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THE POST-COVID-19 PANDEMIC QUALITY OF LIFE: A STUDY OF SPORTS DEPARTMENT STUDENTS

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Purpose: This study aims to evaluate the relationship between the post-covid-19 pandemic quality of life (QoL), body composition and physical activity (PA), and to investigate the gender differences in this relationship among college students. The article presents the results of a study on the impact of physical activity and body composition on the quality of life after the COVID-19 pandemic, focusing on sports department students. The study aims to comprehensively understand this complex phenomenon and provide significant insights for the academic community and the broader society.
Design/methodology/approach: The experimental study included a group of 54 women (age 22 ± 1.63) and 89 men (age 22 ± 1.85). The study included an examination of body composition and BMI and two questionnaires on physical activity level and quality of life. Body composition and BMI analysis was performed using a SECA mBCA 515 (seca GmbH & Co. KG, Hamburg, Germany) with eight electrodes. The same group also completed the International Physical Activity Questionnaire Short Version (IPAQ-SF) and the World Health Organization Quality of Life Questionnaire (WHOQOL-BREF).
Findings: The primary findings of this study highlight notable gender disparities in Quality of Life (QoL), physical activity, and body composition among college students following a series of study interruptions and one year of remote learning due to Covid-19. The research revealed that young women exhibited relatively higher levels of physical activity during the pandemic, resulting in better performance on body composition tests compared to the men in the study.

Despite the adverse conditions brought about by the pandemic, including the closure of sports facilities and gyms, the authors did not observe any negative changes in women's body composition after 12 months. Conversely, significant and observable changes were noted in men's body composition. Furthermore, the women in the study reported relatively higher QoL levels compared to men in various aspects, including the physical, psychological, social relations, and environmental domains, following the Covid-19 pandemic. The findings of this research may provide valuable insights into the long-term effects of the pandemic on young individuals. It may also offer recommendations for universities, policymakers on how to support and enhance the quality of life for students as they navigate the unique challenges of a post-pandemic society.

Research limitations/implications: The main limitation of the included study is a relatively small research group. In future studies, it is also possible to refer to different culturally diverse groups. In this study, the research group was culturally homogeneous, which can also be considered as a research limitation.

Originality/value: The enhanced quality of life observed in women is likely attributed to their higher level of physical activity, a conclusion supported by research on body composition. Conducting gender-specific analyses of quality of life data, including studies related to COVID-19 and other specific investigations into sex differences, is of utmost importance. Having insights into these gender disparities in quality of life would serve as a crucial resource for comprehending the effects of a health crisis on both individuals and communities. It would also aid in the development of effective and equitable policies, public health initiatives, and targeted strategies necessary for achieving sustainable development. Undoubtedly, further extensive research in this area is needed to address this issue thoroughly.

Keywords: quality of life, covid-19 pandemic, physical activity, body composition, gender differences sustainability, public health management, sustainable development.

Category of the paper: Research paper.

1. Introduction

The issue of quality of life of people is highly significant. Quality of life is a multidimensional and very broad category. It is associated with symptoms, side effects, functioning in many spheres of life, and perception of one's own satisfaction and quality of life (Revicki et al., 2014). Cultural resilience, community viability and sustainability are also associated with quality of life (Beyer, 2022). Determinants of quality of life include health, nutrition, mental activity (including education) and physical activity, education and social environment (family, friends and acquaintances, as well as a social group of a similar age) (Babicz-Zielńska et al., 2021).

Results of some earlier studies indicate that decreased quality of life is often associated with the prevalence of psychosomatic and motor function disorders as well as with impaired social performance. Physical activity (PA) improves overall health and quality of life (Fitzgerald, Boland, 2018). In addition, PA is associated with several aspects of quality of life (QoL) (Lobo et al., 2018) and is considered an important factor in increasing QoL (Bize et al., 2007).

This relationship has been consistently reported in previous studies (Guedes et al., 2012; Rejeski, Mihalko, 2001), which showed that physically active individuals rated some of their quality of life domains higher than their physically inactive counterparts (Puciato et al., 2013; Chai et al. 2010; Omorou, 2013).

Physical activity, defined as any movement produced by skeletal muscles and requiring energy expenditure (WHO), plays an important role in human life. Recommended by the World Health Organization, the minimum time per week that adults should devote to physical activity is 150 minutes during moderate exercises or 75 minutes during intense exercises (Guthold et al., 2018). Regular physical activity is an important factor affecting the composition of the human body. Insufficient physical activity can lead to an increase in body weight, an increase in body fat, and a decrease in bone and muscle mass (Kostencka et al., 2016; Ratamess et al., 2009; Roubenoff, 2007), while a high level of physical activity reduces body weight and fat mass and decreases BMI (Štefan et al., 2017; Zaccagni, Barbieri, Gualdi-Russo, 2014). A reduction in body weight and body mass index is considered an indicator of improved health (Domaszewski et al., 2023; Roh et al., 2020), and a reduction in relative fat mass is directly related to a lower risk of cardiovascular disease (Janssen et al., 2004). Many studies have shown that visceral fat mass is even more strongly correlated with metabolic risk factors and health (Głuszek, 2020; Han, Richmond, Lean, 1997; Moon et al, 2020; Domaszewski et al, 2022). Other factors that may negatively affect physical well-being include smoking, alcohol consumption (Croezen et al., 2009), and psychological stress (Atlantis, Ball, 2008). Interestingly, psychologists warn that excessive concern about one's body and slim figure can lead to disorders such as anorexia, bulimia, bigorexia, or orthorexia (Svensson, Hallberg, 2011).

From an economic perspective, physical activity is primarily evaluated for its influence on quality of life, and as a result, on the health status of a specific segment of society. Conversely, the enhancement of this situation is linked to social development, which encompasses a series of profound transformations within a particular society, with the ultimate aim of fostering social well-being. Quality of life, as an interdisciplinary concept, extends beyond physical health and encompasses various dimensions, including mental health, autonomy, social connections, and the natural and spiritual environment, as defined by the World Health Organization (1997). Health and well-being are also part of Sustainable Development Goal No. 3 - to ensure a healthy life and well-being for everyone. However, this is not a hermetically sealed goal. Behaviors related to physical health are also accompanied by others, related to adequate amount of sleep (rest) and sensible diet, and therefore also with the goals of: No. 2. zero hunger; No. 3. clean water and sanitation, and No. 12. responsible consumption and production. The Good Health and Well-Being Goal includes the promotion and use of physical activity, particularly as part of Task 3.4. related to reducing premature mortality from non-communicable diseases by one-third by 2030 through prevention and promotion of well-being (United Nations).

Physical activity includes: sporting activity (exercise), communicative activity (movement to/from work and school), occupational activity (professional work), and non-occupational activity (homework and physical activities). It can be varied due to energy expenditure, intensity of sport activity, duration and body weight, ambient temperature, as well as health, gender, age, capabilities (skills and mobility) and physique (Domaszewski et al., 2023; Drygas et al., 2021). Physical activity has an impact on a person's psychophysical condition, and therefore on his life expectancy – one of the synthetic measures of health. Thus, it is associated with a reduction in expenditure on health care and, in quantitative and qualitative terms, on the group of people of working age and able to work. For example, an increased level of physical activity in free time is often the domain of people with a higher socio-economic status and is treated as an element supplementing the lack of movement in mental work (Puciato et al., 2013).

In developed and developing countries, physical activity is an important factor affecting the health of a citizen, and is part of a health promotion strategy. In addition, in order to prevent adverse lifestyle changes in society, leading to deterioration of health, an important element is the continuous monitoring of the level of physical activity, especially among young people (Haase, Steptoe, Sallis, Wardle, 2004). The aspect of energy expenditure for physical activity purposes in population surveys is measured using primarily the survey method (Stupnicki, Biernat, 2005).

Taking into account the obesity epidemic and the increase in the incidence of cardiovascular diseases, increasing energy expenditure as part of physical activity is one of the most important challenges of the modern world (Drygas et al., 2021). In Poland, there is a trend indicating that people with lower education and living in large agglomerations and smoking cigarettes are much less physically active and more exposed to civilization diseases. Restrictions related to COVID-19 have significantly reduced the level of physical activity of Poles (Zdrojewski et al., 2021), thus affecting the deterioration of health and increasing the risk of civilization diseases.

The aim of this study was to investigate the relationship between quality of life, body composition and physical activity level of post-pandemic sports students COVID-19 in relation to gender. The research hypothesis is that post-pandemic females had higher levels of physical activity and therefore exhibited higher quality of life. Knowledge of gender differences in the pandemic outbreak COVID-19 would be a fundamental tool to understand the impact of a health emergency on individuals and communities, and to implement effective and equitable policies, public health interventions, and targeted solutions. Moreover, knowledge about the mechanisms related to maintaining a relatively high quality of life despite potential lockdowns is crucial in preventing potential threats associated with physical, social, and psychological health challenges.

2. Literature review

The Covid-19 pandemic has undoubtedly contributed to the decline in people's quality of life. Scholars indicate that COVID-19 is expected to exert a significant influence on the functioning and well-being of survivors (Rooney et al., 2020; Simpson, Robinson, 2020). Nonetheless, because the SARS-CoV-2 pandemic has been relatively short-lived, there is only a restricted and fragmented pool of scientific data regarding the physical function and health-related quality of life repercussions of COVID-19 (de Oliveira et al., 2023).

It is interesting that women after recovery report more symptoms and a lower quality of life than men (Lindahl et al., 2022). In addition, due to the pandemic, negative changes in eating habits have been observed that directly and indirectly worsen the quality of life, both on a physical and mental level (García-de-Miguel et al., 2022). In addition, COVID-19 has also become a potent stressor with people experiencing fear and isolation over a long period of time, leading to an increased vulnerability to anxiety, depression, and acute stress that affect women more than men (Mauvais-Jarvis et al., 2020). Proof of this is the higher prevalence and severity of symptoms of anxiety, depression, and acute stress observed in females during the initial phase of the pandemic (Liu et al., 2020).

The COVID-19 pandemic has affected not only the quality of life of people affected by CONTRACTING COVID-19 but also that of people with other mental illnesses (Kvarstein et al., 2022). The emergence of COVID-19 has led to lifestyle changes in both ill and healthy people, popularization of home-based living, reduction in social interaction and physical activity (including popularization of a more sedentary lifestyle), and increased online activity.

The pandemic is also associated with changes in intimate life and the quality of sexual life (Mitchell et al., 2022). This was and is the case because of the severe restrictions put in place to eliminate COVID-19. These range from the promotion of physical activity to the planning and revitalization of residential areas and public spaces (Erfani, Bahrami, 2022) to burial practices (Long et al., 2022). The literature on this topic indicates that COVID -19 patients require multidisciplinary rehabilitation approaches to address persistent symptom profiles and restore quality of life prior to COVID-19 (Faghy et al., 2022; Rodríguez-Galán et al., 2022). During the pandemic COVID-19, the development of the e-economy, the improvement of air quality (in relation to the first months of the pandemic (Aboagye et al., 2021), and the increase of clinical competence were observed. In addition, SARS-CoV-2 had adverse effects on all aspects of quality of life, including sleep, mood, relationships and satisfaction with work, and productivity. The above effects were observed in different parts of the world. In particular, the stress aspect of contact work (contact with other people) has been highlighted as it occurs in health professionals (Abatia et al., 2022; Al Kandari et al., 2022), banks (Kim, 2022). The impact of COVD-19 blockade on the quality of life of the youngest - children - is mainly measured by analysing the observed increase in body mass index (BMI), the phenomenon of

obesity, and decreasing physical fitness (including performance). This has been observed in children in the United Kingdom (Basterfield et al., 2022) and in children and adolescents in Spain and Brazil (López-Gil et al., 2022), among others. Restrictions on the use of public spaces affected the frequency and duration of physical activity behaviours (physical activity, sedentary lifestyle, and sleep) and outdoor activity among children and adolescents. Those who implemented around-the-clock physical activity guidelines had higher quality of life than those who were less physically active (López-Gil et al., 2022). Teenagers spent more time in front of smartphones, computers, and televisions during the pandemic, which affected psychological aspects of quality of life more often in boys than girls (Cheung et al., 2022). Among students, the change in classes forced by the pandemic negatively affected life satisfaction, increases in depression, and feelings of anxiety and stress (Gómez-García et al., 2022).

However, international research by the team of Bachmann et al (2021) shows that life satisfaction in a COVID-19 environment is not identical, but varies according to geographical location. In Western Europe, it is negatively correlated with the prevalence of COVID-19, while in Southern and Western Europe it is slightly correlated. This is due to the stringency of policies, which is negatively correlated with life satisfaction in the West. Strict pandemic policies may alleviate the symptoms of a pandemic but also reduce perceptions of life satisfaction (Geirdal et al., 2021). In addition to lifestyle changes, pandemic vaccination itself has also been found to affect perceived quality of life (related to avoidance of health-promoting problems) (Lin et al., 2022). Similarly, with recreational areas - appreciation of the natural, scenic, and healing values of the landscape, the importance of which increased during the pandemic, affects people's perceived quality of life (Bernat et al., 2022).

Assessing the quality of life is a crucial aspect of studies involving COVID-19 survivors. Findings of de Oliveira et al. (2023) indicate a decline in the health-related quality of life among individuals who have survived COVID-19. Valent et al. (2020) have pointed out that COVID-19 patients may experience more frequent physical and psychological aftereffects due to restrictions on visitation and limitations on social interactions and rehabilitation support, all stemming from concerns about transmission risk. Additionally, Iqbal et al. (2021) have described how COVID-19 survivors often face discrimination and bias from their communities, driven by irrational fears that they remain contagious even after recovery. Consequently, it is imperative to dispel any misconceptions that perpetuate the notion of contagion in COVID-19 survivors post-recovery. This will not only help reduce stigma but also facilitate the swift reintegration of these individuals into society.

3. Material and Methods

3.1. Study Group

The experimental study involved a group of 54 women (age 22 ± 1,63) and 89 man (age 22 ± 1,85). The admission programme for the present experiment was preceded by an information and education campaign including a lecture on diet and healthy lifestyle. The study included an examination of body composition and BMI, as well as two questionnaires on the level of physical activity and quality of life. An analysis of body composition and BMI was performed using a SECA mBCA 515 (seca GmbH & Co. KG, Hamburg, Germany). The same group also completed the International Physical Activity Questionnaire Short Version (IPAQ-SF) as well as the World Health Organization Quality of Life (WHOQOL-BREF) Questionnaire.

All participants of the study signed an informed consent form. All tests were carried out in the physiological laboratory of the Opole University of Technology (Poland).

3.2. Data Collecting Tools

3.2.1. Body composition

An analysis of body composition and BMI was performed using a SECA mBCA 515 (seca GmbH & Co. KG, Hamburg, Germany) analyser with eight electrodes. All body composition measurements were taken in the morning, on an empty stomach.

3.2.2. Physical Activity (PA)

Participants assessed their habitual physical activity with the International Physical Activity Questionnaire Short Version (IPAQ-SF). The IPAQ-SF includes items assessing the frequency and duration of physical activity in three intensity domains: vigorous physical activity (VPA = 8.0 metabolic equivalents [METs]), moderate physical activity (MPA = 4.0 METs), and low physical activity (LPA = 3.3 METs) in a range of domains, including leisure, home and garden (yard), and work-related and transportation-related activities during a typical week of their lives. Based on the data collected on the frequency and duration of physical activity and estimated energy expenditure (EE) expressed in MET·min/week, respondents were classified into three groups according to their physical activity level: 1) High physical activity level (HPAL) - meeting one of the following criteria: 3 or more days of intense physical activity of at least EE 1,500 MET·min/week or 7 or more days of any combination of activities of three intensity ranges of at least EE 3,000 MET·min/week. 2) Moderate physical activity level (MPAL) – 3 or more days of intense activity of at least 20 minutes/day, 5 or more days of moderate- or low-intensity activity of at least 30 minutes/day, or 5 or more days of any combination of low-, moderate-intensity or intense activity of at least EE 600 MET·min/week. 3) Low physical activity level (LPAL) – no physical activity reported or some activity reported but not enough to meet at least the MPAL criteria (physical activity below 600 MET·min/week).

3.2.3. Quality of Life (QoL)

Quality of life was assessed using the World Health Organization Quality of Life (WHOQOL-BREF) instrument. The WHOQOL-BREF comprises 26 items: two measuring GQOL and perceived health condition (PHC), respectively, which were examined separately, and 24 measuring quality of life in four broad domains: PHYD (seven items), PSYD (six items), SD (three items), and ED (eight items). Particular facets incorporated within the domains included the following:

1. Physical domain PHYD: activities of daily living, dependence on medicinal substances and medical aids, energy and fatigue, mobility, pain and discomfort, sleep and rest, and work capacity.
2. Psychological domain PSYD: bodily image and appearance, negative feelings, positive feelings, self-esteem, spirituality/ religion/personal beliefs, thinking, learning, and memory and concentration.
3. Social relationships domain SD: personal relationships, social support, and sexual activity.
4. Environment domain ED: financial resources, freedom, physical safety and security, health and social care: accessibility and quality, home environment, opportunities for acquiring new information and skills, participation in and opportunities for recreation/leisure activities, physical environment (pollution/noise/traffic/climate), and transport. Each item was scored from 1 to 5. Higher scores denoted higher quality of life and better perception of health condition. For the first two items, the numerical scores were the basis for further analysis. The scores to the remaining 24 items were transformed on a special 4- to 20-point scale.

Quality of life (QoL) was assessed using the validated version of the WHOQOL-BREF The brief version of the WHOQOL-BREF contains 26 items, with each item representing one facet. The four main domains have the following facets: (1) physical health domain: to be free of any pain, sleep and rest, mobility, having energy, mobility, activities of daily living, to be free of dependence on medication and treatments, and work capacity; (2) psychological health domain: happiness and enjoyment of life, to be able to concentrate, feeling positive about yourself, bodily image and appearance, to be free of negative feelings, and religion/ spirituality/personal beliefs; (3) social relationships: sexual activity, personal relationships, and social support; (4) environment: feeling physical safety and security, home environment, financial resources, to be able to adequate health care, changes of getting new information and knowledge, participation in recreation/leisure, adequate transport and physical environment. All items on the WHOQOL-BREF are scored on a 5-point Likert Scale (The World Health Organization Quality of Life - WHOQOL).

3.3. Statistical Analysis

Evaluation of all dependent variables was subjected to factor sex (Male, Female) and 2 times (pre and post) mixed ANOVA with repeated measures of the last factor. When significant interactions were identified ($p < 0.05$), Tukey pairwise follow-up analyses were applied as post-hoc tests. The effect size was calculated as partial eta-squared η2p and was interpreted as follows: small = 0.01, medium = 0.06, large = 0.14. All tests were conducted with free and open software JAMOVI, Version 2.0. A Pearson's chi-square test of independence was performed to examine the association between SEX and Physical activity intervals. Pearson's chi-square test analysis was carried out in Statscloud software (https://statscloud.app/beta/).

4. Results

4.1. Body composition

Table 1 shows the body composition parameters in which there was a statistically significant difference between BASELINE and FOLLOW-UP. In the three parameters analyzed (VFM, RFM, BMI), there was a statistically significant interaction between the effect of SEX (between) and TIME (within). For the RFM parameter significant main effects were found for SEX, $F(1, 141) = 45.81$, $p < .001$, $ή^2_p = 0.135$ and TIME, $F(1, 141) = 12.96$, $p < .001$, $ή^2_p = 0.084$. There was also a significant interaction between TIME and SEX, $F(1, 141) = 6.03$, $p = .015$, $ή^2_p = 0.017$. In this study was a significant main effect for SEX for the RFM parameter, $F(1, 141) = 45.40$, $p < .001$, $ή^2_p = 0.134$. There was no significant main effect for TIME, $F(1, 141) = 1.56$, $p = .214$, $ή^2_p = 0.011$. There was a significant interaction between TIME and SEX, $F(1, 141) = 5.72$, $p = .018$, $ή^2_p = 0.016$. It was a significant main effect for SEX for the BMI parameter, $F(1, 141) = 67.90$, $p < .001$, $ή^2_p = 0.190$. There was no significant main effect for TIME $F(1, 141) = 3.03$, $p = .084$, $ή^2_p = 0.021$. There was a significant interaction between TIME and SEX, $F(1, 141) = 5.34$, $p = .022$, $ή^2_p = 0.015$.

Table 2 shows the descriptive statistics of the individual body composition parameters that were tested at the beginning of the experiment and afterwards.

Table 1.
Results of statistical significance of individual effects and interactions between effects, in selected body composition parameters

Factors	*F*	*p*		$ή^2_p$
VFM				
TIME	12.955	< .001		0.08
Gender	45.811	< .001		0.25
TIME * gender	6.028	0.015		0.04

Cont. table 1.

RFM				
TIME	1.561	0.214		0.01
Gender	45.399	< .001		0.24
TIME * gender	5.718	0.018		0.04
BMI				
Time	3.027	0.084		0.02
Gender	67.896	< .001		0.33
Time * gender	5.337	0.022		0.04

Table 2.
Changes in total soft tissue content in the male and female control group

	Male		**Female**	
	Baseline	**Follow-up**	**Baseline**	**Follow-up**
BMI (kg/m^2)	24.48 ± 2.87	24.67 ± 2.84	21.04 ± 2.17	20.91 ± 1.71
Relative fat mass (%)	14.76 ± 6.02	15.83 ± 6.06	22.02 ± 6.20	21.39 ± 4.99
Absolute fat mass (kg)	12.79 ± 7.21	13.93 ± 7.76	13.60 ± 5.11	12.95 ± 4.09
Fat-free mass (kg)	69.65± 8.63	70.11 ± 8.53	46.48 ± 3.55	46.69 ± 4.19
Skeletal muscle mass (kg)	34.91 ± 4.85	35.21 ± 4.76	21.47 ± 2.17	21.48 ± 2.31
Waist circumference (cm)	84.67 ± 8.28	86.25 ± 7.51	68.85 ± 11.34	69.09 ± 10,98
Weight (kg)	82.44 ± 14.15	84.04 ± 14.33	60.08 ± 7.53	59.64 ± 6.65
Visceral fat mass (l)	0.93 ± 0.89	1.10 ± 0.86	0.22 ± 0.20	0.23 ± 0.23

4.2. Physical activity and quality of life

When quality of life was analysed in relation to gender (Tab. 3), it was found that women had higher scores for the body domain (Mdn = 23.00) than the male group (Mdn = 21.00). A Mann-Whitney U test showed that this difference was statistically significant; U = 1682.00, p = .003, r = 0.25. In addition, the female group had higher psychology domain scores (Mdn = 24.00) than the male group (Mdn = 22.00). A Mann-Whitney U test showed that this difference was statistically significant; U = 1636.00, p = .001, r = 0.27. The analysis also showed that the female group had higher social relations domain scores (Mdn = 13.00) than the male group (Mdn = 10.00). A Mann-Whitney U test showed that this difference was statistically significant; U = 1767.00, p = .008, r = 0.22.

In addition, the female group had higher environmental domain scores (Mdn = 31.00) than the male group (Mdn = 28.00). A Mann-Whitney U test indicated that this difference was statistically significant; U = 1720.50, p = .004, r = 0.24.

Table 3.
Relation between quality of life and gender according to Mann-Whitney U results

Outcome	**Predictor**	**Group**	**Median**	**U**	***p***
Physical domain	Gender	F	23	1682	0.003
		M	21		
Psychological domain	Gender	F	24	1636	0.001
		M	22		
Social relationships domain	Gender	F	13	1767	0.008
		M	10		
Environment domain	Gender	F	31	1720.5	0.004
		M	28		

Repeated Measures ANOVA was conducted to examine the effects of gender and physical activity intervals on each quality of life domain, namely: Physical domain, Psychological domain, Social relationship domain, Environmental domain (Fig. 1).

When analysing the influence of gender and physical activity on the first domain, i.e. physical domain, there was a significant main effect for SEX, F(1, 137) = 6.97, p = .009, ω2p = 0.040. No significant main effect was found for physical activity intervals, F(2, 137) = 0.65, p = .524, $ή^2_p$ = -0.005. There was a significant interaction between SEX and physical activity intervals, F(2, 137) = 3.53, p = .032, $ή^2_p$ = 0.034 (Tab. 4).

However, when examining the effect of SEX and the physical activity intervals on the psychological domain, a significant main effect was found for the physical activity intervals, F(2, 137) = 4.61, p = .012, ω2p = 0.048. No significant main effect was found for SEX, F(1, 137) = 3.26, p = .073, ω2p = 0.016. There was no significant interaction between SEX and physical activity intervals, F(2, 137) = 1.08, p = .342, $ή^2_p$ = 0.001 (Tab. 4).

Though, when analysing the effects of SEX and the intervals of physical activity on the domain of social relations, a significant main effect was found for SEX, F(1, 137) = 7.96, p = .006, ω2p = 0.046. No significant main effect was found for physical activity intervals, F(2, 137) = 1.66, p = .195, ω2p = 0.009. There was no significant interaction between SEX and physical activity intervals, F(2, 137) = 2.78, p = .065, $ή^2_p$ = 0.024 (Tab. 4).

Finally, when examining the effects of SEX and the intervals of physical activity on the environmental domain, a significant main effect was found for SEX, F(1, 137) = 10.94, p = .001, ω2p = 0.065. No significant main effect was found for physical activity intervals, F(2, 137) = 2.38, p = .096, ω2p = 0.019. There was a significant interaction between SEX and physical activity intervals, F(2, 137) = 5.28, p = .006, $ή^2_p$ = 0.056 (Tab. 4).

Table 4.
Statistical significance values of the differences between the study groups in each parameter, analysed by ANOVA with repeated measures test

Dependent Variable	Factors	*F*	*p*	$ή^2_p$
Physical domain	Gender	6.975	0.009	0.05
	Physical activity intervals	0.648	0.524	0.01
	SEX * Physical activity intervals	3.531	0.032	0.05
Psychological domain	Gender	3.259	0.073	0.02
	Physical activity intervals	4.613	0.012	0.06
	SEX * Physical activity intervals	1.082	0.342	0.02
Social relationships domain	Gender	7.956	0.006	0.05
	Physical activity intervals	1.657	0.195	0.02
	SEX * Physical activity intervals	2.784	0.065	0.04
Environment domain	Gender	10.935	0.001	0.07
	Physical activity intervals	2.382	0.096	0.03
	SEX * Physical activity intervals	5.28	0.006	0.07

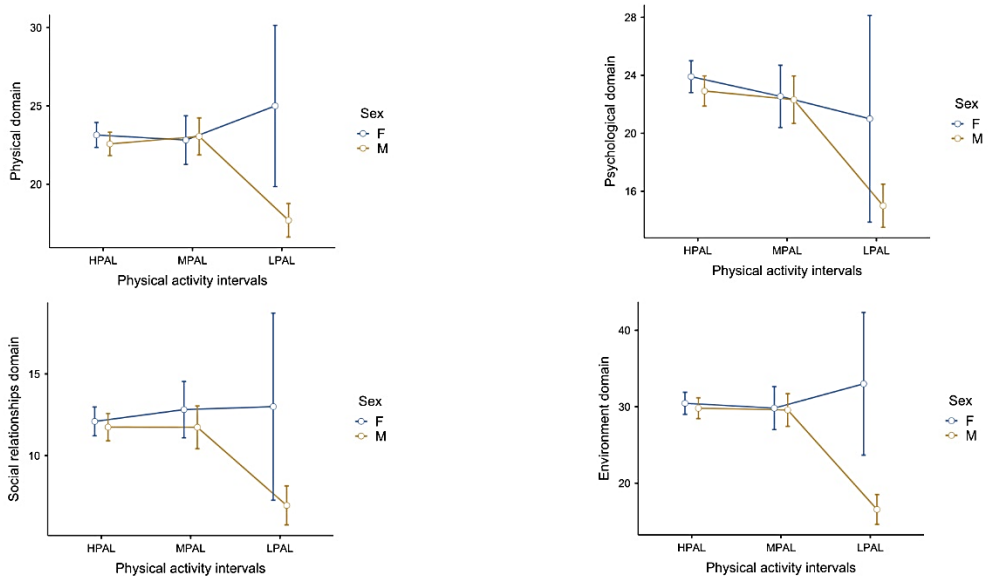

Figure 1. The effects of gender and physical activity intervals on individual areas of quality of life: Physical domain, Psychological domain, Social relationships domain, Environment domain.

5. Discussion

There is no doubt that the quality of life has decreased due to the pandemic COVID-19 (Ferreira et al., 2021) and it is extremely important to find a way to improve it. Currently, only data on gender indicators or patients admitted or deceased are available, but there are no analyses on other gender indicators (Ambrosino et al., 2020). Knowledge of gender differences in the onset of COVID-19 would be a fundamental tool to understand the impact of a health emergency on individuals and communities and to implement effective and equitable policies, public health interventions, and targeted solutions. Further studies evaluating sex-disaggregated data are needed to fill numerous knowledge gaps. Such data would improve our understanding of the complex interactions between these variables and their impact on disease severity and sex-specific outcomes (Lina Ya'qoub et al., 2021).

The main findings of our study suggest that after a series of lockdowns and a year of remote study significant gender differences among students in quality of life, physical activity and body composition were found.

The literature on this topic shows, as has also been observed in Europe and China (Gebhard et al., 2020; Liu et al., 2020; García-Fernández et al., 2021), that women exhibit more severe symptoms of anxiety, depression, and acute stress, suggesting an increased arousal response to stress in women (Bangasser, Wicks, 2017), supporting sex differences in stress response systems, including during COVID-19. The study by García-Fernández et al. 2021 shows that

women living alone exhibit higher levels of anxiety, which was not observed in men, supporting the existence of gender differences in response to COVID-19 and maybe related to women's predominant role as family caregivers and greater vulnerability to social isolation (Gebhard et al., 2020; Spagnolo et al., 2020).

Similarly, the experience of domestic violence during the pandemic period is associated with greater depressive symptomatology only among women. These findings provide valuable information and support gender differences in men's and women's concerns during COVID-19, which focus on economic and social impacts for men and family health and well-being for women (Van der et al., 2020).

On the other hand, there is a relationship between body composition and quality of life in the elderly. Jiao Zhang et al (2019) point out the association between BMI and health-related quality of life (HRQOL), especially for the population with obesity. This is confirmed by Zhu YB et al. (2009). Many studies have shown that the "obesity paradox", a "paradoxical" decrease in morbidity and mortality with increasing BMI, exists in the elderly or patients with chronic diseases (Curtis et al., 2005; Lavie et al., 2010; Lavie et al., 2014). Recent studies have extended the "obesity paradox" to HRQOL outcomes, suggesting that overweight and obesity may paradoxically correlate with higher HRQOL, termed the "obesity-HRQOL paradox" (Zhu et al., 2015; Tsai et al., 2004). There is some emerging evidence that the association between obesity and HRQOL is stronger in women than in men.

Nevertheless, these studies are largely concerned with older women. It turns out that in the case of young women, this relationship may be different. Our research showed that during the pandemic, young women were characterized by relatively higher physical activity, and therefore obtained better results in the body composition study than examined men.

Despite the adverse conditions resulting from the pandemic and isolation, the closure of sports facilities and gyms, the authors of the article did not observe negative changes in body composition in women after 12 months. In men, however, these changes were visible and statistically significant. Although BMI, free fat mass, waist circumference, and skeletal muscle mass changed only slightly, the increase in relative fat mass and visceral fat mass was significant. The changes indicate that the men gained more than 1 kilogramme of additional adipose tissue without any change in other components. In the men, the initial low fat mass may be the key factor in these changes and appears to correlate with the young age of the participants. Furthermore, this seems to translate into a relatively better quality of life in the young women studied compared to the men.

Studies show that body composition is related to quality of life. Normal BMI, relatively low body fat percentage, and high free fat mass are associated with metabolic health (Pickhardt, 2021). In our study, it was confirmed that studied women had relatively higher quality of life after pandemic COVID-19 compared to studied men. The analysis showed that women had higher scores than men in all domains of quality of life - physical domain, psychological

domain, social relations domain, as well as environmental domain. In each quality of life domain, the gender differences were statistically significant.

It seems that the higher quality of life in women is due to the higher physical activity of this group, which was also confirmed by studies on body composition. In our opinion, it is very important to perform a sex-specific analysis of quality of life data and COVID-19 as well as other specific studies to evaluate sex differences. Knowledge of gender differences in quality of life would be a fundamental tool to understand the impact of a health emergency on individuals and communities and to implement effective and equitable policies, public health interventions, and targeted solutions or appropriate strategies to achieve sustainable development. This issue undoubtedly requires further in-depth research in this area.

Understanding disparities between genders in terms of quality of life and physical activity can contribute to more effective future management of public healthcare. Public health management is instrumental in shaping and enhancing the quality of life for both individuals and communities. Its multifaceted role encompasses a comprehensive approach to elevate overall well-being and quality of life by preventing diseases, encouraging healthy lifestyles, ensuring healthcare accessibility, tackling environmental influences, and establishing support systems for individuals and communities. This way, the healthcare system can become more sustainable.

6. Conclusions

The main results of this study indicate that significant gender differences in body composition of the students were found after a series of suspensions and a year of distance learning. In this study, it was established that young women were characterized by relatively higher physical activity during the pandemic and therefore performed better in body composition testing than the men studied. Despite the unfavourable conditions resulting from the pandemic and isolation, closure of sports facilities and gyms, the authors of the article did not observe any negative changes in body composition in women after 12 months.

In men, however, these changes were visible and statistically significant. In our study, it was confirmed that the examined women had a relatively higher quality of life after the Covid-19 pandemic than the studied men. This has been confirmed in all areas of quality of life: physical area, psychological area, area of social relations, as well as environmental.

Having a deep understanding of gender disparities in quality of life is a crucial resource for comprehending how a health crisis affects individuals and communities. It also provides a solid foundation for enacting effective and fair policies, public health interventions, and tailored solutions or suitable strategies aimed at promoting sustainable development. Undoubtedly, further extensive research in this field is imperative. In future studies, it would be worthwhile

to consider the ethnic backgrounds of respondents and investigate whether it is associated with their approach to physical activity and their perception of quality of life.

As the authors of this study, we encourage further research on this topic and the implementation of support programs for students and the academic community that promote physical activity and a healthy lifestyle. This will enable to better prepare for future challenges and enhance overall quality of life after navigating through difficult periods, such as the COVID-19 pandemic.

Disclosure

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