MEDICAL UNIVERSITY
„PROF. DR. PARASKEV STOYANOV" VARNA
SLIVEN AFFILIATE
HEALTH CARE DEPARTMENT

Anushka Strahilova Uzunova

THE IMPACT OF THE COVID-19 PANDEMIC ON NUTRITION AND PHYSICAL ACTIVITY OF THOSE INVOLVED IN THE EDUCATIONAL PROCESS – TRAINERS AND TRAINEES AT THE MEDICAL COLLEGE – STARA ZAGORA

A B S T R A C T

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The dissertation paper consists of 143 pages, including 33 tables, 51 figures, and 3 appendices. 175 literary sources are cited, 31 of which are in Cyrillic letters and 144 – in Latin. The dissertation was discussed and proposed for defense by the departmental Council of the Health Care Department of Sliven Affiliate at MU Varna on 17.06.2025.

Scientific jury:

1. Prof. Elena Grozeva Zheleva, PhD
2. Prof. Maya Lyubomirova Vizeva, PhD - reviewer
3. Prof. Deliana Hadzhideleva, PhD - reviewer
4. Assoc. Prof. Pepa Miteva Dzhedzheva, PhD
5. Assoc. Prof. Katya Genova Mollova, PhD

The public defense of the dissertation will take place on 19.September 2025 at 11.00 AM online via Webex. The materials related to the defense are available at the Department of Sciences at MU - Varna and are published on the website of MU - Varna.

Note: The numbers of the figures and tables in the Abstract do not correspond to their numbers in the dissertation thessis

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Abbreviations used

DEI	Daily energy intake
DNA	Deoxyribonucleic acid
EL	Electronic learning
HEA	Higher Education Act
HEI	Higher education institution
HMS	Higher medical school
ICT	Information and communication technologies
KT	Kinesiotherapy
MC	Medical college
MTR	Material and technical resources
NEAA	National evaluation and accreditation agency
PA	Physical activity
PTS	Practival training session
RNA	Ribonucleic acid
SG	State Gazette
SOD	Superoxide dismutase
TU	Trakia University
USA	United States of America
WHO	World Health Organization

I. INTRODUCTION

„Motion can replace many medicines, but neither medicine in the world can replace motion“

Avicenna

In the year 2019 a new virus SARS-CoV-2 was identified in the Chinese town of Wuhan. This marked the beginning of its spread, which very quickly escalated from an epidemic to a pandemic, declared and recognized by the WHO as an emergency of international concern for the public health.

The first report of infected workers at the Wuhan seafood market was made on 31 December 2019, and on 9 January 2020 the first death case of a 61-year-old man was recorded. According to statistics, as at 18 August 2020 the coronavirus has spread to more than 216 countries, with at least 21,756,357 confirmed cases of infected people and 771,635 confirmed fatalities worldwide.

The viral invasion caused serious disruptions in health, economic, social, and educational aspects. The situation that arose required extraordinary measures to be taken to limit the spread of the disease. Distance learning is one of the measures adopted. Defined as "tele-education" or "online learning", it has many positive aspects in terms of epidemic prevention and economics, but also negative consequences for those involved in the learning process. This training is related to: technological equipment; isolation of participants; prolonged sitting in front of monitors; lack of ergonomics in the learning environment; immobility; impact on circadian rhythm and on physical and mental health.

The compulsory social isolation affected the behavioral and mental health of society. The pandemic led to the destruction of the social fabric and norms, creating a sense of insecurity and anxiety, because the world turned out to be unable to predict or prepare itself for this crisis.

School closures, restrictions on social interactions, travel bans imposed, suspension of sporting and cultural activities and everyone switching to online courses caused emotional stress and fear.

A number of observations and studies examine the link between the physical inactivity and the development of many diseases. Limited physical activity or lack thereof, combined with excessive energy consumption, leads not only to weight gain but also to an increased risk of developing diseases

related to the cardiovascular system and musculoskeletal system, or causing diabetes mellitus, non-alcoholic fatty liver disease, lipid metabolism disorders, and others.

To date, most studies have focused on people who have had COVID-19, which is very important for developing a strategy for treating the infection and its consequences. The online learning that became necessary during the pandemic period made it possible to continue the educational process without having to declare zero academic years. Undoubtedly, this way of educating contributed not only to limiting the spread of the virus, but also to the digitalization of the learning process. In addition to those in the field of education, many other professionals also worked online from home.

Our goal is to investigate the negative impact of online training format and to work on both the physical health of trainers and trainees and their psycho-emotional state. And then – based on this, to develop and implement an experimental universal set of exercises combined with a balanced diet.

The lack of such study up to this moment directed our research interest towards this matter. We believe that conducting this investigation and experiment will contribute to optimize training and reducing and/or overcoming the negative effects on the physical and mental health of those who use online environments for training or work, which undoubtedly increases the significance of the analyses obtained not only from a theoretical, but also from a practical point of view.

CHAPTER II. OBJECTIVE, TASKS, METHODOLOGY AND ORGANIZATION OF THE RESEARCH

2.1. Objective and tasks of the research.

Objective: By exploring the impact of online learning during the COVID-19 pandemic on the physical activity and nutrition of students and their teachers at the Medical College – Stara Zagora, to develop and propose a universal set of healthy practices to reduce and/or overcome the negative effects on the physical and mental health of those using the online environment for training or work. To achieve our goal, we set the following **tasks**:

1. To research and analyse literature on nutrition, physical activity, and physical and mental health of people during the COVID-19 pandemic.
2. To investigate the change in physical activity of students and teachers, which have resulted of the measures imposed due to COVID-19 and model of online learning introduced.
3. To explore changes in the nutrition of students and teachers as a result of the measures imposed in connection with COVID-19 and introduced online learning.
4. To develop a set of exercises for students and teachers to reduce physical inactivity and its consequences.
5. To develop a diet that allows for a balance between calorie intake and body energy consumption.
6. To conduct an experiment that includes:
    - Making measurements and perform studies related to hypodynamia;
    - Conducting studies on changes in ways of nutrition during the pandemic;
    - Applying an especially developed complex of exercises and a diet to the affected groups for a period of time not shorter than two months;
    - Monitoring the indicators selected in the experiment and recording their changes: blood pressure, pulse wave velocity, functional physical capacity, anthropometric and morphometric indicators, muscle strength, osteodensitometry.

2.2. Research hypotheses

Hypothesis 1 – It is assumed that the measures imposed in connection with the COVID-19 for online learning have a negative impact on the physical activity, nutrition, and mental health of participants in the learning process.

Hypothesis 2 – It is assumed that the measures imposed in connection with the COVID-19 for online learning have a negative impact on the physical activity, nutrition, and mental health of participants in the learning process ***with a transitional nature upon application of healthy practices.***

2.3. Organization, time and place of the study

Subject of study:

- The process and conditions for conducting online training in connection with the COVID-19 pandemic and its negative impact on students and teachers.

Object of study:

- Teachers providing training at the Medical College of Trakia University, Stara Zagora;
- Students majoring in "Rehabilitation", "Medical Laboratory Technician", "Medical Cosmetologist" and "Assistant Pharmacist" at the Medical College of Trakia University, Stara Zagora.

Scope of study:

The general assemblage encompasses **191** respondents, which is 82% of the initially envisaged 233 respondents, distributed as follows:

- **Teachers** providing training at the Medical College of Trakia University, Stara Zagora (n=32);
- **Students** majoring in "Rehabilitation", "Medical Laboratory Technician", "Medical Cosmetologist" and "Assistant Pharmacist" (n=159).

Criteria for participation in the study:

- Individuals aged 18 and over;
- Signed informed consent to participate in the study;
- Persons trained/training at the Medical College of Trakia University – Stara Zagora.

Criteria for exclusion from the study:

- Refusal to participate in the study;
- Students who have interrupted their studies;
- Persons who have not signed an informed consent form;
- Teachers and students who are temporarily unable to work due to illness as at the time of the study.

2.3.1. Time and place of study

The comprehensive study covers the period from December 2023 to February 2025, by starting after approval received by the Scientific Research Ethics Committee at the Medical University of Varna via Decision No.139 dated 14.12.2023, and was performed at the Medical College of Trakia University in Stara Zagora.

2.3.2. Organization of the study

The study was conducted after receipt of Declaration of Consent No. 684 dated 19.09.2023 of the Director of Medical College at Trakia University – Stara Zagora. In the initial ***preparatory stage*** the problem was identified, on the basis of which the hypotheses were formulated, and the objectives and tasks were defined. The study design was created with the necessary tools for its implementation. An informed consent form for participation in the study was prepared, providing comprehensive information about the nature of the study, the research team, and a contact person upon necessity of additional information. Two types of author-designed questionnaires were prepared, providing information on the negative aspects of online work in an environment of social isolation. A diagnostic card was created *for quick and accurate recording of the clinical indicators selected by us*: blood pressure, pulse wave velocity, functional physical capacity, anthropometric indicators, muscle strength, and bone density. These are indicators that we believe are sensitive to hypodynamia, nutrition and social isolation. Each respondent was provided with detailed information about the purpose of the study, the benefits for the participant, and the confidentiality of the information.

During the experiment, all participants from both groups (experimental and control) underwent measurements and examinations before and after the period of relative social isolation during online learning. In the ***final stage*** the results of the experiment were analyzed and conclusions, benefits, and recommendations were formulated.

The **stages** of the study are presented in tabular form (Table 1).

Table 1. Stages of the study

Stages	***Activity***	***Instrumentarium***	***Location***	***Period***
I stage	Review of the literature on the explored problem and formulation of the main objective, tasks, and working hypotheses. Preparation of the research tools – questionnaire cards. Obtaining a declaration of consent from the director of the institution where the study will be conducted.	Literary sources on the topic (Bulgarian and foreign), scientific databases related to the examined problem.	City of Stara Zagora	September – December 2023
II stage	Obtaining approval from the Scientific Research Ethics Committee. Conducting an anonymous survey among teachers and students at the Medical College of Trakia University, Stara Zagora.	Information about the participant; Informed consent; Questionnaire cards for teachers and students.	City of Stara Zagora	January – March 2024
III stage	Processing of data from the survey and selection of two focus groups: **Group I** – participating in online training, without applying a healthy motor and nutrition regimen; **Group II** – participating in online training, with application of a healthy motor and nutrition regimen;	Informed consent to participate in an experiment involving diet and exercise.	City of Stara Zagora	April – May 2024
IV stage	Development of a diagnostic card and motor and nutrition regimen. Planning and organizing step-by-step examinations and measurements – for a period of up to 3 months.	Diagnostic card. Balanced diet plan. Exercise routine.	City of Stara Zagora	June – August 2024
V stage	Conducting primary research and recording baseline parameters: blood pressure; pulse wave velocity; functional physical capacity; anthropometric indicators; muscle strength; osteodensitometry.	Diagnostic card for recording measured parameters.	City of Stara Zagora	September 2024
VI stage	Application of the experimental diet and exercise regimen and healthy practices in an online learning environment.	Model of motor and nutrition regimen	City of Stara Zagora	September – December 2024
VII stage	Conducting a secondary study of baseline parameters after implementing a diet and exercise regimen and healthy practices.	Diagnostic card for recording measured parameters	City of Stara Zagora	December 2024

VIII stage	Statistical processing and analysis of the data obtained from the implemented studies. Formulation of conclusions and recommendations from the conducted experiment.	Statistical data processing package IBM Statistick SPSS v.20 for WINDOWS	City of Stara Zagora	January – February 2025r.

Sources for collecting of information:

- Available scientific literature on a national and international scale;
- National and international regulatory documents;
- The opinion of students and lecturers at HEI on the researched issue.

2.4. Materials and methods:

2.4.1. Documentary method:

Review of literature, documents and photographs describing the issues under study.

2.4.2. Sociological method:

Conducting a survey through a specially developed direct, anonymous, individual questionnaire card:

- Questionnaire Card No. 1 (students);
- Questionnaire Card No. 2 (teachers).

2.4.3. Statistical methods:

Methods for analyzing and interpreting data in view of revealing the essence of the observed phenomena and their interdependencies. The data from the study were collected and entered into MC Excel. Statistical analysis was performed using IBM Statistick v.20 for WINDOWS. The results obtained were assessed as statistically dependent when the p-value < 0.05, in which case the null hypothesis was rejected. Depending on the tasks, the following statistical methods were applied:

1. ***Descriptive methods and evaluation methods***
    - Descriptive statistics for quantitative variables – mean value, minimum value, maximum value, and standard deviation;
    - Frequency analysis of qualitative variables (nominal and ordinal), which includes absolute frequencies, relative frequencies (in percentage), cumulative relative frequencies (in percentage).

2. ***Methods for testing hypotheses***

- Kolmogorov-Smirnov and Shapiro-Wilk test to assess the normality of the distribution of a given data sample;
- Chi-square test for goodness-of-fit (consistency), chi-square test for independence, and Fisher's exact test for mutual influence between two qualitative variables;
- Student's t-test for comparing mean values between quantitative variables between different measurements;
- Correlation analysis to establish the relationship between the quantitative and qualitative variables investigated.

The data are graphically illustrated using tables, bar charts, and pie charts created in MS Excel.

2.4.4. Laboratory method:

- Experiment – relating to the development and implementation of a diet and exercise regimen and healthy practices for a specific period of time.

2.5. Research tools.

- ***Direct individual questionnaire card for students***, including twenty-seven closed-ended questions, with answers structured according to the Likert and rank scales. These will be used to measure the varying degrees of attitudes or opinions regarding the negatives caused by online learning, which has become necessary during the COVID pandemic. The questionnaire also contains two open-ended questions, No. 16 and No. 29, which will be used to supplement the information on the negative aspects of online learning in an environment of social isolation. (*Appendix No. 1*);
- ***Direct individual questionnaire card for teachers*** at the Medical College of Trakia University, including twenty-eight closed-ended questions about the impact of COVID-19 and the imposed online learning on the physical, mental, and health status of its participants. The questionnaire also contains two open-ended questions, No. 18 and No. 27, which we use to supplement the information about the negative effects of online work in an environment of social isolation. (*Appendix No. 2*);
- ***Diagnostic card*** consisting of two parts: (*Appendix No. 3*)
  - First part (passport), providing personal information about the respondent;

- Second part for quick and accurate recording of the clinical indicators we have selected: blood pressure, pulse wave velocity, functional physical capacity, anthropometric indicators, muscle strength, bone density. Indicators that we believe are sensitive to hypodynamia, nutrition and social isolation.

- **Informed consent** – certifying the voluntary participation in the study.
- **Information for participants** – developed for the specific investigation and providing detailed information on the purpose and expected benefits of the study.

CHAPTER III. RESULTS FROM OWN RESEARCH

3.1. Analysis of the results of the study among teachers on the impact of the COVID-19 pandemic and the imposed online learning on the physical, mental and health status of those participating in it.

The study included 191 respondents in total with a higher relative share of students (83.25%, n=159) compared to the relative share of respondents from the group of teachers (16.75%, n=32).This difference in relative proportions is statistically considerable at a significance level of $p<0.05$.

According to gender, in the group of teachers, female respondents have a higher relative share (*65.63%, n=21*) compared to the relative share of male respondents (*34.38%, n=11*). This difference is statistically significant ($p<0.05$) (Fig. 1).

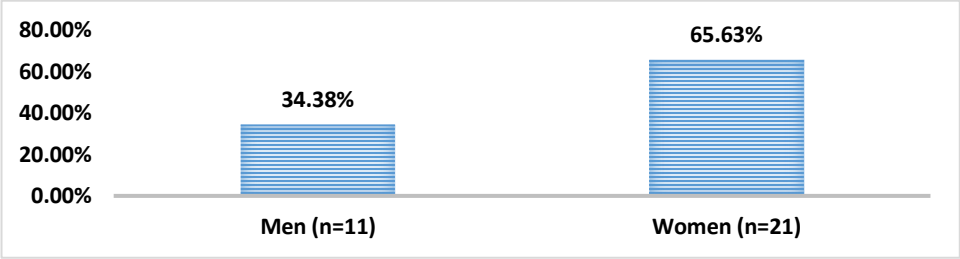


Figure 1. Distribution of respondents from the group of teachers by gender

In terms of age, the highest percentage of respondents are in the group of 41 to 60 (*46.88%, n=15*). Participants in the study aged over 61 represent 28.13% (n=9) of the teachers surveyed, by ¼ of all respondents (25.00%, n=8) are within age interval 23 to 40 (Fig. 2).

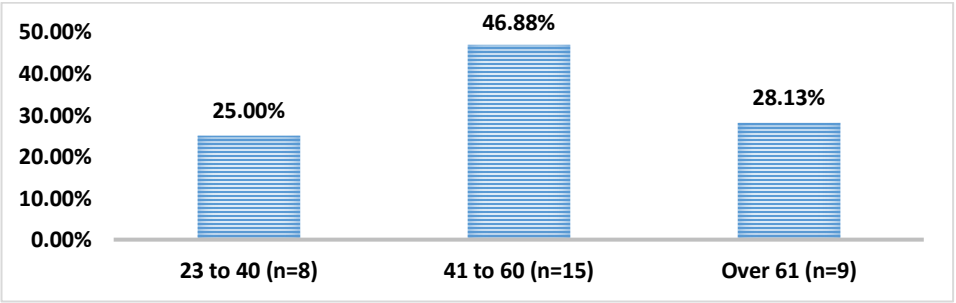


Figure 2. Distribution of respondents from the group of teachers by age

Almost all respondents in this group (84.38%, n=27) answered affirmatively to the question of whether they had noticed any change in their physical activity during the COVID-19 pandemic, while only 12.50% (n=4) said they had not noticed any change in their physical activity during this period. The analysis of data did not reveal any categorically negative responses. This means that each

of the respondents had reduced their physical activity during the pandemic. One participant (3.13%, n=1) had no opinion on the matter.

With regard to walking activity, the highest relative share (37.50%, n=12) is among respondents whose average number of steps per day during the pandemic measures was 4,000. The relative shares (28.13%, n=9) of participants under study who reported walking up to 2,000 steps or up to 3,000 steps per day were equal. Only two respondents (6.25%, n=2) reported walking more than 5,000 steps per day during the COVID-19 pandemic (Fig. 3).

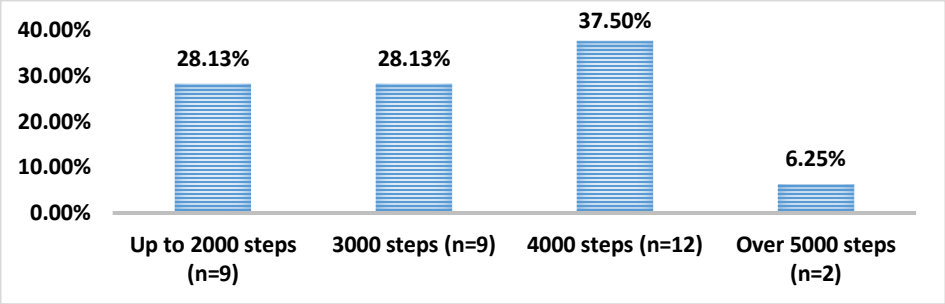


Figure 3. Average number of steps made during pandemic measures

Little above the half of the participants in our study (53.13%, n=17) shared that during the time of pandemic measures they did not engage in physical activity beyond their normal daily routine, while 9.38% (n=3) said that they exercised daily despite the restrictions under pandemic circumstances. 12.50% (n=4) of all respondents in this study exercised between 3 and 4 times a week (Fig. 4).

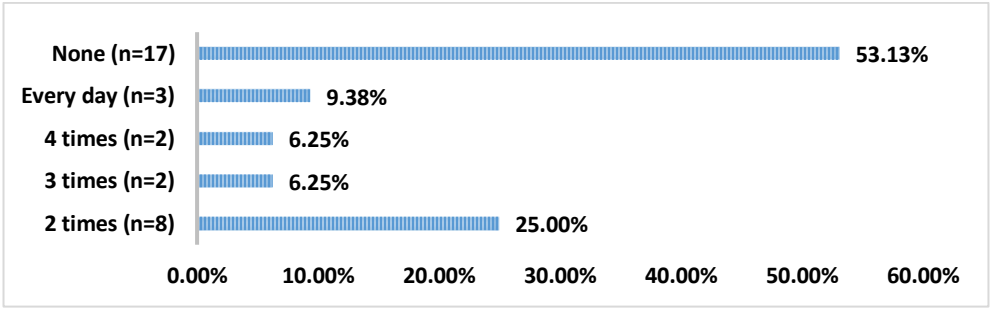


Figure 4. Number of planned physical activities beyond the normal daily routine

In the subgroup of respondents (n=15) who reported having planned physical activities, almost half of them (46.67%, n=7) stated that they exercised for up to 1 hour per week. Exactly 1/3 spent about 1.5 hours on physical activities (33.33%, n=5). 13.33% (n=2) of those who were active did exercises two hours per week, and only one respondent had physical activity of more than two hours per week (6.67%, n=1).

We were interested in finding out whether the participants in the study noticed any change in their heart rate during the extreme physical exertion. Half of the respondents said that they hardly ever noticed a change in their heart rate (50.00%, n=16), while 12.50% (n=4) of all surveyed teachers declared a definite change. In 21.88% (n=7) of cases there was rather no change than yes, while 15.63% (n=5) were unable to assess the situation. No respondents were found who had not noticed any change (Fig. 5).

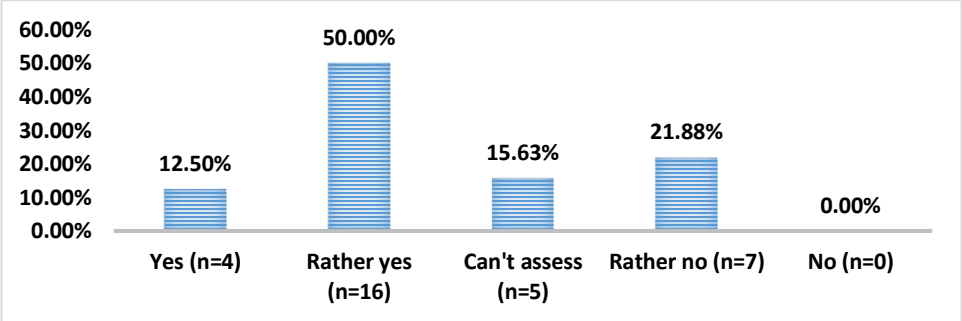


Figure 5. Change in heart rate during extreme physical activity

When asked whether they have difficulty breathing upon climbing stairs, a large proportion of respondents informed that they experience shortness of breath upon climbing stairs (75.00%, n=24). Minor or barely noticeable difficulties were reported by 18.75% (n=6), and only 6.25% (n=2) of all respondents from the group of teachers reported no difficulty breathing upon climbing stairs (Fig. 6).

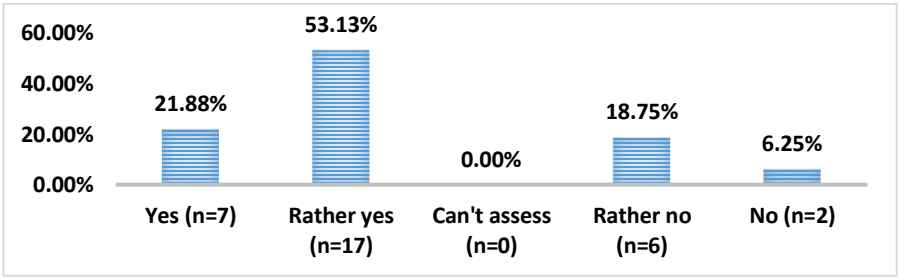


Figure 6. Shortness of breath upon climbing stairs

Teachers were asked whether they had changed their eating habits during the COVID-19 pandemic measures, with 6.25% (n=2) reporting a definite change and nearly half of the respondents (46.88%, n=15) reporting certain change. No significant change in their eating habits was reported by 9.38% (n=3), and according to 1/3 there is almost no change in their eating habits during the pandemic measures (31.25%, n=10). 6.25% (n=2) of the group of teachers had no opinion on this issue (Fig. 7).

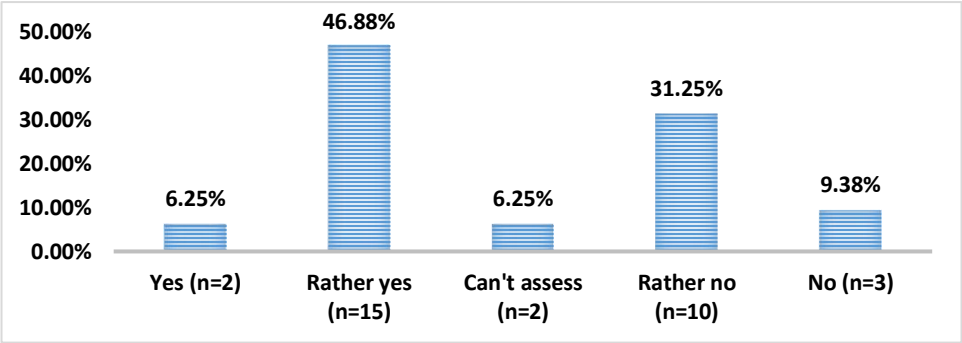


Figure 7. Change in eating habits during the COVID-19 pandemic

With regard to the number of meals per day there were no respondents who ate less than twice a day, by equal proportions of respondents eating three or four times a day (37.50%, n=12) were established. Just over 1/5 of respondents (21.88%, n=7) reported having 5 meals a day, and only 1 participant reported more than 5 meals a day on average during the COVID-19 pandemic (3.13%, n=1) (Fig. 8).

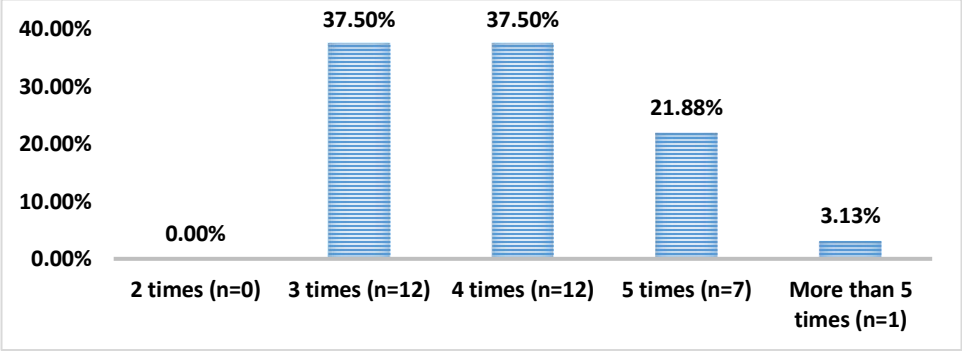


Figure 8. Number of meals per day during the COVID-19 pandemic

A high relative proportion of respondents stated that they could not define their diet during the pandemic as healthy (62.50%, n = 20), while 31.25% (n=10) believe that they almost have managed to eat healthily. No participants were found who adhered to a healthy diet during the pandemic measures (Fig. 9). This can be explained by the synergy between stress, social isolation, and physical inactivity, which leads to a drastic change in eating habits.

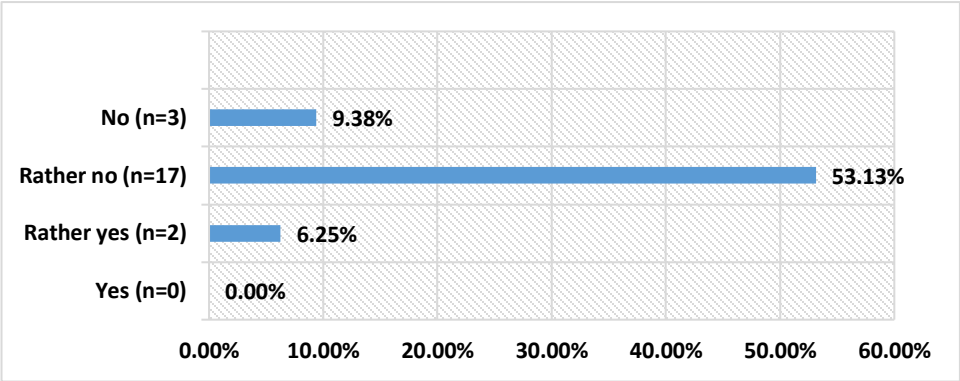


Figure 9. Healthy eating during the pandemic of COVID-19

It was interesting to find out whether the teachers were taking supplements and vitamins during the pandemic and at what frequency. The majority of respondents reported that they took supplements or vitamins (81.25%, n=26), while 65.63% (n=21) did not. Half of the respondents took supplements between 2 and 6 times per week (50.00%, n=16). Daily intake was experienced by 1/4 of all participants (25.00%, n=8) and a half of them did not take supplements in tablet or other form (50.00%, n=16). A high relative proportion of respondents (56.25%, n=18) stated that they took vitamins daily (Table 2).

Table 2. Dietary supplement intake during the pandemic

Type of additive	Once per week		Twice per week		3 to 6 times per week		Every day		Do not take	
	n	%	n	%	n	%	n	%	n	%
Dietary supplements	0	0.00%	3	9.38%	5	15.63%	8	25.00%	16	50.00%
Vitamins	1	3.13%	5	15.63%	3	9.38%	18	56.25%	5	15.63%
TOTAL	1	3.13%	8	25.00%	8	25.00%	26	81.25%	21	65.63%

Nearly two-thirds of the respondents (65.63%, n=21) from the group of teachers marked changes in body weight during the pandemic period and online training, while the remaining one-third (34.38%, n=11) showed no change. These data prove that staying at home, limiting physical activity and introducing online learning as a preventive measure led to change in body weight of respondents (Fig. 10).

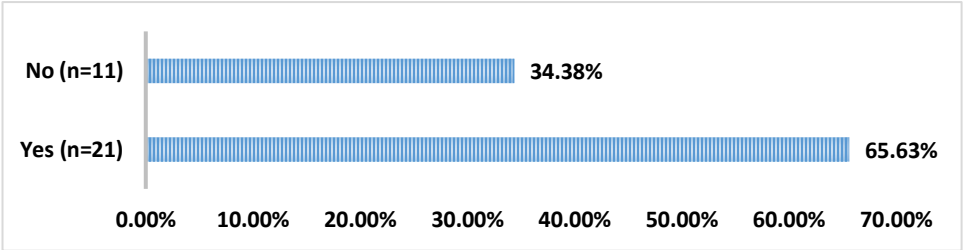


FIgure 10. Weight change during pandemic measures and online training

Majority of the respondents in the study (52.38%, n=11) who found change in their body weight reported that it was up to 5 kg, while the remaining 47.62% (n=10) had body gain by up to 10 kg (Fig.11). No changes above 10 kg were recorded. We assume that this result may be due to the inconvenience of sharing a higher weight gain or the actual change was slightly above 10 kg and, at the discretion of the respondent, a response of up to 10 kg was marked.

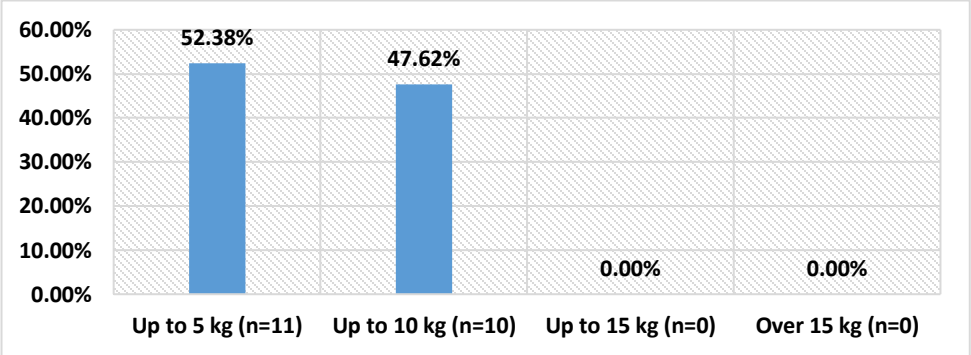


Figure 11. Change of body weight in kilograms

Almost all respondents had to be online every day during the working days (78.13%, n=25), while only 18.75% (n=6) shared that their online work was not daily, which is explained by the frequency and number of horarium of the discipline they lead (Fig. 12).

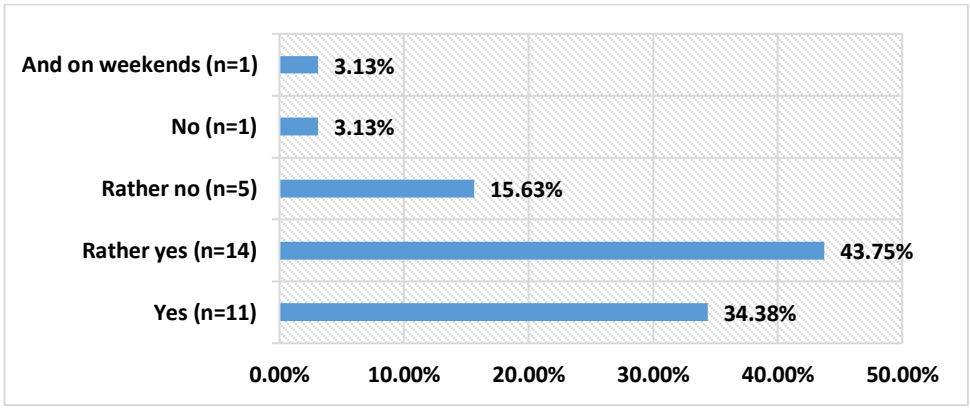


Figure 12. Daily presence in an online environment

When asked what was the daily length of their stay in front of the monitor, half of the lecturers (50.00%, n=16) indicated that they had 8 hours of daily stay, just under 1/3 of all participants had up to 5 hours in front of the monitor (31.25%, n=10) and only 6.25% (n=2) of all surveyed lecturers had minimal stay of up to 3 hours. Four respondents (12.50%, n=4) were found to have spent more than 10 hours per day in front of the monitor on average (Fig. 13).

The reason for this long stay could be the need to quickly revise the course material into a format suitable for online studying on the one hand, and the difficulty of some of the older colleagues to use a computer, on the other hand.

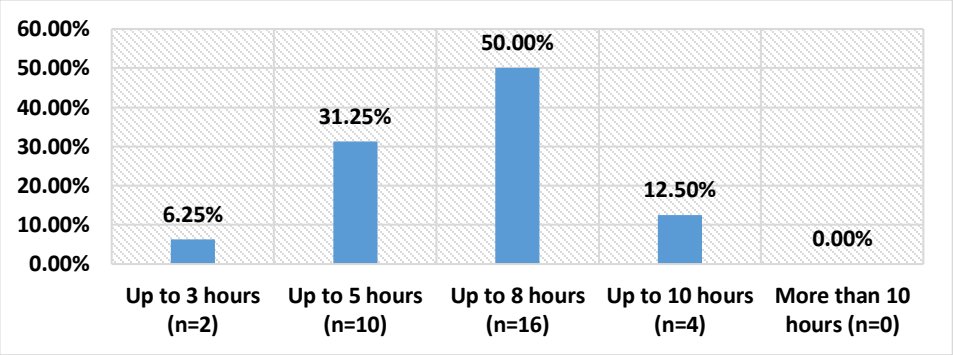


Figure 13. Daily duration of stay in front of the monitor

A high relative proportion of the surveyed lecturers believe that with the introduction of online learning their workload has increased (68.75%, n=22), with a definite increase in workload is stated by 1/5 of all lecturers (21.88%, n=7) (Fig. 14). Not a single negative response was available.

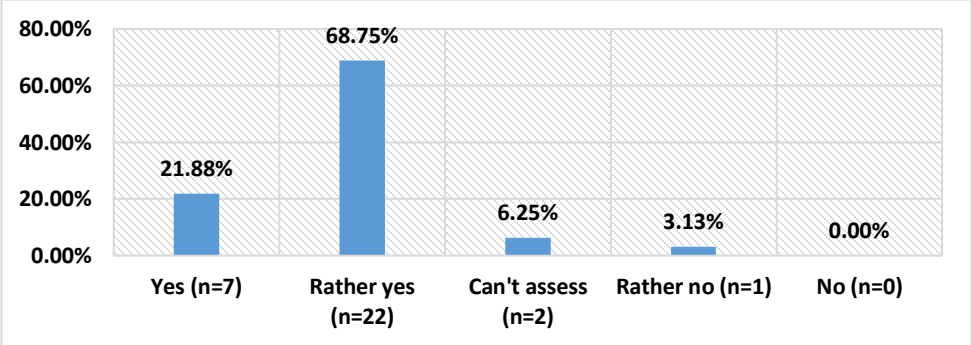


Figure 14. Increase in workload with the introduction of online learning

A large majority of the lecturers (56.25%, n=18) agree around the opinion that they would rather not practice online teaching if there were not urgency measures imposed, while exactly 1/4 of them (25.00%, n=8) would definitely not teach in a remote environment if it were up to them. One respondent expressed a positive attitude towards teaching in an online environment (3.13%, n=1),

while 12.50% (n=4) of the university lecturers who took part in the survey would rather perform teaching in this way (Fig. 15).

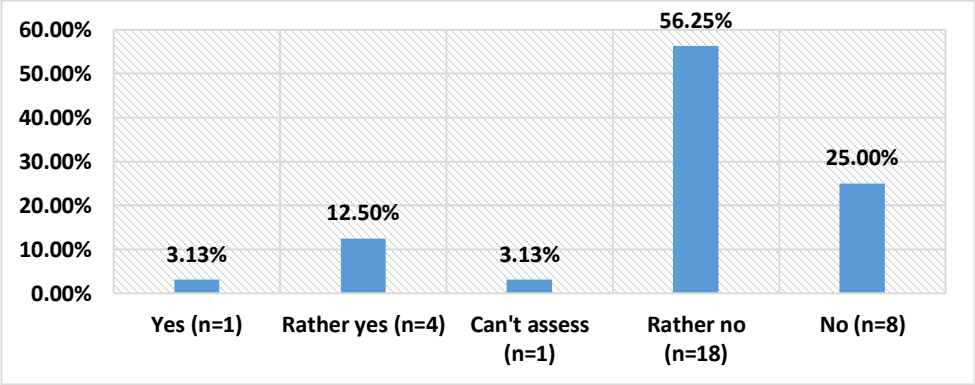


Figure 15. Attitudes towards online learning without emergency measures imposed

One of the downsides of working "online" in an environment of social isolation is the frequently observed change in sleep patterns. A large proportion of faculty respondents (68.75%, n=22) reported sleep changes during online learning, while the remaining 31.25% (n=10) did not (Fig. 16).

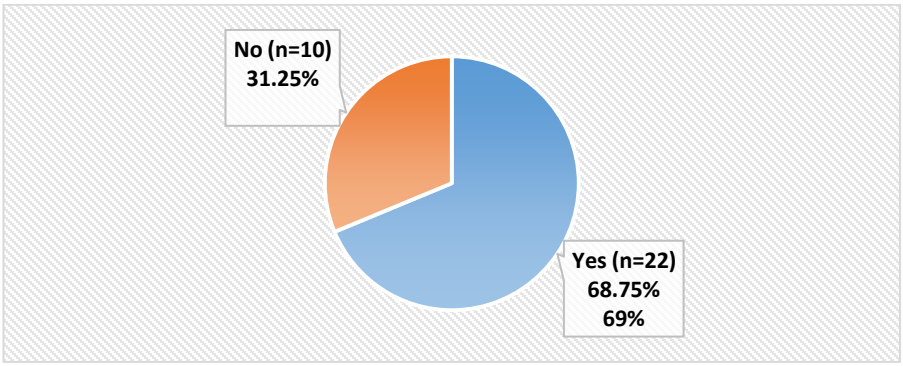


Figure 16. Changes in sleep pattern during pandemic and online learning

These results highlight that for the majority of the tutors, online work had a markedly negative impact on their sleep quality, with n-11 manifesting it by difficulty falling asleep, nine respondents complaining of frequent waking, and n-6 experienced insomnia and staying awake.

3.2. Analysis of the results of study made among students about the impact of COVID-19 pandemic and the necessitated 'online' learning on the physical, mental and health status of involved ones.

In the group of student respondents, the female respondents have a higher relative proportion *(68.55%, n=109)* compared to the relative proportion of male respondents *(31.45%, n=50).* This difference is statistically significant ($p<0.05$) (Fig. 17).

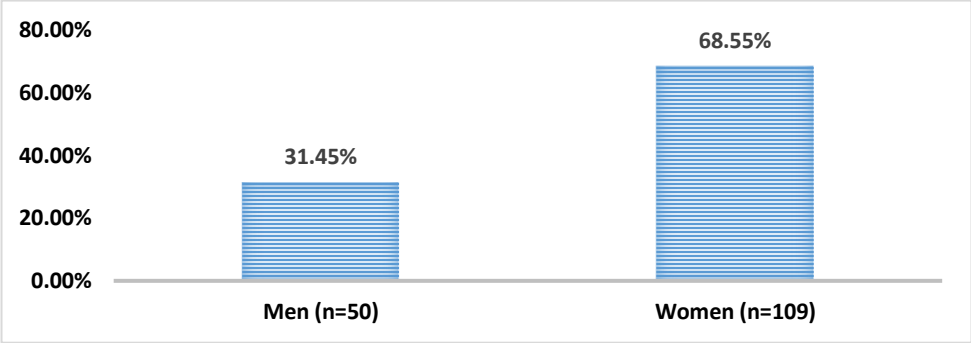


Figure 17. Distribution of respondents from the group of students by gender

From the aspect of age group, the highest percentage of students fell within the range 19 to 31 years *(76.10%, n=121)*, 15.72% (n=25) were between 31 and 40 years of age, and those aged over 41 years represented 8.18% (n=13) (Fig.18).

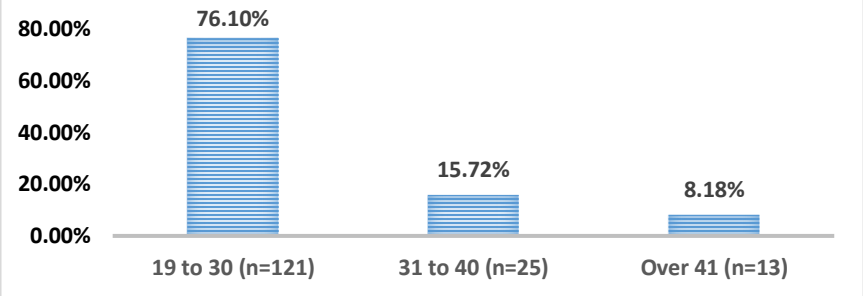


Figure 18. Distribution of respondents by age

With regard to activity related to walking, the highest relative proportion (37.74%, n=60) were respondents for whom the average number of steps walked daily during the pandemic measures was 3000, while 30.19% (n=48) walked up to 2000 steps every day. Slightly less than 1/4 of the respondents reported that they walked an average of about 4000 steps (22.64%, n=36). The lowest relative proportion of respondents walked more than 5000 steps per day during the pandemic measures (9.43%, n=15) (Fig. 19). Taking into consideration the pandemic measures for social isolation the described result was expected.

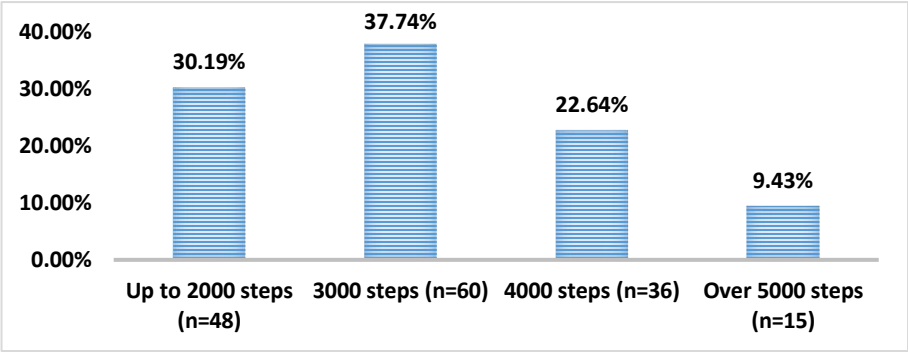


Figure 19. Average number of steps walked during pandemic measures

Nearly one third of respondents (32.70%, n=52) reported that during the pandemic period they did not have any physical activity beyond the normal daily routine, however 15.72% (n=25) responded that they practised exercises on a daily basis despite the restrictions of the pandemic situation, which is because there were athletes among the participants for whom systematic sports activities were established as a habit and necessity. Activity of 3 times a week was practised by 18.87% (n=30) and 4 times – by 12.58% (n=20). Slightly more than 1/5 of all surveyed students reported that they engaged in physical activity on 2 week-days (20.13%, n=32) (Fig. 20).

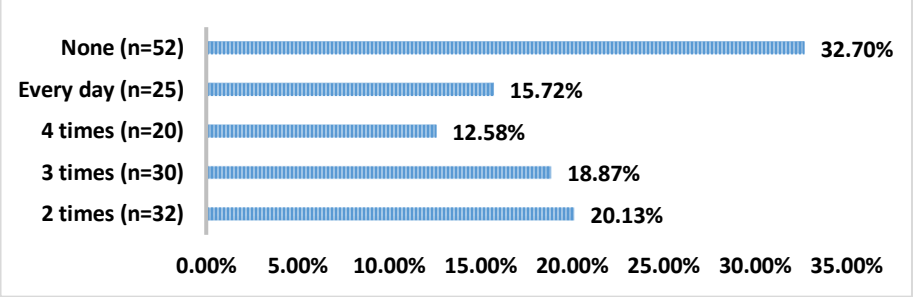


Figure 20. Number of scheduled physical activities beyond the normal daily routine

In the subgroup of respondents (n=107) who reported that they had scheduled physical activities, almost half of them (44.86%, n=48) stated that they exercised up to 1 hour per week. Little above 1/3 spent about 1.5 hours exercising (36.45%, n=39). Two hours per week was spent by 14.02% (n=15) and three respondents had physical activity of 2.5 hours per week (2.80%, n=3). Only two students reported that they had planned physical activity of more than 2.5 hours per week during the pandemic measures (1.87%, n=2) (Fig. 21).

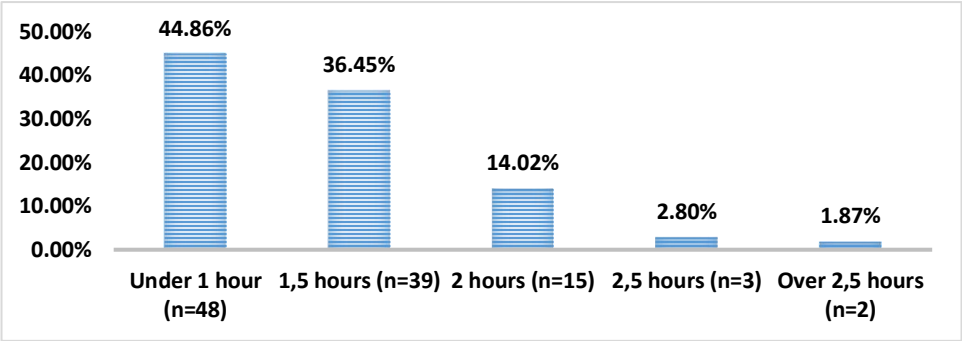


Figure 21. Duration of planned physical activity

Slightly more than 1/3 of the respondents indicated that during the pandemic they found their dietary pattern changed to varying degrees, by 10.06% (n=16) reporting a definite change and 25.16% (n=40) believing that their eating behaviour had changed a little compared to the time before the pandemic measures were introduced. 13.21% (n=21) had no opinion. An absolute lack of change in eating pattern was found in 18.24% (n=29), and 1/3 of respondents said that they almost had not changed their eating habits (33.33%, n=53) (Fig. 22).

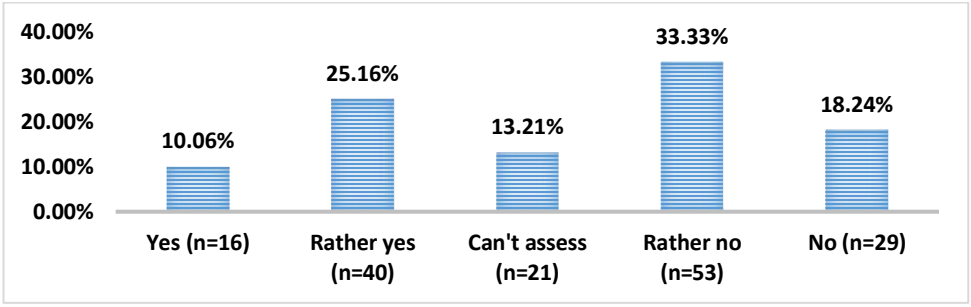


Figure 22. Change in eating behaviour during the pandemc

It was interesting for us to find out what the number of meals of the study participants was during the pandemic. A large proportion of respondents reported that they ate 3 times a day (45.91%, n=73) and 42.14% (n=67) ate 4 times a day. Nearly 1/10 of all respondents ate 5 or more times a day during the COVID-19 pandemic (9.43%, n=15). The relative proportion of students who ate 2 times a day is low (2.52%, n=4) (Fig. 23).

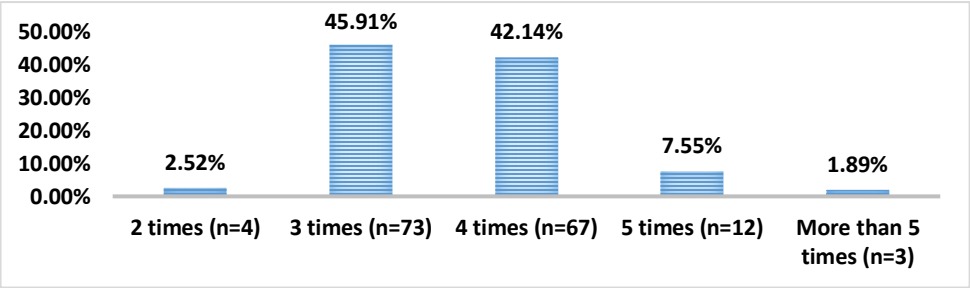
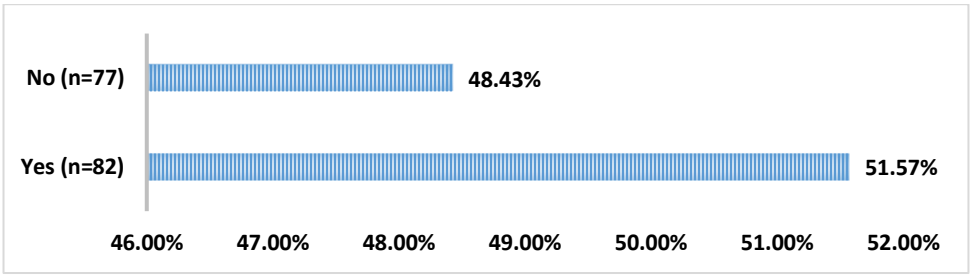


Figure 23. Number of meals per day during the COVID-19 pandemic

One of the expected bad outcomes of reduced physical activity and social isolation is weight change. Just over half of respondents (51.77%, n=82) in this group showed a change in body weight, while 48.43% (n=77) of respondents did not (Figure 24).



Fugure 24. Body weight change during pandemic measures and online training

Majority of the respondents who noticed change in their body weight (75.61%, n=62) reported that this change was up to 5 kg and 1/5 increased their body weight by up to 10 kg (20.73%,n=17). Two respondents had changed their body weight by up to 15 kg (2.44%, n=2) and one respondent by more than 15 kg (1.22%, n=1) (Fig.25).

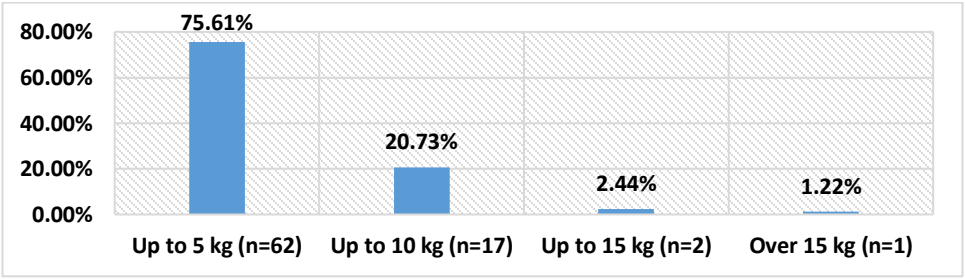


Figure 25. Change of body weight in kilograms

Almost all of the surveyed students (76.10%, n=121) reported that they were online on a daily basis, while 23.90% (n=38) indicated that they did not have to study online every day. There were no responses for such workload on weekends.

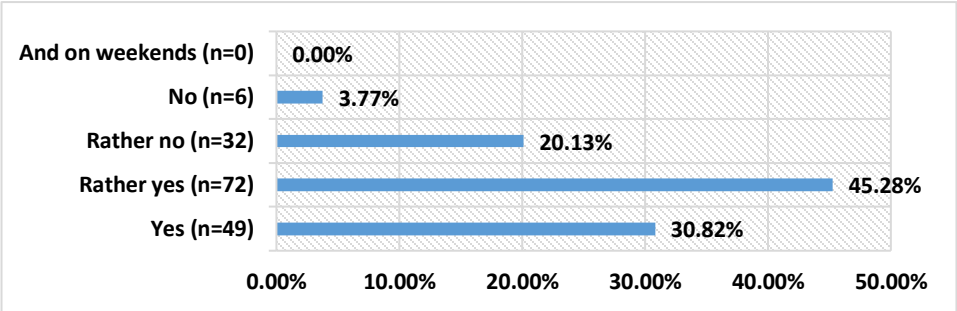


Figure 26. Daily presence in an online environment

During the pandemic, a large proportion of respondents (69.18%, n=110) had an 8-hour average daily time in front of a monitor in an online environment. Just over 1/4 of all had up to 5 hours in front of a monitor (26.42%, n=42), while neither of respondents marked a minimum stay of up to 3 hours. There were six respondents who on average spent up to 10 hours per day in front of a monitor (3.77%, n=6) and one who spent more than 10 hours (Fig. 27).

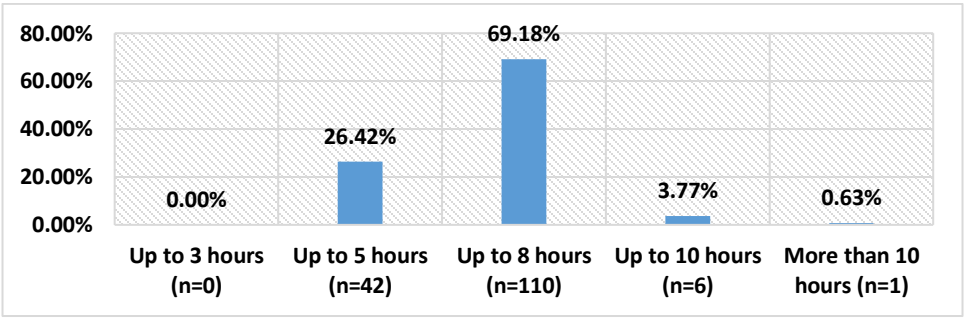


Figure 27. Daily duration of stay in front of the monitor

The relative proportion of the surveyed students, who felt that their study time increased with the introduction of online learning, is high (46.45%, n=74), 15.72% (n=25). About 1/4 of the respondents (26.42%, n=42) could not give a categorical answer to this question and 7.55% (n=12) of the students reported almost no change. Only 3.77% (n=6) of all respondents in this group reported no change in study employment (Fig. 28).

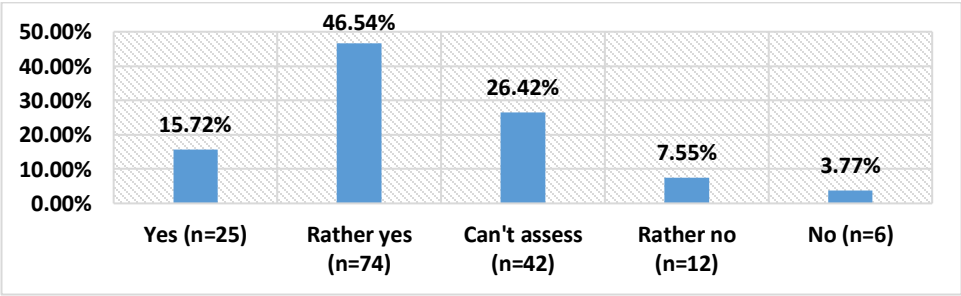


Figure 28. Increase in study employment with the introduction of online learning

A large part of students (38.99%, n=62) strongly agree around the opinion that they would not study online if there were not any emergency measures imposed, and nearly 1/3 (32.70%, n=52) state that if it were up to them they would rather not study in a remote learning environment. Only 6.9%, n=11 were positive about this type of training (Fig. 29).

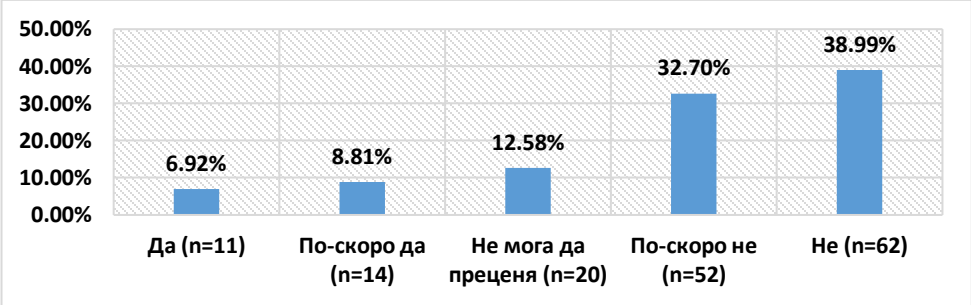


Figure 29. Attitudes towards online learning without emergency measures imposed

Respondents from the student group were also inquired if they have observed any changes in their sleep patterns during the pandemic and online learning. A majority of the surveyed participants reported some sleep changes (59.12%, n=94), while the remaining 40.88% (n=65) had not experienced such changes (Fig. 37).

In the subgroup of respondents (n=94) who shared that they had detected alteration in their sleep pattern during the pandemic, the highest relative proportion (39.36%, n=37) were those who reported difficulty falling asleep, followed by those who woke up frequently (23.40%, n=22), and those who experienced staying awake at night (22.34%, n=21). Insomnia, of all the students surveyed, was reported by 14.89% (n=14) (Fig. 30).

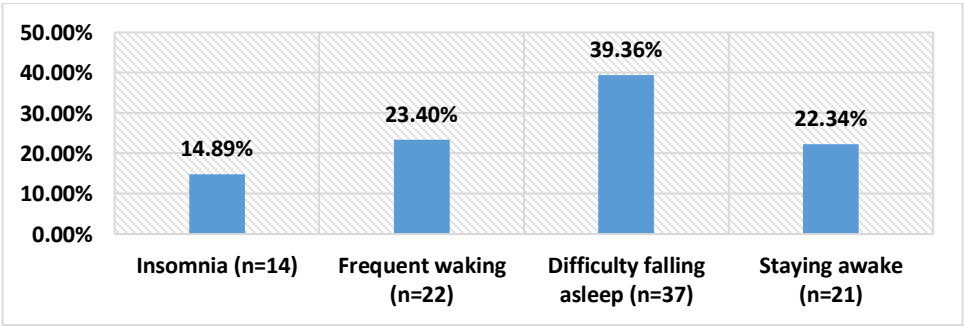


Figure 30. Types of changes in sleep patterns

These results again prove that social isolation, prolonged stay in electronic environment, hypodynamia, fear of contagion and unknown future exert influence on circadian rhythms. One of the real manifestations of this negative impact is difficulty falling asleep, frequent waking up or

staying awake at night, and insomnia, with subsequent effects on cognitive function and mental health.

3.3. ANALYSIS FROM THE DIAGNOSTIC CARD

The present study included 90 participants divided into two groups, experimental and control. In both groups the participants had the same relative proportion of 50.00% (n=45) (Fig. 31).

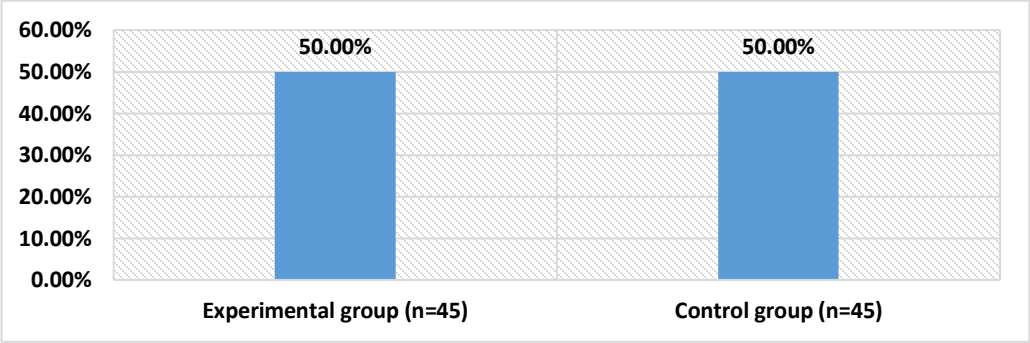


Figure 31. Distribution of participants in the control and experimental group

Students had a higher relative proportion in the experiment (82.22%, n=74) compared to the teacher group (17.78%, n=16). The reason for this is that during the period of the experiment, lecturers were selected who have regular classes in leading subjects or disciplines that are being studied in that semester according to the curriculum.

The average age of the participants in the experimental group was 29.11 (SD±9.153) with a minimum age of 20 years and a maximum of 49 years. In the control group, the average age of the participants was 31.42 (SD±10.631) with a minimum age of 20 and a maximum age of 60 (Table 3).

Table 3. Age of participants in the study by group

Group	Min	Max	Mean	St.Dev	p-value
Experimental group	20	49	29.11	9.153	p=0.272
Control group	20	60	31.42	10.631	

In order to test the hypothesis that the arithmetic average of age for the two groups: control and experimental was equal, a t-test for independent samples was conducted, which revealed that there was no statistically significant difference for the arithmetic mean of age of the participants in the experimental group (M=29.11; SD±9.153) and the control group (M=31.42; SD±10.631): $t(88) = -1.105$, $p>0.05$. These results show a homogeneous distribution of participants in the both groups with respect to age.

The mean height of the participants in centimeters in the experimental group was 166.38 (SD±8.365) with a minimum height of 150 cm and a maximum height of 188 cm, and in the control group the mean height was found to be 166.56 (SD±9.152) with a minimum height of 150 cm and a maximum height of 187 cm (Table 4).

Table 4. Height of participants in the study by group

Group	Min	Max	Mean	St.Dev	p-value
Experimental group	150	188	166.38	8.365	p=0.924
Control group	150	187	166.56	9.152	

There was no statistically significant difference in height between the participants of the experimental group (M=166.38; SD±8.365) and the control group (M=166.56; SD±9.152): t(88)=-0.096, p>0.05. Statistical analysis of the data showed that in terms of height participants in both groups were homogeneously distributed.

The mean body mass in kg of the participants in the experimental group before the start of the experiment was 65.24 (SD±12.281) with a minimum value of 47 kg and a maximum value of 100 kg. After the end of the experiment, the mean body weight in this group was 64.64 (SD±10.605) with a minimum score of 49 kg and a maximum score of 90 kg (Table 5).

Table 5. Weight of participants in the study from the experimental group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	47	100	65.24	12.281	p=0.192
After experiment	49	90	64.64	10.605	

The established difference in body weight of participants in the experimental group was not statistically significant (p>0.05) and no increase or decrease in body weight was found during the course of the experiment.

The mean body mass in kilograms of the participants in the control group before the start of the experiment was 66.87 (SD±13.188) with a minimum indicator value of 50 kg and a maximum value of 120 kg. After the end of the experiment, the mean body weight in this group was 70.31 (SD±14.491) with a minimum value of 50 kg and a maximum value of 127 kg (Table 6).

Table 6. Weight of participants from the control group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	50	120	66.87	13.188	p<0.001
After experiment	50	127	70.31	14.491	

The difference in body weight of the participants from the control group was found to be statistically significant (p<0.001). A statistically significant increase in body mass was found in the course of the experiment.

The difference in the mean value of body mass before the beginning of the experiment in the control group (M=66.87, SD±13.188) and the experimental group (M=65.24, SD±12.281) did not show a statistically significant difference: t(88) = -0.604, p=0.547. The analysis of these data indicates that before the start of the experiment the both groups were homogeneous in terms of the body weight of the participants in each group.

A statistically significant difference in mean body mass was found between the post-experiment value for the experimental group (M=64.64, SD±10.605) and the control group (M=70.31, SD±14.491): t(88) = -2.117, p=0.037. The analysis of these data shows that after the experiment the both groups were not homogeneous in terms of body weight, and the difference in mean values can be explained by the intervention at the time of the experiment (Fig. 32).

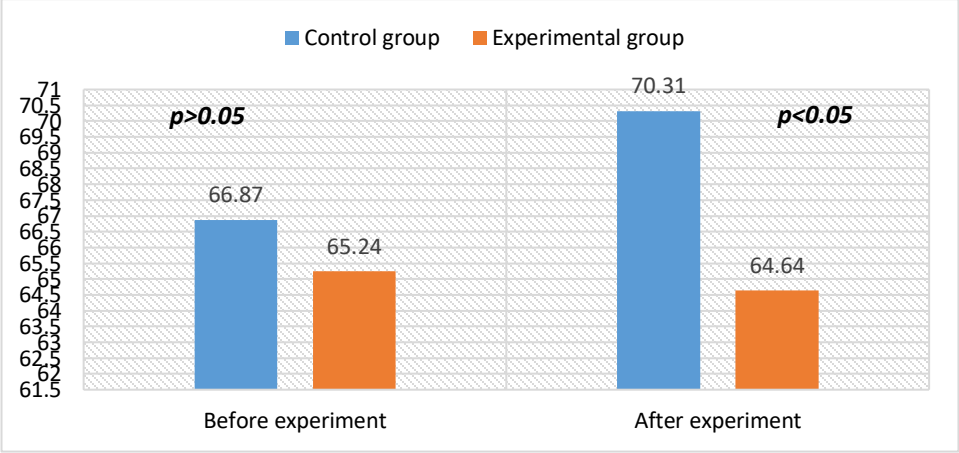


Figure 32. Mean value of body mass in both groups of participants before and after the experiment

According to the pooled data analysis, 15.56% (n=7) of the control group (n=45) showed no change in body mass. Body weight reduction was found in 4.44% (n=2) of the persons. In this group the highest relative proportion is of participants, whose body mass increased by up to 5 kg (64.44%, n=29), and in 15.56% (n=7) the increase in body mass during the experiment was up to 10 kg. The

opposite data were observed in the experimental group (n=45), where 28.89% (n=13) had no change in body mass and 35.56% (n=16) decreased their body mass compared to the beginning of the experiment. The same was the relative proportion of participants in the experimental group, whose body weight increased by up to 5 kg. There were no participants in this group whose body weight increased by up to 10 kg or more (Fig. 33).

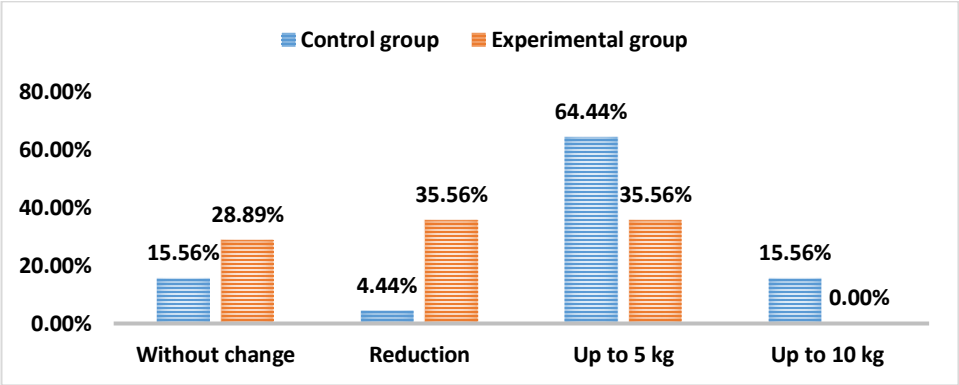


Figure 33. Change in body weight of participants in the control and experimental groups

In the experimental group, before the start of the experiment, nearly half of the participants had standard muscle mass (48.89%, n=22), 1/3 of the participants had low muscle mass (33.33%, n=15), and 17.78% (n=8) had excellent muscle mass. These differences were statistically insignificant (χ^2=4.533, p>0.05). At the end of the experiment, assessment of the muscle mass of the participants showed that just over half of those who participated had standard muscle mass (53.33%, n=24), just over 1/3 had excellent muscle mass (35.36%, n=16), and the change in fat relative to muscle mass was lower in 11.11% (n=5) of all participants. These differences were statistically significant ($\chi^2$12.133, p<0.05) (Table 7).

Table 7. Muscle mass of the participants in the experimental group

Body mass	Up to 30 kg		30 to 39		Over 39		χ^2	p-value
	N	%	N	%	N	%		
Before experiment	15	33.33%	22	48.89%	8	17.78%	4.533	p=0.058
After experiment	5	11.11%	24	53.33%	16	35.36%	12.133	p=0.002

In the control group before the start of the experiment 71.11% (n=32) of the participants had standard muscle mass, nearly 1/4 (24.44%, n=11) had low muscle mass, and 4.44% (n=2) had excellent muscle mass. These differences were statistically significant (χ^2=31.600, p<0.01). At the

end of the experiment the assessment of muscle mass of the participants showed that 2/3 of them had low muscle mass (66.67%, n=30), just under 1/3 of the participants had standard muscle mass (31.11%, n=14), and 2.22% (n=1) had excellent muscle mass. These differences were statistically significant ($\chi 2=28.133$, $p<0.01$) (Table 8).

Table 8. Muscle mass of the participants in the control group

Muscle mass	Up to 30 kg		30 to 39		Over 39		χ^2	p-value
	N	%	N	%	N	%		
Before experiment	11	24.44%	32	71.11%	2	4.44%	31.600	p<0.001
After experiment	30	66.67%	14	31.11%	1	2.22%	28.133	p<0.001

The mean body mass index of the participants from the experimental group before the start of the experiment was 23.52 (SD±3.353) with a minimum value of 15.3 and a maximum value of 33.1. After the end of the experiment the mean value of body mass index in this group was 23.32 (SD±2.731) with a minimum value of 16.3 and a maximum value of 30.5 (Table 9).

Table 9. Body mass index of the participants in the experimental group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	15.3	33.1	23.52	3.353	p=0.209
After experiment	16.3	30.5	23.32	2.731	

The difference calculated in the body mass index of the participants from experimental group was statistically insignificant ($p>0.05$). There was no statistically significant increase or decrease in body mass index in the course of the experiment, i.e. the participants did not show any change in the dynamics of this indicator.

The mean value of the body mass index of the participants from control group before the start of the experiment was 24.01 (SD±2.888) with a minimum value of the indicator of 18 and a maximum value of 35.4. After the end of the experiment the mean value of body mass index in this group was 25.26 (SD±3.348) with a minimum value of 18.9 and a maximum score of 37.5 (Table 10).

Table 10. Body mass index of the participants in the control group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	18.0	35.4	24.01	2.888	p<0.001
After experiment	18.9	37.5	25.26	3.348	

The difference in body mass index of the participants from the control group was statistically significant (p<0.001). There was a statistically significant increase in body mass index over the course of the experiment.

The difference in the mean value of body mass index before the beginning of the experiment in the control group (M=24.01, SD±2.888) and the experimental group (M=23.52, SD±3.353) did not show a statistically significant difference: t(88) = -0.744, p=0.459. The analysis of these data showed that before the start of the experiment the both groups were homogeneous in terms of body mass index. A statistically significant difference in the mean value of the body mass index was found between the value of the index after the end of the experiment for the experimental group (M=23.32, SD±2.731) and the control group (M=25.26, SD±3.348): t(88) = -3.019, p=0.003. The analysis of these data shows that after the experiment the both groups were not homogeneous in terms of body mass index, and the difference in mean values can be explained by the intervention at the time of the experiment (Fig. 34).

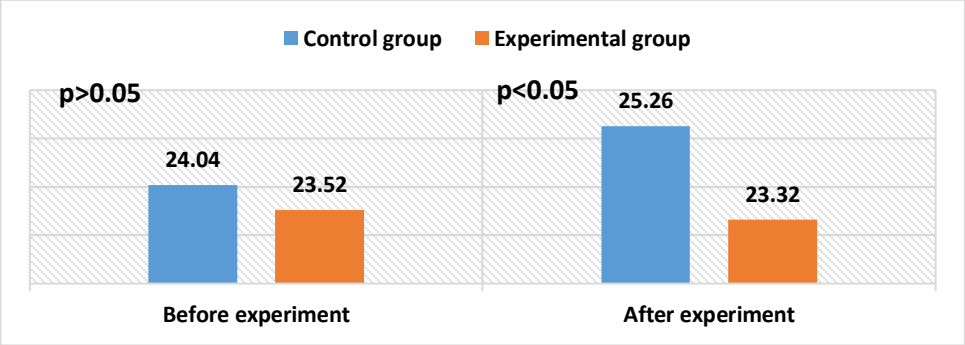


Figure 34. Mean value of body mass index in both groups of participants before and after the experiment

Regarding the absolute values of body mass index in the experimental group before the experiment, it was found that 4.44% (n=2) of the participants were underweight, 17.78% (n=8) had normal weight, and the highest relative proportion, 77.78% (n=35) were overweight. After the experiment these results were reversed with two participants (4.44%, n=2) being underweight,

80.00% (n=36) having normal weight, and 15.56% (n=7) of the participants from control group being overweight (Figure 35).

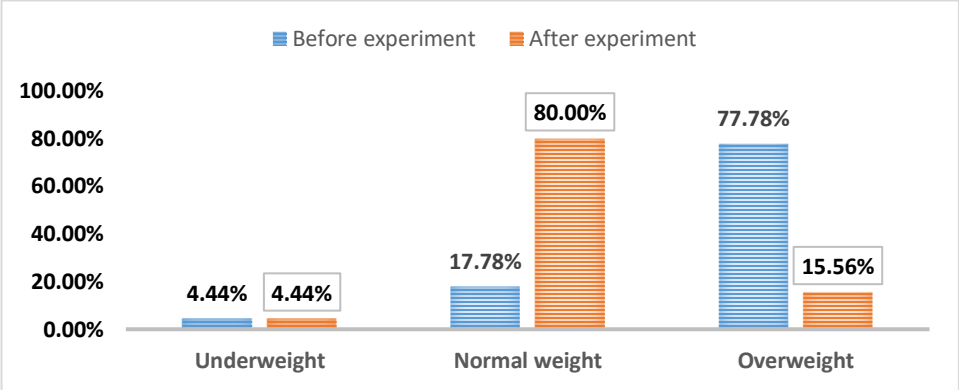


Figure 35. Distribution of participants from experimental group according to body mass index

Regarding the absolute values of body mass index in the control group before the experiment, it was found that 2.22% (n=1) of the participants were underweight, 22.22% (n=10) were overweight, and the highest relative proportion, 75.56% (n=34), had normal body weight. These results were reversed after the experiment, with no underweight participants identified. There was a decrease in the number of participants with normal weight (55.56%, n=25) and an increase in the number of overweight participants (44.44%, n=20) (Fig. 36).

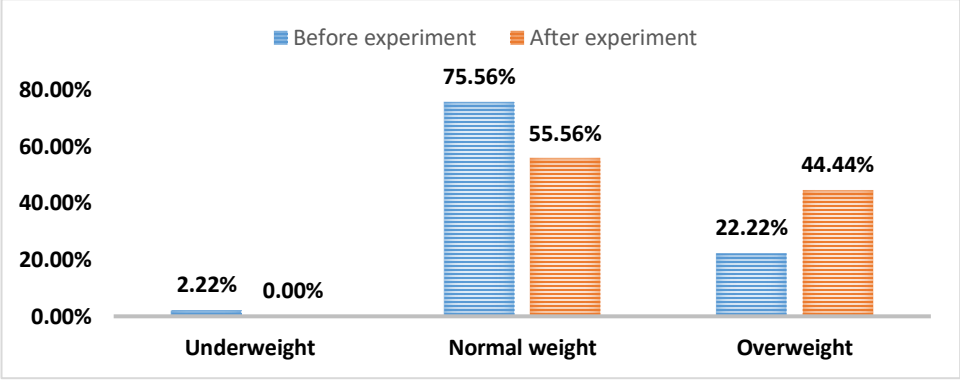


Figure 36. Distribution of participants from control group according to body mass index

HIRTZ 1 for the experimental group

The mean value of the difference in the HIRTZ 1 index at the axillae level of participants in the experimental group before the beginning of the experiment was 4.83 (SD±1.028) with a minimum value of 3.0 and a maximum value of 7.00. After the end of the experiment, the mean value of HIRTZ 1 was 5.14 (SD±0.945) with a minimum value of 3.5 and a maximum value of 7.00 (Table 11).

Table 11. Hirtz 1 index - at the level of axillae for the participants of the experimental group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	3.0	7.0	4.83	1.028	p<0.01
After experiment	3.5	7.0	5.14	0.945	

The difference found in the Hirtz 1 index at the axillae level for the participants in the experimental group before and after the experiment was statistically significant (p<0.01). The change can be explained by the improvement of thoracic cage mobility as a result of systematically applied exercises and respiratory gymnastics.

HIRTZ 2 for the experimental group

The mean value of the difference in the HIRTZ 2 index at the level of mamillae in the group of participants in the experimental group before the beginning of the experiment was 4.91 (SD±1.058) with a minimum value of 3.0 and a maximum value of 7.00. After the end of the experiment, the mean value of Hirtz 2 was 5.21 (SD±0.944) with a minimum value of 3.5 and a maximum value of 7.00 (Table 12).

Table 12. Hirtz 2 index – at the level of mamillae for the participants of the experimental group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	3.0	7.0	4.91	1.058	p<0.01
After experiment	3.5	7.0	5.21	0.944	

The difference found in the Hirtz 2 index at the level of mamillae for the participants in experimental group before and after the experiment was statistically significant (p<0.01). The change can be explained by the improvement of thoracic cage mobility as a result of systematically applied exercises and respiratory gymnastics.

HIRTZ 3 for the experimental group

The mean value of the difference in the Hirtz 3 index at the level of the breastbone (sternum) in the group of participants of the experimental group before the beginning of the experiment was 4.73 (SD±1.070) with a minimum value of 3.0 and a maximum value of 7.00. After the end of the experiment, the mean value of Hirtz 2 was 5.14 (SD±1.009) with a minimum value of 3.0 and a maximum value of 7.00 (Table 13).

Table 13. Hirtz 3 index at the level of the breastbone (sternum) for the participants of the experimental group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	2.5	7.0	4.73	1.070	p<0.01
After experiment	3.0	7.0	5.14	1.009	

The difference found in the Hirtz 3 index at the level of the breastbone of the participants in the experimental group before and after the experiment was statistically significant (p<0.01). The change can be explained by the improvement of thoracic cage mobility as a result of systematically applied exercises and respiratory gymnastics.

The mean values of the Hirtz index for the experimental group before and after the experiment are presented graphically in Fig. 37.

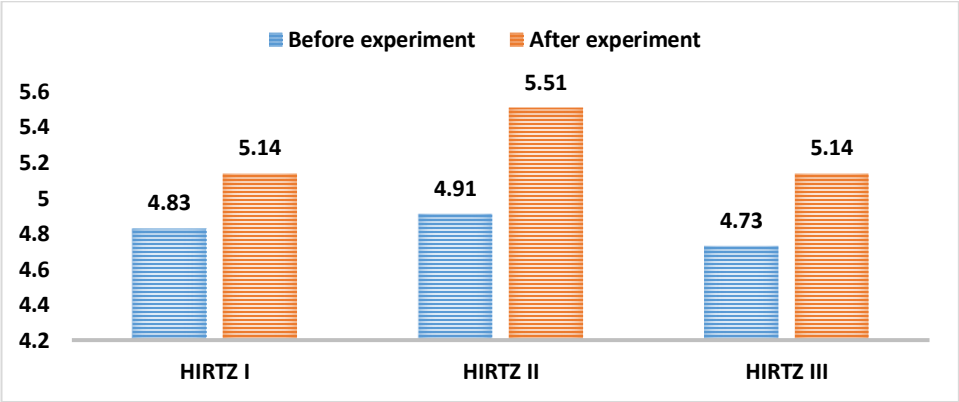


Figure 37. Mean values of Hirtz 1, 2 and 3 in the experimental group before and after the experiment

HIRTZ 1 for control group

The mean value of the difference in the Hirtz 1 index at the axillae level of the participants in control group before the beginning of the experiment was 4.30 (SD±1.047) with a minimum value of 3.0 and a maximum value of 7.00. After the end of the experiment, the mean value of Hirtz 1 was 3.65 (SD±0.902) with a minimum value of 2.5 and a maximum value of 6.00 (Table 14).

Table 14. Hirtz 1 index – at the level of axillae for the participants of the control group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	3.0	7.0	4.30	1.047	p<0.01
After experiment	2.5	6.0	3.65	0.902	

The difference found in the Hirtz 1 index at the axillae level for the participants in the control group before and after the experiment was statistically significant (p<0.01). The change can be

explained by the lack of practicing of the exercise regimen and respiratory gymnastics proposed by us.

HIRTZ 2 for the control group

The mean value of the difference in the Hirtz 2 index at the mamillae level for the participants in the control group before the start of the experiment was 4.27 (SD±1.085) with a minimum value of 3.0 and a maximum value of 7.0. After the end of the experiment, the mean value of Hirtz 2 was 3.62 (SD±0.983) with a minimum value of 2.0 and a maximum value of 6.00 (Table 15).

Table 15. Hirtz 2 index – at the level of mamillae for the participants of the control group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	3.0	7.0	4.27	1.085	p<0.01
After experiment	2.0	6.0	3.62	0.983	

The difference found in Hirtz 2 index at the mamillae level for the experiment participants in the control group before and after the experiment was statistically significant (p<0.01). The change can be explained by the lack of practicing of the exercise regimen and respiratory gymnastics proposed by us.

HIRTZ 3 for the control group

The mean value of the difference in Hirtz 3 index at the level of the breastbone (sternum) for participants of the control group before the beginning of the experiment was 4.18 (SD±0.972) with a minimum value of 2.0 and a maximum value of 6.00. After the end of the experiment, the mean Hertz 3 value was 3.61 (SD±0.898) with a minimum value of 3.0 and a maximum of 6.00 (Table 16).

Table 16. Hirtz 3 index at the level of the breastbone (sternum) for the participants of the control group

Body mass	Min	Max	Mean	St.Dev	p-value
Before experiment	2.0	6.0	4.18	0.972	p<0.01
After experiment	2.0	6.0	3.61	0.898	

The difference found in the Hirtz 3 index at the level of the breastbone for the experiment participants in the control group before and after the experiment was statistically significant (p<0.01). The change can be explained by the lack of practicing the exercise regimen and respiratory gymnastics proposed by us.

The mean values of the Hirtz index for the control group before and after the experiment are presented graphically in (Fig. 38).

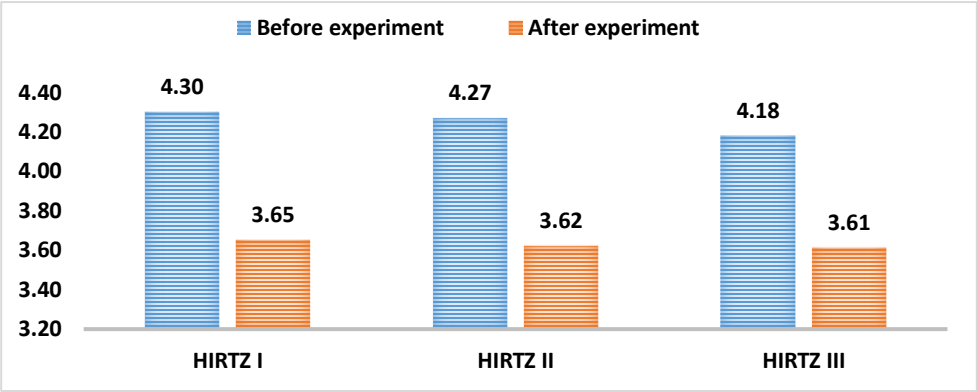


Figure 38. Mean values of Hirtz 1, 2 and 3 in the control group before and after the experiment

TIME-LIMITED TEST – HEART RATE

Experimental group

The mean value of the baseline heart rate before the time-limited test upon inclusion of the participants in study was 69.64 (SD±8.488) with a minimum value of 50 and a maximum value of 85. The same index measured after the completion of the experiment showed a mean value of 68.22 (SD±6.281) with a minimum value of 60 and a maximum value of 80. The difference in the mean values of the pulse index before the time-limited test, respectively before the beginning of the experiment (M=69.64) and after its end (M=68.22) is statistically significant at the significance level p=0.036. The established decrease in mean heart rate by 2.06% can be explained by the conduct of the experiment.

The heart rate of participants measured after the time-limited test had a mean value of 96.73 (SD±8.753) before their inclusion in the experiment with a minimum value of 80 and a maximum value of 120, and after the experiment the calculated mean value was 94.20 (SD±7.467) with a minimum value of 80 and a maximum value of 120. The difference in the mean values of the heart rate index after the time-limited test prior to experiment (M=96.73) and upon its ending (M=94.20), respectively, was statistically significant at the significance level p=0.001. The observed decrease of the mean pulse by 2.65% can be explained by the conduct of the experiment (Table 17).

Table 17. Mean value of heart rate before and after conducting the time-limited test upon beginning and ending of the intervention in the experimental group

Heart rate (experimental group)	Before experiment	After experiment	p-value	Difference
Before time-limited test	69.64 (SD±8.488)	68.22 (SD±6.281)	p=0.036	-2.06%
After time-limited test	96.73 (SD±8.753)	94.20 (SD±7.467)	p=0.001	-2.65%
p-value	p<0.01	p<0.01	-	-
difference	32.57%	31.99%	-	-

Control group

The mean baseline heart rate before the time-limited test upon inclusion of participants in the study was 69.91 (SD±7.564) with a minimum value of 50 and a maximum value of 82. The same parameter measured after the completion of the experiment showed a mean value of 69.67 (SD±7.122) with a minimum value of 60 and a maximum value of 87. The difference in the mean values of the indicator ,,heart rate" before the time-limited test, respectively prior to beginning of the experiment (M=69.91) and after its ending (M=69.67) is statistically insignificant (p=0.795). The established decrease of 0.34% in the mean heart rate cannot be statistically explained by conducting the experiment, as the experiment did not result in a significant change of heart rate.

The pulse of participants measured after the time-limited test had a mean value of 95.11 (SD±10.256) before their inclusion in the experiment with a minimum value of 78 and a maximum value of 130, and after the experiment was completed, the calculated mean value was 94.71 (SD±7.976) with a minimum value of 80 and a maximum value of 120. The difference in the mean values of the parameter ,,heart rate" after conducting the time-limited test, respectively before the beginning of the experiment (M=95.11) and after its end (M=94.71) was statistically insignificant (p=0.675). The 0.42% decrease in the mean heart rate value found could not be statistically explained by conducting the experiment, as the experiment did not result in a significant change in pulse (Table 18).

Table 18. Mean heart rate before and after performing the time-limited test at the beginning and end of the experimental intervention in the control group

Heart rate (control group)	Before experiment	After experiment	p-value	Difference
Before time-limited test	69.91 (SD±7.564)	69.67 (SD±7.122)	p=0.795	-0.34%
After time-limited test	95.11 (SD±10.256)	94.71 (SD±7.976)	p=0.675	-0.42%
p-value	p<0.01	p<0.01	-	-
difference	30.54%	30.47%	-	-

There was no statistically significant difference (p=0.875) between the mean heart rate measured before the time-limited test in the experimental group (M=69.64) and the control group (M=69.91), and between the mean heart rate measured after the time-limited test in the both groups (p=0.422) before inclusion of participants in the experimental interventions (Table 19).

Table 19. Comparison of mean heart rate values for the both groups before and after the time-limited test prior to start of the experiment

Before experiment	Experimental group	Control group	p-value
Heart rate before time-limited test	69.64	69.91	0.875
Heart rate after time-limited test	94.20	95.11	0.422

The analysis of these data shows that the both groups of patients did not show statistically significant differences in terms of their heart rate before inclusion in the experiment, i.e. they were homogeneous and any change in performance indicators upon experiment completion could be explained by the nature of the experimental interventions (Table 20).

Table 20. Comparison of mean heart rate values for the both groups before and after the time-limited test after the end of the experiment

After experiment	Experimental group	Control group	p-value
Heart rate before time-limited test	68.22	69.67	0.310
Heart rate after time-limited test	96.73	94.71	0.753

There was no statistically significant difference (p=0.310) between the mean heart rate measured before the time-limited test in the experimental group (M=68.22) and the control group

(M=69.67), and between the mean heart rate values measured after the time-limited test in the both groups (p=0.753) after performing the experimental intervention.

These data indicate that the experimental intervention did not led to statistically significant changes in the heart rate of the participants in the experimental group compared to the participants in the control group.

TIME-LIMITED TEST – DISTANCE WALKED

The average distance walked by the participants in the experimental group before the start of the experiment was 398.51 (SD±71.589) with a minimum value of 280 and a maximum value of 550. After the end of the experiment the mean value of the distance walked in this group was 412.80 (SD±65.029) with a minimum value of 300 and a maximum value of 550 (Table 21).

Table 21. Mean value of the distance walked by the participants in the experimental group

Distance walked	Min	Max	Mean	St.Dev	p-value
Before experiment	280	550	398.51	71.589	p<0.01
After experiment	300	550	412.80	65.029	

The difference found in the mean distance walked by the participants in the experimental group before the experiment (M=398.51, SD±71.589) and after the experiment (M=412.80, SD±65.029) was statistically significant (p<0.01). There was a statistically significant increase in the distance walked by the experimental group after the completion of the experiment compared to the baseline.

The mean distance walked by the participants in the control group prior to the experiment was 389.71 (SD±50.961) with a minimum value of 290 and a maximum of 550. After the end of the experiment the mean value of distance walked in this group was 369.02 (SD±52.127) with a minimum value of 280 and a maximum value of 550 (Table 22).

Table 22. Mean value of the distance walked by the participants of the control group

Distance walked	Min	Max	Mean	St.Dev	p-value
Before experiment	290	550	389.71	50.961	p<0.01
After experiment	280	550	369.02	52.127	

The difference in the mean distance walked by the participants in control group before the experiment (M=389.71, SD±50.961) and after the experiment (M=369.02, SD±52.127) was found to

be statistically significant ($p<0.01$). There was a statistically significant decrease in the distance walked by the control group after the experiment compared to initial moment.

The difference in the mean distance walked before the start of the experiment in the control group (M=389.71, SD±50.961) and the experimental group (M=398.51, SD±71.589) showed no statistically significant difference: $t(88) = 0.672$, $p=0.503$. The analysis of these data show that before the start of the experiment the both groups were homogeneous in terms of distance walked.

A statistically significant difference in the mean value of the distance walked was found between the value of the indicator after the end of the experiment for the control group (M=369.02, SD±52.127) and the experimental group (M=412.80, SD±65.029): $t(88) = 3.524$, $p=0.001$. The analysis of these data shows that after the experiment, the both groups were not homogeneous in terms of distance walked, and the participants in the experimental group were able to walk a greater distance than the participants in the control group. This can be explained by the interventions during performance of experiment (Fig.39).

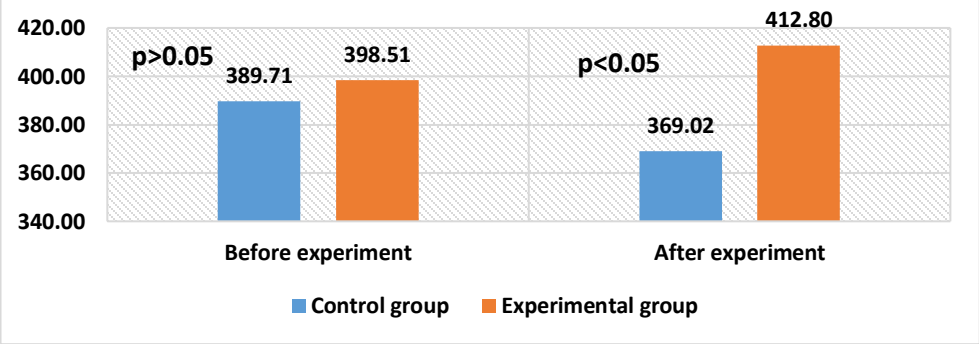


Figure 39. Mean distance walked in the both groups of participants before and after the experiment

TIME-LIMITED TEST – BORG SCALE

The mean value on Borg scale for the participants in the experimental group before the start of the experiment was 0.967 (SD±1.115) with a minimum value of 0 and a maximum of 4. After the end of the experiment, the mean value of the result as per the Borg scale for this group was 0.511 (SD±0.742) with a minimum value of 0 and a maximum of 3 (Table 23).

Table 23. Mean value of Borg scale for the participants in the experimental group

Borg Scale	Min	Max	Mean	St.Dev	p-value
Before experiment	0	4	0.967	1.115	p<0.01
After experiment	0	3	0.511	0.742	

The difference found in the mean value on Borg scale for the participants in the experimental group prior to the experiment (M=0.967, SD±1.115) and after the experiment (M=0.511, SD±0.742) was statistically significant (p<0.01). There was a statistically significant decrease of the value on Borg Scale for the experimental group after the completion of the experiment compared to the baseline.

The mean value from Borg Scale for the participants in control group before the start of experiment was 1.067 (SD±0.902) with 0 as a minimum indicator value and a maximum -3. Upon experiment completion the average on the Borg scale in this group was 1.833 (SD±1.336) with a minimum value of 0 and a maximum recorded value of 5 (Table 24).

Table 24. Mean value on Borg scale for the participants in the control group

Borg scale	Min	Max	Mean	St.Dev	p-value
Before experiment	0	3	1.067	0.902	p<0.01
After experiment	0	5	1.833	1.336	

The calculated difference in the mean value on Borg scale for the participants in control group before the experiment (M=1.067, SD±0.902) and after the experiment (M=1.833, SD±1.336) was statistically significant (p<0.01). There was a statistically significant increase in the result for the control group after completion of the experiment compared to the baseline.

The difference in the mean value on Borg scale before the experiment for the control group (M=1.067, SD±0.902) and the experimental group (M=0.967, SD±1.115) showed no statistically significant difference: t(88) = -0.468, p=0.641. The analysis of these data shows that before the start of the experiment the both groups were homogeneous with respect to the Borg scale.

A statistically significant difference in the mean value on Borg scale was found between the post-experiment value on the scale for the experimental group (M=0.511, SD±0.742) and the control group (M=1.833, SD±1.336): t(88) = -5.804, p=0.001. The analysis of these data indicated that after the experiment the both groups were not homogeneous in terms of the score on Borg scale, by the results of participants in experimental group are better compared to the control group. This can be explained by the intervention during the experiment (Fig. 40).

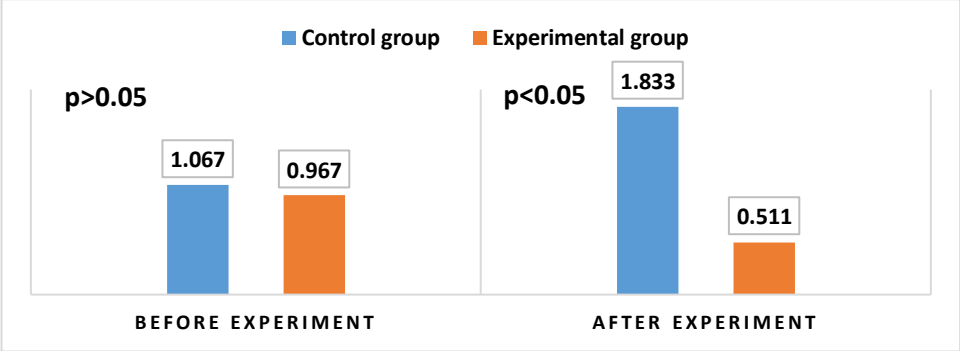


Figure 40. Mean value on Borg scale for the both groups of participants before and after the experiment

OSTEODENSITOMETRY

Experimental group

Osteodensitometry performed in the experimental group revealed that 24.44% (n=11) had been diagnosed with osteopenia prior to start of experiment, by the same relative proportion of participants had borderline (1A). 46.67% (n=21) were in norm, and 2.22% (n=1) had borderline value (2A). Participants with osteoporosis had the same relative proportion.

After conducting the experiment it was found that 68.89% (n=31) of the participants in the experimental group were in norm, and borderline value (1A) was found with 17.78% (n=8). 11.11% had osteopenia, and 2.22% (n=1) were at the borderline (2A). None participants were proved to have osteoporosis (Fig.41).

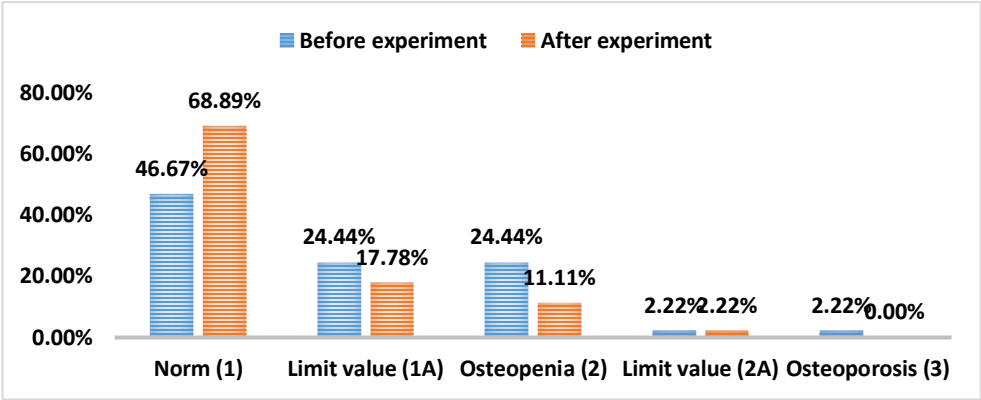


Figure 41. Osteodensitometry in the experimental group

Control group

The osteodensitometry performed in the control group showed that 22.22% (n=10) were diagnosed with osteopenia before the start of the experiment, by 1/5 of the participants (20.00%, n=9) having borderline (1A). 51.11% (n=23) were in norm and 4.44% (n=2) had borderline value (2A). Individuals with osteoporosis accounted for 2.22% (n=1).

After the experiment it was stated that in the control group 33.33% (n=15) of the participants were in norm, by borderline value (1A) was found in the same relative proportion. 24.44% (n=11) were diagnosed with osteopenia, and 4.44% (n=2) – with borderline value (2A). The ones found to have osteoporosis represented 4.44% (n=2) of all individuals in the control group (Fig. 42).

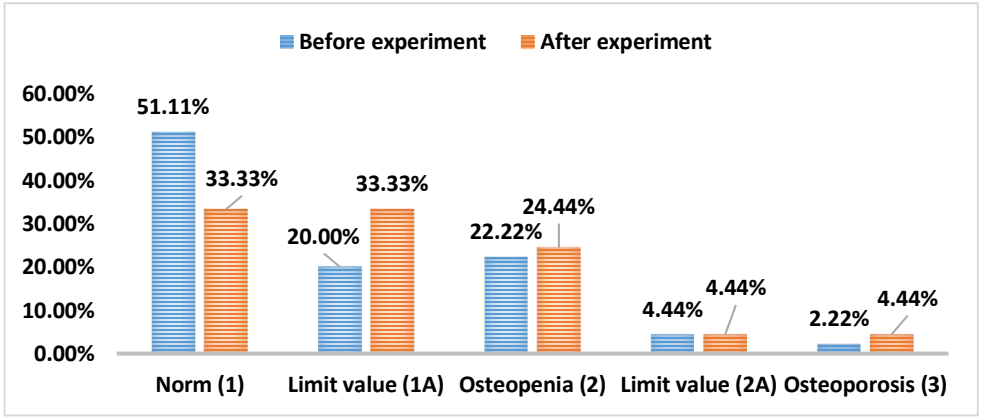


Figure 42. Osteodensitometry in the control group

There was increased number of participants in experiment, who moved into norm after the applied intervention in comparison with the relative proportion of respondents in norm before the experimental intervention was started. Those of experimental group being on osteopenia borderline after the test were also statistically significantly fewer than participants in the same phase in the

control group. With regard to the border value A2 and osteoporosis, there was no statistically significant difference in the relative proportions of respondents from the both groups after the experimental intervention (Table 25).

Table 25. Osteodensitometry in the control and experimental groups

Group	Experimental group		Control group		p-value	p-value
Value	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment
Norm	46.67%	68.89%	51.11%	33.33%	p>0.05	p<0.05
Limit value - A1	24.44%	17.78%	20.00%	33.33%	p>0.05	p<0.05
Osteopenia	24.44%	11.11%	22.22%	24.44%	p>0.05	p<0.05
Limit value - A2	2.22%	2.22%	4.44%	4.44%	p>0.05	p>0.05
Osteoporosis	2.225	0.00%	2.22%	4.44%	p>0.05	p>0.05

3.4. Conclusions about the statistical processing of data from the experiment performed

Prior to experiment performance:

The 90 participants were divided into two groups – experimental and control with equal relative proportion (n=45) and homogeneous distribution in terms of mean value of the indicators:

- **Age –** the arithmetic mean of the age of participants in the experimental group (M=29.11; SD±9.153) and the control group (M=31.42; SD±10.631): t(88) = -1.105, p>0.05;
- **Height –** the experimental group (M=166.38; SD±8.365) and the control group (M=166.56; SD±9.152): t(88)=-0.096, p>0.05;
- **Weight** – the mean value of body mass before the beginning of experiment in the control group (M=66.87, SD±13.188) and the experimental group (M=65.24, SD±12.281) did not show statistically significant difference: t(88) = -0.604, p=0.547;
- **BODY MASS INDEX** – The mean value of body mass index of the participants in experimental group before the start of the experiment was 23.52 (SD±3.353), and that of the control group was 24.01 (SD±2.888);
- **Muscle mass –** before the experiment low muscle mass have (33.33%, n=15) of the experimental group, and (24.44%, n=11) – of the control group; standard muscle mass have (48.89%, n=22) of the experimental group, and (71.11%, n=32) of the control group; excellent

muscle mass have (17.78%, n=8) of the experimental group and (4.44%, n=2) – of the control group;

- **Mobility of thoracic cage upon breathing:**
  - The mean value of the difference in Hirtz I index of participants in experimental group before the start of the experiment was 4.83 (SD±1.028), and control group – 4.30 (SD±1.047);
  - The mean value of the difference in Hirtz II index of participants in experimental group before the experiment was 4.91 (SD±1.058), and control group – 4.27 (SD±1.085);
  - The mean value of the difference in Hirtz III index of participants in experimental group before the experiment was 4.73 (SD±1.070), and control group – 4.18 (SD±0.972);
- **Heart rate –** the mean value of the heart rate measured before the time-limited test in the experimental group (M=69.64) and the control group (M=69.91);
- **Distance walked –** the mean value of the distance walked before the start of the experiment in the control group (M=389.71, SD±50.961) and the experimental group (M=398.51, SD±71.589);
- **Borg scale** – the difference in the mean value on the Borg scale before the experiment for the control group (M=1.067, SD±0.902) and the experimental group (M=0.967, SD±1.115) showed no statistically significant difference: t(88) = -0.468, p=0.641;
- **Bone density**
  - Norm – experimental group 46.67% (n=21), control group 51.11% (n=23)
  - Limit value 1A – experimental group 24.44% (n=11), control group 20.00% (n=9)
  - Osteopenia – experimental group 24.44% (n=11), control group 22.22% (n=10)
  - Limit value 2A – experimental group 2.22% (n=1), control group 4.44% (n=2)
  - Osteoporosis – experimental group 2.22% (n=1), control group 2.22% (n=1).

After conclusion of the experiment

The included 90 participants were divided into two groups, experimental and control, with equal relative proportion (n=45) and homogeneous distribution in terms of mean value of parameters:

- **Weight** – a statistically significant difference of the mean value of body mass was found between the value of the indicator after the end of the experiment for the experimental group (M=64.64, SD±10.605) and the control group (M=70.31, SD±14.491): t(88) = -2.117, p=0.037;

- **BODY MASS INDEX** – a statistically significant difference of the mean value of body mass was found between the value of the parameter after the end of the experiment for the experimental group (M=23.32, SD±2.731) and the control group (M=25.26, SD±3.348): t(88) = -3.019, p=0.003;
- **Muscle mass –** after the experiment low muscle mass have: (11.11%, n=5) of the experimental group and (66.67%, n=30) – of the control group; standard muscle mass have (53.33%, n=24) of the experimental group and (31.11%, n=14) of the control group; excellent muscle mass have (35.36%, n=16) of the experimental group and (2.22%, n=1) of the control group;
- **Mobility of thoracic cage upon breathing:**
  - The mean value of the difference in Hirtz I index of participants in experimental group after the experiment was 5.14 (SD±0.945), and control group – 3.65 (SD±0.902);
  - The mean value of the difference in Hirtz II index of participants in experimental group after the experiment was 5.21 (SD±0.944), and control group was 3.62 (SD±0.983);
  - The mean value of the difference in Hirtz III index of participants in experimental group after the experiment was 5.14 (SD±1.009), and control group – 3.61 (SD±0.898);
- **Heart rate** – the mean value of heart rate measured before the time-limited test in the experimental group was 68.22 (SD±6.281) and control group – 69.67 (SD±7.122);
- **Distance walked –** statistically significant difference in the mean value of distance walked was found between the value of the parameter after the end of the experiment for the control group (M=369.02, SD±52.127) and experimental group (M=412.80, SD±65.029): t(88) = 3.524, p=0.001;
- **Borg scale –** statistically significant difference in the mean value on Borg scale was found between the value of the scale after the end of the experiment for the experimental group (M=0.511, SD±0.742) and the control group (M=1.833, SD±1.336): t(88) = -5.804, p=0.001;
- **Bone density measured after the experiment**
  - Norm – experimental group 68.89% (n=31), control group 33.33% (n=15)
  - Limit value 1A – experimental group 17.78% (n=8), control group 33.33% (n=15)
  - Osteopenia – experimental group 11.11% (n=5), control group 24.44% (n=11)
  - Limit value 2A – experimental group 2.22% (n=1), control group 4.44% (n=2)
  - Osteoporosis – experimental group – not identified, control group 4.44% (n=2).

CHAPTER IV. MODEL OF FOOD AND EXERCISE REGIMEN DURING ONLINE FORM OF EDUCATION

4.1. DIETARY REGIME

4.1.1. Nutritional Plan – Experimental group I

Age: 19-30

Category: normal body weight

Physical activity level (PAL): 1.3 (low active lifestyle)

Average energy requirements for women: 1828kcal

Average energy requirements for men: 2344kcal

Macronutrient distribution for women: proteins:fats:carbohydrates – 90:70:200

Macronutrient distribution for men: proteins:fats:carbohydrates – 115:88:257

Frequency of food intake: 4 times

Distribution of energy intake (%)

Breakfast – 25E%

Lunch – 35E%

Afternoon snack – 15E%

Dinner – 25E%

DEI is calculated taking into consideration:

- ✓ Basic metabolism
- ✓ PAL index
- ✓ Goal orientation (reduction of body mass, change in body composition, maintenance of healthy weight, etc.)

The nutrition plan is based on:

- ✓ Foods contributing to achieving the targeted focus
- ✓ Foods contributing to good health and active longevity

Table 26. **Nutritional plan for WOMEN (age 19 – 30)/ Week I**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Salty pancake	Buckwheat with coconut milk	Whole wheat sheet pasta with egg and mozzarella	Salty pancake	Buckwheat with coconut milk	Whole wheat sheet pasta with egg and mozzarella	Salty pancake
Lunch	Turkey fillet with rice and stewed carrots	Chicken with rice and spinach	Roasted salmon with imperial rice	Turkey fillet with rice and stewed carrots	Chicken with rice and spinach	Roasted salmon with imperial rice	Turkey fillet with rice and stewed carrots
Afternoon snack	Natural skyr with nuts and fruits	Whole grain rice cakes with hummus	Green smoothie	Natural skyr with nuts and fruits	Green smoothie	Whole grain rice cakes with hummus	Natural skyr with nuts and fruits
Dinner	Protein salad	Tuna fillet and roasted pepper salad with chickpeas	Omelette with tofu and olives	Protein salad	Tuna fillet and roasted pepper salad with chickpeas	Omelette with tofu and olives	Protein salad

Table 27. **Nutritional plan for WOMEN (age 19 – 30)/ Week II**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Yogurt with oats and fruit	Whole wheat tortilla sandwich	Slice of bread with avocado and smoked salmon pâté	Yogurt with oats and fruit	Whole wheat tortilla sandwich	Slice of bread with avocado and smoked salmon pâté	Yogurt with oats and fruit
Lunch	Turkey meatballs with fresh salad	Vitamin salad	Veal with rice and vegetables	Turkey meatballs with fresh salad	Vitamin salad	Veal with rice and vegetables	Turkey meatballs with fresh salad
Afternoon snack	Baked slice of bread with egg and cheese mixture	Kefir with nuts and fruits	Stuffed peppers with cottage cheese	Baked slice of bread with egg and cheese mixture	Kefir with nuts and fruits	Stuffed peppers with cottage cheese	Baked slice of bread with egg and cheese mixture
Dinner	Marinated turkey fillet with mixed salad	Baked mackerel with tomato sauce	Omelette with spinach and cheese	Marinated turkey fillet with mixed salad	Baked mackerel with tomato sauce	Omelette with spinach and cheese	Marinated turkey fillet with mixed salad

Nutritional plan for WOMEN (age 19 – 30)/ Week I (Monday, Thursday, Sunday)

***Breakfast**: "Salty pancake"*

2 eggs

80g oatmeal

30g low-fat cottage cheese (4.2%)

5g cow butter

Spices and seasonings: sea salt, black pepper, smoked paprika, savory, thyme, garlic powder (optional)

Garnish: 200g fresh tomato

***Lunch:** 'Turkey fillet with rice and stewed carrots'*

80g turkey fillet (raw)

150g rice (cooked/steamed)

250g steamed carrots

15g extra virgin olive oil

Seasonings: sea salt, lemon juice

***Afternoon snack:** "Natural skyr with nuts and fruits"*

100g natural skyr

15g raw walnuts (pre-soaked in water for about 12h)

100g green apple

***Dinner:** "Protein salad"*

100g baby spinach

100g cherry tomatoes

100g chickpeas (canned)

10g raw pumpkin seeds

1 hard boiled egg

Seasonings: sea salt, lemon juice, 1 tbsp extra virgin olive oil

Nutritional plan for WOMEN (age 19 – 30)/ Week I (Tuesday, Friday)

Breakfast: *"Buckwheat with coconut milk"*

150g buckwheat (boiled)

100ml nut milk (coconut)

50ml condensed coconut milk

20g vegetable protein powder

50g fresh blueberries

Cinnamon – optional

Lunch: *"Chicken with rice and spinach"*

80g chicken fillet (raw)

200ml chicken broth

200g spinach

2-3 stalks of fresh onion

100g carrot

50g rice (raw)

Seasonings: salt, pepper, fresh thyme

For the Chicken/Turkey broth (for 5-6 litres)

3kg bird bones, legs, wings, breast, skin, trimmings.

150g onion

100g carrots

50g parsley – root and stems

50g celery – head and stalks

150g leek onion

5-6 black peppercorns

1 bay leaf

10 l water

Afternoon snack: *"Whole grain rice cakes with hummus"*

30g wholemeal rise cakes

20g humus

50g turkey fillet slice

100g fresh tomato

50g olives

Dinner: *"Tuna fillet and roasted pepper salad with chickpeas"*

50g tuna (fillet or can in own sauce)

100g chickpeas (canned)

25g finely chopped red onion

200g roasted red peppers

30g (1/4 bunch) finely chopped fresh parsley

1 garlic clove/1 tsp garlic powder

Seasoning: sea salt, lemon juice, 2 tbsp extra virgin olive oil

Nutritional plan for WOMEN (age 19 – 30)/ Week I (Wednesday, Saturday)

Breakfast*: " Whole wheat sheet pasta with egg and mozzarella "*

60g whole wheat spelt sheet pasta

1 hard boiled egg (grated)

50g low-fat Mozzarella (grated)

10g cow butter

Lunch: *"Roasted salmon with imperial rice"*

80g salmon fillet

1 garlic clove/1 tsp garlic powder

3-4 fresh parsley sprigs

½ lemon

Seasonings: sea salt, black pepper and grapeseed oil

For the rice:

50g imperial rice (raw)

½ lemon

2 tbsp olive oil

Seasonings: sea salt, 1cm ginger root, 1 cardamom pod, 1 coriander sprig

Garnish:

300g steamed Brussels sprouts

Afternoon snack: *„Green smoothie“*

200ml nut milk

100g baby spinach

200g peeled cucumber

10g spirulina powder

50g green apple

50g avocado

Dinner: *„Omelette with tofu and olives“*

2 eggs

100g natural tofu (grated)

50g chopped olives

25g (1/2) finely chopped red onion

Seasonings: sea salt, black pepper, smoked paprika, garlic powder

Garnish:

250g steamed carrots/broccoli

!Season the vegetables with sea salt, lemon juice and 1 tbsp extra virgin olive oil.

Table 28. **Nutritional plan for MEN (age 19 – 30)/ Week I**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Salty pancake	Buckwheat with coconut milk	Whole wheat sheet pasta with egg and mozzarella	Salty pancake	Buckwheat with coconut milk	Whole wheat sheet pasta with egg and mozzarella	Salty pancake
Lunch	Turkey fillet with rice and stewed carrots	Chicken with rice and spinach	Roasted salmon with imperial rice	Turkey fillet with rice and stewed carrots	Chicken with rice and spinach	Roasted salmon with imperial rice	Turkey fillet with rice and stewed carrots
Afternoon snack	Natural skyr with nuts and fruits	Whole grain rice cakes with hummus	Green smoothie	Natural skyr with nuts and fruits	Green smoothie	Whole grain rice cakes with hummus	Natural skyr with nuts and fruits
Dinner	Protein salad	Tuna fillet and roasted pepper salad with chickpeas	Omelette with tofu and olives	Protein salad	Tuna fillet and roasted pepper salad with chickpeas	Omelette with tofu and olives	Protein salad

Table 29. **Nutritional plan for MEN (age 19 – 30)/ Week II**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Yogurt with oats and fruit	Whole wheat tortilla sandwich	Slice of bread with avocado and smoked salmon pâté	Yogurt with oats and fruit	Whole wheat tortilla sandwich	Slice of bread with avocado and smoked salmon pâté	Yogurt with oats and fruit
Lunch	Turkey meatballs with fresh salad	Vitamin salad	Veal with rice and vegetables	Turkey meatballs with fresh salad	Vitamin salad	Veal with rice and vegetables	Turkey meatballs with fresh salad
Afternoon snack	Baked slice of bread with egg and cheese mixture	Kefir with nuts and fruits	Stuffed peppers with cottage cheese	Baked slice of bread with egg and cheese mixture	Kefir with nuts and fruits	Stuffed peppers with cottage cheese	Baked slice of bread with egg and cheese mixture
Dinner	Marinated turkey fillet with mixed salad	Baked mackerel with tomato sauce	Omelette with spinach and cheese	Marinated turkey fillet with mixed salad	Baked mackerel with tomato sauce	Omelette with spinach and cheese	Marinated turkey fillet with mixed salad

Nutritional plan for MEN (age 19 – 30)/ Week I (Monday, Thursday, Sunday)

***Breakfast**: „Salty pancake“*

2 eggs

100g oatmeal

50g low-fat cottage cheese (4.2%)

5g cow butter

Spices and seasonings: sea salt, black pepper, smoked paprika, savory, thyme, garlic powder (optional)

Garnish: 300g fresh tomato

***Lunch:** "Turkey fillet with rice and stewed carrots"*

150g turkey fillet (raw)

200g rice (cooked/steamed)

300g steamed carrots

20g extra virgin olive oil

Seasonings: sea salt, lemon juice

***Afternoon snack:** "Natural skyr with nuts and fruits"*

130g natural skyr

20g raw walnuts (pre-soaked in water for about 12h)

200g green apple

***Dinner:** "Protein salad"*

100g baby spinach

150g cherry tomatoes

180g chickpeas (canned)

15g raw pumpkin seeds

1 hard boiled egg

Seasonings: sea salt, lemon juice, 1 tbsp extra virgin olive oil

Nutritional plan for MEN (age 19 – 30)/ Week I (Tuesday, Friday)

Breakfast: *"Buckwheat with coconut milk"*

180g buckwheat (boiled)

150ml nut milk (coconut)

60ml condensed coconut milk

25g vegetable protein powder

50g fresh blueberries

Cinnamon – optional

Lunch: *"Chicken with rice and spinach"*

130g chicken fillet (raw)

300ml chicken broth

200g spinach

2-3 stalks of fresh onion

150g carrot

80g rice (raw)

Seasonings: salt, pepper, fresh thyme

For the Chicken/Turkey broth (for 5-6 litres)

3kg bird bones, legs, wings, breast, skin, trimmings.

150g onion

100g carrots

50g parsley – root and stems

50g celery – head and stalks

150g leek onion

5-6 black peppercorns

1 bay leaf

10 l water

Afternoon snack: *"Whole grain rice cakes with hummus"*

40g wholemeal rise cakes

30g humus

70g turkey fillet slice

150g fresh tomato

50g olives

Dinner: *"Tuna fillet and roasted pepper salad with chickpeas"*

60g tuna (fillet or can in own sauce)

150g chickpeas (canned)

50g finely chopped red onion

250g roasted red peppers

30g (1/4 bunch) finely chopped fresh parsley

1 garlic clove/1 tsp garlic powder

Seasoning: sea salt, lemon juice, 2 tbsp extra virgin olive oil

Nutritional plan for MEN (age 19 – 30)/ Week I (Wednesday, Saturday)

Breakfast*: "Whole wheat sheet pasta with egg and mozzarella"*

80g whole wheat spelt sheet pasta

2 hard boiled eggs (grated)

50g low-fat Mozzarella (grated)

10g cow butter

Lunch: *"Roasted salmon with imperial rice"*

100g salmon fillet

1 garlic clove/1 tsp garlic powder

3-4 fresh parsley sprigs

½ lemon

Seasonings: sea salt, black pepper and grapeseed oil

For the rice:

80g imperial rice (raw)

½ lemon

2 tbsp olive oil

Seasonings: sea salt, 1cm ginger root, 1 cardamom pod, 1 coriander sprig

Garnish:

300g steamed Brussels sprouts

Afternoon snack: *"Green smoothie"*

300ml nut milk

200g peeled cucumber

100g baby spinach

20g spirulina powder

100g green apple

50g avocado

Dinner: *"Omelette with tofu and olives"*

2 eggs

200g natural tofu (grated)

50g chopped olives

25g (1/2) finely chopped red onion

Seasonings: sea salt, black pepper, smoked paprika, garlic powder

Garnish:

300g steamed carrots/broccoli

!Season the vegetables with sea salt, lemon juice and 1 tbsp extra virgin olive oil.

4.1.2. Nutritional Plan – Experimental group II

Age: 30-60

Category: normal body weight

Physical activity level (PAL): 1.3 (low active lifestyle)

Average energy requirements for women: 1823kcal.

Average energy requirements for men: 2286kcal.

Macronutrient distribution for women: proteins:fats:carbohydrates – 89:69:200

Macronutrient distribution for men: proteins:fats:carbohydrates – 112:86:250

Frequency of food intake: 4 times

Distribution of energy intake (%)

Breakfast – 30E%

Lunch – 30E%

Afternoon snack – 15E%

Dinner – 25E%

DEI is calculated taking into consideration:

- ✓ Basic metabolism
- ✓ PAL index
- ✓ Goal orientation (reduction of body mass, change in body composition, maintenance of healthy weight, etc.)

The nutrition plan is based on:

- ✓ Foods contributing to achieving the targeted focus
- ✓ Foods contributing to good health and active longevity

Table 30. **Nutritional plan for WOMEN (age 30 – 60)/ Week I**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Swiss muesli	Macaroni and cheese	Oatmeal with apples and pecans	Swiss muesli	Macaroni and cheese	Oatmeal with apples and pecans	Swiss muesli
Lunch	Veal meatballs with imperial rice	Sweet potato with chicken fillet and mozzarella	Baked salmon with vegetable cream soup	Veal meatballs with imperial rice	Sweet potato with chicken fillet and mozzarella	Baked salmon with vegetable cream soup	Veal meatballs with imperial rice
Afternoon snack	Blueberry pie	Protein shake with almond tahini and banana	Whole grain rice cakes with Guacamole	Blueberry pie	Protein shake with almond tahini and banana	Whole grain rice cakes with Guacamole	Blueberry pie
Dinner	Healthy pizza	Green salad with Tuna	Salad with roasted peppers, chickpeas and Halloumi	Healthy pizza	Green salad with Tuna	Salad with roasted peppers, chickpeas and Halloumi	Healthy pizza

Table 31. **Nutritional plan for WOMEN (age 30 – 60)/ Week II**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Wholegrain toast with hummus and turkey fillet	Healthy smoothie	Buckwheat with olives and nut cheese	Wholegrain toast with hummus and turkey fillet	Healthy smoothie	Buckwheat with olives and nut cheese	Wholegrain toast with hummus and turkey fillet
Lunch	Stuffed mushrooms	Vegan salad	Shepherd's pie	Stuffed mushrooms	Vegan salad	Shepherd's pie	Stuffed mushrooms
Afternoon snack	Banana muffins	Fruit skyr with banana and tahini	Slice of rye bread with tuna pate	Banana muffins	Fruit skyr with banana and tahini	Slice of rye bread with tuna pate	Banana muffins
Dinner	Trout fillet with steamed green beans	Omelette with low-fat mozzarella	Poached egg with bulgur and vegetables	Trout fillet with steamed green beans	Omelette with low-fat mozzarella	Poached egg with bulgur and vegetables	Trout fillet with steamed green beans

Nutritional plan for WOMEN (age 30 – 60)/ Week I (Monday, Thursday, Sunday)

Breakfast: *"Swiss muesli"*

250ml kefir

80g oatmeal

15g vegetable or whey protein

10g almond tahini

Boil the oatmeal in advance for about 3-5 minutes, after which add it to the kefir along with the rest of the breakfast components. Mix well and consume immediately afterwards.

Lunch: "*Veal meatballs with imperial rice"*

For the mince:

80 g of veal mince (100%)

25g old onion (finely chopped)

Seasonings and spices: sea salt, black pepper, cumin, dried or fresh parsley

80g imperial rice (raw)

Garnish:

150g steamed broccoli

!Season the broccoli with sea salt, 1 tbsp extra virgin olive oil, lemon and other spices of your choice.

Afternoon snack: *„Blueberry pie"*

40g banana

20g fine oats

10g vegetable or whey protein

60g fresh or frozen blueberries

5g cow butter

Dinner: *„Healthy pizza"*

45g (1pc) whole wheat tortilla

1 egg

2 tsp red pesto

20g grated low-fat mozzarella

32g (1 slice) turkey ham

50g arugula

4-6 baby spinach leaves

4-6 slices of pink tomato

1 sprig fresh green onion (finely chopped)

Seasonings and spices: sea salt, black pepper, smoked paprika, savory

Nutritional plan for WOMEN (age 30 – 60)/ Week I (Tuesday, Friday)

Breakfast: *"Macaroni and cheese"*

70g whole wheat macaroni (raw)

60g semi-hard low-fat cheese

15g cow's butter

Lunch: *"Sweet potato with chicken fillet and mozzarella"*

80g chicken fillet (cooked and shredded)

250g sweet potato

25g (1/2 head) red salad onion (sliced)

100g (1 pc) red pepper (sliced)

30g grated Mozzarella

1tsp red pesto

Seasonings and spices: sea salt, pepper, savory, thyme, garlic powder.

Afternoon snack: *"Protein shake with almond tahini and banana"*

200ml nut milk or water

15g whey protein

10g (1tsp) almond tahini

100g banana

Dinner: *"Green salad with Tuna"*

200g green pepper (sliced)

200g cucumber

100g baby spinach

1-2 green onions (finely chopped)

30g (raw) rice noodles

30g (1/4 bunch) fresh parsley (finely chopped)

60g Tuna fillet (can own sauce)

Seasoning: 2tsp extra virgin olive oil, sea salt, soy sauce and garlic powder as desired

Nutritional plan for WOMEN (age 30 – 60)/ Week I (Wednesday, Saturday)

Breakfast: *"Oatmeal with apples and pecans"*

200ml nut milk

30g whey protein

40g oatmeal

200g apple

10g ground raw walnuts/pecans

cinnamon as desired

Lunch: *"Baked salmon with vegetable cream soup"*

80g salmon fillet (raw)

For the soup: 2 servings

200g potato (peeled and diced)

100g green pepper (finely chopped)

50g old onion (finely chopped)

2 garlic cloves (finely chopped)

200g courgette (diced)

80g raw rice noodles

30g grapeseed oil

Seasonings: salt, pepper, smoked paprika and other spices of your choice

Afternoon snack: *"Whole grain rice cakes with Guacamole"*

20g (2pcs) wholemeal rice cakes

For the Guacamole:

1pc hard boiled egg (grated)

50g avocado

150g tomato (finely chopped)

25g red onion (finely chopped)

30g (1/4 bunch) fresh parsley

Seasonings: sea salt, black pepper, lime or lemon juice

Dinner: *"Salad with roasted peppers, chickpeas and Halloumi"*

200g roasted peppers (cut into strips)

150g tomato

100g chickpeas (canned)

1 garlic clove

50g grilled halloumi cheese

Dressing: 1 tbsp extra virgin olive oil, sea salt, juice of ½ lemon

Table 32. **Nutritional plan for MEN (age 30 – 60)/ Week I**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Swiss muesli	Macaroni and cheese	Oatmeal with apples and pecans	Swiss muesli	Macaroni and cheese	Oatmeal with apples and pecans	Swiss muesli
Lunch	Veal meatballs with imperial rice	Sweet potato with chicken fillet and mozzarella	Baked salmon with vegetable cream soup	Veal meatballs with imperial rice	Sweet potato with chicken fillet and mozzarella	Baked salmon with vegetable cream soup	Veal meatballs with imperial rice
Afternoon snack	Blueberry pie	Protein shake with almond tahini and banana	Whole grain rice cakes with Guacamole	Blueberry pie	Protein shake with almond tahini and banana	Whole grain rice cakes with Guacamole	Blueberry pie
Dinner	Healthy pizza	Green salad with Tuna	Salad with roasted peppers, chickpeas and Halloumi	Healthy pizza	Green salad with Tuna	Salad with roasted peppers, chickpeas and Halloumi	Healthy pizza

Table 33. **Nutritional plan for MEN (age 30 – 60)/ Week II**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Wholegrain toast with hummus and turkey fillet	Healthy smoothie	Buckwheat with olives and nut cheese	Wholegrain toast with hummus and turkey fillet	Healthy smoothie	Buckwheat with olives and nut cheese	Wholegrain toast with hummus and turkey fillet
Lunch	Stuffed mushrooms	Vegan salad	Shepherd's pie	Stuffed mushrooms	Vegan salad	Shepherd's pie	Stuffed mushrooms
Afternoon snack	Banana muffins	Fruit skyr with banana and tahini	Slice of rye bread with tuna pate	Banana muffins	Fruit skyr with banana and tahini	Slice of rye bread with tuna pate	Banana muffins
Dinner	Trout fillet with steamed green beans	Omelette with low-fat mozzarella	Poached egg with bulgur and vegetables	Trout fillet with steamed green beans	Omelette with low-fat mozzarella	Poached egg with bulgur and vegetables	Trout fillet with steamed green beans

Nutritional plan for MEN (age 30 – 60)/ Week I (Monday, Thursday, Sunday)

Breakfast: *"Swiss muesli"*

400 ml kefir

100g oatmeal

15g vegetable or whey protein

10g almond tahini

Lunch: "*Veal meatballs with imperial rice"*

For the mince:

120 g of veal mince (100%)

50g old onion (finely chopped)

Seasonings and spices: sea salt, black pepper, cumin, dried or fresh parsley

100g imperial rice (raw)

Garnish:

150g steamed broccoli

!Season the broccoli with sea salt, 2 tbsp extra virgin olive oil, lemon and other spices of your choice.

Afternoon snack: *„Blueberry pie"*

60g banana

30g fine oats

20g vegetable or whey protein

80g fresh or frozen blueberries

15g cow butter

Dinner: *„Healthy pizza"*

45g (1pc) whole wheat tortilla

2 eggs

2 tsp red pesto

100 g natural tofu (grated)

32g (1 slice) turkey ham

50g arugula

4-6 baby spinach leaves

4-6 slices of pink tomato

1 sprig fresh green onion (finely chopped)

Seasonings and spices: sea salt, black pepper, smoked paprika, savory

Nutritional plan for MEN (age 30 – 60)/ Week I (Tuesday, Friday)

Breakfast: *"Macaroni and cheese"*

90g whole wheat macaroni (raw)

80g semi-hard low-fat cheese

20g cow's butter

Lunch: *"Sweet potato with chicken fillet and mozzarella"*

100g chicken fillet (cooked and shredded)

300g sweet potato

50g (1/2 head) red salad onion

100g (1 pc) red pepper (sliced)

30g grated Mozzarella

1tsp red pesto

Seasonings and spices: sea salt, pepper, savory, thyme, garlic powder.

Afternoon snack: *"Protein shake with almond tahini and banana"*

300ml nut milk or water

15g whey protein

15g (1tsp) almond tahini

160g banana

Dinner: *"Green salad with Tuna"*

300g green pepper (sliced)

200g cucumber

100g baby spinach

1-2 green onions

50g (raw) rice noodles

30g (1/4 bunch) fresh parsley

70g Tuna fillet (can own sauce)

Seasoning: 2tsp extra virgin olive oil, sea salt, soy sauce and garlic powder as desired

Nutritional plan for MEN (age 30 – 60)/ Week I (Wednesday, Saturday)

Breakfast: *"Oatmeal with apples and pecans"*

300ml nut milk

30g whey protein

60g oatmeal

200g apple

20g ground raw walnuts/pecans

cinnamon as desired

Lunch: *"Baked salmon with vegetable cream soup"*

120g salmon fillet (raw)

For the soup: 2 servings

250g potato (peeled and diced)

100g green pepper (finely chopped)

100g old onion (finely chopped)

2 garlic cloves (finely chopped)

200g courgette (diced)

100g raw rice noodles

30g grapeseed oil

Seasonings: salt, black pepper, smoked paprika and other spices of your choice

Afternoon snack: *"Whole grain rice cakes with Guacamole"*

30g (2pcs) wholemeal rice cakes

For the Guacamole:

2 hard boiled eggs (grated)

50g avocado

150g tomato (finely chopped)

25g red onion (finely chopped)

30g (1/4 bunch) fresh parsley (finely chopped)

Seasonings: sea salt, black pepper, lime or lemon juice

Dinner: *"Salad with roasted peppers, chickpeas and Halloumi"*

200g roasted peppers (cut into strips)

200g tomato (diced)

150g chickpeas (canned)

1 garlic clove (finely chopped)

50g grilled Halloumi cheese (cut into strips)

Dressing: 2 tbsp extra virgin olive oil, sea salt, juice of ½ lemon

4.2. EXERCISE REGIMEN

4.2.1. Three-day split home workout

Exercises were selected, which activate the metabolism and thus compensate for reduced physical activity. Easy to perform, they take about 30 minutes and are recommended to be performed in the first half of the day.

First day

1. Bodyweight squats 3x30/40 – inhale during the downward phase and exhale during the upward phase;
2. Overhead dumbbell lifts – 4x15/20 – inhale at the starting position, and exhale as you push the dumbbells overhead;
3. Lunges in place – 4x15 on each leg - inhale as you lower into the lunge and exhale as you stand back up;
4. Thruster – 3x30 – inhale during the squatting portion and exhale during the upward drive;
5. Dumbbell side split – 4x15/20 – inhale at the starting position, and exhale when pushing the dumbbells outwards.

Second day

Warm up with circular movements for shoulders, knees, wrists and lower back.

1. Push-ups – four sets to failure – inhale on decline, exhale on push-up. inhale during the decline and exhale during the pushing phase;
2. Dumbbell biceps curls – 3x15 – inhale at the starting position, exhale as you lift the dumbbells towards your shoulders;
3. Hammers – 3x15 – inhale at starting position, exhale at push up;
4. Romanian deadlift – 3x15 – inhale upon squatting, exhale upon standing back up;
5. Lateral shrugs – 3x30 – for each leg – inhale at the starting position, exhale as you push off;
6. Leg lifts from a lying down position – 3x30 – inhale at starting position, exhale upon leg lift.

Third day

Warm up with circular movements for shoulders, knees, wrists and lower back.

1. Alternate squats with lunges – 3x30 – inhale during the descent of the squat or lunge, and exhale during the ascent back to the starting position;
2. Lunge with a leg extension in the back – 3x15 – inhale while standing and exhale while lunging;
3. Overhead dumbbell triceps extension – 3x15 – inhale as you lower the weight behind your head, exhale as you extend your arms back up to the starting position;
4. Sumo squat with dumbbells – 3x30 – inhale while pushing your hips back and lowering into a squat position, exhale while returning to the starting position;
5. Plank – 2 sets to failure – shallow rhythmic breathing;
6. Samson's chair – 2 sets to failure – shallow rhythmic breathing.

4.2.2. Breathing gymnastics

In the second half of the day breathing exercises (practices for controlled breathing) are performed in order to influence the level of oxygen saturation in the body, blood pressure, heart rate and stress.

To perform breathing exercises correctly, it is important to inhale through the nose and exhale through the mouth.

1. Cyclic breathing – characterized by an emphasis on prolonged exhalation – for 5 minutes.
2. So-called tactical breathing, during which the phases of inhalation and exhalation are equal in duration, but there is an equally long period of holding the inhaled air between them – the exercise is repeated for 5 minutes.
3. Cyclic hyperventilation with retention – characterized by prolonged and deep inhalation, retention of the inhaled air and short exhalations – for 5 minutes.

The duration of breathing practice is about 15 minutes in total every day.

CONCLUSIONS

As a result of the studies and the analysis of the results, we can draw the following conclusions:

1. The comparative analysis made between the benefits and drawbacks of the distance working and training model shows that this form will be used in daily life without the reason being force majeure circumstances such as COVID-19.
2. The use of online training as well as its hybrid forms needs increased awareness of the negatives they entail in terms of the participants' physique and psyche.
3. Defining the negative consequences of social isolation, in combination with hypodinamia and poor eating habits, can be limited or overcome with appropriate healthy practices.
4. Stimulation of the motivation of studying and working in online environment towards a healthy lifestyle is necessary.
5. After performing the experiment, statistically significant differences were found between the experimental and control group in terms of key parameters – body mass, BMI, chest mobility during breathing, muscle mass, distance walked and bone density.
6. Participants of experimental group had significantly lower body mass and BMI compared to the control group ($p<0.05$), demonstrating a positive effect of the intervention applied. Furthermore, chest mobility during breathing was better in the experimental group, indicating potential benefits for the functional respiratory capabilities of participants.
7. In terms of muscle mass, the experimental group showed a significant improvement in the parameter following the applied intervention, demonstrated through a visible decrease in the proportion of participants with low muscle mass and an increase in the proportion of participants with excellent muscle mass. The control group showed a clear deterioration, with an increased proportion of participants with low muscle mass and a sharp decrease with those with excellent muscle mass.
8. For distance walked, there was a statistically significant difference in favour of the experimental group ($p=0.001$), also the subjective perception of fatigue measured by Borg scale was materially lower in this group ($p=0.001$), suggesting a better adaptation to exercise compared to the control group.
9. As regards to the bone density, the experimental group showed a higher proportion of participants with normal values after the experiment (68.89% versus 33.33% in the control

group), while the incidence of osteopenia and osteoporosis was higher in the control group. This may indicate the positive impact of the healthy regimen applied on bone health.

CONCLUSION

In conclusion, the results of experiment show that the applied intervention leads to significant improvements in body composition, respiratory functionality, subjective perception of exertion and bone density in the experimental group, which differed from the control group. The data confirm the effectiveness of the applied methodology in the experimental group, while showing the unfavourable trend in the absence of targeted physical activity or intervention.

SUGGESTIONS

To reduce and/or overcome the negative consequences affecting the physical and mental health of those using online environments to study or work, we propose:

- Increase the knowledge and awareness of learners and workers in the online environment about calorie intake adapted to the new conditions through informative lectures and distribution of leaflets with sample menus adapted to age and gender characteristics.
- To increase the competence of students and workers in an online environment on healthy movement norms, through informative lectures and videos with selected exercises to compensate for motor deficits.

CONTRIBUTIONS

Based on the results of the scientific study, the conclusions and recommendations, the following contributions of theoretical and practically applicable nature can be formulated.

Of cognitive and theoretical nature:

1. The interrelation between physical activity, nutrition and physical and mental health has been confirmed after performing an analysis of Bulgarian and foreign literature sources and a number of regulatory documents.
2. The negative effects of social isolation combined with hypodynamia and poor eating habits have been defined, by these could be limited or overcome via appropriate healthy practices.

Of practically applicable nature:

1. An author's model of nutrition in cases of reduced physical activity was compiled in accordance with Ordinance No.1 dated 22.01.2018 on the physiological norms of nutrition of the population.
2. A set of exercises for training in the home environment was developed to compensate for reduced motor activity due to the online environment for work and study.
3. An experiment was performed to apply the developed dietary and exercise regimen in combination with controlled respiratory gymnastics under online training and work conditions, the results of which confirmed the effectiveness of the methodology implemented.

List of publications related to the thesis:

- Uzunova, A. (2024). COVID-19 SOCIAL, EMOTIONAL AND PHYSICAL DEPRIVATION. *KNOWLEDGE - International Journal* , *66*(4), 483–487. Retrieved from https://ikm.mk/ojs/index.php/kij/article/view/7058
- Uzunova, A., & Krumova, P. (2024). FORCED SOCIAL ISOLATION SYNDROME DURING THE PANDEMIC PERIOD OF COVID-19. *KNOWLEDGE – International Journal*, *67*(4), 623–628. Retrieved from https://ikm.mk/ojs/index.php/kij/article/view/7210

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