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The impact of the COVID -19 pandemic on the health behaviour of Hungarian secondary school students during the distance learning period

DOCTORAL (PhD) DISSERTATION

PÉCSI TUDOMÁNYEGYETEM
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LIST OF ABBREVIATIONS

AE	aerobic exercise
BHS	Beck Hopelessness Scale
BMI	Body Mass Index [testtömeg-index]
CDC	The Centers for Disease Control
ELEF	European Health Interview Survey [Európai Lakossági Egészségfelmérés]
HBSC	Health Behavior in School-aged Children
KSH	Central Statistical Office [Központi Statisztikai Hivatal]
MET	Metabolic Unit
MS	muscle strengthening
MVPA	Moderate to Vigorous Physical Activity
NPK	National Faculty of Education [Nemzeti Pedagógus Kar]
PA	Physical Activity
PE	Physical Education
SB	Sedentary Behavior
SDur	Sleep Duration
SD	Standard Deviations
ST	Screen Time
TUKEB	Ethical Committee of the Medical Research Council [Tudományos és Kutatásetikai Bizottság]
WHO	World Health Organization
YA	young adults
YRBSS	Youth Risk Behavior Surveillance System

GLOSSARY OF TERMS

Term	Definition
Aerobic physical activity	Activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Aerobic activity – also called endurance activity – improves cardiorespiratory fitness. Examples include walking, running, swimming, and bicycling.
Body mass index (BMI)	Weight (kg) / height (m)2
BMI-for-age or BMI z-score	BMI adjusted for age, standardized for children. BMI standard deviation scores are measures of relative weight adjusted for child age and sex. Given a child's age, sex, BMI, and an appropriate reference standard, a BMI z-score (or its equivalent BMI-for-age percentile) can be determined.
Exercise	A subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective. "Exercise" and "exercise training" frequently are used interchangeably and generally refer to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance, or health.
Fitness	A measure of the body's ability to function efficiently and effectively in work and leisure activities, and includes, for example, physical fitness and cardiorespiratory fitness.
Metabolic equivalent of task (MET)	The metabolic equivalent of task, or simply metabolic equivalent, is a physiological measure expressing the intensity of physical activities. One MET is the energy equivalent expended by an individual while seated at rest.
Moderate-intensity physical activity	On an absolute scale, moderate-intensity refers to the physical activity that is performed between 3 and less than 6 times the intensity of rest. On a scale relative to an individual's personal capacity, moderate-intensity physical activity is usually a 5 or 6 on a scale of 0–10.
Muscle-strengthening activity	Physical activity and exercise that increase skeletal muscle strength, power, endurance, and mass (e.g. strength training, resistance training, or muscular strength and endurance exercises).
Physical activity	Any bodily movement produced by skeletal muscles that requires energy expenditure.

Physical inactivity	An insufficient physical activity level to meet present physical activity recommendations.
Sedentary screen time	Time spent watching screen-based entertainment (TV, computer, mobile devices). Does not include active screen-based games where physical activity or movement is required.
Sedentary behaviour	Any waking behaviour characterized by an energy expenditure of 1.5 METS or lower while sitting, reclining, or lying. Most desk-based office work, driving a car, and watching television are examples of sedentary behaviours; these can also apply to those unable to stand, such as wheelchair users. The guidelines operationalize the definition of sedentary behaviour to include self-reported low movement sitting (leisure time, occupational, and total), television (TV viewing or screen time, and low levels of movement measured by devices that assess movement or posture).
Sport	Sport covers a range of activities performed within a set of rules and undertaken as part of leisure or competition. Sporting activities involve physical activity carried out by teams or individuals and may be supported by an institutional framework, such as a sporting agency.
Vigorous-intensity physical activity	On an absolute scale, vigorous-intensity refers to physical activity that is performed at 6.0 or more METS. On a scale relative to an individual's personal capacity, vigorous-intensity physical activity is usually a 7 or 8 on a scale of 0–10.

Source: WHO guidelines on physical activity and sedentary behaviour.World Health Organization; 2020.

Chapter 1. INTRODUCTION

1.1 Introduction of the research topic

At the end of 2019, a new coronavirus disease emerged in Wuhan, China, which later became a pandemic known as COVID-19. Although such an outbreak was a scenario that scientists had long imagined, the fact of its outbreak took everyone by surprise and caught everyone unprepared. Although the pace and dynamism of scientific research and publications on the pandemic and the fight against it have been incredible, there have been only a few studies in Hungary focusing on the secondary school age group, looking at physical activity, screen time, sleep time, and subjective well-being.

1.2 Background and personal motivation

I would like to clarify why I feel strongly motivated by my chosen research topic. "Mens sana in corpore Sano"(lat.) - "a sound mind in a sound body," wrote Juvenal, a Roman poet from the late first and early second century AD. I came across this fascinating idea during my high school studies and it has defined my outlook on life ever since. After graduating from the Hungarian University of Physical Education (TF), I committed myself to a teacher career thirty years ago. As a physical education teacher and coach, I chose the physical and mental education of Hungarian youth as my vocation. I have nearly 20 years of experience as a secondary school teacher, more than 10 years of teaching experience in higher education at Széchenyi István Univesity, and 25 years of experience in sports coaching.

In the course of my work, I noticed as time progressed that the children who joined our school were doing less and less physical activity in their free time. It was getting harder and harder to involve them in participating in sports activities in physical education classes. Even fewer and fewer of them were willing to take part in organized sports activities. As a basketball coach of the school, I noticed that over the years, between 1993-2003, the general fitness level of the pupils deteriorated. Strength and fitness development programs had to be implemented even for motivated players to improve their conditions.

Over the years, I have noticed in the case of my own five children that the higher level of physical activity that was so prevalent in their early childhood seemed to decline by the secondary school years. Concerning my children, I have noticed a significant increase in the amount of time spent in front of a screen, at rest, in their average daily activities. PCs, then

laptops and smartphones, with numerous virtual games to engage their attention and curiosity. They preferred to spend part of their leisure time with these devices, with screen time replacing outdoor running, playing tag cycling, and football. As a physical education teacher and coach in the early 2000s, I wondered how to halt or at least delay the declining trend in physical activity among young people.

My experience was not unique, with many contemporary parents and academic researchers reporting similar results. Parental influences such as control and encouragement, as well as parents' own physical activity levels, showed a significant but small, non (gender) specific association with MVPA levels at age nine and a linear rate of decline in MVPA between ages 9 and 15 (Bradley et al., 2011). WHO's recent recommendation for 5- to 17-year-olds should do at least an average of 60 minutes per day of moderate-to-vigorous intensity, mostly aerobic, physical activity, across the week and as well and should incorporate vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone, at least 3 days a week (WHO, 2020).

Over the past decade, I have worked as a physical education teacher and coach in a university environment, where I have observed similar trends in young adults to what I had previously observed with my children. University students also spend a significant amount of time sitting in lectures and classes, their attention is almost uninterruptedly on their smart mobile phones, and apart from the obligatory attendance at physical education classes, a significant proportion of them do not participate in regular physical activity or only in the evenings (Ács et al. 2020).

In 2020, several studies, mainly focusing on adult populations, have already examined the impact of the COVID-19 pandemic restrictions on individuals and society, but few studies have been conducted on adolescents and young adults. Ács et all reported decreased amounts of PA among university students during the COVID-19 pandemic period and pointed out the need to promote a physically active lifestyle in cases of social restrictions.

A WHO study found that 81% of young people aged 11-17 worldwide did not meet the WHO's 2010 recommendation of at least 60 minutes of moderate to vigorous physical activity (MVPA) per day in 2016. Young people did not reach the recommended PA levels before the world was hit by pandemic COVID-19 in March 2020 (WHO, 2020). The restrictions imposed, quarantine and the introduction of distance learning may have further hampered young people's free PA.

I wondered what has happened to Hungarian young people during this period of curfew and distance learning? How did their physical activity develop, were they able to move at all, to play sports with their peers? How did they cope with the lack of contact with peer groups because of the restrictions? Were they able to keep in touch with their peers? And if so, in what form? Did they become more solitary during lockdowns than before? Were they more rested or tired during this period of distance learning? Did they sleep enough or perhaps more than before distance learning was imposed? This doctoral dissertation presents a description of the research we conducted and a summary of our results.

1.3 Feasibility and significance of the study

This dissertation reports on changes in physical activity, screen time, sleep, and subjective well-being among adolescents and young adults during the second wave of the Covid-19 pandemic in distance education in Hungary. This finding is significant because, to the best of our knowledge, because only few similar studies with such a large number of participants (N = 2556) has been published in this age group in Hungary or Eastern Europe.

It helps us to understand in more depth the changes that have taken place among young people during the period of distance learning imposed by the restrictions. The results of this study may help parents, physical education teachers, sports professionals and authorities to prepare better for and manage the situation in the event of a new pandemic. The conclusions that can be drawn from this research can provide an opportunity to lay the groundwork for the preparation of further measures that may be needed.

1.4 Study Overview

In this paper, we describe many aspects of the lives of Hungarian secondary school students. The research presents and analyses changes in different types of physical activity, time spent in front of a screen, time spent sleeping, and subjective well-being due to the restrictions imposed by the pandemic during and before the normal school attendance period.

After the Introduction part of chapter 1, a summary is presented as an overview of the topic of the Covid-19 pandemic and its impact on individuals and society in chapter 2. In chapter 3 the methodology of this study is presented showing participants of the study, and the process

of data collection. A short description of the questionnaire and the used statistical analysis is described.

Chapters 4, 5, 6, and 7 present four published studies from this research.

- Study 1 in chapter 4 targeted changes in physical activity (aerobic exercise, muscle strengthening) and screen time in adolescents and young adults during the pandemic and focuses on PA; aerobic type exercises and muscle strengthening and screen time. Compares and reports the changes before and during distance education among adolescents and young adults in Hungary. This article has been accepted for publication and the final published version is presented in this chapter. The final published version can be found as indicated at the beginning of the chapter.
- Study 2 in Chapter 5 analyses gender and age group differences in participants from a sociodemographic and anthropometric perspective, and reports age and gender differences in physical activity, time spent sleeping, and time before and during distance learning. This article was published in Hungarian and translated into English by the author of this thesis. The aim of the study was twofold. In addition to presenting the research data in an informative way, its graphics and style were designed with the intention of making it readable for non-experts in the field for the volume of studies entitled "RESEARCH IN THE COVID-19 PANDEMIA". Thus, in some respects, the material in this chapter falls short of the standards of form and content of international scientific journals, as the material in this presentation has been compiled with the aim of being informative and easy to understand for all.
- Study 3 in chapter 6 focuses on PA and subjective perceptions of health status concerning gender and/or age and region, and how these perceptions changed before and during distance education. This article has been written in Hungarian was translated by the author of the dissertation. The study was accepted for publication and the final published version is presented in this chapter. The final published version can be found as indicated at the beginning of the chapter.
- Study 4 in chapter 7 examines the effects of the changes in health and risk behaviors on mental problems and aims to identify an at-risk group for mental problems among Hungarian adolescents and young adults who may currently face serious challenges in social life and education due to the effects of the restrictions. This article is under review before publication. The version submitted for the journal is presented in chapter 7.

Chapter 8 is the conclusion of the study; a summary of the findings and a discussion of its limitations and future directions.

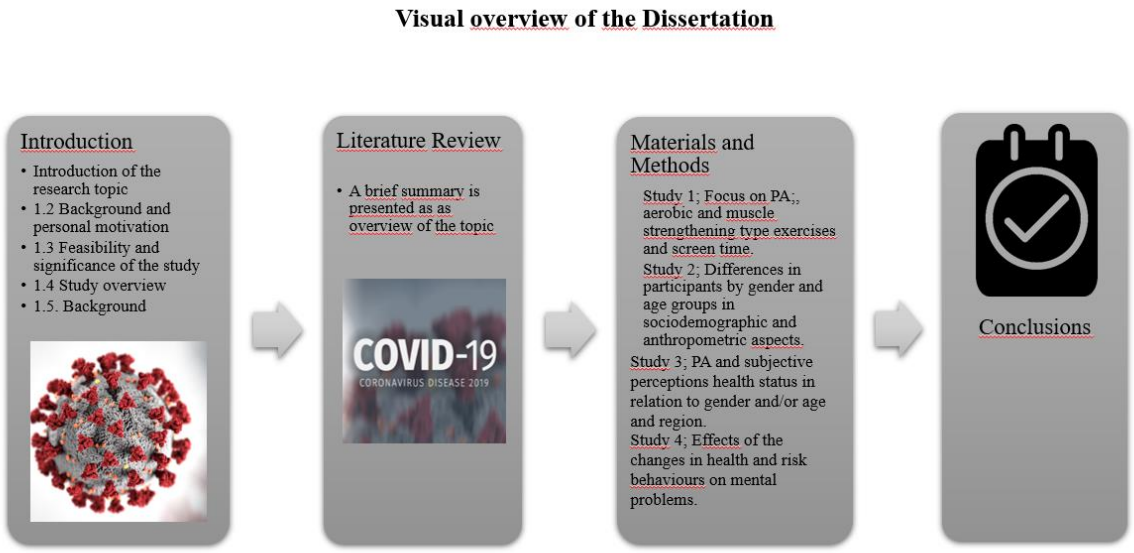


Figure 1. Visual review od the dissertation. Source: Katona, own edition (2022)

1.5 Background

Regular exercise is a cornerstone of a healthy lifestyle and plays an important role in preventing many diseases. According to the World Health Organization (WHO) (World Health Organization, 2020) definition, physical activity is any physical activity that requires the use of energy from striated muscles. Physical activity is the bodily movement produced by the skeletal muscles, which results in energy expenditure.

The amount of energy required for activity can be measured in kilojoules or kilocalories (Dishman et al. 1985). The amount of calories used is related to the amount of muscle mass involved in the movement, the intensity of the movement, the duration of the movement, and the muscle contraction frequency (Taylor et al. 1978; Takács, 2020). It includes physical activity at work, play, sports, around the house, travel, and leisure. The link between health and regular physical activity is supported by the following facts and data (WHO, 2020)

- Phyisical inactivity is the leading cause of death worldwide.
- A sedentary lifestyle is a major contributor to cardiovascular disease, malignant tumors, and diabetes.

- Globally, 1 in 4 adults does not get enough physical activity.
- 80% of adolescents lead sedentary lifestyles.

WHO plays a key role in developing existing guidelines and recommendations on physical activity and policies to combat obesity (Fussenegger et al., 2007). In its work in this area, the organization has adopted several documents setting both individual and collective targets for physical activity and diet (WHO, 2004). These recommendations for physical activity levels are tailored to the needs of three different age groups. It includes recommendations for children and adolescents aged 5-17 years, adults aged 18-64 years, and people aged 65 years and over (WHO, 2020).

Recommendations for adults aged 18-64 years recommend at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity exercise, or an appropriate combination, per week. Moderate-intensity exercise is a type of exercise during which it is no longer possible to carry on a continuous conversation. It is also recommended to do muscle strengthening exercises at least twice a week (WHO, 2010).

Worldwide, physical inactivity is responsible for 6% of coronary heart disease, 7% of type 2 diabetes, and 10% of breast and colon cancer. Overall, physical inactivity is responsible for 5.3 million premature deaths (Lee et al. 2012). There is strong evidence that people who exercise regularly have a lower risk of premature death, coronary heart disease, high blood pressure, cerebrovascular accidents, type 2 diabetes, metabolic syndrome, and colorectal and breast cancer compared to less active people. Active people are less likely to suffer from depression and have a lower risk of vertebral fractures. Adequate quality and quantity of physical activity increase muscle strength and endurance has a positive effect on bone health and the body's metabolism, and helps to keep body weight within physiological limits (WHO, 2010).

Regular physical activity reduces stress sensitivity, increases stress tolerance, and improves sleep quality, so regular exercise should be integrated into our daily lives. (Goodwin et al. 2016). The WHO's latest evidence-based guidance documents identify physical activity as a primary preventive tool for the general population. In 2002, the WHO adopted a recommendation that all people should get at least 30 minutes of physical activity a day.

The guidelines are addressed to decision-makers in government and the private sector at all levels (European, national, regional, local) and, while reinforcing the validity of the WHO approach, aim to provide useful steps to translate objectives into concrete actions. The guidelines are part of the Strategy Paper on the European Strategy on Nutrition, Overweight

and Obesity related health issues, adopted by the Commission on 30 May 2007, in which the Commission expressed its view that "The Member States and the EU should take proactive steps to reverse the decline in physical activity caused by several factors over the past decades".

The White Paper does not address obesity from a purely nutritional perspective but argues strongly that every possible step should be taken to increase physical activity and thereby reduce the current lack of physical activity. The Commission stresses the need to ensure that organizational and structural factors influencing people's opportunities for physical activity are properly coordinated.

Physical inactivity is one of the top ten leading global risk factors for death (along with high blood pressure, smoking, and high blood sugar, (WHO 2014) and is estimated by WHO to be responsible for 3.2 million deaths each year (Pratt et al., 2014). Physically inactive people are defined as those who do not engage in 30 minutes of moderate-intensity physical activity (150 minutes/week) five times a week or 25 minutes of high-intensity physical activity (75 minutes/week) three times a week, or a combination of both, i.e. 150 minutes of physical activity per week, 600 MET minutes/week (MET, metabolic unit: defined as the resting metabolic rate, that is, the amount of oxygen consumed at rest, sitting quietly in a chair, approximately 3.5 ml 02/kg/min (1.2 kcal/min for a 70-kg person) with other words; how much more energy is used during activity than during one minute of rest) (WHO, 2018). Compared to inactive individuals, the overall risk of death is 16-30% lower in those who perform at least 150 minutes of moderate-intensity physical activity per week (Ekelund et al., 2015).

Regular, moderate PA reduces the risk of most common civilization diseases and contributes to improved well-being. (Kruk, 2014). There is strong evidence of additional health benefits of longer duration and higher intensity physical activity (Warburton et al., 2010) Physical activity also has beneficial effects on blood glucose levels. It is known that intense physical activity, i.e. mechanical loading on the skeleton, in children and adolescents results in stronger skeletons and helps mineral incorporation, an effect that makes it even more recommended to start at a younger age (Ojiambo, 2013).

Being aware of the above-mentioned guidelines and recommendations, the Hungarian government introduced daily physical education in schools in September 2012, in the hope that it would make a positive contribution to increasing children's physical activity and reducing daily inactivity. As a result of the measure, daily physical education has become a compulsory part of the timetable for pupils in primary and secondary schools.

1.6 The problem: Declaring COVID-19 a pandemic

The first official cases of COVID-19 were recorded on 31 December 2019, when cases of pneumonia of unknown origin were reported to the WHO in Wuhan, China. (Sohrabi et al., 2020). On 7 January, Chinese authorities identified a new coronavirus, provisionally named 2019-nCoV, as the cause of the cases. Weeks later, on 30 January 2020, the WHO declared the rapidly spreading COVID-19 pandemic a public health emergency of international concern (Yang, Shang, & Rao, 2020). However, the new coronavirus was not officially named COVID-19 until the following month, on 11 February.

In the early months of COVID-19, global health authorities, government agencies, and the public were unsure how the disease would spread and what impact it would have on everyday life. A few days later, on 11 March, the WHO declared COVID-19 a pandemic. COVID-19 went from a serious problem previously confined to China to a global health emergency almost overnight (WHO, 2020).

Following the introduction of unprecedented measures to contain the virus, the number of new cases in China, which had been rising by thousands per day, had fallen to a few dozen by March, while in Europe the number of cases was rising rapidly day by day, with an unprecedented 250 deaths recorded in Italy in the 24-hour period between 12 and 13 March. As a result, on 13 March the WHO declared Europe the epicenter of the pandemic. On the same day, a state of emergency was declared in the United States.

The first case in Hungary was reported on 4 March 2020. During the first wave, the number of active cases increased until the beginning of May and then started to decrease. This decline lasted until the second half of July, then rose rapidly again from August, with the start of the second wave. In mid-February 2021, the number of cases began to rise again, due to the emergence of a British mutant that was much more infectious than the original virus. In this third wave, hospital admissions broke all previous records (https://www.science.org, 2020).

The first wave of the pandemic in Hungary started in March and was characterized by the number of active cases until early May when the number of registered cases started to decline. In anticipation of Hungary's participation, the government established an operational tribe on 31 January 2020. Following the outbreak, a state of national emergency was declared on 11 March, introducing a special legal regime in Hungary: a period of peace, a period of derogation from the general rules of the functioning of the state. Like most countries in the world, Hungary introduced measures restricting people's daily lives, which were only gradually lifted as the first wave of the pandemic subsided.

The second wave of the coronavirus pandemic occurred in the autumn and winter of 2020, followed by a longer summer lead-in period after the first wave has subsided. While during the first wave, the older age group was more affected (14% over 80 years, 9.8% aged 70-79 years), the second wave included younger age groups, with a significant decrease in the average age of infected people (https://covid19.who. int/). Ács et al. (2021) stated in their cross-sectional representative survey during the second wave of the COVID-19 pandemic in Hungary that the second wave has produced a much higher number of active cases, mostly affecting young people, who may have been less at risk.

The economy (as in the rest of the world) suffered a significant downturn and tens of thousands of people lost their jobs, many of them for short periods. The sporting scene also came to a complete standstill for months (Paar et al. 2021). In the second wave, when the health sector was better prepared for the pandemic, less stringent control measures were introduced, partly to maintain the economy. However, from November 2020, the number of people affected by the coronavirus infection increased again, and again epidemiological restrictions had to be introduced to deal with the situation, although the restrictions were still far below the severity of the control measures introduced in the spring.

The general rule in Hungary was a curfew between 8 p.m. and 5 a.m. Exemptions from the curfew include indisputable reasons such as the threat to health, life, or serious harm, the need to protect life, the need to work for a duly justified purpose, the right to engage in sports activities subject to certain conditions or to walk the dog. Groups and assemblies in public places are generally prohibited. Exceptions could be made for the practice of individual recreational sports activities (in particular running, walking, and cycling) to promote health. However, in the case of team sports, only training and sporting events for competitive athletes under the Sports Act could be exempted, due to the higher risk factors involved.

Under the measures introduced on 26 November 2020, a digital timetable was introduced in secondary education in Hungary from the 9th grade onwards. Educational institutions have been instructed to suspend class attendance and switch to online e-learning and e-instruction. Pupils stayed at home and were required to complete the digital timetable, including physical education lessons, between 8 am and 4 pm on school days (Hungarian Government Decree 484/2020).

The pandemic has disrupted normal daily routines around the world: including school attendance of children and adolescents, and the level of vulnerability in all age groups. The

COVID-19 2020 restriction has completely changed the daily behavior of individuals around the world, including young people in Hungary. (Katona et al., 2022)

1.7 Objectives and hypotheses

In light of the findings of studies focusing on and reporting on the adult population worldwide, we felt that there was a need for a study that would examine (1) different types of physical activity among adolescents and young adults, (2) sleep duration (changes in sleep patterns), (3) time spent in front of a screen, (4) frequency and quality of physical activity in the community (peer group), and (5) subjective well-being before and during the pandemic. The aim of this dissertation is to describe and evaluate the physical activity before and during the pandemic:

1. the different types of physical activity (aerobic and muscle strengthening movements, team sports) and its changes
2. changes in time spent in front of a screen - their physical inactivity.
3. subjective assessment of their sleep time and health status,
4. their mental health, especially loneliness and hopelessness.

Also, to answer the question of whether there is a correlation between the above (changes in physical activity, screen time, self-assessed health, sleep time and well-being).

a. gender,
b. age groups,
c. by geographical region

in terms of the above aspects in the pre- and during the pandemic period, while distance learning among Hungarian adolescents and young adults (secondary school students).

5. A further sub-objective of the study was to identify the group(s) at risk of mental health problems among adolescents and young adults who face serious challenges in society and education.

The following hypotheses can be drawn:

Hypothesis 1. We assume that all type of PA activities decreased during the distance education period in the examined cohort.

Hypothesis 2. We assume that all time spent in front of a screen increased among secondary school students.

Hypothesis 3. We hypothise that their sleep time increased during distance education.

Hypothesis 4. We hypothise that subjective ratings of their mental health in the areas of loneliness and hopelessness deteriorated and they felt “more lonely” during the distance learning period.

Chapter 2. LITERATURE REVIEW

2.1 The problem of inactivity

Inactivity has been on the rise worldwide in recent decades. According to population surveys in recent years, nearly one-third of the adult population in the world and Hungary can be considered as practically physically inactive (WHO 2014, 2018; ELEF, KSH 2009), which contributes to the development of physical and mental illnesses.

Reports have shown that the world has been struggling with a global pandemic of physical inactivity for years (Kohl et al., 2012), which particularly affects people from lower socioeconomic groups (Pilgaard & Rask, 2016), but also younger (Rasmussen et al., 2019) and older adults (Bauman et al., 2016).

According to the 2014 Public Health Survey in Hungary, the proportion of people aged 15 and over who did not exercise at all in their leisure time was relatively low at 43%. The EU average at the time was 49% and the inactivity rate was higher in all other V4 countries than in Hungary. 29% of the surveyed age group spent at least 150 minutes a week on sports and leisure activities, a frequency in the middle of the EU extremes, 9% in Romania and 55% in Finland (KSH, 2014). Similar proportions were active in Slovakia and the Czech Republic, while significantly fewer met the 2.5-hour criterion in Poland.

In 2019, the situation is clearly worse than five years earlier: 54% of people aged 15 and over do not exercise and only 23% do at least 150 minutes of leisure time physical activity per week (KSH, 2019). More than half of men aged 15-24 meet this criterion, compared to only one-third of women of the same age. The proportion decreases almost linearly with increasing age and the gender gap in activity levels disappears (KSH, 2019).

2.2 The benefits of Physical Activity

Guyton and Hall (1986) point out that regular physical activity is essential for the adequate supply of blood, oxygen, and nutrients to tissues, thereby increasing the resistance of the human body, and that regular physical activity has been shown to have anti-inflammatory effects through its effects on white blood cells. Amongst other things, it increases the activity of cells involved in defense against viruses and the production of many anti-inflammatory substances.

The link between physical activity and somatic health, and the physiological and somatic effects of physical activity, are now unquestioned. Regular and adequate physical activity is an effective means of prevention and treatment of many somatic chronic diseases, including cardiovascular diseases, diabetes, some cancers (breast and colorectal), obesity, hypertension, bone, and joint diseases (Bouchard et al. 2007). PA plays an important role in reducing the impact of the COVID-19 pandemic through its positive effects on immunity (Jones and Davison, 2019), inflammation (Miles et al, 2019), and viral respiratory tract infections (Nieman & Wentz, 2019). PA can also reduce stress and depression (Powell et al., 2019). Increased leisure-time physical activity in adolescents (in addition to structured school programs) has been shown to significantly reduce depression and accelerate learning by improving cognitive processes such as memory function (Penedo-Dahn 2005).

The beneficial effects of regular physical activity on a range of health conditions are therefore well established (Powell et al., 2019). However, despite the existing evidence, the effective and proven role of physical activity in the prevention and treatment of mental illness is still underestimated. Social distancing and the closure of sports facilities are important in preventing the spread of the virus but may have negative consequences for PA opportunities and motivation among teenagers and younger and older adults, leading to an alarming decline in PA and significant public health consequences. (Schmidt & Pawlowski, 2021) These decisions will inevitably impact people's regular leisure-time physical activity (PA) (Hall et al, 2020). However, mobility restrictions imposed to curb the spread of COVID-19 may alter physical activity (PA) and sleep patterns which are important for health and well-being (Ong et al. 2021).

PA can also reduce stress and depression (Powell et al., 2019), which increased during the pandemic due to health threats, job loss, income loss, and isolation from social contacts (Douglas et al., 2020). The benefits of physical activity, time spent at rest, and adherence to sleep recommendations are independently important for maintaining optimal health (Bronikowska et al, 2021). Appropriate combinations of physical activity can play a significant role in maintaining optimal health. It is therefore particularly important to investigate the impact of physical activity from these perspectives, as it is well known that physical activity and sport have protective effects on health, especially for non-communicable diseases, regardless of age (Ding et al. 2016). Participation in sport improves children's educational attainment and skills development including empowerment, leadership and self-esteem – contributing to their overall well-being and future prospects. (unicef-irc.org, 2019)

One of the focal points of this dissertation is to explore how these not very encouraging data have changed during the COVID-19 pandemic restrictions and the 2020 distance learning period.

2.3 The Covid-19 pandemic resulted in a drop back in PA

The Covid-19 global health crisis has led to high levels of inactivity and many studies have recognized the negative impact of physical inactivity on health. Several studies point out that decreased physical activity was observed among university students during the COVID-19 pandemic (Pietrobelli et al., 2020; Ács et al., 2020). Ács et al. (2020) pointed out that decreased physical activity was observed among Hungarian youth in higher education during the COVID-19 pandemic. The research highlighted the need to promote physically active lifestyles in the face of pandemic-induced restrictions.

In terms of daily expected physical activity requirements for adolescents (5-17 years), the requirement for at least 60 minutes of moderate-intensity physical activity per day has been significantly reduced (Hall et al., 2021). Similarly, Saunders and colleagues (2016) reported that children and adolescents who adhere to 24-h physical activity guidelines (high physical activity/high sleep/low sedentary behavior (SB)) tend to have more favorable adiposity and cardiometabolic indicators compared to those who do not adhere to these recommendations.

Current evidence also suggests that the composition of 24-h physical activity behaviors can have important implications for health at all ages, and that adherence to current 24-h physical activity guidelines is associated with a range of desirable health indicators in children and young people (Tremblay et al., 2017).

However, the restrictions on COVID-19 are likely to exacerbate an already adverse public health situation. Several studies have reported the aforementioned phenomena in Canada (Moore et al., 2020), China (Xiang et al., 2020), Italy (Pietrobelli et al., 2020), Croatia (Zenic et al., 2020), Spain, and Brazil (Lopez et al., 2020; López-Gil et al., 2021) and a large sample, munltinational study on European children (Kovacs et al., 2021). Given the multiple benefits of PA, it would have been important to maintain an active lifestyle during the COVID-19 phase-out. Ács et al. (2020) reported that in Hungary, curfew restrictions led to a significant reduction in all other categories of sports activity.

2.4 Screen time increased due to restrictions

Several studies have shown that screen time has increased under pandemic restrictions. Colley, Bushnik & Langlois 2020; Bergmann et al. 2022). Bergmann et al pointed out that screen time of youth has increased due to the online classes (1) due to the lockdown and also watching TV or streaming channels while at home (2). Lockdown restrictions made everyone stay indoors, during such a crisis time video calling (3) to loved ones, friends, and relatives was one of the ultimate solutions but again exposed to further screen time usage after school hours. Finally, for entertainment purposes (4), such as watching movies has also led to further exposure to screen time.

Public health measures related to the pandemic have led to challenges that have increased screen use among children and adolescents (Bergmann et al. 2022). The seasonal effect combined with the stay-at-home regulation have reduced or eliminated family recreational activities, including sporting events, summer camps, play camps, birthday parties, and other off-screen activities. The social restraining order, therefore, generated additional screen time by moving events or activities to a virtual environment.

As we know, especially at this developmental stage, peer acceptance and a sense of belonging clearly play an important role (Baumeister & Leary, 1995). They may want to belong to a virtual community to fit into the real world, but they still need to feel a sense of belonging in a live, family context (Bonetti, Campbell & Gilmore, 2010).

Bonetti, Campbell, and Gilmore's (2010) research on online communication shows that children and adolescents who identified as lonely were significantly more likely to communicate online about personal and intimate topics than those who did not identify as lonely. Those who identified themselves as lonely were significantly more likely to be motivated to use online communication to meet new people to compensate for their poor social skills. The results suggest that using the Internet, and thus the online space, allows them to engage in social interactions and meet critical needs for self-discovery and identity exploration (Bonetti, Campbell & Gilmore, 2010.)

However, it remains to be seen whether the benefits of online communication can facilitate offline social interactions for children and adolescents who are lonely. In this dissertation, we also seek to answer the question of whether a vulnerable group can be identified among the Hungarian adolescents and young adults who participated in the study. One of the studies presented in this dissertation was designed to examine the impact of changes in health

and risk behaviors on mental health problems and to identify a group at risk for mental health problems, who may currently face serious challenges in social life and education.

2.5 COVID-19 pandemic impact on mental health

Several studies have shown that physical activity has a positive impact on mental health (Abu-Omar, Rütten and Lehtinen, 2004; Paluska and Schwenk, 2000; Cooney et al., 2013; Zeibig et al., 2021), reduces distress (Park et al, 2022; Panshikar and Mullen, 2022; Mouissi, Torki and Bouabdellah, 2015), depression (Khoubaeva et al., 2022), anxiety symptoms and perceived stress (Jewett et al., 2014; Kim et al., 2012), and increases life satisfaction (Guddal et al., 2019) and subjective well-being (Maugeri et al., 2020). Sport, that requires PA, has a positive impact on self-esteem, self-worth, improves learning ability, memory, concentration, workload, creativity, and makes sleep more restful (Keczeli, 2019). Maintaining a daily routine (Lee, 2000), exercise and sport help relieve anxiety, relieve stress, and reduce depression. According to WHO (2020), regularly incorporating simple physical exercises into daily routines helps to maintain mental health. Researchers have recommended maintaining a daily routine (Lee, 2020), getting enough sleep, physical activity, learning stress reduction techniques, staying informed, and communicate with family members (Király et al., 2020).

Kövesdi et al. (2021) pointed out that the COVID-19 pandemic is an external environmental challenge that affects individuals at both physiological and psychological levels through macro- and micro-social consequences, and becomes a determining factor of their well-being. The individual is at the intersection of psychological well-being and subjective well-being and is actively involved in shaping their well-being (Ryff, 1989; Diner, 1984). People are more satisfied with their lives when they set personal goals and are involved in their own achievements (Nagy & Oláh, 2013). However, the restrictions imposed during the pandemic period limited precisely the possibility of achieving personal goals and of being active in the pursuit of well-being. Furthermore, there was increased concern for health and fear of life, which is a powerful stressor for all people. The global Covid-19 pandemic is a period of cumulative stress that feeds on many different sources. Not only the disease is a risk but other macro-social (health, social, economic) influences also affect the lives of children and their parents. While the family can dampen the negative effects, stressful situations, such as imposed restrictions, can also exacerbate family problems (Dubey 2020).

The pandemic situation also creates stress for children, especially as adolescents have particular difficulties in maintaining social distance due to the importance of peer relationships (Andrews 2020). The majority of young people in the Youngminds survey in the UK reported that their quality of life had deteriorated during the period of the outbreak (Lee 2020).

In the case of adverse childhood experiences act as a buffer against anxiety, encouraging self-acceptance. Specifically, social support was associated with lower anxiety, especially among adolescents with fewer adverse childhood experiences or lower levels of self-concept (Chi et al., 2022). The social isolation caused by the pandemic has increased the pressure and anxiety on the individual. The COVID-19 pandemic has introduced extraordinary life changes and stress, particularly in adolescents and young adults. (Hawes et al. 2021)

Szerdahelyi (2020) reports in his study that digital education in public schools fundamentally changed the sporting habits of pupils during this transitional period (lessons, training, exercise without class and training partners), which could even lead to a decrease in motivation levels and required the maximum mobilization of volitional factors.

Chapter 3. MATERIALS AND METHODS

3.1 Participants of the research

As a basis for our research, we designed a complex questionnaire to be completed online by secondary school students participating in the study during the second and third waves of the COVID-19 pandemic. During this period, public education in our country took the form of digital distance learning (Figure 2). Hungarian secondary school students were selected from the state and church schools cooperating in the research. The schools were selected by personal contacts and with the assistance of the National Faculty of Education (NPK) [Nemzeti Pedagógus Kar].

The research was made available to secondary school pupils after approval by the school principals or the heads of the institutions. Secondary school students (N = 2556) from 66 public schools in 37 cities in nine regions of Hungary were surveyed (Figure 3).

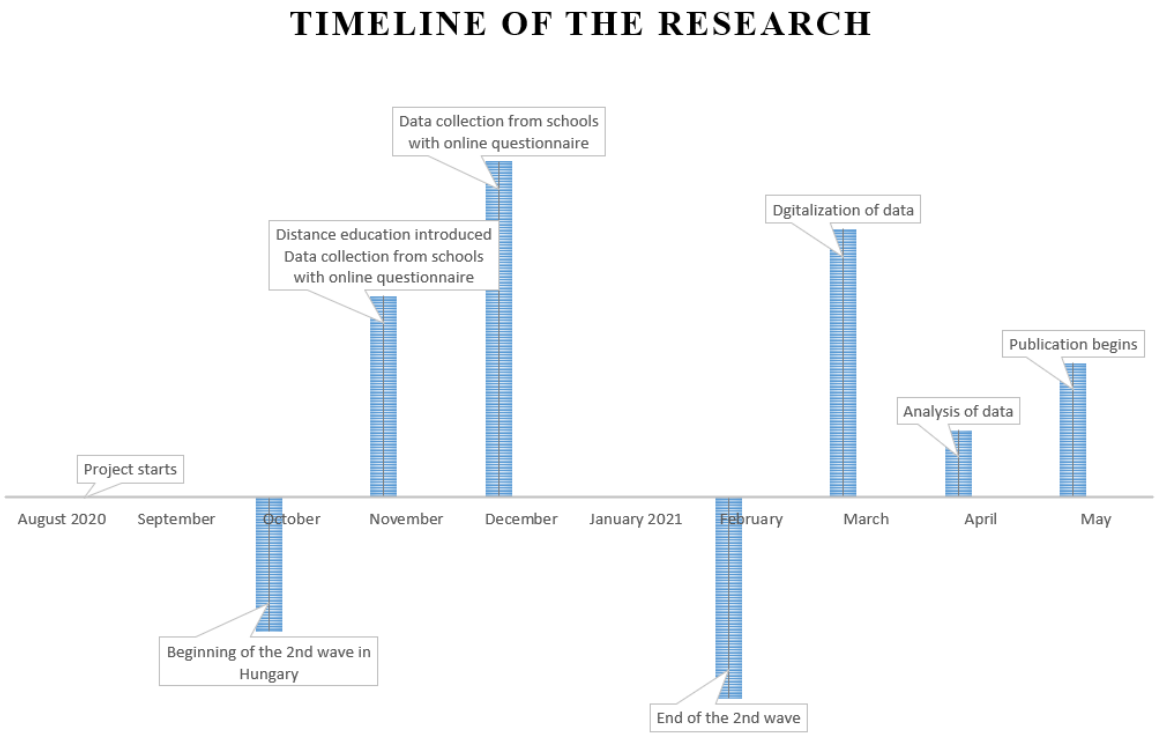


Figure 2. Timeline of the research. Source: Katona, own edition (2022)

In a total of 48 students from the study sample were excluded; 35 responses were non-assessable; 13 students were excluded from the survey due to lack of parental agreement. The nine regions were grouped into four larger units: Budapest, Eastern Hungary, Central Hungary,

and Western Hungary. Due to the structure of education, the age of secondary school students varied between 15 and 21 years depending on the form of education they chose to study.

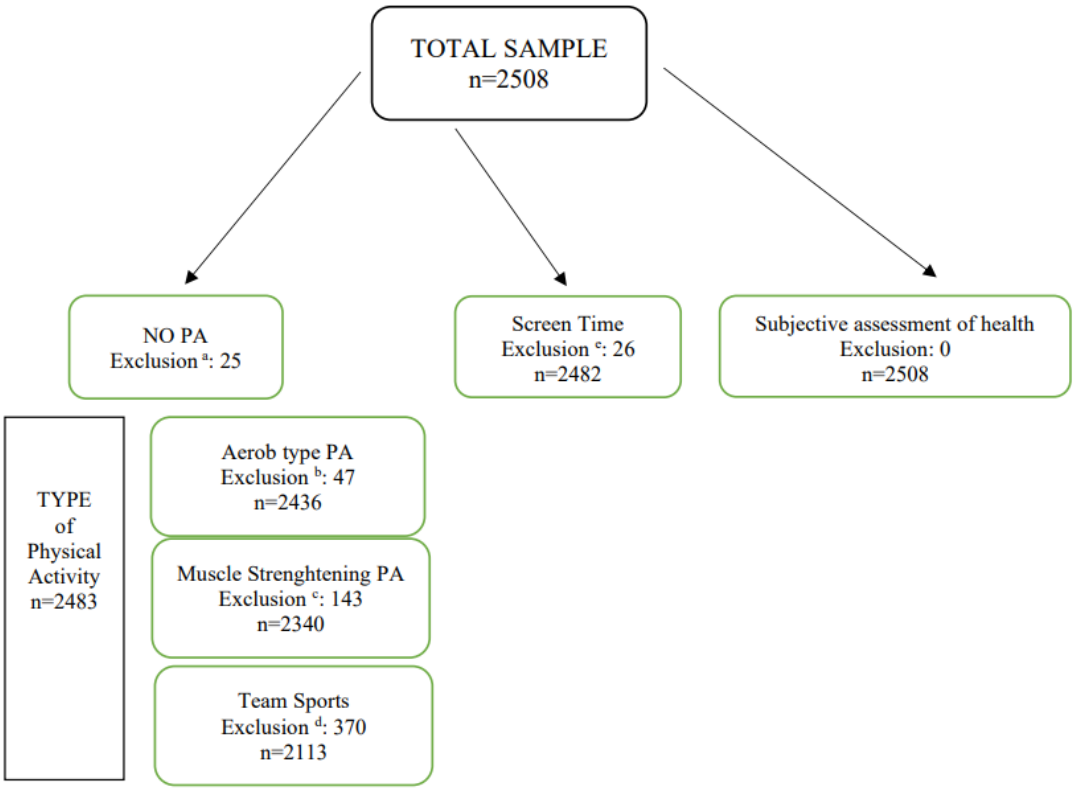


Figure 3. Data cleaning process of the study Source: Katona, own edition (2022)

**Notes*: [a] In the analysis, we excluded students (n = 25). who did not engage in any physical activity (aerobic exercise, muscle strengthening, team sports) before or during distance education (self-reported 0 days/week of all three types of physical activity before and during distance education.

[b] We excluded students (n = 47) who did not perform aerobic exercise at all before or during distance learning. (other types of physical activity).

[c] Students were excluded from the analysis of change (n = 143), who did not perform muscle strengthening type of activities before or during distance learning.

[d] We excluded those students (n = 370) when we examined the change, who neither before nor during distance learning participated in team sports.

[e]Those students who reported 'zero day' time spent in front of the screen in the evenings before and during distance education (n = 26) were excluded.

3.2 The survey

A cross-sectional self-report questionnaire was created for our study (see questionnaire in Appendix 1) using some of the thematic items from the Health Behavior in School-aged Children (HBSC) (Roberts et al. 2007) and CDC Youth Risk Behavior Surveillance System (YRBSS) (Grunbaum et al. 2004) questionnaires and the physical activity measures from the YRBSS questionnaire. Some questions were modified to create pairs of questions during and before the COVID-19 pandemic closure periods (Figure 4).

Before the introduction of distance learning, how many times a week did you exercise or perform physical activity for at least 20 minutes while sweating and breathing heavily, for example, while playing basketball, football, running, swimming, fast cycling, fast dancing or aerobics? (choose the number of times you exercised on average)	**Since the** introduction of distance learning, how many times a week have you exercised or done physical activity for at least 20 minutes while sweating and breathing heavily, for example while playing basketball, football, running, swimming, fast cycling, fast dancing or aerobics? (choose the number that applies to you)	**Before** the introduction of distance learning, how many times a week did you do strength training or more muscle training such as push-ups, sit-ups, pull-ups ?	**Since the** introduction of distance learning, how many times a week have you done strength training or more muscle training such as push-ups, sit-ups, pull-ups ?	How many team games have you played in the **last 12 months?** (Include school running team or community groups.)	**Since the** introduction of distance learning, how many times have you played a team game? (Including school running teams or community groups.)

Figure 4. Example of the paired questions. Source: Katona, own edition (2022)

A further detailed description of the survey, including questions, is described in the following chapters. (See full questionnaire in appendix 1.)

3.2.1 Procedure

The 15-min online survey was shared on a web page and was accessible for six weeks during the lockdown, distance learning period (14 Nov - 21 Dec 2020). Our research team was in touch with school principals and physical education teachers, who encouraged the students to complete the survey. Students primarily completed the survey "during" online physical education classes. Information about the purpose of the survey was provided online, school principals, and parental consent was obtained from all participants before completion (see appendix 2 and appendix 3). Students whose consent was missing or negative were

subsequently excluded from the survey. As a result, forty-eight students were eventually excluded from the study sample due to missing data or lack of parental consent. This research was approved by the Ethical Committee of the Medical Research Council (TUKEB), Hungary, under ETK TUKEB ethical permission No. IV/3067- 3/2021/EKU.

3.3 Data Analysis

Frequencies and percentages for categorical variables and means calculations with their corresponding standard deviations (SD) for continuous variables were reported. Gender and age differences were examined by independent samples t-test with Hedges' g effect size. Associations between age/ gender and categorical variables were examined by calculating Pearson's chi-square test (crosstabs) with Cramer's V effect size. Binary and multinomial logistic regression models were used to ascertain the effects of gender, age, BMI Z Score, change in aerobic exercise, muscle strengthening, screen time, self-rated health, self-rated sleep duration (SDur), the number of close friends, well-being and self-rated loneliness on the likelihood that participants have mental problems.

2 × 2 factorial ANCOVA was used in this model. Dependent variable (reported changes) was calculated as the difference between the number of days/week during and before distance education. Gender (females vs. males) and age groups (adolescents vs. young adults) was used as factors. First, univariate logistic regression models were built for each of the independent variables (that were either dichotomized or scaled). Then, all variables were entered into a final multivariate logistic regression model. Univariate odds ratios (OR) and multivariate-adjusted odds ratios (aOR) with their corresponding 95% confidence intervals (95% CI) were reported. A multinomial logistic regression model was used to examine the association between mental problems, loneliness, and/or hopelessness, and the outcomes of interest. For the regression model, the p-value was calculated using a two-tailed Wald z-test.

Finally, we used Body Mass Index (BMI) Z-score as a covariate in this model. BMI is assumed to relate to reported changes (dependent variable) in physical activity and screen time (Bu, Steptoe & Fancourt 2020), and BMI is also assumed to associate with gender and age 3 (Lee, Cadigan & Rhew 2020). The level of significance was set a priori at 0.05. Statistical analysis and visualization were conducted using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp. Released 2017. Armonk, NY, USA: IBM Corp).

Chapter 4: PHYSICAL ACTIVITY AND SCREEN TIME AMONG HUNGARIAN HIGH SCHOOL STUDENTS DURING THE COVID-19 PANDEMIC CAUSED DISTANCE EDUCATION PERIOD (STUDY 1)

NoteThis article has been accepted for publication and the final published version is presented unchanged in this chapter. The final published version can be found and downloaded online from the publisher's website.

Katona, Z. B., Takács, J., Kerner, L., Alföldi, Z., Soós, I., Gyömörei, T., Podstawski, R., & Ihász, F. (2021). Physical Activity and Screen Time among Hungarian High School Students during the COVID-19 Pandemic Caused Distance Education Period. *International journal of environmental research and public health*, *18*(24), 13024. https://doi.org/10.3390/ijerph182413024

4.1 Abstract

Background: High school education took place in the form of distance learning during the SARS-CoV-2 pandemic worldwide, including Hungary. Decreased physical activity and an increase in inactive behaviors may lead to an increased risk of obesity, diabetes, and cardiovascular disease. Aim: Our study targeted changes in physical activity (aerobic exercise, muscle strengthening) and screen time in adolescents and young adults during the pandemic. Methods: High school students were interviewed in 66 public schools in 37 Hungarian cities (N = 2508). Survey items on physical activity and screen time were derived from the WHO Health Behavior of School-aged Children Survey and the Centers for Disease Control Youth Risk Behavior Survey. A 2 × 2 factorial ANCOVA was used to test the effects of gender (male vs. female) and/or age (adolescents vs. young adults) on the reported changes in physical activity and screen time before and during lockdown (covariate: BMI Z-score). Results: The majority of the cohort indicated less physical activity. Aerobic and muscle-strengthening type of exercises significantly decreased, and screen time increased during distance education. Male individuals showed a higher decrease in the level of aerobic exercise, and young adults reported a higher increase in the time spent in front of the screen.

Keywords: physical activity; screen time; healthy lifestyle; distance education; coronavirus

4.2 Introduction

The SARS-CoV-2 coronavirus pandemic (COVID-19) has overall health, social and economic consequences. The pandemic has disrupted normal daily routines worldwide: including attendance teaching among children and adolescents, and across all age groups, depending on the degree of vulnerability (Mazza et al., 2020). The COVID-19 restrictions have completely changed the daily behavior of individuals worldwide in 2020, including the young people of Hungary. Under the measures introduced on 26 November 2020, a digital timetable has been introduced in secondary education from grade 9 in Hungary. Educational institutions were instructed to suspend in-person class attendance and switch to online e-learning and education.

Students were home-bound and digital class attendance, including Physical Education (PE) lessons, was required between 8 a.m.–4 p.m. on school days (Ministry of Justice, Hungary, 2021). The global health crisis has resulted in a high-level of inactivity and several studies recognized the negative impact of physical inactivity on health status (Pinto et al., 2020; Hall et al., 2021). Ács et al., 2020 pointed out that during the COVID-19 pandemic, decreased levels of physical activity (PA) were detected among young people in higher education, highlighting the need to promote a physically active lifestyle in the face of pandemic-related restrictions. (Bronikowska et al., 2021; Rossi, Behne and Breuer, 2021). As for the daily expected requirement for PA for adolescents (5–17 years)—at least 60 min of moderate-intensity PA has been significantly reduced (King et al, 2020). The benefits of physical activity, time spent in a sedentary position and adherence to sleep recommendations are independently important components (Tremblay et al., 2011) of maintaining optimal health (Carson et al., 2016; Poitras et al. 2016). The right combinations of PA can be of great importance in maintaining optimal health. Similarly, Saunders et al. have reported that children and young people who comply with 24-h PA rules (high physical activity/high sleep/low sedentary behavior (SB)) tend to have more favorable adiposity and cardio metabolic indicators compared to those who do not comply with these recommendations. Current evidence suggests that the composition of PA behaviors within a 24-h period can have important implications for health at all ages, and that meeting current 24-h PA guidelines are related to a variety of a range of desirable health indicators in children and young people (King et al., 2020). However, the restrictions associated with COVID-19 are likely to exacerbate the current, already unfavorable public health situation. Several studies have reported in Canada (Guerrero et al. 2020) China, (Xiang, Zhang and

Kuwahara, 2020), Italy (Pietrobelli et al., 2020), Croatia (Zenic et al., 2020) Spain and Brazil (Lopez at al., 2020). Ács et al. show that curfew restrictions have led to a significant decrease in all other categories of sporting activity in Hungary (Ács et al. 2020). Studies found decreased amounts of PA among university students during the COVID-19 pandemic period (Medrano et al. 2020). Understanding the results of studies worldwide, focused on and reported results of the adult population we considered the necessity of a study that assesses PA, and screen time (ST) in adolescents and young adults. The aim of this study, therefore, was to conduct a report on changes in PA and ST behaviors during versus before the COVID-19 pandemic lockdown between secondary school students during the digital distance education at the time of COVID-19 lockdown in Hungary. We acknowledge that the gender and biological sex of a person are related but not synonymous (Regitz-Zagrosek, 2012). In this paper, the terms "girls/boys"and "female/male" refer to biological females and males and their specific health considerations, respectively (Guss, Shumer and Katz-Wise, 2015). Therefore, the information presented here may be useful for biological females and males, as well as individuals of diverse genders (Garcia-Pelagio et al., 2021).

4.3 Materials and Methods

4.3.1 Participants

Participants were selected from public and private schools as well. Secondary school education takes place in many different types of institutions in Hungary. The age of secondary school students can vary between 15–21 years, depending on the form and type of education they choose. Secondary school students (N = 2556) in 66 public education institutions in 37 cities were surveyed from nine regions in Hungary (Figure 1). In a total of 48 students from the study sample were excluded; 35 responses were non-assessable; 13 students rejected the survey claiming a lack of parental agreement. This research was approved by the Ethical Committee of the Medical Research Council (TUKEB), Hungary, under ETK TUKEB ethical permission No. IV/3067- 3/2021/EKU.

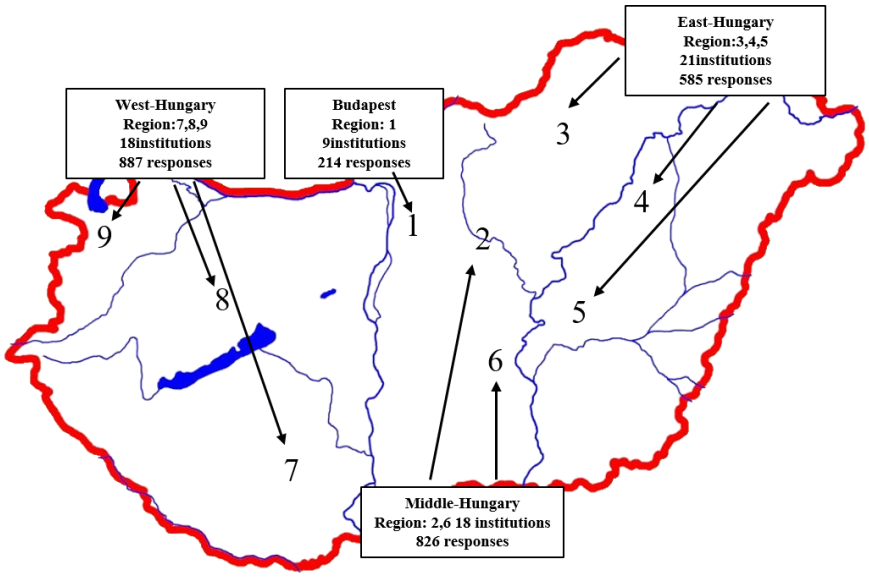


Figure 1. Responses according to geographical locations, institutions, and responses. Source: Katona, own edition (2022)

4.3.2 Survey

A self-report questionnaire based on the Health Behavior of School-aged Children (HBSC) (hbsc, 2006) and the Youth Risk Behavior Survey (YRBSS) (Grunbaum, et al. 2004) created by The Centers for Disease Control (CDC) was created. Some questions were modified for during versus before the COVID-19 pandemic lockdown periods. The 15-min-long online survey was located on a web page and was accessible for six weeks during distance education while lockdown. Our research team was in touch with school principals and physical education teachers, who encouraged the students to complete the survey. The students completed the survey primarily during online physical education lessons. Information about the aims of the research was given online and parental consent was requested before completion. Items from CDC's Youth Risk Behavior Survey (Grunbaum et al., 2004) were used as the PA measures in this study. Change of vigorous PA was assessed by asking set of questions in pairs from respondents such as "On how many days per week did you exercise or participate in physical activity for at least 20 min that made you sweat and breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or similar aerobic activities before distance learning period?" and "On how many days per week did you exercise or participate in physical activity for at least 20 min that made you sweat and breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or similar aerobic activities during distance learning period?" Similarly, change in muscle-strengthening exercise was measured

by asking question pairs “On how many days per week did you do exercises to strengthen or tone your muscles, such as push-ups, sit-ups, or weight lifting before the distance learning period?” and “On how many days per week did you do exercises to strengthen or tone your muscles, such as push-ups, sit-ups, or weight lifting during the distance learning period?” For each questions a 0–7-point scale was provided for answers.

4.3.3 Data Analysis

To describe the data, descriptive analysis, shift tables and the distribution of relative frequencies were used. Data were presented as mean ± SD or frequency and proportion. Characteristics of the sample were examined by age groups and gender, using Independent Samples T test, Fisher’s exact test and Pearson’s chi-square test. To examine the effects of gender (females vs. males) and/or age groups (adolescents vs. young adults) on the reported changes in physical activity (measured by the level of aerobic exercise and muscle strengthening) and screen time. A 2 × 2 factorial ANCOVA was used in this model. Dependent variable (reported changes) was calculated as the difference between the number of days/week during and before distance education. Gender (females vs. males) and age groups (adolescents vs. young adults) was used as factors. Finally, we used Body Mass Index (BMI) Z-score as a covariate in this model. BMI is assumed to relate to reported changes (dependent variable) in the physical activity and screen time (Heinonen et al., 2013; Ding and Jiang, 2020), and BMI is also assumed to associate with gender and age (Nevill and Metsios, 2015). The level of significance was set a priori at 0.05. Statistical analysis and visualization were conducted using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp. Released 2017. Armonk, NY, USA: IBM Corp).

4.4 Results

4.4.1 Characteristics of the Sample

Based on their age, we classified students into two groups, adolescents (A, 56.3% age min-max = 14–17 yr) and young adults (YA, age min-max = 18–21 yr). Age groups showed a non-significant association with gender but revealed a significant association with the BMI category. Thus, BMI Z-score was an appropriate covariate for the analysis. Table 1. shows descriptive sample statistics.

Table 1. Characteristics of the sample.

Variables	Study Sample (N = 2508)					
	Adolescents (*n* = 1413)	Young Adults (*n* = 1095)	*p*	Males (*n* = 1072)	Females (*n* = 1436)	*p*
gender, Male *n* (%)	621 (43.9)	451 (41.2)	0.167 [a]	N/A	N/A	N/A
age (M ± SD)	16.3 ± 0.7	18.6 ± 0.6	N/A	17.3 ± 1.3	17.3 ± 1,3	0.167 [b]
Weight (kg)	63.3 ± 13.6	66.6 ± 14.5	N/A	71.4 ± 14.7	59.8 ± 11.3	N/A
Height (cm)	171.2 ± 9.3	171.9 ± 9.5	N/A	178.6 ± 7.7	166.2 ± 6.5	N/A
BMI categories [1], *n* (%)						
underweight	89 (6.3)	40 (3.7)		55 (5.1)	74(5.2)	
normal weight	1146 (81.1)	856 (78.2)		817 (76.2)	1185(82. 5)	
overweigth/obese **	123 (8.7)	131 (11.9)	<0.001 [c]	142 (13.3)	112(7.8)	<0.001 [c]
obese	55 (3.9)	68 (6.2)		58 (5.4)	65(4.5)	

Notes. [1] BMI categories based on BMI %ile for 2–19 yr, and on BMI score for ≥20 yr, ** 'overweight/obese' terminology based on: Barlow SE and the Expert Committee 2007, [a] Fisher's exact test for association between gender and age-groups, [b] Independent Samples T-Test for differences between males and females, [c] Pearson's chi-square test for association between gender/age-groups and BMI categories, N/A statistical analysis is not applicable.

4.4.2 Physical Activity before and during Distance Education

Physical activity was assessed by the self-reported level of aerobic exercise (AE), and muscle strengthening (MS), before and during distance education. To ensure unbiased data analysis, inactive students, (e.g., did not do AE or MS before or during distance education were excluded (*n* = 41).

4.4.3 Aerobic Exercise (AE)

Nearly three-quarters of the students showed changes in the level of AE, 1485 students (60.9%) reported a decreased level, and 350 (14.4%) an increased level of AE (Table 2). A total of 55% of students were doing one to three days less AE per week during distance education as before (see Figure 2A, subgraph of that picture).

Table 2. Shift table for the level of aerobic exercise before and during distance education.

		AE Days/Week during Distance Education								Total
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
AE days/week before distance education	0	31 *	6	8	6	5	1	1	7	65
	1	34	**39**	18	22	6	2	1	3	125
	2	59	121	**81**	33	18	12	1	6	331
	3	69	133	157	**143**	38	38	10	8	596
	4	31	85	173	103	**112**	34	24	8	570
	5	31	30	71	146	60	**122**	17	11	488
	6	3	1	13	22	27	38	**50**	6	160
	7	6	3	10	16	12	21	10	**54**	132
Total		264	418	531	491	278	268	114	103	2467

Notes. AE: the level of aerobic exercise means the number of days/week doing aerobic exercise * Do not do AE during and before distance education, bold: no changes in the level of exercise, i.e., AE days/week during distance education = AE days/week before distance education, light grey: increased AE level, i.e., AE days/week during distance education > AE days/week before distance education, dark grey: decreased AE level, i.e., AE days/week during distance education < AE days/week before distance education.

For studying the gender and age differences of changes in the AE level, students who did not do AE (n = 31) or reported no changes (n = 601) were excluded. In factorial ANCOVA model gender showed a significant main effect ($F(1,1830) = 6.034$, $p = 0.014$, $\eta^2_p = 0.003$). Male population reported a higher decrease in AE level (M = −1.45, SD = 2.09), than female (M = −1.19, SD = 1.85). Age, gender x age, and the covariate were non-significant.

4.4.3 Muscle Strengthening (MS)

Around 70% of the students showed changes in the level of MS, 1041 students (44.5) reported a decreased level, and 530 (22.6%) had an increased level of MS (Table 3.). 35% of students were doing one to two days less MS per week during distance education as before (Figure 2B, subgraph of the picture).

Table 3. Shift table for the level of muscle strengthening (MS) before and during distance education.

		MS Days/Week during Distance Education								Total
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
MS days/week before distance education	0	127 *	33	24	16	8	10	9	7	234
	1	112	**150**	48	31	13	10	6	6	376
	2	96	175	**209**	64	43	21	9	6	623
	3	64	108	119	**186**	40	33	11	7	568
	4	16	26	59	47	**78**	29	14	10	279
	5	22	14	38	40	27	**84**	7	14	246
	6	3	1	4	12	14	12	**27**	1	74
	7	3	2	3	10	7	4	3	**35**	67
Total		443	509	504	406	230	203	86	86	2467

Notes. MS: the level of muscle strengthening means the number of days/week doing muscle strengthening * not to do MS during and before distance education, bold: no changes in the level of exercise, i.e., MS days/week during distance education = MS days/week before distance education, light grey: increased MS level, i.e., MS days/week during distance education > MS days/week before distance education, dark grey: decreased MS level, i.e., MS days/week during distance education < MS days/week before distance education.

For studying the gender and age differences of changes in the MS level, students who did not do MS (n = 127) or reported no changes (n = 769) were excluded. Based on the 2 × 2 ANCOVA model, there was no significant effect of gender and/or age in the changes of the level of MS.

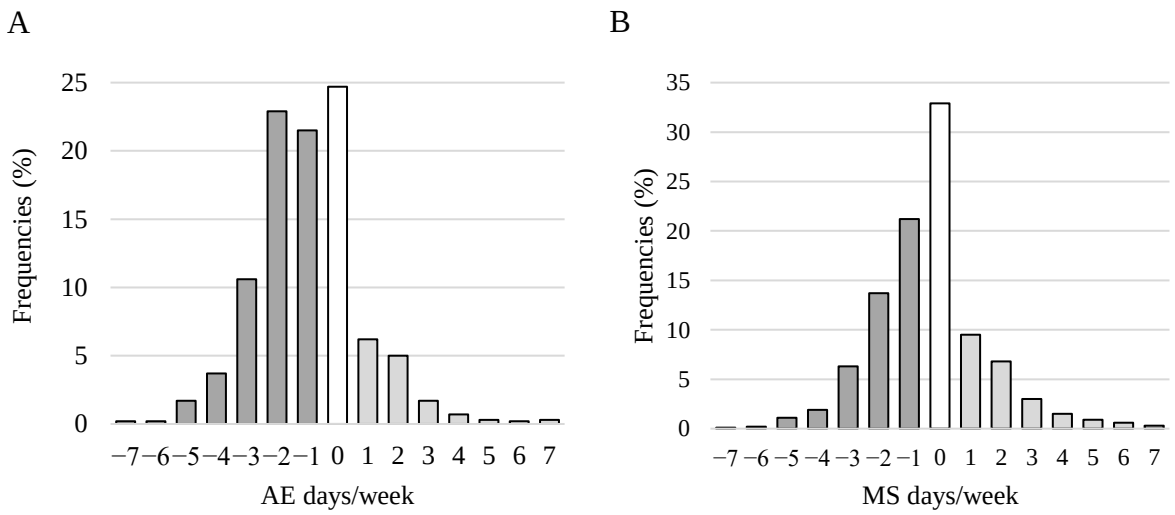
4.4.4 Screen Time (ST) before and during Distance Education

For unbiased analysis, those students who reported ‘zero day’ time spent in front of the screen in the evenings before and during distance education (n = 26) were excluded. In the case of the changes in ST, 42.4% of the students showed no changes and more than half of them (54%) reported an increased level of ST. (Table 4). 42.4% of students were in front of the screen in the evenings one to three days more per week during distance education as before (see Figure 2C).

Table 4. Shift table for the level of screen time (ST) before and during distance education.

		ST Days/Week during Distance Education								Total
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
ST days/week before distance education	0	0 *	8	12	12	13	12	4	25	86
	1	0	**19**	8	25	19	16	9	19	115
	2	0	10	**41**	48	49	58	40	64	310
	3	2	1	8	**64**	71	127	57	85	415
	4	0	0	6	5	**63**	62	72	98	306
	5	0	0	5	3	6	**87**	76	160	337
	6	0	0	3	1	4	7	**56**	91	162
	7	1	2	2	2	8	7	7	**722**	751
Total		3	40	85	160	233	376	321	1264	2482

Notes. ST: screen time means the number of days/week spent in front of the screen in the evenings, * 'zero day' time spent in front of the screen in the evenings during and before distance education, bold: no changes in the level of ST, i.e., ST days/week during distance education = ST days/week before distance education, light grey: increased ST level, i.e., ST days/week during distance education > ST days/week before distance education, dark grey: decreased ST level, i.e., ST days/week during distance education < ST days/week before distance education.



C

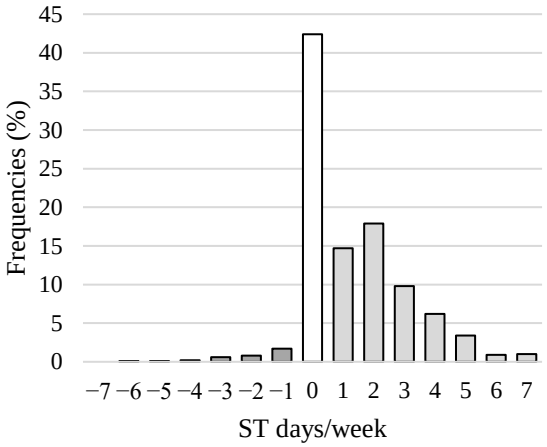


Figure 2. Distribution of the changes (days/week during distance education–before distance education) in the level of aerobic exercise (**A**) and muscle strengthening (**B**), and time spent in front of the screen in the evenings (**C**). Notes. AE: aerobic exercise, MS: muscle strengthening, ST: screen time; AE days/week = AE days/week during distance education–AE days/week before distance education, MS days/week = MS days/week during distance education–MS days/week before distance education, ST days/week = ST days/week during distance education–ST days/week before distance education, white bars: no changes, i.e., the number of the days/week before and during distance education is equal, light grey bars: increase, i.e., days/week during distance education > days/week before distance education, dark grey bars: decrease, i.e., days/week during distance education < days/week before distance education.

For studying the gender and age differences of changes in the ST level, students who reported no changes (n = 1052) were excluded. In the factorial ANCOVA model age showed a significant main effect ($F(1,1425) = 4.280$, $p = 0.039$, $\eta^2_p = 0.003$). Young adults reported a higher increase in ST level (M = 2.31, SD = 1.76), than adolescents (M = 2.13, SD = 1.79). Age, gender x age, and the covariate were non-significant.

4.5 Discussion

This project is one of the first known studies to examine the early effects of the COVID-19 pandemic on different types of PA and ST among Hungarian high school students. Data were collected during a period of time (November–December 2020) when the most restrictive policies were in place to prevent the spread of the virus, including the closure of primary and secondary schools, the cancellation of team sports and activity classes for youth, and the closure

of public parks and playgrounds too. Our findings show a decrease in AE and MS type exercises during the COVID-19 distance education in the samples in comparison with pre-distance education.

Results from Brazilian and Spanish researchers show that the weekly frequency of 60 min of moderate to high-intensity physical activity (MVPA) was significantly reduced in COVID-19 lockdown compared to pre lockdown (Zenic at al., 2020(. In contrast, ST and sleep time duration increased (López-Bueno et al., 2020). Very low proportions of participants in Spain (0.3%) and Brazil (7.5%) met the 24-h physical activity requirement (López-Gil, Tremblay, and Brazo-Sayavera, 2021). Social constraints, including distance education and forced stay-at-home arrangements, made it difficult for children and adolescents to participate in physical education, sports or community-based organized PA related to school (Pietrobelli et al 2020). Another direct consequence of confinement is a decrease in outdoor play, which tends to suggest that this type of physical activity is not part of the daily routine of adolescent children. These results are consistent with other studies that have reported on COVID-19 confinement (Gallè et al., 2020; Štveráková et al. 2021).

These results showed that the activity pattern of adolescents differed from pre- COVID-19. period. The most commonly reported physical activity in the early COVID-19 period was unstructured free play PA. This pattern was not surprising given school closures and cancellation of team sports/activity classes, with most children spending all day at home and not accessing structured activity activities. However, it contrasts with typical patterns of children's PA, suggesting that unstructured and free play activities are becoming less common as children's time is increasingly filled with organized activities. This may also mean that children are not aware of the opportunities offered by their environment and thus look forward to other activities less typical of physical activity during their stay (Gallè et al., 2020).

Despite global predictions of a decline in physical activity levels (PAL) among adolescents due to the COVID-19 pandemic and associated isolation and social distancing, empirical evidence is lacking. In the most recent study, Zenic et al., confirmed a larger decline in PAL levels in boys than in girls, which can be explained by the alarmingly low PAL levels in girls. In the run-up to the COVID-19 pandemic, it highlighted the need for further studies that take into account the potential impact of different environmental factors on changes in human life (Zenic et al., 2020).

As a whole, these data suggest that in the early COVID-19 period, adolescents spent most of their unstructured leisure time in sedentary activities rather than physical activities.

Girls and their older boy peers tended to spend more time in sedentary activities than their younger peers (Verloigne et al., 2012). During the COVID-19 pandemic, this situation may be exacerbated for girls and their older boy peers, as they are at even greater risk of physical inactivity, such as health problems and metabolic dysregulation due to obesity.

The above reasons also provide a strong rationale to study the impact of Covid-19 on the health of adolescents and young adults. Italian researchers have investigated (Maugeri et al., 2020) the benefits of regular physical activity, particularly in times of anxiety, crisis and fear. Therefore, it is of concern that in the context of the pandemic, lack of access to regular exercise or exercise routines has led to challenges in immune and physical health, including leading to the development or exacerbation of existing diseases that have their roots in sedentary lifestyles.

Lack of access to exercise and physical activity has also been associated with mental health effects, complex stress or anxiety, which many people experience due to isolation from normal social life. (Grant, Wardle, and Steptoe, 2009) The potential loss of family or friends due to the virus, as well as the impact of the virus on an individual's economic well-being and access to food, exacerbated these effects (Sallis et al. 2020).

The strengths of this study include its large sample size with nationally comparable demographics and the potential for further regional or age-group analysis. There are some limitations of the present study. Its limitations include the fact that all data were collected online and self-reported by participants. Self-reports are subject to recall biases therefore it is possible that they under- or overestimated the time spent in from of the screen or with PA. There are also some potential response biases of a self-reported questionnaire such as misunderstandings, social desirability and acquiescence bias or extreme responding, etc. At the same time, data collection based on a self-reported questionnaire was the relevant method to answer research questions, even if it has some biases; this method allows the data collection from a large number of study participants with a high response rate. The self-reported measures of physical activity have some biases. There are a huge number of instruments to assess PA with different formats and development. Thus, for assessing PA, we used the Health Behavior in School-aged Children (HBSC) questionnaire which has been a validated instrument for cross-sectional studies for decades. Finally, it is important to note that we assessed only the frequency of PA. It is recommended for future studies assessing the intensity and time of PA.

4.6 Conclusions

The prevalence of adolescents and young adults in Hungary samples meeting PA and ST guidelines was low before the COVID-19 pandemic and even worse afterward during distance education. The effects of a more sedentary lifestyle as a result of distance learning are already being recognized. The health effects of reduced PA and increased ST among young people have further serious negative public health implications. These facts highlight the need to make efforts to support and develop healthy behavior patterns during a period of distance education in young people.

The authors of the study recommend that during any subsequent quarantine restrictions, the national school nurse service should carry out regular periodic tele-health checks. Promotions of responsible COVID19-related behaviors, follow non-pharmacological interventions such as avoiding crowded indoor settings, wearing a mask in unavoidable indoor social situations, practicing good hand hygiene. Further consultations with physical education teachers and sports coaches could prioritize physical activity in school-age children. The proven positive effects of PA on individuals' immune system would ultimately help school children, their families, and societies in general reducing COVID infection-spread.

Authorities should prepare detailed plans for adolescents and young adults to meet health-related guidelines during a potential future pandemic and should develop strategies to avoid the potential harmful collateral effects precipitated by pandemic-related restrictions including school closures.

Author Contributions: Conceptualization, K.Zs.; methodology, Gy.T., R.P. and F.I.; formal analysis, J.T.; data curation, J.T.; writing—original draft preparation, K.Zs.; writing—review and editing, R.P., K. Zs.; visualization, M.B.; supervision, F.I.; project administration, Z.A. resources, L.K., I.S. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethical Committee of the Medical Research Council (TUKEB), Hungary, under ETK TUKEB ethical permission No. IV/3067-3/2021/EKU.

Informed Consent Statement: Informed consent was obtained from all subjects and their guardians involved in the study. Written informed consent has been obtained from the parents to publish this paper.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available because they belong to minors.

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Conflicts of Interest: The authors declare no conflict of interest.

Chapter 5: PHYSICAL ACTIVITY, SEDENTARY TIME, SUBJECTIVE ASSESSMENT OF HEALTH STATUS AMONG HUNGARIAN SECONDARY SCHOOL STUDENTS DURING DISTANCE LEARNING DUE TO THE SECOND AND THIRD WAVES OF COVID-19 PANDEMIC. (STUDY 2)

Note: This article has been accepted for publication and the final published version is presented unchanged in this chapter. The final published version can be found and downloaded online from the publisher's website.

Katona, Z., Kerner, L., Alföldi, Z., Soós, I., & Ihász, F. (2021). Fizikai aktivitás, nyugalomban töltött idő és jóllét érzés a magyar középiskolások körében a covid-19 második és harmadik hulláma során elrendelt távoktatási időszakban. In "KUTATÁSOK A COVID-19 PANDÉMIA IDEJÉN" (pp. 31-42). [Hungarian]

5.1 Abstract

Introduction: During the SARS-CoV-2 pandemic in Hungary, secondary school education was provided through distance learning. Reduced physical activity and increased inactive behaviors may lead to an increased risk of obesity, diabetes, and cardiovascular disease in children. Our study aimed to assess changes in physical activity, screen time, sleep duration, and well-being in adolescents and young adults during the pandemic in Hungary.

Material and methods: 2509 secondary school students (N = 2509) from 66 public schools in 37 cities in Hungary. Physical activity was assessed using an online self-report questionnaire based on the HBSC and YRBSS surveys. Differences in participants by gender and age groups in sociodemographic and anthropometric data for categorical variables were analyzed using the chi-square (¬x2) test. Differences between age groups and gender in physical activity and sleep time before and during distance education were analyzed using the Kruskall-Wallis method, with a p-value of 0.05 indicating statistical significance.

RESULTS: The majority of the cohort reported less physical activity; health scores worsened, with aerobic and muscle-strengthening type exercises significantly reduced; sleep duration and screen time increased during distance learning.

Keywords: physical activity, sleep time, sedentary lifestyle, coronavirus

5.2 Introduction

The 2019 coronavirus pandemic (COVID-19) has had profound health, social and economic consequences. The outbreak disrupted normal daily routines worldwide: including attendance teaching among children and adolescents, and across all age groups, depending on the degree of vulnerability (Rundle, 2020). In terms of the daily expected requirement for physical activity for both children and adolescents (5-17 years) - at least 60 minutes of moderate-intensity physical activity has been significantly reduced (King, 2020). The benefits of physical activity, time spent in a sedentary position and adherence to sleep recommendations are independently important elements (Carson, 2016) of maintaining optimal health (Poitras, 2016). Appropriate combinations of physical activity (i.e. the three elements mentioned above) can be of great importance in maintaining optimal health in the early years of development. Similarly, Saunders et al. reported that children and young people who comply with the 24-hour physical activity rules (high physical activity/high sleep/low sedentary behavior) tend to have more favorable adiposity and cardio-metabolic indicators compared to those who do not comply with these recommendations. Current evidence shows that the composition of physical activity behaviors within a 24-hour period can have important implications for health at all ages, and that meeting the current 24-hour physical activity guidelines is associated with a range of desirable health indicators in children and young people (Guerrero, 2020). However, the restrictions associated with COVID-19 are likely to exacerbate the current, already unfavorable public health situation. Several studies have already reported on the above-mentioned phenomena in Canada (Moore, 2020), China (Xiang, 2020), Italy (Pietrobelli, 2020), Croatia (Zenic, 2020) and Spain (López-Bueno, 2020), and this study presents similar data from Hungary.

This study aims to describe and assess changes in physical activity, social interaction, sleep and lifestyle habits of Hungarian adolescents and young adults (secondary school students) before and during the distance education period due to the restrictions of Covid-19 pandemic.

5.3 Material and methods

We surveyed secondary school students living in Hungary in 66 public education institutions in 37 cities (N=2513; 57% girls). Their average age was (17.27±1.3) years. Physical

activity was assessed using an online questionnaire based on the *"Health Behavior of School-aged Children (HBSC) and the Centers for Disease Control Youth Risk Behavior Survey*" self-report questionnaire. Questionnaires were completed by study participants during the second wave of the COVID-19 pandemic in 2020. During this period, public education in Hungary was delivered through distance learning.

The data were analyzed using the Statistica for Window's 13.2 software package. Individual and group frequency of physical activity and their comparison by gender was performed using the Kruskal-Wallis test at the random error level ($p<0.05$).

5.4 Results

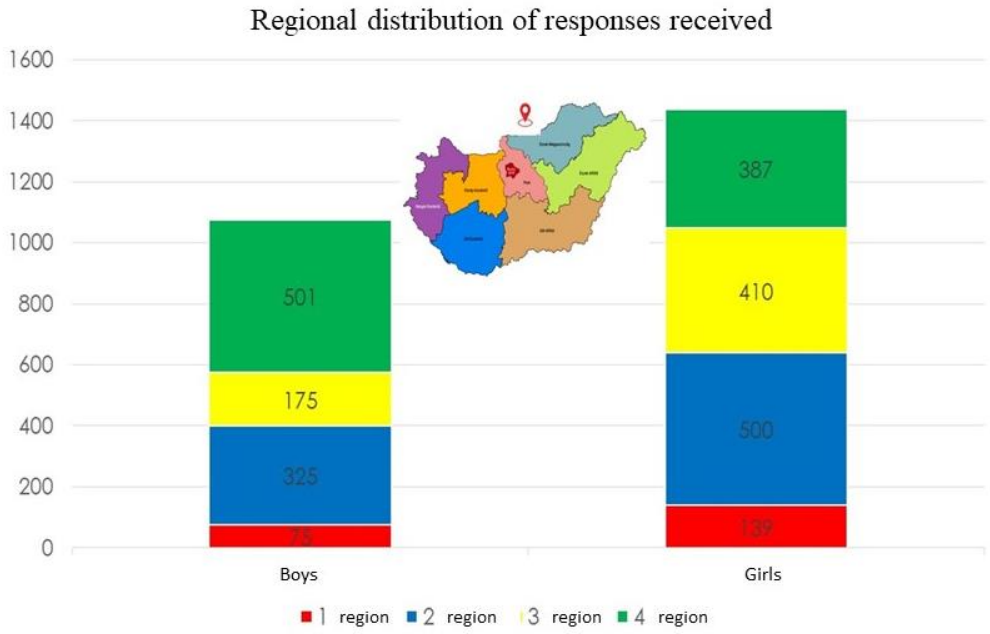


Figure 1: Regional distribution of responses received (Katona, Rikk, Ihász 2021)

Explanation of regions: 1- Budapest, 2- Central Hungary, 3 - Eastern Hungary, 4- Western Hungary

The regional distribution of the 2,513 respondents received shows a relative balance across geographical areas in Hungary.

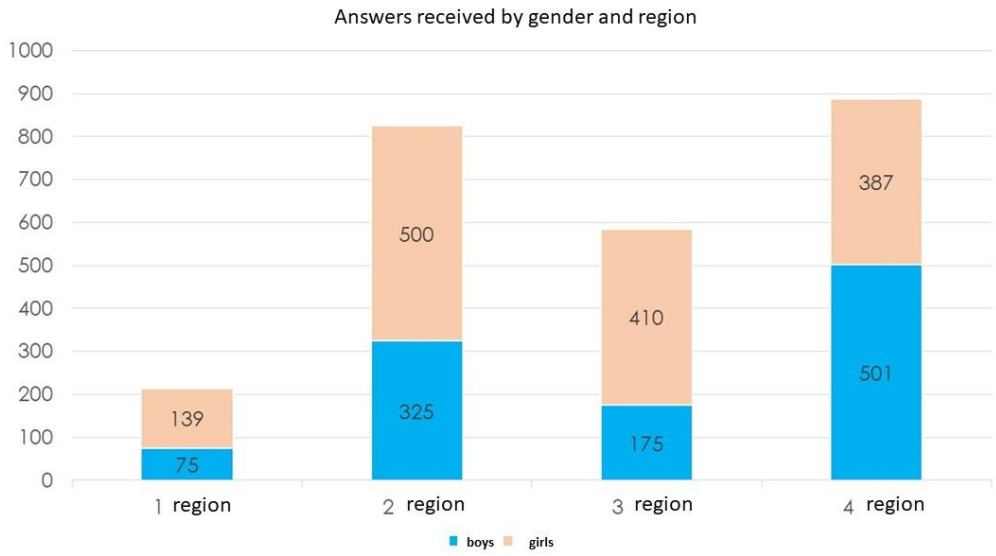


Figure 2: Distribution of responses by gender and region (Katona, Rikk, Ihász 2021)

57% of respondents were girls and 43% were boys. In the West-Hungary region, male respondents are slightly over-represented, while in the other three regions, female respondents dominate.

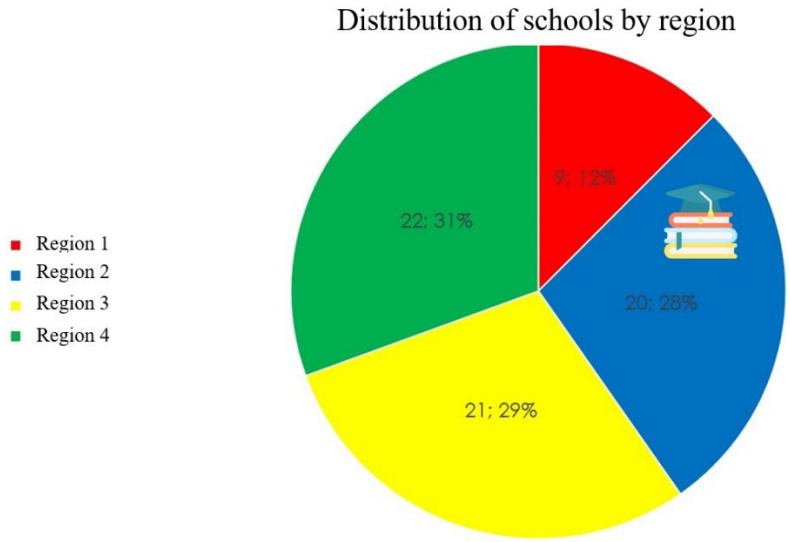


Figure 3: Distribution of schools by region (Katona, Rikk, Ihász 2021)

The distribution of responses by school shows a relative balance of 29%, 28% and 31% between the three regions defined as large areas - East Hungary, Central Hungary, and West Hungary. Budapest is a separate region, with 12% of the population of the capital slightly under-represented compared to those living in the countryside.

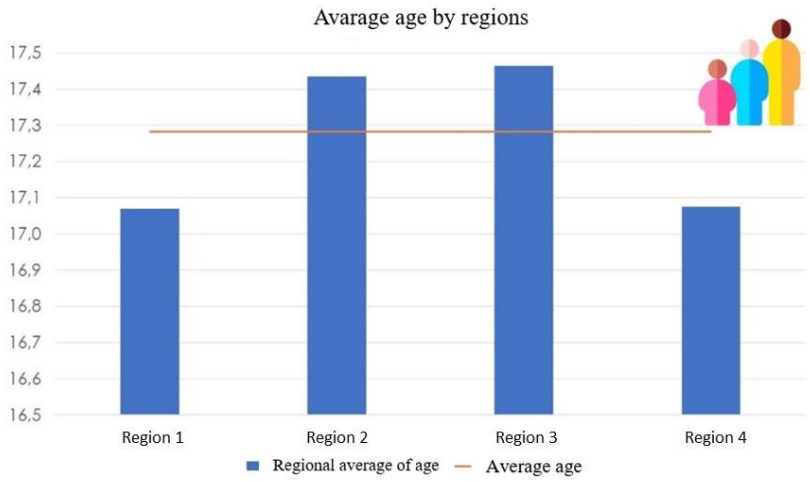


Figure 4: Age distribution of respondents by region (Katona, Rikk, Ihász 2021)

The average age of respondents was (17.27±1.3) years. The age of respondents in Budapest shows the lowest average, followed by the West-Hungary region.

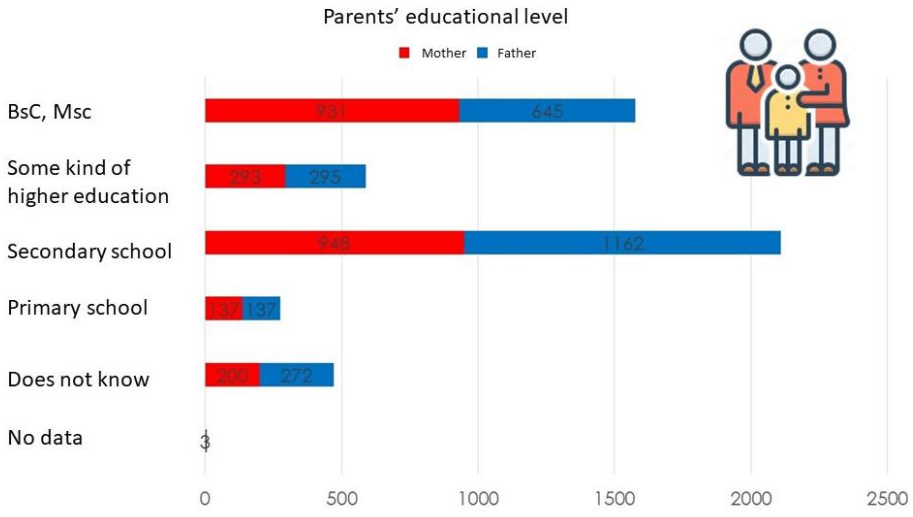


Figure 5: Educational attainment of respondents' parents (Katona, Rikk, Ihász 2021)

Based on the responses received, the majority of students can provide accurate information about their parents' education. The proportion of secondary school graduates is higher among fathers, while the proportion of mothers with tertiary education (BSc, MSc) exceeds the number of fathers with tertiary education.

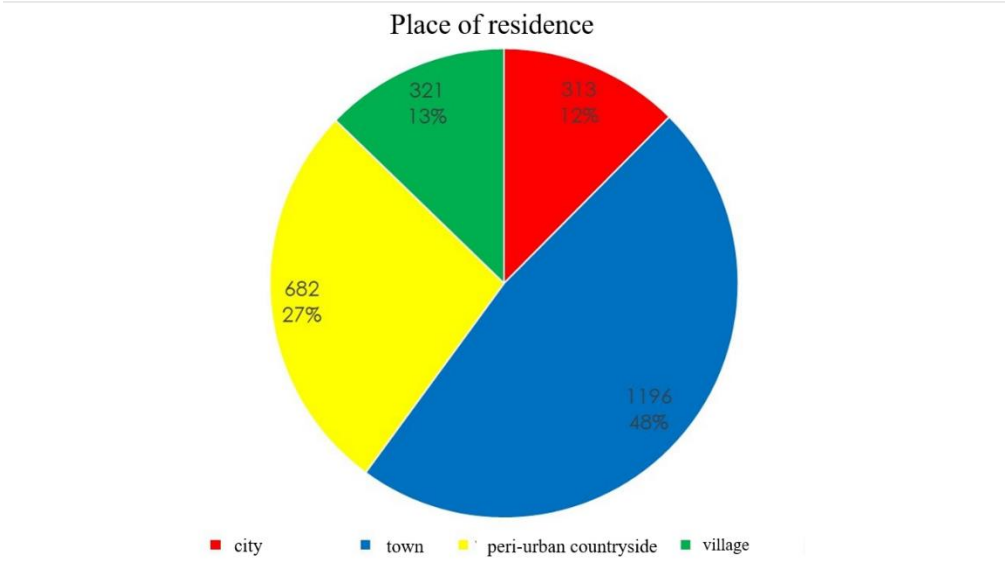


Figure 6: Distribution of respondents by place of residence according to settlement size (Katona, Rikk, Ihász 2021)

The breakdown by place of residence shows that 48% of respondents, or 1196 people, live in a city, while 12%, or 313 people, live in a large city. Of the total, 682 live in a peri-urban area, 27% of all respondents and 13% or 321 pupils live in a village or farm outside the city.

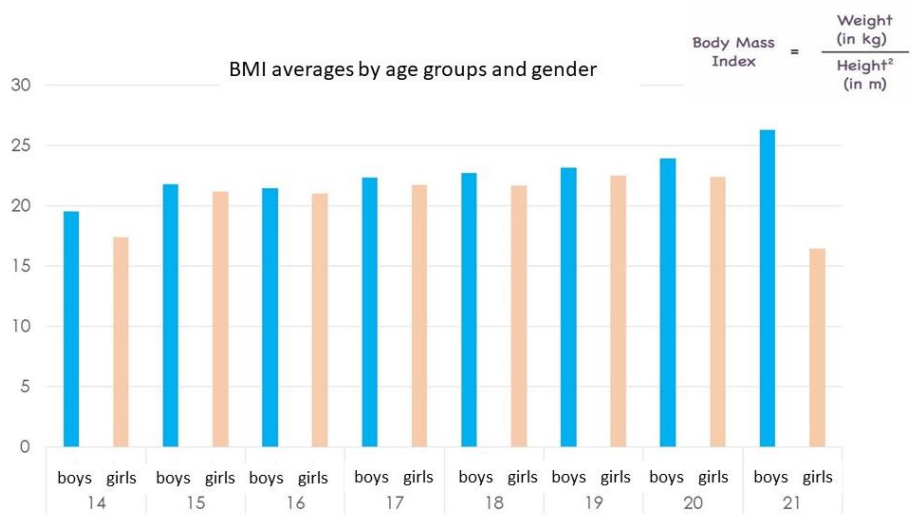


Figure 7: Body mass index of respondents by age and sex (Katona, Rikk, Ihász 2021)

The body mass index shows whether an individual's body weight is normal or not: whether they are thin or overweight. BMI data broken down by age group gives a good indication that BMI values increase with age. However, this is not only due to an increase in natural height but also to an increase in body weight. For the study groups, we find a jump in the data for boys over 20 years of age, indicating an overweight category. The averages for the other age groups show a normal weight category.

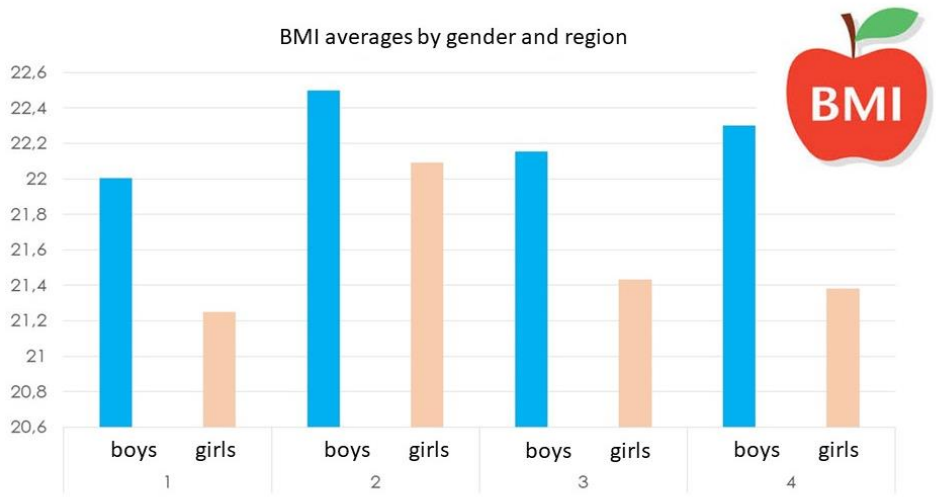


Figure 8: Body mass index of respondents by gender and region (Katona, Rikk, Ihász 2021)

Analysis of BMI data by gender and region shows that boys' BMI data exceeded girls' in all cases. The Central-Hungary region had the highest data. This is followed by the West Hungary region and then by the East Hungary region. The low figures for Region 1 (Budapest) are related to the age of the respondents, as the Budapest region has the youngest average age.

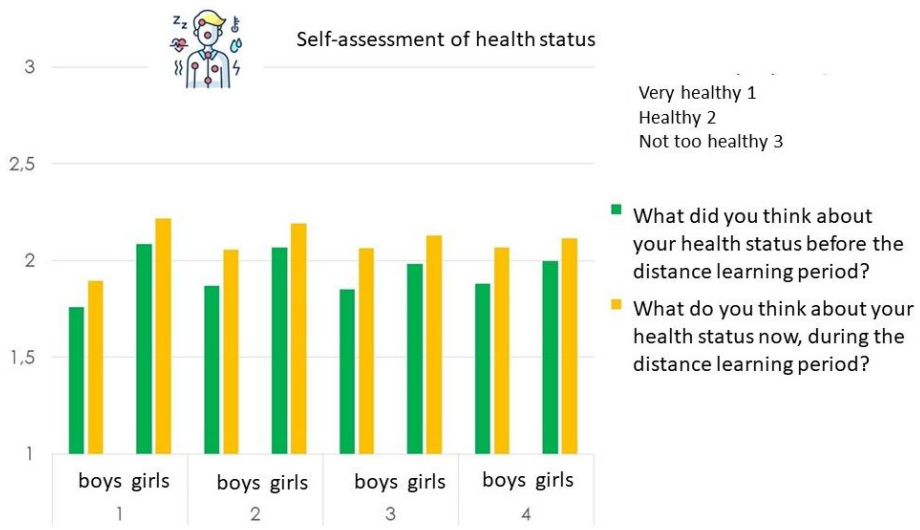


Figure 9: Self-rated health status by gender and region before and during the introduction of distance education (Katona, Rikk, Ihász 2021)

Analysis of our data shows that the self-perception of health has deteriorated for all age groups surveyed. They perceived their health as worse during distance learning compared to face-to-face education. In all cases, the averages for girls were found to be worse than the averages for boys in their age group, suggesting that boys were less likely to perceive the deterioration in their health as significant.

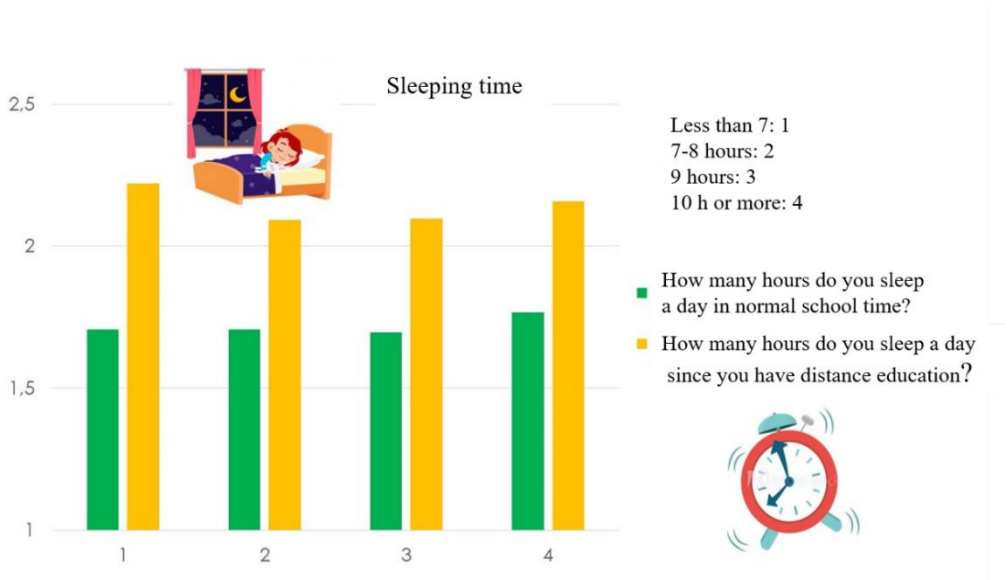


Figure 10: Changes in sleep time by region before and during the introduction of distance learning (Katona, Rikk, Ihász 2021)

Distance learning has increased significantly in all regions for both sexes consistently. This may be due to the relative later wake-up time due to not going to school. Among respondents, girls slept less than boys on average. As a result of increased sleep time, they felt less tired during distance learning, but their self-perception of their health nevertheless deteriorated.

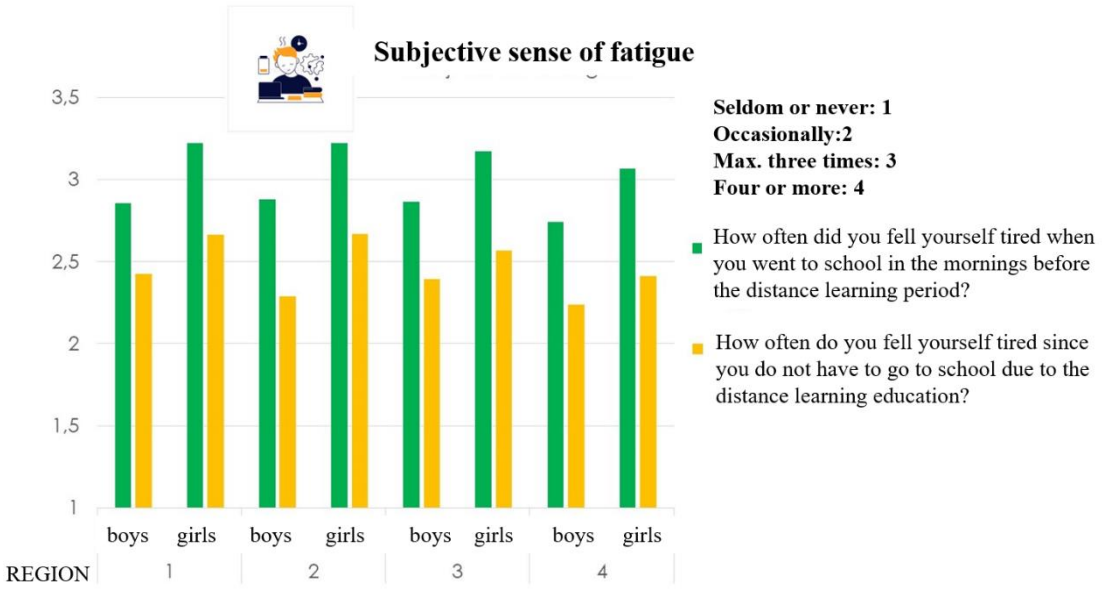


Figure 11: Changes in subjective fatigue perception by region and gender before and during the introduction of distance learning (Katona, Rikk, Ihász 2021)

Subjective fatigue perception increased significantly in all regions and for all age groups. It was observed that girls felt more tired than boys before the introduction of distance learning.

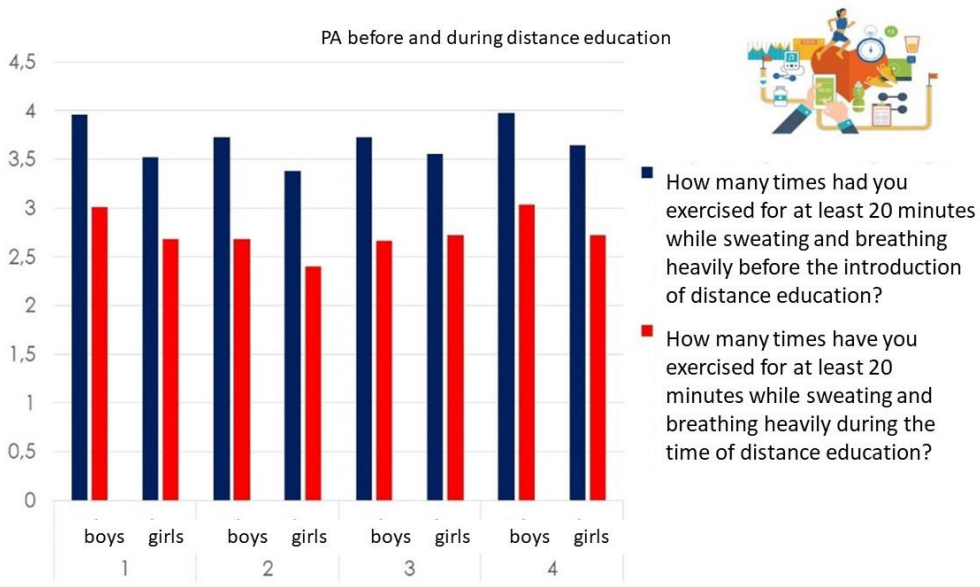


Figure 12: Changes in aerobic physical activity by region and gender before and during the introduction of distance learning (Katona, Rikk, Ihász 2021)

Analyzing the graph, we conclude that in all regions, both sexes have experienced a significant decrease in aerobic physical activity during the introduction of distance learning. The physical activity of students exceeding 20 minutes' minimum time before the introduction of distance education was more significant for boys in all regions but decreased as significantly as for the less active female groups.

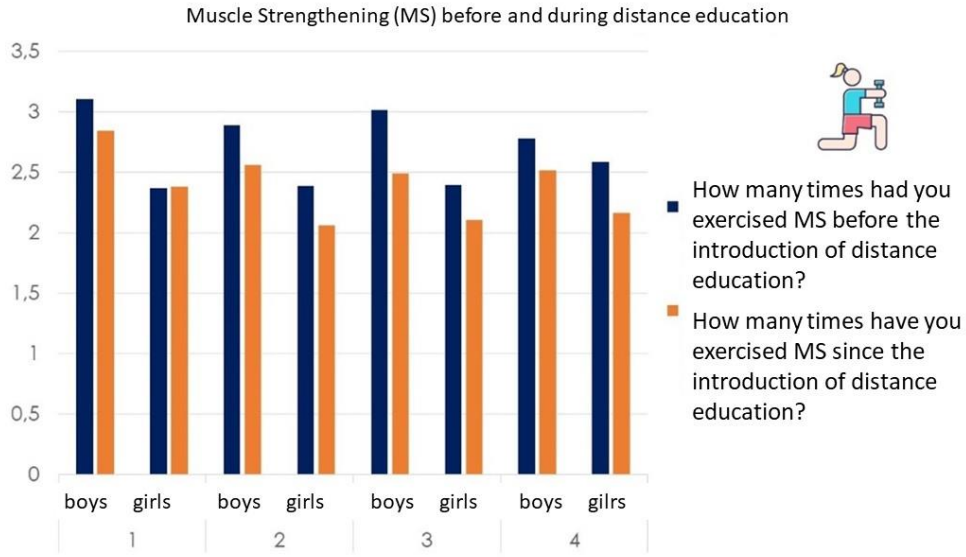


Figure 13: Changes in strength-type physical activity by region and gender before and during the introduction of distance learning (Katona, Rikk, Ihász 2021)

As in the previous Figure 13, we find that in almost all regions, both genders have seen a significant decrease in the amount of physical activity of the strengthening, muscle-strengthening type exercises since the introduction of distance learning. Muscle-strengthening physical activity of students was more significant for boys in all regions before the introduction of distance education but decreased to a lesser extent for the less active groups of girls. The exception is the girls in the Budapest region, where the responses suggest that there has been no significant change.

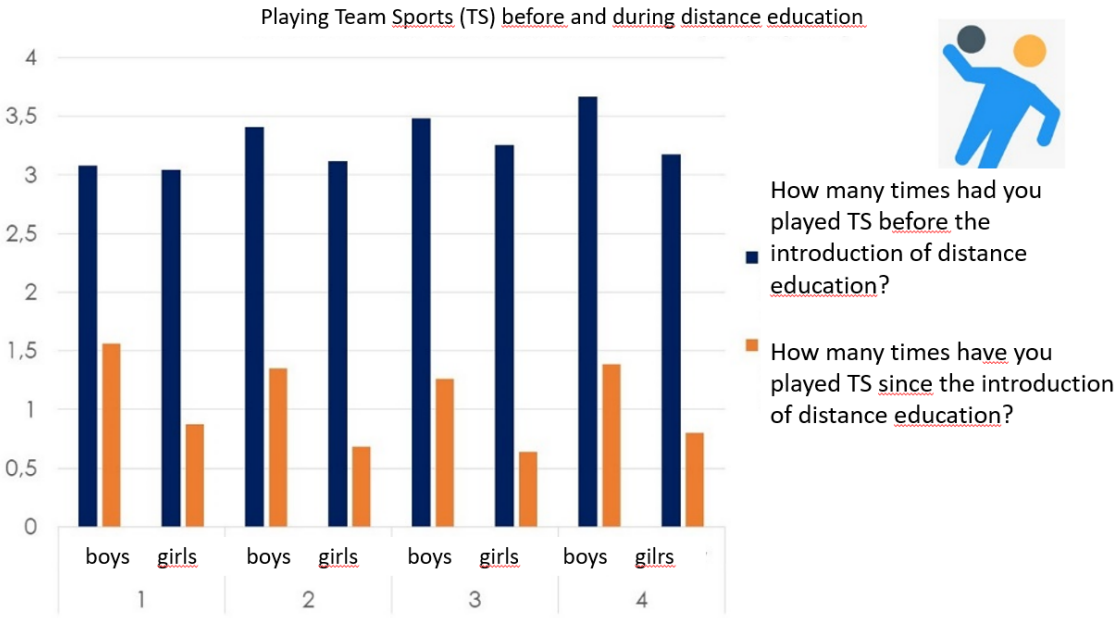


Figure 14: Trends in team games by region and gender before and during the introduction of distance learning (Katona, Rikk, Ihász 2021)

The vertical axis in Figure 14 shows the average number of times per week respondents played team games. The drastic decrease is very visible for both genders and all regions. Whereas before the introduction of distance learning, students had the opportunity to play team sports three to four times a week in their daily PE lessons, under distance learning this opportunity has been minimized. Responses during distance learning include responses from athletes in the club.

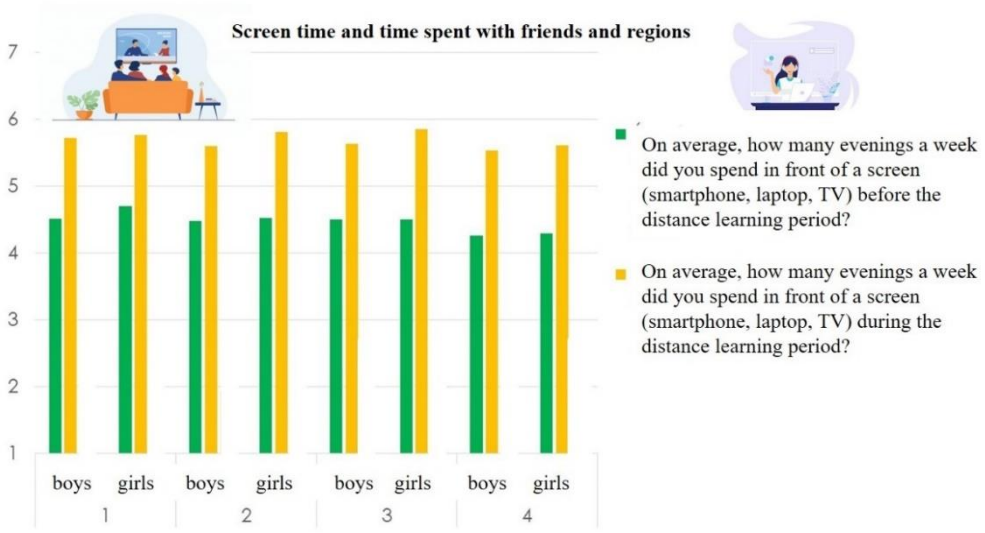


Figure 15: Change in screen time by region and gender before and during the introduction of distance education (Katona, Rikk, Ihász 2021)

According to the survey, distance learning has not only forced secondary school students to spend more time in front of their screens during study time, but also a very large increase in their evenings. The time spent with friends has changed dramatically, with the online space becoming the place for face-to-face encounters.

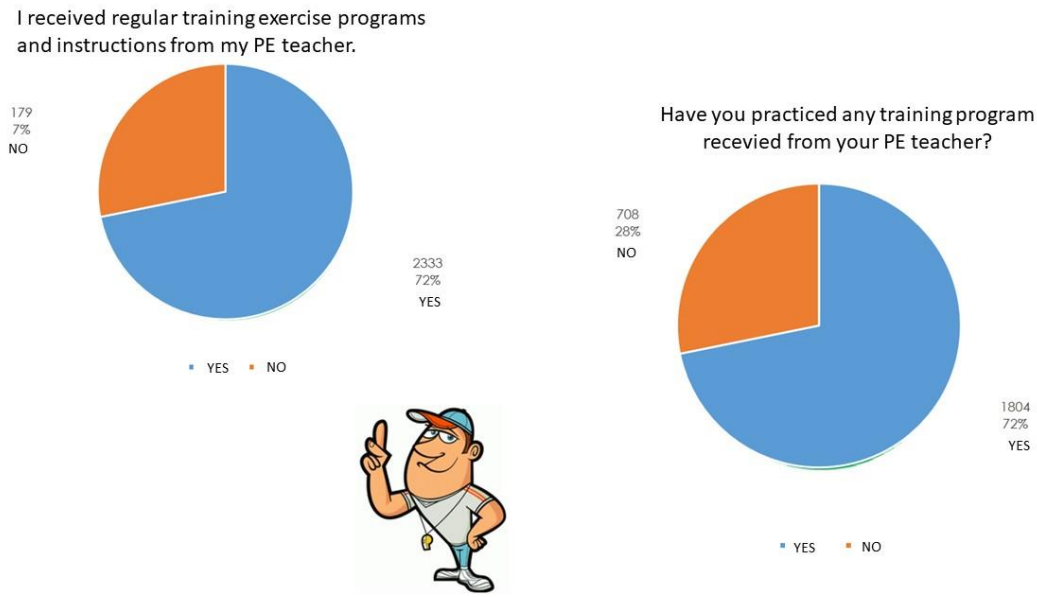


Figure 16: Tasks assigned to physical education teachers and our implementation during periods of distance education (Katona, Rikk, Ihász 2021)

93% of respondents reported that they had received assignments from their PE teacher during the distance learning period. 72% of the assigned tasks were completed to some extent, while 28% of the students did not complete an exercise program.

Chapter 6. ASSESSMENT OF PHYSICAL ACTIVITY AND SUBJECTIVE HEALTH STATUS AMONG HUNGARIAN SECONDARY SCHOOL STUDENTS DURING THE DISTANCE LEARNING PERIOD IMPOSED BY THE COVID -19 PANDEMIC (STUDY 3).

Note: This article has been accepted for publication and the final published version is presented unchanged in this chapter. [Hungarian].

Katona, Z. B., Takács, J., Gyömörei, T., Soldos, P., & Ihász, F. (2022). A fizikai aktivitás és a szubjektív egészségi állapot értékelése magyar középiskolások körében a COVID-19-pandémia okán elrendelt távoktatási időszakban. *Orvosi Hetilap, 163*(17), 655–662. https://doi.org/10.1556/650.2022.32481

6.1 Abstract

Introduction: High school education took place in the form of distance learning during the SARS-CoV-2 pandemic worldwide, including Hungary. Decreased physical activity and an increase in inactive behaviors may lead to an increased risk of obesity, diabetes, and cardiovascular disease. Objective: Our study focused on changes in physical activity (aerobic exercise, muscle strengthening, team sports) and subjective perceptions of health status in adolescents and young adults during the pandemic. Method: High school students in 66 public schools in 37 cities in Hungary (n = 2508) were surveyed. Questionnaire items on physical activity and subjective perceptions of health were adapted from the WHO Health Behavior of School-aged Children Survey and the Centers for Disease Control and Prevention Youth Risk Behavior Survey. 2 × 2 × 4 factorial ANCOVA was used to test the effect of gender and/or age and region on changes in subjective perceptions of physical activity and health before and during distance education. Results: The majority of the high school students reported a decline in physical activity frequency during the distance learning period, with an average of 2-3 fewer days of physical activity per week regardless of region. Nearly a quarter of them rated their health as worse during distance learning than before. A higher proportion of those who reported a subjective decline in health also reported a decline in physical activity. Conclusion: A decline in physical activity during the period of distance learning is associated with a decline in subjective perceptions of health, especially among rural adolescent girls.

Orv Hetil. 2022; 163(17): 655-662.

Keywords: physical activity, health status, distance learning, coronavirus

6.2 Introduction

The SARS-CoV-2 coronavirus pandemic (COVID-19) has general health, social and economic consequences. The restrictions caused by the pandemic in 2020 have changed the everyday behavior of people worldwide, including young people in Hungary.

According to the measures introduced on 26 November 2020, a digital timetable was introduced in public education in Hungary from the 9th grade. Educational institutions have been instructed to suspend face-to-face class attendance and switch to online e-learning and teaching. Students were connected to digital lessons from home, including physical education lessons, which had to be held between 8 am and 4 pm on school days (Hungarian Government Decree 484/2020).

Several studies have highlighted the need to promote a physically active lifestyle in the face of pandemic constraints. [As for the daily expected physical activity requirement for adolescents (5-17 years), as defined by the WHO, *"at least 60 minutes of moderate-intensity physical activity" has been* significantly reduced (King et al.,2020). The benefits of physical activity, sedentary time, and adherence to sleep recommendations are independently important components (Tremblay et al., 2016; Carson et al., 2017) of optimal health maintenance (Poitras et al., 2016). Saunders and colleagues (2016) reported that children and young people who adhere to 24-h physical activity guidelines (high physical activity/high sleep/low sedentary behavior) tend to have more favorable adiposity and cardio-metabolic indicators compared to those who do not adhere to these recommendations. However, the restrictions associated with COVID-19 are likely to exacerbate the current already adverse public health situation. This has been reported in several studies overseas, in Asia, and Europe (King et al., 2020; Guerrero et al. 2020; Moore, et al., 2020; Xiang, Zhang and Kuwahara, 2020; Pietrobelli et al., 2020; Zenic et al. 2020; López-Bueno et al., 2020). Ács et al. (2020) pointed out that physical activity levels among young adults in Hungarian higher education also declined during the COVID-19 pandemic.

The research carried out, both worldwide and in our country, has focused predominantly on lifestyle changes in the adult population. Recognizing this, we felt that there was a need for a study to investigate and assess different types of physical activity and subjective perceptions of health among adolescents and young adults.

The present study aims to present and evaluate the different types of physical activity and subjective health status of Hungarian adolescents and young adults (secondary school students) by gender and age, by geographical region before and during the pandemic.

6.3 Methods and subjects

In our study, we administered a self-report questionnaire using some of the thematic items from the Health Behavior in School-aged Children (HBSC) and the CDC Youth Risk Behavior Surveillance System (YRBSS) (Grunbaum et al., 2003) questionnaires and the physical activity measures from the YRBSS questionnaire.

By "*at least 20 minutes"* we mean at least 20 minutes of moderate-to-vigorous physical activity (≥3MET or 60%HRmax). Changes in moderate-to-vigorous physical activity were assessed by asking respondents a series of paired questions such as, *"On how many days per week did you exercise or participate in at least 20 minutes of physical activity that involved sweating and increased breathing, such as basketball, soccer, running, swimming, fast cycling, fast dancing, or similar aerobic activity* ***before the distance learning period****?" "* and "On *how many days per week did you exercise or participate in physical activity involving sweating and increased breathing, such as basketball, soccer, running, swimming, fast cycling, fast dancing or similar aerobic activity for at least 20 minutes per week* ***during the distance learning period?***".

Similarly, changes in muscle strengthening exercises (performing targeted muscle strengthening exercises, push-ups, sit-ups, pull-ups) and participation in team sports were measured by a pair of questions. Each question was answered on a 0 -7 - point scale.
Regarding the subjective perception of health: *" During the distance learning period, now I feel less comfortable than before the distance learning period."* yes - no - same response options were given, as well as "What did you think about your health before the introduction of distance learning, during normal school hours?" and *"What did you think about your health now, since the introduction of distance learning, during the period of distance learning?", and* they could choose from three categories: very healthy, healthy, not completely healthy. *"I feel less well now during the distance learning period than before the distance learning period."* yes - no - the same response options were given, and additional questions on well-being were included in the survey with a 1 to 4 - point response scale.

The questionnaires were filled in by the participants during the second and third waves of the COVID-19 pandemic, in 2021, when public education was delivered through digital distance learning in our country. Hungarian secondary school pupils were selected from the state and church-run schools cooperating in the research. The nine regions were grouped into four larger units: Budapest, Eastern Hungary, Central Hungary, and Western Hungary. The schools were coded with a four-digit numerical code.

Due to the structure of education, the age of secondary school students varied between 15 and 21 years, depending on the form of education they chose. Secondary school students (N = 2556) from 66 public schools in 37 cities in nine regions of Hungary were surveyed.

The questionnaire was available online during distance learning. Our research team was in constant contact with physical education teachers**.** After evaluating the completed questionnaires received, the results of 48 students were excluded from the database. The research was approved by the Scientific and Research Ethics Committee of the Health Scientific Council (TUKEB) (ETK TUKEB IV/3067- 3/2021/EKU). Table 1 presents the characteristics of the full sample.

Table 1: Characterization of the sample

	Total sample (N =2508)					
	Adolescents (n=1413)	Young adults (n=1095)	p	Boys (n=1072)	Girls (n=1436)	p
Gender: boys n (%)	621(43,9)	451(41,2)	0,167[a]	N/A	N/A	N/A
age (M±SD)	16,3±0,7	18,6±0,6	N/A	17,3±1,3	17,3±1,3	0,167[b]
body weight (kg)	63,3±13,6	66,6±14,5	N/A	71,4±14,7	59,8±11,3	N/A
body height (cm)	171,2±9,3	171,9±9,5	N/A	178,6±7,7	166,2±6,5	N/A
TTI categories[1] , n (%)						
Leanness	89(6,3)	40(3,7)		55(5,1)	74(5,2)	
normal weight	1146(81,1)	856(78,2)	<	817(76,2)	1185(82,5)	<
overweight/obesity**	123(8,7)	131(11,9)	0,001[c]	142(13,3)	112(7,8)	0,001[c]
obesity	55(3,9)	68(6,2)		58(5,4)	65(4,5)	

cross-tabulation analysis (Pearson's chi-square statistic): (4,N = 2508) = 1023.408; p < 0.001
SD = standard deviation; TTI = body mass index
Notes:[1] TTI categories are defined by TTI percentiles for 2-19-year-olds, by calculated TTI for ≥ 20 year olds, ** 'overweight/obese' category see. Barlow SE and the Expert Committee 2007,[a] Fisher's exact test to examine the relationship between gender and age groups for a given variable,[b] Independent samples t-test to examine differences between boys and girls,[c] Pearson's

chi-square statistic to examine the relationship between gender/age groups and TTI categories, N/A statistical analysis not relevant.

Figure 1: Distribution of changes in physical activity (AE: aerobic type exercise, n=2436; MS: muscle strengthening, n=2340; TS: team sports, n=2113)

6.4 Statistical analyses

Descriptive statistical indicators are frequency (%, persons), mean and standard deviation. Possible determinants of change in physical activity were tested in a 2x2x4 ANCOVA model (factors: gender - boys vs. girls, age - adolescents vs. young adults, region - Budapest vs. Central Hungary vs. Eastern Hungary vs. Western Hungary; covariate: TTI Z-score). The relationship between change in physical activity and subjective health status assessment was tested by cross-tabulation analysis with Pearson's chi-square statistic. For statistical analyses, the fixed level of alpha was 0.05 (results were considered statistically significant at $p < 0.05$). Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp. Released 2017. Armonk, NY: IBM Corp), and data visualization was performed with jamovi (Version 2.2.2, The jamovi project 2021. Retrieved from https://www. jamovi.org) and R (R Core Team, 2021; v4.1.1; corrplot package (Wei and Simko, 2021, v0.92).

6.4.1 Physical activity before and during distance learning

Physical activity was assessed by the level of aerobic exercise, muscle strengthening, and team sports before and during distance learning (day/week). Students who did not engage in physical activity (aerobic exercise, muscle strengthening, team sports) before and during distance education were excluded from the analysis (self-reported 0 days/week for all three types of physical activity before and during distance education, n = 25).

6.4.1.1 Aerobic type exercise

Excluded from the analysis of change were those who did not engage in aerobic exercise (other types of exercise) before or during distance learning (n=47). The frequency of aerobic exercise (days/week) did not change for nearly a quarter (24.7%, 601 participants). 61% (1,485 participants) reported a decrease in exercise (AE) frequency, with an average of 2 fewer days of AE per week (M = 2.06, SD = 1.09) and 14.3% (350 participants) reported an increase in frequency, with an average of 2 more days of AE per week (M = 1.99, SD = 1.28).

6.4.1.2 Muscle strengthening

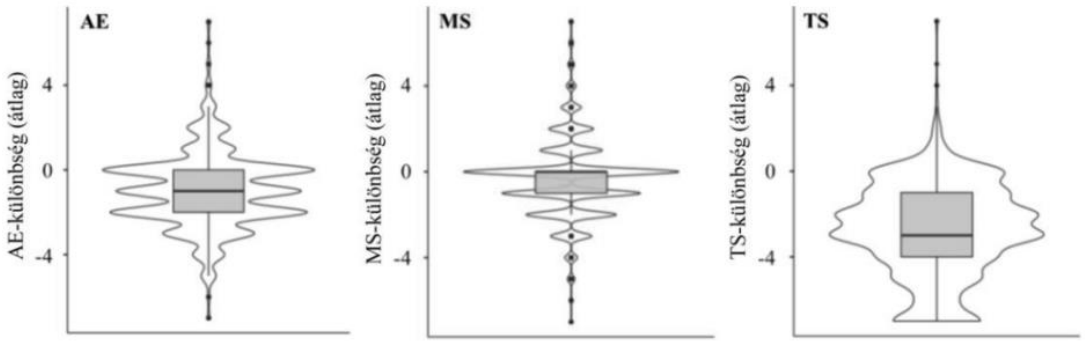
Excluded from the analysis of change were those who did no muscle strengthening (other exercises) before or during distance learning (n=143). The frequency of muscle strengthening (days/week) did not change for one-third (32.9%, 769 participants). 44.5% (1,041 subjects) reported a decrease in MS frequency, performing MS on average 2 fewer days per week (M=2.15, SD=1.40) and 22.6% (530 subjects) reported an increase in frequency, performing MS on average 2 more days per week (M=1.86, SD=1.07).

6.4.1.3 Team sports, physical activity in teams

Excluded from the analysis of change were those who did not participate in team sports (other physical activity) before or during distance learning (n=370). The frequency of team sports (days/week) did not change for 12.9% (273). 84.1% (1777 individuals) reported a decrease in TS frequency, as expected, with an average of 3 fewer days per week of TS (M=3.34, SD=1.82) and 3% (63 individuals) reported an increase in frequency, with an average of 2 more days per week of TS (M=1.83, SD=1.45).

The change in physical activity was defined as the difference in the number of days before and during distance learning (value between -7 and +7, 0: no change). For the distribution of change in each area, see Figure 1.

Possible determinants of change in physical activity were examined in a 2x2x4 ANCOVA model; analyses excluded those who reported 0 days/week of physical activity in the area before and during distance learning and those who reported no change.



Distribution of changes in physical activity

AE = aerobic type exercise, n = 2436; MS = muscle strengthening, n = 2340; TS = team sports, n = 2113

Figure 1: Distribution of changes in PA

Our results show a gender main effect for aerobic exercise (n=1835) ($F(1,1818) = 7.809$, $p = 0.005$). Boys show a greater reduction regardless of age and region. There was neither a significant main effect nor a significant interaction for muscle strengthening (n=1571). For team sports (n=1840), the observed change was significant gender × age interaction ($F(1,1823) = 5.357$, $p = 0.021$). Regardless of region, adolescent girls showed a greater decrease.

6.4.2 Subjective assessment of health status

Looking at the subjective assessment of health status, overall 68.1% (n=1707) reported unchanged health status, 23.1% (n=580) reported worse health status and 8.8% (n=221) reported better health status during distance learning compared to before distance learning (Table 2). This variation was observed regardless of gender, age and region.

Subjective assessment of health before and during distance learning showed a statistically significant relationship (χ^2 (4, N = 2508) = 1023.408; p & lt; 0.001). subjective assessment of health status across all 68.1% (n = 1707) reported unchanged health, 23.1% (n = 580) reported worse health and 8.8% (n = 221) reported better health during distance learning compared to before distance learning (Table 2). This variation was observed regardless of gender, age and region

Table 2: Change in subjective assessment of health status during distance learning compared to before distance learning (white: no change, light grey: better, dark grey: worse)

		Since distance learning, n (%)			
		very healthy	healthy	not entirely healthy	Total
Before distance learning, n(%)	very healthy	251(10,0)	180(7,2)	45(1,8)	476(19,0)
	healthy	86(3,4)	1224(48,8)	355(14,2)	1665(66,4)
	not entirely healthy	17(0,7)	118(4,7)	232(9,3)	367(14,6)
	Total	354(14,1)	1522(60,7)	632(25,2)	2508(100)

Cross-tabulation analysis (Pearson's chi-square statistics):

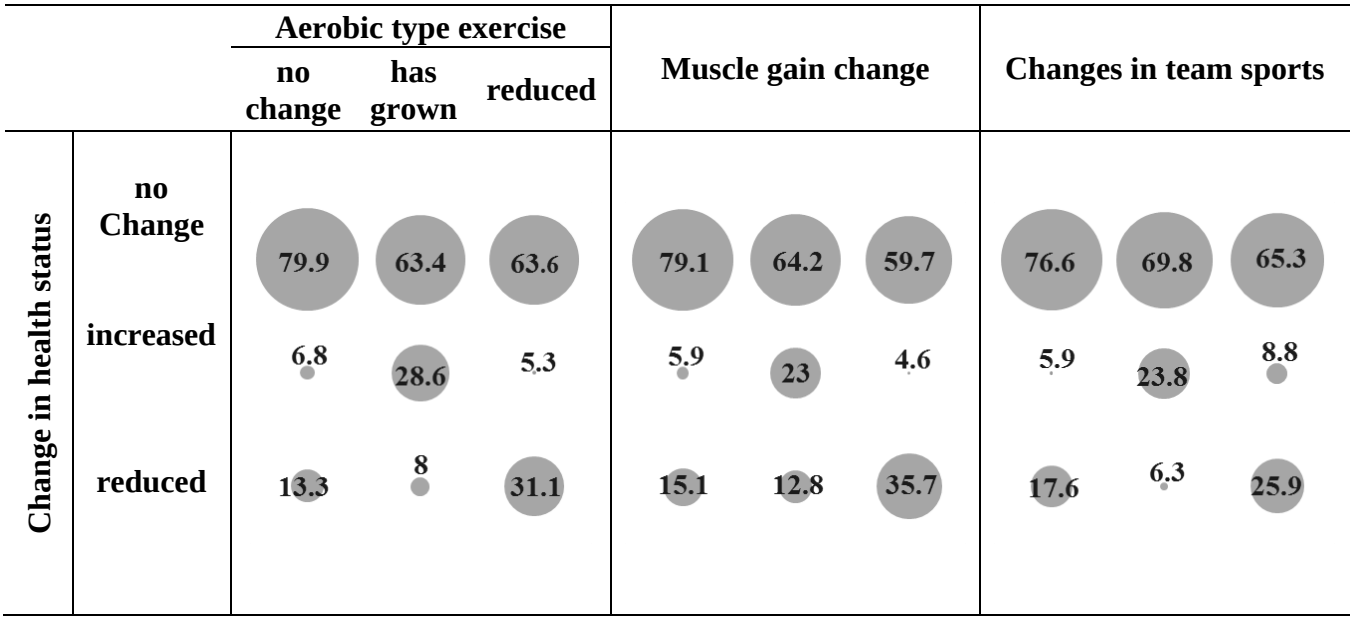
*Aerobic exercise type: χ^2 (4,N = 2436) = 292.573; p<0.001

**Muscle strengthening: χ^2 (4,N = 2340) = 282.936; p<0.001

*** Teamsport χ^2 (4,N = 2113) = 38.537; p<0.001

6.4.3 The relationship between physical activity and subjective assessment of health status

Change in physical activity and change in subjective health status assessment showed a significant relationship for all three types of physical activity (AE: χ^2 (4,N=2436) = 292.573, p < 0.001, MS: χ^2 (4,N=2340) = 282.936, p < 0.001, TS: χ^2 (4,N=2113) = 38.537, p < 0.001). In the majority of cases, changes in physical activity (no change, decreased, increased) did not affect changes in subjective health status ratings (no change). However, subjective decreases in health status were reported more by those who also reported decreases in physical activity, which was the case for nearly one-third and one-quarter of students, respectively. Similarly, subjective increases in health were reported more by those who also reported an increase in physical activity, this was the case for nearly a quarter of students (Figure 2).



Cross-tabulation analysis (Pearson's chi-square statistics):

*Aerobic exercise type: χ^2 (4,N = 2436) = 292.573; p<0.001

**Muscle strengthening: χ^2 (4,N = 2340) = 282.936; p<0.001

*** Teamsport χ^2 (4,N = 2113) = 38.537; p<0.001

Figure 2. Relationship between physical activity (aerobic exercise, muscle strengthening, team sports) and subjective health assessment

Finally, we examined differences by gender, age and region among those who were found to associate reduced physical activity with reduced health. Our results suggest that the sample of rural adolescent girls was considered a risk group (Figure 3).

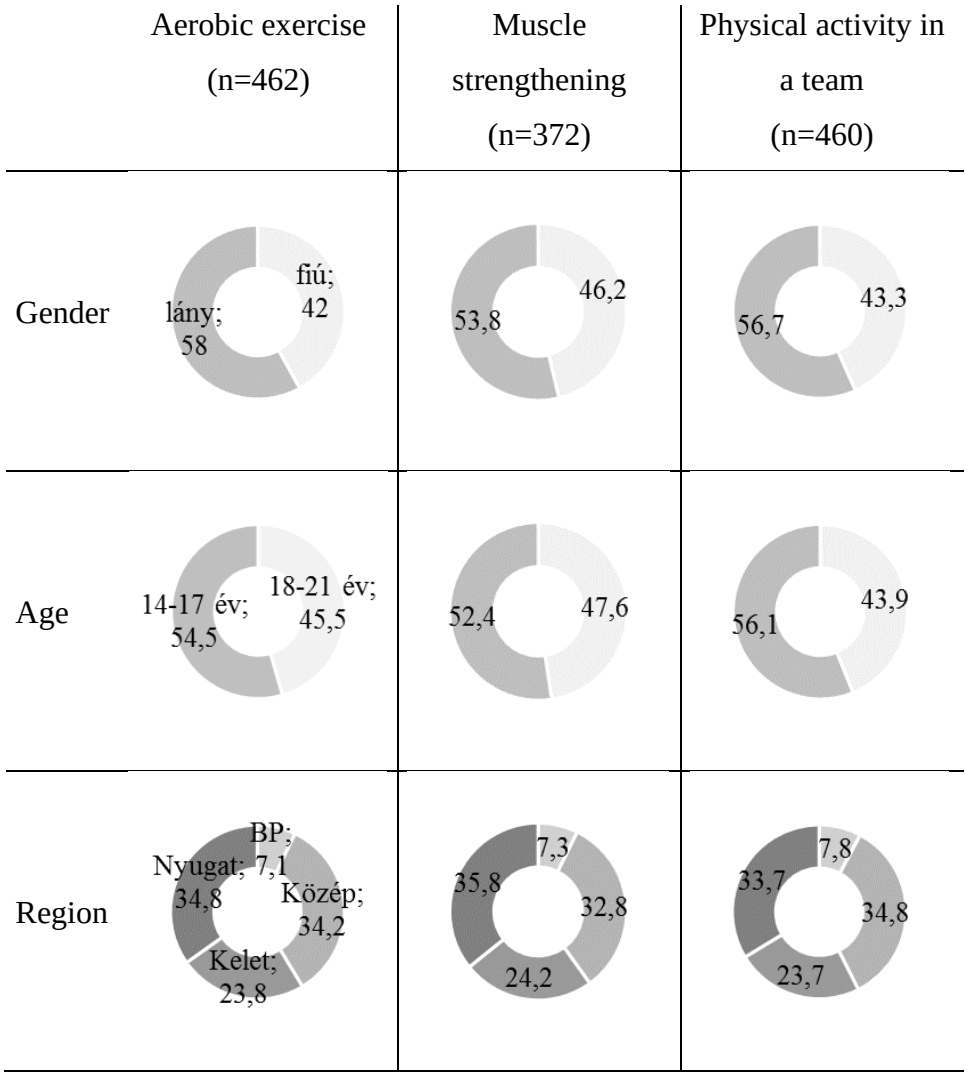


Figure 3: Distribution of groups with reduced physical activity and reduced health status by sex, age and region.

6.5 Discussion

The motivation to exercise is characterized by a desire for continuity and perseverance, both important personality traits that are applied throughout life (Batista at al. 2019). The World Health Organization (WHO) (2019) defines at least 150 minutes of moderate or 70 minutes of vigorous activity per week (WHO, 2020). Some of the most important benefits include: improving body composition, metabolism, circulatory and respiratory fitness, and self-esteem

(Leyton-Román, de la Vega and Jiménez-Castuera. 2020). It also has a positive psychological impact by reducing the rate of morbidity due to anxiety and depression (Chan et al., 2019).

Based on the results of our study, we found that the frequency of both aerobic exercise and targeted muscle strength development decreased. Furthermore, the frequency of team activities decreased, although this was specifically a direct consequence of the enforced quarantine. No significant differences were found between regions in Hungary for the same characteristics, with adolescent girls living in rural areas being the most affected - negatively - by the other main effects (gender, age group). We made an important finding between the frequency of physical activity and health status estimates, i.e. those who are regularly active have a much more favorable health assessment than their less active counterparts, and vice versa. A review of 66 studies published by UK researchers reported that physical activity frequency declined during the COVID-19 pandemic closure, regardless of subpopulation or methodology used. For healthy adults and children, physical activity levels decreased during the lockdown compared to the pre-lockdown period, despite guidance from various governmental organizations and/or health professionals to maintain an active lifestyle (Stockwell et al., 2021). It has also been reported in two studies that people who were more active before the lockdown was more likely to show a more significant decline in physical activity (Di Corrado et al., 2021). Physical activity has been consistently associated with a range of mental health conditions, suggesting that a decline in PA may lead to an increase in adverse mental health outcomes. Indeed, studies have shown a significant increase in anxiety and depression levels during lockdown (Elran-Barak & Mozeikov, 2020). Given the proven negative effects of reduced physical activity, increased anxiety and lower energy levels during lockdown have been shown to affect not only people who have temporarily reduced activity levels but also those who have been sedentary for a long time.

A public health strategy during a pandemic may require radio and TV stations to routinely interrupt their programs and support the absence caused by school closures or even work from home with short celebrity-led programs encouraging physical activity. Public health organizations, as trusted 'formations', should devote a specific strategy to the most vulnerable subgroups, such as inactive, overweight or obese populations (Mutrie & Woods, 2003). Once the closures are lifted, it would be important to develop targeted programs to increase physical activity among at-risk groups, such as the sample of rural adolescent girls identified in our research.

6.6 Limitations of research

The study has some limitations. These include the fact that all data was collected online and the participants completed the questionnaires themselves, so selection bias may occur. Self-report questionnaire completions may be subject to recall bias, and memory inaccuracies, and therefore may under- or overestimate their health status or physical activity frequency. Further respondent bias in self-report questionnaires may be caused by misinterpretation of questions, socially acceptable responses, consent responses or even extreme and middle-of-the-road responses. However, during the period of distance learning imposed during the Canteen, self-administered data collection was one of the most appropriate methods for answering research questions, which allowed for the collection of data from a large number of study participants living far apart.

6.7 Conclusion

With nearly half of adolescents reporting less than optimal physical activity, the WHO target of a 15% reduction in inactivity by 2030 is seriously at risk. The pandemic's long stay here requires a considered response that includes: collaboration with parents, teachers, policymakers, and others in communities. The 'tailoring' of interventions to promote opportunities for leisure activities requires a new content-based behavioral epidemiological framework Jiao et al., 2020).

Currently, global data show that the proportion of adolescents who meet physical activity guidelines is low (around 20%). Adolescence is a transitional period in the process of becoming an adult. A decline in physical activity is reflected in the need for physical activity in adulthood, meaning that a poor pattern may be a cause for concern, particularly in given known diseases (Gallè et al., 2020; Tremblay et al., 2011; Cunningham et al., 2020).

Declarations

Financial support: no financial support was provided for the writing of the communication or the resulting research. Author contribution by K. Zs. B. in data collection, T. J. and I. F. in data analysis and statistical evaluation, T. J., K. Zs. B., I. F. in the editing of figures, K. Zs. B., T. J., Gy. T. and S. P. participated in the preparation of the manuscript. The final version of the article was read and approved by all authors. Interests: The authors have no interests. Acknowledgements: The authors would like to thank Dr. Dániel Veres for his help with data visualization.

Chapter 7: A LARGE SAMPLE CROSS-SECTIONAL STUDY ON MENTAL HEALTH CHALLENGES AMONG HUNGARIAN ADOLESCENTS AND YOUNG ADULTS DURING COVID-19 PANDEMIC (STUDY 4).

At-risk group for loneliness and hopelessness during COVID-19

(Johanna Takács, Zsolt Bálint Katona, Ferenc Ihász)

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7.1 Abstract

Background: The COVID-19 pandemic has posed unprecedented challenges for societies. Emerging data have indicated that the younger population are the most vulnerable group to the development of mental health problems during this pandemic. The present study aimed to examine the effects of the changes in health behaviors on mental health problems to identify an at-risk group among adolescents and young adults

Methods: In the present cross-sectional study, secondary school students (N=2556) ages 15–21 years participated in Hungary. A self-report questionnaire was developed to measure the changes in health behaviors. Mental health problems were measured by the Beck Hopelessness Scale and the 20-item UCLA Loneliness Scale.

Results: A significant proportion of the students showed moderate/severe hopelessness or high loneliness which were more pronounced among adolescent females. An at-risk group was identified among adolescents and young adults. Students who have a lower number of friends, spend less time in front of a screen, and feel lonely often/very often are more likely to have moderate/severe hopelessness with high loneliness. Limitations: All data were collected online, and students completed the questionnaires voluntarily. Cross-sectional, non-preregistered study.

Conclusions: Loneliness and hopelessness were prevalent in the young population during the COVID-19 pandemic. The at-risk group of adolescents characterized by moderate/severe hopelessness with high loneliness highlights the need for follow-up mental health to avoid future poor mental and physical health. It is also recommended to develop effective

interventions targeted to gender and age, with the promotion of resiliencies and buffers against vulnerabilities of negative life events.

Keywords: loneliness, hopelessness, adolescents, young adults, risk group, COVID-19 pandemic

7.2 Background

The SARS-CoV-2 coronavirus pandemic (COVID-19) has overall health, social and economic consequences. The pandemic has disrupted normal daily routines worldwide including attendance teaching among children and adolescents, and across all age groups, depending on the degree of vulnerability (Mazza et al.,2020).

During the first wave of the COVID-19 all schools were closed on March 16, 2020, until the end of the school year, June 15, 2020, in Hungary. Educational institutions were instructed to suspend in-person class attendance and switch to online e-learning and education. Then, during the second and third wave of the COVID-19, the secondary schools were closed again from 12 November 2020, and education was completely switched to online education until May 10, 2021(JCR Technical Report, 2021). The government announced further strict community restrictions on November 10, 2020, which was extended until March 29, 2021. Under the measures introduced on 26 November 2020, a digital timetable has been introduced in secondary education from grade 9 in Hungary. Students were home-bound and digital class attendance was required between 8 a.m.–4 p.m. on school days (Hungarian Government Decree 484/2020). Restaurants, cultural and leisure establishments were closed, and gatherings were being banned in general. There was also a night-time curfew between 8 p.m. until 5 a.m. In this term, individual outdoor activities were allowed considering the restrictions of gathering, and competitive athletes were not restricted in their activities.

The COVID-19 pandemic has posed unprecedented challenges for societies. Since the pandemic began, we are living under social restrictions to reduce the spread of the COVID-19 virus. Living under some community lockdowns for a longer or shorter period and learning in distance education or working in a home office have had negative effects on the daily routine, social contacts, and the normal way of life of the families. It is not surprising that this situation has led to the development of psychological problems or diseases such as low mood, insomnia, depression, post-traumatic stress disorder, anxiety, anger, irritability, loneliness in a wide range of society. There are further factors that had increased the risk of the development of mental health problems during the pandemic in the population such as sociodemographic and

occupational factors, pre-existing mental health problems, as well as a longer period of social isolation (Duan & Zhu, 2020.; Morelli et. al., 2020).

Vulnerable groups such as adolescents/ young adults and older adults have been anticipated that they would have a higher risk of the negative psychological impacts of COVID-19. There is a lot of study in adults and older adults on mental health consequences during lockdown and restrictions. However, emerging data have indicated that the younger population are the most vulnerable group to the development of mental health problems during this pandemic (McQuaid et al. 2020), especially with pre-/ existing psychopathological symptoms (Essau & de la Torre-Luque 2021). Most of the studies demonstrated longitudinal deterioration in the mental health of the young population with increased depression and anxiety symptoms, psychological distress, negative affect, decreased mental well-being and increased loneliness (Rogers, et al. 2021; Cooper, et al. 2021; Ludwig-Waltz, et al. 2022; Cénat, et al. 2022), especially for early and late adolescence (Kauhanen, et al. 2022, Ludwig-Waltz, et al. 2022). Home isolation and social distancing (Loades et al. 2020), lack of prosocial/physical activity (Mittal, Firth & Kimhy, 2020), family stress and heightened concerns (Meade, 2021), increased screen time (Duan et. al., 2020) etc. have contributed to adolescents' and young adults' mental health worldwide (Cao et al., 2020; McElroy et al., 2020; Zou et al., 2020). Examining the global evolution of mental health problems during the COVID-19 pandemic, a spike was detected when social isolation, school closures and confinement occurred (Cénat, et al. 2022).

The present study aims to examine mental health status in adolescents and young adults during distance learning education. In this study, we focused on the relationship between mental health, especially the level of loneliness and hopelessness, and changes in physical activity, screen time, self-rated health status, sleep time, and well-being. A further aim was to identify an at-risk group for mental health problems among adolescents and young adults who may currently face serious challenges in social life and education.

7.3 Methods and Materials

7.3.1 Participants

In a cross-sectional study design, secondary school students (N = 2556) in 66 public education institutions in 37 cities were surveyed from nine regions in Hungary. A total of 48 students were excluded from the study sample because of missing data or lack of parental

agreement. The age of secondary school-going students is between 15–21 years, depending on the form and type of education in Hungary.

7.3.2 Survey

A cross-sectional self-report questionnaire based on the Health Behavior of School-aged Children (HBSC) (hbsc, 2006) and the Youth Risk Behavior Survey (YRBSS) (Grunbaum et al., 2004) created by the Centers for Diseases Control (CDC) was developed. Some questions were modified for during versus before the COVID-19 pandemic lockdown periods. Besides demographics (gender, age), body mass index (BMI) was calculated by weight and height, we used BMI Z scores during the analysis.

From the questionnaire, in the present study, we used the following variables related to mental health issues in adolescents and young adults: moderate-to-vigorous physical activity, screen time, self-rated health, sleep time, well-being, close friends, and self-rated loneliness evaluated before and during the distance learning period.

Moderate-to-Vigorous Physical Activity and Screen Time was measured on a 0–7-point scale. Moderate-to-Vigorous Physical Activity was assessed by sets of questions in pairs such as for aerobic exercise “On how many days per week did you exercise or participate in physical activity for at least 20 min that made you sweat and breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or similar aerobic activities before distance learning period?” and “On how many days per week do you…during distance learning period?”. For muscle-strengthening with the question pairs “On how many days per week did you do exercises to strengthen or tone your muscles, such as push-ups, sit-ups, or weightlifting before distance learning period?” and “On how many days per week do you…during distance learning period?”. To measure spending time in front of a screen, we also used question pairs such as “On how many days per week did you spend time in front of a screen (television, notebook, smartphone) in the evenings before distance learning period?” and “On how many days per week do you…during distance learning period?”. Moderate-to-Vigorous Physical Activity and Screen Time were measured on a 0–7-point scale. The change (days/week) in these variables was calculated with days/week during distance education minus days/week before distance education (from -7 to +7 days=week, 0 means no changes). Based on the Moderate-to-Vigorous Physical Activity change, we used the no change, increased, and decreased aerobic exercise/muscle strengthening categories in models.

Self-rated health was assessed with the questions of "Would you say your health was/is…?" (excellent, good, fair/poor) before and during the distance learning period. Change in SH was examined on a contingency table, classified participants into no change, decreased or increased categories on self-rated health. Self-rated sleep duration (SDur) was assessed with the questions of "How many hours did/do you sleep…?" (less than 7 hours, between 7 to 8 hours, 9 hours, more than 10 hours) before and during the distance learning period. Similar to other variables, we classified participants into no change, decreased or increased categories on self-rated SDur. Change in well-being was evaluated with the statement of "I feel less well now, during the distance learning period than before the distance learning period" (agree, disagree, same). The number of close friends was measured with the question of "At present, how many close male and female friends do you have?". Self-rated Loneliness was assessed with the question of "Do you feel lonely?" (no, sometimes, often, very often). No one answered with "no". Thus, we examined the groups of sometimes versus often and very often lonely.

To measure mental health problems, i.e., problems in the affective-emotional aspects of mental health, we used the Beck Hopelessness Scale (BHS) (Beck, Steer, 1988; Beck, et al. 1974; Perczel, et al. 2001) which is a self-report measure of the three primary aspects of hopelessness: feeling about future, decreases in motivation, and expectations. The higher the total BHS score reflects higher levels of hopelessness. On the total BSH score, normal range (0-3), mild (4-8), moderate (9-14), and severe (>14) hopelessness categories can be determined (Beck, Steer, 1988; Perczel, et al. 2001). For loneliness, the 20-item UCLA Loneliness Scale (UCLA-LS20) was used (Version 3) (Russell, et al. 1978; Russell, 1996) to measure the unpleasant experience, when an individual perceives their social network as insufficient, i.e., a perceived discrepancy between the actual and the ideal/desired social networks/contacts (Peplau, Perlman, 1979). On the total UCLA-LS 20 score, the following loneliness severity cut-offs were used: no/low (≤ 28), moderate (28-43), and high (>43) (Cacioppo, Patrick, 2008).

7.3.3 Procedure

The 15-min online survey was shared on a web page and was accessible for six weeks during the lockdown, distance learning period. Our research team was in touch with school principals and physical education teachers, who encouraged the students to complete the survey. The students completed the survey primarily during online physical education lessons. Information about the aims of the research was given online and parental consent was requested before completion, students were excluded who did not have parental consent or submitted a

negative parental response. This research was non-preregistered, it was approved by the Ethical Committee of the Medical Research Council (TUKEB), Hungary, under ETK TUKEB ethical permission No. IV/3067- 3/2021/EKU

7.3.4 Data analysis

Frequencies and percentages for categorical variables and means calculations with their corresponding standard deviations (SD) for continuous variables were reported. Gender and age differences were examined by independent samples t-test with Hedges' g effect size. Associations between age/ gender and categorical variables were examined calculating Pearson's chi-square test (crosstabs) with Cramer's V effect size. Binary and multinomial logistic regression models were used to ascertain the effects of gender, age, BMI Z Score, change in aerobic exercise, muscle strengthening, screen time, self-rated health, self-rated SDur, the number of close friends, well-being and self-rated loneliness on the likelihood that participants have mental health problems. First, univariate logistic regression models were built for each of the independent variables (that were either dichotomized or scaled). Then, all variables were entered in a final multivariate logistic regression model. Univariate odds ratios (OR) and multivariate adjusted odds ratios (aOR) with their corresponding 95% confidence intervals (95% CI) were reported. A multinomial logistic regression model was used to examine the association between mental health problems, loneliness and/or hopelessness, and the outcomes of interest. For the regression model, the p-value was calculated using a two-tailed Wald z-test. The level of significance was set a priori at 0.05. Statistical analysis and visualization were conducted using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp. Released 2017. Armonk, NY, USA: IBM Corp).

7.4 Results

7.4.1 Characteristics of the sample

A total of 2508 secondary school students participated in the survey, 42.7% males. We classified students based on their age into two groups, adolescents (n=1413, min-max$_{age}$ = 14-17yr,) and young adults (n=1095, min-max$_{age}$ = 18-21 yr). The age showed a non-significant association with gender. BMI categories revealed a significant association with age and gender. A higher proportion of young adults and males was in the overweight/obese, and the obese BMI categories. Characteristics of the sample, see in Table 1.

Table 1. Characteristics of the sample

Variables	Total sample (N =2508)					
	Adolescents (n=1413)	Young adults (n=1095)	p	Males (n=1072)	Females (n=1436)	p
gender, Male n (%)	621(43.9)	451(41.2)	0.167[a]	N/A	N/A	N/A
age, M±SD	16.3±0.7	18.6±0.6	N/A	17.3±1.3	17.3±1.3	0.167[b]
Weight (kg)	63.3±13.6	66.6±14.5	N/A	71.4±14.7	59.8±11.3	N/A
Height (cm)	171.2±9.3	171.9±9.5	N/A	178.6±7.7	166.2±6.5	N/A
BMI categories[1], n (%)						
underweight	89(6.3)	40(3.7)	< 0.001[c]	55(5.1)	74(5.2)	< 0.001[c]
normal weight	1146(81.1)	856(78.2)		817(76.2)	1185(82.5)	
overweigth/obese**	123(8.7)	131(11.9)		142(13.3)	112(7.8)	
obese	55(3.9)	68(6.2)		58(5.4)	65(4.5)	

Notes. [1] BMI categories based on BMI %ile for 2-19 yr, and on BMI score for ≥20yr, ** 'overweight/obese' terminology based on: Barlow SE and the Expert Committee 2007, [a] Fisher's exact test for association between gender and age-groups, [b] Independent Samples T-Test for differences between males and females, [c] Pearson's chi-square test for association between gender/age-groups and BMI categories, N/A statistical analysis is not applicable

7.4.2 Hopelessness and loneliness among adolescents and young adults during the distance learning period

In sum, nearly half of the students showed mild hopelessness (57.2%, n=1435) and moderate loneliness (59.8%, n=1500). Further nearly one-fifth were characterized by moderate/severe hopelessness (18%, n=451) and a quarter by high loneliness (24.9%, n=624). Among adolescents were significant differences in proportions by gender. Moderate/severe hopelessness and moderate/high loneliness showed higher proportions among adolescent females than males (Table 2).

Table 2. Hopelessness and loneliness among adolescents and young adults by gender

	Total sample (N =2508)					
	Adolescents (n=1413)			Young adults (n=1095)		
Variables	Males (n=621)	Females (n=792)	p [ES]	Males (n=451)	Females (n=644)	p [ES]
Beck Hopelessness Scale, M±SD	5.5±3.1	6.0±3.5	0.004 [0.15]	5.9±3.4	6.3±3.5	0.070 [0.12]
normal range, n(%)	172(27.8)	205(25.9)	0.047 [0.08]	103(22.8)	142(22.0)	0.461 [0.05]
mild	353(56.8)	448(56.6)		269(59.7)	364(56.7)	
moderate	89(14.3)	112(14.1)		65(14.4)	116(18.0)	
severe	7(1.1)	27(3.4)		14(3.1)	21(3.3)	
UCLA Loneliness Scale, M±SD	35.9±9.6	37.9±10.1	< 0.001 [0.20]	37.4±10.1	38.0±9.6	0.376 [0.06]
no/low, n(%)	130(20.9)	111(14.0)	0.003 [0.09]	68815.1)	75(11.6)	0.153 [0.06]
moderate	344(55.4)	485(61.2)		263(58.3)	408(63.4)	
high	147(23.7)	196(24.8)		120(26.6)	161(25.0)	

There is a significant, positive moderate correlation between hopelessness and loneliness (rho(2506) = 0.458, p < 0.001) regardless of gender and age.

7.4.3 Univariate and multivariate analysis for hopelessness and loneliness

Binary logistic regression models were built to analyse the relationship between change in physical activity (aerobic exercise/muscle strengthening), screen time, self-rated health, self-rated SDur sleep duration, well-being, the number of close friends, and self-rated loneliness and hopelessness or loneliness adjusted by gender, age, and BMI.

In the final multivariate analysis for hopelessness and loneliness, decreased time spent in front of a screen, lower number of friends, feeling lonely often/very often were an increase in the likelihood of moderate/ severe hopelessness or high loneliness. The model explained 15% (Nagelkerke R^2) of the variance of hopelessness, and correctly classified 83.6% of cases. Table 3 showed the results of the models. The model of loneliness explained 27.4% (Nagelkerke R^2) of the variance, and correctly classified 80.7% of cases. Table 3 showed the results of the models.

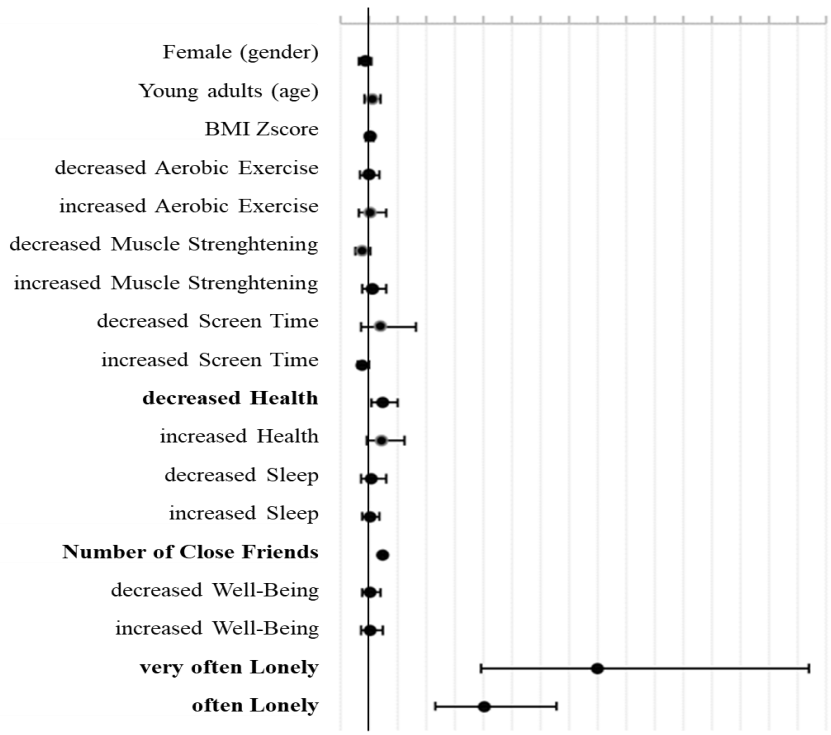
Table 3. Univariate and multivariate analysis for hopelessness and loneliness (OR: odds ratio, aOR: multivariate adjusted odds ratios, 95%CI: confidence interval)

Characteristics	Hopelessness		Loneliness	
	Univariate	Multivariate	Univariate	Multivariate
	OR (95%CI)	aOR (95%CI)	OR (95%CI)	aOR (95%CI)
Gender				
male	ref	ref	ref	ref
female	1.2 [1.0-1.5]	1.2 [0.9-1.5]	1.0 [1.8-1.2]	0.9 [0.7-1.1]
Age				
adolescents	ref	ref	ref	ref
young adults	**1.2 [1.0-1.5]**	1.2 [1.0-1.6]	1.1 [0.9-1.3]	1.2 [0.9-1.4]
BMI Zscore	**1.1 [1.0-1.3]**	1.1 [0.9-1.2]	**1.1 [1.0-1.2]**	1.1 [1.0-1.2]
Aerobic exercise				
no change	ref	ref	ref	ref
decreased	1.3 [1.0-1.6]	1.1 [0.8-1.5]	1.1 [0.8-1.3]	0.9 [0.7-1.3]
increased	1.1 [0.8-1.6]	0.9 [0.6-1.4]	1.3 [0.9-1.7]	0.9 [0.6-1.4]
Muscle strengthening				
no change	ref	ref	ref	ref
decreased	**1.4 [1.1-1.8]**	1.2 [0.9-1.6]	1.1 [0.9-1.3]	0.9 [0.7-1.2]
increased	1.2 [0.9-1.6]	1.1 [0.8-1.6]	1.3 [1.0-1.6]	1.2 [0.8-1.6]
Screen time				
no change	ref	ref	ref	ref
decreased	**1.7 [1.1-2.8]**	**2.1 [1.2-3.5]**	**1.5 [1.1-2.0]**	**1.9 [1.1-3.2]**
increased	0.9 [0.8-1.1]	0.9 [0.7-1.1]	1.2 [0.9-1.5]	0.8 [0.6-1.0]
Self-rated health status				
no change	ref	ref	ref	ref
decreased	**1.4 [1.1-1.8]**	1.1 [0.8-1.5]	**1.5 [1.2-1.8]**	1.3 [1.0-1.7]
increased	1.1 [0.8-1.6]	1.0 [0.7-1.6]	**1.5 [1.1-2.1]**	1.3 [0.9-1.9]
Self-rated sleep duration				
no change	ref	ref	ref	ref
decreased	**1.5 [1.1-2.0]**	1.3 [0.9-1.8]	1.2 [0.9-1.6]	1.0 [0.7-1.4]
increased	1.2 [0.9-1.5]	1.0 [0.7-1.6]	1.0 [0.8-1.2]	1.0 [0.8-1.3]
Number of close friends	**1.6 [1.6-1.7]**	**1.7 [1.6-1.8]**	**1.4 [1.4-1.5]**	**1.5 [1.4-1.5]**
Well-being				
no change	ref	ref	ref	ref
decreased	**1.4 [1.1-1.7]**	1.1 [0.8-1.4]	**1.3 [1.1-1.6]**	**1.1 [0.8-1.4]**
increased	0.9 [0.7-1.3]	1.0 [0.7-1.4]	1.1 [0.9-1.4]	1.0 [0.7-1.4]
Self-rated loneliness				
sometimes	ref	ref	ref	ref
often	**5.3 [4.0-7.1]**	**4.4 [3.2-6.0]**	**6.8 [5.1-9.0]**	**6.5 [4.7-9.0]**
very often	**8.6 [5.9-12.7]**	**6.5 [4.3-9.8]**	**15.0 [9.6-23.3]**	**13.9 [8.6-22.6]**

7.4.4 Multinomial logistic regression model for mental health risk

We classified participants into four categories according to the scores of hopelessness and loneliness. The first group (n=1693, 67.5%) can be considered ‘mentally healthy’ in the sense that it is characterised by no, low/moderate loneliness AND normal/mild hopelessness. The participants in the second group, the ’hopelessness’ group, show moderate/severe hopelessness AND no, low/moderate loneliness (n=191, 7.6%). The third group was the ’loneliness’ group including people characterised by high loneliness AND normal/mild hopelessness (n=364, 14.5%). Finally, people with high loneliness AND moderate/severe hopelessness form a group at particular risk for mental health problems.

A multinomial regression model was used to determine the effect of the outcomes of interest and mental health groups. Based on the result, a lower number of close friends, a decreased self-rated health status, and feeling lonely often /very often were associated with high loneliness. Decreased SDur, decreased well-being, and feeling lonely often were associated with moderate/ severe hopelessness. Students who have a lower number of friends, spend a decreased time in front of a screen, and feel lonely often /very often are more likely to have moderate/ severe hopelessness with high loneliness (Figure 1). The model explained 25.8% (Nagelkerke R^2) of the variance of mental health, and correctly classified 70.7% of cases, with 39.3% correct classification for the particular at-risk group characterised by moderate/severe hopelessness with high loneliness.



	OR	95% CI Lower	Upper	p
Female (gender)	0,84	0,65	1,10	0,761
Young adults (age)	1,10	0,85	1,42	0,202
BMI Zscore	1,02	0,89	1,16	0,823
decreased Aerobic Exercise	0,96	0,69	1,36	0,836
increased Aerobic Exercise	1,03	0,66	1,62	0,893
decreased Muscle Strenghtening	0,74	0,53	1,04	0,079
increased Muscle Strenghtening	1,10	0,76	1,59	0,615
decreased Screen Time	1,38	0,71	2,66	0,341
increased Screen Time	0,78	0,60	1,01	0,056
decreased Health	1,47	1,07	2,02	**0,019**
increased Health	1,43	0,93	2,22	0,107
decreased Sleep	1,09	0,74	1,60	0,676
increased Sleep	1,03	0,78	1,36	0,860
Number of Close Friends	1,48	1,41	1,56	**< 0,001**
decreased Well-Being	1,03	0,76	1,41	0,837
increased Well-Being	1,03	0,73	1,46	0,866
very often Lonely	8,98	4,92	16,39	**< 0,001**
often Lonely	5,02	3,33	7,56	**< 0,001**

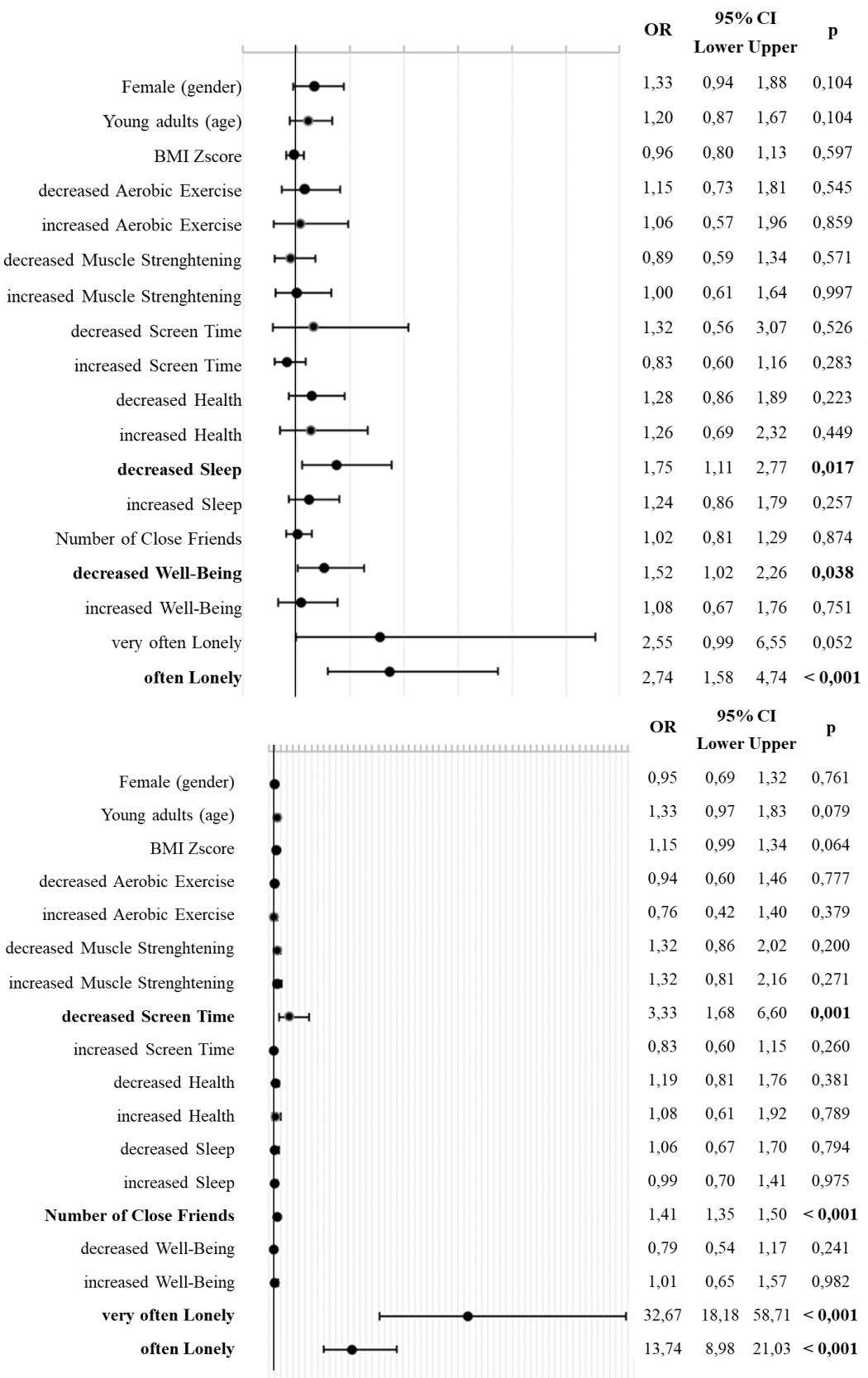


Figure 1. Multinominal logistic regression model for mental health groups (reference group: ‘mentally healthy’; A: ‘loneliness’ group, B: ‘hopelessness’ group, C: ‘at-risk’ group, OR: odds ratio, 95% CI: confidence interval, p: p-value, in bold: statistically significance)

7.5 Discussion

In the present study, we examined the prevalence of loneliness and hopelessness in adolescents and young adults during distance learning education. In sum, more than half of the students reported mild hopelessness and moderate loneliness. Furthermore, a significant proportion of the students, nearly one-fifth and one-fourths showed moderate/severe hopelessness or high loneliness which were more pronounced among adolescent females. Finally, we identified an at-risk group in adolescents and young adults. Students who have a lower number of friends, spend less amount of time in front of a screen, and feel lonely often /very often are more likely to have moderate/ severe hopelessness with high loneliness.

Loneliness can be defined as a subjective experience of a perceived discrepancy between actual and desired social contacts (quantity and/ or quality) (Perlman, Peplau, 1981). The level of loneliness was also significant before the covid-19 pandemic, it has already been recognised as a major public health concern (Leigh-Hunt, et al. 2017; Cacioppo, Cacioppo, 2018; Jeste, et al. 2018).

Social distancing and school closures resulted in an increased level of loneliness, especially with mental health consequences for adolescents/students and young adults (Killgore, et al. 2020; Tull, et al. 2020; Bu, et al. 2020). Although loneliness remained relatively stable in the general population before and after the lockdown period, younger people reported a higher increase in and a higher level of loneliness (Niedzwiedz, et al. 2021). Female young adults aged 18-30 years who had already a higher risk of being lonely experienced an increased level of loneliness during the pandemic (Bu, et al. 2020). One-third of adolescents have reported a high level of loneliness, and almost half of young adults have been lonely during lockdown which might have detrimental consequences on mental health (Mental Health Foundation, 2021; Lee, et al. 2020).

There are a few studies that examined the level of hopelessness during the pandemic and/or lockdown among the younger population. The earliest studies demonstrated an increased level of depression and anxiety (Racine et al. 2020; Marques de Miranda et al. 2020) in children and adolescents which is also supported by further studies. Adolescents or their parents have reported symptoms of internalizing disorders such as depression and anxiety, with increased levels in female adolescents compared to male peers (Duan & Zhu, 2020). Based on previous studies, perceived difficulties such as social isolation, confinement, and school closuresresulted in mental health problems, particularly higher depressive symptoms and more loneliness compared to pre-pandemic baselines (Loades, et al. 2020; Rogers, et al. 2021; Ludwig-Waltz,

et al. 2022). Furthermore, during the COVID-19 pandemic, a higher dose-response relationship was found when school closures occurred (Ludwig-Waltz, et al. 2022).

It can be assumed that there is a relationship between hopelessness and depression. On one hand, based on the hopelessness theory of depression (Abramson, Metalsky & Alloy, 1989), negative life events could lead to hopelessness, through negative inferences, which may result in symptoms of depression. On the other hand, based on the interpersonal theories of depression (Hames, Hagan & Joiner, 2013), interpersonal stress which is related to relationship problems and social rejection may lead to depressive symptoms. There is no question that the COVID-19 pandemic represents a significant negative life event and interpersonal stress for everyone.

Adolescents and young adults during the COVID-19 pandemic, especially during distance learning education have faced many challenges such as the new norm of education and lack of optimal learning with cognitive vulnerability such as school performance and computer competence, and pre-existing vulnerability such as personality, family and environmental characteristics. Many adolescents and young adults may have seen these challenges as a negative life event that they cannot cope with or find difficult to cope with. Based on the results of the present study, the lower number of friends, feeling lonely often/very often and decreased time spent in front of the screen result in an increase in the likelihood of moderate/severe hopelessness or high loneliness.

The pandemic causes significant changes in friendship and family dynamics among adolescents and young adults. They perceived social and emotional changes such as less support from friends and negative affect, which were associated with mental health problems and loneliness (Rogers, Ha & Ockey, 2021; Cooper et al., 2021; Ludwig-Waltz, et al. 2022). For adolescents and young adults, the peer group is one of the most significant groups for supporting and developing identity (Meeus & Dekoviic, 1995). Young adults and having fewer friends are at a greater risk for loneliness (Beutel et al. 2017; Shovestul et al., 2020). During the distance learning education period, there was limited access to social support from the peer group. It is worth highlighting that the size of the social network and quantity of social contacts might be more important than the quality (Nickolaisen &Thorsen, 2014) for this young population, which was significantly impaired by social distancing and isolation during the pandemic.

Finally, we found that spending a decreased time in front of a screen in the evening was associated with moderate/severe hopelessness and/or high loneliness. This result seems to contradict previous studies which demonstrated greater virtual contact, or a higher number of hours spent on social media is associated with increased loneliness (Rumas, Shamblaw &

Jagtap, 2021; Cauberghe et al., 2021) and depressive symptoms in adolescents (Murata et al., 2021). In sum, increasing time or no change in time in front of a screen was the most common among students but nearly a tenth of students spent lesser time in front of a screen. Based on this result, it can be assumed that students commonly use this 'time in front of a screen' to keep in contact with their friends. Thus, a decreased time in front of a screen can be related to a higher level of social isolation from peers and lead to a higher level of hopelessness and loneliness. At the same time, it is unclear whether virtual social contact is helpful during the pandemic when in-person contact is less available. Some evidence suggests that virtual contact does not have the same positive effects as in-person contact (Lee et al., 2011).

There is also some evidence that the pandemic had a greater negative impact on females than on males, possibly exacerbating the gender disparity in health behaviors, especially sedentary/ screen time and physical activity/ exercise that existed among adolescents and young adults before the pandemic (Sterdt, et al. 2014). These findings point to the necessity for gender- and age-sensitive interventions. During a pandemic, it is needed for developing public health strategies by scientists, policymakers and professionals to intervene in health and risk behaviors, as well as minimize the health risks connected with changes in these behaviors. Indirect long-term health risks must be considered for adolescents and young adults when developing restrictive policies.

7.6 Limitations of the present study

There are some limitations of the present study. These include the fact that all data were collected online, and students completed the questionnaires voluntarily in a cross-sectional survey; thus, it is not possible to make any causal inferences. Besides selection bias, recall bias and memory inaccuracies may occur which are common biases in cross-sectional studies, and therefore it is possible that students under- or overestimated their measured status (health, physical activity, sleep, screen time, etc.). Further response bias may be caused by misinterpretation of questions, socially acceptable responses, consent responses or even extreme responses. However, during the period of distance learning imposed during the quarantine, self-report data collection was one of the most appropriate methods for the collection of data from a large number of participants. Another limitation is that it is difficult to measure in detail all aspects of students' lives in one study such as types and modalities of indirect social contacts such as text messaging or evaluate other protecting effects such as the closeness of parents. Finally, although there is an officially translated version of UCLA-LS20

in the Hungarian language (Csóka, 2007), and it is widely used in research and practice, UCLALS20 has not been validated yet in the Hungarian language.

7.7 Conclusions

In the present study, we demonstrated that the COVID-19 pandemic can be associated with significant mental health problems in adolescents and young adults. The identified at-risk group showed moderate/severe hopelessness with high loneliness. The consequences of this pandemic situation on mental health in this young population may be significant considering the fact that loneliness and hopelessness may be associated with future poor mental and physical health. Thus, there is a need for public health strategies to monitor mental and physical symptoms in one of the most vulnerable populations such as adolescents and young adults. For future studies, it is recommended to develop effective interventions targeted to gender and age with the promotion of resiliencies and buffers against vulnerabilities of negative life events.

Declarations

Ethics approval and consent to participate: The study was conducted with the approval of the Ethical Committee of the Medical Research Council (TUKEB), Hungary, under ETK TUKEB ethical permission No. IV/3067- 3/2021/EKU.

Availability of data and materials: The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: No financial support was provided for the writing of the communication or the resulting research.

Authors' contributions: All authors contributed to the conception of the study to the final draft of the manuscript. JT: analysing the data, interpreting the results, and writing the first manuscript, ZSK: collecting data, reviewing/editing of the manuscript, FI: Conceptualization, supervision of the study, reviewing/editing of the manuscript. All authors read and approved the final manuscript.

CHAPTER 8: Conclusions

8.1 Summary of the findings

Hypotheses were formed at the beginning of the thesis, and in light of the results, we can conclude the following. The prevalence of adolescents and young adults in Hungary samples meeting PA and ST guidelines was low before the COVID-19 pandemic and even worse afterwards during distance education. The effects of a more sedentary lifestyle reduced PA, and increased ST as results of distance learning can be recognized. These health effects among young people may have further serious negative public health implications in the future (Zheng et al., 2020; Dunton et el. 2020).

This dissertation searched for answers to the changes in different types of physical activity before and during the pandemic aerobic type of PA (AE) and muscle strengthening (MS) movements, team sports (TS). We found that in all regions, both genders have seen a significant decrease in AE during the introduction of distance learning. Physical activity of students exceeding 20 minutes minimum before the introduction of distance education showed higher change for boys in all regions but decreased as significantly as for the less active female groups.

The average age of respondents was (17.27±1.3) years. The age of respondents in Budapest shows the lowest average, followed by the West-Hungary region. Central Hungary and Eastern Hungary have the highest ages, but these regions differ minimally. The regional distribution showed a relative balance across geographical areas in Hungary. 57% of respondents were girls and 43% were boys. In the West-Hungary region, male respondents are slightly over-represented, while in the other three regions, female respondents dominate.

The frequency of AE (days/week) did not change for nearly one quarter (24.7%) of the students. 61% of participants reported a decrease in exercise frequency, with an average of 2 fewer days of exercise per week and 14.3% reported an increase in frequency, with an average of 2 more days of exercise per week. Our study supports the findings of other reports (Bates et al., 2020; López-Bueno et al., 2020) that almost half of the adolescents reporting less than optimal physical activity and the WHO target of a 15% reduction in inactivity by 2030 is seriously at risk. Global prepandemic data show a low, around 20% proportion of adolescents who meet physical activity guidelines. (WHO, 2016)

In almost all regions, both sexes have seen a noteable decline in the type of physical activity aimed at developing muscle strength since the introduction of distance learning. MS-

type physical activity of students was more remarkable for boys in all regions before the introduction of distance learning but decreased to a lesser extent for the less active groups of girls. The exception is the girls in the Budapest region, where the responses suggest that there has been no significant change. The frequency of MS (days/week) did not change in one-third (32.9%) of the participants. 44.5% of the four regoins reported a decrease in the frequency of muscle strengthening, with an average of 2 fewer days per week of muscle strengthening and 22.6% of the students reported an increase in frequency, with an average of 2 more days per week of MS. Kovács, Starc, Brandes et. al. (2021); Biddle, Whitehead, O'Donovan and Nevill, (2005) pointed out that in some groups, such as adolescent girls, poorer time-management skills are associated with lower physical activity.

The drastic reduction in playing TS is very noticeable for both sexes and all regions. We need to point out that before the introduction of distance learning, students had the opportunity to play team sports at least three times a week in their daily PE lessons, under distance learning this opportunity has been minimized. Responses during distance learning also included responses from registered athletes of clubs who were able to play team sports during the restrictions due to the legal exception. The frequency of team sports (days/week) did not change for 12.9% of the students. Sadly, 84.1% of the participants of our study reported a decrease in the frequency of TS, as expected, with an average of 3 fewer days per week of TS, and 3% of 63 participants reported an increase in frequency, with an average of 2 more days per week of TS.

Adolescence is a transitional period in the process of growing up and becoming an adult. The results of this research may predict students' future life trajectories and personal development, including how their lives will be influenced by the activities in which they participate (Bandura, 2001). The behavioral patterns that develop in their current life situation would determine the extent to which sport and the experience of health-conscious well-being will play a role later in life. A decline in physical activity may be reflected in the need for physical activity in adulthood, which means that poor patterns now emerging may be a cause for concern, particularly with known diseases that develop as a result of inactivity (Tremblay et al., 2011; Gallè F. et al. 2020; Cunningham et al., 2021).

Concerning the changes in the time spent in front of a screen and physical inactivity, it can be stated that distance learning has not only forced secondary school students to spend more time in front of their screens during study time, but also a huge increase in their evenings. The

time spent with friends has changed dramatically, with the online space becoming the place for face-to-face encounters. This finding partially can be explained by the restrictions of the curfew.

However, our results are also in line with other international research results where increased screen time was detected (Kovacs et al., 2021). These studies report that older children in many countries (Australia, China, France, Germany, Italy, Netherlands, South Korea, Spain, UK, USA) spent extended periods engaged with digital media during the lockdown. (Bergmann et al. 2022; Wong et al. 2020; Sultana et al., 2020)

Examination of subjective assessment of their sleep time and health status it can be stated that distance learning has led to a uniformly significant increase in sleep time for both sexes in all regions. We did not specifically ask about bedtime and wake-up time in our survey, but we strongly suspect that the increased sleep time may be due to the lack of school commuting and therefore the relatively later wake-up time. Pupils did not have to get up early, they 'won' the time to get to school and could spend this time sleeping. For respondents, the increase in sleep time is more likely to occur in this morning period and is not likely to be associated with an earlier bedtime. Among respondents of the study, girls slept less than boys on average. As a result of increased sleep time, they felt less tired during distance learning, but their self-perception of their health nevertheless deteriorated.

Subjective assessment of health before and during distance learning showed a statistically significant relationship. Subjective assessment of health status across all 68.1% reported unchanged, 23.1% reported worse and 8.8% reported better health during distance learning compared to before distance learning. This variation was observed regardless of gender, age and region. Their perceived health status less then 25% worse, not noteable change during distance learning compared to face-to-face education. In all cases, the averages for girls were found to be worse than the averages for boys in their age group, suggesting that boys were less likely to perceive the deterioration in their health as significant. (Mansfield et. al., 2021) It is fully consistent with national and international research data that women have a markedly worse health status than men, not only in old age but over the whole life course. The difference between the two sexes is close to 10%, and this difference is also observed when looking at EU-15 data.

However, it is also important to note that the difference between the Hungarian and international averages is significant, i.e. the EU-15 is significantly more optimistic. (Ihász, 2018). Our result seems to be in line with findings suggesting that the association between

screen time and mental health outcomes during the pandemic were pervasive across a type of screen use and type of mental health outcome. (Toombs et al. 2022)

For the most part, changes in physical activity (no change, decreased, increased) did not influence changes in subjective health status ratings (no change). However, a higher proportion of students who reported a decrease in their physical activity also reported a subjective decrease in health status: this was the case for about one-third and one-quarter of students respectively.

In addition, subjective increases in health were reported by a greater proportion of reported an increase in the proportion of students whose physical activity also increased: this was the case for almost a quarter of students. Finally, we examined gender, age and regional distributions among those who were found to associate reduced physical activity with reduced health. Our results suggest that the sample of rural adolescent girls was considered a risk group. Hawes et al. (2020) report that adolescents and young adults at an early epicenter of the COVID-19 pandemic in the U.S. experienced increased depression and anxiety symptoms, particularly amongst females. Mansfield et. al. (2021) in their cross-sectional survey across Southern England during the first COVID-19 school lockdown came up with similar results.

The available literature suggests that depression and anxiety symptoms may have been elevated during the COVID-19 pandemic and that certain populations (e.g. women, and individuals living in areas with a high density of COVID-19 cases) are more vulnerable to worsening mental health during the pandemic (Tolin & Foa, 2008; Torales, O'Higgins, Castaldelli-Maia, & Ventriglio, 2020; Vindegaard & Benros, 2020). Several longitudinal studies on adolescents and young adults have found that symptoms of anxiety and depression increased before the COVID-19 pandemic (Elmer, Mepham, & Stadtfeld, 2020; Li, Cao, Leung, & Mak, 2020; Magson et al., 2020; Saraswathi et al., 2020).

In line with these international studies, we demonstrated that the COVID-19 pandemic can be associated with significant mental health problems in the examined group of Hungarian adolescents and young adults. The consequences of this pandemic situation on mental health in this young population may be significant. It is well established that loneliness and hopelessness are associated with future mental and physical health problems in adolescents and young adults, especially among those who were already at risk of being lonely and hopeless before the pandemic.

Closing the dissertation and answering the hypotheses we can conclude that

Hypothesis 1. All type of PA activities decreased during the distance education period in the examined cohort.

Hypothesis 2. The time spent in front of a screen increased among secondary school students is TRUE.

Hypothesis 3. Their sleep time increased during distance education is TRUE.

Hypothesis 4. Subjective ratings of their mental health in the areas of loneliness and hopelessness deteriorated and they felt “more lonely” during the distance learning period is partially TRUE with the distinctive characteristics reported in chapters 6 and chapter 7.

8.2 Limitations and future directions

8.2.1 Limitations

There are some limitations of the present study. Its limitations include the fact that all data were collected online and self-reported by participants. There are also some the potential response biases of a self-reported questionnaire such as misunderstandings, social desirability and acquiescence bias or extreme responding, etc.. Besides selection bias, recall bias and memory inaccuracies may occur, and therefore it is possible that students under- or overestimated their measured status (health, physical activity, sleep, screen time, etc.). Further response bias may be caused by misinterpretation of questions, socially acceptable responses, consent responses or even extreme responses (Ekelund, Tomkinson és Armstrong, 2011).

Another limitation is that it is difficult to measure in detail all aspects of students’ lives in one study such as types and modalities of indirect social contacts such as text messaging or evaluate other protecting effects such as the closeness of parents. At the same time, due to the restrictions and forced social isolation during period of distance learning imposed the lock down self-administered data collection was one of the most appropriate methods for answering research questions, which allowed for the collection of data from a large number of study participants living far apart.

The self-reported measurement of physical activity has also some biases. There are a huge number of instruments to assess PA with different format and development. Thus, for assessing PA, we used the Health Behavior in School-aged Children (HBSC) questionnaire which has been a validated instrument for cross-sectional studies for decades. Finally, it is important to note that we assessed only the frequency of PA. It is recommended for future studies to assess the intensity and time of PA.

8.2.2 Future directions

In their study, Kokkonen, Yli-Piipari, Kokkonen, & Quay (2019) and Kovacs et al. (2021) suggest that establishing daily routines by following a regular school timetable and organizing the remaining daily time during home study may be a promising intervention strategy to increase physical activity and limit screen time in children and adolescents. While for younger age groups, pre-designed, consistently segmented solutions and parental rules on screens should be promoted to control unhealthy behavior, for older youth, persuasion and internalization of external motivation should be promoted, thus making self-motivated PA a life-long routine.

Education policy makers should seek to make it compulsory for schools to develop online PE programmes and age-specific curricula in case distance learning is reintroduced. Schools should build their distance learning capacity by using P.E. should give priority to P.E. alongside other theoretical subjects. Active participation in physical activity during the online period could be promoted through the use of electronic applications.

Our recommendation is that during any subsequent quarantine restrictions, the national school nurse service should carry out regular periodic tele-health checks. Authorities should prepare detailed plans for adolescents and young adults meeting health-related guidelines during a potential future pandemic and should develop strategies to avoid the potential harmful collateral effects precipitated by pandemic-related restrictions.

There is a need for public health strategies to monitor mental and physical symptoms in one of the most vulnerable populations such as adolescents and young adults. For future studies, it is recommended to develop effective interventions with the promotion of resiliencies and buffers against vulnerabilities of negative life events. Further consultations with physical education teachers and sports coaches could prioritize physical activity in school-age children.

The long stay of the world's population requires a concerted response that includes collaboration with parents, teachers, policy makers and others in communities. The 'tailoring' of interventions to promote the availability of recreational activities that require a new content-based behavioral epidemiological framework (Jiao et al. 2020). The proven positive effects of PA on individuals' immune system would ultimately help school children, their families, and societies in general reducing any future infection-spread or pandemic.

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Appendices

Appendix 1

Kérdőív távoktatás bevezetése előtt és alatt végzett fizikai aktivitásról és jólét érzésről

Kedves Fiatalok!
Egy kutatásunkhoz kérnénk a segítségedet, melyben a karantén előtti és alatti sportolási szokások összefüggéseit vizsgáljuk. A részvétel önkéntes, az adatok feldolgozása névtelenül, statisztikai jelleggel történik, az eredmények kizárólag tudományos szempontokat szolgálnak. A kitöltés kb. 10-15 percet vesz igénybe.

Kérjük, olvasd végig a kérdéseket, és válaszolj őszintén! Ne feledd, nincsenek jó és rossz válaszok, a te tapasztalataidra vagyunk kíváncsiak!
Köszönjük szépen a segítséget!
Alföldi Zoltán (PTE), Kerner László (PTE), Katona Zsolt(PTE), Kósa Lili (ELTE), Tóth László (TE), Ihász Ferenc (PTE)

*Kötelező

1. Kijelentem, hogy a vizsgálat céljáról és jellegéről kielégítő tájékoztatást kaptam. * A vizsgálatokhoz való hozzájárulásomért anyagi ellenszolgáltatást sem én, sem hozzátartozóm nem kapott. Tudomásul veszem, hogy azonosításomra alkalmas személyi adatokat a vizsgálat vezetője bizalmasan kezeli, azokba a kísérlet lebonyolításában részt vevő személyeken kívül másoknak nem enged betekintést. Tudomásul veszem, hogy a vizsgálati adatok kutatási és nem diagnosztikai célokat szolgának, ilyen jellegű szakvéleményre a vizsgálatok elvégzését követően igényt nem támasztok. *

   Soronként csak egy oválist jelöljön be.

   - ◯ A vizsgálatban való részvételhez hozzájárulok.
   - ◯ A vizsgálatban való részvételhez nem járulok hozzá.

2. A szüleimnek beszéltem a kutatásról és beleegyeztek, hogy részt vegyek benne *

   Soronként csak egy oválist jelöljön be.

   - ◯ Igen
   - ◯ Nem

3. Iskolád neve, város *

   _____

4. Nemed *

Soronként csak egy oválist jelöljön be.

- ◯ Fiú
- ◯ Lány

5. Életkorod *

_____

Példa: 2019. január 7.

6. Évfolyamod *

Soronként csak egy oválist jelöljön be.

- ◯ 9
- ◯ 10
- ◯ 11
- ◯ 12

7. A távoktatási időszak előtt többet mozogtam, mint most a távoktatási időszak folyamán. *

Soronként csak egy oválist jelöljön be.

- ◯ Igen
- ◯ Nem
- ◯ Ugyanannyit

8. A távoktatás bevezetése előtt hetente hányszor edzettél vagy végeztél fizikai aktivitást legalább 20 percig úgy, hogy izzadtál és nehezen vettél levegőt, például kosárlabda, futball, futás, úszás, gyors kerékpár körök, gyors táncolás, vagy aerobik közben? (azt a számot válaszd, ahány alkalommal átlagosan edzettél) *

Soronként csak egy oválist jelöljön be.

0	1	2	3	4	5	6	7
◯	◯	◯	◯	◯	◯	◯	◯

9. A távoktatás bevezetése óta hetente hányszor edzettél vagy végeztél fizikai aktivitást legalább 20 percig úgy, hogy izzadtál és nehezen vettél levegőt, például kosárlabda, futball, futás, úszás, gyors kerékpár körök, gyors táncolás, vagy aerobik közben? (azt a számot válaszd, ami most jellemző rád) *

Soronként csak egy oválist jelöljön be.

0	1	2	3	4	5	6	7
◯	◯	◯	◯	◯	◯	◯	◯

10. A távoktatás bevezetése előtt hetente hányszor végeztél erősítő edzést vagy nagyobb hangsúlyt fektetve az izmaidra például fekvőtámasz, felülés, húzódzkodás ? (kérlek válassz) *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	
nap	◯	◯	◯	◯	◯	◯	◯	◯	nap

11. A távoktatás bevezetése óta hetente hányszor végeztél erősítő edzést vagy nagyobb hangsúlyt fektetve az izmaidra például fekvőtámasz, felülés, húzódzkodás ? *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	
nap	◯	◯	◯	◯	◯	◯	◯	◯	nap

12. Az elmúlt 12 hónapban hányszor játszottál csapatjátékot? (Beleértve az iskolai futócsapatot vagy a közösségi csoportokat.) *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	
nap	◯	◯	◯	◯	◯	◯	◯	◯	nap

13. A távoktatás bevezetése óta hányszor játszottál csapatjátékot? (Beleértve az iskolai futócsapatot vagy a közösségi csoportokat.) *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	
nap	◯	◯	◯	◯	◯	◯	◯	◯	nap

14. A távolléti testnevelés oktatás során kaptam rendszeres feladatokat, utasításokat testnevelőmtől. *

Soronként csak egy oválist jelöljön be.

◯ Igen
◯ Nem

15. Végeztél-e testnevelő / edző által kiadott edzésprogramot a kijárási korlátozás idején? *

Soronként csak egy oválist jelöljön be.

- Igen
- Nem

16. A kapott programot .....elvégeztem. *

Soronként csak egy oválist jelöljön be.

	1	2	3	4	5	
egyáltalán nem						mindíg, nagyon pontosan

17. Az edzőtől / testnevelőtől kapott edzésprogramot társaimmal közösen jobban tudtam volna elvégezni. *

Soronként csak egy oválist jelöljön be.

- egyáltalán nem vagy alig
- kicsit jobban
- ugyanolyan szinten
- jobban
- sokkal jobban

18. Az edzőtől / testnevelőtől kapott edzésfeladatokat a testnevelő / edző jelenlétében jobban tudtam volna elvégezni. *

Soronként csak egy oválist jelöljön be.

- egyáltalán nem vagy alig
- kicsit jobban
- ugyanolyan szinten
- jobban
- sokkal jobban

19. Számomra nagyon sokat segít az edzőm/testnevelőm személyes jelenléte az edzésfeladatok végrehajtása során. *

Soronként csak egy oválist jelöljön be.

- egyáltalán nem vagy alig
- kicsit jobban
- ugyanolyan szinten
- jobban
- sokkal jobban

20. Mit gondoltál az egészségi állapotodról a távoltatás bevezetés előtt, normál iskolai időszakban? (kérlek válassz) *

Soronként csak egy oválist jelöljön be.

- Nagyon egészséges
- Egészséges
- Nem teljesen egészséges

21. Mit gondoltál az egészségi állapotodról most, a távoktatás bevezetése óta, a távoktatás alatti időszakban? (kérlek válassz) *

Soronként csak egy oválist jelöljön be.

- Nagyon egészséges
- Egészséges
- Nem teljesen egészséges

22. Az távoktatási időszak alatt most kevésbé érzem jó magam, mint a távoktatási időszak előtt. *

Soronként csak egy oválist jelöljön be.

- Igen
- Nem
- Ugyanúgy

23. Hány órát alszol naponta normál iskolai időszakban? *

Soronként csak egy oválist jelöljön be.

- ◯ kevesebb mint 7 órát
- ◯ 7-8 órát
- ◯ 9 órát
- ◯ 10 vagy több órát

24. Hány órát alszol általában, amióta távoktatás van? *

Soronként csak egy oválist jelöljön be.

- ◯ kevesebb mint 7 órát
- ◯ 7-8 órát
- ◯ 9 órát
- ◯ 10 vagy több órát

25. Általában eleget alszol? (kérlek válassz) *

Soronként csak egy oválist jelöljön be.

- ◯ igen
- ◯ nem

26. Milyen gyakran érezted magad fáradtnak, amikor reggel az iskolába mész? *

Soronként csak egy oválist jelöljön be.

- ◯ ritkán vagy soha
- ◯ alkalmanként (kevesebb, mint egyszer egy héten)
- ◯ maximum 3-szor egy héten
- ◯ 4-szer, vagy többször egy héten
- ◯ Egyéb: _____

27. Milyen gyakran érzed magad fáradtnak, amióta a távoktatás miatt nem mész az iskolába? *

Soronként csak egy oválist jelöljön be.

- ritkán vagy soha
- alkalmanként (kevesebb, mint egyszer egy héten)
- maximum 3-szor egy héten
- 4-szer, vagy többször egy héten
- Egyéb: _____

28. Melyik az az állítás, amelyik legjobban jellemzi a te érzésed a testsúlyodról? *

Soronként csak egy oválist jelöljön be.

- Teljesen elégedett vagyok a testsúlyommal
- 1 - 5 kilót szeretnék fogyni
- 6 - 10 kilót szeretnék fogyni
- 10-nél több kilót szeretnék fogyni
- Gyarapodni szeretnék pár kilóval (Hízni szeretnék)
- Egyéb: _____

29. Melyik az az állítás, amelyik legjobban jellemzi a fiú tanulókat a te középiskoládban? *

Soronként csak egy oválist jelöljön be.

- Teljesen elégedettek a testsúlyukkal
- Sok fiú szeretne fogyni körülbelül 1 - 5 kilót
- Sok fiú szeretne fogyni körülbelül 6 - 10 kilót
- Sok fiú többet szeretne fogyni 10 kilónál
- Sok fiú gyarapodni szeretne pár kilóval (Hízni szeretnének)
- Egyéb: _____

30. Melyik állítás jellemzi a legjobban a középiskoládban tanuló lányok legtöbbjét? *

Soronként csak egy oválist jelöljön be.

- ◯ A legtöbben teljesen elégedettek a súlyukkal.
- ◯ A legtöbben szeretnének fogyni 1 - 5 kilót.
- ◯ A legtöbben fogyni szeretnének 6 - 10 kilót.
- ◯ A legtöbben több, mint 10 kilót szeretnének fogyni.
- ◯ A legtöbben hízni szeretnének.
- ◯ Egyéb: _____

31. Mi a jelenlegi magasságod ?_____cm. (írd a számot a lenti vonalra) *

_____

32. Mennyi a jelenlegi testsúlyod ?_____kg. (írd a számot a lenti vonalra) *

_____

33. Az elmúlt egy év folyamán tettél valamit azért, hogy megpróbálj lefogyni, vagy megakadályozd, hogy meghízz? *

Soronként csak egy oválist jelöljön be.

- ◯ Igen
- ◯ Nem

34. A tavaszi távoktatási időszak folyamán tettél valamit azért, hogy megpróbálj lefogyni, vagy megakadályozd, hogy meghízz? *

Soronként csak egy oválist jelöljön be.

- ◯ Igen
- ◯ Nem

35. Az őszi távoktatási időszak folyamán tettél valamit azért, hogy megpróbálj lefogyni, vagy megakadályozd, hogy meghízz? *

Soronként csak egy oválist jelöljön be.

- ◯ Igen
- ◯ Nem

36. A jelenlegi távoktatási időszak folyamán mit tettél azért, hogy megpróbálj lefogyni, vagy megakadályozd, hogy meghízz? *

Válassza ki az összeset, amely érvényes.

	igen	nem
24 órát vagy többet koplaltál (éhezés)	☐	☐
Kevesebb ételt, néhány kalóriát, vagy zsírszegény ételeket ettél Nem Igen	☐	☐
Fogyókúrás tablettákat, port, folyadékot szedtél orvosi tanács nélkül Nem Igen	☐	☐
hánytál	☐	☐
hashajtót szedtél	☐	☐
testmozgást végeztél	☐	☐
diétáztál	☐	☐

37. Milyennek érzed magad a jelenlegi súlyoddal kapcsolatban? (a megfelelő választ jelöld be) *

Soronként csak egy oválist jelöljön be.

- ◯ teljesen elégedetlen
- ◯ elégedetlen, közömbös
- ◯ elégedett
- ◯ teljesen elégedett

38. Hogyan osztályoznád a testalkatodat? *

Soronként csak egy oválist jelöljön be.

- ◯ eléggé vékony
- ◯ kissé vékony
- ◯ éppen megfelelő
- ◯ kissé kövér
- ◯ elég kövér

39. Mit gondolsz magadról a súlyoddal kapcsolatban? *

Soronként csak egy oválist jelöljön be.

- ◯ nagyon sovány
- ◯ kissé sovány
- ◯ éppen megfelelő
- ◯ kissé kövér
- ◯ elég kövér

40. Az emberek szerint fogynom kellene. *

Soronként csak egy oválist jelöljön be.

- ◯ igen
- ◯ nem
- ◯ Egyéb: _____

41. Az emberek szerint híznom kellene. *

Soronként csak egy oválist jelöljön be.

- ◯ igen
- ◯ nem

42. Az elmúlt évben milyen gyakran gondoltál arra, hogy vékonyabb szeretnél lenni? *

Soronként csak egy oválist jelöljön be.

- ◯ Soha
- ◯ Keveset
- ◯ Néha
- ◯ Sokat
- ◯ Mindíg

43. Szerinted mekkora súlynál néznél ki a legjobban?.....kilogramm (írd a lenti vonalra a számot) *

_____

44. Mindent egybevetve, szerinted mennyire nézel ki jól?(Jelöld be a lenti számok közül azt, amelyik a legjobban tükrözi a véleményedet.) *

Soronként csak egy oválist jelöljön be.

	1	2	3	4	5	6	7	8	9	
Rendkívül taszító	◯	◯	◯	◯	◯	◯	◯	◯	◯	Rendkívül vonzó

45. Szerinted te: *

Soronként csak egy oválist jelöljön be.

- ◯ Nagyon csinos
- ◯ Nem nagyon csinos
- ◯ Eléggé csinos
- ◯ Egyáltalán nem csinos
- ◯ Átlagos vagy
- ◯ Nem gondolsz a kinézetedre

46. Hány közeli barátod van? *

Soronként csak egy oválist jelöljön be.

- ◯ Egy sem
- ◯ 1
- ◯ 2
- ◯ 3 vagy több
- ◯ Egyéb: _____

47. Nehéz vagy könnyű új barátokat szerezned? *

Soronként csak egy oválist jelöljön be.

- ◯ Nagyon könnyű
- ◯ Könnyű
- ◯ Nehéz
- ◯ Nagyon nehéz

48. Milyen gyakran töltötted az időt a barátaiddal közvetlenül iskola után a távoktatás bevezetése előtt? *

Soronként csak egy oválist jelöljön be.

- ◯ Most nincsen barátom
- ◯ Hetente egyszer vagy kevesebbszer
- ◯ hetente 2-3 napot
- ◯ hetente 4-5 napot
- ◯ Egyéb: _____

49. Milyen gyakran töltötesz időt a barátaiddal jelenleg, a távoktatás bevezetése óta? *

Soronként csak egy oválist jelöljön be.

- ◯ Most nincsen barátom
- ◯ Hetente egyszer vagy kevesebbszer
- ◯ hetente 2-3 napot
- ◯ hetente 4-5 napot

50. Milyen formában tartasz kapcsolatot, töltötesz időt barátaiddal jelenleg, a távoktatás bevezetése óta? *

Soronként csak egy oválist jelöljön be.

- ◯ Személyesen
- ◯ Többnyire személyesen
- ◯ Személyesen és online
- ◯ Többnyire online
- ◯ Szinte csak online
- ◯ Egyéb: _____

51. Általában hetente mennyi estét töltöttél együtt a barátaiddal a távoktatás bevezetése előtt? *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	
estét	◯	◯	◯	◯	◯	◯	◯	◯	estét

52. Általában hetente mennyi estét töltöttél a képernyő előtt (TV, laptop, okostelefon stb.) a távoktatás bevezetése előtt? *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	
estét	◯	◯	◯	◯	◯	◯	◯	◯	estét

53. Általában hetente mennyi estét töltöttél a képernyő előtt (TV, laptop, okostelefon stb.) a távoktatás bevezetése óta? *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	
estét	◯	◯	◯	◯	◯	◯	◯	◯	estét

54. Magányosnak érzed magad? *

Soronként csak egy oválist jelöljön be.

- ◯ Nem
- ◯ Igen, néha
- ◯ Igen, eléggé gyakran
- ◯ Igen, nagyon gyakran

55. Kérlek jelölj be I-t minden olyan állításnál, amely IGAZ rád, és az H-át minden olyannál, amely HAMIS rád. *

Válassza ki az összeset, amely érvényes.

	Igaz	Hamis
Jobb lesz, ha feladom, mert nem tudom jobbá tenni a dolgokat számomra	☐	☐
Amikor a dolgok rosszul mennek, kisegít a tudat, hogy nem maradhatnak így örökre.	☐	☐
Nem tudom elképzelni, hogy milyen lesz az életem 10 éven belül.	☐	☐
Elég időm van végrehajtani azokat a dolgokat, amelyeket a legjobban szeretnék megtenni.	☐	☐
Azt várom, hogy a jövőben abban legyek sikeres, ami a legjobban érdekel.	☐	☐
A jövőm sötétnek tűnik nekem.	☐	☐
Azt várom, hogy több jó dolgot kapok az élettől, mint az átlag ember.	☐	☐
Nem tartok szüneteket; nincs okom, hogy higgyek a jövőmben.	☐	☐
A múltbeli tapasztalataim jól felkészítenek a jövőmre.	☐	☐
Amit előre látok magammal kapcsolatban , az	☐	☐

inkább a kellemetlenség, mint kellemesség.		
Nem hiszem, hogy azt kapom, amit igazán várok.	☐	☐
Amikor előretekintek a jövőbe, azt várom, hogy boldogabb leszek, mint most.	☐	☐
A dolgok egyszerűen csak nem úgy alakulnak, ahogy én szeretném.	☐	☐
Hatalmas hitem van a jövőben.	☐	☐
Sosem kapom meg azt, amit szeretnék, szóval bolondság akármit is akarni.	☐	☐
Nagyon valószínűtlen, hogy valódi elégedettséget lelek a jövőben.	☐	☐
A jövő homályosnak és bizonytalannak tűnik nekem.	☐	☐
Több jó időszakra tudok előretekinteni, mint rosszra.	☐	☐
Nincs igazán értelme próbálkozni olyasvalami megszerzésével, amit szeretnék, mert valószínűleg nem kapom meg.	☐	☐

56. A következő kérdéseknél jelöld be minden egyes állításban, hogy mennyire gyakran érezted a leírt szempontokat. *

Soronként csak egy oválist jelöljön be.

	Soha	Ritkán	Néha	Gyakran
Összhangban érzem magam a körülöttem lévő emberekkel.	◯	◯	◯	◯
Hiányolom a baráti társaságot.	◯	◯	◯	◯
Nincs senki, akihez fordulhatnék.	◯	◯	◯	◯
Nem érzem magányosnak magam.	◯	◯	◯	◯
Egy csoport tagjának érzem magam.	◯	◯	◯	◯
Sok a közös bennem és a környezetemben.	◯	◯	◯	◯
Többé nem állok közel senkihez.	◯	◯	◯	◯
Az érdeklődési körömet és az eszméimet nem osztja a környezetem.	◯	◯	◯	◯
Társaságkedvelő személy vagyok.	◯	◯	◯	◯
Vannak hozzám közel álló emberek.	◯	◯	◯	◯
Mellőzöttnek érzem magam.	◯	◯	◯	◯
A társasági kapcsolataim felületesek.	◯	◯	◯	◯
Senki nem ismer igazán.	◯	◯	◯	◯
Elszigeteltnek érzem magam másoktól.	◯	◯	◯	◯
Akkor találok	◯	◯	◯	◯

társaságot, amikor akarok.				
Vannak olyanok, akik igazán megértenek engem.	◯	◯	◯	◯
Boldogtalan vagyok ennyire elzárkózottan.	◯	◯	◯	◯
Az emberek körülöttem vannak, de nem velem.	◯	◯	◯	◯
Vannak olyanok, akikkel beszélgethetek.	◯	◯	◯	◯
Vannak olyanok, akikhez fordulhatok.	◯	◯	◯	◯

57. Mi édesanyád legmagasabb iskolai végzettsége?

Soronként csak egy oválist jelöljön be.

- ◯ Nem fejezte be középiskolai tanulmányait
- ◯ Középiskolai végzettséggel rendelkezik
- ◯ Valamilyen felsőfokú végzettséggel rendelkezik
- ◯ Főiskolai, egyetemi végzettséggel rendelkezik
- ◯ Nem tudom
- ◯ Egyéb: _____

58. Mi édesapád legmagasabb iskolai végzettsége?

Soronként csak egy oválist jelöljön be.

- ◯ Nem fejezte be középiskolai tanulmányait
- ◯ Középiskolai végzettséggel rendelkezik
- ◯ Valamilyen felsőfokú végzettséggel rendelkezik
- ◯ Főiskolai, egyetemi végzettséggel rendelkezik
- ◯ Nem tudom
- ◯ Egyéb: _____

59. Mely településen élsz jelenleg?

Válassza ki az összeset, amely érvényes.

- [ ] Nagyvárosban
- [ ] Városban
- [ ] Vidéken (közel a nagyvároshoz)
- [ ] Falun, tanyán (távol a nagyvárostól)

60. Mely település fajtán szeretnél élni?

Válassza ki az összeset, amely érvényes.

- [ ] Nagyvárosban
- [ ] Városban
- [ ] Vidéken (közel a nagyvároshoz)
- [ ] Falun, tanyán (távol a nagyvárostól)

61. Mit gondolsz, milyen módban él a családod? *

Soronként csak egy oválist jelöljön be.

- ◯ Nagyon jó módban
- ◯ Elfogadhatóan
- ◯ Közepesen
- ◯ Váltakozóan
- ◯ Nem jó módban

62. Általában, hogyan érzed magad? *

Soronként csak egy oválist jelöljön be.

- ◯ Nagyon jól
- ◯ Nem érzem jól magam
- ◯ Nemigazán érzem magam jól
- ◯ Sohasem érzem jól magam

Appendix 2

PANNONHALMI FŐAPÁTSÁG
A.D. 996

Befogadó nyilatkozat

Alulírott, Hardi Titusz OSB, a Magyar Bencés Kongregáció Pannonhalmi Főapátság fenntartásában lévő oktatási intézmények főigazgatójaként nyilatkozom, hogy

a Pécsi Tudomány Egyetem Doktori Iskola keretein belül zajló, prof. Dr. Ihász Ferenc által vezetett,

„Kérdőív távoktatás bevezetése előtt és alatt végezett fizikai aktivitásról és jólétérzésről"

című online kérdőíves kutatást a fenntartásunkban lévő oktatási intézményekben[1] engedélyezem és lefolytatásához hozzájárulok.

[1]A Magyar Bencés Kongregáció Pannonhalmi Főapátság fenntartásában lévő oktatási intézmények:

- Pannonhalmi Bencés Gimnázium és Szakkollégium
- Pannonhalmi Szent Benedek Általános Iskola és Alapfokú Művészeti Iskola
- Szent Benedek Technikum, Szakképző Iskola, Középiskola és Alapfokú Művészeti Iskola Budaörsi Tagintézménye
- Szent Benedek Technikum, Szakképző Iskola, Középiskola és Alapfokú Művészeti Iskola Budapesti Tagintézmény
- Szent Benedek Technikum, Szakképző Iskola, Középiskola és Alapfokú Művészeti Iskola Szegedi Tagintézmény
- Szent Benedek Technikum, Szakképző Iskola, Középiskola és Alapfokú Művészeti Iskola Miskolci Tagintézmény
- Balatonfüredi Szent Benedek Gimnázium, Technikum, Szakképző Iskola és Kollégium
- Kiskunfélegyházi Szent Benedek PG Két Tanítási Nyelvű Technikum és Kollégium
- Szegedi Szent Benedek School of Business Technikum
- Pannonhalmi Főapátság Máriaremete-Hidegkúti Ökumenikus Általános Iskolája

Kelt, Pannonhalma, 2021. év április hó 22. nap

Magyar Bencés Kongregáció Pannonhalmi Főapátság

....

oktatási igazgató
aláírás és p.h

[illegible] Pannonhalma, Vár 1
Pannonhalmi Főapátság OKTATÁSI IGAZGATÓSÁG

Appendix 3

BELEEGYEZŐ NYILATKOZAT (online)

Alábbi beleegyező nyilatkozat szövege *megegyezik a kijárási korlátozások és az elektronikai távoktatás együttes hatása a középiskolások fizikai teljesítményére, motivációjára* online kérdőívben közölt hozzájáruló nyilatkozat és szülői hozzájárulás szövegével.

Kijelentem, hogy a vizsgálat céljáról és jellegéről kielégítő tájékoztatást kaptam. A vizsgálatokhoz való hozzájárulásomért anyagi ellenszolgáltatást sem én, sem hozzátartozóm nem kapott. Tudomásul veszem, hogy azonosításomra alkalmas személyi adatokat a vizsgálat vezetője bizalmasan kezeli, azokba a kísérlet lebonyolításában részt vevő személyeken kívül másoknak nem enged betekintést. Tudomásul veszem, hogy a vizsgálati adatok kutatási és nem diagnosztikai célokat szolgának, ilyen jellegű szakvéleményre a vizsgálatok elvégzését követően igényt nem támasztok. *

igen – nem

A szüleimnek beszéltem a kutatásról és beleegyeztek, hogy részt vegyek benne. igen-nem

Igazolom, hogy a fenti nyilatkozat megegyezik fent nevezett online kérdőívben megfogalmazott és közölni kívánt nyilatkozat szövegezésével.

Győr. 2021. március 18.

Appendix 4

SZÜLŐI LEVÉL ÉS BELEEGYEZŐ NYILATKOZAT

Az iskola címe ……..Dátum

Tisztelt Szülő vagy Gondviselő!

Iskolai online felmérés: a ***„Kérdőív távoktatás bevezetése előtt és alatt végezett fizikai aktivitásról és jólétérzésről”***

Ezúton tájékoztatom, hogy iskolánkat kiválasztották egy olyan felmérésben való részvételre, melyet a Pécsi Tudomány Egyetem ETI Doktori Iskola végez
Az online kérdőív célja naprakész információkat gyűjteni a gyerekek és fiatalok távoktatás bevezetése előtt és alatt végezett fizikai aktivitásról és jólétérzésével kapcsolatban. A kérdőívet a diákok – a távoktatás okán – az online térben töltik majd ki, ez hozzávetőleg 15 percet vesz majd igénybe. A válaszok alapján sem egyének, sem egyes iskolák nem lesznek azonosíthatók, és a felmérés keretében nem gyűjtenek bizalmas adatokat.
Iskolánk elfogadta a felkérést a felmérésben való részvételre, mivel hiszünk abban, hogy annak eredményei diákjaink javát szolgálják majd. Ezért hálás lennék, ha Ön kitöltené a lenti beleegyezési nyilatkozatot, és azt kitöltve ……-ig visszaküldené iskolánkba.
Amennyiben bármilyen kérdése lenne, kérem, forduljon iskolánkhoz bizalommal!
Támogatását előre is köszönöm!
Tisztelettel:

Iskolaigazgató

Iskolai online felmérés: a ***„Kérdőív távoktatás bevezetése előtt és alatt végezett fizikai aktivitásról és jólétérzésről”***

Szülői beleegyező nyilatkozat

Engedélyezem, hogy gyermekem részt vegyen az Európai iskolai felmérés: IKT az oktatásban című kutatásban.

Gyermek neve:.....osztálya:…….

Szülő/Gondviselő aláírása:.....

Kelt: .....

Appendix 5

Tájékoztató és Beleegyező Nyilatkozat (online vizsgálat)

18. életévét betöltött személy részére

Ön egy tudományos kutatásban vesz részt, amelynek vezetője a ***„Kérdőív távoktatás bevezetése előtt és alatt végezett fizikai aktivitásról és jólétérzésről”*** elnevezésű dokumentumban nevesített személy.

Jelen vizsgálat célja a karantén előtti és alatti sportolási szokások összefüggéseinek vizsgálata. A kutatásban való részvétel teljesen önkéntes, az adatok feldolgozása névtelenül, statisztikai jelleggel történik, az eredmények kizárólag tudományos szempontokat szolgálnak.

A feladatok során lehetőség van annak megszakítására, hogy az ne legyen fárasztó. A vizsgálatot bármikor indoklás nélkül akár végleg is megszakíthatja, vagy a kérdések megválaszolását megtagadhatja. A vizsgálatban történt részvételért anyagi javadalmazás **nem jár**.
A vizsgálat során kérdésekre kell válaszolni. A kitöltés kb. 10-15 percet vesz igénybe.

A kutatás során kapott eredményekről később publikáció(k) jelenik (jelennek) meg, és tudományos konferenciákon kerülnek ismertetésre. Ezekről a kívánságnak megfelelően szóbeli vagy írásos tájékoztatást adunk.
A kutatásban az adatokat névtelenül gyűjtjük, és más személyes adatát sem rögzítjük.
Szigorúan bizalmasan kezelünk minden olyan információt, amit a kutatás keretén belül gyűjtünk össze. A kutatás során nyert adatokat kóddal ellátva biztonságos számítógépen őrizzük. Az egyéni kódot minden esetben a kutatásban résztvevő munkatárs adja, csak ő ismeri és ő fér hozzájuk. A kutatás során nyert adatokon statisztikai elemzéseket végzünk, amelyekből egyetlen résztvevő azonossága sem állapítható meg.

A vizsgálat eredményéről orvosi jellegű zárójelentés, laborlelet nem készül.

A továbblépéssel hozzájárul ahhoz, hogy a vizsgálat során az Önről felvett, személye azonosítására nem alkalmas adatokat kutatási célra felhasználjuk, illetve, hogy más kutatók számára is hozzáférhetők legyenek. Fenntartom a jogot arra, hogy a vizsgálat során annak folytatásától bármikor elállhassak. Ilyen esetben a rólam addig felvett adatokat törölni kell.

Kijelentem, hogy 18 éves elmúltam, a kutatásban való részvételem körülményeiről részletes tájékoztatást kaptam, a feltételekkel egyetértek, a részvételt vállalom.

☐ igen ☐ nem

Appendix 6

TOBORZÓ (online)

Kedves Tanulók!

Egy tudományos kutatás részesei lehettek.

A kutatás vezetője a ***Prof. Dr. Ihász Ferenc*** az PTE ETK Doktori Iskola egyetemi tanára munkatársaival ***a „Kérdőív távoktatás bevezetése előtt és alatt végzett fizikai aktivitásról és jólétérzésről”*** végez felmérést.

Jelen kutatás célja a távoktatás bevezetése előtt és alatt végzett fizikai aktivitásotokra és jólétérzésetekre irányul.

A vizsgálat online kérdőíves formában zajlik, kérdésekre kell válaszolnotok. A kapott eredményt rögtön megtudhatjátok és segítünk az értelmezésében.

A kutatásban való részvétel teljesen önkéntes és névtelen. A feladatok során lehetőség van annak megszakítására, hogy az ne legyen fárasztó. A vizsgálatot bármikor indoklás nélkül akár végleg is megszakítható. A vizsgálatban történt részvételért anyagi javadalmazás nem jár. A kitöltés kb. 5 percet vesz igénybe.

A felmérés adatait rögzítjük és abból tudományos cikkek és egyetemi szakdolgozat készül.

Az iskola főigazgatója írásban hozzájárult, szüleitek aláírásukkal igazolták, hogy engedélyezi a kutatásban való részvételeteket.

Köszönjük a segítségeteket!

Üdvözlettel: PTE ETK doktoranduszai

DOKTORI ÉRTEKEZÉS BENYÚJTÁSA ÉS NYILATKOZAT A DOLGOZAT EREDETISÉGÉRŐL

Alulírott

név: KATONA ZSOLT BÁLINT

születési név: KATONA ZSOLT BÁLINT

anyja neve: ZÁSZLÓS ILONA ANIKÓ

születési hely, idő: GYŐR, 1968.07.26.

The impact of the COVID -19 pandemic on the health behaviour of Hungarian secondary school students during the distance learning period című doktori értekezésemet a mai napon benyújtom a PÉCSI TUDOMÁNYEGYETEM EGÉSZSÉGTUDOMÁNYI DOKTORI ISKOLA 7. program / PR-7/ SPORT és EGÉSZSÉGTUDOMÁNY Programjához/ S-45 témacsoportjához

Témavezető neve: DR. IHÁSZ FERENC Társtémavezető neve: DR. GYÖMÖREI TAMÁS

Egyúttal nyilatkozom, hogy jelen eljárás során benyújtott doktori értekezésemet
- korábban más doktori iskolába (sem hazai, sem külföldi egyetemen) nem nyújtottam be,
- fokozatszerzési eljárásra jelentkezésemet két éven belül nem utasították el,
- az elmúlt két esztendőben nem volt sikertelen doktori eljárásom,
- öt éven belül doktori fokozatom visszavonására nem került sor,
- értekezésem önálló munka, más szellemi alkotását sajátomként nem mutattam be, az irodalmi hivatkozások egyértelműek és teljesek, az értekezés elkészítésénél hamis vagy hamisított adatokat nem használtam.

Továbbá nyilatkozom, hogy hozzájárulok a doktori értekezésem DOI azonosító igényléséhez.

Dátum: PÉCS, 2023.02.15.

……
doktorváromanyos aláírása

…… ……
témavezető aláírása társtémavezető aláírása

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DOKTORI ÉRTEKEZÉS BENYÚJTÁSA ÉS NYILATKOZAT A DOLGOZAT EREDETISÉGÉRŐL

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Dátum: PÉCS, 2023.02.15.

.....
doktorvárományos aláírása

.....
témavezető aláírása

.....
társtémavezető aláírása