



Physical activity and sleep quality among students of the Medical University of Wrocław

Aktywność fizyczna i jakość snu wśród studentów Uniwersytetu Medycznego we Wrocławiu

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■ Abstract

Objective. The aim of the article was to present physical activity and sleep quality among the surveyed respondents from Poland.

Materials and method. Students of the Medical University of Wrocław participated in the research. The respondents were selected randomly and all collected records were used in the analysis. A prepared questionnaire was used, based on the International Physical Activity Questionnaire (IPAQ). Data was collected in 2020 (before the COVID pandemic) and in 2021 (a year later).

Results. The study was conducted in a group of 1,600 adult students at Wrocław Medical University between October 2020 – March 2021. The participants were pursuing mandatory remote classes in physical education in the academic year 2020–2021.

Conclusions. The surveyed individuals were pursuing mandatory remote classes in physical education in the academic year 2020/2021. Despite the limitations related to the correct selection of methods or respondents, it is argued that the presented topic deserves further empirical research by scientists in the field of physical activity, sleep quality, and rest. According to the authors of the article, the presented issues are of importance. It is also important to discuss the limitations of the study, which readers should consider when evaluating its results. The limitation of the research is the analysis itself, that focuses on the type of methods used, scope of the research, and research trends in general. Another limitation is the appropriate selection of respondents during the COVID-19 pandemic. Despite the limitations related to the correct selection of methods or respondents, it is argued that the presented topic deserves further empirical research by scientists in the field of physical activity, sleep quality, and rest. In the future, it is worth conducting similar research on the quality of sleep and rest on a larger research sample. The research should be carried out not only in Poland, but also in other countries (comparative analysis).

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■ Key words

students, physical activity, sleep quality, COVID-19 pandemic

■ Streszczenie

Cel. Celem artykułu było przedstawienie aktywności fizycznej i jakości snu wśród ankietowanych respondentów z Polski.

Materiały i metody. W badaniach udział wzięli studenci Uniwersytetu Medycznego we Wrocławiu. Respondenci zostali wybrani losowo, a w analizie wykorzystano wszystkie zebrane dane. Wykorzystano przygotowaną ankietę, opartą na Międzynarodowym Kwestionariuszu Aktywności Fizycznej (IPAQ). Dane zbierano w 2020 roku (przed pandemią Covid) i w 2021 roku (rok później).

Wyniki. Badanie przeprowadzono w grupie 1600 dorosłych studentów Uniwersytetu Medycznego we Wrocławiu w okresie październik 2020 – marzec 2021. Uczestnicy odbywali obowiązkowe zajęcia zdalne z wychowania fizycznego w roku akademickim 2020–2021.

Wnioski. Badane osoby odbywały w roku akademickim 2020/2021 obowiązkowe zajęcia zdalne z wychowania fizycznego. Pomimo ograniczeń związanych z właściwym doбором metod czy respondentów, stwierdza się, że przedstawiony temat zasługuje na dalsze badania empiryczne przez naukowców w zakresie aktywności fizycznej, jakości snu i odpoczynku. Zdaniem autorów artykułu, przedstawione zagadnienia są istotne. Ważne jest również omówienie ograniczeń badania, które czytelnicy powinni wziąć pod uwagę przy ocenie jego wyników. Ograniczeniem badań jest sama analiza, która koncentruje się na rodzaju zastosowanych metod, zakresie badań i ogólnie na trendach badawczych. Kolejnym ograniczeniem jest odpowiedni dobór respondentów w czasie pandemii Covid-19. Pomimo ograniczeń związanych z właściwym doбором metod czy respondentów, stwierdza się, że przedstawiony temat zasługuje na dalsze badania empiryczne przez naukowców w zakresie aktywności fizycznej, jakości snu i odpoczynku. W przyszłości warto przeprowadzić podobne badania dotyczące jakości snu i odpoczynku na większej próbie badawczej. Badania należy przeprowadzić nie tylko w Polsce, ale także w innych krajach (analiza porównawcza).

■ Słowa kluczowe

studenci, aktywność fizyczna, jakość snu, pandemia COVID-19

INTRODUCTION

'Physical activity is any body movement associated with muscle contraction which increases energy expenditure above the resting level' [1–3]. This definition applies to all forms of physical activity, such as: recreation (which includes most sports and dancing), professional sports, activity physically integrated with transport.

Many epidemiological studies have confirmed the impact of reduced physical activity on the development of obesity worldwide. Physical activity is one of the basic elements for comprehensive obesity treatment. Systematic practice of physical exercise by increasing energy expenditure promotes not only weight reduction, but also results in many other beneficial changes in the human body, for example, an increase in muscle and bone mass, improvement of glucose tolerance and lipid profile, reduction of resting and stress blood pressure and heart rate, which improve overall well-being and mental health. The recommendation for physical activity should cover both the increase in basic physical activity as part of daily activities, and the implementation of planned moderate-intensity physical exercise for at least 30 minutes a day at leisure, if possible every day. Such exercises should be tailored to individual abilities and preferences of the patient, and result in a loss of about 300 kcal during one exercise session. Due to the concomitant degenerative changes in the locomotor system, the recommended form of exercise for obese people is unloading exercises (exercises in water, cycling), which do not directly burden the joints of the lower limbs [4].

It is also important to know the physical activity and sleep quality of students who are an important social group that should take care of its health. The article pays special attention to students by presenting their physical activity.

LITERATURE REVIEW

The publications listed in Table 1 show that the scientific literature is focused on the use of databases to develop methods and tools presenting a given issue. The authors used several variables to show the problem of sleep quality, physical activity and its importance nowadays. To present a given issue, the most numerous groups of people used the method of a systematic literature review (SLR) and survey research. Most of the surveys, the results of which were presented in these articles, were conducted via the Internet. On the other hand, students were the most common group of the surveyed. There were also surveys carried out traditionally in classrooms, an example of which is the study on a group of 542 nurses at a hospital in Ethiopia [22].

Conclusions on the results of the studies were varied. Depressive states, anxiety symptoms, stress and drinking alcohol were associated with low sleep quality [22]. In another case, the factors lowering the quality of sleep included, first of all, lack of physical activity and poor nutrition [16]; in the results of another study, apart from lack of exercise, a sedentary lifestyle was also indicated (Luciano, Cennachi, Vegro, Gaspare 2021), and the enforced stay at home during the COVID-19 pandemic [22].

MATERIALS AND METHOD

To assess the impact of the COVID-19 situation on sleep duration, a survey was conducted among the students at Wrocław University in south-west Poland. The participants were selected randomly, and all collected records were used in the analysis. A prepared questionnaire based on the International Physical Activity Questionnaire (IPAQ-short version) was used. The data was collected in 2020 (during the COVID pandemic-October 2020) and in 2021 (a year after the announcement of the Pandemic-March 2021). (Tab. 2).

Table 2. Sample years and size

Year	n
2020	845
2021	753

The study was conducted in a group of 1,600 adult students at Wrocław Medical University from October 2020 – March 2021. The participants were pursuing mandatory remote classes in physical education in the academic year 2020–2021. Two stages were distinguished in the studied group of students: Stage I (n = 845) – analyzed after six months of the pandemic (October 2020); Stage II (n = 753) – analyzed after one year of the pandemic (March 2021). There was one group of students who completed the survey twice at a time interval (stage I, II). The difference in the number of students in each stage was due to the fact that some respondents did not complete the survey each time. Stage II was completed by 89.3% of the initial group of survey participants. Student recruitment procedures did not vary according to the duration of the survey.

International Physical Activity Questionnaire (IPAQ-S). An abbreviated form of the questionnaire was used to measure the level of physical activity of the participants over the past seven days, distinguished into low, moderate and high intensity exercise. Additionally, the amount of walking and sitting for each day was assessed by means of the questionnaire. A specific level of physical activity allowed the participants to be classified into three groups: 1) low level of physical activity, 2) moderate level of physical activity, 3) high level of activity. An additional parameter that determines the level of physical activity is the metabolic equivalent (MET) which shows the amount of energy used to perform physical activity; this is the equivalent of resting metabolism, equal to the energy expenditure of 3.5 ml of oxygen per kilogram of body weight per minute. The IPAQ scoring protocol assigns the following MET values for walking: low physical activity – 3.3, moderate – 4.0, intense activity – 8.0, respectively. The level of physical activity was determined in three categories: low (LPAL), moderate (MPAL) and high (HPAL), according to the IPAQ calculation procedure.

Pittsburgh Sleep Quality Index (PSQI). A questionnaire to retrospectively assess sleep quality and sleep disturbances over the past month. The questionnaire is completed by each respondent. Detailed results obtained by the PSQI enable a detailed assessment, among other things, of quality of sleep, its duration, efficiency, and its disturbances. The questionnaire additionally assesses the scale of the use of hypnotics. The results are the sum of the assigned points according to the adopted procedure PSQI, where each assessed sleep component is assigned points from 0–3. The

Table 1. List of publications on the influence of physical activity on sleep quality in humans

Authors	Title	Method
López-Moreno, Iglesias López, Miguel, Garcés-Rimón [5]	Physical and Psychological Effects Related to Food Habits and Lifestyle Changes Derived from COVID-19 Home Confinement in the Spanish Population	Period: 2020 Area: Spain Method: electronic anonymous questionnaire; snowball sampling method
Luciano, Cennachi, Vegro, Gaspare [6]	COVID-19 lockdown: Physical activity, sedentary behaviour and sleep in Italian medicine students	Period: 2019 Area: Italy Method: online questionnaire survey
Idrissi, Lamkaddem, Benouajjit, El Bouazzaoui, El Houari, Alami, Labyad, Chahidi, Benjelloun, Rabhi, Kissani, Zarhbouch, Ouazzani, Kadiri, Alouane, Elbiaze, Boujraf, El Fakir, Souirti [7]	Sleep quality and mental health in the context of COVID-19 pandemic and lockdown in Morocco	Period: 2020 Area: Morocco Method: survey questionnaire
Saguem, Nakhli, Romdhane, Nasr [8]	Predictors of sleep quality in medical students during COVID-19 confinement	Period: 2020 Area: Tunisia Method: online questionnaire survey
McDonough, Helgeson, Liu, Gao [9]	Effects of a remote, You Tube-delivered exercise intervention on young adults' physical activity, sedentary behaviour, and sleep during the COVID-19 pandemic: Randomized controlled trial	Period: 2020 Area: USA Method: online questionnaire survey
Mahfouz, Ali, Bahari, Ajeebi, Sabei, Somaily, Madkhali, Hrooby, Shook. [10]	Association Between Sleep Quality and Physical Activity in Saudi Arabian University Students	Period: 2020 Area: Saudi Arabia Method: study questionnaire
Bagci Bosi, Kanadiking, Somyürek, Gerçek, Tarnikulu, Öntaş, Uzun [11]	Impact of COVID-19 on eating habits, sleeping behaviour and physical activity status of final-year medical students in Ankara, Turkey	Period: 2020, Area: Turkey, Method: online questionnaire survey
Mishra, Panigrahi, Samanta, Dash, Mahapatra, Beherta [12]	Sleep quality and associated factors among undergraduate medical students during Covid-19 confinement.	Period: 2020 Area: India Method: online questionnaire survey
da Silva Santos, Rossi, dos Santos Nunes de Moura, Marreiro de Sousa Junior, Machado, Neves, Brito, Moura, Monteiro, Freitas Junior, Pereira dos Santos, Ribeiro [13]	COVID-19 pandemic impacts physical activity levels and sedentary time, but not sleep quality in young badminton athletes	Period: 2019 Area: Brazil Method: tri-axial accelerometer
Marelli, Castelnuovo, Somma, Castronovo, Mombelli, Bottoni, Lettner, Fossati, Ferini-Strambi [14]	Impact of COVID-19 lockdown on sleep quality in university students and –? –	Period: 2020 Area: Italy administration staff Method: online questionnaire survey
Werneck, Silva, Malta, Lima, Souza-Júnior, Azevedo, Barros, Szwarcwald [15]	The mediating role of sleep quality in the association between the incidence of unhealthy movement behaviors during the COVID-19	Period: 2020 Area: Brazil Method: online quarantine and mental health. questionnaire survey
López-Bueno, Calatayud, Casaña, Casajús, Smith, Tully, Andersen, López-Sánchez [16]	COVID-19 Confinement and Health Risk Behaviours in Spain. Front Psychol	Period: 2020 Area: Spain Method: online questionnaire survey
Luo, Song, Yang, Huang, Zhou, Zhang [17]	Intervention Effect of Long-Term Aerobic Training on Anxiety, Depression, and Sleep	Period: 2020 Area: China Method: Aerobic exercises
Aguilar-Farias, Toledo-Vargas, Miranda-Marquez, Cortinez-O'Ryan, Cristi-Montero, Rodriguez-Rodriguez, Martino-Fuentealba [18]	Socio-demographic Predictors of Changes in Physical Activity, Screen Time, and Sleep among Toddlers and Preschoolers in Chile during the COVID-19 Pandemic	Period: 2020 Area: Chile Method: online questionnaire survey
Di Renzo, Gualtieri, Pivari, Soldati, Attina, Cinelli, Leggeri, Caparello, Barrea, Scerbo, Esposito, De Lorenzo. [19]	Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey	Period: 2020 Area: Italy Method: online questionnaire survey
Pinto, van Zeller, Amorim, Pimentel, Dantas, Eusébio, Neves, Pipa, Santa Clara, Santiago, Viana, Drummond [20]	Sleep quality in times of Covid-19 pandemic	Period: 2020 Area: Portugal Method: telephone questionnaire
Huang, Zhao [21]	Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey	Period: 2020 Area: China Method: online questionnaire survey
Segon, Kerebih, Gashawu, Tesfaye, Nakie, Anbesaw. [22]	Sleep quality and associated factors among nurses working at comprehensive specialized hospitals in Northwest Ethiopia	Period: 2021 Area: Ethiopia Method: survey questionnaire
Zhou, Bo, Ruan, Dai, Tian, Shi [23]	Deteriorated sleep quality and influencing factors among undergraduates in northern Guizhou.	Period: 2018–2019 Area: China Method: online questionnaire survey
Abdolizadeh, Nabavi [24]	Visual Attention and Poor Sleep Quality.	Period: 2021 Area: Iran Method: online questionnaire survey
Campos-Romero, Barros Araya, Masalan-Apip, Tobar Arias-Ortiz, Bobadila-Beiza [25]	Sleep quality in people with type 2 diabetes controlled at the primary level, and its association with socio-demographic and clinical characteristics	Period: 2021 Area: Chile Method: observation of patients in hospital

Source: [5–25].

sum of all categories is a score in the range of 0–21 points. Respondents with a score greater than five points in the total number of points can be classified as poor sleepers, and those with five or more points may be classified as good sleepers. To assess the relationship between sleep quality and its factors, the following variables were selected: age, BMI, gender, place of residence, weight, height, study year, walking minutes, moderate minutes and vigorous minutes.

Procedures. The study was conducted among students at the Wrocław University of Medical Sciences between October 2020 – March 2021. Each time, study participants completed the same anonymous questionnaires, the International Physical Activity Questionnaire (IPAQ) and the Sleep Quality Questionnaire (PSQI), in online form using the Google document tool. The students received a link that contained the original questionnaires in online form with a request to complete them. The questionnaire was available on -line for seven days for the study participants. The surveys were completely anonymous and voluntary. The participants were students who were participants in compulsory physical education classes implemented in the academic year 2020–2021. The study was approved by the Bioethics Committee at Wroc Wrocław Medical University.

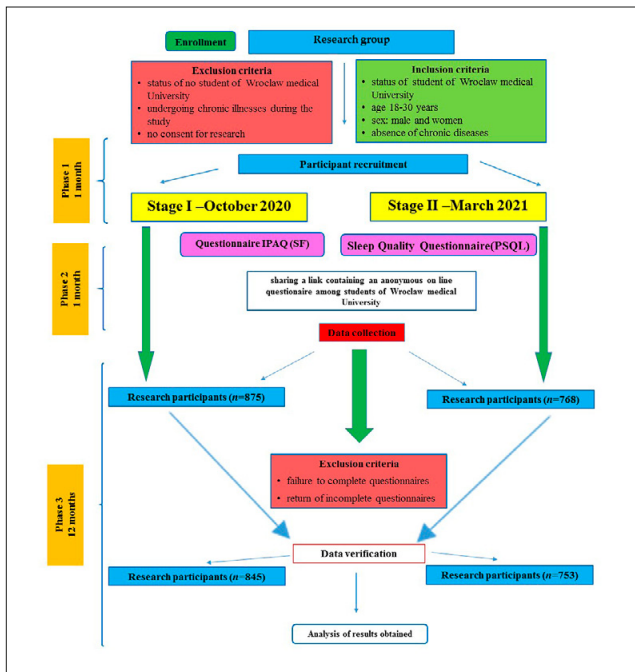


Figure 1. Description of the study stages. Source: own preparation.

Statistical Analysis. A one-way analysis of variance (ANOVA) was performed to determine the differences? The test statistic for a One-Way ANOVA is denoted as F , and can be expressed as follow:

$$F = \frac{SSR / df_r}{SSE / df_e}$$

where: SSR – regression sum of squares;
 SSE – error sum of squares;
 df_r – model degrees of freedom (equal to $df_r = k - 1$);
 df_e – error degrees of freedom (equal to $df_e = n - k$).

To find means that are significantly different from each other, a *post-hoc* analysis with Tukey’s Honest Significant Differences test was used. The differences were deemed statistically significant with a cut-off level $\alpha = 0.05$.

The strength of relationship between two variables was assessed using Pearson’s correlation coefficient, and it can be expressed as follow:

$$r_{XY} = \frac{C(X,Y)}{\sqrt{S_x^2 * S_y^2}} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}} = \frac{C(X,Y)}{S_x S_y} \quad (2)$$

where: $C(X,Y)$ – covariance between the X and Y

S_x^2 – variance of X ;

S_x – standard deviation of X ;

S_y^2 – variance of Y ;

S_y – standard deviation of Y .

The linear correlation coefficient is considered as the normalized covariance. The correlation derives values from the range $(-1, 1)$.

RESULTS

The distribution of sleep duration for 2020 and 2021 is presented in Figure 2. Based on the results, it can be stated that in comparison to 2020, more responses were observed in 2021. This may indicate that the students slept more in 2021.

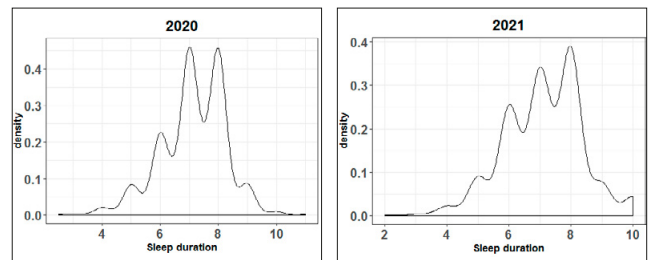


Figure 2. Density plot for sleep duration in 2020 and 2021.

Weight. The first variable used in the questionnaire was weight. The scatter plots for this variable and sleep duration are presented in Figure 3. The results indicate that in 2020 the correlation coefficient was statistically insignificant and negative. In contrast, in 2021 the correlation was also negative, but statistically significant. This means that the students who weighed more slept less.

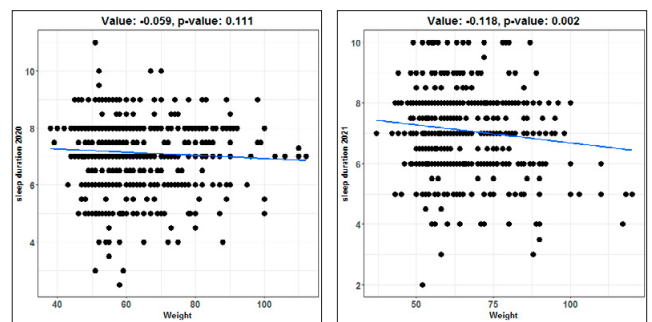


Figure 3.

Height. The second variable used in the questionnaire was height. The scatter plots are presented in Figure 4. Similar to weight, the correlation coefficient between this variable and sleep duration was negative; however, collaterally in 2020, this was statistically significant.

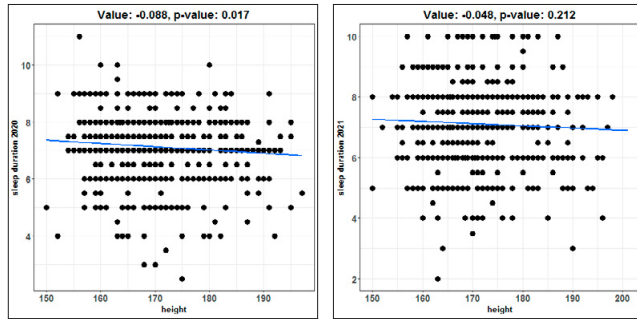


Figure 4. Scatter plot for height variable in 2020 (left) and 2021 (right).

Body Mass Index (BMI). The BMI is a very important variable in assessing the balance between height and weight. The scatter plots for the BMI variable and sleep duration are shown in Figure 5. In 2020, the correlation coefficient between variables was negative and statistically insignificant. In contrast, in 2021, the correlation coefficient was also negative, but statistically significant. This means that the students with a higher BMI index slept less.

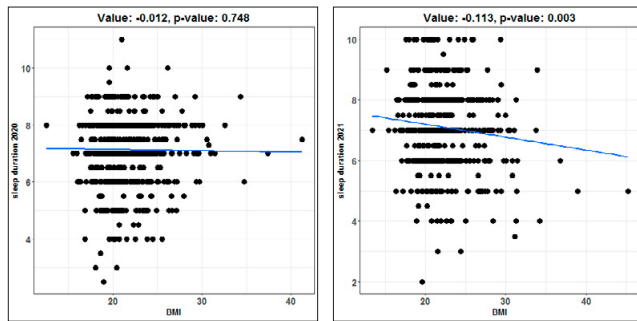


Figure 5. Scatter plot for BMI variable in 2020 (left) and 2021 (right)

Age. The next variable used in the analysis was age. The results indicate that there was no correlation between age and sleep duration for the analyzed period of time (Fig. 6).

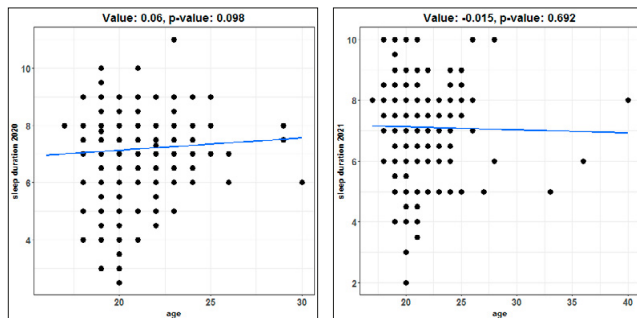


Figure 6. Scatter plot for age variable in 2020 (left) and 2021 (right)

Gender. The next variable used in the analysis was gender. The *post-hoc* tests indicate that between males and female there is no statistical difference in sleep duration in 2020 and 2021 Figure 7 indicates that the mean value in sleep duration for males is slightly lower in comparison to females.

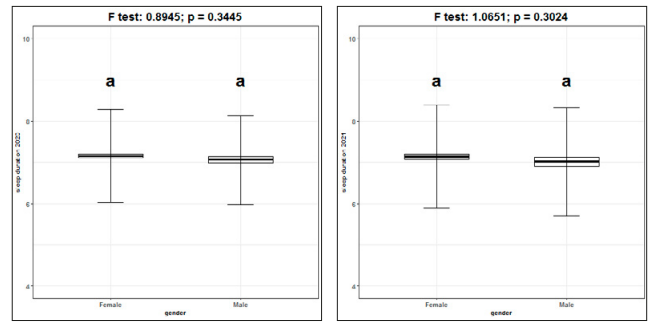


Figure 7. Box plot for sleep duration for male and female in 2020 (left) and 2021 (right)

Study year. Additionally, a study year was analyzed in the questionnaire. The scatter plots between the study year and sleep duration were presented below (Fig. 8). Based on the collected data it can be stated that there is no correlation for the analyzed period. The correlation coefficient is positive but statistically insignificant.

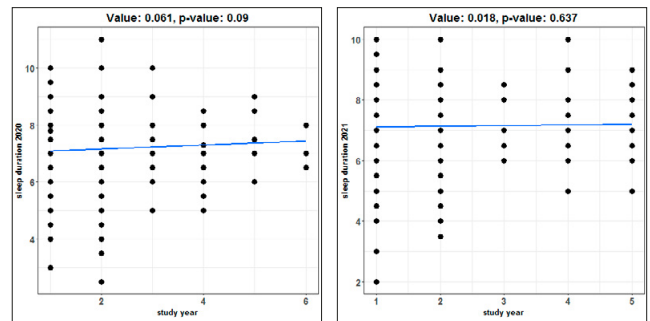


Figure 8. Scatter plot for study year and sleep duration in 2020 (left) and 2021 (right).

Place of residence. This demographic was also recorded to assess disparities in sleep duration between different places of residence. The *post-hoc* tests showed no statistical difference there in sleep duration in 2020 and 2021 (Fig. 9).

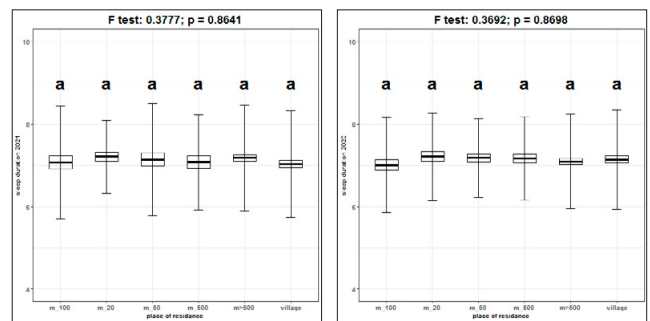


Figure 9. Box plot between sleep duration and place of residence in 2020 (left) and 2021 (right).
village – village; m_5 – city below 5; m_20 – city between 5 and 20; m_50 – city between 20 and 50; m_100 – city between 50 and 100; m_500 – city between 100 and 500; m>500 – city above 500.

Walking minutes. Physical activity was additionally recorded in the questionnaire. The first variable analyzed in this section was walking minutes, defined as the average walking minutes per day. Figure 10 indicates a negative correlation between walking minutes and sleep duration in 2021. This means that the more students walked per day, the less they slept.

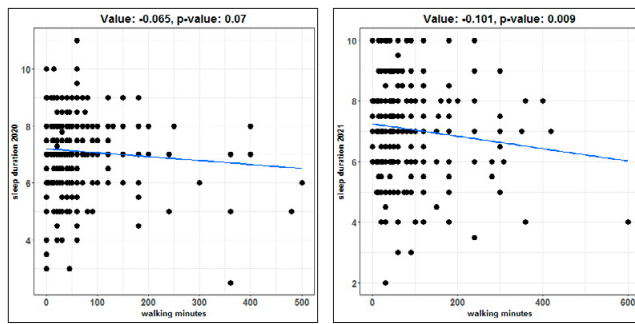


Figure 10. Scatter plot for walking minutes and sleep duration in 2020 (left) and 2021 (right)

Moderate minutes. Other information collected about physical activity included moderate minutes, defined as the average moderate activity (in minutes) per day. The Pearson correlation coefficients in 2020 and 2021 were negative, but statistically insignificant (Fig. 11). This may indicate that there was no correlation between moderate minutes and sleep duration.

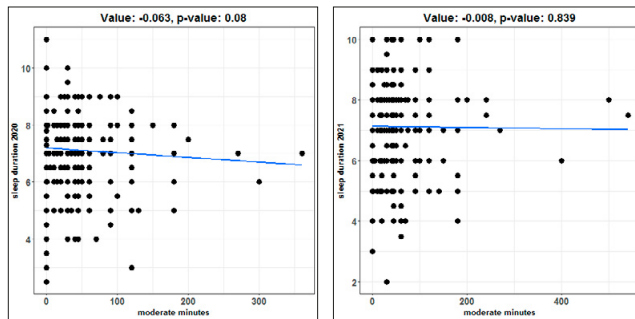


Figure 11. Scatter plot for moderate minutes and sleep duration in 2020 (left) and 2021 (right)

Vigorous minutes. The last information collected about physical activity was vigorous minutes, defined as average vigorous activity (in minutes) per day. In 2020, the Pearson correlation coefficient was negative and statistically insignificant. In contrast, in 2021, the Pearson correlation coefficient was positive, but also statistically insignificant. This means there was no correlation between vigorous minutes and sleep duration.

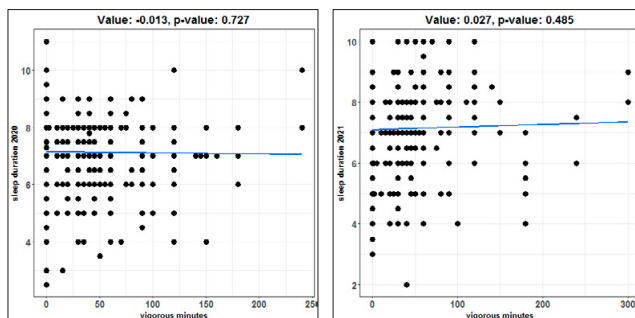


Figure 12. Scatter plot for vigorous minutes and sleep duration in 2020 (left) and 2021 (right)

CONCLUSIONS

According to the authors of this article, although the issues presented are very important, it is also important to discuss the limitations of the study, which should be taken into consideration when evaluating the results. The limitation of the research is the analysis itself that focuses on the methods used, scope of the research, and research trends in general. Another limitation is the appropriate selection of respondents during the COVID-19 pandemic. Despite the limitations related to the correct selection of methods or respondents, the presented topic deserves further empirical research by scientists in the field of physical activity, sleep quality, and rest.

In the future, it would be worth conducting similar research on the quality of sleep and rest on a larger research sample. The research should be carried out in Poland as well as in other countries for comparative analysis.

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