intrinsic motivation.

Each subscale consists of 4 statements, to which responses range from 0 - "Not true for me" to 4 - "Very true for me." An assessment is then formed, which is the arithmetic mean of the ratings for each of the four statements within the respective subscale, as follows:

- Amotivation – statements 2, 8, 14, 20;
- External regulation – statements 6, 12, 18, 24;
- Introjected regulation – statements 4, 10, 16, 22;
- Identified regulation – statements 1, 7, 13, 19;

- Integrated regulation – statements 5, 11, 17, 23;
- Intrinsic regulation – statements 3, 9, 15, 21.

High scores on the amotivation subscale indicate the lowest level of autonomy, whereas high scores on the intrinsic regulation subscale signify a high level of autonomy in decision-making.

The study of sleep characteristics and influencing factors was conducted by incorporating questions into the questionnaire from established instruments for investigating sleep characteristics in adolescents. These instruments include the Adolescent Sleep-Wake Scale (ASWS) and Adolescent Sleep Hygiene Scale (ASHS) from the studies by LeBourgeois and Storfer-Isser. These instruments are widely used in clinical research, are commonly accepted, and have been validated. They explore factors determining bedtime, the ability to maintain sleep, re-initiation of sleep upon awakening, the process and manner of awakening, as well as factors related to sleep hygiene, including behavioral, emotional, and environmental influences.

Methodology of data processing

The gathered primary data underwent processing utilizing statistical software packages, namely SPSS for Windows, version 23, and Microsoft Office Excel 2013.
Descriptive analysis was conducted, wherein frequency distributions of variables were presented in tabular format. Quantitative variables were described by their means (M) and standard deviations (SD) or standard errors of the mean (SEM), while qualitative variables were represented by relative frequencies of their categories.
The distributional form of quantitative variables was assessed using the Kolmogorov-Smirnoff test, guiding the selection of appropriate parametric or non-parametric analytical methods.
Hypothesis testing concerning the presence of statistically significant differences in mean values of quantitative variables between two independent samples employed the Fisher's t-test for independent samples and the Mann-Whitney test. Comparison across more than two independent samples utilized one-way analysis of variance (ANOVA) or the Kruskal-Wallis test.
Correlational analysis was applied to ascertain dependencies among variables, employing Pearson's (r) or Spearman's (rs) correlation coefficients to assess the strength of relationships.
Visualization of obtained results was facilitated through graphical analysis techniques.
Hypothesis testing was conducted at a significance level of $\alpha=0.05$.

2. RESULTS AND DISCUSSION

2.1. Study of physical activity in different periods of adolescence

Over half, specifically 305 (54%), of the adolescents reported engaging in high-intensity physical activity with a frequency of up to four days in the last week (Figure 1). The mean frequency for the entire sample is 2.84±0.09 days (M±SEM). The duration of high-intensity physical activity ranges from 10 to 180 minutes, with an average time of 64.45±2.01 minutes. More than 40%, or 230 children, reported allocating more than one hour for their sports training sessions.

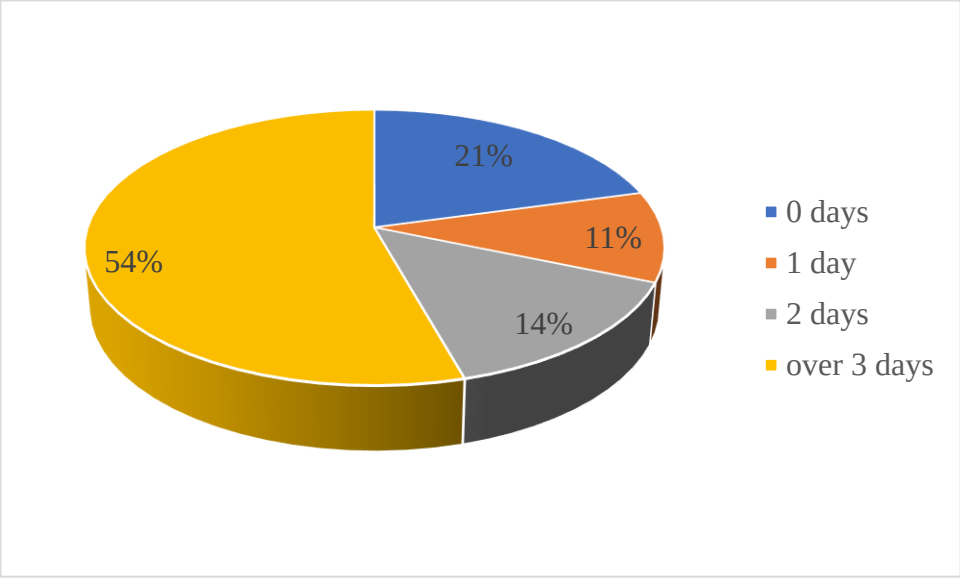


Fig. 1. Distribution of sportsmen with high intensity of physical activity by days

During the investigation of the time adolescents spend sitting reading books or engaging with electronic devices such as computers, laptops, or video games, it was found that they reported spending, on average, three times more time (228.89±6.76 minutes) on such activities compared to the time spent on intensive physical activities. The data indicate that a significant portion of adolescents' leisure time is devoted to inactive behaviors, as depicted in Figure 2.

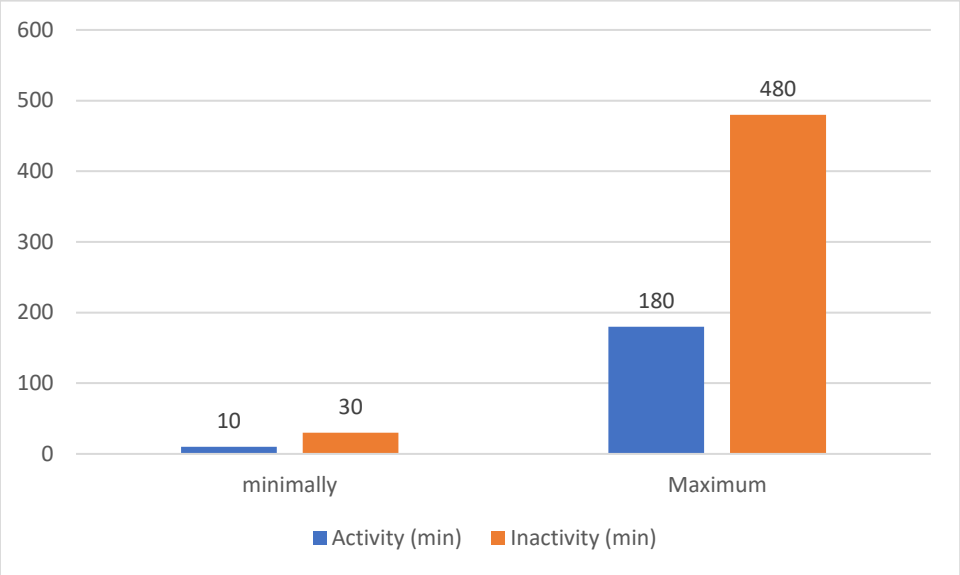


Fig. 2. Variation in time spent in activity and inactivity by adolescents in the study group

Moderate-intensity physical activity with a frequency of up to four days in the previous week was reported by 343 (60.7%) of the surveyed children, with an average duration of 52.44±2.41 minutes per session. Approximately one-fifth of those engaged in moderate physical activity spent more than one hour per session, with session durations ranging from 10 to 200 minutes across the entire sample.

Walking is considered an equivalent to low-intensity physical activity. More than half, specifically 316 (55.9%) of the surveyed individuals, reported walking every day during the last week, with one-third of them walking for more than an hour. The average duration of a walk was 72.99±2.93 minutes per child in the entire sample, making it a preferred form of physical activity among adolescents. A negligible number of students, 9 (1.6%), reported not walking at all.

The World Health Organization (WHO) recommends that children and adolescents aged 6 to 17 engage in at least one hour (60 minutes) of moderate to vigorous physical activity on at least three days per week. Comparing the results of the conducted study with these recommendations reveals that 390 children (69.1%) reported engaging in physical activity meeting the WHO's minimum daily requirements.

A positive conclusion drawn is that over half of the adolescents achieve healthy levels of physical activity in line with the recommendations. However,

simultaneously, it is necessary to encourage and make efforts with nearly one-third of the study participants to reach the recommended levels of physical activity (Figure 3).

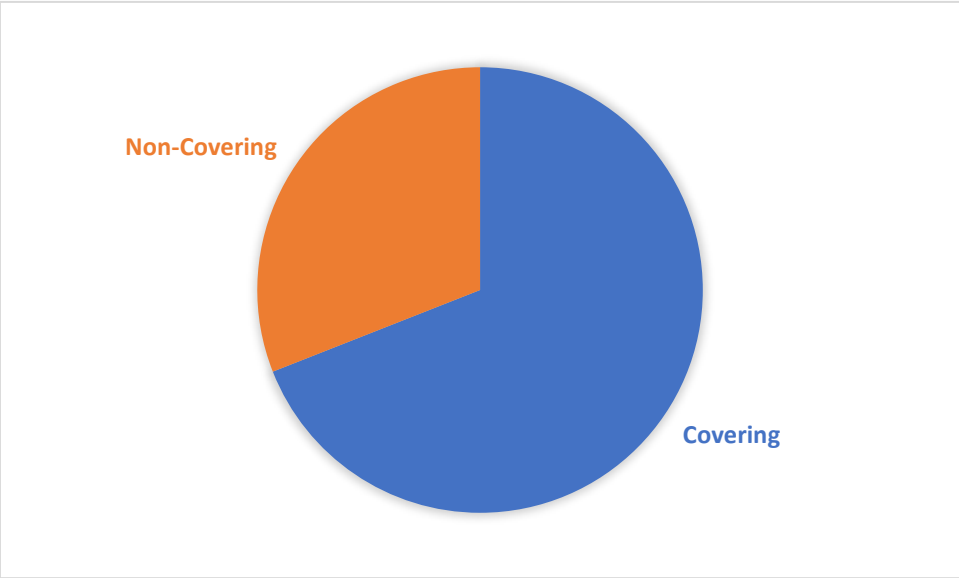


Fig. 3. Distribution of adolescents meeting and not meeting WHO minimum requirements for physical activity

More than 90.6% of children engaging in high-intensity physical activity reported practicing sports with high intensity between 3 and 7 days per week. Around 40% of those engaging in moderate-intensity sports, who reported engaging in high-intensity sports, preferred to distribute this activity once a week, while the majority of those engaging in low-intensity activities did so only on one day (6.7%).

Physical activity was investigated for three periods of adolescence: between 10 and 14 (group 1), 15-17 (group 2), and over 18 years of age (group 3). The relative proportions of adolescents engaging in physical activity of a specific intensity type were compared after determining the type of activity for each child based on calculated overall metabolic equivalents. Differences between the three age groups in the number of days and the average duration of sessions of specific types of physical activity were tracked.

The relative proportion of adolescents engaging in high-intensity physical activity is highest across all adolescent age periods and does not differ substantially between them. There is a slight decrease observed after the age of 15, with the relative proportion of adolescents engaging in such activity remaining constant after reaching adulthood: from 76.8% engaged in high-intensity physical activity in early

adolescence (10-14 years), it changes to 70.6% for the 15-17 age group, and 70.3% in late adolescence (over 18 years old) (p=0.36).

The analysis of the frequency of days with high-intensity physical activity in the past week shows that during early adolescence, it is 3.1±0.12 days; for the age group 15-17 years, it decreases to 2.74±0.18 days and 2.21±0.20 days for adolescents over 18 years old, with the observed differences being statistically significant (p=0.001). As adolescents enter later stages of adolescence, the average duration of sessions of high-intensity physical activity also decreases, with the first group averaging 71.49±2.82 minutes, 66.6±4.03 minutes for the 15-17 age group, and the least for the third group – 56.32 minutes (p=0.001).

A tendency towards an increase in the relative proportion of adolescents engaging in moderate-intensity physical activity is observed among older adolescents. With this type of activity, 17% of adolescents aged 10-14 engage, followed by an increase among 15-17-year-olds, where it is 21.6%, reaching the highest levels in the over 18 age group – 24.8%.

Despite the increasing relative proportion of adolescents engaging in moderate-intensity physical activity in later adolescence periods, its frequency as the number of days in the past week significantly decreases – from 2.34±0.11 days in early teenagers, 1.69±0.15 days in the 15-17 age group, and 1.31±0.15 days in late adolescence (p=0.001). The differences between the first group and the other two are significant, while those between the second and third group do not reach statistical significance. The average duration of sessions of moderate-intensity physical activity among adolescents aged 10-14 is 60.73±3.65 minutes and decreases by nearly 20 minutes in the 15-17 group and the older group, respectively, to 43.21±3.72 minutes and 40.59±4.33 minutes (p=0.006).

The final determination of low-intensity physical activity among adolescents reveals a low relative proportion of this type of activity across all age groups. Low-intensity physical activity is reported by 6.1% of adolescents in the first age group of adolescence. The highest proportion of this type of physical activity is found among 15-17-year-olds, decreasing to 5% among adolescents over 18 years old.

The frequency in days of engagement in low-intensity physical activity is highest in the 15-17 age group (group 2) – 6.25±0.11 days, followed by adolescents over 18 years of age - 5.90±0.17 days, and those in the youngest age group at 5.58±0.1 days. The observed differences between groups 2 and 1 are statistically significant (p=0.001).

A change is also observed in the time spent on individual sessions of low-intensity physical activity. The most time for such activities is allocated by children in the early period of adolescence, with an average single session duration of 78.04±4.48 minutes, decreasing by about 10 minutes in the next two periods – for group 2 it is 66.38±4.33 minutes, and in late adolescence it is 67.68±5.9 minutes, with these differences not being significant (p=0.165).

The results obtained in this study regarding the physical activity of adolescents are similar to observations on adolescent behavior in the United States, as summarized by the Centers for Disease Control and Prevention (CDC) in Atlanta. They show that in the United States, only about half of children meet the criteria to be active for at least 60 minutes daily, with 14% of them not engaging in any physical activity. This is partly explained by the fact that in their free time in the era of digital technologies, children have many activity choices, most of which are sedentary and lead to a sedentary lifestyle.

According to a study conducted as part of the Child and Adolescent Health Measurement Initiative, about 51% of children aged 6 to 17 spend more than 1 hour daily playing video games, watching TV, or surfing the Internet, from which the authors conclude that these children are not motivated to participate in activities that initiate physical activity. This underscores the need for a more detailed examination and understanding of the motivation of children in early school age and adolescents to participate in physical activities.

Studies on physical activity in our country by other authors show a lower relative proportion of students engaging in high-intensity physical activity - 34.3% compared to the results obtained in this study – 74%. The likely reason for the difference in the results obtained is due to the methodology by which adolescents are classified based on their activity, as well as the difference in the timing of the study.

The same group of authors concludes that 32% of the respondents have daily activity, and only half of them meet WHO recommendations for activity. These results are close to those obtained by us regarding the proportion of adolescents (69.1%) meeting WHO recommendations for physical activity. In contrast to the predominance of actively engaged in sports in our study, the authors report that every fourth student does not engage in sports at all, and about a third of the participants in the study watch TV for an hour daily, with the time spent on this activity reaching 5 hours for 8.2% of those surveyed. The reported data on engagement in a sedentary lifestyle for much of adolescents' daily lives (up to 480 minutes per day) confirms the need to encourage physical activity from early childhood and adolescence and to implement educational approaches whereby physical activity and sports are established as an integral part of adolescent behavior. In school age, physical activity sessions should be tailored to the academic workload to maintain a balance between time spent in inactive and active states. As a premise for low physical activity, psychological attitudes, lack of motivation, and self-discipline are of fundamental importance. The consequences of hypodynamia at this age negatively affect the development of the musculoskeletal system and are a prerequisite for obesity. The onset of obesity in adolescence tends to persist into later ages, while also being a precursor to osteoporosis.

2.2. Study of the influence of some socio-demographic and behavioral factors on the physical activity of adolescents

The second task of the present study examines the influence on physical activity (PA) among adolescents of certain demographic (gender, place of residence) and social factors – family structure and socio-economic status, measured through family income. Alongside this, the effects of multiple behavioral factors are examined, aiming to provide clarity on the determinants of the level of physical activity and to provide guidance for developing strategies to encourage activity among adolescents.

Men and women differ in their physical activity levels from early childhood. These differences deepen during the adult years, especially during the reproductive period, as women significantly limit their physical activity and reduce it to household

chores and childcare. The presence of differences in the pattern of physical activity between the two genders during the adolescent years is of interest.

Our study establishes differences between genders regarding the practiced physical activity. When comparing the frequency of engagement in PA of various intensities by the number of days in the last week and the duration of individual activities, consistent differences by gender are observed for reported high and moderate-intensity PA (Table 3). Similar differences are not found among girls and boys reporting low-intensity PA.

Table. 3. Comparisons by gender of mean frequency of FA activity in days and mean single duration in minutes

Type of physical activity	Men	Women	Significance level r
Average duration in days during the last week			
High intensity	3.70±0.15	2.36±0.11	0,001
Moderate-intensity	2.74±0.14	1.70±0.09	0,001
Low intensity	5.76±0.12	5.85±0.9	0,371
Average duration of FA activities in minutes			
High intensity	80.86±.30	59.94±2.45	0,001
Moderate-intensity	59.33±4.09	48.60±2.97	0,005
Low intensity	78.54±5.45	69.87±3.39	0,591

When comparing the distributions of boys and girls based on the final determination of the type of physical activity, it is found that active athletes are significantly more prevalent among males 168 (82.8%) compared to females 250 (69.1%). Girls more frequently engage in moderate physical activity - 85 (23.5%) compared to boys - 26 (12.8%). Similar results are obtained for respondents classified as having low physical activity, with females representing 27 (7.5%) and males 9 (4.4%). The observed differences between the two genders are statistically significant (p=0.02).

We examined the influence of gender on a range of behavioral characteristics and motivations for physical activity in adolescents. Out of the 24 characteristics tested, significant differences between boys and girls were found for 4 of them. Nearly 60% of boys - 118 (58.1%) - indicate as very true the statement "It is important for me

to exercise regularly," while among girls, only 42.8% (p=0.005) provide such an answer. Again, significantly more frequently (p=0.003), male adolescents state that sports are part of their essence - 72 (35.5%). Slightly more than one-fifth of girls define sports in a similar way - 82 (22.7%). Nearly one-third - 118 (32.6%) of girls disagree that exercises are a fundamental part of their essence, and this statement is untrue for 42 (20.7%) of boys, with the differences being statistically significant (p=0.015). Consistent with these findings, 74 (36.5%) of boys exercise because it aligns with their life goals, while this is true for only 88 (24.3%) of girls (p=0.012).

Based on a quantitative analysis of questions regarding motivation and other behaviors related to physical activity by gender, the most significant factors for engaging in physical activity among male respondents are the motivation to be active, the benefits of physical activity, and the satisfaction derived from exercising.

Our results confirm the established differences in the physical activity of adolescents by gender from other studies. Similar higher results regarding the frequency and duration of high-intensity physical activity among boys are reported by Icelandic researchers in a study with over 3200 participants. Concurrently, there is data showing lower levels of physical activity during the COVID-19 pandemic period, as well as increased sedentary time among adolescents. A study on the level of physical activity between individual waves of COVID-19 shows initially decreased physical activity, but a return to initial levels after the second wave, albeit with increased sedentary time. The higher levels of physical activity reported by us can be explained by the preceding restrictions aimed at limiting the spread of COVID-19 in our country. Gender has been confirmed as a significant factor for observed differences in the frequency of school and extracurricular physical activity of high and moderate intensity in the study by Brigita Mieziene and colleagues.

Boys demonstrate significantly higher self-determined motivational characteristics compared to girls in our study. This confirms the nuanced variation by gender in psychological characteristics depending on the undertaken physical activity.

The physical activity of adolescents is influenced by their place of residence. The effect of residency is associated with opportunities for sports activities in leisure time, the presence of sports clubs and infrastructure for active sports, as well as

differences in psychological attitudes and motivation for physical activity among children.

The study compared the frequency of engagement in various types of physical activity and their single-session duration among children living in the capital city, regional cities, small towns, and rural areas.

The analysis of data on high-intensity physical activity did not reveal significant variation in the average frequency of engagement among adolescents living in different-sized settlements. Measured in days over the past week, it is highest among children in rural areas - 3.24±0.38 days, and lowest among those living in regional cities - 2.71±0.17 ($p=0.562$). The average duration of single-session high-intensity physical activity in minutes is the same for children in regional cities and rural areas - around 70 minutes, and is 5 minutes shorter in the capital city and small towns ($p=0.775$). Similar nonsignificant differences are found for moderate and low-intensity physical activity, both in terms of frequency in days and duration of single activities in minutes. The study does not demonstrate an influence of adolescents' place of residence on the frequency and duration of engagement in physical activity of different intensities.

When comparing the final determined level of physical activity by adolescents' place of residence, no significant differences are found ($p=0.557$). The highest relative proportion of active athletes is observed in the capital city (75.3%) and regional cities (74.5%), while the lowest is in rural areas (67.6%). In rural areas, the proportion of children with low physical activity is twice as high (13.5%). Although not reaching statistical significance, these results are useful for planning future health promotion intervention programs specifically targeted at children with low physical activity and the sports environment in small communities and rural areas.

The influence of place of residence on adolescents' physical activity remains poorly understood, with contradictory results from scientific studies on the issue. Some studies find lower levels of physical activity among teenagers living in rural areas. Other authors find higher frequencies of high and moderate-intensity physical activity and lower sedentary time for children in rural areas. The results of our study support those of R. Christiana et al., who found no differences in leisure-time physical

activity by place of residence among adolescents. The lack of statistically significant influence of place of residence in our study could also result from the small number of children living in rural areas participating in it - 6.55% of the total sample. In studies with a similar sample size, adolescents living in rural regions also have the smallest proportion, but it is usually above 15%.

The family context has a proven influence on adolescents' physical activity. Changes in family structure - increasing or decreasing the size of the family due to a new family member, divorce, or the death of a parent - affect children's behavior, including their engagement in physical activity.

The teenagers participating in the study mainly live in families with a nuclear structure (parents with their children) - 472 (83.5%). Seventy (12.4%) of the respondents live in single-parent families, and only one child lives in an extended family structure with parents, children, grandparents, and/or grandparents. In the statistical analyses determining the influence of family structure on physical activity, 542 children were included, as 22 (3.89%) did not specify the type of family they live in, and the sole extended family was not sufficient to draw valid conclusions and was also excluded from the analyses. Table 4 presents the distribution of the study group by family structure and gender, with no significant differences found between boys and girls (p=0.33).

Table. 4. Distribution of participants by family structure and by gender (number and relative part in %)

Family structure	Men	Women
Nuclear	176 (89,80%)	295 (85,26%)
Incomplete	20 (10,20%)	50 (14,45%)
Advanced	-	1 (0,28%)
Total	196 (100%)	346 (100%)

In the comparative analysis of the influence of family structure on physical activity with different intensities (Table 5), statistically significant dependencies are found regarding the time spent on single physical activities with moderate (p=0.033) and low intensity (p=0.007).

Table 5. Family structure and frequency of FA activities in days and average single duration in minutes

Type of physical activity	Nuclear family	Incomplete family	Significance level r
Average duration in days during the last week			
High intensity	2.84±0.10	2.60±0.25	0,411
Moderate-intensity	2.00±0.09	1.70±0.21	0,165
Low intensity	5.81±0.08	5.94±0.20	0,559
Average duration of FA activities in minutes			
High intensity	68.56±2.22	61.07±5.32	0,264
Moderate-intensity	55.18±2.74	Priced 37.96±4.81	0,033
Low intensity	74.54±3.12	62.24±9.17	0,007

For both types of physical activity, teenagers from single-parent families spend less time on individual activities – 17.22 minutes less for moderate-intensity physical activity and 12.3 minutes less for low-intensity physical activity. Sedentary activities do not differ between children from complete and incomplete families in terms of frequency in days (p=0.599) or average single-time duration in minutes (p=0.634).

Табл. 6. Level of physical activity of adolescents by family structure (number and relative part in %)

Physical activity	Nuclear family	Incomplete family
High	353 (88,0%)	48 (68,6%)
Moderate	90 (19,1%)	18 (25,7)%
Low	29 (6,1%)	4 (5,7%)
Total	**472 (100%)**	**70 (100%)**

The data in Table 6 show that family structure does not significantly influence the level of physical activity among adolescents (p=0.430). The relative proportions of active athletes and adolescents with moderate levels of activity are almost the same among those in nuclear families and those in single-parent families.

The impact of family structure was also investigated for behavioral characteristics and motivations leading to physical activity. A statistically significant dependence of family structure influence was found for motivating children for physical activity through their sense of responsibility to meet the expectations of

others (p=0.035). They are more likely to agree with the statement that they engage in sports because others would not be happy if they didn't.

Family structure is one of the factors that can influence adolescent behavior regarding physical activity. Several studies demonstrate that teenagers raised in incomplete or restructured families are more likely to have low physical activity levels and fail to meet WHO recommendations for daily exercise. They pay attention to the higher risks of adopting other unhealthy behaviors from children in single-parent families. Our results show that despite the lack of significant differences in the level of physical activity among children from nuclear and incomplete families, the time spent in daily moderate physical activity among the latter is significantly reduced and does not reach the recommended 60 minutes.

Studies on the psychological development of adolescents raised by a single parent identify the formation of a tendency towards future "people-pleasing" behavior. When building their own identity during adolescence, children in single-parent families often take responsibility for their parent's feelings and try to offer support in every way, neglecting their own thoughts and feelings. Similar tendencies probably lead to the observed higher frequency of wanting to please others in the motivation of children from single-parent families to engage in sports.

The socioeconomic status of the family is an important factor regarding health behavior and health risks among adolescents. Several studies provide compelling evidence for the strong positive influence of parents' higher education and family income on adolescents' physical activity, as well as their limiting effect on the time spent watching television or using other screens.

In this dissertation study, socioeconomic status was measured using the income of a family member based on data provided by surveyed students, with families categorized as having high, moderate, or minimal incomes. Among the surveyed group, adolescents from families with moderate incomes predominated - 397 (70.3%), followed by students from families with high incomes - 134 (23.7%). At the bottom of the distribution were adolescents who indicated that their families had minimal incomes - 30 (5.3%).

Table 7. Socio-economic status of families by gender of adolescents (n=561)

Family income	Men	Women
High	54 (26,7%)	80 (22,1%)
Medium	141 (69,8%)	256 (71,3%)
Minimum	7 (3,4%)	23 (6,4%)

Table 7 presents the distributions of boys and girls based on the incomes of their families, with no significant difference observed by gender (p=0.332). The frequency in days and the duration of individual sessions of high-intensity sports activities among students by socioeconomic status are described in Table 8.

Table. 8. Frequency and duration of high-intensity FA by family income

Family income	High-intensity physical activity	
	Frequency (in average number of days)	**Duration (in minutes once)**
High	3.48±0.18	85.63±4.25
Medium	2.67±0.11	62.12±2.31
Minimum	2.53±0.42	61.57±8.55
Significance level P	0,001	0,001

When analyzing the socioeconomic status of children engaging in high-intensity physical activities, it is found that those from families with the highest incomes are the most active compared to children from families with average and minimal incomes (p=0.001). They engage in physical activities with the highest frequency and duration - averaging 3.48±0.18 days and single sessions of 85.63±4.25 minutes per day. There is a statistically significant relationship between the socioeconomic status of the family and the frequency and duration of moderate-intensity physical activities. Again, children from families with high incomes show the highest frequency and duration of moderate-intensity physical activities. They engage in physical activities an average of 2.54±0.18 days per week, with sessions lasting an average of over an hour - 68.34±4.98 minutes (Table 9). It is noteworthy that children from families with minimal incomes have the second highest frequency and duration of moderate physical activity.

Table. 9. Frequency and duration of FA of moderate intensity by family income

Family income	Moderate-intensity physical activity	
	Frequency (in average number of days)	**Duration (in minutes once)**
High	2.54±0.18	68.34±4.98
Medium	1.80±0.09	47.16± 2.78
Minimum	2.20±0.370	54.53± 12.62
Significance level R	0,001	0,001

The analysis of the relationship between the socioeconomic status of the family and the level of physical activity among adolescents shows that despite the observed high levels of physical activity in all income categories of families, there is a social gradient with an increasing proportion of children with low physical activity (p=0.002). Figure 4 illustrates this finding of the study - the proportion of adolescents with low physical activity is highest - 13.3% in the group with minimal family income.

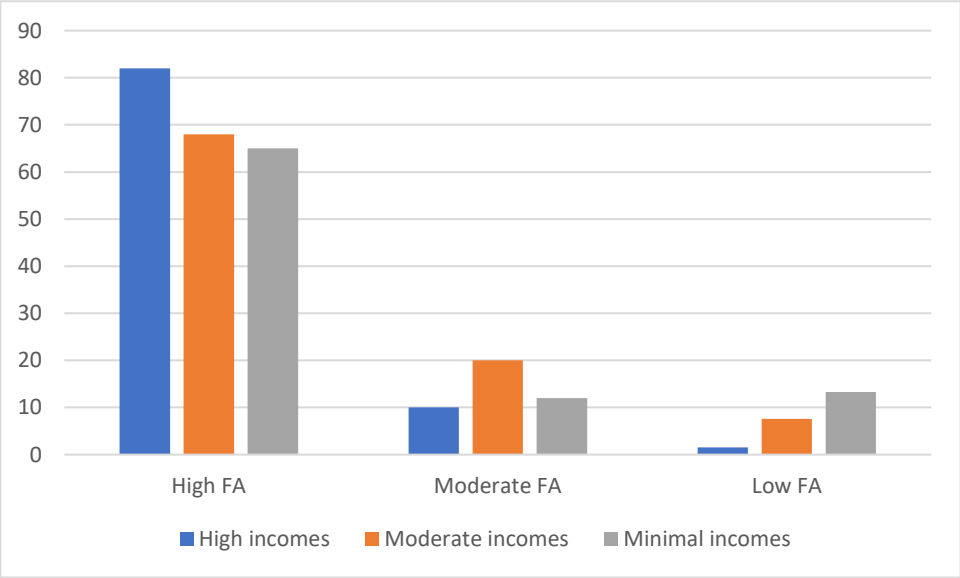


Fig2. 4. Family socioeconomic status and adolescent physical activity level.

When examining the protective role of socioeconomic status regarding sedentary behavior and the allocation of time for low-energy activities, no significant differences are observed between families with high, moderate, and minimal incomes (p=0.209). Adolescents from families with higher incomes spend the least time sedentary on average - 206.68±12.88 minutes. The differences with the other two groups are insignificant: children in families with moderate incomes spend

235.01±8.16 minutes daily, while those in families with minimal incomes spend 231.33±32.43 minutes.

Our study finds that adolescents from families with higher socioeconomic status demonstrate greater engagement in sports activities. The better family income provides a wider range of opportunities for physical activity in leisure time, including paid activities or those requiring expensive equipment and gear. Good physical fitness and appearance are more often social norms for these families and serve as strong motivators for adolescents to participate in sports activities. The identified social gradient in adolescents' involvement in physical activity necessitates economic support for extracurricular sports activities and expansion of school sports offerings, especially for children from families with minimal incomes. This will ensure equal opportunities for physical activity for all teenagers, regardless of their family's socioeconomic status.

The results of the study confirm the influences of family socioeconomic status on adolescents' physical activity, as established by numerous authors. The presence of social inequalities concerning adolescents' physical activity is unacceptable, and the literature discusses possibilities for improving physical activity among children from low-income families through various forms of support and elimination of social disparities. According to authors investigating the effect of COVID-19 on physical activity, low socioeconomic status may pose a barrier to adolescents' participation in structured and organized activities aimed at overcoming the barriers resulting from COVID-19.

Approximately half of the respondents report that they enjoy exercising with friends - 46.4% (262 individuals), while being alone is preferred by about one-third, with both genders showing similar preferences (Table 10) ($p=0.01$). In this regard, males and females exhibit similar preferences ($p=0.001$), and place of residence does not significantly influence adolescents' choice of exercise partners ($p=0.394$).

Table. 10. Gender distribution of adolescent preferences for cooperative sports

Sports with:	Men	Women
Friends	55,2%	41,4%
Boyfriend	3,4%	5,5%
Family	5,9%	7,2%
Himself	20,2%	32,6%
Classmates	2%	5%
Coach	13,3%	8,3%

These findings underscore the role of sports activities in facilitating socialization among adolescents, which in turn entails engagement and consistency on one hand, and fosters teamwork skills and collaborative qualities on the other.

2.3. Charactics of sleep in different age groups

The mean duration of nocturnal sleep on school days for all surveyed students is 7 hours and 51 minutes (±0 hours and 15 minutes), with boys sleeping for 7 hours and 52 minutes (±0 hours and 18 minutes) on average, and girls sleeping for 7 hours and 50 minutes (±0 hours and 12 minutes) on average.

In our study, the quantity of nocturnal sleep during weekdays was examined across different age groups, with analyses conducted based on gender, place of residence, family structure, and socio-economic status of the family. Table 11 summarizes the data on the duration of nocturnal sleep among adolescents from various groups according to the respective characteristics.

Table. 11. Nighttime sleep duration in adolescents during the days of the school week

Sign	Group 1 10-14 y.o.	Group 2 15-17 y.o.	Group 3 18-19 y.o.
Men n=203	8:42 AM±0:19 AM	7:28±0:22 AM	7:02±0:18 AM
Women n=362	8:37 AM±0:22 AM	7:31±0:15 AM	7:06±0:16 AM
To the capital n=300	8:15 AM±0:19 AM	7:10±0:22 AM	6:58 AM±0:11 AM
In the district city n=153	8:32 AM±0:14 AM	7:35±0:27 AM	7:08 AM±0:23 AM
In a small town n=75	8:34 AM±0:19 AM	7:29±0:37 AM	7:11±0:18 AM
To the village n=37	8:12±0:21 AM	7:18±0:09 AM	6:55 AM±0:13 AM
In nuclear family n=472	8:29 AM±0:34 AM	7:32±0:17 AM	7:01±0:15 AM
In incomplete family n=22	8:10±0:16 AM	7:15±0:11 AM	6:56±0:23 AM
High income n=134	8:40 AM±0:17 AM	7:22±0:18 AM	7:10±0:21 AM
Average earnings n=397	8:36 AM±0:07 AM	7:26±0:19 AM	7:06±0:11 AM
Minimum earnings n=30	8:16 AM±0:09 AM	7:02±0:22 AM	6:48 AM±0:17 AM

The duration of sleep varies across the later stages of adolescence. Adolescents in the early teenage group sleep the most, with their nocturnal sleep duration being approximately one and a half hours longer than that of the over 18-year-old group

(p=0.001). This trend persists across all other demographic and social characteristics. For instance, although there are almost no differences in the quantity of nocturnal sleep between the two genders during weekdays in each age group (p>0.05), girls and boys in the younger age group have, respectively, 1 hour and 24 minutes and 1 hour and 27 minutes longer nocturnal sleep. Adolescents in the capital and rural areas have shorter sleep durations compared to those in large and small towns, with statistically significant differences that persist in stratified analyses by age.

Social factors also influence adolescents' sleep quantity. Family structure affects the duration of nocturnal sleep, with children in single-parent families sleeping less (p=0.001), and again, significant differences in sleep quantity by age are observed. Adolescents from high-income families also achieve the most hours of nocturnal sleep compared to those from lower-income families (p=0.001), while maintaining the trend of substantially reduced sleep quantity in older age groups.

Weekends are a time when adolescents catch up on sleep deficits. With no school activities, homework, or lesson preparation, children typically maintain a later bedtime but delay waking up in the morning by more than 2 hours. There are no significant differences in sleep quantity on weekends among children in different age groups of adolescence. Girls sleep more during weekends compared to boys. The average duration of nocturnal sleep on weekends for all adolescents in the sample is 10 hours and 1 minute (±0 hours and 8 minutes), with boys averaging 9 hours and 56 minutes (±0 hours and 19 minutes), and girls averaging 10 hours and 4 minutes (±0 hours and 9 minutes).

Table. 12. Nighttime sleep duration in adolescents on weekend days of the week

Sign	Group 1 10-14 y.o.	Group 2 15-17 y.o.	Group 3 18-19 y.o.
Men n=203	9:56 AM±0:04 AM	9:52 AM±0:08 AM	10:02±0:14 AM
Women n=362	10:06±0:11 AM	9:58 AM±0:07 AM	10:08 AM±0:16 AM
To the capital n=300	9:48 AM±0:12 AM	9:41 AM±0:06 AM	9:43 AM±0:13 AM
In the district city n=153	9:55 AM±0:07 AM	9:42 AM±0:12 AM	9:48 AM±0:17 AM
In a small town n=75	10:02±0:15 AM	9:39 AM±0:08 AM	9:28±0:11 AM
To the village n=37	9:45 AM±0:09 AM	9:31 AM±0:16 AM	9:42 AM±0:14 AM
In nuclear family n=472	9:56 AM±0:21 AM	9:49 AM±0:19 AM	9:52±0:13 AM
In incomplete family n=22	9:18 AM±0:09 AM	9:32 AM±0:17 AM	9:39 AM±0:21 AM
High income n=134	10:06±0:22 AM	9:57 AM±0:12 AM	9:46 AM±0:10 AM
Average earnings n=397	9:53±0:21 AM	9:58 AM±0:12 AM	9:43 AM±0:08 AM
Minimum earnings n=30	9:32 AM±0:08 AM	9:41 AM±0:18 AM	9:21±0:23 AM

Table 12 presents the values of nocturnal sleep during weekends by the age of the children and the investigated demographic and social characteristics. The increase

in nocturnal sleep, as a compensation for sleep deficits during weekdays, is noteworthy.

The analysis of the data shows an increase in nocturnal sleep during weekends, with differences in sleep hours during the week increasing with age – in early adolescence, an average of 1 hour and 23 minutes of additional sleep is added during weekends, in the 15-17 age group, the additional sleep is on average 2 hours and 22 minutes, and in the older group, it reaches 2 hours and 42 minutes ($p=0.001$). Statistically significant differences in the quantity of sleep added during weekends are maintained between adolescents in the capital and those in rural areas, as well as between adolescents from high-income and low-income families.

The results regarding the duration of sleep among adolescents in the study do not differ in value and trends from those observed in a large-scale contemporary study on sleep duration in 24 countries across Europe, Canada, and the USA. Other authors have found large variations between the average number of minutes of sleep on workdays and weekends, namely 96.8 minutes during the school week and 133.2 minutes on Sundays. This difference in sleep duration is associated with mental and emotional symptoms, as well as with more difficult concentration and aggression among adolescents. With less than 6 hours of sleep, the risk of several health problems increases, as well as the risk of obesity. An analysis by Eduarda Sousa et al. found similar results regarding the longest sleep duration among the youngest in the sample.

Bedtime and falling asleep time are important for both the duration and quality of sleep. They are influenced by children's daily routines, television viewing and social media activity in the evening, parental control, and physical activity in the late hours of the day.

In the conducted study, the largest percentage of children - 231 (40.9%), reported going to bed between 11 PM and midnight when they have school the next day (Figure 5). Around one-third - 160 (28.3%) of adolescents go to bed after midnight.

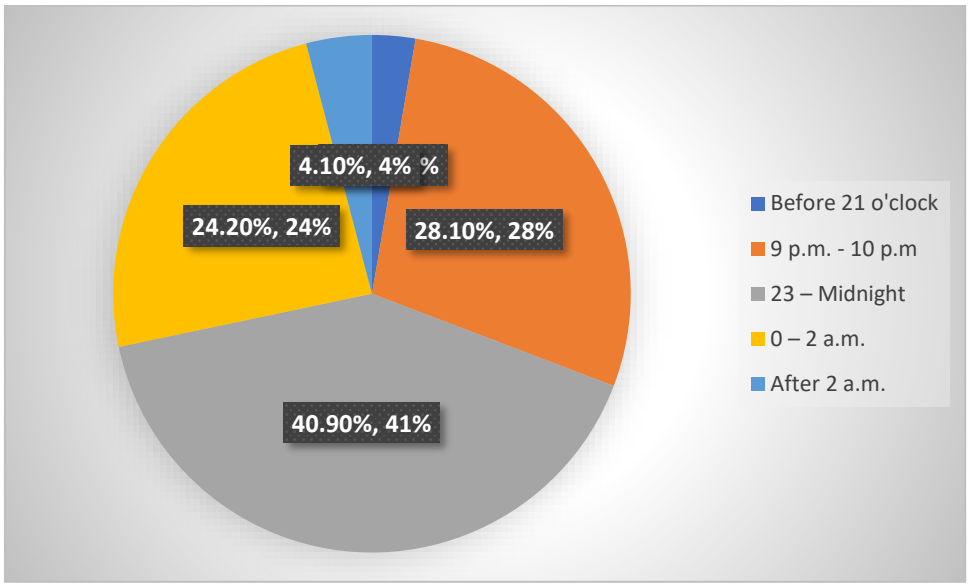


Fig. 5. Distribution of adolescents by bedtime (in %)

The investigation into bedtime across different age groups reveals that in the earlier time intervals before 10 PM, a significant portion of adolescents from Group 1 (10-14 years old) go to bed, accounting for 42.8%. As the children's age increases, the proportion of those staying awake until later hours rises (Fig. 6), with 405 (71.7%) going to bed by midnight.

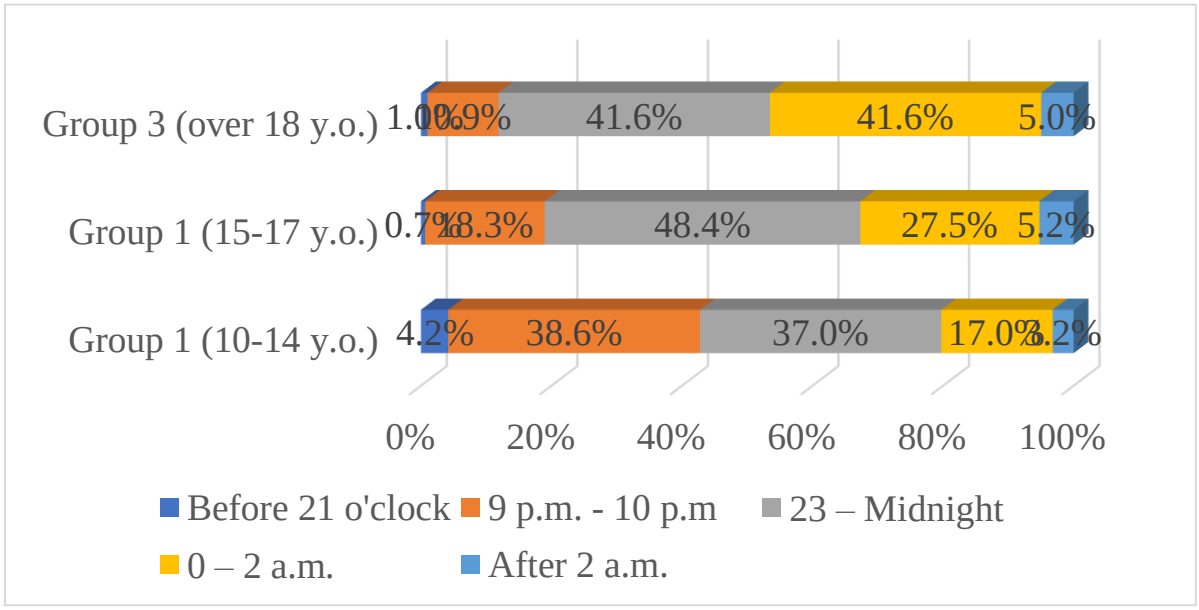


Fig 6. Distribution of surveyed students by age group and bedtime

Late hours around midnight are a typical bedtime for the group over 18 years old - an equal share (41.6%) of those who go to bed between 11 PM and midnight and those between midnight and 2 AM. The observed differences in bedtime for nighttime sleep by age of adolescents are statistically significant ($\chi^2 = 58.435$; $p=0.0001$).

When studying the reasons for going to bed at the specified time among the entire sample, children report that they feel sleepy at that time - 176 (31.2%) of those surveyed, while another 114 (20.2%) share that they have decided to go to bed then. The specific bedtime for 201 (35.6%) is associated with preparing lessons and homework, as well as the need to wake up early for school the next day. Parents have set the bedtime for a negligible number of children - 23 (4.3%), indicating that the role of parents in determining the bedtime for teenagers is not decisive (Fig. 7).

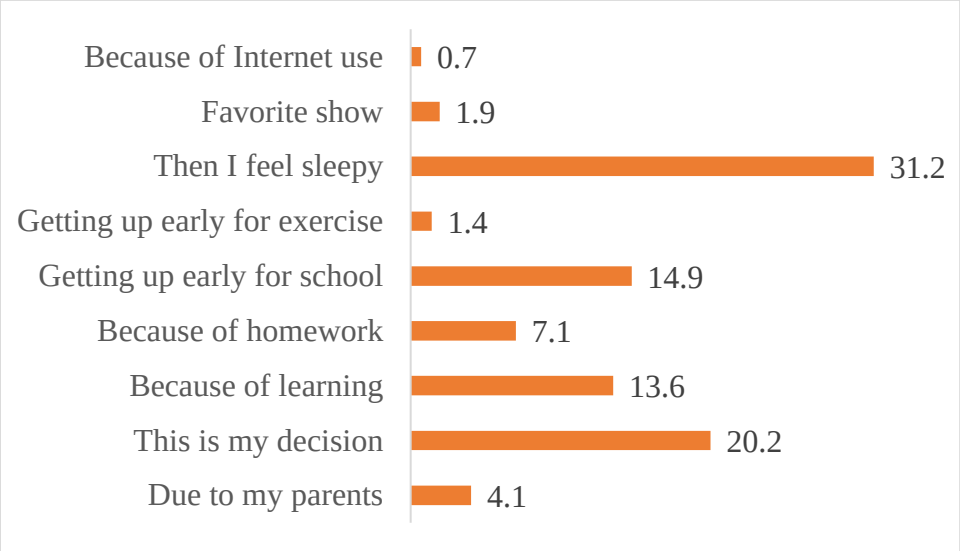


Fig. 7. Distribution of surveyed students by reasons for going to bed in the specific time interval (in %)

The analysis of the distribution of factors influencing bedtime for sleep by adolescents' age reveals significant differences in the relative proportion of those citing early wake-up for school as the reason. The relative proportion of children in Group 1 (10-14 years old) who go to bed at a specific time due to school activities the next day is twice as high - 19.3%, compared to the oldest group (Group 3), where this relative proportion is only 7.9%.

The physiological need for sleep (response "I feel sleepy at that time") dictates the bedtime for almost an equal relative proportion of children in all three age groups. Only 2% of adolescents over 18 years old go to bed at a specific time because of their parents, while the relative proportion is 5.1% for children in early adolescence and 3.3% for those aged 15-17 (Group 2). The decrease in the relative influence of parents on adolescents' decisions reflects increasing independence with each subsequent age

group. Among the remaining factors, no significant differences are observed between the three age groups.

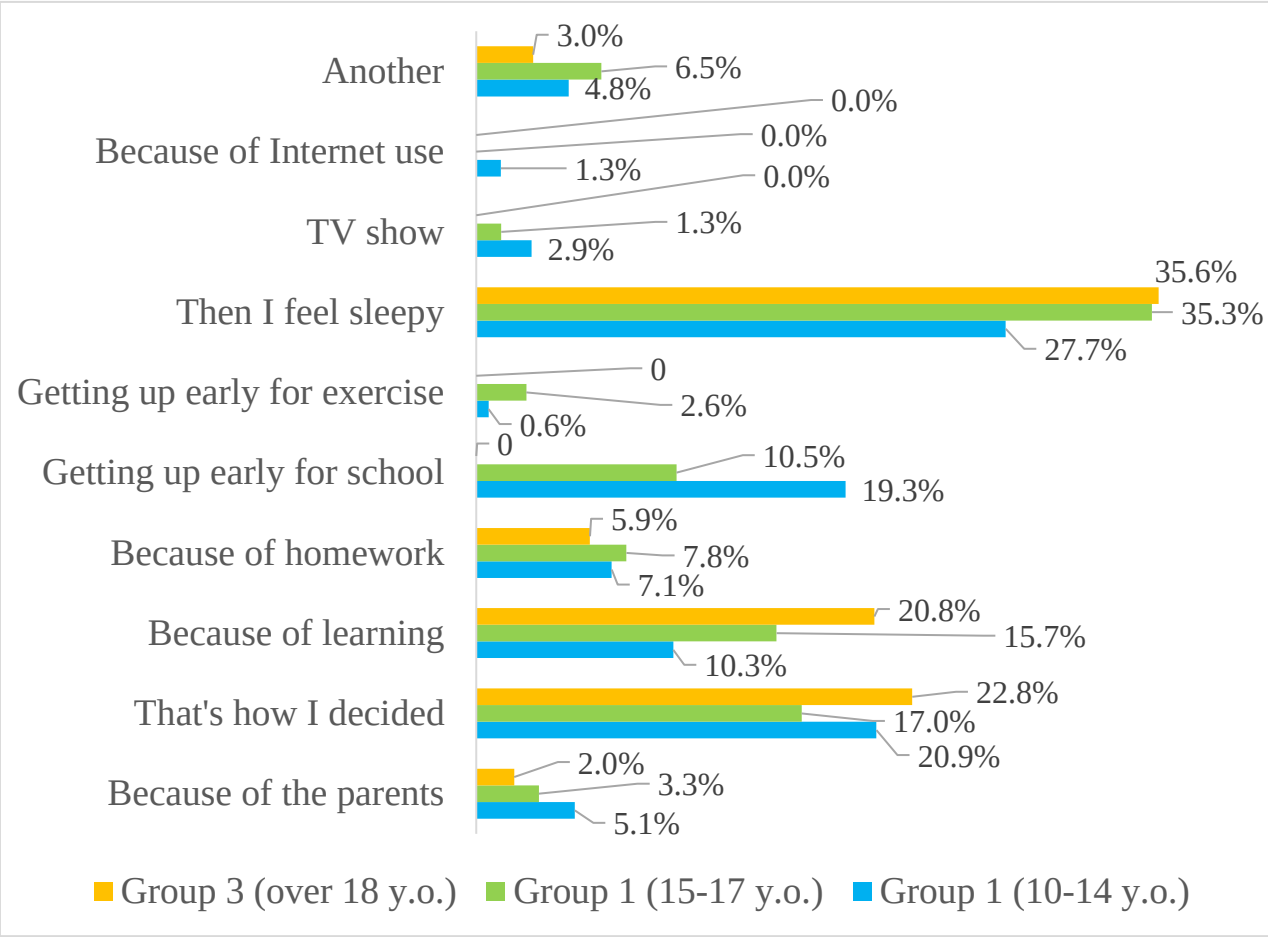


Fig. 8. Distribution of reasons for going to bed at a specific time by age of adolescents

During the school week, incidentally staying awake after the usual bedtime occurs only once a week for 231 (40.9%) of the respondents, while 35.9% delay their bedtime 2-3 times a week. Nearly every day of the week, 131 (23.2%) children go to bed later than the specified time.

When examining differences in age groups regarding staying awake past the specified time, no statistically significant differences are found between the three age groups (p=0.711).

More than half of the participants in the study - 296 (52.4%) - report falling asleep immediately or within 10 minutes, while 120 (21.2%) require more than 20 minutes to fall asleep.

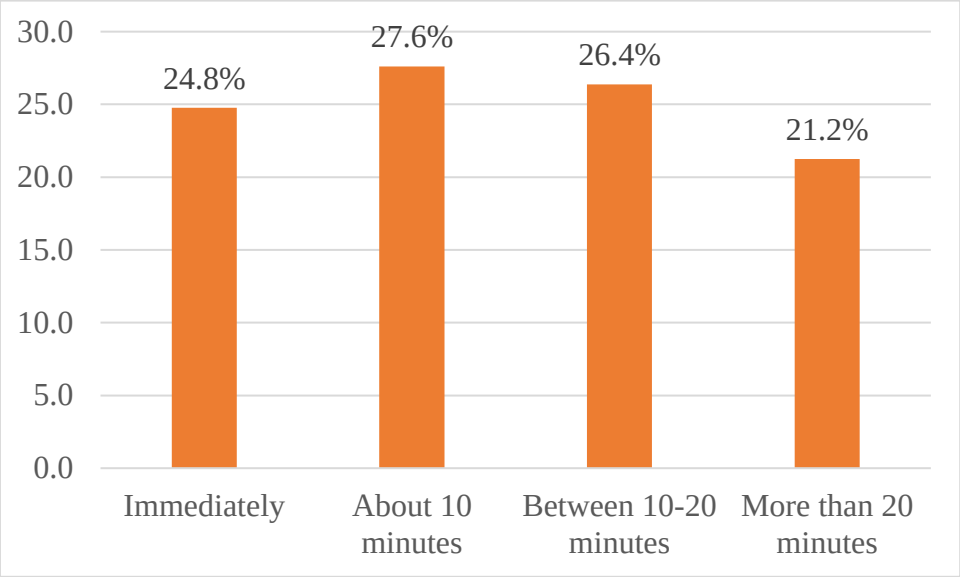


Fig. 8. Time to fall asleep on school days

There are no statistically significant differences observed among the individual age groups regarding bedtime in the evening (p=0.261).

More than half of the surveyed students report sleep-related problems. The primary sleep issue reported by 330 (58.4%) of the children is not feeling rested upon waking up. Another significant portion of adolescents reports difficulty waking up - 302 (53.5%). A relatively smaller proportion of them (110, 19.5%) complain about waking up at night and not being able to fall back asleep afterward. For a very small portion - 67 (11.9%) of the children, no sleep quality-related problems are identified.

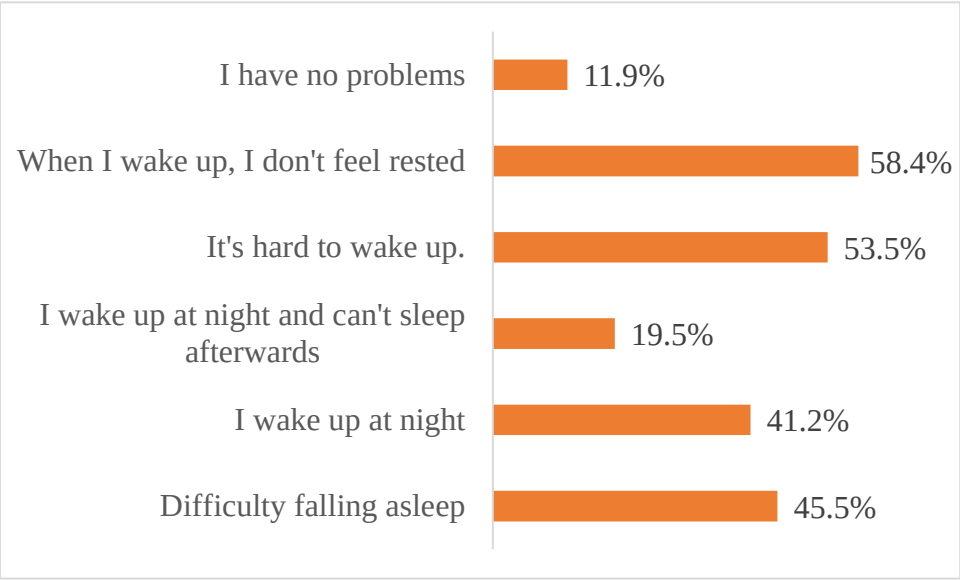


Fig.9. Sleep quality problems among the children in the sample

Figure 10 illustrates the waking-up routine in the morning. The majority of adolescents use an alarm clock - 347 (61.4%) or are awakened by their parents - 140

(24.8%), while the remaining 49 (8.7%) wake up out of habit or to use the bathroom - 7 (1.2%).

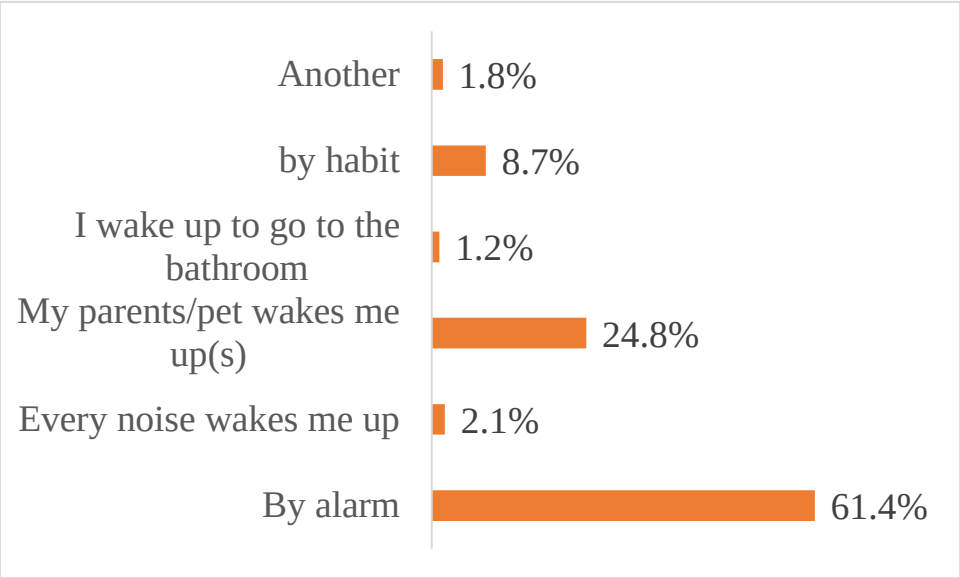


Fig. 10. Way of waking up in the morning for children in the entire sample

Statistically significant differences in the waking-up routine in the morning are observed among the three investigated age groups (p=0.0001). The relative proportion of adolescents who are awakened in the morning by their parents significantly differs among the three groups, with 35.7% in Group 1 (10-14 years old), 14.4% in Group 2 (15-17 years old), and decreasing to 6.9% in Group 3 (above 18) (Figure 11).

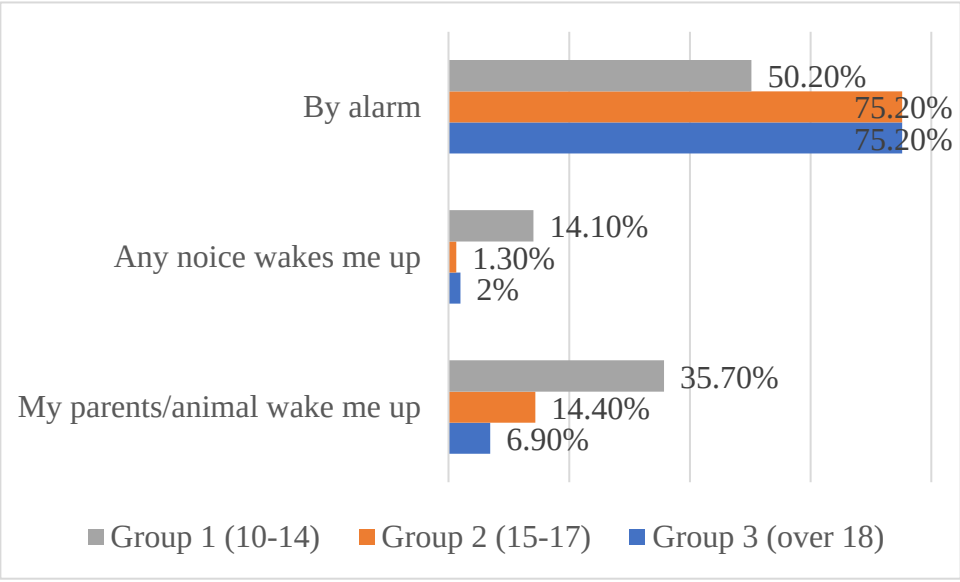


Fig. 11. Distribution by groups of the way adolescents wake up in the morning

The decreasing involvement of parents in the waking-up process in late adolescence is replaced by alarm clocks (72.5%) or by establishing a habit of waking up at the same time (11.9%). This trend towards greater freedom and independence,

as well as the development of trust from parents, characterizes the transition to late adolescence.

Shorter sleep duration may also be attributed to disrupted breathing during sleep. Frequent awakenings, restlessness, and apnea are noted as nocturnal manifestations associated with sleep quality. Excessive sleepiness, fatigue, and difficulty concentrating, reported by some participants, are among the daytime manifestations of poor sleep quality. When frequently recurring symptoms are identified, the authors advise thorough diagnosis and treatment.

The study examined primary causes of sleep problems, including factors related to sleep hygiene. These factors were assessed using 12 statements, where students indicated their level of agreement on a six-point scale ranging from 0 - "False" to 5 - "True." The causal factors were treated as quantitative variables in the analyses, with higher mean values indicating greater agreement with the statements. Table 13 presents the mean agreement value ± SEM for each of the sleep problems.

Table. 13. Causes of sleep problems

Causes of sleep problems	Mean value of agreement	THAT
Unwritten domestic	1.260	0.073
Stress from tasks at home	0.896	0.064
Relationship problems	1.188	0.072
Watching TV before bed	1.428	0.080
Excessive use of a phone/Internet before going to bed	2.637	0.085
Insufficient physical activity	0.938	0.063
Going to the bathroom at night	1.218	0.071
Noise from outside	0.646	0.054
Noise in room	0.726	0.059
The temperature in the room	0.812	0.059
Difficult breathing	0.372	0.044
Having nightmares	1.025	0.064

The excessive use of phones and internet surfing before bedtime emerges as the most significant cause of sleep problems, followed by watching television before bedtime and preparing homework and lessons for the next day.

Analysis of the causes of sleep problems by the children's age reveals statistically significant differences between the various age groups. Significant

differences exist among the three periods of adolescence for unfinished homework, stress from tasks at home, problems in interpersonal relationships, watching television before bedtime, and the need to use the bathroom at night. Unfinished homework worries one in ten children in the younger and middle age groups, whereas it affects the sleep of 5% of adolescents over 18 years old (p=0.007).

Statistically significant differences by age are observed when studying stress from tasks at home, which affects adolescents most in the middle age group (15-17 years old). Data in Table 14 show that slightly more than one-fourth (26.8%) of them rate the indicator with a value above 3, which significantly differs from the relative proportion of children giving similar ratings in the younger group (11.3%) and among adolescents over 18 years old – 12.9% (p=0.001).

Table. 14. Distribution of children who indicated stress from homework as a cause of sleep problems by age group

Sign	Group 1 (10-14 years)		Group 2 (15-17)		Group 3 (over 18)	
	n	(%)	n	(%)	n	(%)
0 - False	230	74.0%	84	54.9%	59	58.4%
1	28	9.0%	18	11.8%	18	17.8%
2	18	5.8%	10	6.5%	11	10.9%
3	8	2.6%	18	11.8%	4	4.0%
4	6	1.9%	12	7.8%	3	3.0%
5 - True	21	6.8%	11	7.2%	6	5.9%
Total	311	55.0%	153	27.1%	101	17.9%

As age increases, the proportion of adolescents indicating the presence of relationship problems as a cause of sleep disturbances increases (Table 15). The data in the table indicate that adolescents in the middle age group have a higher proportion of ratings above 3 compared to the other two age groups (p=0.001).

Table. 15. Distribution of children with relationship problems as a cause of sleep disturbances by age group

Sign	Group 1 (10-14 years)		Group 2 (15-17)		Group 3 (over 18)	
	n	(%)	n	(%)	n	(%)
0 - False	233	71.7%	56	36.6%	43	42.6%
1	37	11.9%	20	13.1%	24	23.8%
2	11	3.5%	22	14.4%	8	7.9%
3	11	3.5%	14	9.2%	11	10.9%
4	7	2.3%	15	9.8%	3	3.0%
5 - True	22	7.1%	26	17.0%	12	11.9%

Total	311	55.0%	153	27.1%	101	17.9%

The act of watching television before bedtime as a cause of sleep problems exhibits a decreasing gradient with increasing age (Table 16). In the early adolescent age group, 70 children (22.55%) report watching TV before bedtime. Among adolescents aged 15-17 years, only 9.8% of the group watch television before bedtime, while among 18-year-olds, only 4 individuals (4%) cite this reason for sleep problems (p=0.001).

Table. 16. Distribution of children watching TV before bed by age group

Sign	**Group 1 (10-14 years)**		**Group 2 (15-17)**		**Group 3 (over 18)**	
	n	**(%)**	**n**	**(%)**	**n**	**(%)**
0 - False	146	46.9%	96	62.7%	67	66.3%
1	38	12.2%	17	11.1%	12	11.9%
2	22	7.1%	7	4.6%	7	6.9%
3	22	7.1%	9	5.9%	2	2.0%
4	13	4.2%	9	5.9%	9	8.9%
5 - True	70	22.5%	15	9.8%	4	4.0%
Total	311	55.0%	153	27.1%	101	17.9%

The insufficient quantity and poor quality of nocturnal sleep impact adolescents' ability to cope with various responsibilities and roles they have. The consequences for the social functioning of adolescents have been explored through their reports on experiencing difficulties staying awake under certain circumstances in the past few weeks. Using 10 statements, the frequency of encountering such a problem has been assessed, with adolescents rating it on a provided 5-point scale (from 1 - Never to 5 - Always)..

The analyses of adolescents' responses indicate that insufficient sleep affects both the engagement in leisure activities, such as watching television and playing games, and essential academic tasks. Adolescents more frequently experience difficulties staying awake during academic lessons, while preparing homework assignments for school, and while reading or writing. Table 17 summarizes the relative proportions of adolescents reporting "Half the time," "Most of the time," and "Always" responses.

Table. 17. Distribution of responses indicating a higher frequency of difficulty staying awake for certain activities

Activities where children have trouble staying awake	Half the time	Most of the time	Always
Travel to school	33 (5,8%)	16 (2,8%)	33 (5,8%)
Per hour	72 (12,7%)	48 (8,5%)	45 (8,0%)
When writing homework	62 (11%)	50 (8,8%)	46 (8,1%)
During a delay in traffic	43 (7,6%)	17 (3,0%)	12 (2,1%)
Reading/writing	81 (14,3%)	51 (9,0%)	35 (6,2%)
During test	30 (5,3%)	10 (1,8%)	30 (5,3%)
During TV viewing	85 (15,0%	63 (11,2%)	63 (11,2%)
When playing video games	31 (5,5%)	18 (3,2%)	22 (3,9%)
During a project	39 (6,9%)	19 (3,4%)	16 (2,8%)
During an excursion	58 (10,3%)	20 (3,5%)	28 (5,0%)

For each of the specified activities, differences between the individual age groups in the reported difficulties of adolescents staying awake during the surveyed activities were examined. Statistically significant differences were found among children who have difficulty staying awake during academic lessons (Table 18).

In the group of 10-14-year-olds, nearly one-fourth (24.8%) of the children reported experiencing difficulty staying awake during lessons for more than half the time, most of the time, or always. Responses from these categories were given by 36.7% of adolescents in the 15-17 age group and 31.7% in the older age group ($\chi 2=20.715$; $p=0.008$).

Table. 18. Distribution of children's responses regarding difficulty staying awake in class by age group

Sign	Group 1 (10-14 years)		Group 2 (15-17)		Group 3 (over 18 years old)	
	n	Rel. Share (%)	n	Rel. Share (%)	n	Rel. Share (%)
1. Never	148	47.6%	45	29.4%	40	39.6%
2. From time to time	86	27.7%	52	34.0%	29	28.7%
3.Half the time	29	9.3%	24	15.7%	19	18.8%
4. Most of the time	22	7.1%	18	11.8%	8	7.9%
5. Always	26	8.4%	14	9.2%	5	5.0%

Total	311	55.0%	153	27.1%	101	17.9%

Statistically significant differences were found between the three adolescent age groups when comparing the frequency of difficulty staying awake while reading and writing ($\chi 2=15.684$; $p=0.047$), and children's responses are presented in Table 19.

Table 19. Distribution of children's responses to difficulty staying awake while writing and reading by age group

Sign	Group 1 (10-14)		Group 2 (15-17)		Group 3 (over 18)	
	n	Rel. Share (%)	n	Rel. Share (%)	n	Rel. Share (%)
1. Never	151	48.6%	55	35.9%	35	34.7%
2. From time to time	79	25.4%	50	32.7%	28	27.7%
3. Half the time	38	12.2%	20	13.1%	23	22.8%
4. Most of the time	24	7.7%	18	11.8%	9	8.9%
5. Always	19	6.1%	10	6.5%	6	5.9%
Total	311	55.0%	153	27.1%	101	17.9%

The consequences of insufficient sleep among adolescents include tardiness and absences from school due to difficulties waking up on time. In our study, despite inadequate sleep duration during middle and late adolescence, only 59 (10.4%) of adolescents were absent because they failed to wake up in time for school. More than half of the students prefer to start school in the morning between 8-10 am - 379 (67.1%), around noon - 10-13 o'clock is the preferred time for 146 (25.8%) of the respondents, while some respondents would prefer to start school after 3 pm - 40 (7.1%). The desire for a later start to school corresponds to the shorter duration of nighttime sleep for many children.

Sleep is a crucial determinant of adolescent health. Quality sleep is an important prerequisite for the development of the nervous system during the transitional and vulnerable teenage years. Sleep problems in children and adolescents have a negative impact on development, physical fitness, and cognitive status, which can deteriorate quality of life and productivity. According to literature data, about 30% of children and adolescents worldwide experience some form of sleep-related issues, including insomnia, restless leg syndrome, sleepwalking, sleep talking, bruxism, delayed sleep phase, as well as night awakenings. In our study, the relative proportion of children

reporting such deviations in sleep is higher (more than half), likely due to undeveloped habits of sleep hygiene. The results may also partly reflect increased levels of anxiety and distress among adolescents due to the effects of the COVID-19 pandemic on their mental health.

Numerous factors affect the quality of sleep in teenagers. Apart from restricting sleep time due to increased social interactions, the main factors influencing sleep quality at this age include: insufficient sleep hygiene; sleep disorders related to sleep onset and wakefulness; parental health culture and family influence on the formation of good sleep hygiene; habits related to afternoon naps, use of electronic devices (television, laptop, tablet, phone); intake of caffeine-containing drinks, tea, and alcohol.

The use of electronic devices late at night and during the night, which is observed in almost half of the respondents, may be explained by the integration of these devices into the daily lives of adolescents and their concerns about negative consequences for personal authority and social contacts if they do not actively monitor social media. Our study confirms that adolescents prefer social media over sleep, leading to later sleep onset, inadequate sleep, and daytime fatigue. Systematic analysis indicates the use of the Internet as a means for adolescents to be accessible, including at night. There is a clear link between nighttime chatting, inadequate sleep, and mental health issues. At the same time, the authors conclude that nighttime technology use is a prerequisite for behavior change in children with consequences for sleep quality and duration. This, in turn, affects their daytime effectiveness and academic performance. Nearly half of the surveyed students report difficulty falling asleep, and over 50% of them note that they have difficulty waking up and do not feel rested at the same time.

2.4. Investigating the influence of some socio-demographic and behavioral factors on sleep in adolescents

Various demographic and social factors influence the characteristics of sleep, and their effects have been examined. The impact of gender, place of residence, family structure, and its financial status on individual sleep characteristics has been explored.

The acquisition of specific gender roles and behavioral characteristics during adolescence affects all aspects of adolescents' lives, including behaviors related to sleep. Making independent decisions about bedtime within a certain time interval is a more typical behavior for boys (p=0.002). One in four (25.1%) male students has independently decided what time to go to bed, while this relative proportion among girls is 7.4% (Figure 12). This indicates greater autonomy in decision-making by boys.

At the same time, it is noteworthy that the relative proportion of girls who go to bed later in the evening due to homework and school assignments is three times higher than that of boys. This suggests that girls are more strict and responsible in completing their school tasks.

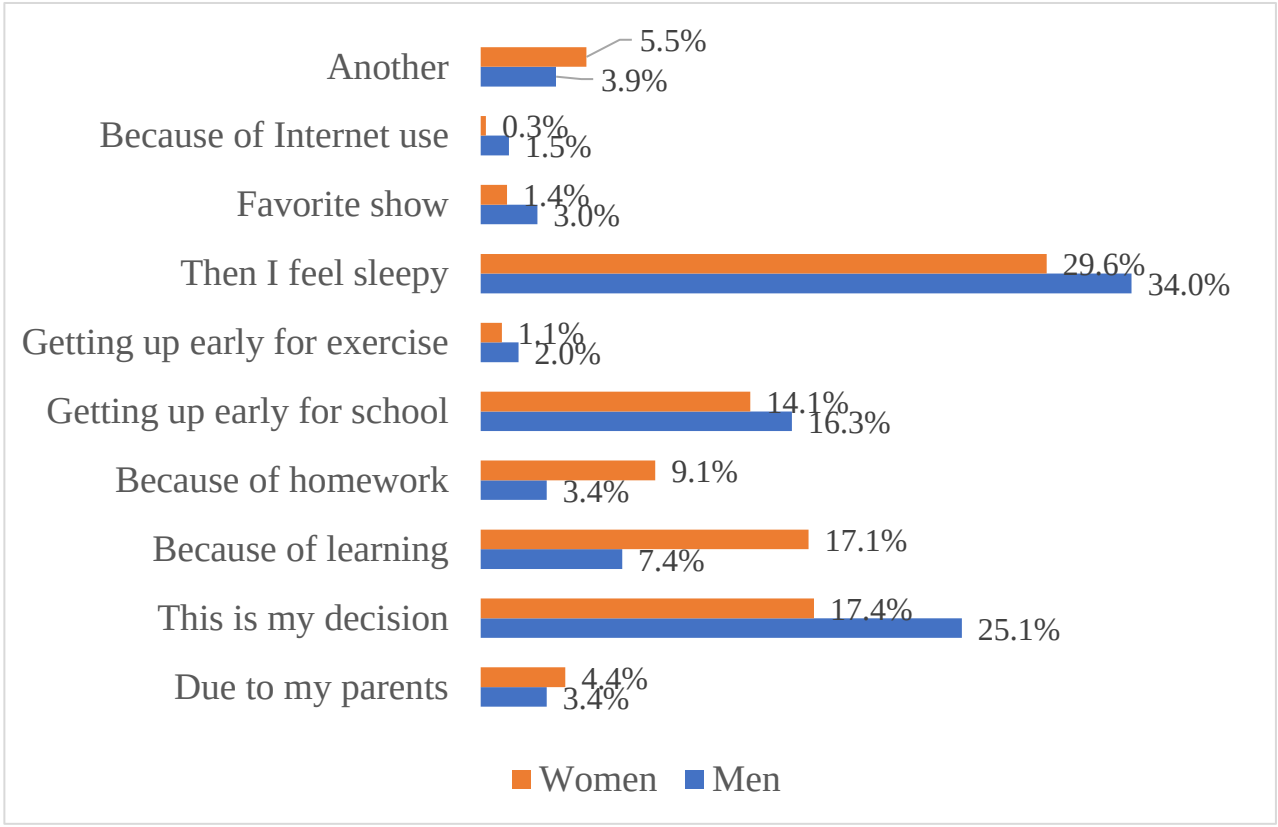


Fig. 12. Distribution of students by gender and reasons for going to bed for sleep

A relatively low proportion of children determine their bedtime based on early waking for training. Only 2% of males and 1.1% of females go to bed earlier due to planned physical activity the next day.

Statistically significant differences by gender are observed in the frequency of incidents of staying awake beyond the usual bedtime (p=0.018). Every second boy (47.3%) stays awake once a week beyond the established bedtime (Figure 13). A larger relative proportion of females, 26.5%, stay awake more than four times a week compared to males, who account for 17.2%.

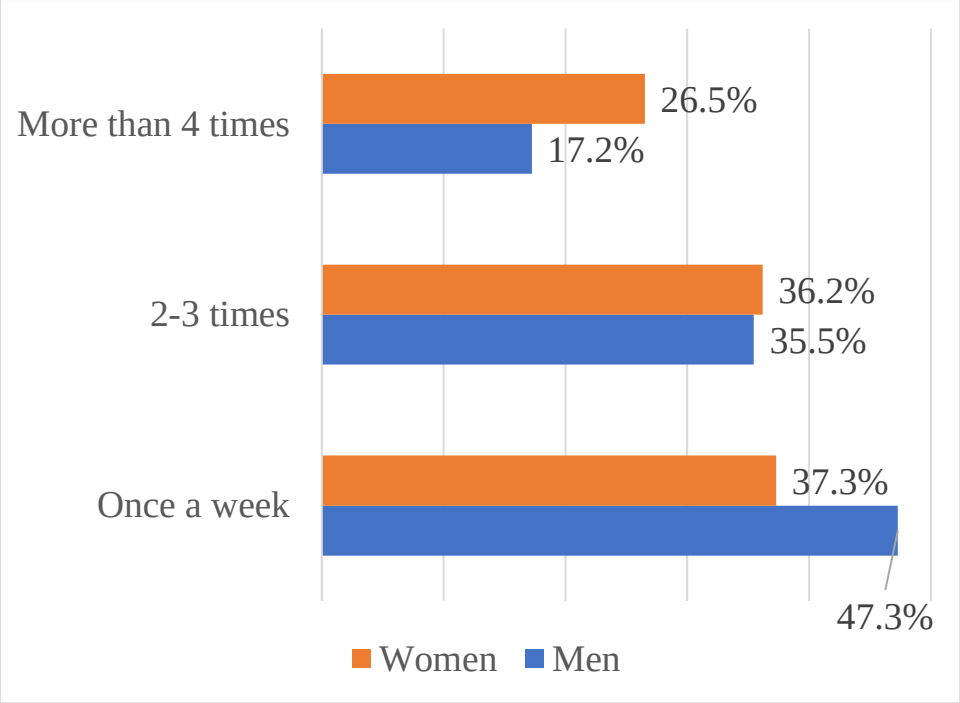
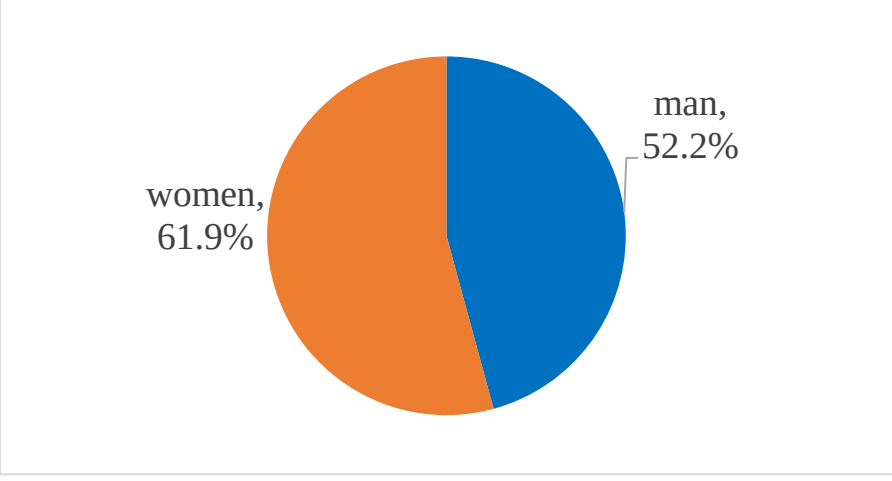


Fig. 13. ***Gender distribution of incidental stay after the usual bedtime during the school week***

Figure 14 illustrates the gender distribution of children who do not feel rested in the morning after waking up.



Фиг. 14. Distribution by gender of children who do not feel rested when they wake up

Later bedtimes among girls lead to a more significant proportion - more than half (61.9%) - feeling unrested in the morning upon waking, compared to boys ($\chi2=4.998$; $p=0.025$).

Statistically significant differences are observed between males and females regarding the method of waking up in the morning ($\chi2=14.793$; $p=0.011$). Alarm clocks are the preferred method of waking up for both genders (Figure 15), while the relative proportion of waking up at a specific time as a habit among boys (12.3%) is nearly twice as high as that among girls (6.6%).

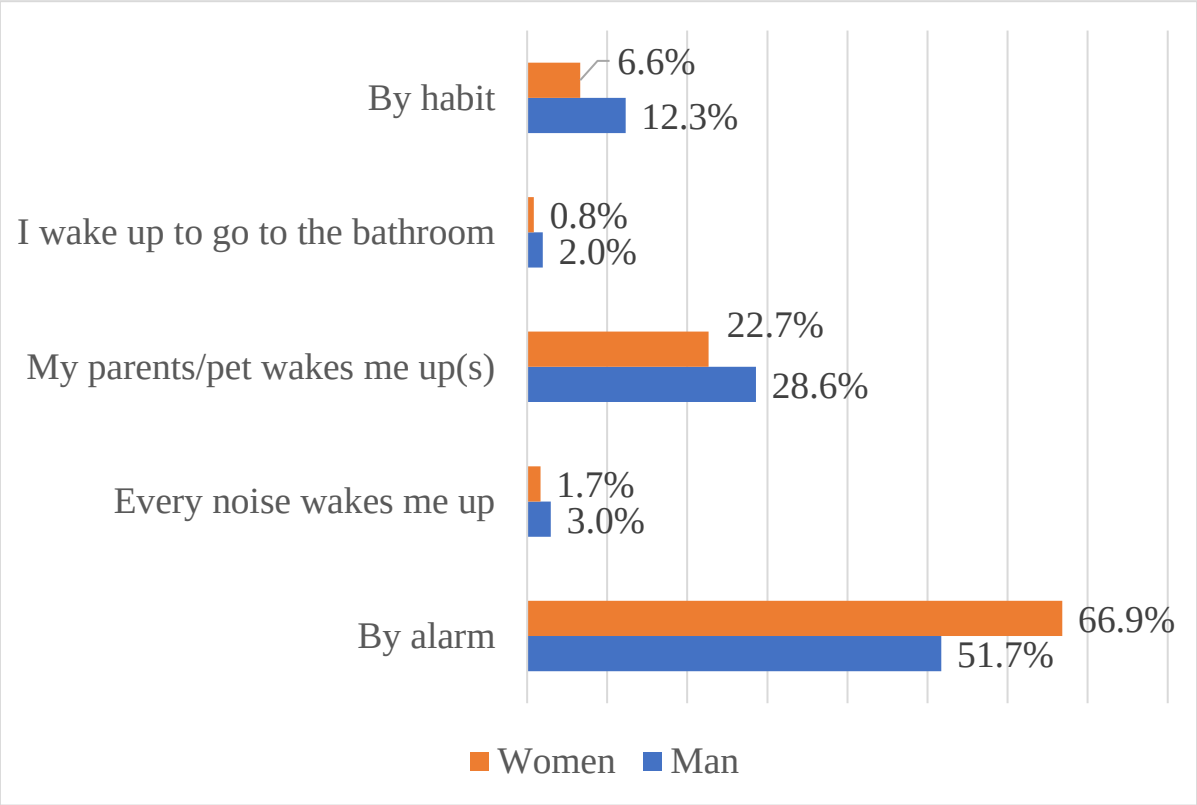


Fig. 15. Gender distribution children by way of waking up in the morning

Statistically significant differences between the two genders are also observed in some of the reasons for sleep problems. These include: relationship issues; insufficient physical activity, and experiencing nightmares.

As expected, problematic interpersonal relationships negatively impact sleep more frequently among girls than boys (Table 20). The observed differences are significant ($p=0.021$).

Table. 20. Distribution by gender of children and by assessment of relationship problems as a cause of sleep disturbances

Sign	Men	Women
0 - False	67.0%	51.4%
1	10.8%	16.3%
2	5.9%	8.0%
3	5.4%	6.9%
4	3.4%	5.0%
5 - Mn. Faithfully	7.4%	12.4%
Total:	35.9%	64.1%

Girls also suffer more from sleep problems due to insufficient physical activity compared to boys (χ^2=15.641; p=0.008), who engage in sports activities with greater frequency and intensity (Table 21).

Table. 21. Distribution of children by gender and by assessment of insufficient physical activity as a cause of sleep disorders

Sign	Men	Women
0 - False	70.0%	57.2%
1	14.3%	16.3%
2	4.4%	7.5%
3	2.5%	8.3%
4	4.4%	3.0%
5 - Mn. Faithfully	4.4%	7.7%
Total:	35.9%	64.1%

Significant differences between the two genders are also found in some daily activities and circumstances where adolescents struggle to stay awake. Many of these

are related to school activities: concentration during class, writing, reading, as well as some leisure activities.

The analyses reveal a significantly higher relative proportion of girls reporting more frequent difficulty staying awake during class compared to boys (Table 22)..

Table.22. Distribution by gender of children and by frequency of the problem of staying awake during class

Sign	Men	Women
1. Never	48.8%	37.0%
2. From time to time	30.0%	29.3%
3.Half the time	8.4%	15.2%
4. Most of the time	6.9%	9.4%
5. Always	5.9%	9.1%
Total:	35.9%	64.1%

Staying awake while preparing for the next day's lessons also differs in frequency between children of both genders ($\chi 2=24.828$; $p=0.001$). Girls report more frequent difficulties staying awake while doing homework compared to boys (Table 23).

Table. 23. Adolescent gender distribution and frequency of difficulty staying awake while writing homework

Sign	Men	Women
1. Never	60.6%	41.4%
2. From time to time	22.2%	24.6%
3.Half the time	5.9%	13.8%
4. Most of the time	4.9%	11.0%
5. Always	6.4%	9.1%
Total:	35.9%	64.1%

Similar significant statistical differences ($\chi 2=21.767$; $p=0.001$) are observed in activities such as reading and writing – girls more frequently experience difficulties staying awake compared to boys (Table 24).

Table. 24. Distribution of adolescents by gender and frequency of difficulty staying awake while reading/writing

Sign	Men	Women
1. Never	52.7%	37.0%
2. From time to time	28.6%	27.3%
3.Half the time	9.4%	17.1%
4. Most of the time	6.9%	10.2%
5. Always	2.5%	8.3%
Total:	35.9%	64.1%

Drowsiness and lack of concentration during written test tasks are not common issues for both genders. Over 80% of boys and over 70% of girls report being highly concentrated (Table 25), yet girls again report more difficulties staying awake during such activities ($\chi 2=13.367$; $p=0.015$).

Table. 25. Distribution of adolescents by gender and frequency of difficulty staying awake during a test

Sign	Men	Women
1. Never	81.8%	71.5%
2. From time to time	9.9%	13.8%
3.Half the time	1.5%	7.5%
4. Most of the time	1.5%	1.9%
5. Always	5.4%	5.2%
Total:	35.9%	64.1%

Less significant differences between the two genders are observed in the frequency of difficulties staying awake during leisure activities such as playing games/video games ($\chi 2=9.996$; $p=0.040$). During these activities, about 15% of boys report difficulties half the time, most of the time, or always, while about one-tenth of girls experience such difficulties.

When studying the influence of the place of residence on sleep characteristics, some deviation from our expectations formed based on the data on sleep duration is noted. Despite the observed differences in the frequency of specific sleep disturbances by place of residence, no statistically significant differences are found for any of them. Table 26 presents the relative proportions of children in different types of settlements reporting sleep disturbances. It is noteworthy that more than half of the children in rural areas report having sleep problems compared to those living in urban areas, except for waking up at night with difficulty returning to sleep, which is not a typical sleep disturbance in adolescence. Children in the capital, contrary to expectations, do not differ in the frequency of sleep deviations from other youths living in urban areas.

Table. 26. Presence of sleep problems by place of residence of adolescents

Sleep problems	Capital	District city	Small town	Village
It's hard to fall asleep	44,0%	41,2%	54,7%	56,8%
I wake up at night	40,0%	38,6%	42,7%	59,5%
I wake up at night and have trouble falling back asleep	18.0%	20,9%	18,7%	27,0%
It's hard to wake up in the morning.	50,3%	56,9%	56,0%	59,5%
I'm not rested after sleeping.	56,3%	62,1%	62,7%	51,4%
Total:	53,1%	27,1%	13,3%	6,5%

When studying the reasons for sleep disturbances by place of residence, statistically significant differences are noted for two reasons - doing homework and room temperature. Adolescents in rural areas and regional towns more often cite doing homework for the next school day as a reason for sleep problems - 16.2% and 15%, respectively (Table 27), while children in the capital and small towns have a lower relative proportion for this reason (p=0.04).

Table. 27. Distribution by place of residence of students who have sleep problems due to unwritten homework

Sleep problems	Capital	District city	Small town	Village
0 - False	56.3%	46.4%	62.7%	54.1%
1	13.3%	20.9%	20.0%	10.8%
2	7.7%	3.3%	5.3%	8.1%
3	6.7%	5.2%	5.3%	2.7%
4	7.3%	9.2%	5.3%	8.1%
5 Very true	8.7%	15.0%	1.3%	16.2%
Total:	53,1%	27,1%	13,3%	6,5%

Adolescents in rural areas, where home heating problems are more common than in urban areas, more frequently cite room temperature as a reason for sleep disturbances compared to those living in cities. Among them, the positive responses (3, 4, and 5) regarding the accuracy of the statement are 29.7%, which significantly differs from the proportion of adolescents with such responses in the capital and cities (p=0.004).

Table. 28. Distribution by place of residence of students who have problems sleeping due to room temperature

Sleep problems	Capital	District city	Small town	Village
0 - False	67.7%	68.6%	58.7%	59.5%
1	14.3%	15.0%	10.7%	5.4%
2	7.3%	6.5%	8.0%	5.4%
3	3.7%	2.6%	8.0%	2.7%
4	4.0%	1.3%	9.3%	18.9%
5 Very true	3.0%	5.9%	5.3%	8.1%
Total:	53,1%	27,1%	13,3%	6,5%

Tracking the influence of residential location on the effects of sleep disturbances in children revealed significant differences only regarding the frequency of difficulties staying awake in class (Table 28). Adolescents living in rural areas, who more often report sleep disturbances, have a three times higher relative proportion of

respondents indicating that they always find it difficult to stay awake in class (27%) compared to the same response rate among children in small towns - 9.3% (p=0.006).

Table. 29. Distribution by place of residence of students who have sleep problems

Sleep problems	Capital	District city	Small town	Village
1. Never	44.3%	36.6%	41.3%	35.1%
2. From time to time	29.0%	32.0%	29.3%	24.3%
3. Half the time	14.3%	12.4%	9.3%	8.1%
4. Most of the time	6.7%	11.8%	10.7%	5.4%
5. Always	5.7%	7.2%	9.3%	27.0%
Total:	53,1%	27,1%	13,3%	6,5%

The study on the influence of family structure did not find significant differences in the frequency of reported sleep problems among adolescents raised in nuclear families compared to those in single-parent families.

However, statistically significant differences were observed in the responses of students from families with different structures regarding the reasons for going to bed at a specific time interval (Fig. 16). Adolescents in nuclear families are more influenced by parental control (4.2%) compared to those in single-parent families (1.4%). Engaging in schoolwork and homework preparation are cited more frequently as reasons by children in nuclear families (14.4%) compared to those in single-parent families (11.4%). In single-parent families, the relative proportion of children using the internet and indicating it as a reason for going to bed late is twice as high as that in nuclear families (p=0.001).

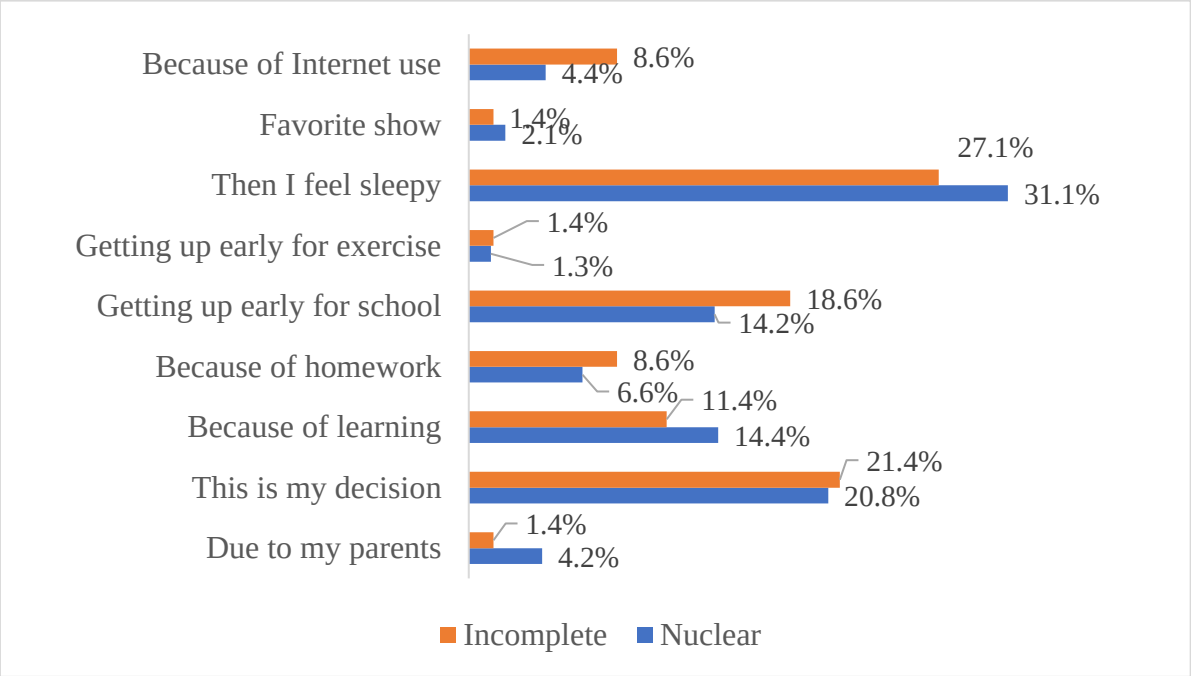


Fig.16. Distribution of reason for going to bed in a specific interval by family structure

The influence of family structure on the reasons for sleep disturbances reported by children has been examined. There are differences in these reasons between children living in intact and non-intact families, and they are significant for the following reasons: unfinished homework, stress from household tasks, presence of noise in the room, difficulty breathing, and nightmares.

Table 30 presents the results of the distribution of responses from children from nuclear and non-intact families regarding unfinished homework as a reason for sleep disturbances. Unfinished homework worries and creates sleep problems for almost one-third (31%) of children in non-intact families, while in intact families, the overall relative proportion of children giving a positive rating (3, 4, and 5) to this reason is 21.8% (p=0.020).

Table. 30. Distribution by family structure and assessment of unwritten homework as a cause of sleep disorders

Sign	Nuclear family	Incomplete family
0 - False	55.9%	48.6%
1	16.1%	11.4%
2	6.1%	8.6%
3	5.1%	8.6%
4	7.4%	10.0%
5 - Mn. Faithfully	9.3%	12.9%
Total:	83.5%	16.5%

The following Table 31 describes the distribution by family structure of children's responses regarding the assessment of stress from household tasks as a reason for sleep problems. The relative proportion of children reporting stress from household tasks in non-intact families is higher compared to that among students from intact families (p=0.001).

Table. 31. Distribution by family structure and assessment of stress from home tasks as a cause of sleep disturbances

Sign	Nuclear family	Incomplete family
0 - False	73.3%	55.7%
1	11.2%	18.6%
2	4.2%	8.6%
3	3.8%	2.9%
4	3.0%	7.1%
5 - Mn. Faithfully	4.4%	7.1%
Total:	83.5%	16.5%

Noise in the room can be a factor contributing to sleep disturbances, with family structure proving to be a significant influencing factor in this regard (Table 32). Positive responses indicating the presence of disruptive noise in the room as a reason for sleep problems are more commonly reported by children from non-intact families (17.1%), compared to the limited mention of noise by children living in intact families (11.2%). The observed differences in responses by family structure are statistically significant (p=0.041).

Table. 32. Distribution by family structure and assessment of the presence of noise in the room as a cause of sleep disturbances

Sign	Nuclear family	Incomplete family
0 - False	85.6%	77.1%
1	8.1%	5.7%
2	1.7%	4.3%
3	1.1%	4.3%
4	1.5%	4.3%
5 - Mn. Faithfully	2.1%	4.3%
Total:	83.5%	16.5%

Another factor affecting the quality of sleep is nightmares. One-fourth (24.4%) of adolescents from non-intact families provide positive responses indicating the presence of nightmares that interfere with good sleep..

Table. 33. Distribution by family structure and assessment of the presence of noise in the room as a cause of sleep disturbances

Sign	Nuclear family	Incomplete family
0 - False	59.1%	47.1%
1	17.6%	18.6%
2	10.2%	10.0%

3	3.0%	8.6%
4	4.9%	2.9%
5 - Mn. Faithfully	5.3%	12.9%
Total:	83.5%	16.5%

Around 13% of respondents from intact families provide positive responses indicating the presence of nightmares as a reason for sleep problems ($\chi 2=27.204$; $p=0.002$).

Systematic meta-analysis reports conflicting associations from the family environment that determine the quality of sleep in adolescents. On one hand, demographic factors such as low socioeconomic status do not influence the sleep quality of adolescents. On the other hand, positive and negative family relationships are significant predictors of adolescent sleep quality. Adolescents in non-intact families are at a higher risk of short sleep duration on weekdays, long sleep onset latency, prolonged awakenings after sleep onset, excessive sleepiness, and insomnia compared to their peers in intact families.

2.5. Analyzing the relationship between physical activity and sleep as the main factors of a healthy lifestyle

In pursuit of the fifth research objective, the relationships between the level of physical activity in adolescents and sleep quality were examined. The influences of physical activity levels (high, moderate, and low physical activity) on sleep duration on school days, bedtime interval for sleep, incidental awakenings during the school week, and the presence of sleep problems were investigated.

The relationship between physical activity and sleep duration in adults is well-established, and physical exercises are often used as a non-pharmacological means to improve sleep duration and quality. However, during adolescence, this relationship is still not well understood.

In our study, we examined the average amount of nocturnal sleep during the school week in children with different levels of physical activity (Table 34). Children with high levels of physical activity have a significantly longer sleep duration (8:09±0:14 hours) compared to adolescents with low physical activity (p=0.028).

Table. 34. Duration of night sleep during the school week according to the level of physical activity of adolescents

Duration of night sleep	High FA	Umeren FA	Low FA
Total for both sexes	8:09 AM±0:14 AM	8:00 AM±0:12 AM	7:58 AM±0:13 AM
Men	8:16 AM±0:13 AM	8:01±0:11 AM	7:57 AM±0:09 AM

Among boys, statistically significant differences were observed, with those actively engaged in sports having a longer nocturnal sleep during the school week by 19±2 minutes compared to those with low physical activity (p=0.029). However, no significant differences were found among girls based on the level of physical activity (p=0.230).

The influence of physical activity levels on bedtime for adolescents was examined, represented in hourly intervals, but no association was found between the two variables ($\chi 2=4.075$; p=0.850).

The relationship between adolescents' level of physical activity and the frequency of incidental awakenings during weekdays when they have school was explored (Figure 17). A trend was observed where students with high and moderate activity levels were least likely to stay awake more than 2-3 times a week after the usual bedtime. This is likely due to the good personal discipline instilled in actively sports-involved children. The highest relative proportion of adolescents (36.1%) staying awake almost every day of the week after the designated bedtime belongs to those with low physical activity. The observed dependency is on the border of statistical significance ($\chi 2=9.075$; p=0.059).

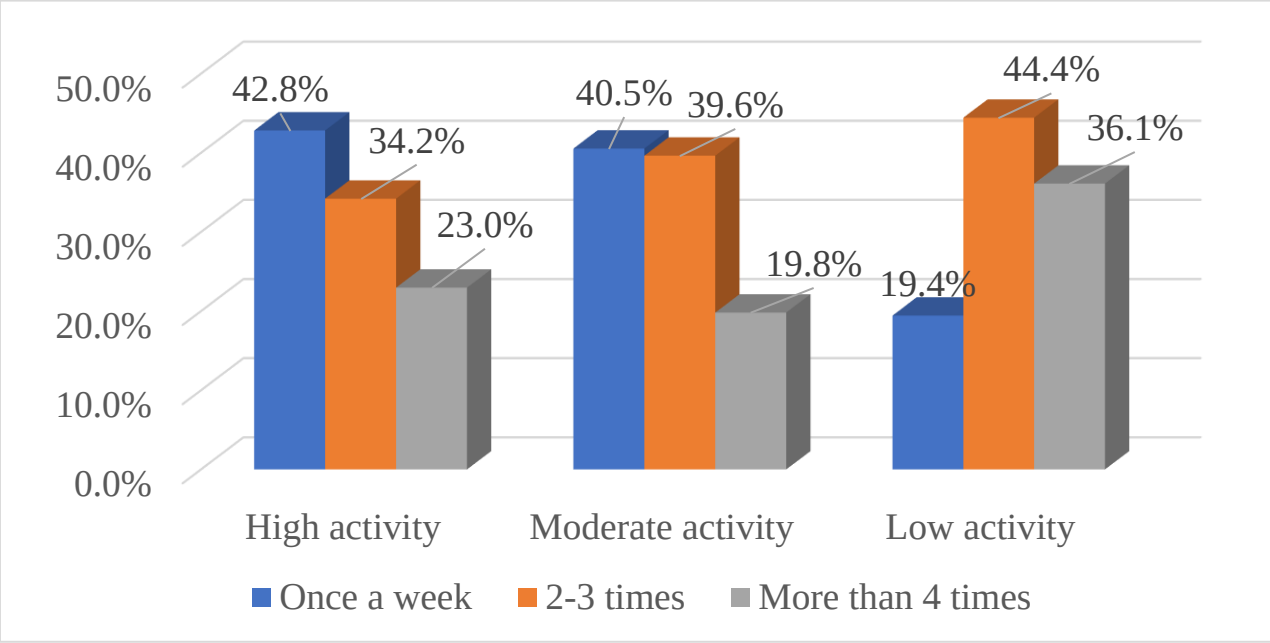


Fig. 17. Distribution of the frequency with which children accidentally stay awake after the usual bedtime by FA level

The analysis of the influence of physical activity levels on the presence of sleep problems did not reveal statistically significant differences among children with different levels of physical activity. No association was found between the level of physical activity and difficulty falling asleep ($\chi2=1.415$; $p=0.493$), nighttime awakenings ($\chi2=1.267$; $p=0.528$), inability to fall back asleep after awakening ($\chi2=0.988$; $p=0.610$), difficulty waking up in the morning ($\chi2=1.407$; $p=0.495$), and feeling unrested upon waking ($\chi2=4.957$; $p=0.084$). Similarly, no statistically significant differences were observed among children reporting no sleep problems ($\chi2=15.123$; $p=0.128$). Watching television before bedtime is a widespread behavior among adolescents and did not show a statistical difference in frequency among different groups based on levels of physical activity ($\chi2=3.867$; $p=0.960$).

The level of physical activity is associated with excessive use of phones and/or the internet by adolescents (Table 35). It was found that adolescents with moderate activity levels most frequently use their phone/internet before bedtime - 43.2%, followed by nearly 30% of children with high physical activity, and one in four children with low physical activity ($\chi2=19.608$; $p=0.033$).

Table. 35. Excessive phone/Internet use before bed by physical activity level in adolescents

Excessive phone/Internet use	High FA	Umeren FA	Low FA
0 - False	26.1%	12.6%	36.1%
1	15.1%	14.4%	16.7%
2	7.9%	9.9%	8.3%
3	11.2%	10.8%	0.0%
4	9.8%	9.0%	13.9%
5 – Very true	29.9%	43.2%	25.0%
Total	74.0%	19.6%	6.4%

No statistically significant influence of the level of physical activity on waking up on time was found. There were no statistically significant differences in the frequency of missing classes due to late awakening in the morning among groups with different levels of physical activity ($\chi 2=0.543$; $p=0.762$).

A positive correlation between quality and sufficient duration of sleep and good physical fitness in adolescents has been confirmed by other researchers. Among the group of students who meet the WHO criteria for physical activity and have sufficient sleep duration, greater life satisfaction has also been observed. Significant attention has been paid to the effects of COVID-19 on physical activity, sleep quality, and screen time. Pandemic restrictions have negatively impacted children's activity levels and exacerbated sleep problems, a result of increased screen time during isolation. This underscores the need for new programs and campaigns focusing on reducing screen time.

METHODOLOGICAL GUIDE FOR HEALTH PROMOTION IN SCHOOL THROUGH PHYSICAL ACTIVITY AND OPTIMAL SLEEP HYGIENE

INTRODUCTION

The current methodological guide is intended for healthcare professionals working in school health offices and aims primarily to support their efforts in improving children's health in schools by promoting physical activity among adolescents and achieving good sleep hygiene. Physical activity and quality sleep with sufficient duration offer numerous benefits for achieving optimal health in children and preventing socially significant diseases. The significance of promoting physical activity is supported by the results obtained from the present study regarding the low levels of physical activity among one-third of teenagers who do not meet the criteria for optimal physical activity and the observed decline in physical activity as adolescence progresses to adulthood. On the other hand, insufficient sleep due to late bedtime after midnight, mainly due to social media interactions, feelings of unrest, and other sleep-related issues, affects the effectiveness of children's academic work and their performance in school, providing a basis for seeking appropriate mechanisms to overcome these patterns.

Adolescents spend a significant amount of time in school, turning the school environment into a setting that provides key opportunities for adolescents to access health-enhancing physical activity and develop sustainable sleep hygiene patterns. The healthcare professional in the school health office is well-positioned and largely prepared to organize and implement targeted activities to promote and maintain a healthy lifestyle among adolescents, leveraging adolescents' natural inclination towards movement and physical activity.

The current methodological guide comprises two groups of activities: those aimed at forming optimal physical activity and a proper sleep pattern at the individual level, and others aimed at promoting physical activity and an adequate sleep pattern through actions at the meso level.

I. ACTIVITIES AT INDIVIDUAL LEVEL

A. The process of gathering information necessary for the initial diagnosis and assessment of children's physical activity and sleep patterns involves several sequential steps. This information is systematically recorded in the health records of children aged 10-19 years and is diligently monitored and tracked over time by healthcare professionals within the school setting.:

1. Evaluation of the child's level of physical activity involves gathering information regarding:
    - Preferred sports activities;
    - Whether the sports activities are group-based or practiced with friends, which may indicate the level of engagement with a peer group;
    - The frequency and duration of physical activity sessions per week;
    - Consistency in engaging in sports activities;
    - If physical activity is lacking, clarifying the reasons behind it and whether the child has concerns about participating in sports (this is often more relevant for girls). Identifying a trusted individual to gradually and permanently change their attitude towards sports as part of their value system.
2. Determining the child's habits related to their activity and sleep hygiene includes:
    - How much time they spend playing computer games;
    - Whether they prefer to watch sports broadcasts; if so, recommendations are given to actively participate physically while watching sports on screen.
    - Whether they experience sleep problems such as difficulty falling asleep and waking up in the morning, and under what circumstances these occur (e.g., playing computer/internet games, anxiety about unfinished homework, family problems, consumption of energy drinks).
3. Identifying the role of parents involves:

- Whether both parents are simultaneously involved in caring for the child (indicating whether they live in a full/incomplete family). If the family is incomplete, directing the adolescent to consult with a psychologist for optimal encouragement for effective sleep hygiene and sufficient physical activity.
- Whether parents encourage the child to engage in sports and monitor whether they go to bed on time, especially when the child has school the next day, as well as whether they need additional assistance with school activities.

Based on this assessment, the school health worker can selectively provide appropriate guidance to the child for physical activity and sleep hygiene from the following list of activities.

Activities related to physical activity:

1. Informing children about the benefits of physical activity – engaging in sports and physical activity will make them feel more energetic and stronger, as well as more attractive to others. It will improve their mood and success in school and their hobbies.
2. Guiding adolescents towards sports that bring them the most enjoyment and encouraging them to actively engage in it for at least 60 minutes daily. If they already practice it, they should try to increase the time spent on training for additional health benefits from that sport. Preferably, the sport should be of moderate to high intensity. Such sports and activities include brisk walking (5 km/h), tennis, leisure cycling, boxing, yoga (moderate intensity), as well as running, carrying heavy objects upstairs, fitness, skipping rope, soccer, basketball, fast cycling/mountain biking (high intensity).
    - Children who are not physically active need to gradually and gently engage in activities with moderate and high intensity so that it brings them pleasure and enjoyment.

- If infrastructure and safety are provided, it is recommended that children commute to school by bicycle or on foot, essentially engaging in low-intensity physical activity, instead of using public transportation or cars. This way, walking provides additional physical activity, replacing a sedentary lifestyle and simultaneously increasing children's socialization. Such small steps pave the way for an active lifestyle and moderate to high-intensity physical activity such as cycling, swimming, and group sports activities.
- Encourage girls to participate in organized sports activities, organizing teams jointly with physical education teachers and providing opportunities for girls to participate in them.

Activities related to sleep hygiene:

It is advisable for children in early adolescence to have a monthly task to record daily in a diary: bedtime; duration of sleep; whether they feel rested in the morning, and whether they had physical activity that day. This diary can be used as a diagnostic tool to assess the quantity and quality of sleep, and based on it, with the participation of the children, a plan for behavioral change can be developed if sleep problems are identified.

Providing recommendations for a minimum of 8-9 hours of sleep. Parents should be involved in monitoring the duration of sleep after receiving written instructions regarding their role in this process.

Advising children to adhere to a consistent sleep schedule – approximately the same bedtime and wake-up times for a period of at least 3 months.

Advising children not to consume caffeine-containing beverages, including energy drinks, in the afternoon, as well as alcoholic beverages. Although alcohol promotes falling asleep, it reduces the REM phase of sleep and overall sleep duration, increasing nighttime awakenings, which affects the condition of children the next day. This creates a vicious cycle, as adolescents resort to caffeine drinks to compensate for drowsiness the next day.

At least one hour before bedtime, children should discontinue the use of phones/computers, and avoid watching television. Recommendations should be given to ensure that there are no electronic devices in the bedroom, as it has been proven that even their presence in the sleep environment can negatively impact sleep.

Advising children to keep the sleep environment dark and at a lower temperature to allow for normal melatonin secretion.

If insufficient sleep is identified, recommending that the adolescent go to bed ten minutes earlier each night than the previous night until the necessary duration of sleep is reached.

In case of insufficient sleep and the need for daytime naps, recommending that the nap should not exceed 30 minutes to avoid affecting nighttime sleep.

If necessary, healthcare professionals in school health offices can be assisted by child psychologists, teachers, and educators who can guide and encourage children towards higher physical activity and good sleep hygiene. Pedagogical staff, in turn, should receive systematic information from healthcare professionals about the level of activity of the children and their habits, for innovative methods through which to change their students' attitude towards physical activity.

II. Activities for promoting health through physical activity and sleep hygiene, directed towards the school community:

1. Conducting informational campaigns – days and weeks of physical activity aimed at adolescents and parents, including the creation and distribution of informational materials, joint parent meetings, roundtable discussions, etc.
2. Organizing joint sports afternoons, outings, competitive games, etc., together with parents and children.
    - Providing expert opinion and advocating for the establishment of a school environment that encourages children to engage in sports and offers suitable conditions for sports and physical activity at school.

- With the assistance of school management and physical education teachers, initiating 15-minute morning exercises for all children before the start of classes.
- Recommending to school management to organize and provide opportunities for free participation in extracurricular sports activities for children in disadvantaged situations, as well as for children from single-parent families.
- Seeking opportunities for physical activity during the long break – group games, dancing, etc.
- Offering 5-minute movement breaks for children in the classroom during lessons.
- Preparing informational materials regarding sleep hygiene.
- Conducting informational campaigns regarding the importance of sleep and involving parents in establishing sustainable and healthy sleep patterns during adolescence.
- Ensuring regular participation of school health professionals, doctors, medical students, and other specialists in classroom sessions and initiating periodic health classes focusing on informing and discussing with adolescents about healthy lifestyles.

In building lasting habits for an active life, modern technologies can be utilized (such as electronic applications, virtual coaches, smart wristbands for tracking activity through biometric data, and generating motivational messages and advice), engaging adolescents in physical activity.

Teachers, together with healthcare workers, can organize periodic extracurricular activities, as well as additional general meetings among peers with more active presenters from the respective age group to inspire others towards proper behaviors and actions related to optimal health. Such events should be organized with the additional support of school directors and the teaching staff.

The parental community is another pillar for shaping the healthy lifestyle of adolescents. Parents should be engaged in their children's health not only in case

of identified health problems but also in understanding the risks for future health problems related to behavior and health habits that adolescents develop during adolescence. Specialized training for parents on topics related to promoting high levels of physical activity and sleep hygiene should be included in the comprehensive health promotion program carried out by the school.

CONCLUSIONS

1. A significant portion of the participating adolescents (69.1%) meet the WHO recommendations for daily physical activity of at least 60 minutes. Nearly three-quarters of the children exhibit a high level of physical activity.
2. Physical activity changes in intensity and duration during adolescence. In later stages, there is a decrease in both characteristics of physical activity. At the same time, the time spent by adolescents from older age groups in front of a computer or watching television and playing video games increases.
3. Boys are more actively engaged in sports compared to girls, with a high level of physical activity. For boys, the leading motives for sports activities are the desire to be active, the benefits of physical activity, and the satisfaction derived from sports participation.
4. The place of residence of adolescents does not affect their level of physical activity. Those living in single-parent families allocate less time for training. The socioeconomic status of the family determines the level of physical activity of adolescents. High family incomes have a strongly positive influence and support adolescents' participation in high-intensity sports activities.
5. The observed social gradient in adolescent involvement in active sports activities requires economic support for leisure sports activities for adolescents and the expansion of free school sports activities, especially for children from low-income families.
6. The average duration of nighttime sleep during the school week reaches the recommended 8 hours per day only for early adolescents. In the late teenage group, those living in the capital, in rural areas, in single-parent families, and in families with minimal income have less than 7 hours of sleep per night during the week. The insufficient amount of sleep is compensated by increased sleep duration on weekends.
7. As adolescents progress into later stages of adolescence, the duration of nighttime sleep decreases by nearly an hour and a half due to an increase in the proportion of adolescents going to bed after midnight. Children in single-parent families with one parent are more likely to go to bed after midnight.
8. Sleep quality problems are reported by nearly 90% of adolescents. More than half of adolescents do not feel rested after night sleep and have difficulty waking up in the morning. Nearly 40% have difficulty falling asleep and experience frequent nocturnal awakenings. The main reasons for sleep problems are excessive use of phones/internet before bedtime, watching TV shows, preparing lessons, and homework for the next day.
9. High levels of physical activity positively influence the duration of sleep in adolescents. There is no evidence of a relationship between the type and level of physical activity and sleep quality.

The results of the conducted dissertation study confirm the formulated working hypotheses.

RECOMMENDATIONS

1. **To Faculties of Public Health and Medical Universities:** Create modules on physical activity and sleep as elements of a healthy lifestyle in the curricula of Preventive Medicine, Health Promotion, and Health Promotion Strategies in bachelor's and master's programs. Develop a specialization in healthy lifestyle and physical activity within bachelor's programs in Public Health and Health Management and in Physiotherapy.
2. **To the Ministry of Education and Science, Ministry of Youth and Sports:** Motivate children to engage in moderate to vigorous physical activity for at least 60 minutes daily. Utilize the opportunities provided by schools to systematically instill lasting behavioral habits for physical activity of moderate to high intensity. Optimize educational plans by including sufficient hours of Physical Education and sports throughout the entire course of schooling, maintaining a high number even among late teenagers. Initiate programs for organized free sports activities for children in neighborhoods with lower socioeconomic status and in smaller communities. Increase investments in improving sports infrastructure in schools, as well as in publicly-owned facilities. Increase the number of outdoor fitness equipment areas in parks and gardens.
3. **To the Ministry of Health, Ministry of Youth and Sports, Regional Health Inspectorates:** Organize informational campaigns aimed at increasing public awareness of the benefits of regular physical activity. Launch programs to increase the relative proportion of individuals engaging in moderate-intensity physical activity for at least 30 minutes, 5 days a week. Develop regional comprehensive strategies to promote active mobility. Initiate the introduction of a car-free day in major cities - one day per week (on Sundays), which will increase both physical activity and reduce air pollution from car traffic.

CONTRIBUTIONS

Original contributions include:

1. Conducted a comprehensive socio-medical study: This research represents an original endeavor in the field by conducting a thorough investigation into the influence of physical activity and sleep as components of a healthy lifestyle among students over the age of 10. By delving into the behavioral attitudes towards physical activity, this study fills a gap in existing literature and provides valuable insights into the factors shaping health-related behaviors in this demographic.
2. Simultaneous examination of physical activity and sleep: For the first time, this study examined both physical activity and sleep concurrently within the adolescent population residing in the territory of the Republic of Bulgaria. By addressing these two crucial aspects of health simultaneously, the research offers a novel perspective on their interplay and sheds light on potential synergies or conflicts between them, thereby advancing our understanding of adolescent health behaviors.
3. Development of a health promotion program model: The creation of a model program aimed at promoting health through the optimization of physical activity among students aged 10-19 demonstrates originality in practical application. By synthesizing the findings from the socio-medical study, this program model offers actionable strategies for enhancing physical activity levels among adolescents, thereby contributing to the development of evidence-based interventions in health promotion efforts.

Contributions Enriching Existing Knowledge:

1. Comprehensive Social-Medical Study Conducted: A comprehensive socio-medical study was conducted to examine the influence of physical activity and sleep as components of a healthy lifestyle and the behavioral attitudes toward physical activity among students aged over 10 years. This study provided detailed analytical information on the relationships between various socio-demographic and behavioral factors and the levels of physical activity and sleep among students aged 10 to 19 years. The analysis traced the dynamics of these relationships across different age periods of adolescence, thereby enriching existing knowledge in the field and providing a more detailed and differentiated overview of the impact of factors on the health and behavior of adolescents.

Contributions with Applied Character:

1. Identification of Important Regularities and Factors for Health Promotion Program Planning: The study identified significant regularities and factors associated with physical activity and sleep among students, providing a basis for planning and implementing comprehensive and specifically targeted health promotion programs in the school environment. The obtained database can serve as a basis for developing strategies to optimize physical activity and sleep among students, thereby contributing to the implementation of effective measures to improve the health status of students.
2. Development of Methodological Guidance for Health Promotion among Students: The developed methodological guidance represents a valuable tool for professionals working in the school environment, including health workers, general practitioners, social workers, and educators. It provides specific and goal-oriented measures to improve students' health both at an individual level and within the school community. These applied measures are essential for creating a healthy educational environment and promoting healthy practices among young people.

Publications related to the study

1. Ivan T. Ivanov. Sleep hygiene as part of a healthy lifestyle for adolescents. *Health Policy and Management, 1, 2023.*

2. Iv. Ivanov, Eng. Velkova. Importance of physical activity as a component of a healthy lifestyle of adolescents. *Health Policy and Management 23,* 2023, 26-29.

3. Ivanov I., A. Velkova. INFLUENCE OF SOME FACTORS ON ADOLESCENT SLEEP HYGIENE *J Biomed Clin Res Volume 16, Number 1, Supplement 1, 2023*.