ORIGINAL ARTICLE

PHYSICAL HEALTH OF STUDENTS AND DIGITALIZATION OF HIGHER MEDICAL EDUCATION: RISK FACTORS

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ABSTRACT

The aim: To study the dynamics of gadget use by higher education students of the Bogomolets National Medical University and to assess technological impact on the physical health of students.

Materials and methods: To accomplish the tasks set using theoretical and experimental methods of scientific research: systematic analysis, comparison and generalization of the bibliosemantic method, questionnaires, and interviews with students. Quantitative data collected during the survey of students studying in the «Dentistry», «Pediatrics», «Medicine», «Pharmacy, Industrial Pharmacy», «Physical Therapy, Occupational Therapy», and «Medical Psychology» specialties were processed using the MedCalc statistical software, and there was carried out comparative analysis afterwards.

Results: During the quarantine and martial law, medical university students were forced to study distantly or in a mixed format using various gadgets and computers. It is obvious that the physical condition of a person is affected by the duration of their use of various devices. In this paper, therefore, the risks and the researched dynamics of gadget use by higher education students of the Bogomolets National Medical University were identified. Thus, the technological impact on the physical health of students was also defined. Moreover, the data based on the results of height and weigh calculation of higher education students, which used to diagnose types of obesity by anthropometric indicators, were also collected.

Conclusions: According to the results of the research, it was established that the students of the Bogomolets National Medical University spent a significant part of their study time sitting in the classroom or at the computer (40 hours weekly average). We found that in the process of distance learning, prolonged sitting at a PC or other gadget (as well as general sedentary lifestyle) has affected the female higher education students majoring in 222 «Medicine» course their body mass index. The time spent using gadgets both in the educational and non-formal education (self-education) processes has increased significantly. We attribute this fact to the emergence of a significant number of online educational resources in the public domain, the growing number of webinars, trainings, and master classes conducted by both domestic and foreign experts online.

KEY WORDS: Higher medical education, physical health, gadget, students, distance learning

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INTRODUCTION

The process of digitalization is one of the defining trends in the development of modern society, and virtually all areas of our lives are transformed under its influence: education, economy, everyday life, and healthcare. The widespread use of technical innovations (gadgets) requires the study of various aspects related to this phenomenon: ethical, psychological, and health-preserving. The study of the relationship between time spent with gadgets and the state of physical and mental health of different age groups has become a subject of interest to scholars in various fields of knowledge. The large share of such research is focused on the impact of gadgets on the health of children and adolescents, and it is reflected in reasonable restrictions recommended at the state level by associations of national academies in different countries (e.g. the American Association of Pediatrics). A much smaller number of studies have examined the impact of gadgets on physical health (ophthalmic, musculoskeletal, obesity, etc.) of older age groups (more than 17 years). This happened due to the difficulty of isolating digitalization as an influence factor, the need for longitudinal studies, and the selection of a civilizational community outside of this influence as a control group to compare research results. The circumstances in which the national education system has been operating in recent years may provide grounds for such research and cautious assessments of such influence According to sociological research, most Ukrainians use screen gadgets (phones, computers, tablets, TVs) and the global Internet on a daily basis, with the vast majority of students and pupils. Therefore, this is quite obvious as the process of digitalization of society is closely linked to the educational process. With the

spread of the COVID-19 pandemic and the outbreak of hostilities in Ukraine, distance learning and, accordingly, the use of digital technologies have become even more important, and the time spent using any gadgets has increased significantly.

THE AIM

There were alalyzed the study of dynamics of gadget use by higher education students of the Bogomolets National Medical University and assessment of their impact on the physical health of students.

MATERIALS AND METHODS

The accomplishment of the tasks set using theoretical and experimental methods of scientific research was done: systematic analysis, comparison and generalization of the bibliosemantic method, questionnaires, and interviews with students. Quantitative data collected during the survey of students studying in the «Dentistry», «Pediatrics», «Medicine», «Pharmacy, Industrial Pharmacy», «Physical Therapy, Occupational Therapy» and «Medical Psychology» specialties were processed using the G*Power and MedStat software with the carried out comparative analysis of their results.

In order to diagnose physical health of students, the types of obesity (based on anthropometric indicators) were used the formula:

$$I = \frac{m}{h^2} \quad (1),$$

where *m* is a body weight in kilograms, and *h* is a height in meters (BMI is measured in kg/m^2).

A BMI of up to 18.5 is considered underweight. Normal BMI for men and women is measured between 18.5-24.9 kg/m^2. With an index of 25.0-29.9 kg/m^2, the presence of overweight is obviously stated, but this is not yet a diagnosis of obesity itself. In case of a first-degree obesity, the BMI is within the range of 30.0-34.9 kg/m^2; in case of second-degree obesity – it is 35.0-39.9 kg/m^2; and more than 40.0 kg/m2 means third-degree obesity [1-2].

In order to study the impact of the use of computer technology in blended (classroom and distance) learning under adaptive quarantine, we conducted a study at the Bogomolets National Medical University. In the fall of 2021-2022 academic year, 243 respondents of 3-5 courses took part in the survey, majoring in 221 «Dentistry» and «Pediatrics», 222 «Medicine», 226 «Pharmacy, Industrial Pharmacy», 227 «Physical Therapy, Occupational Therapy» and «Medical Psychology» disciplines. In the fall of the 2022-2023 academic year, we conducted a survey of mixed (classroom and distance) learning under martial law. The total of 434 higher education students were expressed. Those included 4 (2) respondents in the 073 «Management» specialty, 115 respondents in the 221 «Dentistry» specialty, 263 applicants in the 222 «Medicine» specialty, 18 future masters in the 226 «Pharmacy, Industrial Pharmacy» specialty, 1 in the 227 «Physical Therapy, Occupational Therapy» specialty, 29 in the 228 «Pediatrics» specialty, and 4 applicants in the «Public Health» specialty. Among them, there are 125 applicants of 4-6th courses in the 222 «Medicine» specialty. Last year, there were 101 female and 24 male respondents in the 222 «Medicine» specialty being surveyed who are currently studying the 4-6th academic year.

The questionnaires in 2021-2022 (retrospective group) and 2022-2023 (prospective group) were conducted according to the same methodology, and the calculations were performed within the G*Power software [3] according to Fisher's test in order to determine the power and sample size for comparing two independent binomial populations. According to the results of the calculations, it can be stated that the samples of 243 and 434 respondents (with an allocation ratio of 1.8) are sufficient to detect the possibility of excess weight at a power of 0.8 and at a significance level of 0.05, thus, it can be concluded to comparability of the studied groups.

To compare the samples of respondents in 2021-2022 and 2022-2023 was used the statistical package MedStat [4], and the calculations were made by the Chi-squared test. Two-sided extreme values were defined: Chi-square = 3.85, degrees freedom k = 5. There is a difference at significance level, p = 0,95 ($\chi^2 > \chi^2_{cr}$).

RESULTS

The development of modern society is influenced by the total digitalization of all spheres of life and is characterized by the widespread use of information technology. During the COVID-19 pandemic and subsequently martial law in Ukraine, the role of distance learning technologies has grown significantly and become crucial as they created the informational and educational environments of the university [5-7]. This has led to a significant increase in various gadgets used by students and teachers: laptops, tablets, smartphones, etc. Apparently, the organization of the educational process requires prolonged work with a gadget, and the process of teaching higher education students (users) acquires the characteristics of PC (personal computer) users with all its inherent features and health risk factors (sedentary and inactive lifestyle). Occupational pathologies of PC users have now reached such

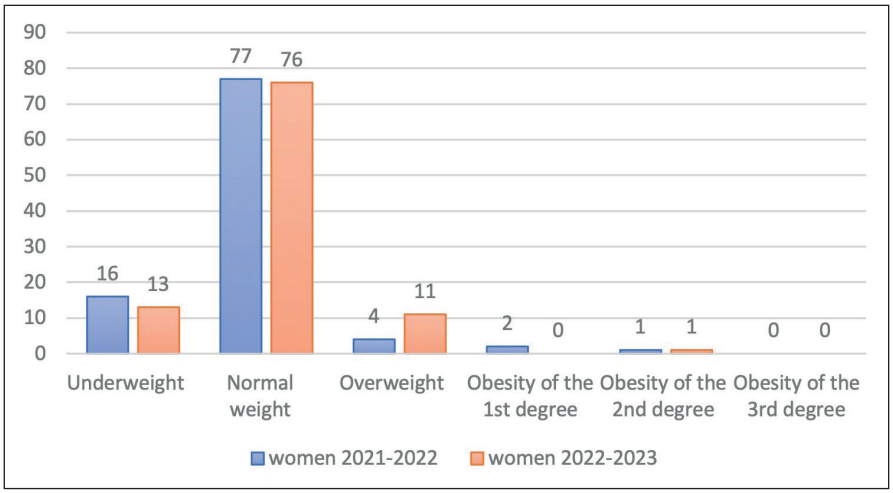

Fig. 1. Distribution of BMI of female higher education students in the specialty 222 «Medicine»

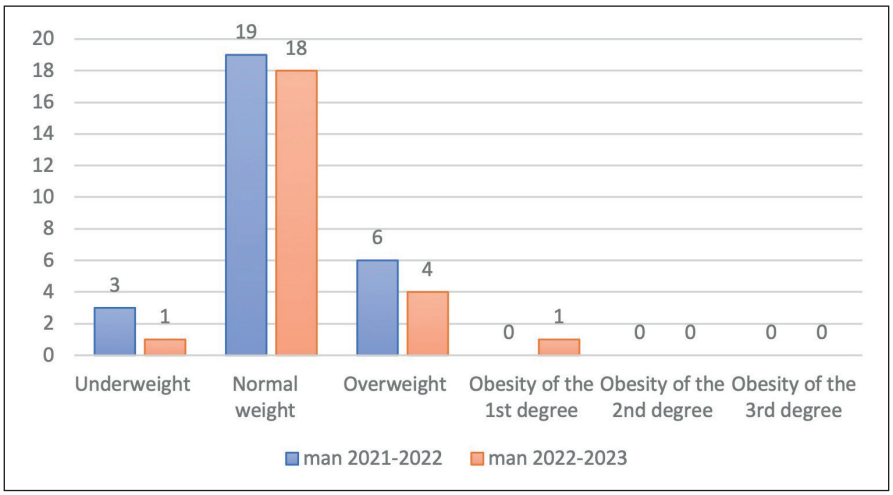

Fig. 2. Distribution of BMI of male applicants for higher education in the specialty 222 «Medicine»

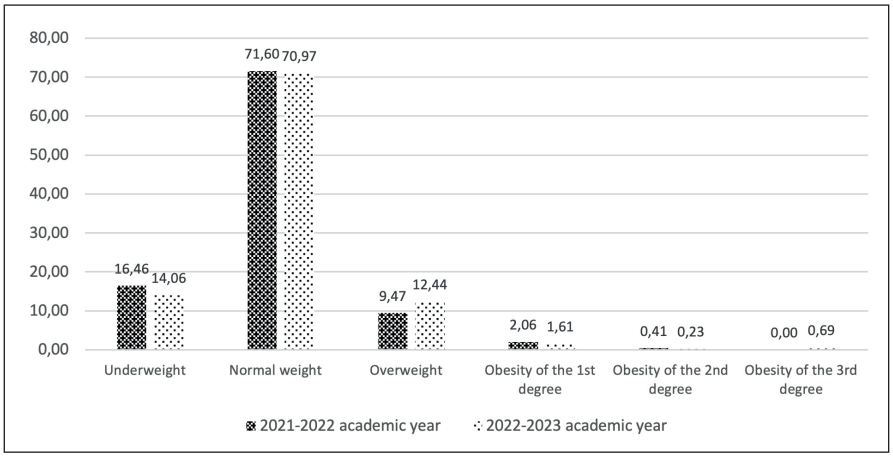

Fig. 3. Percentage distribution of BMI of higher education students in the 2022–2023 academic year

a scale that medical professionals have begun to use the term «repetitive strain injury» in order to define a complex set of symptoms caused by their long-term professional activities. Numerous studies by ergonomics, occupational safety, and biomechanics experts [8-13] show that one of the most threatening factors to the psychophysiological capabilities of PC users is static-dynamic stress on the spine caused by being in a static, uniform position against the background of a large number of stereotypical loads performed during coordinated movements of the hand muscles alone. The analysis of regulations and documents that establish safety, sanitary, and hygienic requirements for the equipment of workplaces of PC users shows that the defining regulatory document to date is the «State Sanitary Rules and Norms for Working with Visual Display Terminals of Electronic Computers» DSanPiN 3. 3.2.007-98, approved by the Resolution of the Chief State Sanitary Doctor of Ukraine No. 7 of 10.12.1998 [14], which clearly states the need for regulated rest

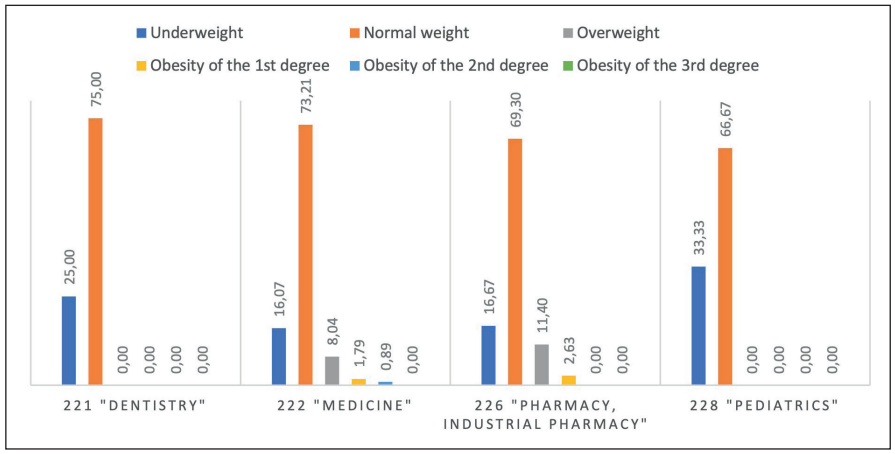

Fig. 4. Percentage distribution of BMI within specialties in the 2021–2022 academic year

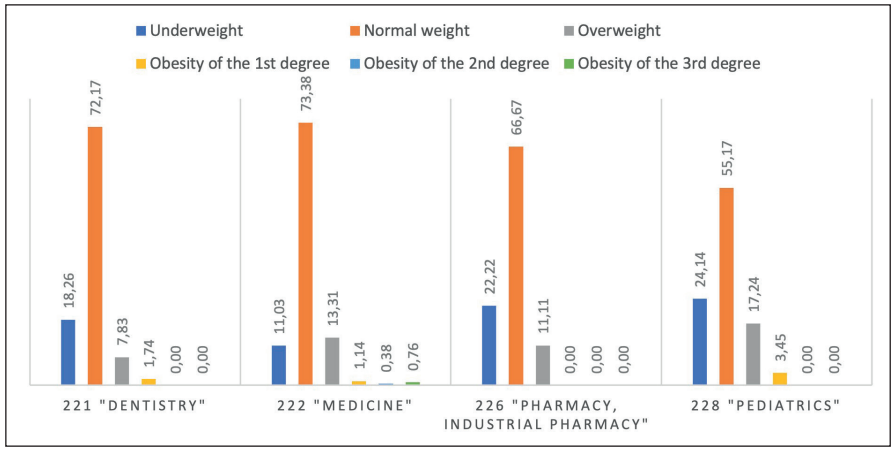

Fig. 5. Percentage distribution of BMI within specialties in the 2022–2023 academic year

breaks for PC users. However, both sources and our own experience show that, unfortunately, these breaks are either not used properly or are not available at all.

As a result of the study, we found that among female higher education students majoring in 222 «Medicine» discipline, the distribution of BMI has the following dynamics: the percentage of people with underweight decreased from 16% to 12.87%, the normal weight indicator also decreased from 77% to 75.25%, the overweight indicator has the opposite trend - the percentage of people with this indicator increased by almost 7% (from 4% to 10.89%), the rate of 1st degree obesity in 2022–2023 students also increased by 2%, and the rates of obesity of 2nd and 3rd degrees remain stable and amount to almost 1% and 0% respectively (Fig 1).

Moreover, in the dynamics of two years, the share of BMI of underweight persons decreased and amounted to 4.7%, the share of normal weight increased from 67.86% to 75%, the percentage of overweight decreased to 16.67%, and the rate of obesity of the 1st degree increased from 0 to 4.17% among male higher education students majoring in 222 "Medicine" discipline (Fig 2).

The overall percentage distribution of respondents by BMI is as follows (Fig 3): the rate of underweight decreased from 16.46% to 14.06%, the rate of normal weight decreased from 71.60% to 70.97%, the rate of overweight increased from 9.47% to 12.44%, the rate of obesity decreased from 2.06% to 1.61%, the rate of obesity of the 1st degree decreased from 0.41% to 0.23%, and the rate of obesity of the 3rd degree increased by 0.69%.

As for the last 2 academic years, the percentage distributions for the 221 «Dentistry», 222 «Medicine», 226 «Pharmacy, Industrial Pharmacy» and 228 «Pediatrics» specialties are shown in Figs 4 and 5.

As for the numerical data of 2021–2022 academic year, 40 respondents were underweight, 174 were normal, 23 were overweight, and 5 and 1 respondents were obese respectively, having no obese people of the 3rd degree. In the 2022-2023 academic year, 61 surveyed applicants were underweight, 308 applicants were of normal weight, 54 respondents were overweight, 7, 1, and 3 applicants were obese respectively.

During the survey of this academic year, almost half of the respondents indicated that they have posture disorders (44.9%), while 12% indicated the presence of spinal diseases. A significant proportion of respondents reported pain in the joints when using gadgets: 9.7% - in the elbow joints, 12% - in the wrist joints, 30.4% - in the knee joints. The applicants noted that they feel discomfort after long-term work at a computer or other gadgets in the cervical (50.2%), thoracic (25.1%) and lumbar (46.1%) departments.

Table I. Average time per day of PC use by higher education students for educational purposes

PC time per day	During the educational process		For the purpose of self-education	
	21–22	22–23	21–22	22–23
> 5 hours	32,5 %	34,1 % ↑	12 %	13,9 %↑
4-5 hours	24,3 %	23,7 %	7 %	10,4 %↑
3-4 hours	21,4 %	25,1 %↑	16,9 %	16,9 %
2-3 hours	14 %	12 %	25,6 %	30,5 %↑
1-2 hours	5,3 %	3,5 %	33,1 %	25,9 %
I do not use	2,5 %	1,6 %	5,4 %	2,5 %

Table II. Average time per day of PC use by higher education students for entertainment

PC time per day	For entertainment		Trend
	21–22	22–23	
> 4 hours	14,4 %	16,3 %	↑
3-4 hours	17,4 %	16,5 %	↓
2-3 hours	20,8 %	30,2 %	↑
< 2 hours	47,5 %	36,9 %	↓

Table III. Physical activity of students during prolonged using PC

Answer option	Physical exercises (mini sets of exercises) when working at the computer		Self-massage while working at the computer	
	21–22	22–23	21–22	22–23
Yes	26,7 %	25,8 %	27,6 %	31,3 %
No	41,6 %	44,5 %	50,6 %	45,6 %
At times	31,7 %	29,7 %	27,6 %	23 %

Table IV. Lifestyles of higher education students

Answer option	Your lifestyle	
	2021-2022	2022-2023
I lead an active lifestyle	27,2 %	22,4 % ↓
I follow the principles of a healthy lifestyle	50,6 %	48,8 % ↓
I lead a passive lifestyle	15,2 %	21 % ↑
I lead a lifestyle that is not conducive to maintaining my health	7%	7,8 % ↑

DISCUSSION

The obtained results prompted us to analyze the factors that determine them and find ways to reduce their negative impact on the health of young student. It is quite logical to assume the relationship between changes in the physical health of students and the time of using gadgets, which has significantly increased both in the process of formal and informal education (or self-education). (Tables I, II).

We associate the increase in time spent at the PC for the purpose of education and self-education with the appearance of a significant number of freely accessible online educational resources, the increase in the number of webinars, trainings, and master classes held online by local and foreign specialists.

As a part of our study, we tried to find out whether there was a redistribution of time spent at the PC. For this purpose, the duration of using gadgets for entertainment was investigated. It has been found that less than 6% (5.8% this year and 4.9% last year) of respondents do not use gadgets for entertainment despite the fact that according to students themselves, 59% of them use it «often» (54.3% during the last year) and 35.3% «very often» (40.7%).

According to the results of the questionnaire, the students note a decrease in physical activity by 8.4% during the present year compared to the last one despite the fact that the vast majority of classes are held in classrooms. A significant percentage of students (78–80%) feel that the length of time spent on a computer, phone, or other gadgets has increased over the past two years.

To reduce the feeling of discomfort, students try to control their working posture, systematically engage

in health gymnastics, take short breaks, massage or self-massage, strengthen muscles, etc. Therefore, we investigated the interval physical activity of students during long-term use of a PC (Table III) and their lifestyle (Table IV). In the course of the research, we also found that more than 25% of users are not familiar with the concept of «ergonomic posture» and neglect the correct one when using gadgets, although 35-40% of respondents are concerned about maintaining the posture. 23.4% of respondents constantly monitor their posture when using gadgets, and 17% do not think about what position they are in when using a PC, laptop, etc.

The state of their musculoskeletal system is positively assessed by 52.3% of applicants, satisfactorily by 39.2%, and unsatisfactorily by 8.5%.

The results of the questionnaire and their subsequent discussion in focus groups give reason to assume greater self-criticism of students in evaluating their lifestyle, noting a decrease in current physical activity compared to the last year despite the fact that the vast majority of classes are held in classrooms. In our opinion, this can be the evidence of a more responsible attitude to one's health and the basis for the development and implementation of measures aimed at preventing the negative impact on the physical health of students of the factors that necessarily accompany the processes of education digitalizing [5].

CONCLUSIONS

In the course of the study, we found that the level of both formal and non-formal education had been greatly increased. With the spread of COVID-19 pandemic and the start of hostilities in Ukraine, the distance learning has become a dominant education. In its turn, this has led to an increase in the length of time spent at a computer or other gadget, and as a result, led to a sedentary lifestyle and changes in physical health indicators. Thus, among Bogomolets National Medical University female higher education graduates of the 222 "Medicine", a redistribution of body mass index was stated. Namely, the rate of overweight increased by almost 7%, the share of respondents who noted a decrease in current motor activity compared to last year increased by 8.4%, and, finally, a significant share of higher education graduates neglects the correct posture when using gadgets and feels discomfort or pain in their joints, muscles, or spine during a prolonged using PC.

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Conflict of interest:
The Authors declare no conflict of interest.

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