sustainability

MDPI

Article

The Relationship between Physical Activity Level and Sociodemographic Factors in Romanian Adults in the Post-COVID-19 Pandemic Period

Elena Ioana Iconaru [1,†], Emilian Tarcau [2,*,†], Manuela Mihaela Ciucurel [3,†], Liviu Draghici [4,†] and Constantin Ciucurel [1,†]

[1] Department of Medical Assistance and Physical Therapy, University Center of Pitesti, National University for Science and Technology Politehnica Bucuresti, 110040 Pitești, Romania; ioana.iconaru@upit.ro (E.I.I.); constantin.ciucurel@upit.ro (C.C.)
[2] Department of Physical Education, Sport and Physical Therapy, University of Oradea, 410087 Oradea, Romania
[3] Department of Psychology, Communication Sciences and Social Assistance, University Center of Pitesti, National University for Science and Technology Politehnica Bucuresti, 110040 Pitești, Romania; manuela.ciucurel@upit.ro
[4] Department of General Surgery, Sf. Ioan Emergency Clinical Hospital, Carol Davila University of Medicine and Pharmacy, 050474 București, Romania; liviudraghici@hotmail.com
* Correspondence: emilian.tarcau@yahoo.com; Tel.: +40-770104471
† The authors contributed equally to the work.

Abstract: Background: This study examines how socio-demographic factors relate to post-pandemic physical activity patterns among Romanian adults. Methods: A cross-sectional study explores post-COVID-19 physical activity levels (PAL) and their correlation with socio-demographic factors in Romanian adults (n = 237, average age 28.23 ± 9.91 years). An online questionnaire covering constitutional, socio-demographic, and physical activity-related variables was administered for data collection. Data analysis involves descriptive and inferential statistics, including Kendall's tau correlation, along with multinomial regression analyses. Results: Noteworthy correlations emerged, including a robust association (r = 0.79, $p < 0.001$) between testing and history of clinical signs of COVID-19; a significant moderate correlation between health status and PAL compared to the period before the pandemic (τ = 0.56, $p < 0.001$); and significant moderate correlation between health status and current PAL (τ = −0.51, $p < 0.001$). Multinomial regression underscores an intricate relationship; testing for COVID-19 relates to clinical sign severity, health status changes influence post-pandemic PAL, and self-perceived health associates with current PAL ($p < 0.001$). Conclusions: Revealing significant links between PAL and socio-demographic factors among adults in Romania's post-pandemic landscape, this study emphasizes the interaction between health changes and activity involvement. It also highlights the potential to guide interventions for rehabilitation and healthier living.

Keywords: activity patterns; lifestyle; post-pandemic; sociodemographic characteristics; Romanian population

Citation: Iconaru, E.I.; Tarcau, E.; Ciucurel, M.M.; Draghici, L.; Ciucurel, C. The Relationship between Physical Activity Level and Sociodemographic Factors in Romanian Adults in the Post-COVID-19 Pandemic Period. *Sustainability* **2023**, *15*, 13488. https://doi.org/10.3390/su151813488

Academic Editor: Gianpiero Greco

Received: 11 August 2023
Revised: 3 September 2023
Accepted: 7 September 2023
Published: 8 September 2023

1. Introduction

The COVID-19 pandemic, declared by the World Health Organization on 2020, has had profound and widespread impacts on health, the environment, psychology, education, and the global economy [1]. This pandemic has affected humanity significantly, particularly vulnerable individuals. It resulted in reduced physical condition, quality of life, physical activity levels (PAL), healthcare access, health service quality, safe food availability, sleep quality, life satisfaction, vitamin D production, and healthy lifestyle. Additionally, there has been a rise in falls among the elderly, depression, loneliness, social injustice and inequality, bodily pain, coronaphobia, and the risk of secondary diseases [2].

Different authors reported that individuals who maintained or increased their PAL during the lockdown showed improved quality of life, highlighting the importance of promoting physical activity, especially in challenging situations like the pandemic [3]. The findings offer valuable guidance for shaping policies and interventions to promote physical activity engagement in challenging circumstances, like the pandemic, by underscoring its positive influence on quality of life [4]. This calls for the development of specific strategies, such as eHealth (electronic health)/mHealth (mobile health) approaches, to encourage individuals to stay physically active during such periods. Subsequent research should focus on identifying factors that predict changes in health behaviors compared to maintaining them following stressful life events, such as the pandemic and its associated restrictions [3].

One compelling argument for conducting our study is the potential to identify crucial insights that can inform public health policies and interventions. Understanding how socio-demographic factors influence PAL in the aftermath of the COVID-19 pandemic can help develop targeted strategies to improve overall population health and well-being [5]. Moreover, as the pandemic has introduced unique challenges and disruptions to daily life, investigating the impact on physical activity can provide valuable knowledge to guide individuals, communities, and policymakers in fostering healthier behaviors and resilience in times of crisis. By addressing this research question, we can contribute to a deeper understanding of the complex interplay between socio-demographic factors and physical activity, ultimately leading to evidence-based measures that promote healthier lifestyles and long-term post-pandemic rehabilitation.

Existing evidence indicates a general decline in physical activity due to the COVID-19 pandemic, but this impact may vary among different sub-populations. However, there is a lack of comprehensive understanding regarding the specific social and physical factors that can encourage physical activity while minimizing safety risks during pandemics [6]. In the context of the Romanian population, there is a need to explore these aspects further to bridge the existing knowledge gaps and better inform public health interventions.

As we shift our focus to the post-pandemic era, it is imperative to recognize the paramount importance of acknowledging the potential enduring implications stemming from diminished physical activity during lockdown periods. As restrictions ease, there may be a change in physical activity patterns, and it becomes essential to assess how the population's activity levels evolve. Understanding the factors influencing physical activity in the aftermath of the pandemic is vital for designing effective interventions to promote healthier lifestyles.

Moreover, considering the socio-demographic characteristics unique to the Romanian population, tailored strategies should be developed to address the specific challenges and opportunities for enhancing PAL. This could involve leveraging technology, such as eHealth/mHealth solutions, to reach and engage diverse age groups and socio-economic backgrounds effectively. Furthermore, considering the influence of pandemic-related psychological stressors, initiatives centered on mental health support and coping mechanisms might assume a pivotal role in fostering physical activity engagement.

Collaboration between public health authorities, researchers, and community organizations is essential in implementing sustainable initiatives aimed at revitalizing physical activity behaviors in the post-pandemic era. By utilizing data-driven approaches and considering the specific needs of the Romanian population, we can create a healthier and more resilient society with improved well-being and quality of life.

This study aimed to conduct a comprehensive cross-sectional, descriptive, and epidemiological investigation by administering an online survey to assess the PAL and explore the underlying socio-demographic factors among the adult population in Romania. The research seeks to contribute to the creation of valuable information resources essential for managing the uncertainties associated with a novel disease, such as the COVID-19 pandemic. Understanding the link between physical activity and socio-demographic characteristics in the post-pandemic period can provide valuable insights for public health

interventions and policy-making to promote a healthier lifestyle and well-being in the Romanian population.

As a research hypothesis, this study postulates that socio-demographic factors may be predictive of variations in individual physical activity levels. Additionally, the research hypothesizes that the experience of the COVID-19 pandemic might have led to changes in physical activity patterns, with potential implications for health outcomes.

2. Materials and Methods

2.1. Participants

This research was conducted on a cohort of adult participants (n = 237), with an average age of 28.23 $\pm$ 9.91 years, comprising 82 men and 155 women, falling within an age range of 18 to 49 years. Prior to data collection, we ensured that each participant provided online written informed consent, adhering to the ethical guidelines governing research involving human subjects. The study was granted approval by the Research Ethics Committee of the Research Center for Promoting Excellence in Professional Training, University of Pitesti, under reference number 168/6 February 2023.

The study was conducted on a sample of the Romanian adult population, with an initial recruitment of 310 volunteers who completed an online questionnaire. Among them, 237 individuals (a response rate of 90.9%) met the criteria for inclusion in the study, which required residing in Romania and providing complete responses on the questionnaire. Furthermore, as exclusion criteria, we considered the condition that subjects did not experience acute illnesses in the last week, given that our survey assesses physical activity over the past 7 days.

To ensure standardized testing, a group of students from University of Pitesti received training and were responsible for administering the test. Subsequently, each student selected 3-5 acquaintances (such as family members or friends) who also underwent the online survey procedure. The research aimed to focus exclusively on the adult population, including individuals aged between 18 and 49 years. By concentrating on this adult stage, the study pursued to gain a relevant perspective on the behavior, preferences, and specific needs of this age group, considering they are in a significant phase of life with responsibilities and meaningful experiences.

2.2. Data Acquisition

For online data collection, the PsyToolkit software (https://www.psytoolkit.org/) (accessed on 4 March 2023) was used [7,8]. The survey can be completed on a PC, laptop, tablet, or smartphone (with Android or iOS operating system) in approximately 10 min and includes three mandatory parts:

I. Introduction of the study title and purpose, along with obtention of online informed consent from the participants.

II. Socio-demographic data that include 18 variables. These variables cover the following aspects: age, weight (W), height (H), sex, level of education, professional status, type of residence, health status, level of anxiety related to one's health, history of chronic illnesses, occurrence of acute illness in the past week, testing for COVID-19, history of clinical signs of COVID-19, COVID-19 vaccination, smoking status, dietary habits, health status compared to the period before the pandemic, and level of physical activity compared to the period before the pandemic.

Within this section of the survey, there are 3 numerical continuous variables (age, weight, and height) and 15 nominal variables that were converted to numerical dummy values. The nominal variables in the study were obtained through close-ended questions, where respondents were asked to choose only one answer option for each question. To calculate the body mass index (BMI), we utilized the data from W (in kg) and H (in m) according to the following formula:

$$\mathrm{BMI} = \frac{\mathrm{W}}{\mathrm{H}^2}. \quad (1)$$

III. Physical Activity Questionnaire—The International Physical Activity Questionnaire—Short Form (IPAQ). The IPAQ short form is an instrument with reasonable to moderate validity, primarily designed for population surveillance of PAL among adults aged 15 to 69 years [9]. The IPAQ evaluates physical activity over the past seven days, covering four main domains: leisure, domestic and gardening (yard), work, and transport [10]. The IPAQ includes three specific types of physical activity: walking, moderate-intensity, and vigorous-intensity activities [11].

From the IPAQ, we gathered both categorical and continuous indicators of physical activity. The IPAQ scoring protocol allows us the calculation of IPAQ scores expressed in MET minutes/week as a continuous variable. This was achieved by assigning weights to each type of activity based on their energy requirements [12]. To compute the IPAQ scores, we summed up the duration (in minutes) and frequency (days) of the mentioned activities. The data collected using IPAQ as a self-report measure enabled us to classify individuals into three categories of PAL: 1 = low PAL, 2 = moderate PAL, and 3 = high PAL [13].

Completing the questionnaire allows for the assessment of an individual's PAL, offering an opportunity for self-reflection on health status, health behaviors, and the influence of the COVID-19 pandemic on these variables. After categorizing the participant into one of the three mentioned PAL categories, personalized feedback is provided regarding their status. Consequently, if the subject achieves a high level of physical activity, they are encouraged to sustain this positive behavior. Conversely, if the observed level of physical activity is low or moderate, the patient receives recommendations to enhance their engagement in physical activities.

2.3. Statistical Analysis of Data

The responses gathered from the survey were subjected to scientific analysis using the IBM SPSS 26.0 software (IBM Corp., Armonk, NY, USA) [14]. The data underwent descriptive statistical procedures, including calculations of mean, standard deviation, and frequency distribution. Additionally, inferential statistical methods, such as Kendall's tau correlation analysis, and multinomial regression analysis, were employed to derive further insights from the data.

3. Results and Discussion

The primary aim of our research was to identify potential associations and patterns between physical activity participation and socio-demographic variables, shedding light on the possible impact of the pandemic on activity behaviors. To achieve this, we conducted a comprehensive analysis of data collected from 237 participants. Before delving into the complex relationship between physical activity and socio-demographic factors, we provide an overview of the baseline descriptive statistical indicators for the study participants.

Table 1 presents a comprehensive overview of the essential characteristics pertaining to the study participants, focusing specifically on continuous numerical variables. The respondents' average age was 28.23 $\pm$ 9.91 years, and the age range encompassed individuals aged 19 to 49 years. The sample comprised 237 participants, consisting of 82 men and 155 women, resulting in a sex ratio of 0.53.

Table 1. Summary of the characteristics of study participants (n = 237), continuous variables.

Variable	Age (Years)	W (kg)	H (cm)	BMI (kg/m^2)	MET Minutes/Week
mean	28.23	69.79	170.42	23.99	7547.81
SD	9.91	13.78	9.07	4.18	7930.51

Note—W: weight; H: height; BMI: body mass index; MET: metabolic equivalents; SD: standard deviation; n: group size.

Based on the participants' BMI values, the study sample exhibited a diverse nutritional status. The majority (67.1%) fell within the normal weight range, indicating a significant proportion of individuals with a healthy weight. However, it is important to note that

32.9% of the participants were categorized as underweight (3.8%), pre-obese (17.3%), or displaying different degrees of obesity (obesity class I: 10.5% and obesity class II: 1.3%). These findings suggest the presence of various nutritional challenges within the sample, underscoring the need for further attention and potential interventions to address the distinct health requirements of these individuals.

The study participants' physical activity was quantified and expressed in MET minutes/week score. This metric serves as a robust measure to assess their weekly PAL. Upon analyzing the data, we found that the mean MET minutes/week score for the participants was 7547.81 ± 7930.51. This indicates a considerable variability in PAL among the study participants.

From Table 2, which summarizes the nominal variables collected through the questionnaire applied to the study participants, it can be observed that the majority of them (73.4%) were university graduates or students pursuing a master's or a PhD degree. Regarding professional status, 45.6% were employed or self-employed, 51.9% were unemployed students or householders, and a small proportion (1.3%) were retired. Most participants resided in urban areas (70%) compared to rural areas (30%). In terms of health status, 28.7% rated their health as excellent, while 15.7% reported fair or poor health. Approximately 53.6% experienced moderate health-related anxiety. The data show that 11.8% of participants reported a history of chronic illnesses, while none reported an occurrence of acute illness in the past week. The majority had not tested positive for COVID-19 (58.6%) and had not been diagnosed with the disease (53.2%). Vaccination rates were 19% for one dose, 38.8% for two doses, and 12.7% for three doses. The study also explored lifestyle factors, such as smoking status and dietary habits, as well as self-reported changes in health and PAL compared to the pre-pandemic period.

Table 2. Summary of the characteristics of study participants (n = 237), nominal variables.

Code	Variable	Answers	Frequency (n)	Percent (%)
Q1	sex	male	82	34.6
		female	155	65.4
Q2	level of education	secondary education graduate	24	10.1
		high school or vocational school student	39	16.5
		university graduate or student/master's/PhD candidate	174	73.4
Q3	professional status	employed/self-employed	108	45.6
		unemployed/householder	3	1.3
		unemployed student	123	51.9
		retired	3	1.3
Q4	type of residence	urban	166	70
		rural	71	30
Q5	health status	excellent	68	28.7
		very good	65	27.4
		good	67	28.3
		fair	30	12.7
		poor	7	3
Q6	level of anxiety related to one's health	not anxious at all (restless)	96	40.5
		moderately anxious (restless)	127	53.6
		very anxious (restless)	14	5.9

Table 2. *Cont.*

Code	Variable	Answers	Frequency (*n*)	Percent (%)
Q7	history of chronic illnesses	yes	28	11.8
		no	209	88.2
Q8	occurrence of acute illness in the past week	yes	0	0
		no	237	100
Q9	testing for COVID-19	I have tested positive multiple times, with an interval of more than one month	14	5.9
		I have tested positive only once	84	35.4
		I have never tested positive	139	58.6
Q10	history of clinical signs of COVID-19	I have had the illness at least once with severe clinical signs and/or hospitalization	14	5.9
		I have had the illness with moderate/mild clinical signs, once or multiple times	82	34.6
		I have tested positive, but I was asymptomatic	15	6.3
		I have not been diagnosed with COVID-19	126	53.2
Q11	COVID-19 vaccination	yes, with one dose of vaccine	45	19
		yes, with two doses of vaccine	92	38.8
		yes, with three doses of vaccine	30	12.7
		no	70	29.5
Q12	smoking status	yes	77	32.5
		no	160	67.5
Q13	dietary habits	omnivore (mixed diet, including meat and vegetarian options)	231	97.5
		lacto/ovo vegetarian (no meat, but includes dairy and/or eggs)	5	2.1
		vegan (strictly plant-based)	1	0.4
Q14	health status compared to the period before the pandemic	weaker, as I have experienced health issues following COVID-19	19	8
		weaker, but unrelated to COVID-19 illness	42	17.7
		the same	149	62.9
		better	27	11.4
Q15	PAL compared to the period before the pandemic	lower, as I have experienced health issues following COVID-19	6	2.5
		lower, but unrelated to COVID-19 illness	53	22.4
		the same	129	54.4
		higher	49	20.7
Q16	PAL	low	45	19
		moderate	47	19.8
		high	145	61.2

Note—PAL: physical activity level; *n*: group size; Low PAL: individuals not meeting criteria for higher categories; Moderate PAL: engaging in 3 or more days of vigorous-intensity activity for at least 20 min each day, or participating in 5 or more days of moderate-intensity activity and/or walking for at least 30 min each day, or combining these activities to achieve a minimum of 600 MET-minutes/week; High PAL: involves either engaging in vigorous-intensity activity on 3 or more days, totaling at least 1500 MET-minutes/week, or participating in a combination of walking, moderate-intensity, or vigorous-intensity activities for at least 3000 MET-minutes/week [9,11–13].

The data provided in Table 2 indicate also the distribution of PAL among the study participants. Out of the total respondents, 19% had a low PAL, 19.8% had a moderate PAL, and the majority, 61.2%, exhibited a high PAL. This distribution indicates that a substantial number of participants regularly engaged in physical activity, with most falling into the high PAL category. Understanding these fitness and behavioral patterns could offer valuable insights into the participants' overall health and well-being. Further analysis exploring the relationship between PAL and other variables could provide deeper understanding of the impact of physical activity on various aspects of health. These insights pave the way for robust inferential statistical analyses to uncover potential connections and patterns within the dataset.

Next, we conducted a correlational analysis to explore the interrelationships among the nominal variables in our dataset. To assess these associations, we utilized Kendall's tau correlation coefficient, a non-parametric measure well-suited for our data. Additionally, we calculated the statistical significance of the correlations to determine their meaningfulness. To aid in the identification of potential patterns and associations, we constructed a correlation matrix, which visually represents the relationships between key pairs of variables (see Table 3).

Table 3. Key correlations (Kendall's tau correlation coefficient, *r*) between recorded variables and level of statistical significance, *p* (*n* = 237).

Variable	Q1	Q5	Q6	Q7	Q9	Q10	Q11	Q14	Q15	
Q1	1									
Q5	0.21 *	1								
Q6	0.21 *	0.21 *	1							
Q7	−0.18 *	−0.23 *	−0.17 *	1						
Q9	−0.07	−0.18 *	−0.06	0.02	1					
Q10	−0.15 *	−0.20 *	−0.05	0.06	0.79 *	1				
Q11	0.04	−0.05	−0.04	0.07	0.07	0.07	1			
Q14	−0.18 *	−0.30 *	−0.23 *	0.16 *	0.23 *	0.20 *	0.21 *	1		
Q15	−0.10	−0.31 *	−0.23 *	0.18 *	0.15 *	0.13 *	0.11	0.56 *	1	
Q16	−0.10	−0.51 *	−0.15 *	0.11	0.29 *	0.25 *	0.02	0.16 *	0.24 *	1

Note: Q1: sex; Q5: health status; Q6: level of anxiety related to one's health; Q7: history of chronic illnesses; Q9: testing for COVID-19; Q10: history of clinical signs of COVID-19; Q11: COVID-19 vaccination; Q14: health status compared to the period before the pandemic; Q15: PAL compared to the period before the pandemic: Q16: PAL; * $p < 0.05$ was considered statistically significant (2-tailed); *n*: group size.

Moving forward with our analysis, we delve into the important correlations obtained from our dataset, with a particular focus on the most significant ones. This sheds light on how certain factors may influence others within the dataset. One highly significant correlation, with a coefficient τ of 0.79, was observed between the variables Q9 (testing for COVID-19) and Q10 (history of clinical signs of COVID-19). This result indicates a robust association between the frequency of positive COVID-19 tests and the severity of clinical signs experienced by the participants. Specifically, participants who reported multiple positive COVID-19 tests with intervals of more than one month tended to have a history of the illness with severe clinical signs and/or hospitalization. Conversely, those who tested positive only once or never tested positive generally had a history of mild or moderate clinical signs of the illness or were asymptomatic.

It is important to emphasize that this significant correlation does not imply causation, and other factors may also influence the relationship between the frequency of positive COVID-19 tests and the severity of clinical signs. Further in-depth analysis and investigations are warranted to gain a more comprehensive understanding of this association.

Moreover, our analysis revealed another notable finding—a significant correlation of 0.56 between Q14 (health status compared to the period before the pandemic) and Q15 (PAL compared to the period before the pandemic). This value suggests a moderate positive association between the participants' reported changes in health status and their PAL

after the pandemic. Specifically, participants who experienced a decline in health status following COVID-19 or due to other unrelated factors also tended to exhibit lower PAL levels at present, after the pandemic. This implies that changes in health status may be linked to changes in PAL in the post-pandemic period.

Lastly, we observed a moderate negative correlation (−0.51) between health status (Q5) and the current level of physical activity (PAL) (Q16). This indicates that participants with better health (higher values in Q5, e.g., "excellent" or "very good") tended to exhibit higher levels of physical activity (higher values in Q16, e.g., "high"). In essence, a healthier state is associated with increased levels of physical activity.

Apart from these significant correlations, other obtained Kendall nonparametric correlations were found to be weak. These results suggest a weak or negligible association between the respective variables, and no significant linear trends were observed in the analyzed data.

In summary, our analysis has offered valuable insights into the interconnectedness among different variables within our dataset. Certain correlations have exhibited robust associations, while others have displayed less substantial or insignificant links. These findings contribute to our understanding of the factors influencing different aspects of the participants' health and behavior, emphasizing the importance of further investigations to unveil the complex dynamics within the dataset.

Continuing with the statistical analysis, we performed a multinomial logistic regression to examine the associations between the nominal variables that showed significant Kendall correlations. The purpose of this regression was to assess the effects of these variables on the different categories of the dependent variable. By employing this regression technique, we aimed to gain valuable insights into the factors influencing the outcomes observed in our study. The results of the multinomial logistic regression are presented and discussed in the following sections.

The first multinomial logistic regression analysis was conducted to explore the relationship between variables Q9 (testing for COVID-19) and Q10 (history of clinical signs of COVID-19). In this analysis, the dependent variable was Q10, which represents the history of clinical signs of COVID-19, categorized into four levels. The independent variable in this analysis was Q9, representing the frequency of COVID-19 testing, categorized into three levels. The multinomial logistic regression allowed us the examination of how the frequency of positive COVID-19 tests (Q9) influenced the history of clinical signs of COVID-19 (Q10) experienced by the participants. The results of the regression analysis provided information on the odds ratios and significance levels for each level of the dependent variable (history of clinical signs of COVID-19) compared to the reference category "I have not been diagnosed with COVID-19".

By using the multinomial logistic regression, we aimed to understand whether there was a significant association between the frequency of positive COVID-19 tests and the severity of clinical signs experienced by the participants. This analysis helped us identify whether participants who tested positive more frequently were more likely to experience severe clinical signs and/or hospitalization compared to those who tested positive only once or never tested positive.

As a result, the likelihood ratio tests for the multinomial regression analysis indicated a statistically significant relationship between the predictor variable "COVID-19 testing" and the dependent variable "history of clinical signs of COVID-19" ($\chi^2 = 227.195$, df = 3, $p < 0.001$). These tests were performed to evaluate the overall model fit and demonstrated that the inclusion of the "COVID-19 testing" variable significantly improved the model's ability to explain the variability in the clinical signs of COVID-19 categories.

The results from the multinomial logistic regression analysis revealed a significant relationship between the frequency of COVID-19 testing (Q9) and the history of clinical signs of COVID-19 (Q10) categories (Table 4). As indicated by the negative coefficients for the "testing for COVID-19" variable in all three clinical sign categories, higher frequencies of positive COVID-19 tests were associated with an increased likelihood of experiencing

more severe clinical signs, both moderate/mild and severe, compared to the reference category "I have not been diagnosed with COVID-19". The odds ratios and corresponding 95% confidence intervals further confirmed these associations, highlighting the elevated risk of developing severe clinical signs and/or hospitalization among participants with more frequent positive test results.

Table 4. Results of multinomial logistic regression analysis for the relationship between the independent variable Q9 (testing for COVID-19) and the dependent variable Q10 (history of clinical signs of COVID-19)—parameter estimation (n = 237).

History of Clinical Signs of COVID-19 [a]		B	Std. Error	Wald	df	Sig.	Exp (B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
I have had the illness with moderate/mild clinical signs, once or multiple times	Intercept	17.579	3.085	32.481	1	0.001			
	Testing for COVID-19	−6.729	1.055	40.668	1	0.001	0.001	0.001	0.009
I have had the illness at least once with severe clinical signs and/or hospitalization	Intercept	15.616	3.240	23.225	1	0.001			
	Testing for COVID-19	−6.631	1,160	32.696	1	0.001	0.001	0.001	0.013
I have tested positive, but I was asymptomatic	Intercept	14.587	3.222	20.490	1	0.001			
	Testing for COVID-19	−6.099	1.134	28.914	1	0.001	0.002	0.001	0.021

[a] The reference category is: I have not been diagnosed with COVID-19.

Our findings prompt a broader contextual analysis informed by recent research. A significant study explored the interrelation between COVID-19 testing patterns and the gravity of clinical presentations, aligning with our own results. This investigation delved into the correlation between testing approaches and the severity of clinical indications, underscoring the importance of comprehensive testing strategies [15].

Other researchers have similarly examined the intricate interplay between testing methodologies and their practical implications. For instance, in a related study, it was observed that testing patterns hold valuable insights into the dynamics of COVID-19 diagnosis within an academic medical center [16]. The ongoing nature of the pandemic underscores the need for continuous assessment, as the researchers emphasized the importance of further analysis utilizing up-to-date data to corroborate existing findings and provide a robust basis for future testing guidelines. Notably, a significant proportion of subjects in their study underwent multiple rounds of testing, which resonates with our own findings and highlights the potential nuances and complexities that arise from repeated testing. This collective body of research contributes to a comprehensive understanding of COVID-19 testing strategies, emphasizing the importance of informed decision-making in healthcare settings. As the scientific community continues to navigate the evolving landscape of the pandemic and beyond, these insights remain instrumental in shaping effective testing protocols and enhancing diagnostic practices.

The intricate relationship revealed between COVID-19 testing frequency and clinical signs in our study aligns with recent findings underscoring the significance of comprehensive diagnostic approaches for SARS-CoV-2 [17]. Notably, the use of markers indicating viral load emerges as essential, offering substantial insights into disease prognosis and informing healthcare choices [18].

In the broader context of global testing efforts, it is worth noting that the lack of systematic testing across the world has posed challenges to the accuracy of epidemiological data, particularly during the initial stages of the outbreak [19]. Within this framework, the observation that individuals who received positive test results were more prone to indicate greater severity of symptoms compared to those who yielded negative outcomes [20] further accentuates the significance of comprehensive testing approaches. Additionally, the

relationship between test positivity and the vaccination status of subjects should also be taken into account due to potential immunological interferences that may occur [21,22].

Reflecting on the concluded pandemic, our study's insights cast light on the intricacies of COVID-19 testing patterns. The correlation unveiled between testing frequency and clinical outcomes offers a retrospective perspective that guides our understanding of the past. Moving forward, our results hold relevant significance in shaping future healthcare strategies. The observed prevalence of repeated testing underscores the need for adaptable testing frameworks, which will likely continue to play a pivotal role in managing potential health challenges [23]. This forward-thinking strategy aligns with a broader perspective on healthcare preparedness, highlighting the significance of versatile strategies that can be effectively employed across diverse medical scenarios, thus reimagining pandemic readiness to bolster global health and ensure our shared trajectory towards lasting well-being [24,25]. As we transition beyond the pandemic era, our findings contribute to evidence-based decision-making, fostering resilient testing protocols that are well-equipped to address forthcoming health dynamics.

The next multinomial regression analysis was between variables Q14 (health status compared to the period before the pandemic) and Q15 (PAL compared to the period before the pandemic). In this analysis, Q14 served as the independent variable, representing the perceived change in health status due to COVID-19, categorized into four levels. Q15 was the dependent variable, representing the change in PAL compared to the period before the pandemic, also categorized into four levels. The analysis aimed to investigate how changes in health status (Q14) were associated with variations in PAL (Q15), providing insights into how perceived health alterations might relate to shifts in physical activity patterns during the pandemic.

The outcomes of the likelihood ratio tests in the context of the multinomial regression analysis unveiled a notable statistical linkage between the independent variable "health status compared to the period before the pandemic" and the dependent variable "PAL compared to the pre-pandemic period" ($\chi^2 = 98.919$, df = 3, $p < 0.001$). These tests were executed with the intent to evaluate the holistic model suitability. It was evident from the results that the inclusion of the "health status compared to the period before the pandemic" variable substantially augmented the model's efficacy in comprehending the fluctuations in PAL relative to the period preceding the pandemic.

The results presented in Table 5 underscore a significant relationship between perceived changes in health status and variations in levels of physical activity (PAL) after the pandemic. More specifically, it is observed that individuals who report a lower health status due to COVID-19-related issues or unrelated causes are associated with a decreased likelihood of maintaining the same or higher levels of physical activity compared to the pre-pandemic period.

This finding suggests that changes in health status have a substantial impact on individual physical activity behavior in the post-pandemic period. Individuals who have experienced a decline in health status, either due to COVID-19 or other reasons, appear to be less likely to sustain previous or higher levels of physical activity compared to that in the pre-pandemic period. This association can be explained by the fact that changes in health status may influence the individuals' capacity and motivation to actively engage in physical activities, regardless of whether these changes are directly related to COVID-19 or not. Thus, this study highlights the importance of assessing health status in the context of its influence on physical activity and underscores the need for an integrated approach in promoting health and physical activity during periods of significant change, such as those generated by a pandemic.

Our study corresponds with the findings of numerous investigations that elucidate the pervasive adverse influence of COVID-19 on physical activity. In the context of COVID-19, physical inactivity can pose greater risks than the viral infection itself, with alarming health implications [26]. Notably, this is particularly relevant considering the established role of physical activity in both the mitigation and management of COVID-19 [27]. Together,

these findings emphasize the necessity of comprehensive approaches that consider health status, social factors, and physical environments in promoting physical activity amidst post-pandemic challenges [28,29].

Table 5. Results of multinomial logistic regression analysis for the relationship between the independent variable Q14 (health status compared to the period before the pandemic) and the dependent variable Q15 (PAL compared to the period before the pandemic)—parameter estimation (n = 237).

PAL Compared to the Period before the Pandemic [a]		B	Std. Error	Wald	df	Sig.	Exp (B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
Lower, as I have experienced health issues following COVID-19	Intercept	10.075	1.871	29.011	1	0.001			
	Health status compared to the period before the pandemic	−4.345	0.721	36.338	1	0.001	0.013	0.003	0.053
Lower, but unrelated to COVID-19 illness	Intercept	11.160	1.595	48.972	1	0.001			
	Health status compared to the period before the pandemic	−3.801	0.523	52.824	1	0.001	0.022	0.008	0.062
The same	Intercept	8.652	1.461	35.057	1	0.001			
	Health status compared to the period before the pandemic	−2.467	0.459	28.936	1	0.001	0.085	0.035	0.208

[a] The reference category is higher.

Given the well-documented positive effects of physical activity on both physical and mental health [30], our findings, in alignment with Wilson et al. [31], emphasize the importance of promoting and facilitating safe and regulated physical activity opportunities. Additionally, the transition of sports offerings to the digital realm, as explored by Parker et al. [32], offers a creative avenue to maintain engagement with physical activity, even in times of restrictions. Overall, the collective body of research underscores the necessity for adaptable strategies that encourage physical activity while navigating the evolving landscape of COVID-19 pandemic-related challenges. This is further accentuated by recognizing the concurrent pandemic of cardiovascular diseases, underscoring the urgency for holistic health approaches and acknowledging the detrimental effects of sedentary behavior [33,34].

In contrast to the transient decrease in exercise engagement during COVID-19 restrictions and subsequent return to pre-pandemic activity levels, as demonstrated in some studies [35,36], our investigation delves more deeply into the enduring repercussions of health status changes on post-pandemic physical activity behaviors. Moreover, some researchers have observed an alteration in physical activity patterns during periods of relaxation, with the decline in physical activity primarily arising from mobility constraints, while activities of moderate-to-vigorous intensity remain unaffected [37]. Our findings elucidate a more intricate interplay between health status and the continuity of physical activity. Specifically, our study unveils that individuals experiencing declines in health status, regardless of COVID-19, are less likely to maintain their previous or heightened levels of physical activity after the pandemic. This nuanced perspective extends the discourse regarding the repercussions of the pandemic on physical activity by highlighting the enduring impact of health-related factors, encompassing immune system dysfunction and deterioration in mental well-being [38]. In conclusion, our study contributes to the evolving understanding of post-COVID-19 physical activity patterns, underscoring the enduring role of health status transitions in shaping activity levels in the aftermath of the pandemic.

The final multinomial regression analysis examines the relationship between the variables "health status" (Q5) and the "current PAL" (Q16). In this analysis, the independent variable is "health status" (Q5), which represents individual self-perceived health status categorized into five levels. The dependent variable is the "current PAL" (Q16), which categorizes individual PAL into three categories: low, moderate, and high. The analysis aims to investigate how variations in individuals' self-reported health status (Q5) are associated with different PALs (Q16), providing insights into how perceived health status might relate to current physical activity patterns.

The outcomes of the likelihood ratio tests in the context of the multinomial regression analysis revealed a significant connection between the independent variable "health status" (Q6) and the dependent variable "PAL" (Q16) (χ^2 = 87.565, df = 2, $p < 0.001$). These tests were conducted with the aim of assessing the overall appropriateness of the model. The results indicated that the inclusion of the "health status" variable (Q6) substantially improved the model's effectiveness in understanding the variations in PAl (Q16). This statistical linkage suggests that changes in health status have a noteworthy influence on the shifts in individual physical activity patterns.

From Table 6, the coefficients associated with the variable "health status" (Q6) provide important insights into the relationship between individuals' self-perceived health status and their current PAL. The coefficients indicate the direction and strength of the effect that changes in health status have on the odds of being in different PAL categories.

Table 6. Results of multinomial logistic regression analysis for the relationship between the independent variable Q6 (health status) and the dependent variable Q16 (PAL)—parameter estimation (n = 237).

PAL [a]		B	Std. Error	Wald	df	Sig.	Exp (B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
Low	Intercept	−5.834	0.766	58.015	1	0.001			
	Health status	1.751	0.249	49.296	1	0.001	5.761	3.533	9.393
Moderate	Intercept	−3.204	0.498	41.333	1	0.001			
	Health status	0.915	0.191	23.066	1	0.001	2.497	1.719	3.628

[a] The reference category is: High.

The coefficient for "Health status" in the "Low" PAL category is 1.751 ($p < 0.001$), while in the "Moderate" PAL category, it is 0.915 ($p < 0.001$), both significant at a high level of statistical significance. These coefficients suggest that as individuals' self-perceived health status decreases, the odds of being in the "Low" or "Moderate" PAL categories increase compared to the reference category, which is the "High" PAL category. In other words, individuals reporting lower health status are more likely to have lower or moderate levels of physical activity compared to those with higher perceived health status. The lower coefficients for the "Moderate" PAL category also indicate that the impact of health status on activity levels is slightly weaker in this category compared to the "Low" PAL category.

Overall, the statistical linkage between health status and PAL underscores the importance of considering health-related factors when analyzing variations in PAL. These findings offer valuable insights into the complex interplay between health and physical activity behaviors, highlighting the need for tailored interventions and strategies to promote and sustain healthy levels of physical activity, particularly among individuals with lower health status.

It is intriguing to examine our findings in light of other research. Accordingly, conclusions from another study [39] underscore the intricate relationship between physical activity, physical fitness, and health status. Their findings highlight that equivalent levels of physical activity can yield varying effects on physical fitness or health status due to

contextual factors, content, and the purpose of the activity. Their study emphasizes that mere movement is not the sole determinant of fitness or health benefits. Consequently, these collective insights emphasize the critical need not only to grasp the connection between health status and PAL [40], as our study accomplishes, but also to recognize the multifaceted nuances of physical activity's influence on overall fitness and health. Ultimately, this intricate relationship manifests at the level of individuals' well-being, where those maintaining high activity levels are poised to experience elevated states of well-being [41].

By contextualizing our findings, we acknowledge the intricate interplay encompassing health status, physical activity patterns, fitness outcomes, and overall well-being [42]. Studies link insufficient physical activity to noncommunicable diseases, cognitive impairments, and reduced quality of life [43,44]. The reciprocal health–physical activity connection is clear: better health drives physical activity, and physical activity enhances biological states. The benefits of physical activity extend beyond physiology, encompassing quality of life, self-esteem, and systemic effects like endorphin release [45]. These insights support holistic, tailored approaches for promoting healthy activity, especially for those with compromised health [46]. Modern strategies to combat sedentary behavior are based on motivating patients to engage in regular activity, creating conducive environments, tracking disease incidence among active and inactive patients, and disseminating exemplary approaches [47]. These interventions hold particular relevance in the context of an aging population [48]. Furthermore, their importance is accentuated within the current global landscape as humanity navigates the post-COVID-19 pandemic transition [49].

A brief final mention should be made regarding certain correlations in Table 3, which are statistically significant but of weak intensity. Thus, our analysis revealed statistically significant but weak correlations (Kendall's tau of -0.23) between "the level of anxiety related to one's health" (Q6) and "health status compared to the period before the pandemic" (Q14) and "physical activity level compared to the period before the pandemic" (Q15). These results suggest that while there is a connection between anxiety and changes in health and physical activity, this link is not particularly strong. This implies that while anxiety could contribute somewhat to the pandemic's negative impact, it is only one factor among many others. Socio-economic status, coping strategies, social support, and personal resilience likely interact with anxiety to collectively shape participant experiences [50]. In essence, our findings underscore the complexity of these interactions. While neuroticism-related traits could play a role, a comprehensive understanding of the overall quality of life during and after the pandemic requires considering multiple contributing factors [51]. Further research could delve into these mechanisms for deeper insights.

While we did not specifically focus on athletes, our findings can be contextualized within the framework of research that examines the impact of the COVID-19 outbreak on the mental health of individuals engaged in various sports. This broader context aligns with the approach taken by some authors who emphasize the significant mental health challenges faced by athletes during the pandemic, driven by factors such as isolation and disrupted training [52]. Furthermore, it appears that psychological distress related to the COVID-19 pandemic, including concerns about both sports and careers, is more pronounced in team sports compared to individual sports [53]. These observations resonate with the focal points of our study, underscoring a potential avenue for future exploration.

In summary, our research emphasizes the intricate interplay between health status, patterns of physical activity, and sociodemographic variables, underlining the importance of tailored strategies to encourage healthier activity levels, particularly among individuals at risk due to sedentary behaviors. By exploring the complex connections among health-related variables, socio-demographic factors, and post-pandemic physical activity behaviors, this study provides new insights into the complex interdependencies within this multifaceted context. Through thorough analysis and interpretation of the collected data, this research expands the current understanding of the factors influencing physical activity behaviors, underscoring their significance in advancing post-pandemic public health strategies. The study's innovative perspectives not only contribute to scholarly

knowledge but also have practical implications for designing effective interventions to enhance physical activity engagement in the aftermath of the pandemic.

As with any study, certain limitations must be acknowledged. Despite the meticulous design and implementation of our research methodology, several constraints are worth noting. First, the study was conducted exclusively within the Romanian adult population, limiting the generalizability of the findings to other cultural or geographical contexts. Second, the data collection relied on self-report measures, which could introduce recall bias or social desirability effects, potentially affecting the accuracy of the reported physical activity behaviors. Third, the cross-sectional nature of the study design prevents us from establishing causal relationships between the examined variables. Furthermore, while efforts were made to ensure a diverse participant pool, there may still exist some degree of selection bias, as participants were recruited through acquaintances.

4. Conclusions

Our study delved into the intricate interplay between physical activity engagement and socio-demographic factors in the post-pandemic context among Romanian adults. The main findings underscore the essential role of health-related factors in shaping post-pandemic physical activity behaviors. The significant impact of health status changes, whether prompted by COVID-19 or other factors, on individual activity levels showcases the enduring interrelation between health transitions and participation in physical activity. These insights are further underscored by the multinomial regression outcomes, revealing the intricate interplay of COVID-19 testing frequencies and clinical sign severity, the influence of health status shifts on post-pandemic PAL, and the noteworthy link between self-perceived health status and current engagement in physical activity ($p < 0.001$). These important findings highlight the necessity for holistic strategies that integrate health considerations, aiding the formulation of evidence-based approaches to foster and maintain healthy engagement in physical activity.

To summarize, it is important to acknowledge the limitations of our study. These comprise a singular focus on the Romanian adult population, utilization of self-report measures, adoption of a cross-sectional design, and the potential for selection bias. Certain avenues for future research stemming from these limitations include expanding the study's scope to encompass diverse cultural and geographical contexts, employing more objective measures in addition to self-report data, adopting longitudinal designs to explore causal relationships, and employing randomized sampling methods to mitigate potential selection bias.

Author Contributions: Conceptualization, E.I.I., E.T., M.M.C., L.D. and C.C.; methodology, E.I.I., E.T., M.M.C., L.D. and C.C.; validation, E.I.I., E.T., M.M.C., L.D. and C.C.; formal analysis, E.I.I., E.T., M.M.C., L.D. and C.C.; resources, E.I.I., E.T., M.M.C., L.D. and C.C.; data curation, E.I.I., E.T., M.M.C., L.D. and C.C.; writing—original draft preparation, E.I.I., E.T., M.M.C., L.D. and C.C.; writing—review and editing, E.I.I., E.T., M.M.C., L.D. and C.C.; visualization, E.I.I., E.T., M.M.C., L.D. and C.C.; supervision, E.I.I., E.T., M.M.C., L.D. and C.C.; project administration, E.I.I., E.T., M.M.C., L.D. and C.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the Research Centre for Promoting Excellency in Professional Training, University of Pitesti (reference number 168/6 February 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data are available on request from the corresponding author. All data relevant to the study are included in the article.

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

References

1. Miyah, Y.; Benjelloun, M.; Lairini, S.; Lahrichi, A. COVID-19 Impact on Public Health, Environment, Human Psychology, Global Socioeconomy, and Education. *Sci. World J.* **2022**, *2022*, 5578284. [CrossRef]
2. Şevgin, O.; Alptekin, H.K.; Şevgin, K. The Weak Ring of the COVID-19 Pandemic: The Elderly (A Literature Review). *J. Geriatr. Med. Gerontol.* **2021**, *7*, 111. [CrossRef]
3. Niermann, C.; Bollenbach, L.; Kanning, M. Perceiving reduced physical activity during COVID-19 lockdown is related to lower quality of life: A cross-sectional study with young adults. *Ger. J. Exerc. Sport Res.* **2022**, *52*, 472–476. [CrossRef]
4. Symons, M.; Meira Cunha, C.; Poels, K.; Vandebosch, H.; Dens, N.; Alida Cutello, C. Physical Activity during the First Lockdown of the COVID-19 Pandemic: Investigating the Reliance on Digital Technologies, Perceived Benefits, Barriers and the Impact of Affect. *Int. J. Environ. Res. Public Health.* **2021**, *18*, 5555. [CrossRef] [PubMed]
5. Ciucurel, C.; Iconaru, E.I. An Epidemiological Study on the Prevalence of the Clinical Features of SARS-CoV-2 Infection in Romanian People. *Int. J. Environ. Res. Public Health* **2020**, *17*, 5082. [CrossRef] [PubMed]
6. Park, A.H.; Zhong, S.; Yang, H.; Jeong, J.; Lee, C. Impact of COVID-19 on physical activity: A rapid review. *J. Glob. Health* **2022**, *12*, 05003. [CrossRef] [PubMed]
7. Stoet, G. PsyToolkit—A software package for programming psychological experiments using Linux. *Behav. Res. Methods* **2010**, *42*, 1096–1104. [CrossRef]
8. Stoet, G. PsyToolkit: A novel web-based method for running online questionnaires and reaction-time experiments. *Teach. Psychol.* **2017**, *44*, 24–31. [CrossRef]
9. Craig, C.L.; Marshall, A.L.; Sjöström, M.; Bauman, A.E.; Booth, M.L.; Ainsworth, B.E.; Pratt, M.; Ekelund, U.; Yngve, A.; Sallis, J.F.; et al. International physical activity questionnaire: 12-country reliability and validity. *Med. Sci. Sports Exerc.* **2003**, *35*, 1381–1395. [CrossRef]
10. Ciucurel, C.; Iconaru, E.I. The Relationship between the Frontal QRS-T Angle on ECG and Physical Activity Level in Young Adults. *Int. J. Environ. Res. Public Health* **2023**, *20*, 2411. [CrossRef]
11. Manta, A.; Cojocaru, E.; Leon-Constantin, M.M.; Mastaleru, A.; Roca, M.; Rusu, C.; Cojocariu, S.A.; Mitu, F. IPAQ-L and CPET usefulness in a North-Eastern Romanian population undergoing cardiac rehabilitation. *Appl. Sci.* **2021**, *11*, 5483. [CrossRef]
12. Ainsworth, B.E.; Haskell, W.L.; Herrmann, S.D.; Meckes, N.; Bassett, D.R., Jr.; Tudor-Locke, C.; Greer, J.L.; Vezina, J.; Whitt-Glover, M.C.; Leon, A.S. 2011 Compendium of Physical Activities: A second update of codes and MET values. *Med. Sci. Sports Exerc.* **2011**, *43*, 1575–1581. [CrossRef]
13. International Physical Activity Questionnaire. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ)—Short and Long Forms. 2005. Available online: https://sites.google.com/view/ipaq/home (accessed on 7 February 2023).
14. IBM Corp. *IBM SPSS Statistics for Windows*; Version 26.0, Released 2019; IBM Corp.: Armonk, NY, USA, 2019.
15. Wohl, D.A.; Barzin, A.H.; Napravnik, S.; Davy-Mendez, T.; Smedberg, J.R.; Thompson, C.M.; Ruegsegger, L.; Gilleskie, M.; Weber, D.J.; Whinna, H.C.; et al. COVID-19 symptoms at time of testing and association with positivity among outpatients tested for SARS-CoV-2. *PLoS ONE* **2021**, *16*, e0260879. [CrossRef] [PubMed]
16. Salerno, S.; Zhao, Z.; Prabhu Sankar, S.; Salvatore, M.; Gu, T.; Fritsche, L.G.; Lee, S.; Lisabeth, L.D.; Valley, T.S.; Mukherjee, B. Patterns of repeated diagnostic testing for COVID-19 in relation to patient characteristics and outcomes. *J. Intern. Med.* **2021**, *289*, 726–737. [CrossRef]
17. Shafie, M.H.; Antony Dass, M.; Ahmad Shaberi, H.S.; Zafarina, Z. Screening and confirmation tests for SARS-CoV-2: Benefits and drawbacks. *Beni. Suef. Univ. J. Basic Appl. Sci.* **2023**, *12*, 6. [CrossRef]
18. Rabaan, A.A.; Tirupathi, R.; Sule, A.A.; Aldali, J.; Mutair, A.A.; Alhumaid, S.; Muzaheed; Gupta, N.; Koritala, T.; Adhikari, R.; et al. Viral Dynamics and Real-Time RT-PCR Ct Values Correlation with Disease Severity in COVID-19. *Diagnostics* **2021**, *11*, 1091. [CrossRef] [PubMed]
19. Šuljagić, V.; Đurić-Petković, D.; Lazić, S.; Mladenović, J.; Rakonjac, B.; Opačić, D.; Ljubenović, N.; Milojković, B.; Radojević, K.; Nenezić, I.; et al. Epidemiological Predictors of Positive SARS-CoV-2 Polymerase Chain Reaction Test in Three Cohorts: Hospitalized Patients, Healthcare Workers, and Military Population, Serbia, 2020. *Int. J. Environ. Res. Public Health* **2023**, *20*, 3601. [CrossRef]
20. Morlock, R.; Morlock, A.; Downen, M.; Shah, S.N. COVID-19 prevalence and predictors in United States adults during peak stay-at-home orders. *PLoS ONE* **2021**, *16*, e0245586. [CrossRef] [PubMed]
21. Zhao, Z.; Salerno, S.; Shi, X.; Lee, S.; Mukherjee, B.; Fritsche, L.G. Understanding the Patterns of Serological Testing for COVID-19 Pre- and Post-Vaccination Rollout in Michigan. *J. Clin. Med.* **2021**, *10*, 4341. [CrossRef] [PubMed]
22. Song, S.; Zang, S.; Gong, L.; Xu, C.; Lin, L.; Francis, M.R.; Hou, Z. Willingness and uptake of the COVID-19 testing and vaccination in urban China during the low-risk period: A cross-sectional study. *BMC Public Health* **2022**, *22*, 556. [CrossRef] [PubMed]
23. Goss, C.W.; Maricque, B.B.; Anwuri, V.V.; Cohen, R.E.; Donaldson, K.; Johnson, K.J.; Powderly, W.G.; Schechtman, K.B.; Schmidt, S.; Thompson, J.J.; et al. SARS-CoV-2 active infection prevalence and seroprevalence in the adult population of St. Louis County. *Ann. Epidemiol.* **2022**, *71*, 31–37. [CrossRef] [PubMed]
24. Lal, A.; Abdalla, S.M.; Chattu, V.K.; Erondu, N.A.; Lee, T.L.; Singh, S.; Abou-Taleb, H.; Vega Morales, J.; Phelan, A. Pandemic preparedness and response: Exploring the role of universal health coverage within the global health security architecture. *Lancet Glob. Health* **2022**, *10*, e1675–e1683. [CrossRef]

25. Coccia, M. Sources, diffusion and prediction in COVID-19 pandemic: Lessons learned to face next health emergency. *AIMS Public Health.* **2023**, *10*, 145–168. [CrossRef] [PubMed]
26. Segura-Ortí, E.; Martínez-Olmos, F.J.; Ródenas-Pascual, Á.; Guillem-Giménez, E.; Vercher-Narbona, V.; Piñón-Ruiz, M.J.; Garcia-Testal, A. Impact of COVID-19 Pandemic on Health-Related Quality of Life and Physical Activity of Patients in Hemodialysis. *Healthcare* **2022**, *10*, 2217. [CrossRef]
27. Yang, J.; Li, X.; He, T.; Ju, F.; Qiu, Y.; Tian, Z. Impact of Physical Activity on COVID-19. *Int. J. Environ. Res. Public Health* **2022**, *19*, 14108. [CrossRef] [PubMed]
28. Yang, X.; Lo, K. Environmental health research and the COVID-19 pandemic: A turning point towards sustainability. *Environ Res.* **2021**, *197*, 111157. [CrossRef]
29. Wunsch, K.; Kienberger, K.; Niessner, C. Changes in Physical Activity Patterns Due to the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. *Int. J. Environ. Res. Public Health* **2022**, *19*, 2250. [CrossRef]
30. Ciucurel, C.; Iconaru, E.I. The importance of sedentarism in the development of depression in elderly people. *Procedia Soc. Behav. Sci.* **2012**, *33*, 722–3726. [CrossRef]
31. Wilson, D.; Driller, M.; Johnston, B.; Gill, N. The effectiveness of a 17-week lifestyle intervention on health behaviors among airline pilots during COVID-19. *J. Sport Health Sci.* **2020**, *10*, 333–340. [CrossRef]
32. Parker, K.; Uddin, R.; Ridgers, N.D.; Brown, H.; Veitch, J.; Salmon, J.; Timperio, A.; Sahlqvist, S.; Cassar, S.; Toffoletti, K.; et al. The use of digital platforms for adults' and adolescents' physical activity during the COVID-19 pandemic (our life at home): Survey study. *J. Med. Internet Res.* **2021**, *23*, e23389. [CrossRef]
33. Vinciguerra, M.; Romiti, S.; Sangiorgi, G.M.; Rose, D.; Miraldi, F.; Greco, E. SARS-CoV-2 and Atherosclerosis: Should COVID-19 Be Recognized as a New Predisposing Cardiovascular Risk Factor? *J. Cardiovasc. Dev. Dis.* **2021**, *8*, 130. [CrossRef]
34. Wang, C.; Wang, J. Ethnolinguistic diversity and the spread of communicable diseases: A cross-country study on the COVID-19 pandemic. *Health Promot. Int.* **2022**, *37*, daac082. [CrossRef]
35. Schöttl, S.E.; Schnitzer, M.; Savoia, L.; Kopp, M. Physical Activity Behavior During and After COVID-19 Stay-at-Home Orders—A Longitudinal Study in the Austrian, German, and Italian Alps. *Front. Public Health* **2022**, *10*, 901763. [CrossRef]
36. Jago, R.; Salway, R.; House, D.; Walker, R.; Emm-Collison, L.; Sansum, K.; Breheny, K.; Reid, T.; Churchward, S.; Williams, J.G.; et al. Short and medium-term effects of the COVID-19 lockdowns on child and parent accelerometer-measured physical activity and sedentary time: A natural experiment. *Int. J. Behav. Nutr. Phys. Act.* **2023**, *20*, 42. [CrossRef]
37. Mason, M.R.; Hudgins, J.H.; Campbell, M.S.; Biddle, M.J.; Ickes, M.J.; Dugan, A.; Bollinger, L.M. Changes in physical activity during the initial stages of the COVID-19 pandemic. *J. Sports Sci.* **2022**, *40*, 116–124. [CrossRef] [PubMed]
38. Wafi, A.M.; Mosleh, A.A.; Mutaen, A.A.; Hakami, D.F.; Baeshen, R.A.; Rajhi, S.A.; Alamri, J.M.; Alqassim, A.Y. The Impact of COVID-19 on Maintaining Physical Activity and Its Associated Factors among Medical Students. *Int. J. Environ. Res. Public Health.* **2022**, *19*, 15752. [CrossRef]
39. Schmidt, S.C.E.; Tittlbach, S.; Bös, K.; Woll, A. Different Types of Physical Activity and Fitness and Health in Adults: An 18-Year Longitudinal Study. *Biomed. Res. Int.* **2017**, *2017*, 1785217. [CrossRef]
40. Kapoor, G.; Chauhan, P.; Singh, G.; Malhotra, N.; Chahal, A. Physical Activity for Health and Fitness: Past, Present and Future. *J. Lifestyle Med.* **2022**, *12*, 9–14. [CrossRef]
41. Rampisheh, Z.; Ramezani, M.; Khalili, N.; Massahikhaleghi, P.; Hoveidamanesh, S.; Darroudi, S.; SoleimanvandiAzar, N.; Tayefi, B. Physical Activity and Well-being Status among Employees of University of Medical Sciences. *Med. J. Islam. Repub Iran.* **2022**, *36*, 97. [CrossRef] [PubMed]
42. Roychowdhury, D. Using Physical Activity to Enhance Health Outcomes Across the Life Span. *J. Funct. Morphol. Kinesiol.* **2020**, *5*, 2. [CrossRef] [PubMed]
43. Park, J.H.; Moon, J.H.; Kim, H.J.; Kong, M.H.; Oh, Y.H. Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks. *Korean J. Fam. Med.* **2020**, *41*, 365–373. [CrossRef] [PubMed]
44. Alnofaiey, Y.H.; Atallah, H.M.; Alrawqi, M.K.; Alghamdi, H.; Almalki, M.G.; Almaleky, J.S.; Almalki, K.F. Correlation of Physical Activity to Mental Health State and Grade Point Average Among Medical Students in Saudi Arabia: A Cross-Sectional Study. *Cureus* **2023**, *15*, e40253. [CrossRef]
45. Anokye, N.K.; Trueman, P.; Green, C.; Pavey, T.G.; Taylor, R.S. Physical activity and health related quality of life. *BMC Public Health* **2012**, *12*, 624. [CrossRef]
46. Ball, K.; Carver, A.; Downing, K.; Jackson, M.; O'Rourke, K. Addressing the social determinants of inequities in physical activity and sedentary behaviours. *Health Promot Int.* **2015**, *30* (Suppl. S2), ii8–ii19. [CrossRef] [PubMed]
47. Tuso, P. Strategies to Increase Physical Activity. *Perm. J.* **2015**, *19*, 84–88. [CrossRef] [PubMed]
48. Ramalho, A.; Petrica, J. The Quiet Epidemic: An Overview of Emerging Qualitative Research Trends on Sedentary Behavior in Aging Populations. *Healthcare* **2023**, *11*, 2215. [CrossRef]
49. Hughes, D.C.; Orchard, J.W.; Partridge, E.M.; La Gerche, A.; Broderick, C. Return to exercise post-COVID-19 infection: A pragmatic approach in mid-2022. *J. Sci. Med. Sport* **2022**, *25*, 544–547. [CrossRef] [PubMed]
50. Kindred, R.; Bates, G.W. The Influence of the COVID-19 Pandemic on Social Anxiety: A Systematic Review. *Int. J. Environ. Res. Public Health* **2023**, *20*, 2362. [CrossRef]
51. Kroencke, L.; Geukes, K.; Utesch, T.; Kuper, N.; Back, M.D. Neuroticism and emotional risk during the COVID-19 pandemic. *J. Res. Pers.* **2020**, *89*, 104038. [CrossRef] [PubMed]

52. Shukla, A.; Dogra, D.K.; Bhattacharya, D.; Gulia, S.; Sharma, R. Impact of COVID-19 outbreak on the mental health in sports: A review. *Sport Sci. Health* **2023**, *20*, 1–15. [CrossRef]
53. Håkansson, A.; Moesch, K.; Kenttä, G. COVID-19-related impact on mental health and career uncertainty in student-athletes-Data from a cohort of 7025 athletes in an elite sport high school system in Sweden. *Front. Sports Act. Living* **2022**, *4*, 943402. [CrossRef] [PubMed]