CHAN YI FEI FATIGUE, BLOOD PRESSURE AND PHYSICAL ACTIVITY 2023

PREVALENCE OF FATIGUE, BLOOD PRESSURE, AND ITS ASSOCIATION TO PHYSICAL ACTIVITY AMONG POST COVID-19 UNIVERSITY STUDENTS

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PREVALENCE OF FATIGUE, BLOOD PRESSURE, AND ITS ASSOCIATION TO PHYSICAL ACTIVITY AMONG POST COVID-19 UNIVERSITY STUDENTS

By

CHAN YI FEI

A Research project submitted to the Department of Physiotherapy,
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PREVALENCE OF FATIGUE, BLOOD PRESSURE, AND ITS ASSOCIATION TO PHYSICAL ACTIVITY AMONG POST COVID-19 UNIVERSITY STUDENTS

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ABSTRACT

Background and Objective: During Covid-19 pandemic, the physical activity level of an individual was drastically decreased. This situation was due to the lock down period and restrictions in place. Sports and exercise were mostly affected. Physical activity potentially could be related to a reduced level of feelings of low energy and fatigue in the general population. Regular physical activity is associated with lower blood pressure and reduced cardiovascular risk. Overall, physical activity does decrease the blood pressure. This research is aimed to investigate the prevalence of fatigue, blood pressure, and its association to physical activity among post Covid-19 university students.

Methods: The sampling method used in the study was convenience sampling and the sample size was calculated to be at 367 students. Online survey form which contains two questionnaires, Multidimensional Fatigue Symptom Inventory-Short Form (MFSI-SF) and International Physical Activity Questionnaire–Short Form (IPAQ-SF) was distributed to all UTAR students physically. The data collected were then analyzed using Pearson's Chi-square test and Spearman's correlation test in IBM SPSS software statistics version 29.

Results: The total participants recruited were 206 students. The students consist of 50.5% male and 49.5% female which have mean age of 20.25±1.633. No significant association was detected between different types of fatigue and blood pressure with correlation coefficient (General=0.065, Physical=0.04, Emotional=0.064, Mental=0.026, Vigor=-0.118& Total=0.084), all p-values are >0.05. Moreover, there was also no significant association between 4 types of fatigue and level of physical activity with correlation coefficient (General=0.002, Physical=0.015, Emotional=0.056, Mental=-0.018& Total=-0.027) with all p>0.05. However, there was a significant association between vigor and level of physical activity with correlation coefficient 0.181 and p=0.009. When determining the association between blood pressure and level of physical activity, the results showed correlation coefficient 0.039, and

$p>0.05$.

Conclusion: In general, there is no significant association between fatigue and blood pressure. No significant association was detected between fatigue and level of physical activity except for vigor. In investigating the association between blood pressure and level of physical activity, the findings shown that it was not significant.

Keywords: Fatigue, Blood Pressure, Physical Activity, Post Covid-19, University students

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APPROVAL SHEET

This Research project entitled **"PREVALENCE OF FATIGUE, BLOOD PRESSURE, AND ITS ASSOCIATION TO PHYSICAL ACTIVITY AMONG POST COVID-19 UNIVERSITY STUDENTS"** was prepared by CHAN YI FEI and submitted as partial fulfilment of the requirements for the degree of Bachelor of Physiotherapy (HONOURS) at Universiti Tunku Abdul Rahman.

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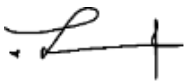

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PERMISSION SHEET

It is hereby certified that **CHAN YI FEI** (ID No: **21UMB06630**) has completed this Research project entitled "PREVALENCE OF FATIGUE, BLOOD PRESSURE, AND ITS ASSOCIATION TO PHYSICAL ACTIVITY AMONG POST COVID-19 UNIVERSITY STUDENTS" under the supervision of MS SITI HAZIRAH SAMSURI (Supervisor) from the Department of Physiotherapy, Faculty of Medicine and Health sciences.

Yours truly,

(CHAN YI FEI)

DECLARATION

I hereby declare that the Research project is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

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LIST OF ABBREVIATIONS

UTAR	Universiti Tunku Abdul Rahman
MFSI-SF	Multidimensional Fatigue Symptom Inventory-Short Form
IPAQ-SF	International Physical Activity Questionnaire-Short Form
BMI	Body Mass Index
BP	Blood Pressure
PA	Physical Activity
ARDS	Acute Respiratory Distress Syndrome
SARS	Severe Acute Respiratory Syndrome
PEM	Protein Energy Malnutrition
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
CVD	Cardiovascular Disease
WHO	World Health Organization
QoL	Quality of Life
CFS	Chronic Fatigue Syndrome
IL-6	Interleukin-6
SERC	Scientific and Ethical Review Committees
METS	Metabolic Equivalent of Task
HEPA	Health Enhancing Physical Activity
SD	Standard Deviation

CHAPTER 1

INTRODUCTION

1.1 Chapter overview

In this chapter, the background for the overall study will be presented. Following this, it will delve into the significance and pertinence of the study, elucidating the research objectives, null and alternate hypothesis, and the operational definitions for the research project.

1.2 Background

1.2.1 Covid-19

In December of 2019, an outbreak of an unusual respiratory illness appeared in Wuhan, China, and rapidly spread to other area. Upon investigation, it was identified that a new coronavirus was the causative agent. This novel coronavirus was labeled as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2, 2019-nCoV) owing to its considerable resemblance (approximately 80%) to the SARS-CoV, which caused acute respiratory distress syndrome (ARDS) and significant mortality during the period of 2002 to 2003 (Thomas G. Ksiazek et al., 2003). Initially, the emergence of SARS-CoV-2 was believed to be associated with a zoonotic transmission connected to the seafood market in Wuhan, China. However, it was subsequently recognized that human-to-human transmission played a crucial role in the subsequent dissemination of the disease (Q. Li et al., 2020). The virus that causes this is called as Coronavirus

Disease 2019 (COVID-19). COVID-19 has had a substantial global impact, with reported cases spanning around 200 countries and territories (Zhang et al., 2020). This illness also possesses the potential for lethality. The SARS-CoV-2 virus predominantly targets the respiratory system, while also impacting other organ systems. The initial cases reported from Wuhan, China, exhibited symptoms commonly associated with lower respiratory tract infections, including fever, dry cough, and dyspnea. (Huang et al., 2020). Additionally, observations included headache, dizziness, general fatigue, vomiting, and diarrhea (Shi et al., 2020).

1.2.2 Impact of Covid-19 to university students

The global pandemic of 2020 was instigated by the coronavirus disease 2019 (COVID-19). The aftermath of the COVID-19 pandemic has left a lasting impact on various aspects of individuals' health and well-being. One research finding suggests that specific demographics, such as college students, are more prone to experience increased mental health impacts (Pedrosa et al., 2020). One crucial aspect of the emotional and behavioral reactions to the Covid-19 pandemic involves alterations in daily habits. Examination of sleep quality during the SARS-CoV-2 pandemic has shown an escalation in sleep disruptions, a noteworthy condition linked to anxiety, depression, and inclinations toward suicidal behavior (Sher, 2020).

In the wake of the pandemic, university students have faced unique challenges in adapting to a new normal. Many universities suspended physical classes and shut down campuses as a preventive measure to curb the virus spread. In the aftermath Covid-19, universities transitioned from online classes back to

physical ones, permitting students to return to campus as usual. However, due to the ongoing pandemic, students remain concerned about the risk of infection. These changes have increased the stress level of students and potentially leading to fatigue.

1.2.3 Fatigue

Formal definitions of fatigue can be categorized into several overarching definitions that encompass the experiential, physiological, and performance components of the concept. According to the Oxford Dictionaries, fatigue is defined as profound exhaustion resulting from mental or physical exertion. Fatigue could be an experience. Fatigue is characterized as a subjective sensation, experience, awareness, or feeling akin to tiredness. Fatigue also could be a physiological condition, as performance decrement, and could be a dynamic multidimensional concept (Billones et al., 2021).

Several studies found that university students were experiencing fatigue or low energy levels. The participants that enrolled in those studies stated they skipped class, considering dropping out from the course, and not enjoying their study life (Hussain et al., 2013). All the situations above may affect the university students' academic performance and their examination results. Some of the contributing factors found were psychological distress and self-reported health status. Hence, it is important to find out the fatigue level among undergraduate university students and take action to overcome this problem and bring them towards a better future.

1.2.4 Post Covid-19 fatigue

The mortality rate associated with SARS is reported to be 10.8%, whereas the corresponding fatality rate for COVID-19 is documented at 4.6% (Caldaria et al., 2020). While COVID-19 exhibits a lower mortality rate, it has been likened to severe acute respiratory syndrome (SARS) because of their similar clinical symptoms (Rudroff et al., 2020). Similar to COVID-19, persistent fatigue was observable in individuals who had contracted SARS, persisting for up to one year following their initial infection (Tansey et al., 2007). An additional investigation indicated that 40% of individuals who had recovered from SARS still experienced fatigue even after four years (Lam et al., 2009).

1.2.5 Blood pressure classification

Blood pressure is measured using two values: systolic blood pressure (SBP) and diastolic blood pressure (DBP). These values represent the force of blood against the walls of the arteries during two different phases of the heartbeat. SBP is the higher of the two numbers in a blood pressure reading. It represents the maximum pressure exerted on the arterial walls when the heart contracts and pumps blood into the arteries. DBP is the lower of the two numbers in a blood pressure reading. It represents the pressure in the arteries when the heart is at rest between beats or in the diastolic phase.

According to American Heart Association (AHA), blood pressure can be categorized into 5 categories. Normal blood pressure is characterized by a SBP <120 mm Hg and a DBP <80 mm Hg. Elevated blood pressure falls within the range of 120-129 mm Hg systolic and less than 80 mm Hg diastolic.

Hypertension Stage 1 is identified by a SBP between 130 to 139 mm Hg or a DBP between 80 to 89 mm Hg. Hypertension Stage 2 is defined as a SBP >140 mm Hg or a DBP >90 mm Hg. In cases of a hypertensive crisis, the systolic pressure exceeds 180 mm Hg, and/or the diastolic pressure surpasses 120 mm Hg (Carey et al., 2018). However, AHA does not provides any specific guidelines for categorizing low blood pressure. The National Heart, Lung, and Blood Institute provides guidance for classifying low blood pressure. Low blood pressure is identified when the SBP is below 90 and the DBP is below 60 mm Hg.

1.2.6 Prevalence of hypertension and hypotension among university students

The diverse categories of blood pressure among university students may be attributed to insufficient sleep duration and an unhealthy diet. Multiple studies have identified a low occurrence of hypertension, with rates of 1.8% for systolic hypertension and 3.6% for diastolic hypertension, among university students (F. Ghadhban & S Habib, 2011). Yet, certain studies have reported a higher prevalence of hypertension among university students, reaching 26.5%. (Mohamed Moussa et al., 2016). No study has been conducted to investigate the prevalence of low blood pressure among university students. Hence, there is a necessity to explore the prevalence of various blood pressure categories among university students, aiming to enhance early awareness. This is crucial as both hypertension and hypotension can impact the functioning of the cardiovascular system.

1.2.7 Level of physical activity (PA) among Covid-19 survivors

The level of physical activity among individuals who have recovered from Covid-19 varies, influenced by factors such as the severity of their disease, persisting symptoms, and individual recovery speed. Some COVID-19 survivors may gradually resume regular physical activity as they regain their strength and health, while others, especially those who experienced more severe symptoms or complications, may face challenges in returning to their previous activity levels.

The impact of post-COVID-19 symptoms, also known as "long COVID" can also play a role in determining the level of physical activity. Symptoms such as fatigue, dyspnea, and muscle weakness may persist, affecting the ability of an individual to participate in physical activities.

Numerous studies have indicated that, in individuals recovering from Covid-19, there is a significant decrease in the extent of physical activity, contributing to an elevated sense of fatigue. (Aldhahi et al., 2022). Engaging in physical activity serves as a beneficial means for enhancing physical, psychological, and emotional well-being for individuals (G. S. F. Li et al., 2009), and it has a positive impact on their subjective evaluation of overall QoL and well-being (Vagetti et al., 2014). Regular physical activity is effective in lowering BP and reduced CVD risk (James et al., 2014).

1.2.8 Importance and relevance

A significant segment of the younger demographic consists of undergraduate university students who are poised to wield considerable influence in society as they assume roles as professionals, senior executives, and potential politicians in the future (Hussain et al., 2013). Understanding the prevalence of fatigue and blood pressure among post-COVID-19 university students is crucial for several reasons. Firstly, the chronic effects of the virus on the cardiovascular system remain a subject of significant concern. Secondly, the university environment, often characterized by academic stress and sedentary behavior, could exacerbate these health issues. Exploring the association between fatigue, blood pressure, and physical activity levels is essential for developing targeted interventions to enhance the overall well-being of this demographic.

This study holds considerable significance in both academic and practical contexts. In the academic sphere, it contributes to the growing body of knowledge on the post-COVID-19 health landscape, providing insights that may inform future research endeavours. From a practical standpoint, uncovering the relationship between fatigue, blood pressure, and physical activity levels could guide health professionals, educators, and policymakers in designing strategies to reduce health risks and promote a healthier lifestyle among university students.

1.2.9 Concluding remark

In general, this aim of this study is to identify the prevalence of different types of fatigue, as well as the prevalence of different categories blood pressure and its association to physical activity among post Covid-19 university students.

1.3 Objectives

i. To identify the prevalence of different types of fatigue among post Covid-19 university students.
ii. To identify the prevalence of different categories of blood pressure among post Covid-19 university students.
iii. To identify the association between fatigue, blood pressure, and physical activity levels among post Covid-19 university students.

1.4 Hypotheses

H0i) There is no significant association between fatigue and blood pressure among post Covid-19 university students.

H1i) There is a significant association between fatigue and blood pressure among post Covid-19 university students.

H0ii) There is no significant association between fatigue and physical activity level among post Covid-19 university students.

H1ii) There is a significant association between fatigue and physical activity level among post Covid-19 university students.

H0iii) There is no significant association between blood pressure and physical activity level among post Covid-19 university students.

H1iii) There is a significant association between blood pressure and physical activity level among post Covid-19 university students.

1.5 Operational definitions

i. Fatigue

A psychophysiological state of feeling of tired, sleepy, or exhausted due to sustained performance (A. Craig et al., 2011).

ii. Blood pressure

It is an indicator of the force exerted by the heart in pumping blood throughout the entire body. 2 readings can be obtained from the blood pressure measurement which upper number represent SBP and lower number represent DBP.

iii. Physical activity

Any body movement produced by muscles that results in energy expenditure(Caspersen et al., 1985).

iv. Post Covid-19 university students

Individuals who enrolled in any courses in a university and suffered from covid-19 previously.

1.6 Structure of research project

In this research paper, the study's background, research questions, objectives, and the study's importance and relevance will be presented in Chapter 1. Chapter 2 will follow with a comprehensive review of literature focusing on relevant information from previous studies. Subsequently, Chapter 3 will introduce the methodology employed in this research, covering aspects such as design of this study, sampling design, instruments used, and data collection procedures. Chapter 4 will present the results obtained after conducting descriptive and inferential analyses, including hypothesis testing. Lastly, Chapter 5 will be the discussion the findings, addressing the limitations of this study, and proposing suggestions for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter overview

This chapter delineates various topics explored in past journals and literature, laying the groundwork for this study.

2.2 Fatigue

2.2.1 Types of fatigue

According to MFSI-SF, fatigue can be divided into 4 categories as shown in below:

i. **General fatigue** is a word that usually used to describe an overall feeling of tiredness, sleepiness, and lack of energy (Shen et al., 2006).

ii. **Physical fatigue** that occurs after sustained physical workloads can decrease an individual's ability to execute physical tasks effectively (Gawron et al., 2001). Physical fatigue may affect around all physical abilities of the individual including muscle power, speed, time to react, coordination, in making decision or in balancing (International Maritime Organization, 2019).

iii. **Emotional fatigue** is also known as emotional exhaustion. It is a psychological symptom of stress. It occurs in the interpersonal domain and the individuals will have a feeling of emotional and physical resources have been overextended. Increased levels of emotional fatigue are more likely to feel dissatisfaction in job, physical and psychological discomfort, and overall decrement in performance (Khamisa et al., 2017).

iv. When weariness is brought about by extended involvement in mental exertion, it is conventionally termed cognitive fatigue or **mental fatigue** (C. Wang et al., 2016). An extended duration of intense cognitive activity can result in a psychobiological condition recognized as mental fatigue. Increased feelings of fatigue or even exhaustion, reluctance to continue the current task, and a decline in cognitive ability can all be indicators of it (Boksem & Tops, 2008).

v. **Vigor** is defined as active physical strength or mental energy and enthusiasm.

2.2.2 Prevalence of fatigue

University students frequently encounter study stress, stemming from the pressure of demanding academic requirements and concerns about their academic performance (Lingard, 2007). When stress related to academic performance persists and surpasses the student's perceptual threshold, it can lead to study-related fatigue or burnout (Schaufeli et al., 2002). The prevalence of study-related fatigue is estimated at 10% in the Netherlands (de Vries et al., 2016). In the post-COVID-19 period, the prevalence of fatigue was reported as 67.3% among Chinese nursing students (Liu et al., 2021).

2.2.3 Physiological Basis of Fatigue

Fatigue is a symptom that associated with different chronic disease such as cancer, Parkinson's disease, congestive heart failure etc. Hence, it is important to learn about the physiological basis of fatigue. A wide range of causes may lead to fatigue and several examples are shown below:

i. Submaximal activities

During exercise at different intensities, skeletal muscles produce lactic acid as a source of energy. In low-intensity exercise, lactic acid is utilized to prevent its accumulation. However, as exercise intensity rises and oxygen consumption increases, the production of lactic acid also escalates. In certain scenarios, the production of lactic acid surpasses its utilization, resulting in its accumulation. The rising levels of lactic acid contribute to muscle fatigue (Evans & Lambert, 2007).

ii. Nutritional deficiencies

Lossing of appetite is a symptom frequently observed among chronic disease patients. Reduced food intake may lead to loss in weight and cause nutritional deficiencies, with Vitamin D deficiency being one of the most prevalent. Insufficient vitamin D levels can result in muscle weakness, type II fiber atrophy, and increased muscle loss (Pfeifer et al., 2002). Additionally, protein-energy malnutrition (PEM) adversely affects proper muscle function (Vaz et al., 1996), causing a decline in high-energy phosphate levels in skeletal muscle and impacting various components of contractile function (Bissonnette et al., 1997). Long term PEM will cause muscle atrophy, hence decreasing in strength, that might be the potential cause leading to fatigue.

2.3 Blood Pressure

2.3.1 Definition

Blood pressure is the amount of force that the blood used to get through the arteries in the body system. When the heart pumps, it used force to push the oxygenated blood out to the arteries. Then, the arteries bring the oxygenated blood to body's cells and tissues. The sole method to determine blood pressure is through measurement. There are two readings in measuring blood pressure. The upper number represents SBP while the lower number represents DBP. According to American Heart Association, 120/80 mmHg or lower will be the normal BP reading (Miller & Jehn, 2004).

There are two categories of atypical blood pressure, namely, **hypotension** and **hypertension**. Hypotension is defined as a BP of <90/60mmHg (Ko et al., 2019). Hypertension is defined as BP >140/80mmHg (Tajeu et al., 2017).

2.4 Association of Fatigue with Blood Pressure (BP)

The association between fatigue and blood pressure can be found in several articles. One study was done among shift working police officers. This study reported that the injury incidence among midnight shift police is 72% higher than the day shift ones (Violanti et al., 2012). Most of the night shift workers experienced sleepiness. One of the contributing factors to this high occurrence of injury is due to the combination of insufficient sleeping time and the necessity to fight natural tendencies to fall asleep. These factors collectively can be characterized as fatigue, manifested through feelings of sleepiness and a

reduced in both physical and mental capabilities. Moreover, shift work between police officers is associated with different cardiovascular disease (CVD) and sleep disorders, that lead to circadian rhythm dysfunction. The association between sleep duration and blood pressure is clearly explained by Calhoun & Harding, 2010. The findings of this article show that a connection is existed between short sleep duration and insomnia with hypertension. (Calhoun & Harding, 2010).

The underlying mechanism surrounding fatigue is mostly due to state of hypotension, the state of being abnormally low blood pressure. In studies surrounding chronic fatigue syndrome, low ambulatory blood pressure is observed among the participants (Newton et al., 2009). The authors suggested a few mechanisms that could explain the correlation between fatigue and low blood pressure, the primary being the dysfunction of the autonomic nervous system (Newton et al., 2009). Secondary mechanisms included are the dysfunction of the hypothalamic-pituitary-adrenal axis, which is a negative feedback mechanism of the endocrine system regulating glucocorticoids, and also poor perfusion of blood to the central nervous system and peripheral extremities (Newton et al., 2009). Similar findings were also noted in studies of different conditions, such as Parkinson's Disease, stating that there were lower ambulatory diastolic blood pressures among the patients (Kotagal et al., 2019).

However, despite many evidence observing fatigue and lower blood pressure of individuals, there are a few studies that found its subjects to have higher incidence of fatigue with daytime ambulatory pressure. One article regarding stroke and transient ischemic attack (TIA) patients noted the higher incidence of fatigue among patients with daytime hypertension (Harbison et al.,

2009). Another study also noted similar findings, where patients were more fatigued in incidence of hypertension (Erickson et al., 2001). The underlying mechanism for this observation was not fully understood, suggesting that antihypertensive medications, such as beta-blockers, may cause a rise in blood pressure (Harbison et al., 2009). More evidence is needed to further explore this interesting change seen.

2.5 Impact of Physical Activities on Fatigue

According to the World Health Organization (WHO), physical activity referred to any movement that generated by skeletal muscles that necessitates energy expenditure. Physical activity is a useful behaviour that is effective for overcome low energy level or fatigue (O'Connor & Puetz, 2005). Fatigue represents a significant public health concern, with roughly 20% of adults worldwide reporting persistent fatigue (Wessley, Hotopf, & Sharpe, 1998). There is a potential link between physical activity and a decreased risk of fatigue in the general population. A study was done with the purpose of establishing the association between physical activity levels and the prevalence of sensations related to energy and fatigue. In conclusion, this study shown that the individual who engage in physical activity during their leisure time have reduced the risk of fatigue with 40-50% (Puetz, 2006). An individual with multiple sclerosis is easier to get fatigue. Hence, a study aimed to compare fatigue, depression and QoL scores, focused on patient with multiple sclerosis who did and didn't participant in regular physical activity. This study concluded that multiple sclerosis patient who consistently engage in physical activity tend to exhibit favorable scores in terms of fatigue, depression, and quality of life (QoL) (Stroud

& Minahan, 2009), which means that regular physical activity may improve fatigue. Another study focused on chronic fatigue syndrome (CFS). By increasing their physical activity level by 28%, large differences were seen in several fatigue ratings as well as ratings of muscle pain among CFS patient (Black et al., 2005).

2.6 Impact of Physical Activity on Blood Pressure

Hypertension is a prevalent condition in industrial societies, and numerous studies, including one by Paffenbarger et al. in 1983, have demonstrated an association between physical inactivity and hypertension. The global burden of hypertension is on the rise, contributing significantly to morbidity and mortality, as noted in a study by Campbell et al. in 2014. Lifestyle factors such as an unhealthy diet and lack of exercise contribute to this burden. Regular physical activity is linked to lower BP and reduced CVD risk, as indicated by James et al. in 2014.

Numerous studies have explored the impact of physical activity on blood pressure, with varied findings. Some studies suggest that physical activities can reduce both systolic and diastolic blood pressure, while others propose a reduction primarily in systolic blood pressure. For instance, a study from 1986 found that blood pressure decreased by 11/9 mmHg with exercise three times per week and by 16/11 mmHg with daily exercise (Nelson et al., 1986). Another study in 1992 reported an average reduction of 6 to 7 mmHg in both SBP and DBP (Arroll & Beaglehole, 1992).

A 1991 study focused on the association between physical activity during free time and blood pressure level in older lady population. The findings showed that blood pressure levels decreased with increasing activity intensity, with SBP approximately 20 mmHg lower in the heaviest activity group compared to sedentary women (Reaven et al., 1991).

Another study explored the potency of regular physical activity in reducing blood pressure. Participants were instructed to incorporate physical activity into their daily routines, including home and gardening activities, as well as brisk walking. While specific blood pressure reduction readings were not provided, the study concluded that physical activity is effective in lowering systolic blood pressure (Padilla et al., 2005).

2.7 Physical Activity Among University Students

Several studies have reported the physical activity level in university students. Physical activity does improve general health and quality of life (FitzGerald & Boland, 2018). Physical activity is effective in improving physical, psychological and emotional health (G. S. F. Li et al., 2009) and positively influences the personal perception of quality of life and well- being (Vagetti et al., 2014). One study was conducted to compare the relationship between physical activity and quality of life (QoL) among sports and other department students in a university. They found that the students in the sports department had a higher PA level and QoL scores, comparing to other departments (Çiçek, 2018). In 2004, one study was conducted in a college, and it aimed to investigate the association between physical activity, exercise, and sedentary behaviours.

The research revealed that initially, students were generally engaged in physical activity at the onset of the course, consistently reporting regular exercise during the initial two years. However, as age increased, there was a correlation with an extended duration spent using computers.

2.8 Post Covid-19 And Fatigue

Fatigue is a common symptom for many post Covid-19 patients. There are studies which reported that SARS-CoV-2 survivors may present manifestations that highly resembles chronic fatigue syndrome (Mantovani et al., 2021). Although the underlying mechanism is yet to be fully understood, Rudroff et al. (2020) suggested that fatigue from the SARS-CoV-2 is due to three domains, which are central, psychological and peripheral factors.

In terms of central factors, it is hypothesized that the central nervous system is compromised due to the viral infection (Rudroff et al., 2020). There is multiple evidence showing that 36.4% of hospitalized covid-19 patients presented neurological involvement such as nausea, fatigue, hypogeusia and hyposmia (Mao et al., 2020). Poor prognosis was often noted in patients with such cases (H. Li et al., 2020).

The mechanism of psychological factors of fatigue from Covid-19 is hypothesized to be similar to that of myasthenia gravis (Rudroff et al., 2020). The level of neurotransmitter transmission, such as acetylcholine, dopamine and serotonin, is affected by the viral invasion of the olfactory bulb (Rudroff et al., 2020). This often results in mood changes, alongside with fatigue (Rudroff et al., 2020).

Muscle pathologies are also associated with the infection of the Covid-19 virus, often presenting symptoms such as peripheral pain and musculoskeletal weakness (Rudroff et al., 2020). Significant release of interleukin-6 (IL-6) is observed in patients infected with SARS-CoV-2 virus, resulting in excess inflammatory responses producing the musculoskeletal pathologies associated with fatigue (Coomes & Haghbayan, 2020).

2.9 Level of Physical Activity After Covid-19 Pandemic

Many literature states that the levels of physical activity drastically decrease in patients recovering from Covid-19 to levels considerate inadequate (Galluzzo et al., 2023). One category of population that is most affected from physical inactivity, as a result of the pandemic, is the elderly. Even though that exercise remains an important part in maintaining the general health of individuals above 75 years old, both environmental and personal factors could be used to explain why there is reduced levels of physical activities resulting in increased sedentary lifestyles (Oliveira et al., 2022).

Recovering patients of Covid-19, especially women, were reported to have significantly reduced levels of physical activities as a result of fatigue (Aldhahi et al., 2022). On the hand, hospitalized patients were often immobilized, unable to perform routine exercises that greatly benefit various systems of the body (Woods et al., 2020). This further increased the risk of such patients developing complications which may alter the functions of many organs of the body (Woods et al., 2020).

Even in healthy individuals, the quarantine period had caused the levels of physical activities to be drastically reduced (Puccinelli et al., 2021). Sports and exercise are the most significantly affected, due to travel time and the restrictions in place (Engels et al., 2021).

CHAPTER 3

METHODS

3.1 Chapter overview

An in-depth overview of the research methodology, including the research design, sampling approach, the instrumentation employed, and a detailed description of the procedures followed will be presented in this chapter.

3.2 Research design

Cross sectional correlational study was used in this study. This study design involves gathering pertinent information or data at a specific point in time, without incorporating a time dimension. A cross-sectional study focuses on capturing a snapshot of information at a single moment rather than tracking changes over time. Cross-sectional design is the most suitable design to assess the prevalence of diseases (Kesmodel, 2018). Correlational study is a type of research design that used to determine the relationships between two or more variables (Tan, 2014).

3.3 Ethical approval

This study was started after getting the ethical approval letter from the Scientific and Ethical Review Committees (SERC) of UTAR (Appendix A).

3.4 Sampling Design

The participants of this study were university students that enrolled in any courses in Sungai Long Campus that were at the age between 18 to 26 (Bonnie et al., 2015). Convenience sampling method was used to recruit the participants. This study design entails collecting relevant information or data at a specific moment without incorporating a time dimension. The emphasis of a cross-sectional study is on capturing a single snapshot of information rather than monitoring changes over time (Etikan et al., 2016). Sample size was calculated according to the total number of UTAR students and using the Krejcie & Morgan (1970) table (Appendix D) to determine the final sample size. According to the Division of Admissions and Credit Evaluation of UTAR, the total number of students in UTAR Sungai Long Campus is around 8200 and by using the Krejcie & Morgan (1970) table, the final sample size for the study is 367 people.

The students will be included in this study if they meet the criteria a) Individuals aged 18 to 26 years old, b) UTAR students, c) Covid-19 survivors, and d) those who able to understand English language. The participants will be excluded from this study if they have a) history of mental illness, b) any vascular disease (Virdis & Schiffrin, 2003), c) chronic pain (Saccò et al., 2013), d) chronic migraine (Y.-F. Wang & Wang, 2021), e) suffered from fatigue related syndrome and f) diagnosed with cancer (Seretis et al., 2019).

3.5 Research instruments

The survey distributed contained 13 sections with the first section (Appendix B) Informed consent form containing a brief description of introduction about the study, purpose, risks and benefits of the study. The initial section of the survey includes the researcher's contact information, allowing participants to reach out if they desire further information about the study.

The second section of the survey included the Personal Data Protection notice and consent form (Appendix B), requiring participants to indicate their willingness to participate in the study.

In the third section, demographic data (Appendix E) was collected, including information such as name, age, gender, UTAR email, UTAR student ID, contact number, height, weight, and history of Covid-19 infection.

The fourth part of the form is to check whether participants met the exclusion criteria. The questions included some of their medical history, such as mental illness, vascular disease, chronic pain, chronic migraine, fatigue related illness, and cancer.

The fifth section of the form comprises the MFSI-SF, which consists of 30 questions derived from the MFSI. This section is specifically designed to evaluate the primary manifestations of fatigue. MFSI-SF yields scores only for empirically derived subscales. The empirically derived subscales are employed to evaluate various aspects of fatigue, including general, physical, emotional, and mental manifestations, along with an assessment of vigor, which estimates the individual's energy level. MFSI-SF takes about 5 minutes to be completed. Each item is rated on a five-point Likert scale from 0 (not at all) to 4 (extremely).

The total score ranges from -24 to 96. MFSI-SF does not have a cut-off point, with higher scoring means more intense fatigue (Kłysiak et al., 2023). The internal consistency reliability of MFSI-SF (Multidimensional Fatigue Symptom Inventory-Short Form) subscales has been demonstrated with the following alpha values: Physical=0.84; General=0.93; Mental=0.87; Emotional=0.90; Vigor=0.86. Additionally, the validity of MFSI-SF has been established. The mean effect size (mean d) across 15 studies for each of the subscales is as follows: Physical= 0.73; General= 0.78; Mental= 0.54; Emotional = 0.53; Vigor= 0.76 (Donovan et al., 2015).

From the sixth section to the final part of the form, the participants' level of physical activity in the past 7 days was evaluated using the IPAQ-SF (Appendix F). The IPAQ questionnaires yielded consistent data (Spearman's ρ clustered around 0.8), demonstrating comparability between the short and long forms (C. Craig et al., 2003). The median ρ for criterion validity was approximately 0.30, a value that aligned with the findings of many other self-report validation studies (C. Craig et al., 2003). And this shows that it is a good measure for accessing level of physical activity. This questionnaire contains of 7 questions, related to the frequency and the duration of the participants spending in various intensity of physical activity in the past 7 days. After getting the data, total METS will be calculated and further categorize into insufficiently active, minimally active and HEPA levels.

The criteria for being classified as minimally active include: a) Engaging in vigorous activity for at least 20 minutes per day on 3 or more days per week, OR b) Participating in moderate-intensity activity or walking for at least 30 minutes per day on 5 or more days per week, OR c) Involvement in any

combination of walking, moderate-intensity, or vigorous-intensity activities on 5 or more days per week, achieving a minimum of at least 600 MET-minutes/week. To be classified as HEPA (Health Enhancing Physical Activity) active, individuals must meet one of the following criteria: a) Participating in vigorous-intensity activity on at least 3 days per week, achieving a minimum of at least 1500 MET-minutes/week, OR b) Engaging in any combination of walking, moderate-intensity, or vigorous-intensity activities on 7 or more days per week, achieving a minimum of at least 3000 MET-minutes/week. Those individuals who do not meet the criteria for being minimally active or HEPA active are considered insufficiently active.

3.6 Procedure

Following the letter of ethical approval from the UTAR Scientific and Ethical Review Committee, the researcher initiated the physical distribution of the survey forms on the UTAR Sungai Long campus. Before commencing the questionnaire, all participants were mandated to provide their consent along with an electronic signature. Participants were encouraged to reach out and contact the researcher for any inquiries or further information. After responding to all the questions, participants were obligated to physically attend the campus for the purpose of collecting blood pressure readings. After the data collection process is finish, the researcher then proceed to data cleaning and coding.

3.7 Data analysis

IBM SPSS software statistics version 27 is used for data analysis. Descriptive analysis was done on the age, BMI, systolic, diastolic, MFSI-SF and IPAQ scores to get the mean (M), and standard deviation (SD). Normality of the data will be tested using Shapiro-wilk method. Pearson Chi-Square test was used to analyse the relationship between blood pressure and the level of physical activity. Spearman's correlation test has been used to assess the association between blood pressure, fatigue, and level of physical activity.

CHAPTER 4

RESULTS

4.1 Chapter overview

This chapter presents the outcomes obtained after the completion of the data collection stage for the study. Initially, demographic data of the participants is presented. Subsequently, presenting the outcome measures, followed with results from the inferential tests, and finally the hypothesis testing is provided. The presentation of results follows an order, which was starting with from graphs or figures, followed by a description relating the figure presented, and concluding with table (if any) at the end of each component.

4.2 Demographic data of participant

This subsection presented the demographic data of the participants through a combination of graphs, descriptive information, and, ultimately, a summarized table that encapsulates the key details of the entire subsection.

4.2.1 Age

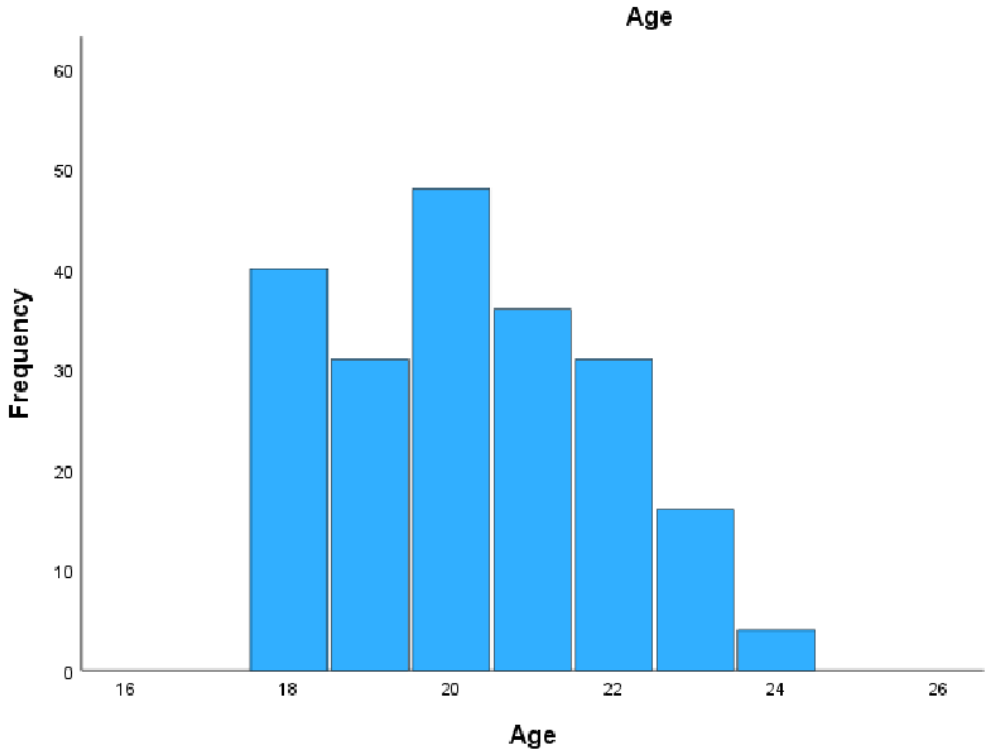

Figure 4.1: Age of participants

Figure 4.1 shows the age of participants of this study which has a mean (M) and standard deviation (SD) of 20.25 and 1.633 years (Table 4.1) respectively. The participants who are the youngest in this study are 18 years old, constituting 19.4% with a count of 40 individuals. There are 31 or 15% of 19-year-old individuals, and 20-years-old individuals were the highest population with 48 or 23.3% of the total participants recruited. 21-year-old individuals has 36 people or 17.5%. 22-year-olds has 31 people or 15%, 23-year-olds follows with 16 or 7.8%. Lastly, there are four 24-year-old individuals participate in this study. These individuals make up the remaining 1.9% of the participants (Table 4.1).

4.2.2 Gender

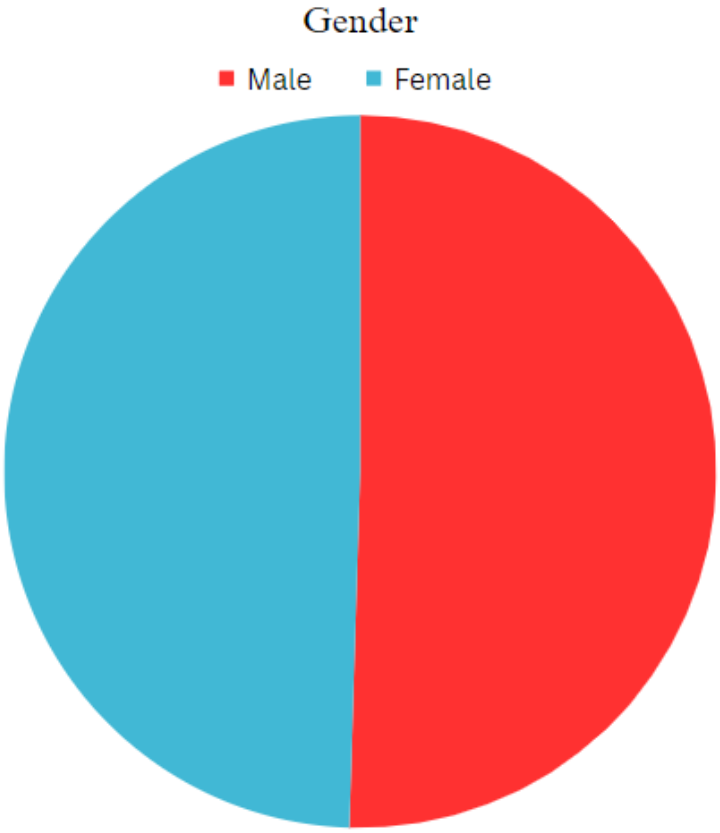

Figure 4.2: Gender of participants

Figure 4.2 demonstrates the gender distribution in this study. There are 104 male students involved in this study, which makes up 50.5% of the total participants and 102 female students participate in this study, which constitute the remaining 49.5% of participants (Table 4.1).

4.2.3 BMI category

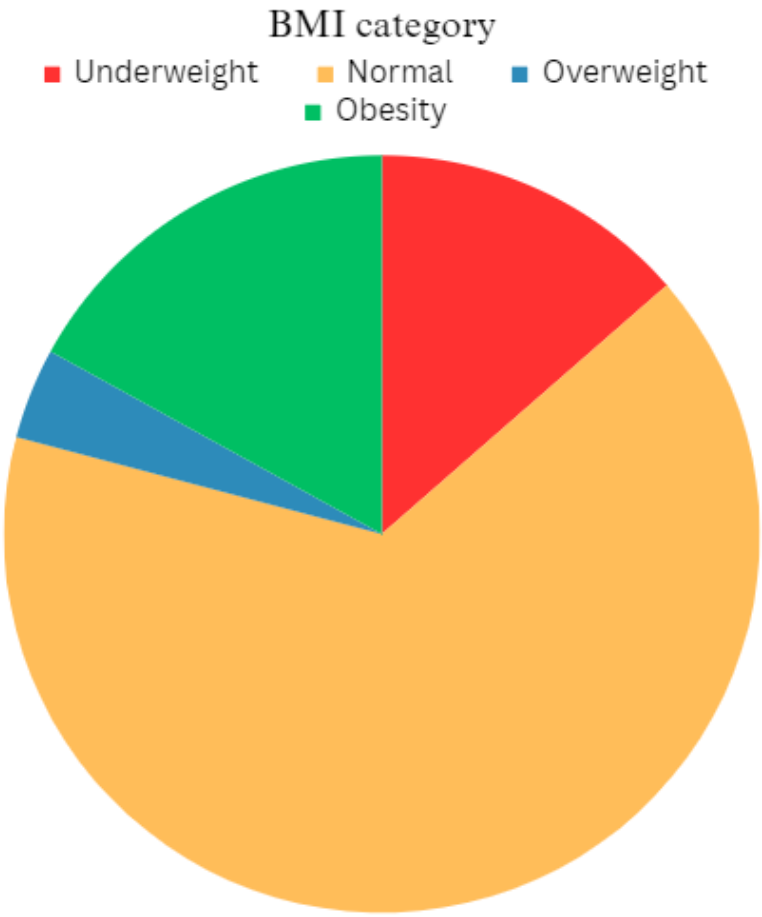

Figure 4.3: BMI category of participants

The BMI category of participants is displayed by Figure 4.3, and it is obvious that most of the participants have normal BMI, which makes up 65.5% of the population with 135 students recruited. Then followed with 35 students with overweight, which makes up 17% of the population. 28 underweight students representing 13.6% of the population, and lastly 8 students with obesity, constitute the final 3.9% (Table 4.1).

Demographic data	Frequency (%)	Mean (SD)
Age		20.25 (1.633)
18	40 (19.4)	
19	31 (15.0)	
20	48 (23.3)	
21	36 (17.5)	
22	31 (15.0)	
23	16 (7.8)	
24	4 (1.9)	
Gender		
Male	104 (50.5)	
Female	102 (49.5)	
BMI category		
Underweight	28 (13.6)	
Normal	135 (65.5)	
Overweight	35 (17.0)	
Obesity	8 (3.9)	

Table 4.1: Demographic data of participants

4.3 Outcome measure

4.3.1 BP category

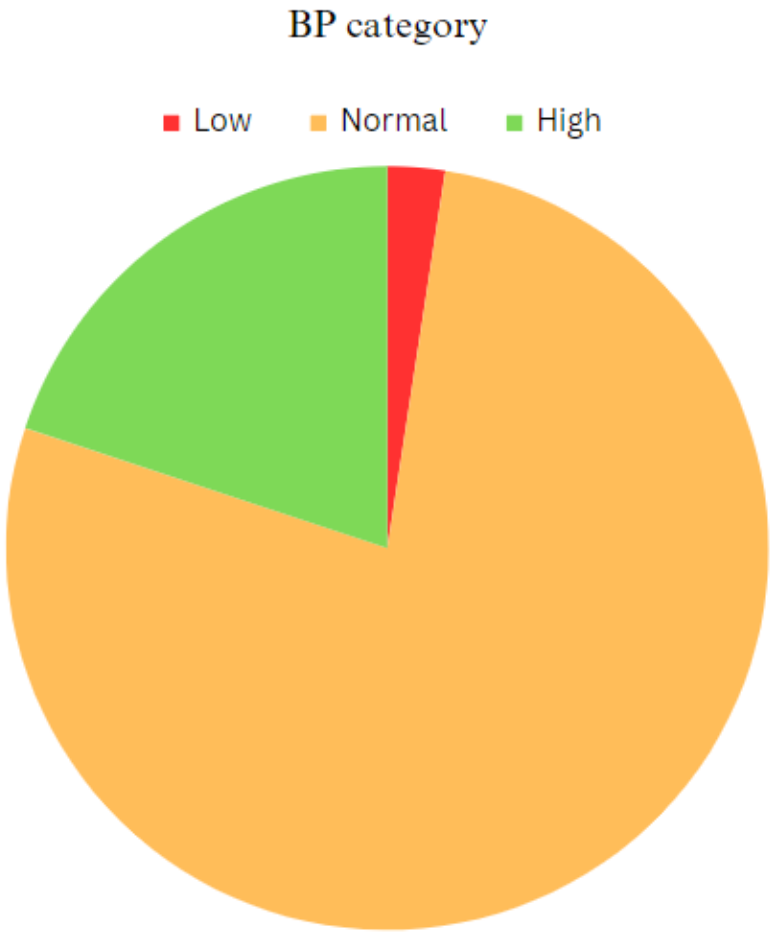

Figure 4.4: BP category of participants

Figure 4.4 illustrates three categories of blood pressure taken from participants. It is obvious that most of the participants have normal blood pressure, which makes up 77.7% of the population with 160 students recruited. Then followed with high blood pressure, which makes up of 41 students or 19.9% of the population. There are only 5 students with low blood pressure representing the final 2.4% of the population (Table 4.2).

4.3.2 MFSI-SF General fatigue score

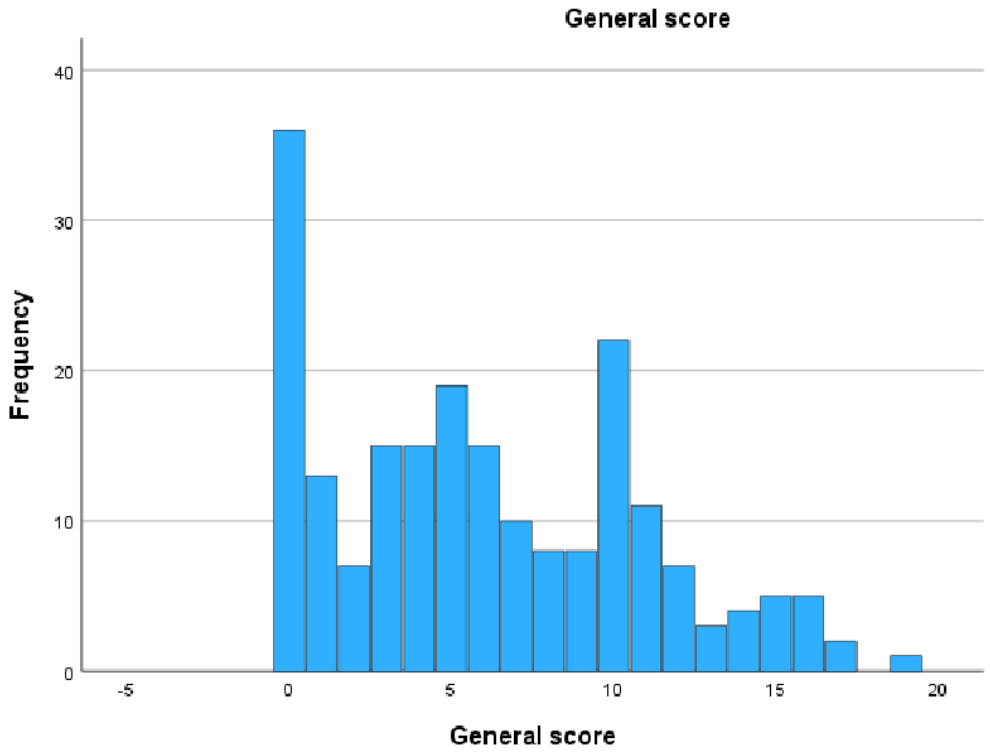

Figure 4.5: General fatigue score of participants

Figure 4.5 shows the general fatigue score of the participants in this study, which has a mean (M) and standard deviation (SD) of 6.07 and 4.767 (Table 4.2) respectively. In the assessment of participants' scores, it was observed that the highest score achieved was 19, indicating that the general fatigue level among post Covid-19 university students is approaching the extreme. On the other hand, the lowest score recorded was 0, indicating a low or non-fatigue is observed from participants. These extremities in scores provide valuable insights into the level of general fatigue within the studied population, allowing for a comprehensive understanding of prevalence of general fatigue among post Covid-19 students (Table 4.2).

4.3.3 MFSI-SF Physical fatigue score

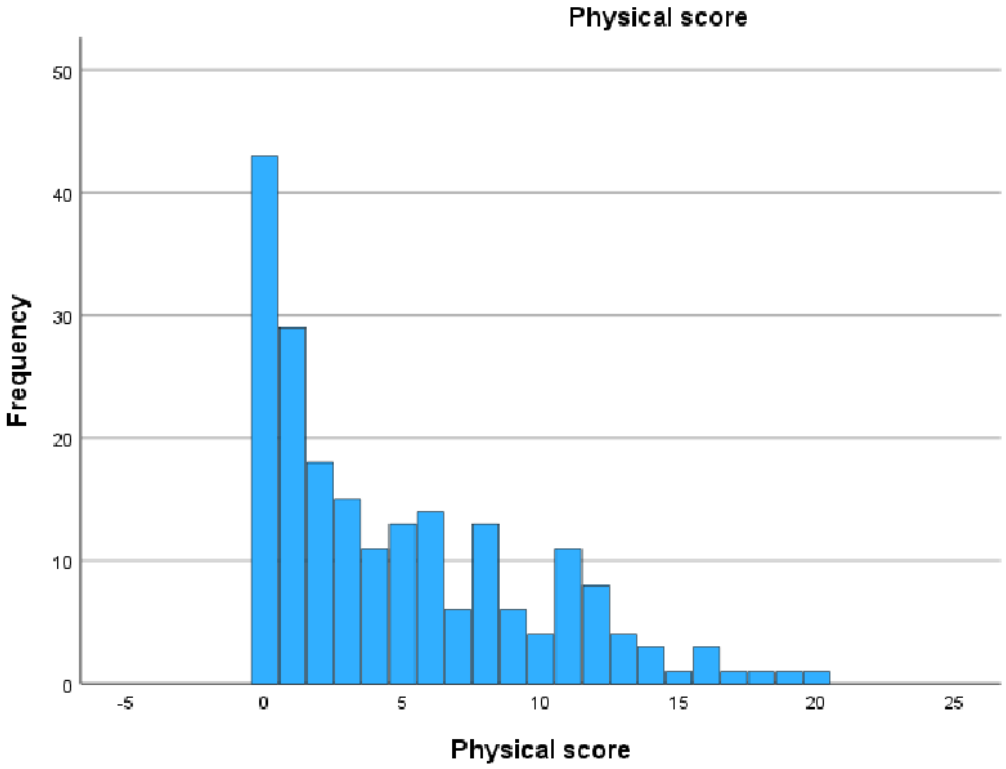

Figure 4.6: Physical fatigue score of participants

Figure 4.6 demonstrates the physical fatigue score of the participants in this study, which has a mean (M) and standard deviation (SD) of 4.81 and 4.737 (Table 4.2) respectively. In the analysis of participants' responses, participants exhibited a range of scores, reflecting different experiences with physical fatigue. The highest scoring, indicating the most severe physical fatigue level, was observed with a score of 20. On the other end of the spectrum, the lowest score was recorded in participants is 0, signalling a relatively lower level of [physical fatigue. These findings provide valuable insights into the variability of physical fatigue experiences among participants (Table 4.2).

4.3.4 MFSI-SF Emotional fatigue score

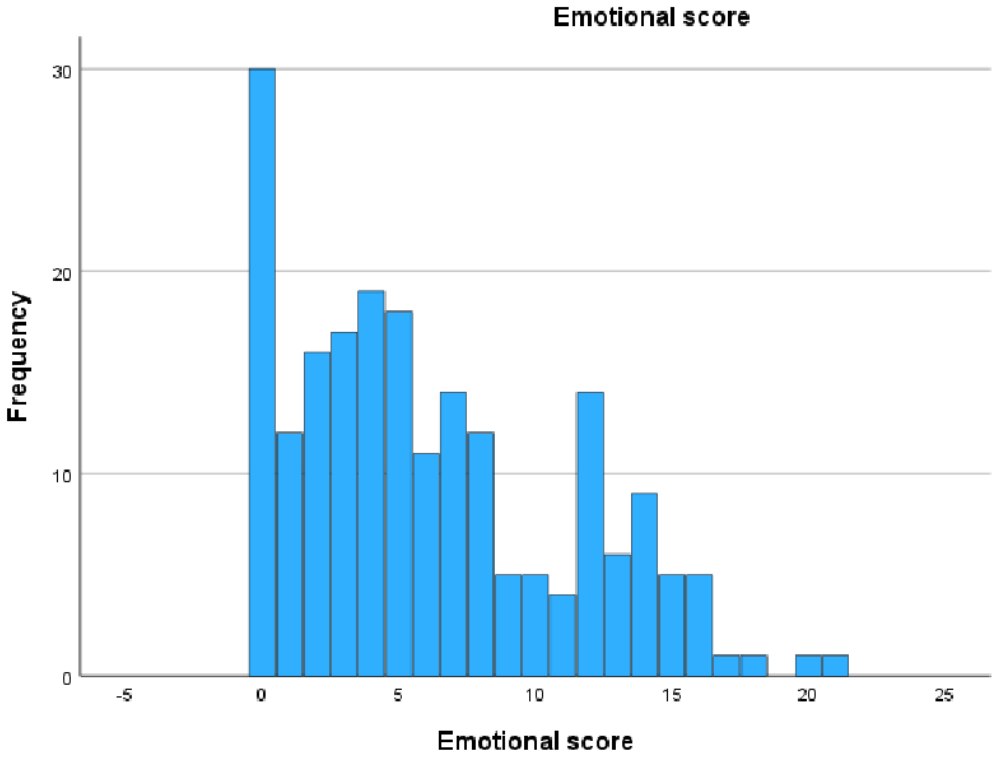

Figure 4.7: Emotional fatigue score of participants

Figure 4.7 displays the emotional fatigue score of the participants in this study, which has a mean (M) and standard deviation (SD) of 6.13 and 5.003 (Table 4.1) respectively. In the assessment of participants' responses to the MFSI-SF, the domain of emotional fatigue revealed different scores, illustrating varying levels of emotional exhaustion. The highest score, indicative of the most severe emotional fatigue, was observed with a score of 21. Conversely, the lowest score within the emotional fatigue domain was recorded with a score of 0, reflecting a comparatively lower level of emotional fatigue. These findings provide important insights into the spectrum of emotional fatigue experiences among participants (Table 4.2).

4.3.5 MFSI-SF Mental fatigue score

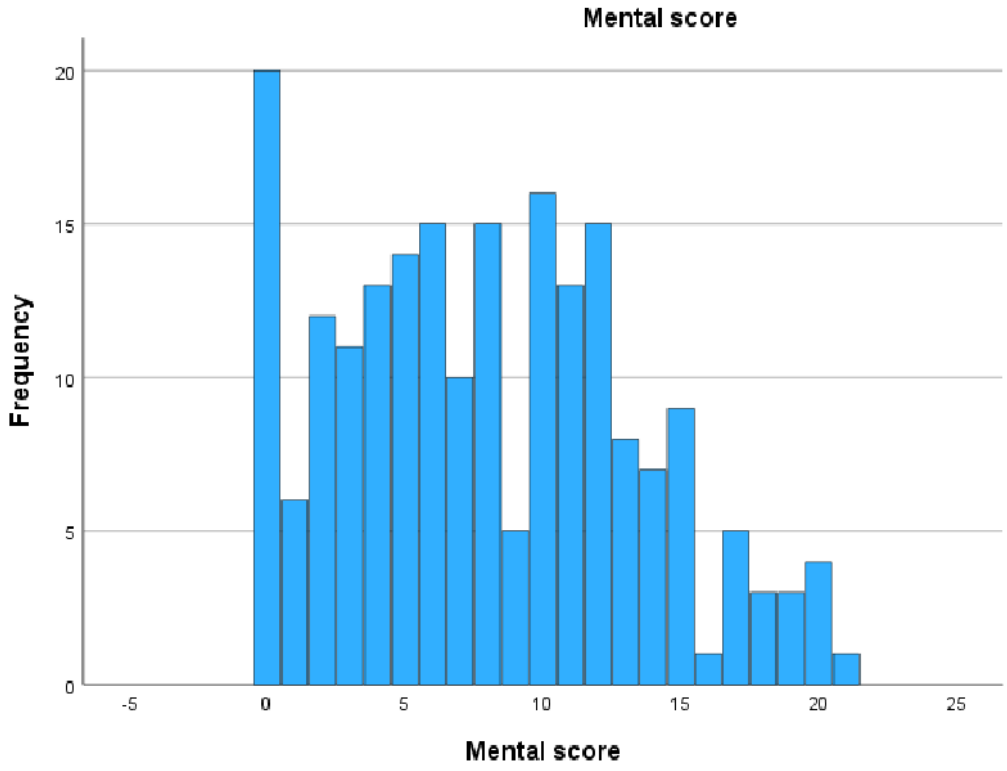

Figure 4.8: Mental fatigue score of participants

Figure 4.8 illustrates the mental fatigue score of the participants in this study, which has a mean (M) and standard deviation (SD) of 7.98 and 5.356 (Table 4.2) respectively. When looking at how participants answered the MFSI-SF about mental fatigue, different scores showing how tired participants felt mentally. The highest score, which means the most mental fatigue, is 21. On the other hand, the lowest score in mental fatigue was 0, reflecting a lower level of fatigue among post Covid-19 university students (Table 4.2).

4.3.6 MFSI-SF Vigor score

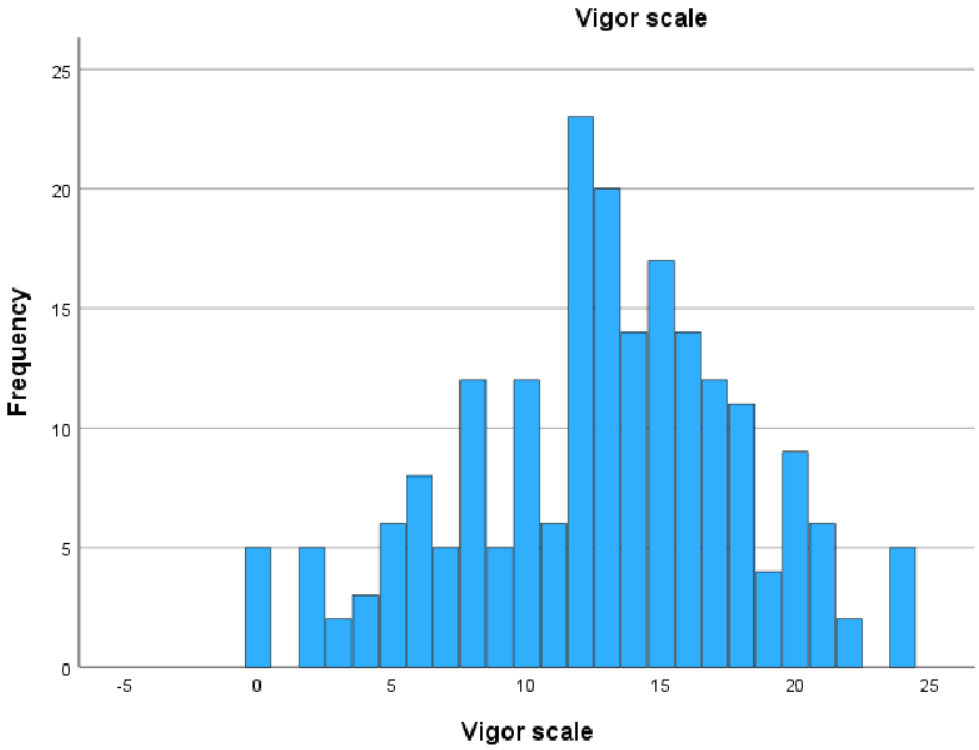

Figure 4.9: Vigor score

Figure 4.9 depicts the vigor score of the participants in this study, which has a mean (M) and standard deviation (SD) of 12.75 and 5.311 (Table 4.1) respectively. Different levels of vigor can be found from the participants' responses. The highest score, indicating the highest vigor level was 24, which is the highest score obtained from all participants. On the other hand, the lowest score for vigor level was 0, revealing that some individuals experienced lower vigor level (Table 4.2).

4.3.7 MFSI-SF Total fatigue score

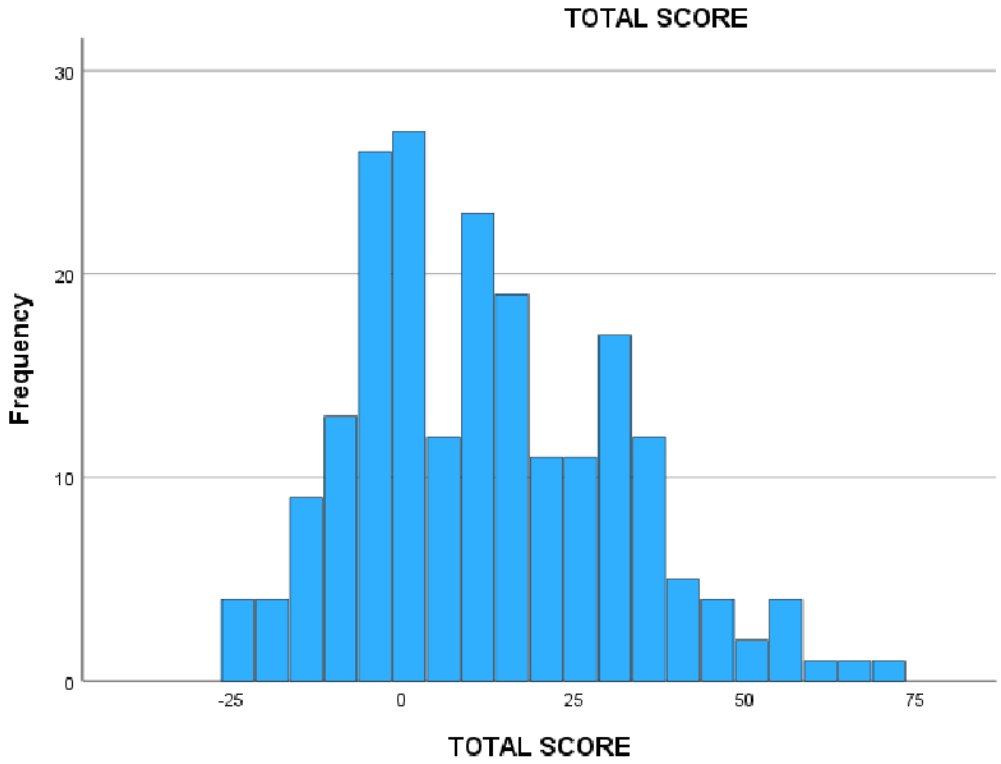

Figure 4.10: Total fatigue score of participants

Figure 4.10 displays the total fatigue score of the participants in this study, which has a mean (M) and standard deviation (SD) of 12.24 and 19.2433 (Table 4.2) respectively. In reviewing how individuals responded to questions about the MFSI-SF, we found different levels of fatigue among them. The highest score, indicating the most severe fatigue level was 69. This suggests a significant high level of fatigue on people's well-being. On the other end of the spectrum, the lowest score for fatigue was -24, revealing that some individuals experienced no fatigue. These findings offer insights into the varying levels of fatigue among participants (Table 4.2).

4.3.8 IPAQ category

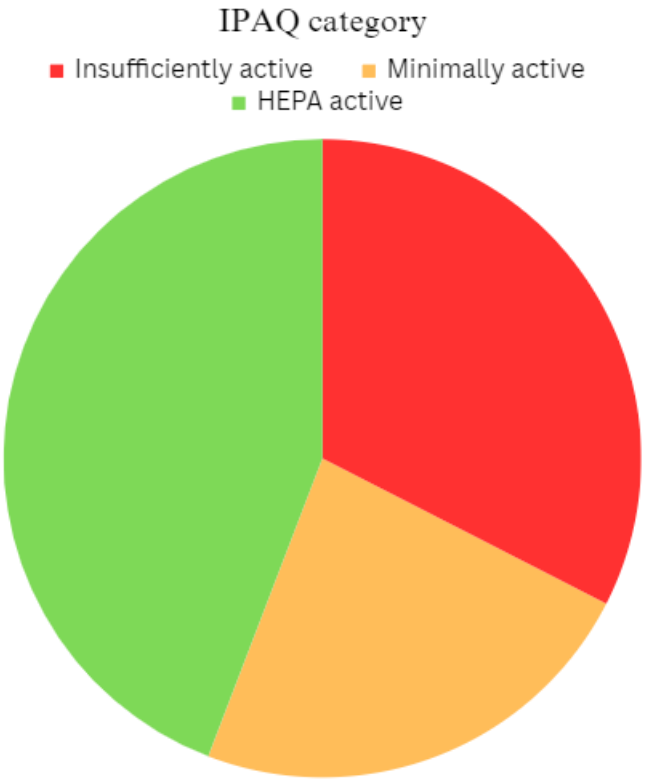

Figure 4.11 IPAQ category of participants

The distribution of IPAQ category of the participants is shown by Figure 4.11. From the figure, most of the participants are HEPA active, which makes up 44.2% of the population with 91 students recruited. There are 67 or 32.5% of students insufficiently active in physical activity, and 48 students or 23.3% of the sample are minimally active (Table 4.2).

Outcome measure	Frequency (%)	Mean (SD)
BP category		
Low	5 (2.4)	
Normal	160 (77.7)	
High	41 (19.9)	
MFSI-SF		
General fatigue score		6.07 (4.767)
Physical		4.81 (4.737)
Emotional		6.13 (5.003)
Mental		7.98 (5.356)
Vigor		12.75 (5.311)
Total		12.4 (19.243)
IPAQ category		
Insufficiently active	67 (32.5)	
Minimally active	48 (23.3)	
HEPA active	91 (44.2)	

Table 4.2 Outcome measure

4.4 Test of Normality

To test the normality of data, Shapiro-Wilk method is used in this study. According to Table 4.3, except the diastolic blood pressure and MFSI-Vigor score ($p>0.05$) is being normal, all the remaining values of the outcome measures have p value that less than 0.05, which indicates the results obtained is being not normal.

4.5 Inferential analysis

This subsection will present the inferential analysis used in research project, including Pearson Chi-square test and Spearman's correlation test to assess the research objectives and hypotheses. Each section will start with a description of the test applied, followed with the findings and finally the table of results will be presented. IBM SPSS Software statistics version 29 was used to analyse the data collected from participants.

4.5.1 Pearson Chi-square test

Pearson Chi-square test is a statistical test to determine the relationship between two variables, and it is only applicable for both categorical data. This test was used to determine the significance differences between blood pressure and level of physical activity. The observed frequencies revealed that among those participants with low blood pressure, 2 are insufficiently active in physical activity, 1 participant is minimally active in physical activity, and 2 are HEPA active. Among those participants with normal blood pressure, 51 individuals are insufficiently active in physical activity, 41 are minimally active, and 68 are HEPA active. For high blood pressure, 14 individuals exhibit a low level of physical activity, 6 participants exhibit minimally active while 21 of them exhibit high level of physical activity. The analysis resulted in a Chi-square statistic (X^2) of 2.438, with 4 degrees of freedom. The associated p-value was 0.656, above the alpha level of 0.05, suggesting a not statistically significant association between blood pressure and level of physical activity. Additionally, an effect size was calculated using Cramer's V, which was found to be 0.077, suggesting the result is weak in association (Table 4.3).

	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-square	2.438	4	0.656

Table 4.3: Results of Chi-square test

4.5.2 Spearman’s correlation test

Spearman’s correlation test will be used in this study. This test examines whether two variables are correlated with one another or not. In this study, it aims to examines the correlation between blood pressure, fatigue, and level of physical activity among post Covid-19 university students.

First, Spearman’s correlation test is used to determine the correlation between blood pressure category and 4 different categories of fatigue as well as vigor level. The test revealed a correlation coefficient of 0.065 between the blood pressure and general fatigue scoring, with a significance level of 0.356. Although there is an association between blood pressure and scores on physical fatigue, the correlation coefficient is 0.04, and the significance level is 0.568. The correlation between blood pressure and emotional fatigue scoring, is indicated by a correlation coefficient of 0.064, with a significance level of 0.36. Moving forward, let's discuss the correlation between blood pressure and mental fatigue score, revealing a correlation coefficient of 0.026, with a significance level of 0.715. The correlation between blood pressure and vigor score is shown in a correlation coefficient -0.118 and with a significance level of 0.092. The correlation between blood pressure and total fatigue scoring is indicated by a correlation coefficient 0.084 and a significance level of 0.227 (Table 4.4).

Next, the Spearman's correlation test is used to assess the relationship between four distinct fatigue categories and vigor level and the level of physical activity. The correlation between general fatigue and level of physical activity is indicated by a correlation coefficient of 0.002, with a significance level of 0.982. The correlation between physical fatigue and level of physical activity is shown in a correlation coefficient of 0.015 and with a significance level of 0.832. The

correlation between emotional fatigue and level of physical activity is indicated by a correlation coefficient 0.056 and a significance level of 0.424. The test revealed a correlation coefficient of -0.018 between the mental fatigue and level of physical activity, with a significance level of 0.795. The correlation between total fatigue scoring and level of physical activity shows a correlation coefficient of -0.027, with a significance level of 0.701, indicates a non-significant correlation.

A special attention to the correlation between vigor and level of physical activity, revealing a correlation coefficient of 0.181, with a significance level of 0.009, which is highly significant.

Lastly, the correlation between blood pressure and level of physical activity is reported with correlation coefficient 0.039 and significance level of 0.575 (Table 4.4). This value reported suggesting a weak and non-significant relationship between these two variables.

	General fatigue score	Physical fatigue score	Emotional fatigue score	Mental fatigue score	Vigor score	Total fatigue score	PA level
BP category							
Correlation coefficient	0.065	0.040	0.064	0.026	-0.118	0.084	0.039
Sig. (2-tailed)	0.356	0.568	0.360	0.715	0.092	0.227	0.575
PA level							
Correlation coefficient	0.002	0.015	0.056	-0.018	0.181	-0.027	-
Sig. (2-tailed)	0.982	0.832	0.424	0.795	**0.009**	0.701	-

Table 4.4: Results of Spearman's correlation test

4.6 Hypothesis Testing

H0i) There is no significant association between fatigue and blood pressure among post Covid-19 university students.

H1i) There is a significant association between fatigue and blood pressure among post Covid-19 university students.

Examining the correlation between level of physical activity and four distinct forms of fatigue- namely general, physical, emotional, mental, and vigor—is one the focus of this study. Spearman's correlation test reveals a non-significant correlation ($p>0.05$) between all these variables. Therefore, the null hypothesis is failed to be rejected.

H0ii) There is no significant association between fatigue and physical activity level among post Covid-19 university students.

H1ii) There is a significant association between fatigue and physical activity level among post Covid-19 university students.

As mentioned, 4 distinct forms of fatigue including general fatigue, physically fatigue, emotional fatigue, mental fatigue, and vigor, as well as total fatigue scoring, which is calculated from all the five types of fatigue are used to identify the correlation between them and the level of physical activity. Spearman's correlation test shows a statistically significant correlation ($p<0.05$) with significance level $p=0.009$, indicates the significant relationship between vigor and level of physical activity. The significance level of other types of fatigue is general fatigue (0.982), physical fatigue (0.832), emotional fatigue (0.424), mental fatigue (0.795), and total fatigue scoring (0.701), reveals a non-

significant correlation ($p>0.05$). Therefore, the null hypothesis cannot be totally rejected nor accepted. This is due to the fact that vigor shows a significant correlation ($p<0.05$) with the level of physical activity.

H0iii) There is no significant association between blood pressure and physical activity level among post Covid-19 university students.

H1iii) There is a significant association between blood pressure and physical activity level among post Covid-19 university students.

The Spearman's correlation test is also used to determine the relationship between blood pressure and physical activity level. The test conducted results in significance level of 0.575 which again does not point to a statistically significant correlation between these two variables. Therefore, the null hypothesis is failed to be rejected.

CHAPTER 5

DISCUSSION

5.1 Chapter overview

This chapter will be the discussion of the findings interpreted from the results sections, aligning them with the objectives. Following this, the limitations of this study and the recommendations will be presented as well. The chapter will conclude with a comprehensive summary and conclusion of this study.

5.2 Discussion

5.2.1 Association between fatigue and blood pressure

Spearman's correlation test was attempted to identify the relationship between the fatigue and blood pressure among the post Covid-19 students. In this study, 4 types of fatigue and vigor were applied to determine their association. The types of fatigue included general, physical, emotional, and mental. As outlined in the results, no significant correlations were observed between various types of fatigue and blood pressure. One possible explanation for this outcome could be attributed to the fact that over 75% of the participants exhibited normal blood pressure levels. (77.7%), which have SBP<120mm Hg and DBP<80mm Hg. Only 2.4% of participants are having low blood pressure and 19.9% of them are high blood pressure. This phenomenon makes it difficult to draw any correlation as most of the data will be accumulating around the normal BP and without many variations. It is believed that if the blood pressure of participants is more evenly distributed, a significant finding can be found.

In terms of fatigue, most of the participants reported a low fatigue score in all types of fatigue. This situation also makes the results to be not statistically significant.

Several studies reported that there is an association between blood pressure and fatigue. According to Helena (2008), “High levels of fatigue were correlated with low blood pressure” (p.284). This study focused on a population diagnosed with Sjogren's syndrome, an autoimmune condition characterized as a type of 'epithelitis' or an exocrinopathy. Fatigue is identified as one of the symptoms in primary Sjogren's syndrome, with approximately 70% of patients reporting this symptom (Strömbeck et al., 2005). The findings indicated that individuals with primary Sjogren's syndrome exhibited significantly lower blood pressure levels compared to those without the condition.

However, Richard Nelesen said that “At rest, fatigue is not associated with BP” (Nelesen et al., 2008). In this study, the participants were instructed to be sitting quietly for 30 minutes in the testing environment. After that, the subjects were instructed to perform a special task that involved preparing and presenting a speech and a camera was placed prominently throughout the procedure. No significant difference was found in BP from the starting until the preparation to speaking period. Hence, the researcher concluded that fatigue is not significant on simple measures such as BP (Nelesen et al., 2008).

In another study, by Barendregt et al, there is no association between fatigue and systolic BP in primary Sjogren’s syndrome (Barendregt et al., 1998). In this study, the objective was to evaluate fatigue concerning depression, blood pressure, and plasma catecholamines in patients with primary Sjogren's

syndrome, comparing them to healthy controls and patients with rheumatoid arthritis. Blood pressure was measured through continuous registration of arterial blood pressure over a 15-minute period during supine rest. The researcher concluded that no significant correlation was identified in patients with primary Sjogren's syndrome between fatigue scores and systolic blood pressure.

These two articles suggested that there is no association between fatigue and blood pressure. The similarity of the findings between Barendregt et al (1998) and Nelesen et al (2008) and my results might be explained. The resemblance in findings between the studies done by Barendregt et al, Nelesen et al, and my own results could potentially be elucidated.

5.2.2 Association between fatigue and PA level

The association between fatigue and PA level is complex and can vary based on individual factors, overall health, and lifestyle. Generally, regular physical activity is associated with increased energy levels and a reduction in fatigue (Puetz, 2006). Engaging in exercise can enhance cardiovascular and muscular fitness, improve sleep quality, and boost overall well-being (Dolezal et al., 2017).

On the other hand, excessive or intense physical activity without adequate rest and recovery can lead to fatigue (Green, 1997). At the cellular level of muscle tissue, there is a significant rise in the consumption of ATP to meet the demands of processes such as muscle excitation, contraction, and relaxation. This includes activities like the exchange of sodium and potassium ions across the sarcolemma, sequestration of calcium ions in the sarcoplasmic reticulum, and the cycling of actomyosin. To sustain elevated ATP levels, mechanisms such as high-energy phosphate transfer, glycolysis, and oxidative phosphorylation are activated. However, during intense physical activity, the rate of ATP production fails to keep pace with its consumption, resulting in a decrease in ATP levels and the accumulation of certain ions. These ions are thought to disrupt the balance of sodium and potassium ions, ultimately contributing to the onset of fatigue (Green, 1997).

Additionally, individuals experiencing chronic fatigue may find it challenging to engage in regular physical activity (Egerton et al., 2016). A study was done among older population. Fatigue is one of the most commonly reported symptoms among older people that restricting their participation in activity and social. From the findings, 9% of the population reported being fatigue. A

decrease in the level of physical activity was observed, indicating a reduction in the duration of physical activity per day across various exercise intensities. In walking steps, 1150 fewer steps, 9 minutes for moderate-vigorous activity and 12 minutes for daily activity were obtained from the population (Egerton et al., 2016). Hence, it can be said that there is an association between fatigue and reduced level of physical activity.

These two articles suggested a potential bidirectional relationship where excessive activity can contribute to fatigue, and fatigue can limit physical activity.

However, in this study, it was found that vigor is associated with PA level among university students. Previous studies were done to investigate the relationship between off-job moderate to vigorous physical activity (MVPA) and vigor at work among workers. The results indicate that having a high level of energy and enthusiasm at work can motivate people to participate in moderate-to-vigorous physical activity during their leisure time.

Two similar studies were done in 2012 and 2014. In 2012, a study was done among nurses in Netherland to examine whether off-job activities enhance next morning vigor to the extent that they enable employees to relax and detach from work. From the findings, the researchers highlighted the importance of recovery after work: Sufficient recovery not only boosts morning vigor but also supports employees in maintaining engagement throughout the following workday (Ten Brummelhuis & Bakker, 2012). In 2014, a study done by Oerlemans and Bakker also focused on employee's population. In the result, the researchers stated that time spent on physical activities has a positive effect on

all daily recovery outcomes including physical vigor (Oerlemans & Bakker, 2014).

It's important to note that various health conditions, stress, sleep quality, and nutritional factors can also influence the relationship between fatigue and physical activity. A systematic review with 168 studies that determine the influence of stress on physical activity was done by Matthew (2014). From the results, the majority of the studies (76.4%) indicated that psychological stress reduced physical activity (Stults-Kolehmainen & Sinha, 2014). Nutritional status can be a mediator of fatigue in older people. This statement was proved by Azzolino et al (2020). Aging can be seen in different aspects such as physiological, psycho-social and pathological changes, leading to poor appetite and affecting the quantity of food consuming (Leslie & Hankey, 2015). This condition can be called ‘anorexia of aging”, potentially leading to malnutrition. Malnutrition may cause weight loss and nutritional deficiencies and lead to fatigue (Azzolino et al., 2020). One study was conducted in UK to investigate how sleep is related to fatigue. In this study, the researcher reported that fatigue was significantly predicted by subjective sleep quality. The researcher further analysed the correlation between fatigue and quantitative sleep characteristics, but it is not statistically significant (Lavidor et al., 2003).

5.2.3 Association between blood pressure and PA level

A Spearman's correlation test was conducted to examine the potential association between blood pressure and the level of physical activity among post-COVID-19 students. The results, as outlined in the results section, indicated no significant correlation between blood pressure and the level of physical activity, with a significance value of 0.575.

One potential explanation for this finding could be attributed to the fact that over 25% of the participants engaged in vigorous physical activity (35.3%). In one study, while comparing the different exercise intensities, the researcher stated that fluctuations in blood pressure were small or non-existent in normal population. Additionally, there is no clear evidence that sticking to an exercise intensity of around 70% would bring about significantly different results compared to exercising at an intensity between 30% and 50% (Fagard, 2001). However, Kingwell and Jennings reported that changes in blood pressure was less effective when comparing the training intensities at 80-90% and training at 65-70% (Kingwell & Jennings, 1993). Three studies reported that a lesser reduction of systolic BP after training in intensity between 65-75% compared to intensity about 40% (Hagberg et al., 1989; Matsusaki et al., 1992; Rogers et al., 1996). Hence, the finding was not statistically significant ($p>0.05$) might be due to the lack of significant effect of vigorous activity on regulating blood pressure.

On the other hand, the IPAQ solely examines the physical activity level over the previous 7 days and does not assess participants' exercise history, such as the number of years they have been engaged in various intensities of physical activity. Hence, it is believed that IPAQ cannot examines the duration of participants they have been engaged in PA. From a study by Cardoso (2010), "It

is clear that acute and chronic aerobic exercise is able to reduce ambulatory blood pressure levels, while in contrast, the acute and chronic effects of resistance exercise on ambulatory blood pressure levels are uncertain". The researcher conveyed that an acute aerobic exercise session has the potential to reduce blood pressure during the post-exercise period by a range of 2 to 12 mm Hg. It has been called post-exercise hypotension (Pescatello et al., 2004). On the flip side, while resistance exercise also induces post-exercise hypotension, there are lingering concerns regarding its effects. Due to the structure of questions of IPAQ such as not investigating the history of engaging in physical activity, it is believed that the responses from participants were not consistent.

Moreover, the IPAQ categorizes heavy lifting as part of vigorous physical activity. Heavy lifting involves using resistance or weight to enhance muscle strength. When examining the results, it was found that 35.3% of the participants engaged in vigorous physical activity, which includes heavy lifting. Drawing a connection to the findings of Cardoso (2010), it is suggested that blood pressure is not significantly associated with the PA level among post Covid-19 university students.

5.3 Limitation of study

In this study, the MFSI-SF and IPAQ-SF questionnaires were employed as validated tools to assess the outcomes. It is important to clarify that these instruments are not diagnostic tools; instead, they serve as self-reporting questionnaires. Participants provided information about their experiences and behaviors through these validated questionnaires, contributing to the study's assessment. It's crucial to recognize that the data collected from these tools reflect subjective self-reports rather than diagnostic conclusions. These questionnaires are valuable for capturing participant perspectives and behaviors within the study parameters, but they do not substitute for clinical or diagnostic assessments. This leads into the limitation of the study where the data collection process is done through online platform (Google form) and in self-reporting method. This approach to gathering data poses challenges in acquiring responses from participants that are clear, accurate, and precise due to potential difficulties in comprehending the questions. It is suggested that conducting face-to-face interviews or physical survey sessions would enhance the accuracy of the outcomes.

Moreover, an additional limitation from the recall bias exhibited by participants regarding their physical activity. Participants are obligated to complete an IPAQ-SF, necessitating them to recall their physical activity over the past 7 days. The act of recalling events may increase inaccuracies, thereby influencing the reported physical status of the participants.

The limitation concerning participant recruitment in this research is the insufficient number of individuals enrolled in this study. According to the criteria outlined in the Krejcie and Morgan table, a minimum of 367 participants was

required for adequate sample size. Regrettably, the researcher was only able to recruit 206 participants, falling significantly short of the recommended threshold. This discrepancy between the ideal and actual participant count poses a limitation to the study, potentially impacting the statistical power and generalizability of the findings. This limitation emphasizes the need for caution when interpreting and analysing the results, as the sample size recruited may not adequately represent the whole population.

Finally, since the study exclusively focused on UTAR students, its generalizability to the entire population of university students is limited. Consequently, future studies should broaden participant recruitment beyond a single institution to enhance the external validity of the findings.

5.4 Recommendations for future study

In proposing suggestions for future research, it is advisable for researchers to opt for physical, face-to-face interviews or one-on-one interactions to enhance the validity of the results. Conducting interviews in this manner allows researchers to provide clarification on questions posed and specify the desired types of responses, potentially facilitating a smoother data cleaning process. The risk of typing errors is possible in online data collection methods, underscoring the recommendation for a physical data collection approach.

Furthermore, expanding the sample size of the population would contribute to a more comprehensive representation of the overall population. For instance, most of students were in the physically HEPA active group and a very high percentage of normal blood pressure were presented in this study. This concentration of certain groups may lead to a potential bias, either underrepresenting or overrepresenting specific student categories, thus potentially distorting the study's outcomes. To overcome this issue, future research could be expanded the recruited sample size which will definitely increase the overall quality and impact of study.

5.5 Conclusion

In summary, the findings of this study revealed that among post-COVID-19 university students, there is no statistically significant association between blood pressure and fatigue. The analysis, characterized by a significance value greater than 0.05, indicates that fluctuations in blood pressure are not significantly correlated with the experience of fatigue in this particular study. These results suggested a lack of a direct relationship between blood pressure and fatigue or vice versa within the context of post Covid-19 recovery among university students. It is essential to consider these outcomes when interpreting the broader implications for health and well-being in this specific population. Additional investigation and research may be necessary to explore the intricate relationship between blood pressure and fatigue following COVID-19, adding to a more complete comprehension of the health changes that occur after illness in university students.

Additionally, the study revealed that among 5 types of fatigue, there is no significant association observed in general fatigue, physical fatigue, emotional fatigue and mental fatigue, with levels of physical activity among post-COVID-19 university students, as evidenced by a p-value exceeding 0.05. However, a significant relationship between vigor fatigue and level of physical activity, with a significance value, $p=0.009$. This implies that the presence of vigor fatigue is significantly associated with the degree of physical activity in this particular group of students who have experienced the aftermath of Covid-19. These findings underscore the importance of understanding the intricate relationship between fatigue and physical activity in post-illness scenarios,

suggesting that, within this specific cohort, levels of fatigue do not significantly vary based on the extent of physical activity engagement.

Last but not least, the findings revealed that there is no significant association between blood pressure and level of physical activity, as evidenced by a p-value exceeding 0.05, indicates that fluctuations in blood pressure are not significantly correlated with the level of physical activity in this particular study. These findings suggested a lack of a direct relationship between blood pressure and level of physical activity or vice versa within the post Covid-19 university students.

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APPENDIX A – ETHICAL APPROVAL LETTER

UNIVERSITI TUNKU ABDUL RAHMAN
Wholly Owned by UTAR Education Foundation (Company No. 578227-M)

Re: U/SERC/248/2023

26 September 2023

Mr Muhammad Noh Zulfikri bin Mohd Jamali
Head, Department of Physiotherapy
M. Kandiah Faculty of Medicine and Health Sciences
Universiti Tunku Abdul Rahman
Jalan Sungai Long
Bandar Sungai Long
43000 Kajang, Selangor

Dear Mr Muhammad Noh,

Ethical Approval For Research Project/Protocol

We refer to your application for ethical approval for your students' research project from Bachelor of Physiotherapy (Hons) programme enrolled in course UMFD3026. We are pleased to inform you that the application has been approved under Expedited Review.

The details of the research projects are as follows:

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
48.	The Effects of Balancing Exercise on Balance, Jumping Performance and Agility in Recreational University Badminton Players	Khu Khang Zhuang	Mr Sathish Kumar Sadagobane	
49.	Prevalence of Fatigue and Blood Pressure, and Its Association to Physical Activity among Post Covid-19 University Students	Chan Yi Fei	Ms Siti Hazirah Binti Samsuri	
50.	Association between Fatigue and Psychological Factors among Undergraduate University Students: A Cross-sectional Study	Chan Zhi Xin		
51.	Association between Sleep Quality, Life Satisfaction, and Health Related Quality of Life among Post Covid-19 Survivors	Chek Ru-E		

The conduct of this research is subject to the following:

(1) The participants' informed consent be obtained prior to the commencement of the research;

(2) Confidentiality of participants' personal data must be maintained; and

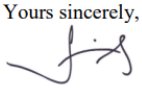
(3) Compliance with procedures set out in related policies of UTAR such as the UTAR Research Ethics and Code of Conduct, Code of Practice for Research Involving Humans and other related policies/guidelines.

(4) Written consent be obtained from the institution(s)/company(ies) in which the physical or/and online survey will be carried out, prior to the commencement of the research.

Should the students collect personal data of participants in their studies, please have the participants sign the attached Personal Data Protection Statement for records.

Thank you.

Yours sincerely,



Professor Ts Dr Faidz bin Abd Rahman
Chairman
UTAR Scientific and Ethical Review Committee

c.c Dean, M. Kandiah Faculty of Medicine and Health Sciences
Director, Institute of Postgraduate Studies and Research

Kampar Campus : Jalan Universiti, Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia
Tel: (605) 468 8888 **Fax**: (605) 466 1313
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Tel: (603) 9086 0288 **Fax**: (603) 9019 8868
Website: www.utar.edu.my

APPENDIX B – INFORMED CONSENT FORM

Prevalence of Fatigue and Blood Pressure, and Its Association to Physical Activity Among Post Covid-19 University Students

Dear respondant,

First of all, thank you for participating in this study! Your efforts are much appreciated.
You are being asked to volunteer in this study that is being conducted as part of the requirement to complete UMFD3026 RESEARCH PROJECT.

Please read the information sheet and contact me to ask any questions that you may have before agreeing to take part in this study.

Purpose of the Research Study

The purpose of this study is to examine the prevalence of fatigue and blood pressure, and its association with physical activity among post covid-19 university students.

Approximately 404 individuals will participate in this study.

Procedures

If you agree to be in this study, you will be asked to fill up 2 questionnaires regarding fatigue level and the level of physical activity in past 7 days. these 2 questionnaires will take 5-10 minutes to complete. Then, you will be asked to attend to university to measure the blood pressure. The measurement will take 5 minutes to complete. The relevant data will then be collected and analyzed.

Length of participation

One time participation only

Risks and Benefits

No risk will be involved throughout in the current study.

The benefits of participating in this study include screening for blood pressure, knowing your fatigue level, and understand the importance of physical activity in controlling blood pressure and reducing the level of fatigue.

Confidentiality

No information that will make it possible to identify you, will be included in any reports to the University or in any publications.

Research records will be stored securely and only approved researchers will have access to the records.

Voluntary Nature of the Study

Participation in this study is voluntary. If you withdraw or decline participation, you will not be penalized or lose benefits or services unrelated to the study. If you decide to participate, you may decline to answer any question and may choose to withdraw at any time.

Contacts and Questions

If you have any questions, clarifications, concerns or complaints, about the research, the researcher conducting this study can be contacted at 011-36343623, or by email with yifeichan020205@1utar.my.

My Research Supervisor, Ms Siti Hazirah binti Samsuri, can be contacted at 019-7104186, or by email with hazirahs@utar.edu.my if there are any inquiries, concerns or complaints about the research and there is a wish to talk to someone other than individuals on the research team.

Please keep this information sheet for your records.

If you have read the information sheet and agree to participate in this study, please tick the checkbox *

☐ I have read the above statements and agree to take part in this study

E-signature (Eg. Chan Yi Fei) *

Short answer text

APPENDIX C – PERSONAL DATA PROTECTION NOTICE

Personal Data Protection Notice

Please be informed that in accordance with Personal Data Protection Act 2010 ("PDPA") which came into force on 15 November 2013, Universiti Tunku Abdul Rahman ("UTAR") is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal information.

1. Personal data refers to any information which may directly or indirectly identify a person which could include sensitive personal data and expression of opinion. Among others it includes:
a) Name
b) Identity card
c) Place of Birth
d) Address
e) Education History
f) Employment History
g) Medical History
h) Blood type
i) Race
j) Religion
k) Photo
l) Personal Information and Associated Research Data

2. The purposes for which your personal data may be used are inclusive but not limited to:
a) For assessment of any application to UTAR
b) For processing any benefits and services
c) For communication purposes
d) For advertorial and news
e) For general administration and record purposes
f) For enhancing the value of education
g) For educational and related purposes consequential to UTAR
h) For replying any responds to complaints and enquiries
i) For the purpose of our corporate governance
j) For the purposes of conducting research/ collaboration

3. Your personal data may be transferred and/or disclosed to third party and/or UTAR collaborative partners including but not limited to the respective and appointed outsourcing agents for purpose of fulfilling our obligations to you in respect of the purposes and all such other purposes that are related to the purposes and also in providing integrated services, maintaining and storing records. Your data may be shared when required by laws and when disclosure is necessary to comply with applicable laws.

4. Any personal information retained by UTAR shall be destroyed and/or deleted in accordance with our retention policy applicable for us in the event such information is no longer required.

5. UTAR is committed in ensuring the confidentiality, protection, security and accuracy of your personal information made available to us and it has been our ongoing strict policy to ensure that your personal information is accurate, complete, not misleading and updated. UTAR would also ensure that your personal data shall not be used for political and commercial purposes.

Consent:

6. By submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and conditions in the Notice and our relevant policy.

7. If you do not consent or subsequently withdraw your consent to the processing and disclosure of your personal data, UTAR will not be able to fulfill our obligations or to contact you or to assist you in respect of the purposes and/or for any other purposes related to the purpose.

8. You may access and update your personal data by writing to us at yifeichan020205@1utar.my.

Acknowledgement of notice *

- ○ I have been notified and that I hereby understood, consented and agreed perUTAR above notice.
- ○ I disagree, my personal data will not be processed.

E-signature (Eg. Chan Yi Fei) *

Short answer text

Date *

Month, day, year

APPENDIX D – KREJCIE AND MORGAN (1970) TABLE

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

APPENDIX E – DEMOGRAPHIC DATA FORM

Demographic Data

Description (optional)

Full Name (as per NRIC) *

Short answer text

Age *

Short answer text

Gender *

- Male
- Female

UTAR email (Eg. xxx@1utar.my) *

Short answer text

UTAR Student ID (Eg. 20UMB01234) *

Short answer text

Contact Number (Eg. 010-xxx xxxx) *

Short answer text

Weight (kg) *

Short answer text

Height (cm) *

Short answer text

Have you ever had Covid-19? *

- Yes
- No

APPENDIX F – MFSI-SF

Multidimensional Fatigue Symptom Inventory - Short Form (MFSI-SF)

Below is a list of statements that describe how people sometimes feel. Please read each item carefully, then tick the one which best describes how true each statement has been for you in the past 7 days.

0 - Not at all
1 - A little
2 - Moderately
3 - Quite a bit
4 - Extremely

I have trouble remembering things. *

0	1	2	3	4
○	○	○	○	○

My muscles ache. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel upset. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

My legs feel weak. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel cheerful. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

My head feels heavy. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel lively. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel nervous. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel relaxed. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel pooped (exhausted). *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I am confused. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I am worn out. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel sad. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel fatigue. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I have trouble paying attention. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

My arms feel weak. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel sluggish (lack of energy). *

0	1	2	3	4
○	○	○	○	○

I feel run down. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I ache all over. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I am unable to concentrate. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel depressed. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel refreshed. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel tense. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel energetic. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I make more mistakes than usual. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

My body feels heavy all over. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I am forgetful. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel tired. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I feel calm. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

I am distressed. *

	0	1	2	3	4	
Not at all	○	○	○	○	○	Extremely

APPENDIX G – MODIFIED IPAQ-SF

International Physical Activity Questionnaire (IPAQ)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. 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.

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.

Description (optional)

During the **last 7 days**, did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling? *

- ○ Yes
- ○ No

If yes, on how many days did you do **vigorous** physical activities? *

Short answer text

How much time did you usually spend doing **vigorous** physical activities on one of those days? (in minutes per day) *

Short answer text

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.

Description (optional)

During the **last 7 days**, did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking. *

- Yes
- No

If yes, on how many days did you do **moderate** physical activities? *

Short answer text

How much time did you usually spend doing **moderate** physical activities on one of those days? (in minutes per day) *

Short answer text

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.

Description (optional)

During the **last 7 days**, did you **walk** for at least 10 minutes at a time? *

- Yes
- No

If yes, on how many days did you **walk** for at least 10 minutes at a time? *

Short answer text

How much time did you usually spend **walking** on one of those days? (in minutes per day) *

Short answer text

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.

Description (optional)

During the last 7 days, how much time did you spend sitting on a week day? (in minutes per day) *

Short answer text

APPENDIX H – TURNITIN REPORT

Turnitin Originality Report

turnitin **Turnitin Originality Report**

association between fatigue, blood pressure, and physical activity levels among post Covid-19 university students
by Yifei Chan

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