Physical Activity before and during COVID-19 Pandemic and its Influence on Perceived Stress in University Students

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Abstract

Background: The Covid-19 pandemic is expected to negatively impact the physical activity and mental health of university students. Therefore, the aim of this study was to examine changes in physical activity since the beginning of the Covid-19 pandemic. As previous literature identified the positive influence of physical activity on the mental well-being, it was tested if there is a causal relationship among physical activity and perceived stress. Lastly, gender differences regarding physical activity and perceived stress were tested.

Methods: A web based cross-sectional design was used, to investigate physical activity (International Physical Activity Questionnaire- Short Form) and perceived stress (Perceived Stress Scale-10). To investigate the causal relationship between physical activity and perceived stress, a simple regression analysis was conducted. A repeated measures ANOVA was carried out to examine changes in physical activity. T-tests were carried out to identify gender differences in physical activity and perceived stress.

Results: Results of 217 participants showed that the amount of Metabolic Equivalent score (MET-score) of university students significantly decreased since the beginning of the Covid-19 pandemic ($p=0.001$). Physical activity during the Covid-19 pandemic significantly predicts the score of perceived stress among university students ($\beta 1 = -.245$). Female university students ($M= 18.87$) showed more perceived stress than male students ($M=14.44$). Male university students ($M=3032$) indicated higher MET-scores than female students ($M=2045$).

Conclusion: This study provides evidence that there is a negative effect of the Covid-19 pandemic on physical activity and that physical activity can reduce perceived stress of university students.

Keywords: physical activity, perceived stress, university students, Covid-19 pandemic, gender differences

Contents

Physical Activity before and during Covid-19 Pandemic and its Influence on Perceived Stress

The ongoing pandemic caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) affects the general population and many different areas of the daily life. According to the World Health Organization (WHO, 2020), SARS-CoV-2 causes the infectious coronavirus disease (Covid-19). The SARS-CoV-2 was initially observed in Wuhan, China at the end of 2019 and within a month the Covid-19 was also detected in Europe (Nadeau et al., 2021). The Covid-19 pandemic causes various symptoms when infected. The key symptoms associated with the Covid-19 are fever, shortness of breath, dry cough, fatigue and body aches. In some cases, people also experience headache, abdominal pain, diarrhea and sore throat. The symptoms appear usually 2-14 days after exposure with the virus (Desai & Patel, 2020). Depending on the age and general health conditions, individuals can experience mild, moderate or severe forms of the disease. Elderly people and individuals with coexisting medical conditions, such a hypertension, diabetes, chronic respiratory disease or cardiovascular disorders, show a higher likelihood to develop severe forms of the Covid-19 (Pascarella et al., 2020; Stein, 2020). It is also possible, that people infected with the Covid-19 do not show any symptoms at all. A recent systematic review determined that 17% of people infected with the Covid-19 were asymptomatic cases (Byambasuren et al., 2020). In other words, despite being asymptomatic, these people were carrying the Covid-19 and were spreading the virus, without having knowledge about it. Currently, there were over 117 million cases of Covid-19 and over 93 million people had recovered from the disease, while the number of deaths worldwide due to the virus reached 2.6 million (Elflein, 2021). Therefore, many countries implemented restrictions in order to prevent the spread of the Covid-19, such as travel restrictions, social distancing, self-isolation or quarantine (Meier et al., 2020). In addition, the closing of educational institutions, shops, gyms, and other places were introduced.

Impact of Covid-19 on Mental Health

The administration of quarantine measures to control the pandemic, the uncertainty about the Covid-19 pandemic and high deaths rates, are expected to have a negative influence on the general mental health of individuals globally. To be able to put the consequences of the Covid-19 pandemic into the context of mental health, it is necessary to understand what mental health is. According to the WHO (2021) “mental health is a state of well-being in

which the individual can fully function and cope with daily stresses of life and can productively contribute to the community." It is important to mention that mental health is not solely explained by the absence of psychopathological symptoms, in contrast, it means that the presence of psychological and social wellbeing is crucial for complete mental health (Arslan & Allen, 2020). Wang et al. (2020), performed a longitudinal study on the mental health of the Chinese population during the Covid-19. Their study emphasizes that the pandemic is associated with poor self-rated health status, higher levels of stress, depression and anxiety. Several studies showed that individuals developed a series of undesirable emotions, such as anger, fear of being infected and also behavioral problems, including an increase in alcohol consumption and smoking, social isolation and social anxiety (Dong & Bouey, 2020; Shigemura et al., 2020; Wang et al., 2020). The recent literature review on the psychological effects of Covid-19, conducted by Xiong et al. (2020) highlighted that the Covid-19 pandemic is highly associated with high rates of depression, post-traumatic stress disorder, overall psychological distress, and stress among the general population in eight countries (China, Spain, Italy, Iran, the US, Turkey, Nepal, and Denmark). According to the studies assessing the prevalence of depressive symptoms, the rate ranged from 14.6% to 48.3% (Ozamiz-Etxebarria et al., 2020; Sønderskov et al., 2020). Recent studies addressing depressive symptoms during Covid-19 pandemic identified many predictive factors leading to higher levels of depressive symptoms. Especially females were reported to develop generally more depressive symptoms than men (Lei et al., 2020; Sønderskov et al., 2020; Ustun, 2020). A further determinant of greater depressive symptom was the age. Participants aged under 40 years showed more depressive symptoms (Ozamiz-Etxebarria et al., 2020; Ustun, 2020). Furthermore, some studies identified that lower educational level also predicts greater depressive symptoms (Gao et al., 2020; Wang et al., 2020). In addition to that, several studies found out that student status is also a predictive factor for depressive symptoms, due to changes in the educational system (Lei et al., 2020; Olagoke et al., 2020; Ustun, 2020).

Despite depressive symptoms, the Covid-19 pandemic also affects the experience of anxiety symptoms. According to a new investigation on comparison of prevalence and the associated factors of anxiety and depression, individuals who needed to be quarantined showed generally higher levels of anxiety, due to concerns about being infected, economical losses and worries about the one's family (Lei et al., 2020). Likewise, individuals without being in quarantine, showed anxiety symptoms, which were attributed to social media exposure and frequent exposure to information concerning Covid-19 (Gao et al., 2020).

Symptoms of post-traumatic stress disorder (PTSD) and psychological distress can

also be observed during the recent pandemic. The PTSD is a psychiatric disorder which follows overwhelming stressful events, such as a natural disaster, personal traumatic experiences or in this case it can also refer to the Covid-19 pandemic (Cameron & Gusman, 2003). The term 'stress' is usually used to describe experiences that are emotionally or physiologically challenging (Stults-Kolehmainen & Sinha, 2014). Underlying reasons for stress can be acute, such as hassles, or chronic (e.g., suffering a traumatic injury that leads to physical disability), traumatic (e.g., accident) or small in magnitude (Sandi, 2004). According to Liu et al. (2020), high numbers of infections, the lack of information and high levels of uncertainty, as well as the shortage of medical workers and high rates of death resulted in greater levels of anxiety and stress among the general population and therefore can be perceived as stressors. In particular, the Covid-19 pandemic can be perceived as a long-lasting stressor for many people. It was found that the prevalence of PTSD a month after the Covid-19 peak, was around 7% and previous to Covid-19 the prevalence was around 3.7% (Liu et al., 2020).

Psychological stress is associated with a variety of physical and mental illnesses. In terms of the development of acute or chronic illnesses, stress can be a contributing factor. It has been strongly associated with several coronary heart diseases, cardiovascular diseases and even in alterations in the immune system (Rozanski et al., 1999; Segerstrom & Miller, 2006). As mentioned, besides physiological effects, stress has an adverse impact on mental health as well. Chronis stress is associated with dementia and emotional exhaustion (Sandi, 2004). A substantial number of studies established the negative consequences of stressful events on fatigue (Kizhakkeveettil et al., 2017) and depression (Bergdahl & Bergdahl, 2002; Kwag, 2011; Lee et al., 2013). A prior study found out that individuals experiencing high levels of work-related stress show a twofold risk of developing major depression disorder and generalized anxiety disorder compared to individuals who reported low stress (Melchior et al., 2007). Apart from that, stress symptoms also include sleep disturbances, irritability and concentration problems (Bergdahl & Bergdahl, 2002). Pruncho and Meeks (2004) also found out that the perception of stress is likely to trigger negative affect which is an important factor in the development of psychological distress. Based on the previous studies, thus, it is expected that higher levels of stress are associated with mental health problems.

Impact of Covid- 19 on Physical Activity

Furthermore, being in quarantine lead to less physical activity which has an adverse effect on individuals' health (Maugeri et al., 2020). According to Booth et al. (2011) and

Miles (2007) physical inactivity leads to deterioration of many body functions, such as obesity, muscle atrophy, bone loss and decreased aerobic capacity. Physical activity can be defined as 'any bodily movement produced by skeletal muscle that results in energy expenditure' (Sirard & Pate, 2001). Hereby it is possible to differentiate between different levels of physical activity, namely mild, moderate and vigorous (Romeo et al., 2010). Activities, such as going for a walk, dancing, playing football, cycling and home workouts can be included under the term physical activity. To maintain mental health during the pandemic, physical activity may help individuals to develop self-care behaviour or even be a coping behaviour itself. According to a recent data analysis concerning coping behaviours during the pandemic, individuals try out new hobbies, talk more frequently to their loved ones, engage in self-reflecting activities, such as meditation and carry out more often sports (Rettie & Daniels, 2020). The WHO (2020) indicated that 30 minutes of moderate to intense physical activity per day, can already reduce the burden of various diseases, such as cardiovascular diseases, diabetes, and various types of cancer (including breast cancer and colon cancer), as well as depression. Concerning the Covid-19 pandemic, physical activity may counteract the burden (or consequences) of the pandemic. Literature has generously described the beneficial impact of physical activity on the physiological and psychological wellbeing. As specified by Miles (2007), physical activity has several physiological effects. It is proven that regular physical activity is associated with reduced resting blood pressure, with favourable changes to the immune system (Miles, 2007; Romeo et al., 2010) and with reduced risk of type 2 diabetes (Hardman & Stensel, 2009). Moreover, growing evidence has confirmed that physical activity lowers the risk for cardiovascular diseases, such as coronary heart diseases, hypertension and also stroke (Ahmed et al., 2012; Ignarro et al., 2007).

Besides physiological benefits, physical activity has a positive effect on the mental health of individuals. Physical activity can be used as means to improve self-esteem and mood (Miles, 2007). Individuals with high self-esteem are more likely to be emotional stable and have effective coping styles. Furthermore, they have higher levels of perceived social support from friends and family and experience less stress and loneliness, which are helpful mechanisms during the Covid-19 pandemic (Cekin, 2015). Regular exercise also leads to lower levels of depressive and anxiety symptoms. Furthermore, it operates as a regulator against stress (Saxena et al., 2005). Individuals who reported regular exercise were less likely to be diagnosed with major depression and anxiety disorders (including panic attacks) (Saxena et al., 2009). For this reason, research indicated that physical activity is an effective method to counteract the effects of depression and anxiety (Camacho et al., 1991).

Existing literature largely describes the existence of the relationships between stress and physical activity as well. It is still debatable in which way the two variables influence each other, hence studies focusing on stress and physical activity are frequently ambivalent (Stults-Kolehmainen & Sinha, 2014). On the one side, there is evidence that stress has a negative influence on physical activity. It is proposed that stress is a predictor for negative health behaviours, such as increased smoking. It is assumed that individuals are more likely to resort to unhealthy behaviors instead of exercising in stressful periods (Tucker et al., 2012). There is also evidence for the reverse direction of causality, in that physical activity is associated with less stress. Studies assume that physical activity is used as a channel to overcome daily stressors, and by this to reduce the psychological stress (Heaney et al., 2014; Schultchen et al., 2019). Therefore, it is concluded that physical activity could be a helpful coping behavior during the Covid-19 pandemic.

Impact of Covid-19 Pandemic on University Students

As already mentioned, several studies determined that student status is a predictive factor for lower mental health as well, due to many changes and challenges in their daily life. In the first place, students were confronted with Covid-19 measures implemented by the government and by their educational institution, which led to drastic changes (Van De Velde et al., 2021). On-site classes were shifted into online classes, thesis planning needed to be adjusted, and the examination and evaluation forms changed, since most of the exams needed to be performed online (Sahu, 2020). Apart from that, students experienced a standstill in their social life. Many students preferred previously to Covid-19 to study at the university, meet friends there and take part in social activities. Due to the Covid-19 regulations this was not possible anymore (Van de Velde et al., 2021). Students had to adapt to the new regulations and drastically change their social life. In addition, students were also affected by the economic consequences of Covid-19. The vast majority of students lost their jobs, on which they relied and needed to finance their studies or accommodation (Sundarasen et al., 2020). Further challenges were travel restrictions, especially for international students. Some international students were alone and far away from their families, and by this had less social contact and support. Other international students had to leave the country while they were currently studying (Sahu, 2020).

Impact on University Students' Mental Health and Physical Activity

All the mentioned modifications due to the Covid-19 pandemic have a negative impact on the mental wellbeing of students. Cao et al. (2020) evaluated the mental situation of college student during the pandemic in China. Their findings showed that 25% of the respondents experienced some levels of anxiety. Mild anxiety symptoms were experienced by almost 21.3% of the students and 0.9% of the students experienced severe anxiety. Moreover, they found out that the economic situation and delays in academic activities of students were positively associated with anxiety symptoms. Cao et al. (2020) also indicated that students living away from their parents showed an increased risk of suffering from anxiety and stress. There is also some indication that female students are more likely to be affected by mental health problems as a result of the Covid-19 pandemic (Wang et al., 2020). The implemented restrictions also lead to drastic decrease in the amount of physical activity of university students. Xiang et al. (2020) indicated an increase of physically inactive students from 21.3% to 65.5% during the Covid-19 pandemic. Comparable results showed the sample of Füzéki et al. (2021). Hereby, the percentage of university students meeting the WHO recommendation decreased from 34.9% to 24.6% during the lockdown period. Therefore, it can be assumed that the implemented measures resulted in changes in physical activity.

Thus, the purpose of the present study is to investigate changes in physical activity since the beginning of the Covid-19 pandemic. Additionally, the study will examine the relationship between physical activity and perceived stress in university students and determine the potential beneficial effects of physical activity patterns during Covid-19 pandemic. Further attention will be drawn to possible gender differences regarding physical activity and perceived stress. In summary, the variables of interest will be perceived stress of university students and their physical activity before and during Covid-19. Therefore, following hypotheses (H) were formulated:

H_1: There is a significant reduction in physical activity of university students as a result of the Covid-19 pandemic.

H_2: Physical activity significantly predicts perceived stress in university students.

H_3: There is a significant difference between female and male students in terms of their physical activity before and during Covid-19 pandemic.

H_4: There is a significant difference in the level of perceived stress between female and male university students.

Method

Design

A cross-sectional design was chosen to collect data for this research project. This study investigated four variables of interest. The independent variable in this research was 'gender'. The dependent variable was 'perceived stress'. Other variables which were explored in this research were 'physical activity before Covid-19' and 'physical activity during Covid-19', and depending on the analysis were either independent or the dependent variable.

Participants

The target group consisted of university students and hereby 362 university students were recruited through convenience sampling. The following inclusion criteria were used in this research: respondents needed to be at least 18 years old or older, having a good command of English and to be currently enrolled in a university or in a university of applied sciences. Respondents who did not meet these criteria were excluded from the data analysis.

Due to the inclusion criteria, missing or incomplete data, the data of 217 respondents was used for this data analysis. As can be seen in Table 1, of the responses received, 156 (71.9%) were female, 59 (27.2%), were male and 2 (0.9%) choose other. Participants ages ranged from 18 to 32 years, with the mean age being 21 years (SD=2). There were 22 different nationalities among the participants. Major part of the participants was from Germany (N=150; 69.1%). Followed by 30 Dutch respondents (13.8%) and 9 Turkish respondents (4.1%). The remaining 13% were from other nations, like Turkey, Romania, Czech Republic, South Korea, and Curacao. As a requirement for participation was to be enrolled in a university, 191 participants (88%) were bachelor students, 24 participants were master students (11.1%) and two were PhD students (0.9%). Further descriptive statistics showed that 20 respondents (8.9%) were already infected with the Covid-19 virus. Regarding whether the participants ever sought psychological or pharmacological treatment for any mental health concerns, 41 participants (18.9%) indicated 'yes' and 176 participants (81.1%) indicated that they did not sought any psychological or pharmacological treatment. Next, 30 participants (13.8%) indicated being diagnosed with a mental health condition. Hereby, most of the participants mentioned depression, anxiety, bipolar and eating disorder.

Table 1.
Descriptive Data of Variables of Interest

Participants Characteristics	n	%
Gender		
Female	156	71.9
Male	59	27.1
Nationality		
German	150	69.1
Dutch	30	13.8
Other	37	17.1
Student Status		
Bachelor	191	88
Master	24	11.1
PhD	2	0.9
Infection with Covid-19		
Yes	20	9.2
No	197	90.8
Psychological/ Pharmacological Treatment		
Yes	41	18.9
No	176	81.1
Diagnose of a Mental Health condition		
Yes	30	13.8
No	187	86.2

Participants Characteristics	N	Minimum	Maximum	Mean	SD
Age	217	18	32	21.7	2.1
PA during Covid-19					
MET total	217	0	7765	2046	1568
Vigorous level	45	3057	7765	4513	1276
Moderate level	133	624	2979	1709	650
Walking	217	0	3465	761	741
PA before Covid-19					
MET total	217	0	11172	3033	2640
Vigorous level	90	3016	11172	5382	1887
Moderate level	97	660	2978	1698	676
Walking	217	0	5940	1049	1001
Perceived stress	217	2	35	17.1	6.8

Note. SD= standard deviation, MET= Metabolic Equivalent of Task, PA= Physical Activity

Measures

Demographics

The survey included the collection of sociodemographic data, such as gender, age, nationality, and educational level. Further questions investigating whether they already had COVID-19 were included. Participants were also asked to indicate whether they have ever been diagnosed with a mental health condition. An example question from the survey would be 'Have you ever sought psychological or pharmacological treatment for any mental health concerns (e.g., anxiety, depression, eating disorders)?' (see Appendix A for full questionnaire).

Perceived Stress Scale (PSS-10)

To investigate the perceived stress of the students a self-report scale, namely Perceived Stress Scale (PSS-10) was used. The scale is composed of ten items and was designed to measures how stressed individuals felt during certain situations. Moreover, it evaluates the degree to which individuals felt that their life has been unpredictable, overloaded and uncontrollable in the past month. The PSS had initially 14 items and was shortened to 10 items by Cohen et al (1983). The psychometric evaluation showed that the Cronbach's alpha for the 10-item scale was >.70 which is an indicator for a good internal consistency. Also, the test-retest reliability of the PSS-10 was assessed in several studies and in almost all cases it met the criterion of >.70, indicating a good reliability of the scale (Cohen et al., 1983; Lee, 2012). Participants were able to rate on a 5-point Likert scale ranging from zero (never) to four (very often). The PSS-10 scores were obtained by reversing the scores of the four positive stated items (items 4,5,7 and 8). Afterwards, the scores of all items were summed up to one total score. The total score can range from 0-40 with higher score indicating a higher perceived stress level. Scores between 0-13 are considered as low and scores ranging from 14 to 26 are considered moderate perceived stress. Individuals indicating a score of 27 or higher are considered high perceived stress (Cohen et al.,1994). An example of a positive stated item would be: *"In the past month, how often have you felt confident about your ability to handle personal problems?"* and a negative stated item is *"In the last month, how often have you been upset because of something that happened unexpectedly?"* (see Appendix B for full questionnaire).

International Physical Activity Questionnaire in Short Form (IPAQ-SF)

The second variable of interest, 'physical activity during Covid-19' was measured with the International Physical Activity Questionnaire – Short Form (IPAQ-SF), developed by a group of experts in 1998 to facilitate surveillance of physical activity (Craig et al., 2003). The questionnaire records the physical activity in the last 7 days, in four intensity levels, namely *sitting, walking, moderate* and *vigorous intensity*. Participants could state the frequency per week and the minutes they spend on physical activity. In the category of *vigorous intensity*, the respondents were asked: *"During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, running or fast bicycling*?". This question was followed by: "*How much time did you usually spend doing vigorous physical activities on one of those days?*". Hereby, the respondents could answer *"don't know/ not sure" or* indicate the exact time in minutes they spend performing physical activity. Similar questions followed in the categories, *moderate physical activity*, *walking and sitting,* also with the same response possibilities (see Appendix A for full questionnaire). The IPAQ-SF has been reported to demonstrate acceptable test-retest reliability (coefficient ranging from 0.32-0.88), as well as fair to moderate criterion validity (average coefficient 0.30) in several studies in various countries. It was also tested with adults, including college students (Lee et al., 2011; Wang et al., 2013).

To calculate the scores of the IPAQ-SF, the 'IPAQ scoring protocol' was used. By using this protocol two different outcomes were obtained. First, a continuous variable of physical activity was obtained using the MET formula. Hereby, the physical activity was indicated in Metabolic Equivalent of Task (MET) with minutes per week, which represents the amount of energy which was expended carrying out certain physical activity. Thus, walking was equivalent to 3.3 METs, moderate physical activity to 4 METs and vigorous physical activity to 8 METs. To calculate the MET per week, the following formula was used: MET level x minutes of activity x events per week.In other words, the minutes spent carrying out physical activity per week were multiplied by the MET value, which was also multiplied by the number of days per week the certain activity was carried out (Forde, 2018).

Secondly, the scores were classified in three categories namely *walking*, *moderate physical activity*, and *vigorous physical activity*. To be categorized as being *high in physical activity*, individuals either engaged at least three times per week in vigorous physical activity of at least 1500 MET or they engaged seven or more days in physical activity of at least 3000 MET. Following criteria had to be met in category '*moderate in physical activity':* respondents performed in three or more days 30 minutes of vigorous activity, or they reached

on five or more days in a week at least 600 MET (Forde, 2018). Participants not meeting any of the requirements were not classified in a group.

Physical Activity Before COVID-19

To collect physical activity data of the participants before the Covid-19, modified items of the IPAQ-SF were used. Respondents were asked to indicate their physical activity in a usual week before the start of the Covid-19 pandemic. At the beginning of the questionnaire, respondents received information about the following items and about the time range, they should indicate their physical activity: *"The following questions relate to your physical activity before the start of the Covid-19 pandemic. As this is already some time ago, try to indicate your physical activity as accurately as possible."* The items were stated likewise as in the IPAQ-SF, except that the item regarding sitting was not included, since it had no importance in this research. The response scale and the total scoring was hereby the same as for the IPAQ-SF.

Procedure

The survey was designed using the online program Qualtrics and was administered in English. The developed survey was online accessible from 9th of April until the 10th of May 2021. The participants could complete the survey individually and chose the place and the moment in time for participation. There was no time limit given for the completion of the questionnaire. Moreover, the study was approved by the Ethical Committee of the University of Twente on the 30.03.2021 (approval number 210233). The link of the survey was provided to the participants by the researchers through various means, including personal direct messaging and multiple social media platforms and also available on SONA-Subject pool. Sona is a platform on which students can conduct experiments and collect data from the participants in the pool. Participants get in return a compensation in form of SONA points. For students participating in this study via SONA, a compensation of 0.25 SONA points was given.

At the beginning of the survey, respondents were informed about the aim of the research and the approximate time to complete the survey. Students could participate in this study based on their written informed consent. After giving their consent, the participants were asked to fill out the survey.

Data Analysis Plan

The data analysis was conducted with SPSS version 27 (International Business Machines Corporation). As this research was a subpart of a larger study, only the measurements relevant to this study were used. Those are namely the PSS-10 scores, IPAQ-scores, and the physical activity scores before the Covid-19 pandemic.

The first step of the data analysis was to exclude all responses who did not fulfil the inclusion criteria. Afterwards, the socio-demographic data and individual variables such as being previously infected with the Covid-19 virus, having previous mental health conditions and if they ever sought pharmacological or psychological help, were computed using the descriptive command from SPSS.

Before starting to analyze the hypotheses, new variables needed to be created. For the IPAQ-SF outcomes, the new variable "MET during Covid-19" was created. The same procedure was also done for the physical activity scores before the Covid-19. This variable was called "MET before Covid-19". The variable called 'PSS' was created for the outcomes of the PSS-10. Furthermore, new variables for the different levels of physical activity were created.

After the creation of new variables, the Shapiro Wilk test was performed, to test the normality of the data. The Shapiro Wilk test showed a deviation from normality for the variables MET scores during Covid-19, $W(217)= 0.9$, $p=0.01$ and the MET score before Covid-19 ($W(217)=0.91$, $p=0.01$). The assumption of normality was met for the PSS ($W(217)=0.99$, $p=0.08$). Even after deleting the outliers of the variables before and during Covid-19 pandemic, they did not show normality. However, after inspecting the QQ plots of the two variables (Appendices C & D) and also based on the reasonable sample size (N=217), it was decided to still use parametric tests in this data analysis. Furthermore, the two respondents indicating 'other' on gender, were excluded from analysis of gender differences as a result of a significant gender imbalance.

To address the first hypothesis a repeated measures ANOVA was conducted. The dependent variable was 'PSS' and the independent variables were 'MET before Covid-19' and 'MET during Covid-19'.

For the second hypothesis, a linear regression analysis was performed to investigate if there is a causal relationship between physical activity and PSS. The variable 'MET during Covid-19' was the independent variable and 'PSS' was the dependent variable.

To test H_3, independent T-Tests were used. First, an independent T-test was conducted for the physical activity before the Covid-19 pandemic and gender. Hereby, 'gender' (female and male) was the independent variable and 'MET before Covid-19' was

the dependent variable. Afterwards, the second T-test was carried out for physical activity during the Covid-19 pandemic. Here, with the same independent variable 'gender' and dependent variable 'MET during Covid-19'.

For the last hypothesis an independent T-test was carried out as well. Hereby, the variable 'gender' was independent and 'PSS' was the dependent variable.

Results

Descriptive Data

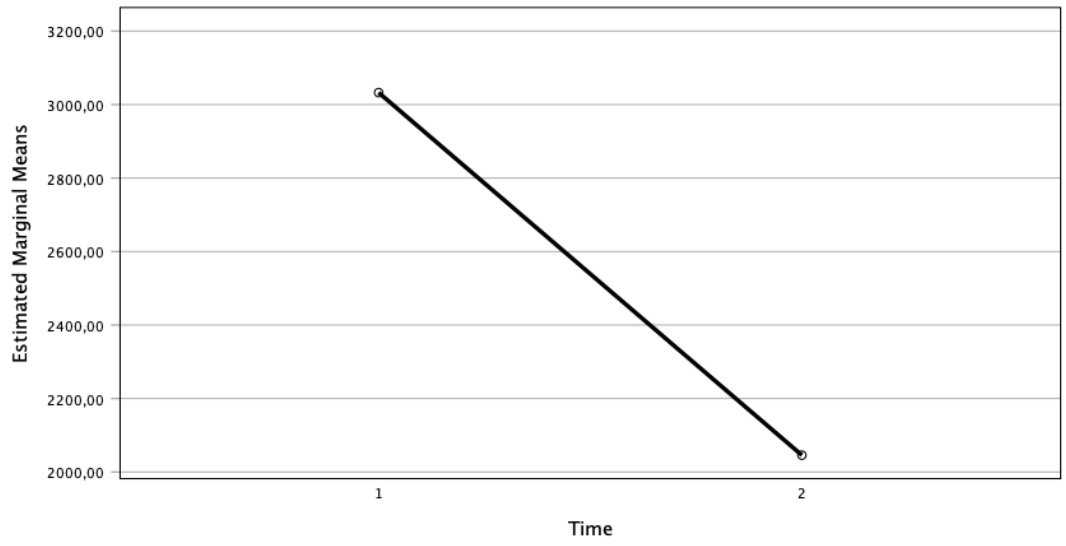
The mean PSS of the participants was 17.1 (*SD*=6.8). Furthermore, a difference in the mean values of MET scores before and during Covid-19 was found. More precisely it could be observed that the mean value of MET before Covid-19 was higher than during Covid-19 pandemic. Differences were also found in the different levels of physical activity. In Table 1. it can be seen that previous to the Covid-10 pandemic, the number of students engaging in moderate and vigorous physical activity was well balanced. Regarding physical activity during the Covid-19 pandemic, the results indicated that less people engaged in vigorous levels of physical activity (*N*=45) than before the pandemic (*N*=90). However, students engaging in moderate levels of physical activity increased from 97 to 133 students. While the number of students engaging in moderate physical activity increased, the mean MET-score did not increase (*M*= 1709) and was approximately the same as before the pandemic (*M*=1698).

Physical Activity before and during Covid-19 Pandemic

To test H_1, a repeated measures ANOVA with a Greenhouse-Geisser correction indicated a statistically significant difference in physical activity between two time points (T0- before and T1- during Covid-19 pandemic) as reported by MET scores ($F(1,216)=40.53$, $p < .05$). As it can be seen in Figure 1, the test revealed that there was a significant mean difference of 986.84 MET between two time points. Based on these results the first hypothesis was accepted, and it can be concluded that there is a significant reduction in physical activity as a result of the Covid-19 pandemic.

Figure 1.

Profile Plot of Estimated Means of Physical Activity



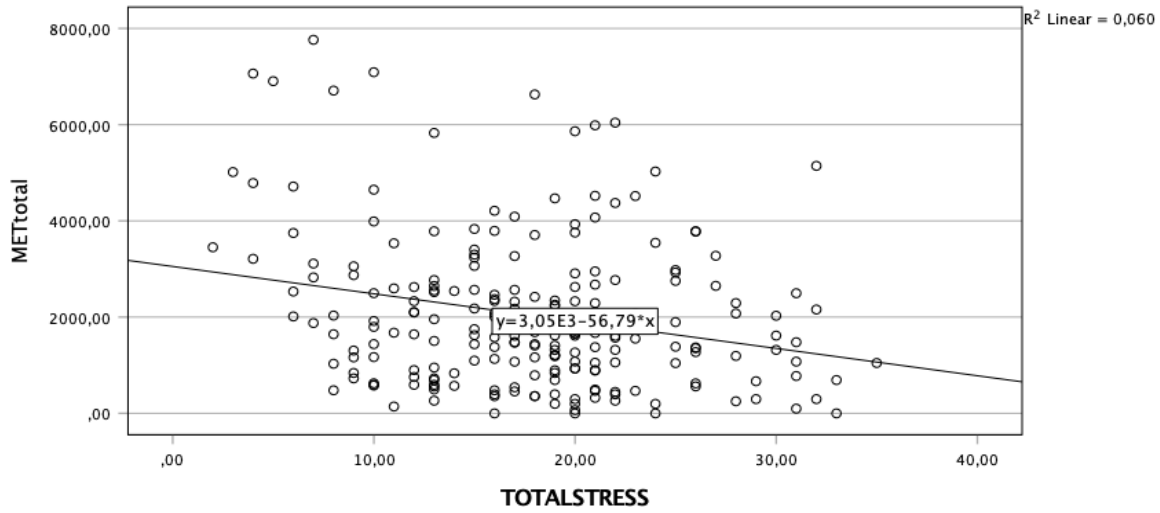
Note. Estimated Marginal Means represents the means of the physical activity scores in MET. Time, represents the means of physical activity before (1) and during (2) Covid-19 pandemic.

Causal Relationship between Physical Activity and Perceived Stress

Next, a simple linear regression analysis was carried out to investigate the causal relationship between physical activity and PSS. As it can be seen in Table 2., the results of the regression analysis showed that physical activity predicted PSS, b= -.001, t(216)= 27.15, $p < .05$. Physical activity also explained a significant proportion of variance in PSS, R^2= 0.06, F(1, 216)=13.69, $p < .05$. It was found that physical activity during the Covid-19 pandemic significantly predicted the score of perceived stress among university students ($\beta 1 = -.245$). In Figure 2, the predictive model between physical activity and PSS can be seen. Based on the mentioned outcomes, H_2 was accepted.

Figure 2.

Scatterplot of the Relationship between Perceived Stress (dependent variable) and Physical Activity (independent variable).



Note. Physical Activity in MET predicting Perceived Stress of University Students.

Gender Differences regarding Physical Activity and Perceived Stress

Regarding H_3 two independent t-tests were carried out. In Table 2, it can be seen that the first test showed no significant difference ($t(213)=0.84$, $p=0.4$.) in the physical activity scores between female ($M=2957$, $SD=2236$) and male students ($M=3267$, $SD=2851$) before the Covid-19 pandemic. The same procedure was done for the dependent variable, physical activity during Covid-19 pandemic. Hereby, a significant difference ($t(213)=3.07$, $p < .05$) was found in the physical activity score for female ($M=1860$, $SD=1432$) and male students ($M=2582$, $SD=1788$). Based on these results, it can be said that there was no significant gender difference in physical activity before the Covid-19 pandemic. Thus, a significant gender difference was found in the physical activity during the Covid-19 pandemic. A difference of 722 MET indicated that male students have higher MET scores than female students. Therefore, H_3 was partially accepted, hence a significant difference could only be detected during the Covid-19 pandemic.

To test the last hypothesis, an independent t-test was performed as well. The results showed, that there was a significant difference ($t(213)= -4.52$, $p< .05$) in the score for perceived stress in female ($M=18.87$, $SD=6.52$) and male students ($M=14.44$, $SD=6.12$). These results suggest that female students perceive higher levels of stress than male students during the Covid-19 pandemic. Based on these outcomes, H_4 was accepted.

Table 2

The relationship between demographic data, PSS, and Physical Activity before and during the Covid-19 pandemic

Characteristic	Physical Activity	
	***M* (*SD*)**	***F* (*p*)**
Difference in physical activity		40.53 (0.001)
(T0)	3032 (2410)	
(T1)	2045 (1567)	

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	S.D	Beta	t	Sig.
Constant	19.913	.734		27.145	<.001
MET during Covid-19	-.001	.000	-.245	-3.700	<.001

	Physical Activity before Covid-19	
	***M* (*SD*)**	***t* (*p*)**
Gender		0.84 (0.4)
Female	2957 (2236)	
Male	3267 (2851)	

	Physical Activity during Covid-19	
Gender		3.07 (0.02)
Female	1860 (1432)	
Male	2582 (1788)	

	Perceived Stress Score	
Gender		-4.25 (0.001)
Female	18.87 (6.52)	
Male	14.44 (6.12)	

Note. M = mean; *SD* = Standard deviation; F = repeated measures ANOVA; T0 = Physical Activity before pandemic; T1 = Physical Activity during pandemic; Model= Regression Analysis of Physical Activity predicting PSS; *t* = t-test for independent samples

Discussion

The aim of this research was to examine the influence of the Covid-19 pandemic on the perceived stress and physical activity of university students. Hereby, one of the goals was to test whether Covid-19 pandemic affected the physical activity of university students. The impact of physical activity on psychological health during Covid-19 pandemic and gender differences regarding physical activity and perceived stress were assessed as well.

Physical Activity Changes

Research investigating physical activity in university students before the Covid-19 pandemic, observed that the majority of adults was not sufficiently active (Haase et al., 2004; Papathanasiou et al., 2021). Kreating et al. (2005) found evidence that the contemporary design of work and study have significantly reduced the demand for physical activity and created a higher risk for poor health. Haase et al. (2004) also found out that physical activity among university students was below the recommended levels and further discovered that physical activity is related to cultural factors. University lifestyle, lack of time due to exams and academic pressure were mentioned as reasons for reduced physical activity as well (Deliens et al., 2015; Haase et al., 2004). Based on the mentioned studies it can be assumed that physical activity among university students was already decreasing. The findings of this study provide evidence to support the first hypothesis and revealed that there is a further significant reduction in the physical activity of university students since the beginning of the Covid-19 pandemic. The statistically significant decrease in physical activity agrees with findings from other studies that also investigated the influence of Covid-19 on university students (Barkley, 2020; Füzéki et al., 2021). Bertrand et al. (2021) also found that during confinement students physical activity decreased and that instead their sedentary behaviour increased from 8 hours to 11 hours per day. The observed changes in sedentary behaviour can be due to the shift of university classes from on-campus to remote during the Covid-19. Measures implemented to prevent the spread of the Covid-19, such as the closures of sport facilitations, resulted in reductions in physical activity. Furthermore, it was found that the pandemic resulted in a lack of motivation in university students (Meeter et al., 2020). It is further argued that this lack of motivation can result in less motivation for studying, social contacts and physical activity as well. Therefore, psychological factors (e.g., lack of motivation, stress), social factors (e.g., no group sports) and physical environmental factors

(e.g., closing of sport facilities) might influence the physical activity of university students before and during the Covid-19 pandemic.

Although the general physical activity decreased, the number of students engaging in moderate levels of physical activity increased. Possibly because students were hindered in performing high levels of sport, since most of the opportunities were taken. Therefore, home workouts and going for a run remained the only possibility to do sports and stay active during the COVID-19 pandemic. Similar results were also found by Maugi et al. (2020). They found out that there was a decrease in the total MET of physical activity and a decrease in walking and vigorous activity. Also, Barkley et al. (2020) identified an increase in moderate physical activity and a decrease in high physical activity. These findings reflect a major difficulty of performing an intense exercise at home, compared to moderate physical activity.

Positive Effect of Physical Activity on Perceived Stress

Regarding $H_{2,}$ the current study identified a link between physical activity and perceived stress. The positive effect of physical activity on the perceived stress, and by this on mental well-being, are generally consistent with existing empirical findings. Previous research suggests that physical activity leads to a better stress regulation, which in turn mediates protective and positive effects of physical activity on mental health. Furthermore, it is advocated that exercising can influence an individual's response to stressful events (Greenwood & Fleshner, 2011). Since in the development of anxiety and depressive disorder, stress is an important factor, this means that physical activity may help to reduce the incidence and severity of stress-related psychiatric disorders. Also, according to Salmon (2001), regular physical activity leads to resilience to a wide range of stressors. The author indicated that regular physical activity induces biological changes in the body which in turn help the individual to cope better with certain stressors. Concerning the Covid-19 pandemic and the higher levels of stress among university students, it can be said that physical activity may be an important behavioral pattern for stress management during this difficult period (Ellis et al., 2020; Stults-Kolehmainen & Sinha, 2014). The results of this research and further studies show that physical activity can be used as targeted prevention strategy to avoid the negative effects of the global pandemic (Bell et al., 2019). Also, Berger (1994) suggest that deliberate exercising can improve the short-term mood, and by this motivate and help to cope with certain stressors. Furthermore, physical activity can act as a coping mechanism to reduce stress not only during the pandemic, also after the pandemic it might be a helpful tool against stress.

Gender Difference in Physical Activity and Perceived Stress

Based on the results, it can be said that physical activity and perceived stress among university students may have gender implications. It was found that physical activity during the Covid-19 pandemic differed by gender. Previous studies investigating the motives for physical activity by gender identified some variables that motivated men and women differently. Men were motivated by elements related to their environment, such as competition or social recognition. For women the main motivation for physical activity was weight control (Kilpatrick et al., 2005; Lauderdale et al., 2015). The finding that male university are more active than female university students is in line with previous findings and can be explained due to the mentioned motivations (Colley et al., 2011). Next, female university students seem to experience higher levels of perceived stress than male students. Many previous investigations are consistent with the findings of gender difference. Although some reports claim that there is no gender difference in the experience of stress (Niemi & Vainiomäki, 2006), the majority of investigations agree and support that woman report more stress than men (Tavolacci et al., 2013; Matud, 2004). Besides, previous literature search showed that gender determines whether a situation will be perceived as stressful and predicts the coping strategies and the stress reactions of an individual (Barnett et al., 1987). Matud (2004) also found out that women are more vulnerable and therefore, perceive certain live events more stressful than men. Concerning the Covid-19 pandemic, female students may have been emotionally more affected than male students. Another possibility is that since male students showed higher levels of physical activity, this could be an explanation for their lower levels of perceived stress, considering the before mentioned effect of physical activity on perceived stress. Furthermore, research describes largely the differences in coping behaviors of men and women. Research found out that women are more likely to use passive and emotion-focused behaviours and that men prefer to be active and make use of instrumental coping behaviours, such as direct problem solving or exercising (Matud, 2004). By this, it would be possible to understand the higher levels of perceived stress and lower levels of physical activity in female university students.

Limitations, Strengths and Future Research

Several limitations of the study need to be highlighted. First of all, self-administered questionnaires were used to evaluate physical activity. Albeit the IPAQ-SF showed acceptable test-retest reliability (Lee et al., 2011), a comparative study indicated that the self-report

method, in this case the IPAQ-SF, overestimated the physical activity levels and is not as reliable as the methods with an accelerometry (Downs et al., 2014). The use of a smartwatch or other tracking instruments could help to achieve more accurate and reliable data. Secondly, the study sample showed a gender imbalance, because it mainly consisted of female (72%) university students. Consequently, this might have an effect on the results about gender differences. Next to that, almost 70% of the participants were from Germany and thus can limit the generalizability of the findings to other countries. Even though a large part of the sample size was from Germany, still participants from 22 different countries took part in this study. It is important to keep in mind that almost each country implemented different measurements. Therefore, differences in the physical activity scores in MET might be due to several different reasons. Thirdly, almost 20 % of the participants mentioned that they have sought a psychological or pharmacological treatment and 14% of the participants indicated that they have been diagnosed with a psychological disorder. As the general aim was to assess the PSS of university students during the Covid-19 pandemic, their current mental health status was not taken into account. To obtain more precise data regarding their PSS, it might be helpful to test whether there are any confounding variables regarding PSS. However, the impact is expected to be small, since it is a small part of the sample size.

This study also has some strong points, including the reasonable sample size. Furthermore, the sample consisted fully of university students and therefore, it is possible to generalize the findings for university students. Besides that, the survey was conducted during the pandemic, which means that participants had the possibility to adjust their daily routines, including their physical activities to the new situation. As already mentioned, further studies should focus on a representative and balanced sample size in terms of gender to clearly determine gender differences in physical activity and PSS. Regarding physical activity, it is also advised to use tracking devices, such as a smartwatch to investigate the physical activity of participants. Furthermore, it could be helpful to understand what kind of physical activity participants engage in. By this gender differences in physical activity may be explained and understood more precisely.

Conclusion

The present findings contribute support to arguments that physical activity decreased since the beginning of the worldwide pandemic. As the findings support that physical activity can be used as a coping method against stress, it can be concluded that university students can make use of physical activity to counteract the negative consequences of the global

pandemic. Although it is important to keep individuals safe from the Covid-19, the mental well-being should not be neglected, and a midway should be aimed. Next, as university students were already before the start of the pandemic insufficiently active, university and government institutions should aim to provide enough possibilities for students to be physically active during the Covid-19 pandemic and also in long term.

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Appendices

Appendix A

Informed Consent Form and Questionnaires used for the Study

Exploring the impact of Covid-19

Welcome!

You are invited to participate in a research study titled “Exploring the impact of COVID-19 on students mental wellbeing”. This study is conducted by Marius Schulte-Frankenfeld, Emma Simons, Lia Landwehr, Buket Korkut and Laura Holzwarth from the Faculty of Behavioural, Management and Social Sciences at the University of Twente.

The purpose of this research study is twofold. On the one hand, the study aims at exploring the impact of the COVID-19 pandemic on different aspects of mental well-being. On the other hand, the purpose is also to explore the influence of protective factors on well-being during the pandemic. Generally, the survey will take you approximately 20 minutes to complete. The data will be used for research purposes only.

Your participation in this study is entirely voluntary and you can withdraw at any time. **Please be aware that all of your data will be treated confidentially and your responses are anonymous!**

We believe there are no known risks associated with this research study; however, as with any online related activity the risk of a breach is always possible. To minimize your risks, no identifying information about you will be collected and survey data will only be stored on a password-protected computer.

By clicking "I agree" below you are indicating that you are at least 18 years old, have read and understood the consent form and agree to participate in this research study.

- ○ I agree (1)
- ○ I don't agree (2)

Background questions

Dear participant, before starting the questionnaire we would like to ask you some general questions.

After the general questions, the survey will cover six different areas of mental wellbeing, which are namely: physical activity, sleep habits, positive and negative emotions, fear of Covid-19, depressive symptoms and alcohol consumption patterns.

Q3 Are you currently enrolled in a university or an applied university?

- ○ Yes (1)
- ○ No (2)

Q4 What is the degree you are currently working on?

- ○ Bachelor (1)
- ○ Master (2)
- ○ PhD (3)

Q5 What is your age?

_____

Q6 What is your country of origin?

_____

Q7 What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ other (4) _____

Q8 Since the beginning of the pandemic, have you been infected with SARS-COV-2 virus (causing the Covid-19 disease) ?

- ○ Yes (1)
- ○ No (2)

Q9 Have you ever sought psychological or pharmacological treatment for any mental health concerns (e.g. anxiety, depression, eating disorders)?

- ○ If yes, please indicate (1) _____
- ○ No (2)

Q10 Have you ever been diagnosed with a mental health condition? Yes/No, If yes, please mention:

- ○ if yes, indicate (1) _____
- ○ no (2)

Q11 In the following section, we kindly ask you to complete several questionnaires.

In the next part of the survey we are interested in your physical activities **during** the COVID-19 pandemic and **before** the start of COVID-19 pandemic.
First of all, we will ask you to indicate your physical activity **during** the COVID-19 pandemic. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Please indicate the amount of time you spent in the empty box.

International Physical Activity Questionnaire

Q13

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling, jumping rope etc. ?

- ...days per week (1) _____
- no vigorous activities (2)

Q14 How much time did you usually spend doing **vigorous** physical activities on one of those days?

- ...minutes per day (1) _____
- don't know/ not sure (2)

Q15 Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you

do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis, dancing, pilates, inline skating? Do not include walking.

- ○ days per week (1) _____
- ○ no moderate activities (2)

Q16 How much time did you usually spend doing **moderate** physical activities on one of those days?

- ○ minutes per day (1) _____
- ○ don't know/ not sure (2)

Q17 Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

- ○ days per week (1) _____
- ○ no walking (2)

Q18 How much time did you usually spend **walking** on one of those days?

- ○ minutes per day (1) _____
- ○ don't know/ not sure (2)

Q19 The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

- ○ minutes per day (1) _____
- ○ don't know/ not sure (2)

Q20 The following questions relate to your physical activity **before** the start of the Covid-19 pandemic. As this is already some time ago, try to indicate your physical activity as accurately as possible.
How many days **per week** did you do **vigorous** activities like heavy lifting, fast bicycling, running, jumping rope etc.? Think only about activities that you did for **at least** 10 minutes.

- ○ days per week (1) _____
- ○ no vigorous activities (2)

Q21 How much time did you usually spend doing vigorous physical activities on one of those days?

- ○ minutes per day (1) _____
- ○ don't know/ not sure (2)

Q22 How many days per week did you do **moderate** activities like dancing, pilates, bicycling at a regular pace, inline skating? Think only about activities you did **at least** for 10 minutes.

- ○ days per week (1) _____
- ○ no moderate activities (2)

Q23 How much time did you usually spend doing moderate activities on one of those days?

- ○ minutes per day (1) _____
- ○ don't know/ not sure (2)

Q24 Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.During a week, on how many days did you walk for at least 10 minutes at a time?

- ○ days per week (1) _____
- ○ no light activities (2)

Q25 How much time did you usually spend on walking on one of those days?

- ○ minutes per day (1) _____
- ○ don't know/ not sure (2)

Part 4 - Perceived Stress Scale

Q42 The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way.

	0 = never (1)	1 = almost never (2)	2 = Sometimes (3)	3 = Fairly often (4)	4 = Very often (5)
1. In the last month, how often have you been upset because of something that happened unexpectedly? (1)	○	○	○	○	○
2. In the last month, how often have you felt that you were unable to control the important things in your life? (2)	○	○	○	○	○
3. In the last month, how often you felt nervous and "stressed"? (3)	○	○	○	○	○

4. In the last month, how often have you felt confident about your ability to handle your personal problems? (4)	○	○	○	○	○
5. In the last month, how often have you felt that things were going your way? (5)	○	○	○	○	○
6. In the last month, how often have you found that you could not cope with with all the things that you had to do? (6)	○	○	○	○	○
7. In the last month, how often have you been able to control irritations in your life? (7)	○	○	○	○	○
8. In the last month, how often have you felt that you were on top of things? (8)	○	○	○	○	○
9. In the last month, how often have you been angered because of things that were outside of your control? (9)	○	○	○	○	○

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? (10)	○	○	○	○	○

Appendix B

Perceived Stress Scale-10 with Coding Scheme and Norm Table

PERCEIVED STRESS SCALE

by Sheldon Cohen

The *Perceived Stress Scale* (PSS) is the most widely used psychological instrument for measuring the perception of stress. It is a measure of the degree to which situations in one's life are appraised as stressful. Items were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes a number of direct queries about current levels of experienced stress. The PSS was designed for use in community samples with at least a junior high school education. The items are easy to understand, and the response alternatives are simple to grasp. Moreover, the questions are of a general nature and hence are relatively free of content specific to any subpopulation group. The questions in the PSS ask about feelings and thoughts during the last month. In each case, respondents are asked how often they felt a certain way.

Evidence for Validity: Higher PSS scores were associated with (for example):

- failure to quit smoking
- failure among diabetics to control blood sugar levels
- greater vulnerability to stressful life-event-elicited depressive symptoms
- more colds

Health status relationship to PSS: Cohen et al. (1988) show correlations with PSS and: Stress Measures, Self-Reported Health and Health Services Measures, Health Behavior Measures, Smoking Status, Help Seeking Behavior.

Temporal Nature: Because levels of appraised stress should be influenced by daily hassles, major events, and changes in coping resources, predictive validity of the PSS is expected to fall off rapidly after four to eight weeks.

Scoring: PSS scores are obtained by reversing responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively stated items (items 4, 5, 7, & 8) and then summing across all scale items. A short 4 item scale can be made from questions 2, 4, 5 and 10 of the PSS 10 item scale.

Norm Groups: L. Harris Poll gathered information on 2,387 respondents in the U.S.

Norm Table for the PSS 10 item inventory

Category	N	Mean	S.D.
Gender			
Male	**926**	**12.1**	**5.9**
Female	**1406**	**13.7**	**6.6**
Age			
18-29	**645**	**14.2**	**6.2**
30-44	**750**	**13.0**	**6.2**
45-54	**285**	**12.6**	**6.1**
55-64	**282**	**11.9**	**6.9**
65 & older	**296**	**12.0**	**6.3**
Race			
white	**1924**	**12.8**	**6.2**
Hispanic	**98**	**14.0**	**6.9**
black	**176**	**14.7**	**7.2**
other minority	**50**	**14.1**	**5.0**

PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.**

Name _____ Date _____

Age _____ Gender (*Circle*): **M F** Other _____

	0 = Never	**1 = Almost Never**	**2 = Sometimes**	**3 = Fairly Often**	**4 = Very Often**
1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

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The PSS Scale is reprinted with permission of the American Sociological Association, from Cohen, S., Kamarck, T., and Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24,* 386-396.

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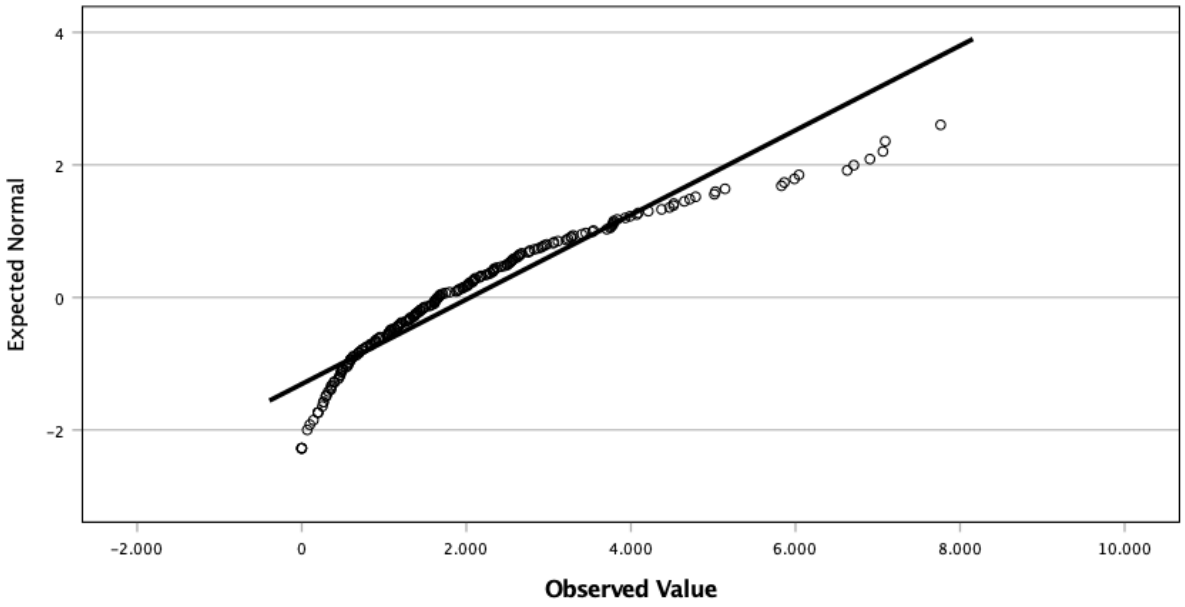
Appendix C

Q-Q Plot of MET Score during Covid-19 Pandemic



Appendix D

Normal Q-Q Plot of MET Score before COVID-19 Pandemic