DELPHINE YEO SZE QI

CHRONIC FATIGUE SYNDROME AND ITS ASSOCIATION WITH QUALITY
OF LIFE AND SLEEP QUALITY

PREVALENCE OF CHRONIC FATIGUE SYNDROME AND ITS ASSOCIATION WITH QUALITY OF LIFE AND SLEEP QUALITY AMONG YOUNG ADULTS: A CROSS-SECTIONAL STUDY

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By

DELPHINE YEO SZE QI

A Research project submitted to the Department of Physiotherapy, Faculty of Medicine
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PREVALENCE OF CHRONIC FATIGUE SYNDROME AND ITS ASSOCIATION WITH QUALITY OF LIFE AND SLEEP QUALITY AMONG YOUNG ADULTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background and Objective: Chronic fatigue syndrome (CFS), also called as myalgic encephalomyelitis (ME) is a exhausting clinical condition classified by continuous and unexplained fatigue after physical activity accompanied by a spectrum of symptoms linked to cognitive, immune, hormonal, and autonomic dysfunctions. Individuals affected by CFS are unable to perform their usual social, work, or recreational activities, and some of them may be restricted to home or bed. Their quality of life related to health is lower compared to individuals dealing with depression or those who have experienced a stroke condition. Therefore, this study aims to investigate the prevalence of chronic fatigue syndrome and its association with quality of life and sleep quality among young adults.

Methods: This is a cross-sectional study. The sampling method used in the study was convenience sampling and the sample size was calculated to be at 385 participants. Data analysis will be performed using SPSS and Excel. Descriptive statistics (frequency, percentage, mean, standard deviation) will be used for demographic data and SF-36/PSQI scores. Normality of SF-36 and PSQI will be checked with the Kolmogorov-Smirnov test. Chi-Square tests will assess associations between CFS and quality of life/sleep quality, with significance set at $p<0.05$.

Results: In the study, 248 participants were recruited in total but only 224 participants including with xx of female and xx of male meet the inclusion criteria, proceeding to the study. The prevalence of chronic fatigue syndrome was xx, There is no statistically significant ($p>0.05$) association between CFS with quality of life and sleep quality.

Conclusion: There is low prevalence of CFS and no association between CFS and quality of life and sleep quality among young adults. It is possibly due to the small sample size. Further research with larger, more representative samples is needed.

Keywords: Chronic fatigue syndrome, quality of life, sleep quality, young adults

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APPROVAL SHEET

This Research project entitled **"PREVALENCE OF CHRONIC FATIGUE SYNDROME AND ITS ASSOCIATION WITH QUALITY OF LIFE AND SLEEP QUALITY AMONG YOUNG ADULT: A CROSS-SECTIONAL STUDY"** was prepared by **DELPHINE YEO SZE QI** 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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Date: 20/12/2023

PERMISSION SHEET

It is hereby certified that **DELPHINE YEO SZE QI** (ID No: **20UMB06111**) has completed this Research project entitled “PREVALENCE OF CHRONIC FATIGUE SYNDROME AND ITS ASSOCIATION WITH QUALITY OF LIFE AND SLEEP QUALITY AMONG YOUNG ADULTS: A CROSS-SECTIONAL STUDY.” under the supervision of MR. SATHISH KUMAR SADAGOBANE (Supervisor) from the Department of Physiotherapy, Faculty of Medicine and Health sciences.

Yours truly,

(DELPHINE YEO SZE QI)

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.

Name: DELPHINE YEO SZE QI

Date: 20/12/2024

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LIST OF ABBREVIATIONS

UTAR	Universiti Tunku Abdul Rahman
CFS	Chronic Fatigue Syndrome
SF-36	Short form-36
PSQI	Pittsburg Sleep Quality Index
M	Mean
SD	Standard Deviation
p	p-value (Significance)
n	Number of participants
$\chi 2$	Chi-square

CHAPTER 1

INTRODUCTION

1.1 Chapter Overview

This chapter introduces the research project by covering the background of the study, research questions, problem statement, research objectives, and operational definitions. It also outlines the structure of the research project and explains the rationale for conducting the study.

1.2 Background of Study

Chronic fatigue syndrome (CFS), also called as myalgic encephalomyelitis (ME) is a exhausting clinical condition classified by continuous and unexplained fatigue after physical activity accompanied by a spectrum of symptoms linked to cognitive, immune, hormonal, and autonomic dysfunctions (Brurberg et al., 2014). Individuals affected by CFS are unable to perform their usual social, work, or recreational activities, and some of them may be restricted to home or bed. Their quality of life related to health is lower compared to individuals dealing with depression or those who have experienced a stroke condition (Chu et al., 2017). An article references a study that examined the mortality outcomes of over 2000 CFS patients over a 7-year period. The study found that while the overall risk of death and cancer mortality in CFS patients was similar to the general population, the risk of suicide was almost seven times higher (Kapur & Webb, 2016b). Due to this exhausting condition, the burden on both patients and their caregiver is immense. An alteration in family roles and a decrease in social support were also reported by the siblings, and these were attributed to their sibling's illness (Velleman et al., 2016). The study found that siblings of pediatric CFS patients exhibited significant anxiety, with a one-fourth of siblings achieving a score higher than the 90th percentile for anxiety. Thus, an article underscores the significance of showing empathy and offering both practical and emotional assistance to children, adolescents, and parents dealing with CFS (Loades et al., 2020).

There is still no universally approved and definitely effective treatment for individuals with ME/CFS despite multiple approaches with different interventions has been tried (Chambers et al., 2006). Through a comprehensive clinical investigation called as PACE trial, behaviour therapy (CBT) and graded exercise therapy (GET) were recommended as effective treatments for ME/CFS. However, there is ongoing argument and critique from both scientist and patients regarding these recommendations. (Shepherd, 2017).

In 1959, the term "benign myalgic encephalomyelitis" eventually was adopted to describe an inflammatory disease defined by intense muscular pains and the indications of parenchymal damage to the nervous system, without associated mortality ("CFS: Redefining an Illness," 2015). Interestingly, most individuals in this hospitalize group experienced upper airway infection before the commencement of the illness. Additionally, they encountered gastrointestinal changes, acute vertigo, and a sore throat. Subsequently, they developed severe headaches intensified by movement and change of position, nuchal pain, limb pain, profound fatigue, and paraesthesia. More critical symptoms were reported in some cases, such as muscle cramps, twitching, sensory deficits, muscle tenderness, cranial nerve abnormalities, and disorders in ocular movements, indicative of a condition resembling "epidemic neuromyasthenia" (Ramsay, 1978). According to Missailidis et al. (2019), the lack of diagnostic biomarkers has been a challenge in ME/CFS research and patient treatment. However, modern research indicates that there is a concrete biomedical foundation for the disorder affecting multiple body systems, including disturbances in immunological and inflammatory processes, autonomic and neurological dysfunctions, abnormalities in muscle and mitochondrial function, metabolic changes, and disturbances in gut physiology or microbiota. These abnormalities may be interconnected and reflect an underlying molecular pathology. Making the use of case definition criteria the sole method for diagnosing CFS/ME. Two primary case definition tools, Oxford 1991 (Sharpe) and CDC 1994 (Fukuda), have been mainly employed (Naviaux et al., 2016).

1.3 Research Questions

1. To determine the prevalence of chronic fatigue syndrome among young adults.
2. To identify the association between chronic fatigue syndrome and quality of life among young adults.

3. To identify the association between chronic fatigue syndrome and sleep quality among young adults.

1.4 Problem Statement

Several research studies have shown that Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS) is prevalent in middle-aged adults, particularly in the female population. However, there has been no research conducted to determine the prevalence of CFS and its impact on the quality of life and sleep quality among young adults. Therefore, this study will determine the prevalence and investigate the association between CFS and quality of life and sleep quality among young adults in Klang Valley, Malaysia. Due to the lack of awareness of the association between CFS and quality of life and sleep quality among young adults, the prevalence the health condition is increasing and even affects their quality of life and sleep quality. Based on the findings of the results of the research, physiotherapist can recommend appropriate interventions or support mechanisms for young adults affected by CFS, aiding in the management of their condition and enhancing their overall quality of life and sleep quality. Additionally, these professionals can raise awareness of CFS to public by disseminating research findings and cultivating a supportive environment for individuals with CFS.

1.5 Research Objective

1. To determine the prevalence of chronic fatigue syndrome among young adults.
2. To identify the association between chronic fatigue syndrome and quality of life among young adults.
3. To identify the association between chronic fatigue syndrome and sleep quality among young adults.

1.6 Operational Definition

1. Prevalence is described as the fraction of a population that possesses a particular characteristic in a given time period is known as its prevalence (*What Is Prevalence?*, n.d.).

2. Chronic fatigue syndrome (CFS) is a complicated and not fully understood condition characterized by extreme fatigue persisting for at least 6 months, with symptoms intensifying both physical and mental exertion and showing limited improvement with rest (*Symptoms and Cause*, 2023).
3. Association is defined as several coefficients and factors are used to measure the relationship between two or more variables (Haug, 2016).
4. Quality of life refers to an individual's wealth or fulfilment with life, can also be defined as the essential capabilities needed to live a fulfilling life in terms of emotional and physical well-being (Jenkinson, 2023).
5. Sleep quality is described as the level of fulfilment with one's sleep experience, encompassing elements such as falling asleep, staying asleep, the amount of sleep, and feeling refreshed upon waking (Kline, 2013).
6. Young adulthood is a distinct developmental stage that takes place between the ages of 18 and 30, characterized by important tasks that enable individuals to engage in self-discovery and shape their identities (Higley, n.d.).

1.7 Structure of Research Project

This research paper is organized into five chapters. Chapter 1 introduces the study by providing the background, research questions, problem statement, objectives, and the significance of the study. Chapter 2 presents a comprehensive literature review, exploring relevant themes and findings from previous research. Chapter 3 describes the study's methodology, including the research design, sampling methods, research instruments, and data collection procedures. Chapter 4 focuses on the results of the study, incorporating both descriptive and inferential analyses, along with hypothesis testing. Lastly, Chapter 5 discusses the study's findings, highlights its limitations, and offers recommendations for future research.

1.8 Rationale of Study

There are many studies have examined the risk factors that are possible to cause CFS in terms of childhood trauma and infection and prevalence of CFS among different population and at different nations. There is also much research that study the association between CFS and academic performance among adolescents in the age group of 12-18. However, not much research has been conducted in Klang Valley to investigate the prevalence of CFS and its association with quality of life and sleep quality among young adults in Klang Valley. Thus, the aim of this study is to determine the prevalence of CFS and its association with quality of life and sleep quality among young adults.

Research on this study is crucial to understand the scope of the problem and its possible effect on the community. The result of the study may discover how common CFS is within the young adult population. This population may experience difficulties regarding social relationships, academic obligations, self-development and general well-being. Based on the findings, physiotherapists play a vital role in tailoring interventions for individuals with CFS to manage symptoms such as fatigue, pain, and unexplained fatigue after exertion. In addition, physiotherapist can address comorbidities associated with ME/CFS, such as musculoskeletal pain or cardiovascular problems. Due to the complexity of this condition, physiotherapist can collaborate with other healthcare professionals as well to provide holistic care for individuals who are affected.

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter Overview

This chapter provides a comprehensive review of the relevant literature related to the study. It explores the critical aspects of the topic, highlighting previous studies, identifying research gaps, and establishing the rationale for the current investigation.

2.2 **Prevalence of Chronic Fatigue Syndrome**

The prevalence of chronic fatigue syndrome (CFS) varies depending on the criteria used for diagnosis and the population studied. Other than that, the accurate method to measure the prevalence of CFS is challenging due to the absence of biomarkers and specific diagnostic criteria. According to Nacul et al. (2015), the study employed a combination of clinical evaluations and patient questionnaires to estimate the prevalence of CFS acorss three regions of England. The study recruited population of 143000 people between ages of 18 to 64 years. The overall prevalence rate of CFS across the three regions studied in England (East Anglia, London, and East Yorkshire) was 0.20%. The prevalence rate varied slightly among and within the regions, with London having the highest rate of 0.31%, followed by East Anglia at 0.25%, and East Yorkshire at 0.14%. The minimum prevalence rates of CFS vary relying on different case definitions, with the CDC-1994 definition at 0.19%, the Canadian definition at 0.11%, and the Epidemiological Case (ECD) definition at 0.03%. Another study mentioned a rough prevalence figures for CFS within the primary care setting in Australia from 2015 to 2019 which is ranging between 94.9 and 101.5 per 100000 population throughout this timeframe (Orji et al., 2022).

The systematic review conducted a search for the prevalence of CFS in public databases spanning from 1980 to December 2018. The prevalence rates of CFS vary based on different factors. In the general population aged 18 years and above, the prevalence is estimated at 0.65%, while for children and adolescents below 18 years, it is slightly lower at 0.55%. Gender differences indicate a higher prevalence among females at 1.36% compared to males at 0.86%. Among study participants, community-based samples have a prevalence of 0.76%, while primary care sites show a slightly lower prevalence of 0.63%. The rates also differ based on specific case definitions, with CDC-1994 criteria at 1.46 ± 1.34%, Holmes criteria at 0.34 ± 0.40%, Australian criteria at 2.52 ± 2.99%, and Oxford criteria at 1.73 ± 1.35%. The diagnostic method influences prevalence, with interview-based diagnoses with/without medical tests yielding a rate of 1.40 ± 1.57%, while rates for physician diagnosis and medical record reviews are not provided. When considering geographic locations, Western countries have a prevalence of 1.32 ± 1.45%, and Asian countries have a slightly higher prevalence at 1.51 ± 1.74%. According to Crawley (2018), the prevalence of CFS in children and adolescents is estimated to be between 0.11% and 4%. However, the similarity across these studies lies in the potential for the actual prevalence rate might be higher, given that certain individuals may not seek advice from their general practitioners or receive a medical diagnosis.

2.3 Risk Factors that Cause ME/CFS

2.3.1 Childhood Trauma

Multiple studies have demonstrated elevated prevalence of childhood trauma in samples of individuals with chronic fatigue syndrome (CFS), with rates ranging from 45.7% to 64.1%, observed in both community-based and tertiary care centre samples (Johnson et al., 2010). Based on these data, it has been proposed that childhood trauma could be a predictor for the onset and development of CFS in susceptible individuals (Van Houdenhove et al., 2001). Although the exact cause of CFS remains unknown, various factors have been recognized as potential contributors to its onset. According to Heim et al. (2006), range of childhood trauma including sexual, physical, and emotional abuse as well as emotional and physical neglect, were identified as significant risk factors for CFS. This study involved 117 participants in Wichita, Kansas aged 18-69 who were split into two groups: experimental group (N=58), comprising individuals who met criteria for clinically confirmed CFS and control group (N=59), serving as comparative group who had unexplained fatigue for 6 months or longer but did not meet full criteria for CFS. The study found that individuals who encountered childhood trauma was linked to a 3 to 8 times rise in the likelihood of developing ME/CFS when compared to the control group (P=0.002). The odds ratios (OR) and respective p-values correlated with CFS for emotional abuse (OR = 3.35, P = .006), physical abuse (OR = 2.87, P = .02), sexual abuse (OR = 6.53, P = .008), and emotional neglect (OR = 6.53, P = .02). Meanwhile, Sáez-Francàs et al. (2015) also indicated the same association that individuals who have experienced childhood trauma may be more susceptible to develop CFS compared to those who have not experienced trauma. According to Collin et al. (2015), maternal anxiety exhibited stronger association with CFS compared to antenatal anxiety at the age of 5-6 years, but there was no identified critical period or cumulative impact for maternal depression. The study does not specify the underlying mechanisms linking maternal and childhood psychological factors to fatigue in children, potential explanations include in prenatal or early-life epigenetic or biochemical factors influenced by maternal anxiety and depression. However, maternal distress may impact family functioning and affect childhood behaviours, such as reduced physical exercise, potentially contributing to chronic fatigue.

2.3.2 Infection

Chronic Fatigue Syndrome (CFS) has been linked to infections such as tuberculosis (TB), a widely prevalent infectious disease. Individuals with CFS and those who have experienced post-tuberculosis experience similar symptoms. As reported by Yang et al. (2022), the study findings indicate that infection with Mycobacterium tuberculosis (MTI) is linked to an increased risk of developing CFS later. Within the subgroup analysis, the group with MTI infection consistently exhibited an increased risk of chronic fatigue syndrome among males (HR = 1.27, 95% CI 1.02–1.58) and individuals aged 65 years and older (HR = 2.50, 95% CI 1.86–3.38). In the case with 95% confidence interval (CI) is reported, there is 95% probability that the true hazard ratio (HR) lies within the specified range. Other than MTI, infectious mononucleosis (IM) was discovered as a risk factor for CFS in adolescents (Katz et al., 2009). IM is marked by manifestations like tiredness, aching throat, enlarged lymph nodes, and elevated body temperature. Among the 301 enrolled adolescents diagnosed with monospot-positive acute Infectious Mononucleosis (IM), the study identified that 13% of teenagers experienced ME/CFS 6 months after contracting IM. This figure decreased to 7% after 12 months and further declined to 4% after 24 months. While the majority of individuals recovered over time, 2 adolescents who had initially recovered were recategorized as having CFS at 24 months. Notably, all 13 adolescents with CFS at 24 months were female and had reported higher levels of fatigue severity at the 12-month mark. Additionally, SARS-CoV-2 infection is considered a risk factor for CFS although the exact reasons behind are not fully understood (Davis et al., 2023). Nevertheless, there are various potential mechanisms have been suggested, including viral persistence, immune dysregulation, inflammation, and autonomic dysfunction. The prevailing notion is that the immune response to the viral infection might initiate a series of events leading to persistent symptoms, such as fatigue, cognitive impairment, and other neurological manifestations frequently observed in CFS.

2.4 The Association between Chronic Fatigue Syndrome and Quality of Life

According to Hvidberg et al. (2015), The HRQoL of patients with chronic fatigue syndrome (CFS) is notably less than the population mean. The unadjusted EQ-5D-3L HRQoL utility score for individuals with CFS was 0.47, falling below the population mean of 0.85. However, the adjusted score of 0.56, which considers variables such as gender, age, education, and the presence of co-morbidities, provides a more accurate evaluation. These results indicate a significant adverse effect of CFS on the quality of life for those affected. In comparison to 20 other health conditions, CFS patients exhibited the poorest recorded HRQoL, even worse than multiple sclerosis and stroke. EQ-5D-3L, a self-reported questionnaire was used in the study to assess the HRQoL which comprises 5 aspects: mobility, self-care, regular activities, pain/discomfort, and anxiety/depression. It is a commonly employed metric to compare HRQoL among various conditions or groups. In the study of Attree et al. (2014), the Prospective and Retrospective Memory Questionnaire (PRMQ) and Cognitive Failures Questionnaire (CFQ) were used to assess the cognitive abilities in individuals with CFS. The results underlined that individuals suffering from CFS may encounter cognitive failure, especially in the context of retrospective memory. Based on Castro-Marrero t al. (2019), the research revealed that individuals with CFS had a high rate of unemployment and work disability. Among 1086 participants with CFS, 58.6% were unemployed, 66% were on medical leave, and 34% had a disability attributed to their illness. In the study of Winger et al. (2015), the HRQoL of CFS patients aged 5-18 years was measured by Pediatric Quality of Life (PedsQL) which comprises physical functioning, emotional functioning, social functioning, and school functioning. Patients with CFS may encounter challenges in social interactions and peer relationships. Their limited participation in school, along with reduced attendance, contributes to feelings of isolation and a sense of being different or overlooked. Additionally, adolescents may experience heightened depressive symptoms and decreased activity levels, accompanied by activity-related pain. The malaise and pain followed by activities may lead patients to readily adopt avoidance behaviour.

2.5 The Association between Chronic Fatigue Syndrome and Sleep Quality

Chronic Fatigue Syndrome (CFS) is a complex and exhausting disorder characterized by extreme fatigue that is not relieved by rest. Among the many symptoms faced by individuals with CFS, poor sleep quality is particularly prevalent and significantly impacts overall health and quality of life. According to Yang et al. (2022b), 87%-95% of individuals with CFS reported unrefreshing sleeps, poorer sleep quality, and more daytime disruption compared to healthy controls. Other than that, adolescents with CFS were also observed to have notably longer sleep onset latency, time spent in bed, total sleep duration, and a later wake-up time. Additionally, they reported significantly worse perceived sleep quality compared to their healthy peers (Josev et al., 2017). The study found that adolescents with CFS showed increased anxiety levels compared to healthy adolescents, which significantly related to poorer perceived sleep quality in both groups. As reported by Mohamed et al. (2023), sleep disturbance and unrefreshing sleep are major complaints reported by patients diagnosed with CFS. CFS patients tend to spend more time in bed, have shorter total sleep duration, take longer to fall asleep, experience prolonged wakefulness after sleep onset, show reduced sleep efficiency, spend less time in N2 sleep, have extended N3 sleep, and take longer to reach REM sleep. According to Collin et al. (2018 further noted that children who later developed CFS were more likely to struggle with falling asleep, and for each additional hour of nighttime sleep at age nine, the likelihood of developing CFS by age 13 decreased by 39%.The study concluded that increased tendency to CFS during adolescence may be associated with a physiological mechanism that negativly affects sleep from early developmental age. Besides, one study using the Pittsburgh Sleep Quality Index (PSQI) found that 43.6% of participants with CFS had poor sleep quality. This was further supported by the fact that 39.6% of the participants were taking medication to help them sleep.

2.6 Common Disorders Among Young Adults

During young adulthood, individuals are often intensely focused on pursuing personal and academic achievements, navigating a period marked by significant challenges that can have profound implications for their health and well-being. The unique lifestyle of young adults, such as academic pressures, social activities, and sometimes irregular sleep patterns, can make them susceptible to few common epidemic disorders. Several epidemic diseases among young adults share clinical features with Chronic Fatigue Syndrome (CFS), particularly the symptoms of persistent fatigue, cognitive dysfunction, and general malaise.

2.6.1 Depression

Depression is a prevalent and severe psychological disorder classified by persistent, continuous sadness and a reduced interest in activities and socializing. Clinical depression can also manifest physical symptoms such as fatigue, sleep disturbances, unexplained pain (like back pain or headaches), and memory or concentration issues (Bernstein, 2022). Both chronic fatigue syndrome (CFS) and depression are chronic illnesses that has higher prevalence among women than men. However, there are notable differences between the two. Unlike depression, CFS does not typically include symptoms like a sore throat, weakness, or swollen and tender lymph nodes. According to Liu et al. (2020), the study in United States reported increased in depression among young adults during and after COVID-19 pandemic. In this study, depression was evaluated using the Patient Health Questionnaire (PHQ-8) which measured the frequency of depressive symptoms over the past 2 weeks. It revealed that 43.3% of the sample exhibited high levels of depression among young adults due to the disruption disruptions in daily routines, including the shift to remote work or job loss, along with the increased loneliness due to social distancing and isolation. Another study also suggested that the connection between social media use and depression symptoms among young adults may be more closely linked to the number of different social media platforms used (Matthews et al., 2016). Engaging with multiple platforms may lead to multitasking, which is related with poor cognitive and mental health outcomes. As the number of platforms increases, individuals may find it challenging to navigate these various online environments effectively, potentially resulting in negative moods and emotions. As reported by Goodwin et al. (2022), the study also highlights an evident increase in the prevalence of depression at 17.2% among young adults, particularly among those who never married and with at least a high school diploma.

2.6.2 Fibromyalgia

Fibromyalgia (FM) is a chronic pain syndrome classified by widespread pain affecting various parts of the body, including the skin, muscles, and joints which is unpredictable, varying in severity and location from day to day (News-Medical, 2024). Additionally, FM is related with other symptoms such as sleep disturbances leading to restlessness and fatigue, cognitive difficulties like "brain fog," and problems with concentration. Chronic fatigue syndrome (CFS) shares several overlapping symptoms with fibromyalgia, including muscle and joint pain, persistent tiredness, cognitive dysfunction. According to Lourenço et al. (2015), the study revealed the prevalence of fibromyalgia among young adults was 1.0%, with women exhibiting significantly higher symptom severity scores (SSS) and widespread pain index (WPI) compared to men. Other than that, women were notably more likely than men to report pain or tenderness in at least one body part such as lower abdominal pain or cramps, headaches and tenderness in various body regions. Non-pain symptoms like fatigue, unrefreshing sleep and depressive symptoms were frequently reported in both women and men.

CHAPTER 3

METHODS

3.1 Chapter overview

This chapter outlines the methodology employed in the study, detailing the research design, ethical approval, sampling design, research instruments used, procedure, followed by data analysis.

3.2 Research design

This study adopts a cross-sectional design to investigate the prevalence of CFS and its association with quality of life and sleep quality among young adults. A cross-sectional study is an observational and descriptive research method that involves collecting data from a specific population at a single point in time, making it suitable for assessing prevalence and identifying potential correlations between variables. The recruitment process targets young adults aged 18–30 years who can read and write in English. Participants meeting these criteria are invited to complete the study questionnaire, which is distributed via a soft copy Google Form. This approach ensures accessibility and convenience for participants while enabling efficient data collection on CFS symptoms, quality of life, and sleep quality.

3.3 Ethical Approval

This research is subject to ethical approval from the Scientific and Ethical Review Committee (SERC) at the University Tunku Abdul Rahman (UTAR). Individuals meeting the criteria will be given informed consent before giving the questionnaire to ensure they are ready to take part in this study voluntarily. The informed consent also makes sure that the participants are fully aware of the study's aim, procedure, potential risk and benefits. Participants might make voluntary and informed decisions about their own participation.

3.4 Sampling Design

This study focuses on young adults aged 18 to 30 years residing in the Klang Valley, Malaysia. To determine the required sample size, the OpenEpi software was used, considering an estimated population of 2.4 million undergraduate university students in the Klang Valley. The hypothesized frequency of the outcome factor in the population (ppp) was set at 50% with a margin of error of ±5%. To account for potential dropouts, incomplete data, and participants not meeting the inclusion criteria, an additional 15% was added to the sample size calculation at a 95% confidence level. Based on these parameters, the final calculated sample size was 385 individuals. This number ensures sufficient statistical power to investigate the prevalence of chronic fatigue syndrome (CFS) and its associations with quality of life and sleep quality.

The sampling method employed in this study is the convenience sampling method, chosen for its practicality, cost-effectiveness, and time-saving advantages. Convenience sampling allows the researcher to recruit participants more easily, particularly when accessing a random or representative sample is challenging. This method aligns with the study's constraints and facilitates efficient data collection, especially given the widespread distribution of the survey via Google Forms.

3.5 Research Instrument

3.5.1 Canadian Consensus Criteria (CCC)

The Canadian Consensus Criteria (CCC) were introduced in 2003 as proposed clinical criteria for CFS. This set of criteria is frequently employed as a case definition in research studies. CCC represent a stricter diagnostic criterion, identifying a population with more pronounced impairment (Nimmo, 2015). Individuals are diagnosed following a minimum duration of six months of illness, while children are diagnosed after a minimum of 3 months. An individual diagnosed with CFS will meet the criteria for fatigue, post-exertional malaise and/or fatigue, sleep dysfunction and pain. Other than that, they will exhibit 2 or more neurological or cognitive manifestations and 1 or more symptoms from 2 of the categories: autonomic, neuroendocrine, and immune manifestations. Furthermore, adherence to core symptom 7 is required (*Canadian Consensus Criteria - MEPEDIA*, n.d.).

Several studies have revealed that CCC was suitable to be selected as research criteria for CFS. It is a frequently recommended diagnostic criteria in national guidelines for the diagnosis of CFS in various European countries (Strand et al., 2019). This decision was based on the criteria's specification of core symptoms believed to be more specific to CFS, such as post-exertional malaise, impairment of memory and concentration, unrefreshing sleep, arthralgia and/or myalgia, and various autonomic, neuroendocrine, and immune manifestations (*Clinical Versus Research Criteria*, 2015)). By requiring the presence of at least 7 core symptoms, the Canadian criteria aim to identify a more homogeneous group of patients with CFS specifically for research purposes. The Canadian Consensus Criteria is recommended to be used as a diagnostic criterion for CFS because it is considered an acceptable case definition by EUROMENE (Estévez-López et al., 2020).

3.5.2 Short Form-36 (SF) Questionnaire

SF-36 is a widely used questionnaire that assessing health-related quality of life. It has been found to be reliable and valid across a range of medical diagnoses, It comprises of 36 questions covering 8 distinct domains, including physical functioning, role limitations due to physical health problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health (Lins & Carvalho, 2016). According to *Medical Outcomes Study Short Form 36*, (2015), the assessment of function and well-being in the 36-item questionnaire is conducted using Likert scales and yes/no options. Survey participants are requested to respond to answer items pointing to the past 4 weeks. Items within subscales are totaled to generate a total score for the particular subscale or dimension. The resulting 8 summed scores are then converted linearly onto a scale ranging from 0 (negative health) to 100 (positive health), thus providing score for each subscale. Notably, each subscale can be used independently. Participants were categorized into **high functioning** > 60 and **low functioning** ≤ 60 groups based on their health-related quality of life.

Additionally, a standard metric is established for both the physical and mental composite domains, where the mean score is set at 50 and the standard deviation at 10. The standardization allows consistent interpretation of scores across different subscales and dimensions.

According to Izhar et al. (2021), SF-36 questionnaire has been found to be valid and reliable form health-related quality of life (HRQOL). The validity of the SF-36 questionnaire was assessed using the intraclass correlation coefficient (ICC), which ranged from 0.658 to 0.802, showing good agreement between measurements. Additionally, the reliability of the SF-36 questionnaire was assessed using Cronbach's α coefficient, which was found to be 0.864, showing strong internal consistency. Mbada et al. (2015) also confirmed the SF-36's validity and reliability, noting high scores for concurrent validity (0.749 to 0.902), meaning it aligns well with established tools, and effective discriminant validity, indicating it accurately differentiates between different health dimensions.

Table 3.1: Calculation table for SF-36.

SF-36 Subscale	SF-36 Calculation
Physical functioning	sum of items 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12
Role limitations due to physical health	sum of items 13, 14, 15, and 16
Role limitations due to emotional problems	sum of items 17, 18 and 19
Energy/fatigue	Sum of items 23, 27, 29, and 31
Emotional well-being	sum of items 24, 25, 26, 28, 30
Social functioning	sum of items 20 and 32
Pain	sum of items 21 and 22
General health	sum of items 1, 33, 34, 35, 36

3.5.3 Pittsburgh Sleep Quality Index (PSQI)

The Pittsburg Sleep Quality Index (PSQI) is a valuable tool for assessing sleep quality and patterns by distinguishing between “poor” and “good” sleep. It comprises of 7 components, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the past month. Each of these components is scored on a scale from 0-3, with a score of 3 representing the worst sleep quality. The total PSQI score is obtained by the sum of 7 component scores which can range from 0 to 21. A higher total score indicates worse sleep quality, with a score above 5 indicating significant sleep disturbance. Additionally, there are 5 optional items reported by a bedpartner or roommate, which are not included in the scoring of the instrument (*Pittsburgh Sleep Quality Index*, 2021).

The reliability of the test-retest is valued at 0.85, meaning it provides stable results over time. In terms of validity of the test, the scale demonstrated a sensitivity of 89.6% while the specificity of the test is 86.5%. The high validity indicates how well the scale accurately identifies and distinguishes between individuals with and without sleep issues (De La Vega et al., 2015).

Table 3.2: Calculation table for PSQI.

PSQI Subscales	PSQI Calculation
Subjective sleep quality	item 9
Sleep latency	sum of items 2 and 5a
Sleep duration	item 4
Sleep efficiency	((item 4/ (item 3 – item 1)) *100%
Sleep disturbance	sum of items 5b, 5c, 5d, 5e, 5f, 5g, 5h, 5i, and 5j
Sleep medication	item 6
Daytime dysfunction	sum of items 7 and 8

3.6 Procedure

This descriptive cross-sectional study aims to recruit 385 participants who are young adults aged 18-30 years and capable of understanding and writing in English. Participants will be conveniently recruited through social media platforms, including Gmail, Microsoft Teams, Facebook, Instagram, and WhatsApp, as well as face-to-face recruitment in the Klang Valley, Malaysia. Upon recruitment, participants who meet the eligibility criteria will be asked to complete a soft copy Google Form containing two sections: (A) Demographic Data, where information such as age, gender, and contact details will be collected, and eligibility criteria questions will be asked to ensure that only eligible participants are included in the study, and (B) Informed Consent Form, where participants will voluntarily consent to take part in the study. After providing informed consent, eligible participants will complete the Canadian Consensus Criteria (CCC) questionnaire to assess the prevalence of chronic fatigue syndrome (CFS). Following this, participants will be required to fill out the Short Form-36 (SF-36) and Pittsburgh Sleep Quality Index (PSQI) questionnaires to assess the association between CFS, quality of life, and sleep quality. Once all data is collected, statistical analysis will be conducted, and the findings will be documented in a final report.

3.7 Data Analysis

The collected data will be analysed by using IBM Statistical Package for Social Science (SPSS) software VERSION 26.0 and Microsoft Excel to generate study outcomes. Descriptive statistics will be applied to analyse demographic information, including personal details such as name, age, gender, race, and employment status . The results will be presented in terms of frequency and percentage for categorical variables and Mean (M) and Standard Deviation (SD) for continuous variables. Data normality of age will be determined using Kolmogrov-Smirnov test. The score of Short-form 36 (SF-36) and Pittsburg Sleep Quality Index (PSQI) were reported as Mean (M), Standard Deviation (SD), and median. For inferential analysis, a Chi-Square test will be conducted to assess the association between chronic fatigue syndrome (CFS) and two contingent data (quality of life and sleep quality). In addition, the association between CFS and quality of life were analysed using Chi-Square test, the data were reported as value (X^2) and p-value while the data of association between CFS and sleep quality were reported as frequency (N), value (X^2) and p-value. The significant value of data for Chi-Square test was set at $p< 0.05$, indicating the normal distribution of data.

Chapter 4

Result

4.1 Chapter Overview

This chapter outlines the findings derived from the data collection process conducted for this research. It begins with a detailed presentation of the participants' demographic profiles. Following this, the results from various inferential tests will be presented, along with a discussion on the outcomes of the hypothesis testing. The findings will be structured systematically, incorporating visual aids such as bar charts and pie charts to enhance clarity. Each section will conclude with a concise summary, supported by relevant tabulated data as needed, to provide a clear understanding of the findings.

Among the total of 248 participants involved in this study, 225 individuals (90.7%) met the inclusion criteria. However, 23 participants (9.3%) were excluded based on various factors. Specifically, 4 participants (1.61%) did not fall within the required age range of 21 to 30 years, and 3 participants (1.2%) resided outside the Klang Valley area. Additionally, 16 participants (6.45%) met exclusion criteria, including those diagnosed by a doctor with mental health conditions, experiencing substance abuse, or being diagnosed with treatable sleep disorders and other medical conditions.

4.2 Demographic Population

This section presents the demographic characteristics of the study population through descriptive statistics, graphical presentations, and a summarized tabulation method (Table 4.1). The table provides detailed information on key variables, including age, gender, race, and employment status among all young adult participants in the Klang Valley. The demographic data are presented in terms of frequency (n) and percentage (%) for categorical variables, as well as the mean (M) and standard deviation (SD) for continuous variables, respectively.

Table 4.1: Demographic data of participants

Demographic Data	Frequency, n (%)	Mean ± SD
Age		3.43 ± 2.569
21	46 (20.63)	
22	67 (30.04)	
23	40 (17.94)	
24	17 (7.62)	
25	11 (4.93)	
26	6 (2.69)	
27	10 (4.48)	
28	9 (4.04)	
29	6 (2.69)	
30	11 (4.93)	
Gender		
Male	80 (35.71)	
Female	144 (64.29)	
Race		
Chinese	170 (75.89)	
Malay	34 (15.18)	
Indian	20 (8.93)	
Employment Status		
Employed	12 (5.36)	
Unemployed	73 (32.59)	

Student	139 (62.05)	

Data of age is presented as total number, n (percentage), and means ± standard deviation. Gender, race and employment status are presented as total number, n (percentage).

4.2.1 Age

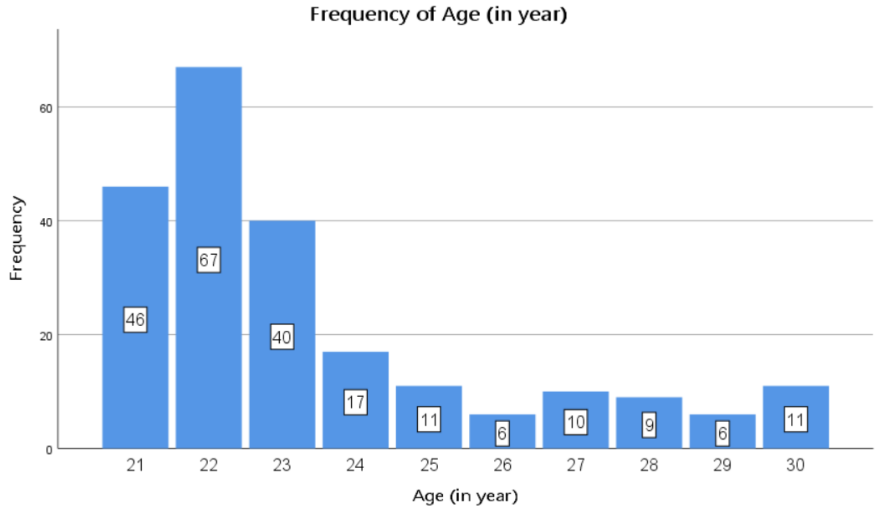

Figure 4.1 Age of participants in Klang Valley

Figure 4.1 illustrates the age distribution of the 225 participants between 21-30 years who met the study's inclusion criteria. The data reveals that the majority of participants are between 21 and 23 years old, with age 22 being the most common at 67 participants (30.18%). This is followed by age 21 with 46 participants (20.72%) and age 23 with 40 participants (18.02%). Besides, the representation declines for ages 24 through 30, with the lowest counts observed at ages 26 and 29, each having 6 participants (2.70%). At 24 years, there are 17 participants (7.62%), while 25 years has a frequency of 11 participants (4.93%) which similar to 28 years. Finally, 30 years accounts for 11 participants (4.93%). On average, the distribution of age in this study was 3.43 ± 2.569 which shown in Table 4.1.

4.2.2 Gender

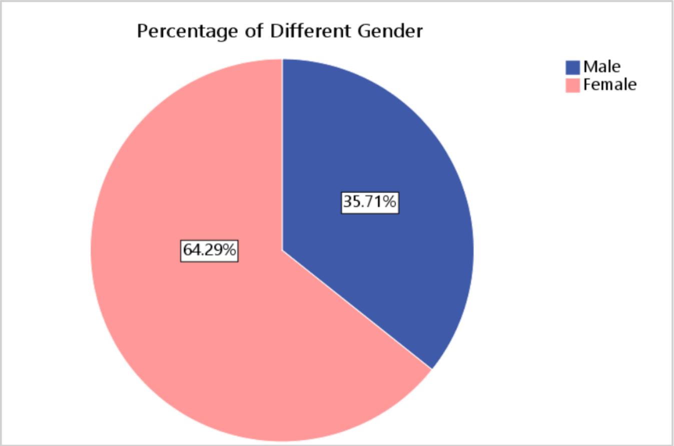

Figure 4.2 Percentage of different gender of participants

Figure 4.2 illustrates the gender distribution among the participants in this study. It shows that the majority of participants are female, with 144 individuals, accounting for **64.29%** of the total. In contrast, 80 participants are male, comprising **35.71%** of the total. This indicates a significantly higher proportion of female participants compared to males in this study.

4.2.3 Races

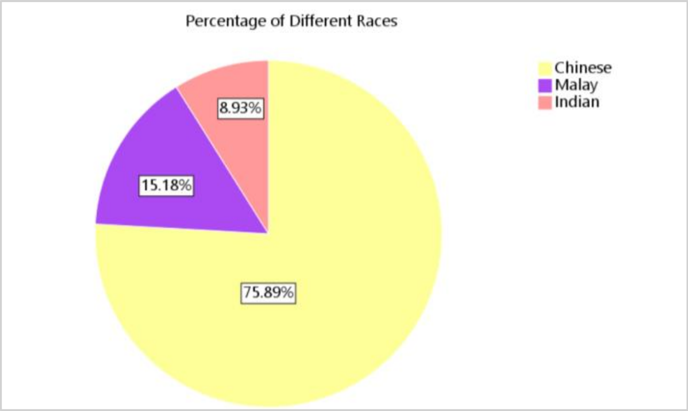

Figure 4.3 Percentage of different races of participants

Figure 4.3 illustrates the ethnic distribution of participants in the study. The majority of participants are Chinese, comprising 170 individuals (75.89%), followed by Malay participants, who account for 34 individuals (15.18%). Indian participants represent the smallest proportion, with 20 individuals (8.93%).

4.2.4 Percentage of different employment status of participants

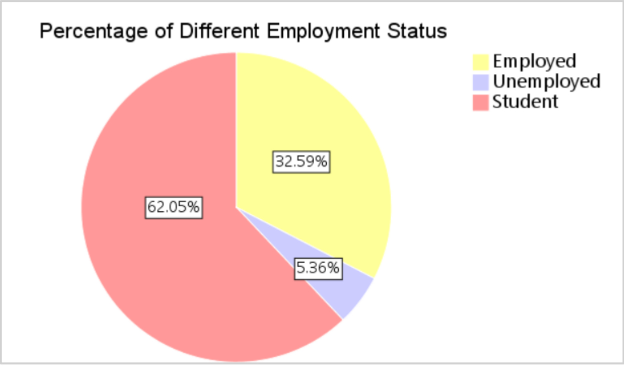

Figure 4.4 Percentage of different employment status of participants

Figure 4.4 illustrates the percentage distribution of employment status among participants, divided into three categories: employed, unemployed, and student. Students represent the largest group, accounting for 139 (62.05%) of participants; meanwhile employed participants make up 73 (32.59%) of the group, indicating a smaller yet significant portion of employed individuals; followed by unemployed participants account for 12 (5.36%), representing the smallest category in the employment status distribution.

4.3 Prevalence of CFS

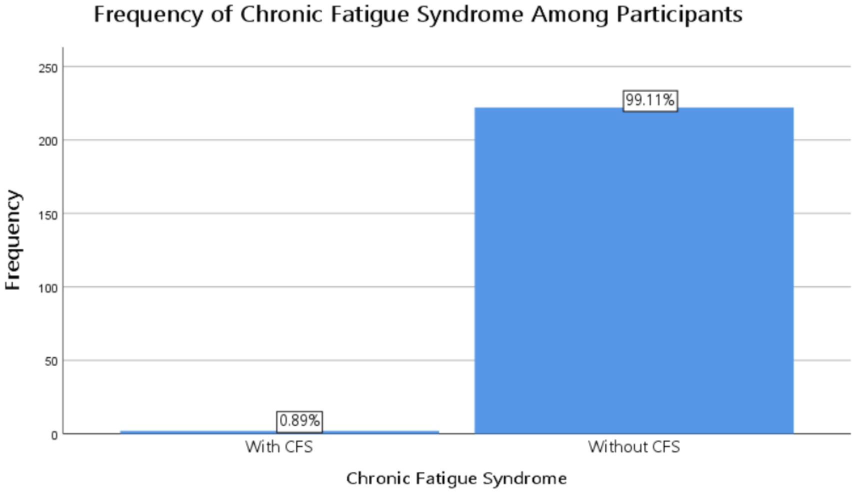

Figure 4.5 Percentage Prevalence of Chronic Fatigue Syndrome (CFS) Among Participants

Figure 4.5 shows the percentage prevalence of CFS among participants. There are divided into two group, which are participants with CFS and participants without CFS. From the figure, the results revealing that only a small percentage of participants (0.89%) were identified with CFS, while the vast majority (99.11%) were not affected.

4.4 Total scores for SF-36 and PSQI

This section focuses on presenting the total scores of participants for each instrument, specifically the SF-36 and PSQI. Each subscale is reported in terms of mean (M) and standard deviation (SD) for two groups: participants with positive outcomes (no CFS) and those with negative outcomes (with CFS). Detailed descriptions and tables (Table 4.2 and Table 4.3) will be provided to present the findings in a clearer and more comprehensive manner. This will allow for a better understanding of the differences in scores between the two groups across the various subscales.

4.4.1 Total scores for SF-36

Referring to the data in Table 4.2, the total scores are presented for eight subscales: physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, pain, and general health. Each subscale is scored on a scale ranging from 0 to 100.

A comparison of total scores across seven SF-36 subscales between participants with positive and negative outcomes. For physical functioning, both groups showed high scores, with the negative outcome group scoring slightly higher at 87.91 ± 16.81 compared to 85.00 ± 7.07 in the positive group. In contrast, participants with negative outcomes reported significantly higher scores in role limitations due to physical health at 82.88 ± 29.12 and role limitations due to emotional problems at 80.03 ± 33.96, indicating greater perceived limitations than the positive group, which scored 37.50 ± 17.68 and 33.33 ± 47.14, respectively. The negative group also reported higher scores for energy and fatigue at 50.43 ± 14.25, emotional well-being at 59.21 ± 12.88, social functioning at 72.73 ± 21.28, and pain at 80.82 ± 19.06, compared to 32.50 ± 17.68, 52.00 ± 5.66, 55.00 ± 17.68, and 28.75 ± 40.66 in the positive group. General health scores were comparable, with the negative group scoring 59.84 ± 14.43 and the positive group scoring 57.50 ± 3.54. These results highlight that participants with negative outcomes experience greater perceived limitations in most of the aspects compared to those with positive outcomes.

On Table 4.3, it displays the median scores of participants on different scales, grouped into positive and negative categories. Half of the participants in the positive group scored 85 or above, indicating a relatively good level of physical functioning while participants in the negative group scored higher on average, with half scoring 95 or above. This suggests better physical functioning in this group compared to the positive group.

Table 4.2 Total score of participants with physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, pain and general health score.

Scale	**Mean ± SD (positive)**	**Mean ± SD (negative)**
Physical functioning	85.00 ± 7.07	87.91 ± 16.81
Role limitations due to physical health	37.50 ± 17.68	82.88 ± 29.12
Role limitations due to emotional problems	33.33 ± 47.14	80.03 ± 33.96
Energy/fatigue	32.50 ± 17.68	50.43 ± 14.25
Emotional well-being	52.00 ± 5.66	59.21 ± 12.88
Social functioning	55.00 ± 17.68	72.73 ± 21.28
Pain	28.75 ± 40.66	80.82 ± 19.06
General health	57.50 ± 3.54	59.84 ± 14.43

Data are presented as means ± standard deviation (SD).

Table 4.3 Score of median of participants with physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, pain and general health score.

Scale	**Q1 (positive)**	**Q1 (negative)**	**Median (positive)**	**Median (negative)**	**Q3 (positive)**	**Q3 (negative)**
Physical functioning	80.00	85.00	85.00	95.00		100.00
Role limitations due to physical health	25.00	75.00	37.50	100.00		100.00

Role limitations due to emotional problems	0.00	66.67	33.33	100.00	100.00
Energy/fatigue	20.00	40.00	32.50	50.00	60.00
Emotional well-being	48.00	52.00	52.00	60.00	68.00
Social functioning	42.50	57.50	55.00	77.50	90.00
Pain	0.00	67.50	28.75	90.00	100.00
General health	55.00	50.00	57.50	60.00	70.00

Data are presented as Mean (M), First Quartile (Q1), and Third Quartile (Q3).

4.4.2 Total scores for PSQI

By refer to the data in Table 4.4, the total scores are presented for seven subscales: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication and daytime dysfunction. Each subscale is scored on a scale ranging from 1 to 3.

The table compares sleep quality scores between participants with positive and negative outcomes across seven PSQI subscales. Subjective sleep quality was higher in the positive group at 2.50 ± 0.71, compared to 0.93 ± 0.61 in the negative group. Sleep latency was slightly higher in the positive group, scoring 1.00 ± 1.41, compared to 0.86 ± 0.81 in the negative group. Sleep duration showed a clear difference, with the positive group scoring 2.00 ± 0.00, while the negative group scored 0.78 ± 0.62. Sleep efficiency was minimal in both groups, with the positive group scoring 0.00 ± 0.00 and the negative group 0.01 ± 0.12. Sleep disturbance was higher in the positive group at 1.50 ± 0.71, compared to 1.01 ± 0.41 in the negative group. The use of sleep medication was absent in the positive group at 0.00 ± 0.00, but slightly reported in the negative group at 0.13 ± 0.43. Daytime dysfunction was higher in the positive group at 1.50 ± 0.71, compared to 0.66 ± 0.80 in the negative group.

In terms of subjective sleep quality, the positive group shows a higher (Q1 = 1.00, Q3 = 3.00) compared to the negative group, which has consistent lower scores (Q1 = 1.00, Q3 =

1.00). For sleep latency, both groups report minimal delays, with (Q1 = 0.00, Q3 = 1.00), indicating that most participants experience little to no difficulty in falling asleep. Sleep duration in the positive group shows consistency (Q1 = 2.00, Q3 = 2.00), while the negative group exhibits more variability (Q1 = 0.00, Q3 = 1.00), suggesting shorter sleep durations in some individuals. Sleep efficiency remains consistent across both groups, with Q1 and Q3 values at 0.00, indicating no significant issues in this area. Sleep disturbance scores are similar between the groups, with both reporting (Q1 = 1.00, Q3 = 1.00), reflecting mild disturbances overall. Use of sleep medication is minimal or absent in both groups, as indicated by Q1 and Q3 values of 0.00. Lastly, daytime dysfunction shows slightly higher scores in the positive group (Q1 = 1.00, Q3 = 1.50) compared to the negative group (Q1 = 0.00, Q3 = 1.00), suggesting mild dysfunction is more prevalent among the positive group participants. Sleep efficiency remains consistent across both groups, with Q1 and Q3 values at 0.00, indicating no significant issues in this area. Sleep disturbance scores are similar between the groups, with both reporting (Q1 = 1.00, Q3 = 1.00), reflecting mild disturbances overall. Use of sleep medication is minimal or absent in both groups, as indicated by Q1 and Q3 values of 0.00. Lastly, daytime dysfunction shows slightly higher scores in the positive group (Q1 = 1.00, Q3 = 1.50) compared to the negative group (Q1 = 0.00, Q3 = 1.00), suggesting mild dysfunction is more prevalent among the positive group participants.

Table 4.4 Total score of participants with subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication and daytime dysfunction.

Scale	**Mean ± SD (positive)**	**Mean ± SD (negative)**
Subjective sleep quality	2.50 ± 0.71	0.93 ± 0.61
Sleep latency	1.00 ± 1.41	0.86 ± 0.81
Sleep duration	2.00 ± 0.00	0.78 ± 0.62
Sleep efficiency	0.00 ± 0.00	0.01 ± 0.12
Sleep disturbance	1.50 ± 0.71	1.01 ± 0.41
Use of sleep medication	0.00 ± 0.00	0.13 ± 0.43
Daytime dysfunction	1.50 ± 0.71	0.66 ± 0.80

-Data are presented as means ± standard deviation (SD).

Table 4.5 Score of median of participants with subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication and daytime dysfunction.

Scale	**Q1 (positive)**	**Q1 (negative)**	**Median (positive)**	**Median (negative)**	**Q3 (positive)**	**Q3 (negative)**
Subjective sleep quality	2.00	1.00	2.50	1.00		1.00
Sleep latency	0.00	0.00	1.00	1.00		1.00
Sleep duration	2.00	0.00	2.00	1.00	2.00	1.00
Sleep efficiency	0.00	0.00	0.00	0.00	0.00	0.00
Sleep disturbance	1.00	1.00	1.50	1.00		1.00
Use of sleep medication	0.00	0.00	0.00	0.00	0.00	0.00
Daytime dysfunction	1.00	0.00	1.50	0.00		1.00

Data are presented as Mean (M), First Quartile (Q1), and Third Quartile (Q3).

4.5 Test of Normality

This section presents the test of normality, which is conducted to determine whether the data are normally distributed. The analysis includes the normality assessment for the prevalence data, the 8 SF-36 subscales (measuring various aspects of quality of life), and the 7 PSQI subscales (measuring components of sleep quality). Testing for normality is essential to decide on the appropriate statistical tests for further analysis, such as parametric or non-parametric methods.

In this study, the Kolmogorov-Smirnov test was chosen to determine the data normality due to the large sample size (n = 224) in this study. This is because it provides a non-parametric method to compare the observed distribution of the data with the expected theoretical distribution which known as the normal distribution. This test able to evaluate the assumption of normality holds for the age data. It is also possible to determine if the observed distribution significantly deviates from the normal distribution by examining the test statistic and its associated p-value. If the p-value exceeds the chosen significance level ($\alpha = 0.05$), it suggests that the data is normally distributed. On the other hand, if the p-value is less than the chosen significance level ($\alpha = 0.05$), it suggests that the data is deviated from the normal distribution.

4.5.1 Kolmogorov-Smirnov Test for Normality of SF-36 Data

Kolmogorov-Smirnov Test is used in this study to determine the normality of the SF-36 data. Table 4.6 displays the results of the Kolmogorov-Smirnov test for assessing data normality across the eight domains of the SF-36 questionnaire. For all domains—Physical Functioning, Role Limitations due to Physical Health, Role Limitations due to Emotional Problems, Energy/Fatigue, Emotional Well-being, Social Functioning, Pain, and General Health—the Kolmogorov-Smirnov statistics indicate significant deviation from normality, with p-values less than 0.001. The sample size for each domain (df = 224) was consistent, and the high significance values suggest that the data do not follow a normal distribution in any domain. These results imply the need to consider non-parametric statistical methods for further analysis.

Table 4.6: Result of the Kolmogorov-Smirnov Test for Data Normality of SF-36

Domains	**Kolmogorov-Smirnov**		
	Statistics	**df**	**Sig.**
Physical functioning	0.251	224	<0.001
Role limitations due to physical health	0.395	224	<0.001
Role limitations due to emotional problems	0.412	224	<0.001
Energy/ fatigue	0.119	224	<0.001
Emotional well-being	0.104	224	<0.001
Social functioning	0.151	224	<0.001
Pain	0.191	224	<0.001
General health	0.112	224	<0.001

df = degree of freedom, p-value set at p > 0.05. Data are presented as statistic, degree of freedom (df) and significant value in each test of normality.

* Liliefors Significance Correction

4.5.2 Kolmogorov-Smirnov Test for Normality of PSQI data

The Table 4.7 presents the results of the Kolmogorov-Smirnov test for assessing the normality of data across various domains of the Pittsburgh Sleep Quality Index (PSQI) among 224 participants. The test statistics range from 0.236 to 0.533, with all p-values reported as <0.001, indicating that none of the domains follow a normal distribution. Specifically, the domains of Sleep Efficiency (0.533) and Use of Sleep Medication (0.521) show the highest test statistics, suggesting the greatest deviation from normality. Other domains, including Subjective Sleep Quality, Sleep Latency, Sleep Duration, Sleep Disturbance, and Daytime Dysfunction, also demonstrate significant non-normality. These results confirm that the data distribution across all PSQI domains deviates significantly from normality, warranting the use of non-parametric statistical methods for further analysis.

Table 4.7: Result of the Kolmogorov-Smirnov Test for Data Normality of PSQI

Domains	Kolmogorov-Smirnov		
	Statistics	**df**	**Sig.**
Subjective Sleep Quality	0.322	224	<0.001
Sleep Latency	0.236	224	<0.001
Sleep Duration	0.318	224	<0.001
Sleep Efficiency	0.533	224	<0.001
Sleep Disturbance	0.423	224	<0.001
Use of Sleep Medication	0.521	224	<0.001
Daytime Dysfunction	0.315	224	<0.001

df = degree of freedom, p-value set at $p > 0.05$. Data are presented as statistic, degree of freedom (df) and significant value in each test of normality.

* Liliefors Significance Correction

4.6 Inferential Analysis

This section presents the inferential analysis conducted to evaluate the research objectives and hypotheses using the Chi-Square test. Detailed descriptions and tables (Table 4.7 and Table 4.8) are provided to clearly present the findings. The analysis was performed using IBM SPSS Statistics software version 26.0.

4.6.1 Chi-Square Test for Association between CFS and Quality of Life

In this study, the Chi-Square test is used to identify the association between chronic fatigue syndrome (CFS) and quality of life because both variables are categorical in nature. The test compares the observed frequencies of individuals with and without CFS across different levels of quality of life (good or poor). The purpose is to determine whether there is a statistically significant relationship between the two variables, helping to understand if the presence of CFS is associated with differences in quality of life. The results of this analysis are presented and interpreted below. The data were reported as value, degree of freedom (df) and p-value in Table 4.8 and Table 4.9.

Out of the 223 valid cases, only 2 individuals had CFS, with both of them were reported as good quality of life in Table 4.7. In contrast, among the 221 individuals without CFS, 204 reported good quality of life, while 17 reported poor quality of life. Overall, there were 206 individuals with good quality of life and 17 individuals with poor quality of life. In Table 4.8, the Chi-Square value measures the difference between the observed and expected frequencies in the crosstabulation. In this case, the p-value of quality of life (physical functioning, energy/fatigue, emotional well-being, general health, social functioning, role limitations due to physical health, role limitations due to emotional problems and pain) are 1.000, 1.000, 1.000, 1.000, 0.379, 0.376, 0.348 and 0.189. From the p-value obtained for all elements under the quality of life, the values are much greater than the standard significance level, 0.05, indicating there is no significant association between CFS and quality of life. This suggests that quality of life (good or poor) does not statistically differ between individuals with CFS and those without it.

Table 4.8: The frequency of valid cases for SF-36

Count, n	**Quality of Life**	
	Good	**Poor**
Physical functioning		
With CFS	2	0
Without CFS	204	17
Role limitations due to physical health		
With CFS	1	1
Without CFS	176	45
Role limitations due to emotional problems		
With CFS	1	1
Without CFS	180	41
Energy/fatigue		
With CFS	1	1
Without CFS	65	156
Emotional well-being		
With CFS	1	1
Without CFS	128	93
Social functioning		
With CFS	2	0
Without CFS	160	161
Pain		
With CFS	1	1
Without CFS	135	86

Data was presented as total number, n.

Table 4.9: The result of Chi-Square test

Pearson Chi-Square	X^2	**df**	**p-value**
Physical functioning	0.176	1.00	1.000
Role limitations due to physical health	1.025	1.00	0.376

Role limitations due to emotional problems	1.234	1.00	0.348
Energy/fatigue	0.409	1.00	1.000
Emotional well-being	0.048	1.00	1.000
Social functioning	0.772	1.00	0.379
Pain	1.722	1.00	0.189
General health	0.097	1.00	1.000

p-value set as <0.05. df = degree of freedom. Data are presented in value, X^2 and p-value

4.6.2 Chi-Square Test for Association between CFS and Sleep Quality

In this study, the Chi-Square test is used to identify the association between chronic fatigue syndrome (CFS) and sleep quality because both variables are categorical in nature. The test compares the observed frequencies of individuals with and without CFS across different levels of sleep quality (good or poor). The purpose is to determine whether there is a statistically significant relationship between the two variables, helping to understand if the presence of CFS is associated with differences in sleep quality. The results of this analysis are presented and interpreted below. The data were reported as frequency, n (%), value, degree of freedom (df) and p-value in Table 4.10 and Table 4.11.

Out of the 223 valid cases, only 2 individuals had CFS, with 1 reporting good sleep quality and 1 reporting poor sleep quality in Table 4.5. In contrast, among the 221 individuals without CFS, 128 reported good sleep quality, while 93 reported poor sleep quality. Overall, there were 129 individuals with good sleep quality and 94 individuals with poor sleep quality. In Table 4.6, the Chi-Square value measures the difference between the observed and expected frequencies in the crosstabulation. In this case, the Chi-Square value is 0.051. A small Chi-Square value like this indicates that the observed data closely matches the expected data under the null hypothesis, meaning there is no association between the variables. Other than that, the p-value, 0.821 is much greater than the standard significance level, 0.05, indicating there is no significant association between CFS and sleep quality. This suggests that sleep quality (good or poor) does not statistically differ between individuals with CFS and those without it.

Table 4.10: The frequency of valid cases for PSQI

Count, n	**Sleep Quality**		**Total**
	Good	**Poor**	
With CFS	1	1	2
Without CFS	128	93	221
Total	129	94	223

Data was presented as total number, n.

Table 4.11: The result of Chi-Square test

	frequency, n (%)	X^2	**df**	**p-value**
Pearson Chi-Square	223(99.6%)	0.051	1.00	0.821

p-value set as <0.05. df = degree of freedom. Data are presented in valid case, n (%), value, X^2 and p-value.

4.7 Hypothesis Testing

Association between CFS and Quality of Life

H01: There is no significant association between CFS and quality of life among young adults.

HA1: There is significant association between CFS and quality of life among young adults.

Association between CFS and Sleep Quality

H01: There is no significant association between CFS and sleep quality among young adults.

HA1: There is significant association between CFS and sleep quality among young adults.

The Chi-Square test was conducted to assess the association between CFS and quality of life as well as sleep quality. By referring to Table 4.8, the null hypothesis is accepted as both p-value >0.05. The p-value for each domain in SF-36 that scored by participants have exceeded significant 0.05. indicating no association between CFS and quality of life among young adults. Moreover, the p-value for overall score in PSQI that scored by participants is higher than the significant 0.05 too. The null hypothesis is accepted. Thus, showing no significant association between CFS and sleep quality among young adults.

Chapter 5

Discussion

5.1 Chapter overview

This chapter presents a discussion of the key findings from Chapter 4 in alignment with the research objectives. It will also address the study's limitations, provide recommendations for future research, and conclude the research project.

5.2 Discussion

5.2.1 Prevalence of Chronic Fatigue Syndrome among young adults

Throughout the study, the target population comprises healthy young adults aged between 21 and 30 years. As mentioned in the beginning of literature review, chronic fatigue syndrome (CFS) is a complex disorder characterized by persistent fatigue lasting over six months, worsened by physical or mental activity and not fully alleviated by rest (ME/CFS - Symptoms and Causes, n.d.). To be considered as prevalent, participants must fulfil all Canadian Consensus Criteria (CCC) criteria, which include persistent fatigue, post-exertional malaise (PEM), sleep dysfunction, pain neurological/cognitive symptoms, followed by autonomic, neuroendocrine, and immune symptoms, without exceptions to ensure a robust, consistent definition of CFS prevalence. From the figure 4.4, the bar graph shows a very small portion, 0.89% of the participants were identified as having CFS. This indicates that only a minor fraction of the population meets the diagnostic criteria for CFS, suggest that it remains an uncommon condition. In this case, it limits the ability to perform meaningful statistical analyses to assess associations between variables when the prevalence of a condition is too low. Low prevalence can lead to unreliable estimates of associations in terms of odds ratios or relative risks because these calculations depend on the number of cases and controls. Furthermore, this small sample size for cases can also lead to false positives, where random variation or noise in the data is mistakenly identified as a significant association, reducing confidence in the findings (Stephanie, 2015).

Froehlich et al. 2021 conducted a meta-analysis using the Canadian Consensus Criteria and reported a pooled prevalence of 0.4 percent across 46 studies in 13 countries. In comparison, the prevalence rate in this study is notably higher at 0.89 percent, suggesting variability in CFS prevalence even when using the Canadian Consensus Criteria (CCC). Furthermore, Huth et al. (2020) conducted a study using the same diagnostic criteria and reported a global prevalence of CFS at 0.4%, which is notably lower compared to the 2.5% reported when using the Fukuda Criteria.The findings further highlight that CFS predominantly affects young adults, particularly those aged between 20 and 40 years. In overall, all findings indicate relatively low prevalence, suggesting that this study aligns consistently with global prevalence trends when applying the same diagnostic criteria. Bakken et al. (2014) utilized the ICD-10 code G93.3 to diagnose CFS and identified two age peaks in its incidence: one in the 10 to 19 years group and another in the 30 to 39 years group. The overall incidence rate of CFS was about 0.0258% for all participants. This age distribution may be linked to initial exposure to an infectious agent in adolescence (first peak) and the reactivation of latent infections in adulthood (second peak), with factors such as stress, chronic stress, or pregnancy potentially triggering the reactivation of viral infections. Moreover, Chu et al. (2019) conducted a study with participants aged 20 to 75 years, finding that middle-aged individuals were the most affected. The median age of illness onset was 36.6 years, suggesting that the most prevalent age group is likely those in their 30s to 50s. In the study by Nacul et al. (2021), prevalence rates of CFS are estimated to range between 0.1% and 0.7%, with an incidence rate of 0.015 new cases per 1000 person-years. Many more individuals experience chronic fatigue from other causes, often leading to significant impairment. Women account for at least 2/3 of CFS cases, and the condition predominantly affects individuals in their most productive years. However, although this study did not specify the exact age range with higher prevalence, it highlights the significant impact of CFS across all age groups, raising questions about whether middle-aged adults are more commonly affected. According to Nacul et al. (2021), the study, which utilized Centers for Disease Control (CDC) criteria, found that men are diagnosed with CFS at a younger age compared to women, who tend to be older at the time of diagnosis. The findings also highlight that CFS predominantly affects young adults, particularly those aged 20 to 40 years. This trend may be influenced by lifestyle and social factors, such as being younger, unmarried, and more frequently employed in skilled occupations.

As highlighted in a meta-analysis by Luo et al. (2023) which employed Fukuda criteria, CFS is particularly prevalent among high-risk groups such as teachers, nurses, and students. These individuals often face high-pressure environments combined with societal and cultural expectations, such as the traditional emphasis on male superiority and the demands of modern competitive environments. Female students may experience increased inner conflicts and pressures, making them more susceptible to CFS. University students have been identified as having the highest prevalence of ME/CFS. For instance, a university in Zhejiang province reported a prevalence rate of 20.2%, while medical students in Jiangxi and Hunan provinces showed a prevalence of 17.55%. Although many researchers suggest that medical students are more susceptible to ME/CFS, this study found no significant difference in prevalence between medical students and those pursuing other fields of study.

Another meta-analysis study by Lim and Son (2021) combines data from multiple studies to estimate the overall prevalence of CFS in Korea and Japan which were reported as 0.77% and 0.76% respectively. Both rates are considered low compared to the global prevalence of approximately 1.0%. This study exclusively used the Fukuda criteria (CDC-1994) for diagnosing CFS and suggests that Korea's lower prevalence rate may be due to the inclusion of medical tests alongside interviews for diagnosis, distinguishing it from Japan's approach.

As mentioned in Bested and Marshall (2015), the CCC offers significant advantages when measuring the prevalence of CFS, primarily due to its strict diagnostic process. It begins by ruling out other treatable conditions that could cause symptoms such as fatigue, sleep disturbances, cognitive dysfunction, and pain. If an underlying, treatable condition is identified, the diagnosis of CFS is deferred until that condition has been addressed. This step ensures that only those who truly meet the specific criteria for CFS are diagnosed. Compared to other diagnostic criteria, the CCC’s more specific exclusion criteria often result in fewer patients being diagnosed, enhancing the accuracy and reliability of the diagnosis. Moreover, the CCC helps differentiate CFS from overlapping conditions, such as depression, by emphasizing the exclusion of other potential causes of symptoms. This makes the CCC particularly useful for primary care clinicians, as it provides a clear and structured approach to diagnosing CFS.

In a nutshell, the prevalence of ME/CFS varies across studies based on the definition of the condition, the population being studied, and the methods used to assess it.

5.2.2 Association between Chronic Fatigue Syndrome and Quality of Life

Chronic Fatigue Syndrome (CFS) is a debilitating condition that significantly impacts patients' quality of life (QoL). Despite the findings from Table 4.8 suggesting a lack of significant association between CFS and QoL due to a small sample size, existing literature indicates a strong positive correlation between these two variables. Research consistently demonstrates that individuals with CFS experience markedly lower QoL compared to healthy populations and those with other chronic illnesses. For instance, a study published in *BMJ Open* revealed that CFS patients reported significant impairments in their ability to perform daily activities, manage pain, and maintain mobility, which collectively contribute to their overall health status being rated as low on a Visual Analogue Scale with mean score of 33.8 (Baker, 2022). Another study by Eaton-Fitch et al. (2020) also highlighted the severity of QoL impairment in CFS patients. This study reported notably low scores in physical role (4.1), pain (47.5), fatigue (13.5), emotional role (51.9), and general health (23.9). These findings align with our results, emphasizing significantly low scores in these domains.

Despite being well-educated, over half of the participants were on disability, highlighting the economic burden from reduced workforce participation. With more than 95% facing fatigue for over two years, the condition is unlikely to improve without proper intervention (Jason & Mirin, 2021). Furthermore, the emotional toll on family members of those with CFS is profound, indicating that the impact of this syndrome extends beyond the individual to affect their loved ones (Baker, 2022). Another comprehensive study emphasized the global burden of CFS on QoL, asserting that the condition leads to substantial limitations in various life domains, such as social and occupational functioning (Muirhead et al., 2024). Individuals with CFS struggle to maintain full-time employment and reported living alone, which exacerbating feelings of loneliness and hinder social interactions, further impacting their overall well-being (Muirhead et al., 2024).

Daily activities and lifestyle choices play a crucial role in influencing fatigue and overall well-being. Studies reveal that individuals displaying CFS-like symptoms who possibly fall in to false positive category often engage in sedentary behaviours, follow poor dietary practices, and maintain low levels of physical activity. For example, one study indicated that CFS respondents were more likely to experience obesity, consume less nutritious food, and participate in minimal exercise (van't Leven et al., 2009). All factors that can exacerbate fatigue and lead to lower QoL scores on tools like the SF-36. This pattern of unhealthy living might result in a misclassification of their symptoms as CFS, highlighting the potential for false-positive diagnoses. People who avoid regular exercise may develop muscle weakness and decreased stamina, which can mimic the symptoms of CFS. In contrast, a sedentary lifestyle can lead to a cycle of fatigue and inactivity, increasing the risk of being mistakenly diagnosed with CFS (Factors, n.d.). Other than that, individuals consuming diets high in processed foods, sugars, and unhealthy fats may experience fluctuations in energy that mimic CFS symptoms. For instance, diets low in essential nutrients can lead to deficiencies that contribute to fatigue, muscle weakness, and cognitive difficulties which are common symptoms of CFS. A study by Goedendorp et al., (2009) found that a high percentage of CFS patients reported unhealthy dietary patterns, which could exacerbate their fatigue and impair their quality of life.

People living with CFS frequently encounter stigma and misunderstanding from those around them, including family, friends, and even healthcare providers. This lack of awareness can foster feelings of prejudice and disbelief, making individuals hesitant to seek social support or participate in work-related activities. To address this, we can focus on raising awareness and educating communities about CFS to foster understanding and empathy.

5.2.3 Association between Chronic Fatigue Syndrome and Sleep Quality

By referring to the findings from Table 4.5, the findings of the Chi-Square test revealed no significant association between chronic fatigue syndrome (CFS)and sleep quality among young adults in this study. This suggests that having CFS does not necessarily determine whether an individual will have good or poor sleep quality. The small sample size of individuals with CFS (n = 2) may have influenced this result, as statistical tests require adequate group sizes to detect meaningful relationships. it is worth considering whether these cases might be false positives, particularly if the diagnosis of CFS was based on self-reported symptoms (Stephanie, 2015).

Although this study found no significant association between CFS and sleep quality, evidence from polysomnography (PSG) strongly supports a link between CFS and sleep disturbances. A study analysing PSG data revealed that CFS patients spent more time awake and experienced reduced time in deeper sleep stages compared to healthy individuals (Gotts et al., 2013). In this study by Chang et al. (2021), IOM criteria was utilized to diagnose patients with CFS as part of the Severely Ill Patient Study (SIPS). The Pittsburgh Sleep Quality Index (PSQI) revealed that patients had significantly lower sleep quality, more frequent sleep disturbances, and worse Global PSQI scores compared to the controls. These differences were evident in areas such as sleep quality, habitual sleep efficiency, sleep disturbances, and the use of sleeping medications which showed p-value <0.05.

Sleep disturbances are a key feature of CFS, closely tied to disrupted circadian rhythms, fatigue, anxiety, and depression (Luo et al. 2023). Patients often show unstable daily activity patterns, which can exacerbate symptoms, but studies suggest that regulating circadian rhythms may help. Research highlights a strong correlation between fatigue and mental health conditions ($r = 0.98$, $P < 0.05$). Additionally, habits like staying up all night worsen fatigue, while taking naps reduces it, as shown by. Other than that, highlights that non-restorative sleep is one of the most common symptoms of CFS, affecting up to 95% of patients. This poor-quality sleep has been closely associated with worsening daytime symptoms, directly influencing the overall health, energy levels, and daily functioning of individuals with CFS In-text citation: (Ferré, 2018). This strong connection underscores the critical role sleep quality plays in managing the condition.

Additionally, it is worth noting that sleep disturbances in the general population may be influenced by other factors such as lifestyle habits, stress, or mental health conditions, which could overshadow the specific effects of CFS. According to Mohamed et al., (2023), daytime napping and extended sleep periods may contribute to difficulties falling asleep at night. Patients with ME/CFS who nap during the day often experience lower sleep efficiency, longer time to fall asleep, and more interruptions in their nighttime sleep. While some suggest that reduced physical activity could play a role in these sleep disruptions in the general population, the impact seems particularly pronounced in CFS patients (Neu et al., 2007). Another key feature of sleep disturbances in CFS patients that mentioned in (Mohamed et al., 2023) is marked by more frequent and prolonged awakenings after sleep onset. However, these conditions may be influenced by various factors, one-night studies, physical limitations, and environmental distractions can affect the accuracy of findings. For instance, incorporating an adaptation night before the actual sleep study and allowing flexible sleep schedules can improve the reliability of sleep measurements in CFS patients.

5.3 Limitation

The study's findings are based on a specific subset of young adults from the Klang Valley, which may not fully represent the broader population. This limited representativeness can introduce sampling bias, as certain groups like university students or urban residents may be overrepresented, while others like those from rural areas or those not actively engaged in higher education may be underrepresented. Consequently, the prevalence rates of CFS and its associations with QoL and sleep observed in this study might not be generalizable to the entire young adult population in the Klang Valley or other regions.

Furthermore, the study limitations also include short duration of the study, small sample size and thus the results cannot decisively be generalized. Besides, there had emerged gender disparity in that majority of participants were females compared to male participants. This imbalance may have significantly enhanced the incidence of detecting the condition among the females consequently affecting the results as the prevalence of the condition is reported to be higher in females. Thus, future studies should aim to recruit a larger and more balanced sample with a longer study duration to address these limitations and improve the robustness of the findings.

One limitation of using the Canadian Consensus Criteria (CCC) for diagnosing healthy individuals is the ceiling effect. The CCC focuses on identifying clear symptoms in people with certain conditions, but it may not pick up subtle or mild differences, especially in healthy individuals. This makes it less suitable for diagnosing those without obvious symptoms. On the other hand, a multi-dimensional questionnaire is better at capturing a wider range of symptoms and can provide a more accurate assessment. Because of the ceiling effect, the CCC might miss important details, making it less effective for this purpose.

Lastly, the study relies on self-reported questionnaires to assess CFS symptoms, quality of life, and sleep quality. Participants may overestimate or underestimate their symptoms or quality of life due to memory recall issues, social desirability, or subjective interpretation of questions. For instance, individuals experiencing fatigue may be more likely to perceive and report lower sleep quality or life satisfaction. This reliance on subjective data can affect the accuracy and reliability of the study findings.

5.4 Recommendation for Future Research

Firstly, since Chronic Fatigue Syndrome (CFS) is a condition with symptoms that can fluctuate over time, longitudinal research would be highly valuable. Unlike cross-sectional studies, longitudinal studies follow participants over an extended period, allowing researchers to observe the onset and progression of CFS and its impact on quality of life and sleep quality. This approach can help identify potential causal relationships, such as whether poor sleep quality precedes the onset of fatigue or if reduced quality of life is a consequence of CFS symptoms worsening. Longitudinal studies can also help detect periods when symptoms are most intense, enabling more precise timing for interventions and giving insights into whether CFS stabilizes, improves, or worsens with age. Understanding these patterns is essential for developing more effective, personalized treatment and management strategies.

In addition, sleep disturbances and reduced quality of life are major challenges for CFS patients, yet these areas are often under-researched in terms of targeted interventions. Future studies could explore specific therapies to improve sleep, such as cognitive- behavioral therapy for insomnia (CBT-I), pharmacological treatments tailored for CFS-related sleep disturbances, or non-pharmacological methods like sleep hygiene practices and relaxation techniques. Research into improving quality of life should also focus on holistic approaches, such as mind-body therapies, lifestyle modifications, and social support interventions, as well as physical rehabilitation tailored to energy limitations. Investigating the efficacy of these interventions in randomized controlled trials (RCTs) would provide valuable data on their impact, helping to build a repertoire of evidence-based treatments that could alleviate the day-to-day challenges of living with CFS.

Other than that, among the various recommendations mentioned for future studies on CFS, the lack of preparation among healthcare workers is one of the fields that needs improvement. To date, only a few medical schools offer training sufficient to equip doctors with the knowledge required to diagnose and treat ME/CFS. Besides that, most of the textbooks also contain outdated information about the illness. Consequently, there is no formal or systematic way to teach ME/CFS to general practitioners and specialists, unlike the focused training provided for emerging diseases such as HIV/AIDS in the past. This gap in education results in significant delays in diagnosing patients, with some waiting years for an accurate diagnosis. Addressing this issue requires improvements in the education and training of healthcare workers and practitioners. Raising awareness and increasing recognition of ME/CFS among doctors could significantly reduce the time to diagnosis, especially considering that only 20% of people with the disease have been properly diagnosed.

5.5 Conclusion

This study aimed to examine the prevalence of Chronic Fatigue Syndrome (CFS) and its association with quality of life and sleep quality among young adults. By exploring these relationships, the study sought to provide valuable insights into the impact of CFS on health and daily functioning, particularly in the context of young populations.

The study finding's showed no significant link ($p>0.05$) between CFS, quality of life, and sleep quality. However, this finding may be due to the small number of participants in the study, which made it harder to detect a clear relationship. Other research has strongly shown that CFS is closely connected to lower quality of life and poor sleep. These differences highlight the need for future studies with larger groups of participants to better understand these links. To improve future research, it's important to include a larger number of participants, as CFS is not very common. Efforts should also be made to reduce sampling bias to better represent the wider population. These steps will provide a clearer picture of how CFS impacts quality of life and sleep, which could lead to better support and care for those affected.

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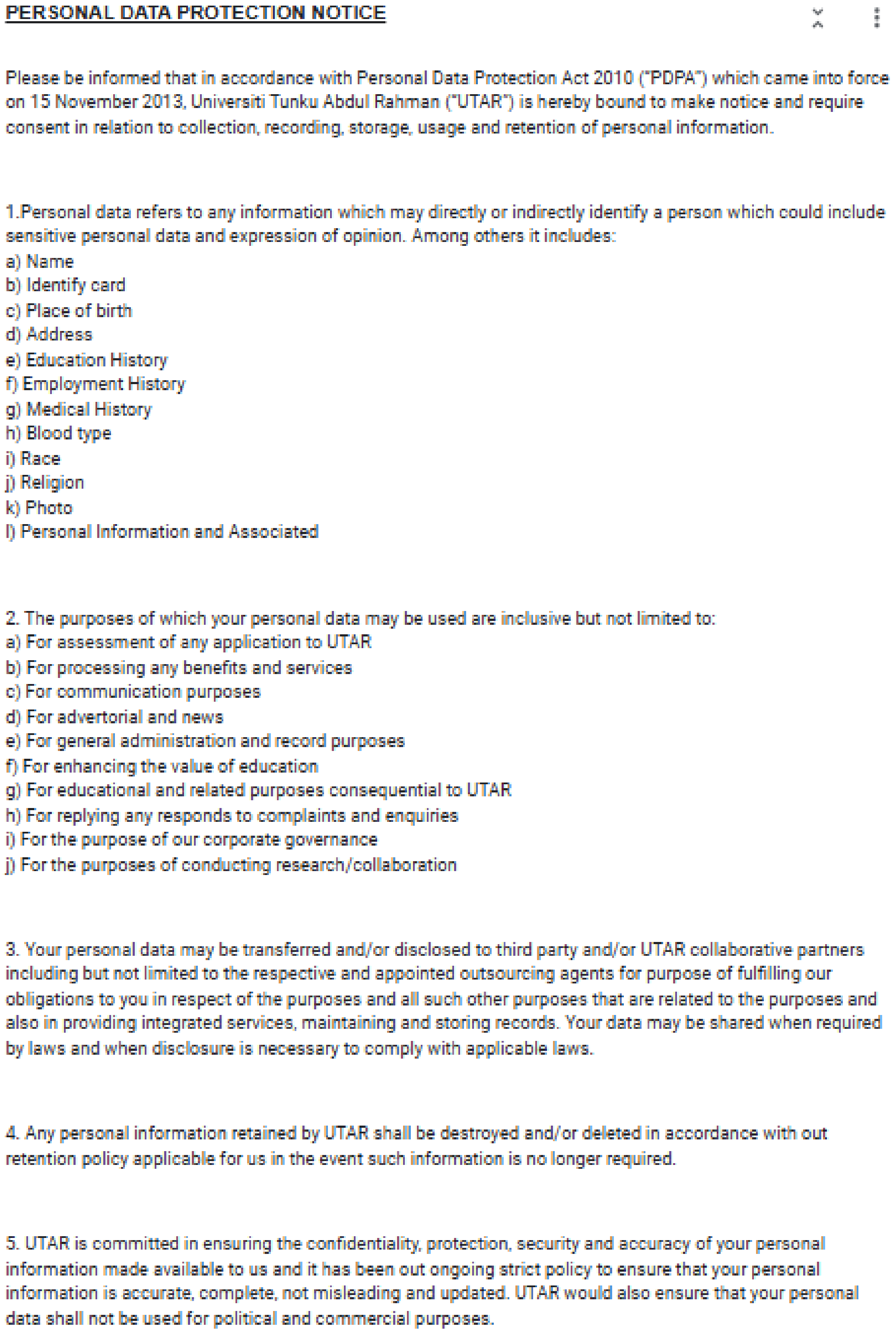
APPENDIX A – ETHICAL APPROVAL FORM

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
9.	Assessment Of Diagnostic Clinical Reasoning Skills Among Undergraduate Physiotherapy Students	Jason Ho Yi Zeng	Mr Avanianban Chakkarapani	23 September 2024 – 22 September 2025
10.	Awareness, Knowledge, Attitude and Perception of Active Isolated Stretching Among Physiotherapy Academics and Students in a Private University: A Cross Sectional Study	Law Jing Tien		
11.	Knowledge Of Quadriceps Angle (Q-Angle) Among Physiotherapy Students	Tay Yu Xin		
12.	Cortical Excitability and Body Awareness in Individuals with Adolescent Idiopathic Scoliosis: An Exploratory Study	Mark Isaac Fernandez	Dr Deepak Thazhakkattu Vasu	
13.	Exercise Interventions in Primiparous Women for the Prevention and Management of Pelvic Floor Dysfunction: A Systematic Review	Jenny Peng Mei Shi		
14.	Exploring the Novel Sensor System for Detecting Postural Reactions Among Healthy Younger Adults: A Pilot Study	Ooi Xin Rou		
15.	Prevalence of Chronic Fatigue Syndrome (CFS) and Its Association on Quality of Life and Sleep Quality Among Young Adults: A Cross-sectional Study	Delphine Yeo Sze Qi	Mr Sathish Kumar Sadagobane Co-Supervisor: Mr Tarun Amalnerkar	
16.	Association Between Level of Ergonomic Knowledge and Prevalence of Neck Pain Among Part-time Postgraduate Students in Klang Valley	Ng Jia Xuan	Mr Sathish Kumar Sadagobane Co-Supervisor: Mr Edwin Gaspar	
17.	Effectiveness of Kinesiotaping with Static Stretching and Proprioceptive Neuromuscular Facilitation Stretching for Gastrocnemius Tightness Management Among Adults	Tan Jia Yin	Ms Heaw Yu Chi	
18.	Awareness, Knowledge and Perceptions of Chronic Fatigue Syndrome/ Myalgic Encephalomyelitis Between Student and Working Physiotherapists: A Comparative Study	Tee Yee Pei		
19.	Effect of Pulmonary Rehabilitation on Dyspnea and Quality of Life Among Chronic Obstructive Pulmonary Disease Patients: A Systematic Review	Chin Jay Ven	Mr Imtiyaz Ali Mir	
20.	Efficacy of Music Therapy and Mindfulness Meditation on Blood Pressure and Mental Health Among University Students	Tan Pei Chen		
21.	Effects of Music Therapy on Haemodynamic Variables and Mental Health in Patients with Coronary Artery Disease: A Systematic Review	Foong Ei Yan		
22.	Effects of Different Phases of the Menstrual Cycle on Daytime Drowsiness and Muscular Fatigue Among Recreational Female Badminton Players	Lee Kae Shyan	Mr Muhammad Noh Zulfikri Bin Mohd Jamali Co-supervisor: Mr Tarun Amalnerkar	
23.	Association between Gastrocnemius Tightness, Hallux Valgus and Physical Activity Among University Students	Chong Yi Xian	Ms Siti Hazirah Binti Samsuri	
24.	The Prevalence of Lower Urinary Tract Symptoms (LUTS) and Its Associated Risk Factors Among Male University Students	Gan Xinyi		
25.	Examining Doms Reduction in Recreational Versus Competitive Athletic Populations	Jona Kong Zong Na	Ms Kamala a/p Krishnan	
26.	Effectiveness of Virtual Reality Games on Hand Movement and Strength rehabilitation in Stroke Patients: A Systematic Review	Rachel Hew Zi Qi		

APPENDIX B – 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) Identify 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

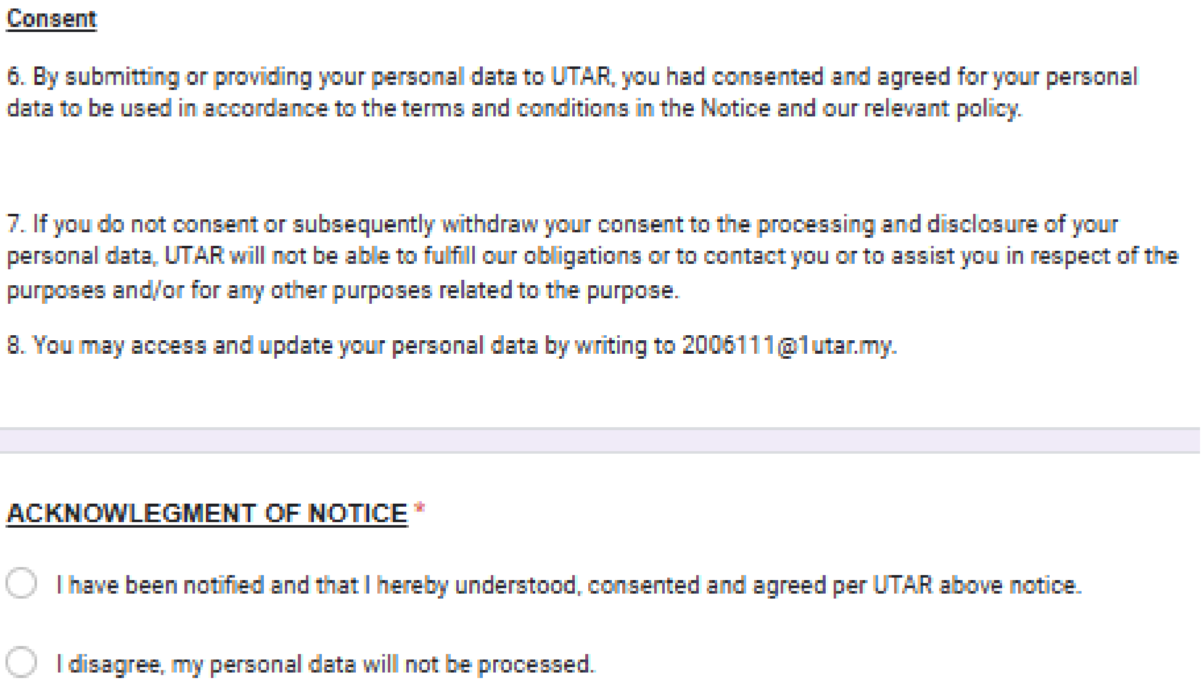
2. The purposes of which your personal data may be used are inclusive but not limited to:
a) For assessment of any application to UTAR
b) For processing any benefits and services
c) For communication purposes
d) For advertorial and news
e) For general administration and record purposes
f) For enhancing 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 out 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 out 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.

APPENDIX C – INFORMED CONSENT FORM



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.

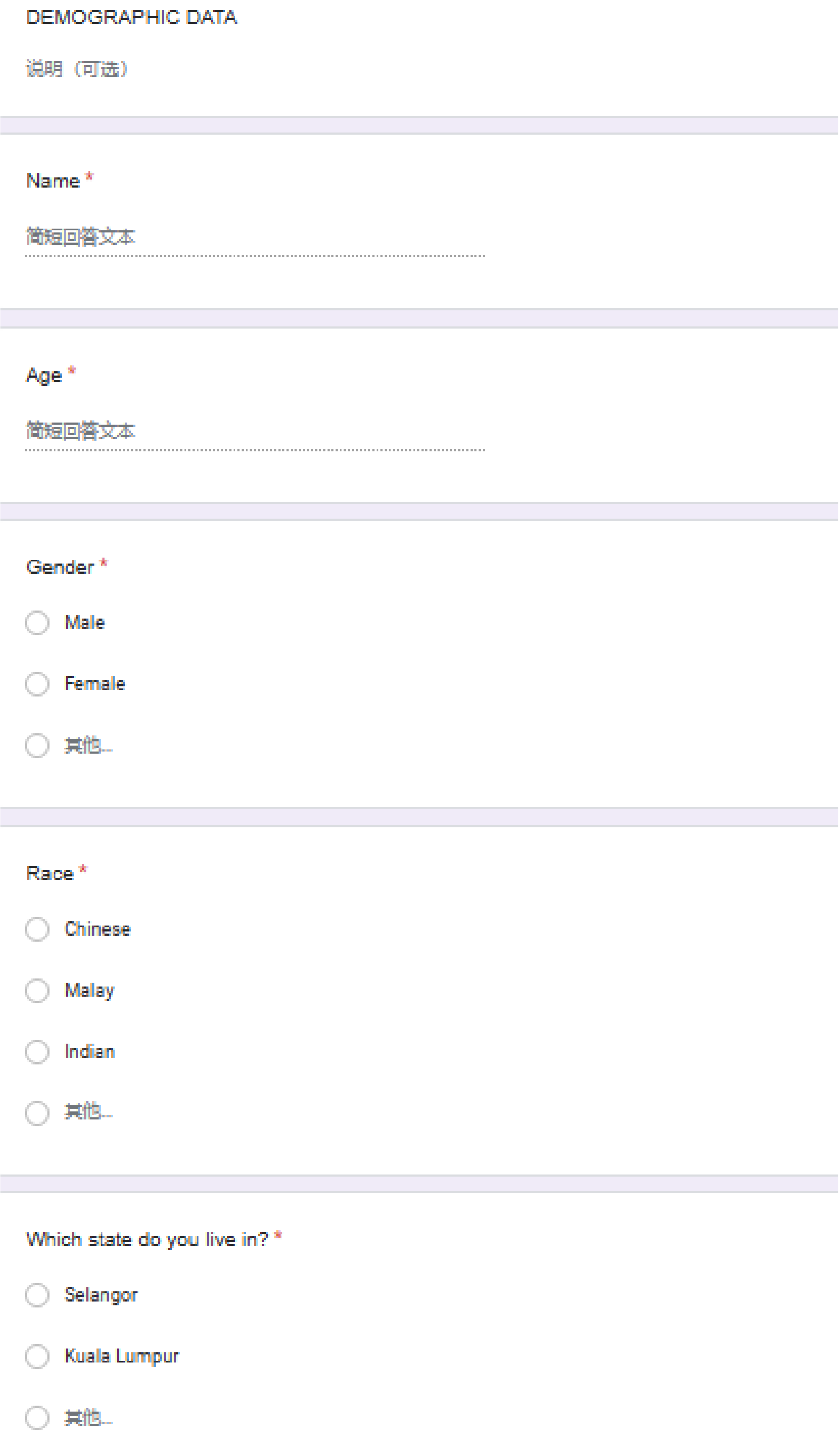
8. You may access and update your personal data by writing to 2006111@1utar.my.

ACKNOWLEGMENT OF NOTICE *

○ I have been notified and that I hereby understood, consented and agreed per UTAR above notice.

○ I disagree, my personal data will not be processed.

APPENDIX D – DEMOGRAPHIC DATA



DEMOGRAPHIC DATA

说明（可选）

Name *

简短回答文本

Age *

简短回答文本

Gender *

○ Male

○ Female

○ 其他...

Race *

○ Chinese

○ Malay

○ Indian

○ 其他...

Which state do you live in? *

○ Selangor

○ Kuala Lumpur

○ 其他...

What is your employment status?

○ Employed

○ Unemployed

○ Student

○ 其他...

Do you have any history of medical condition? *

Example: cancer, diabetes mellitus, thyroid disease, etc.

○ Yes

○ No

Have you been diagnosed for any mental health condition? *

Example: depression, anxiety , PTSD, OCD, etc.

○ Yes

○ No

Have you experienced any substance abuse issues in the past year excluding nicotine and caffeine *

Example: alcohol, cocaine, opioids , etc.

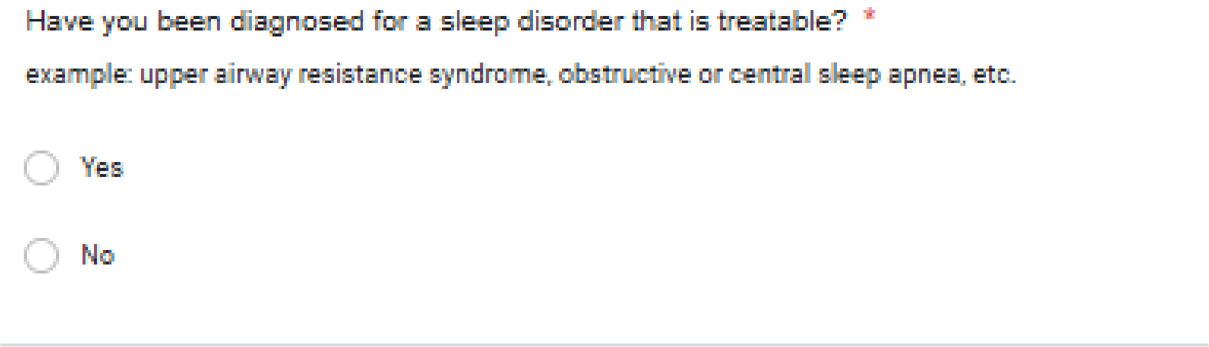
○ Yes

○ No

Have you received an influenza vaccination within the last 4 weeks? *

○ Yes

○ No



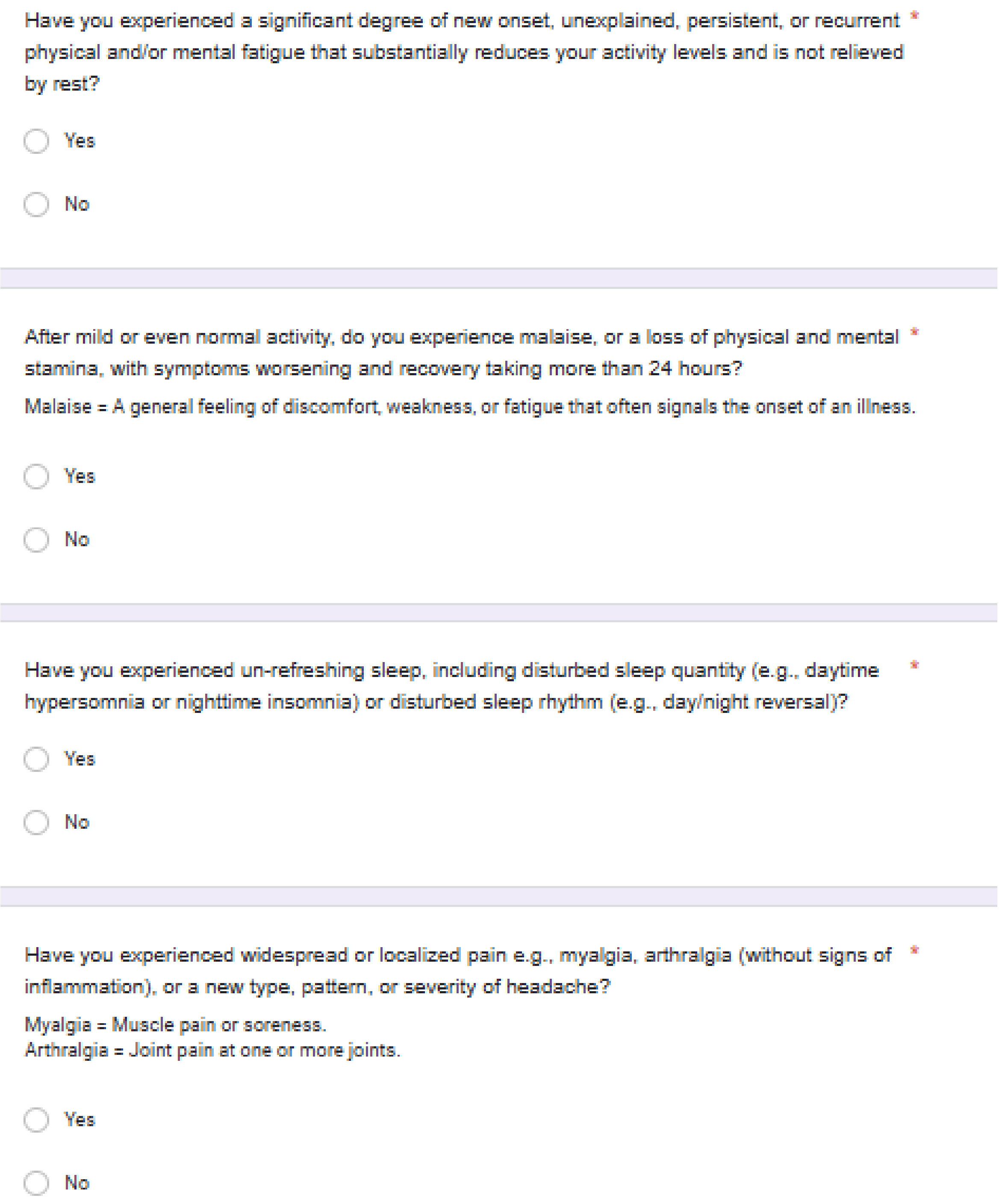
Have you been diagnosed for a sleep disorder that is treatable? *

example: upper airway resistance syndrome, obstructive or central sleep apnea, etc.

○ Yes

○ No

APPENDIX E – CANADIAN CONSENSUS CRITERIA (CCC)



Have you experienced a significant degree of new onset, unexplained, persistent, or recurrent physical and/or mental fatigue that substantially reduces your activity levels and is not relieved by rest? *

○ Yes

○ No

After mild or even normal activity, do you experience malaise, or a loss of physical and mental stamina, with symptoms worsening and recovery taking more than 24 hours? *

Malaise = A general feeling of discomfort, weakness, or fatigue that often signals the onset of an illness.

○ Yes

○ No

Have you experienced un-refreshing sleep, including disturbed sleep quantity (e.g., daytime hypersomnia or nighttime insomnia) or disturbed sleep rhythm (e.g., day/night reversal)? *

○ Yes

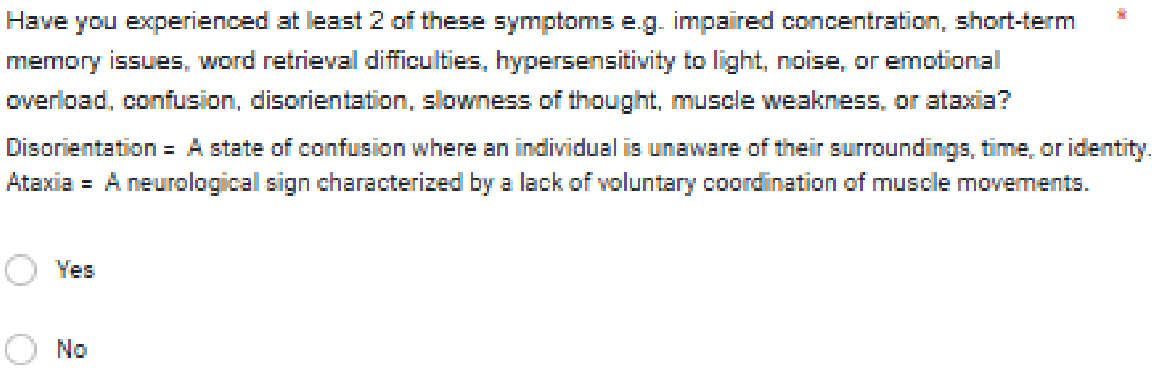
○ No

Have you experienced widespread or localized pain e.g., myalgia, arthralgia (without signs of inflammation), or a new type, pattern, or severity of headache? *

Myalgia = Muscle pain or soreness.
Arthralgia = Joint pain at one or more joints.

○ Yes

○ No

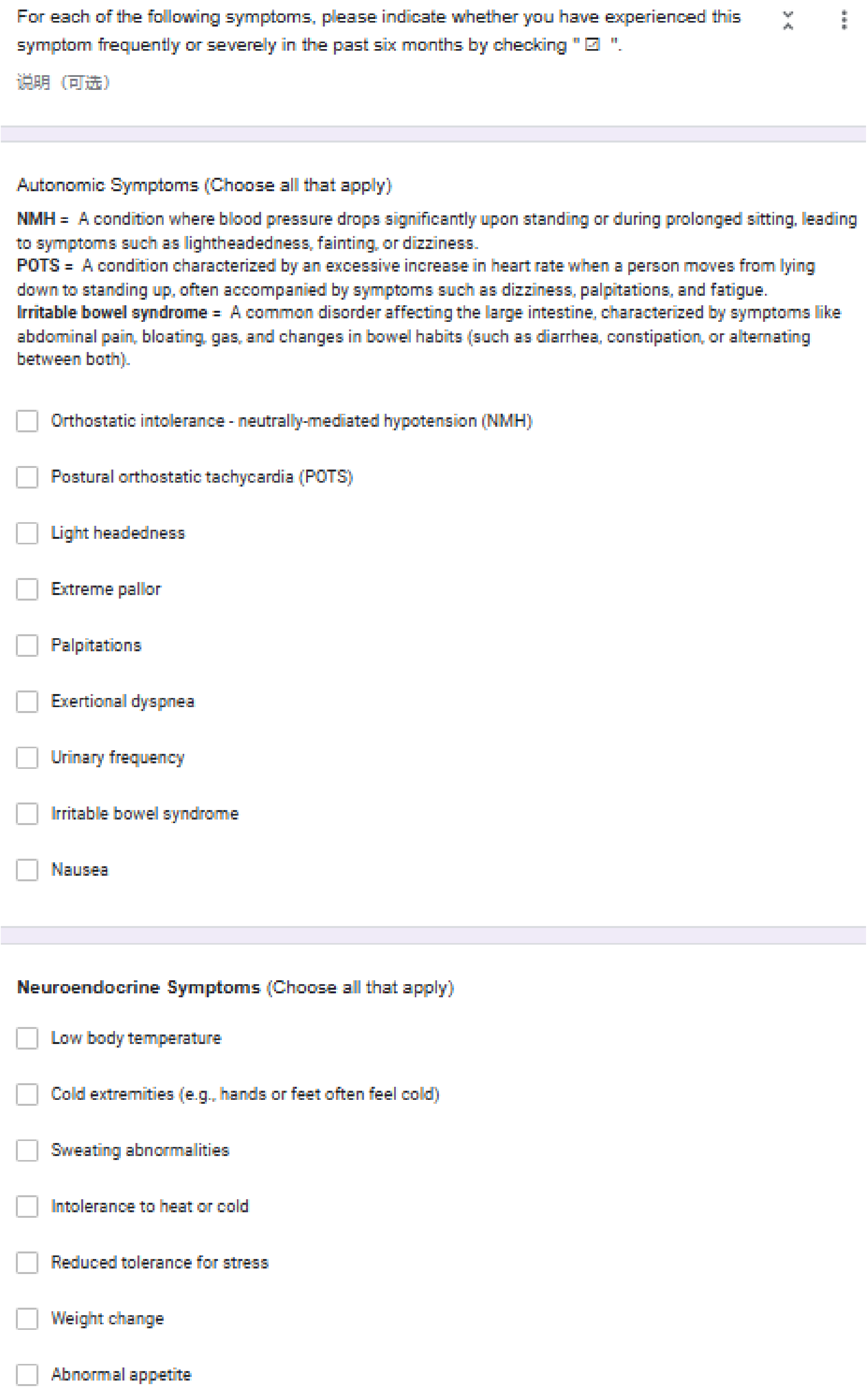


Have you experienced at least 2 of these symptoms e.g. impaired concentration, short-term memory issues, word retrieval difficulties, hypersensitivity to light, noise, or emotional overload, confusion, disorientation, slowness of thought, muscle weakness, or ataxia? *

Disorientation = A state of confusion where an individual is unaware of their surroundings, time, or identity.
Ataxia = A neurological sign characterized by a lack of voluntary coordination of muscle movements.

○ Yes

○ No



For each of the following symptoms, please indicate whether you have experienced this symptom frequently or severely in the past six months by checking " ☑ ".

说明（可选）

Autonomic Symptoms (Choose all that apply)

NMH = A condition where blood pressure drops significantly upon standing or during prolonged sitting, leading to symptoms such as lightheadedness, fainting, or dizziness.
POTS = A condition characterized by an excessive increase in heart rate when a person moves from lying down to standing up, often accompanied by symptoms such as dizziness, palpitations, and fatigue.
Irritable bowel syndrome = A common disorder affecting the large intestine, characterized by symptoms like abdominal pain, bloating, gas, and changes in bowel habits (such as diarrhea, constipation, or alternating between both).

☐ Orthostatic intolerance - neutrally-mediated hypotension (NMH)

☐ Postural orthostatic tachycardia (POTS)

☐ Light headedness

☐ Extreme pallor

☐ Palpitations

☐ Exertional dyspnea

☐ Urinary frequency

☐ Irritable bowel syndrome

☐ Nausea

Neuroendocrine Symptoms (Choose all that apply)

☐ Low body temperature

☐ Cold extremities (e.g., hands or feet often feel cold)

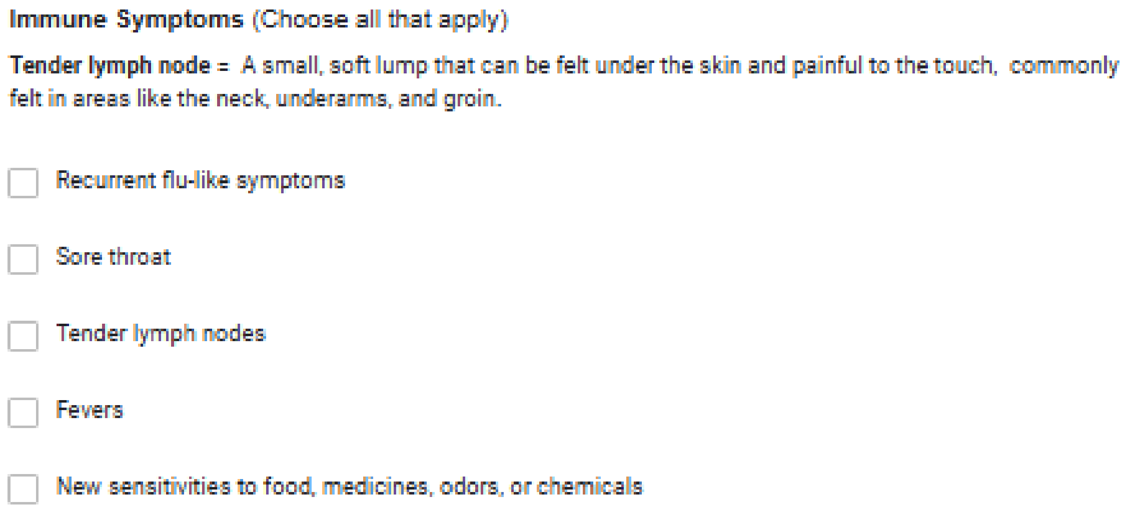
☐ Sweating abnormalities

☐ Intolerance to heat or cold

☐ Reduced tolerance for stress

☐ Weight change

☐ Abnormal appetite



Immune Symptoms (Choose all that apply)

Tender lymph node = A small, soft lump that can be felt under the skin and painful to the touch, commonly felt in areas like the neck, underarms, and groin.

☐ Recurrent flu-like symptoms

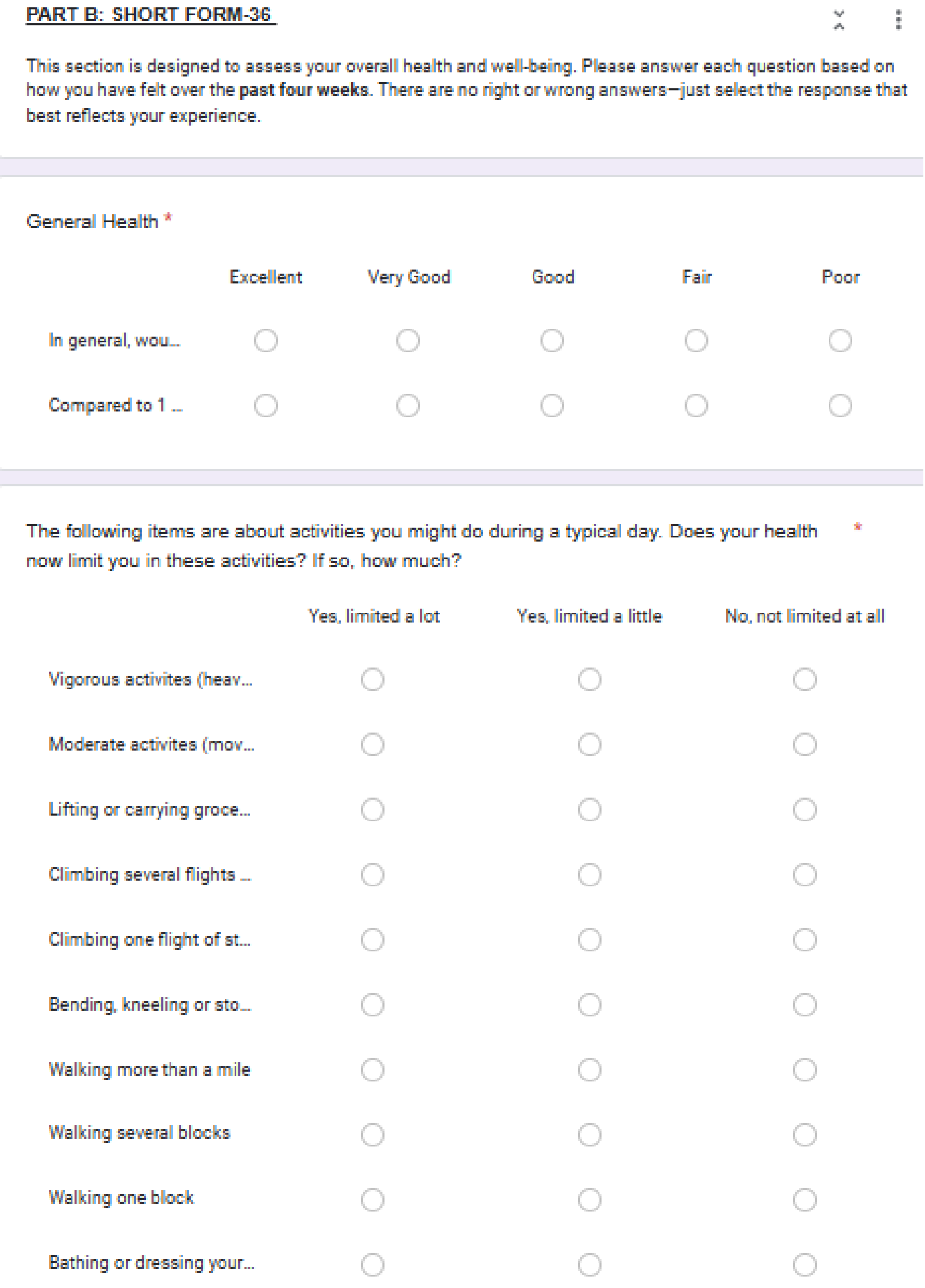
☐ Sore throat

☐ Tender lymph nodes

☐ Fevers

☐ New sensitivities to food, medicines, odors, or chemicals

APPENDIX F – SHORT FORM-36 (SF-36)



PART B: SHORT FORM-36

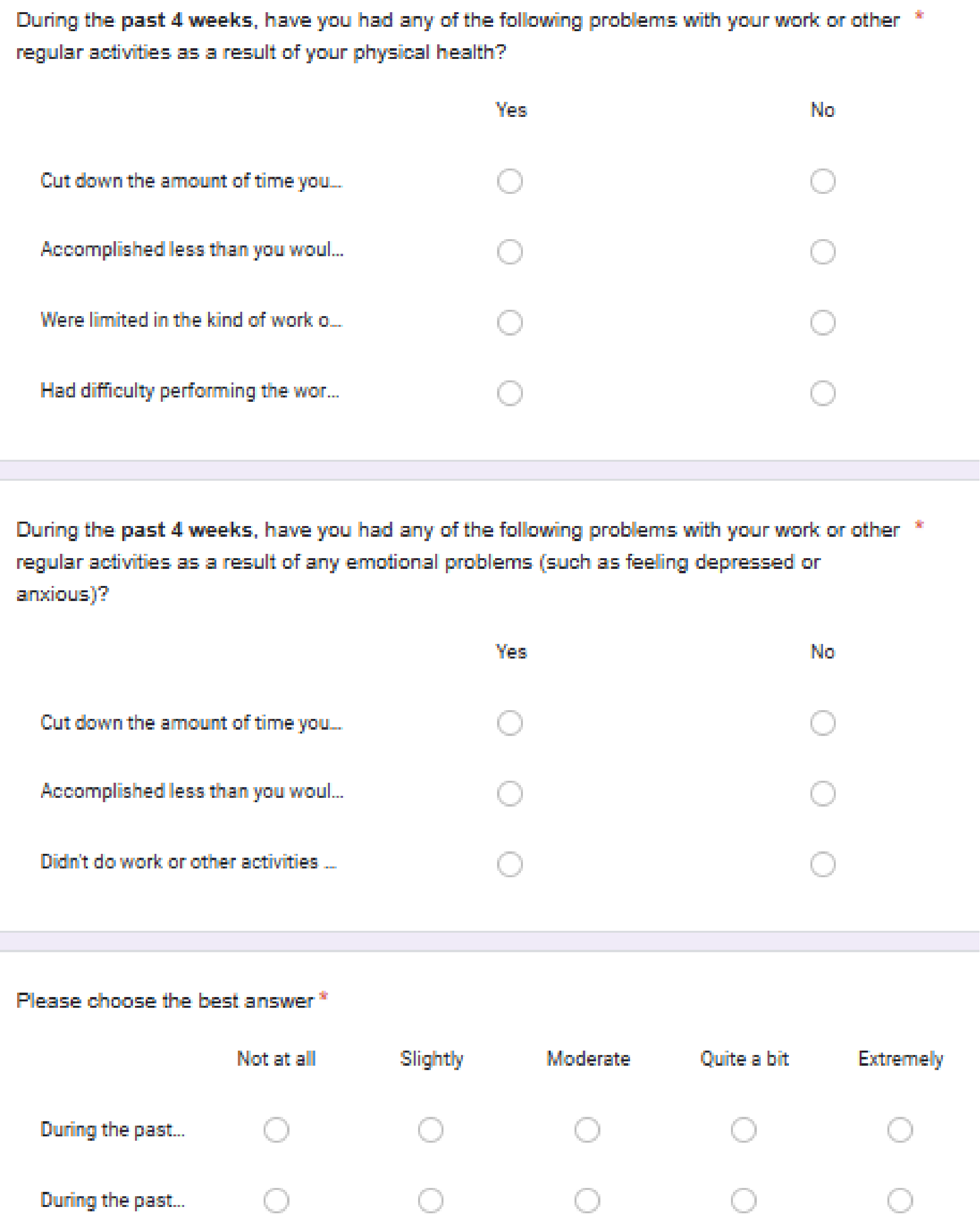
This section is designed to assess your overall health and well-being. Please answer each question based on how you have felt over the **past four weeks**. There are no right or wrong answers—just select the response that best reflects your experience.

General Health *

	Excellent	Very Good	Good	Fair	Poor
In general, wou...	○	○	○	○	○
Compared to 1 ...	○	○	○	○	○

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? *

	Yes, limited a lot	Yes, limited a little	No, not limited at all
Vigorous activites (heav...	○	○	○
Moderate activites (mov...	○	○	○
Lifting or carrying groce...	○	○	○
Climbing several flights ...	○	○	○
Climbing one flight of st...	○	○	○
Bending, kneeling or sto...	○	○	○
Walking more than a mile	○	○	○
Walking several blocks	○	○	○
Walking one block	○	○	○
Bathing or dressing your...	○	○	○



During the **past 4 weeks**, have you had any of the following problems with your work or other regular activities as a result of your physical health? *

	Yes	No
Cut down the amount of time you...	○	○
Accomplished less than you woul...	○	○
Were limited in the kind of work o...	○	○
Had difficulty performing the wor...	○	○

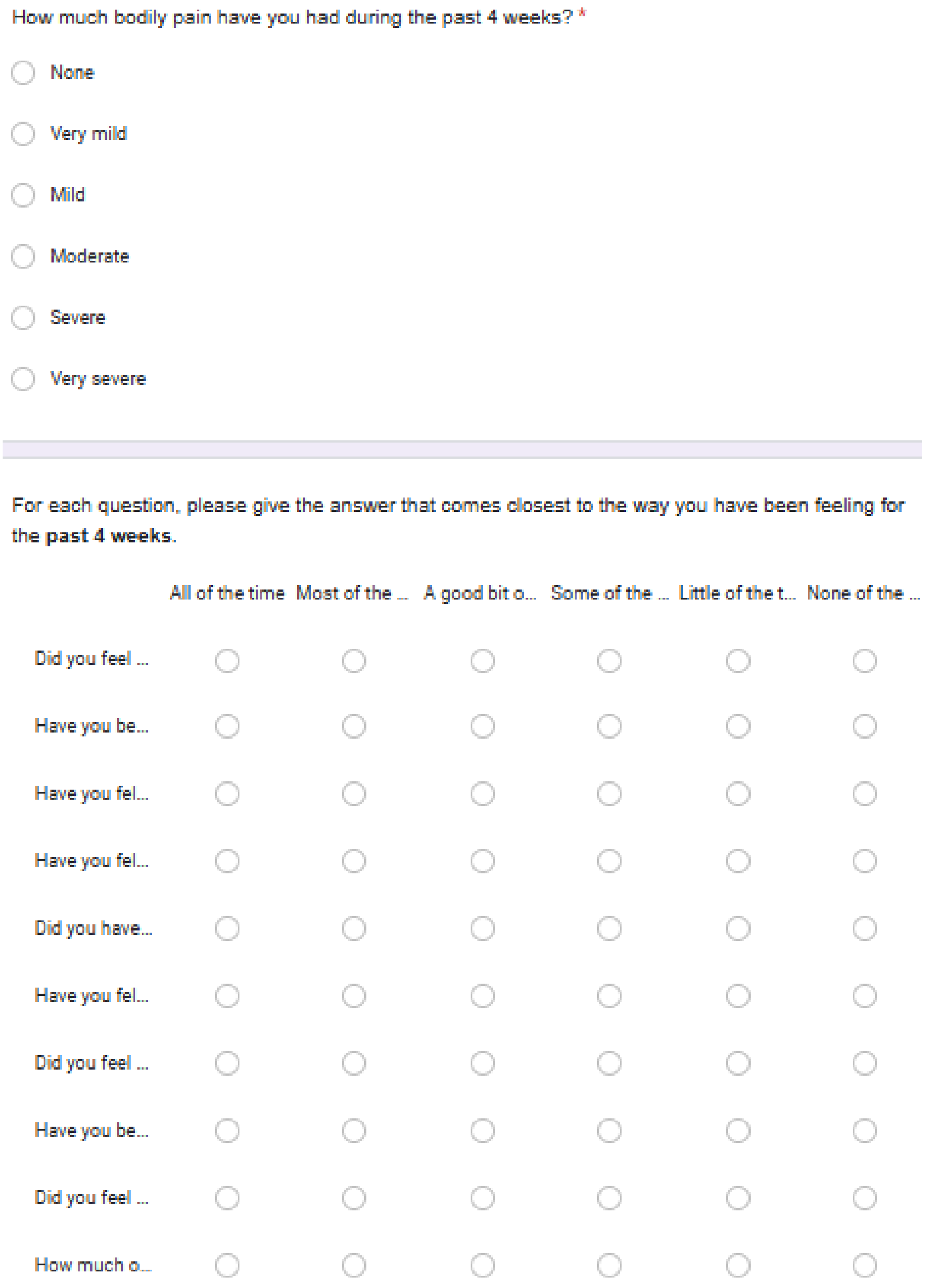
During the **past 4 weeks**, have you had any of the following problems with your work or other regular activities as a result of any emotional problems (such as feeling depressed or anxious)? *

	Yes	No
Cut down the amount of time you...	○	○
Accomplished less than you woul...	○	○
Didn't do work or other activities ...	○	○

Please choose the best answer *

	Not at all	Slightly	Moderate	Quite a bit	Extremely
During the past...	○	○	○	○	○
During the past...	○	○	○	○	○

APPENDIX G – PITTSBURG SLEEP QUALITY INDEX (PSQI)



How much bodily pain have you had during the past 4 weeks? *

○ None

○ Very mild

○ Mild

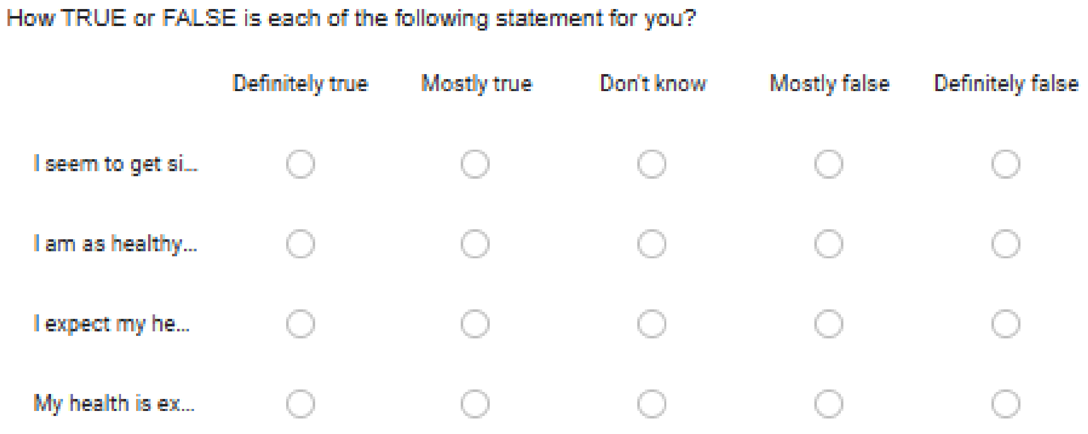
○ Moderate

○ Severe

○ Very severe

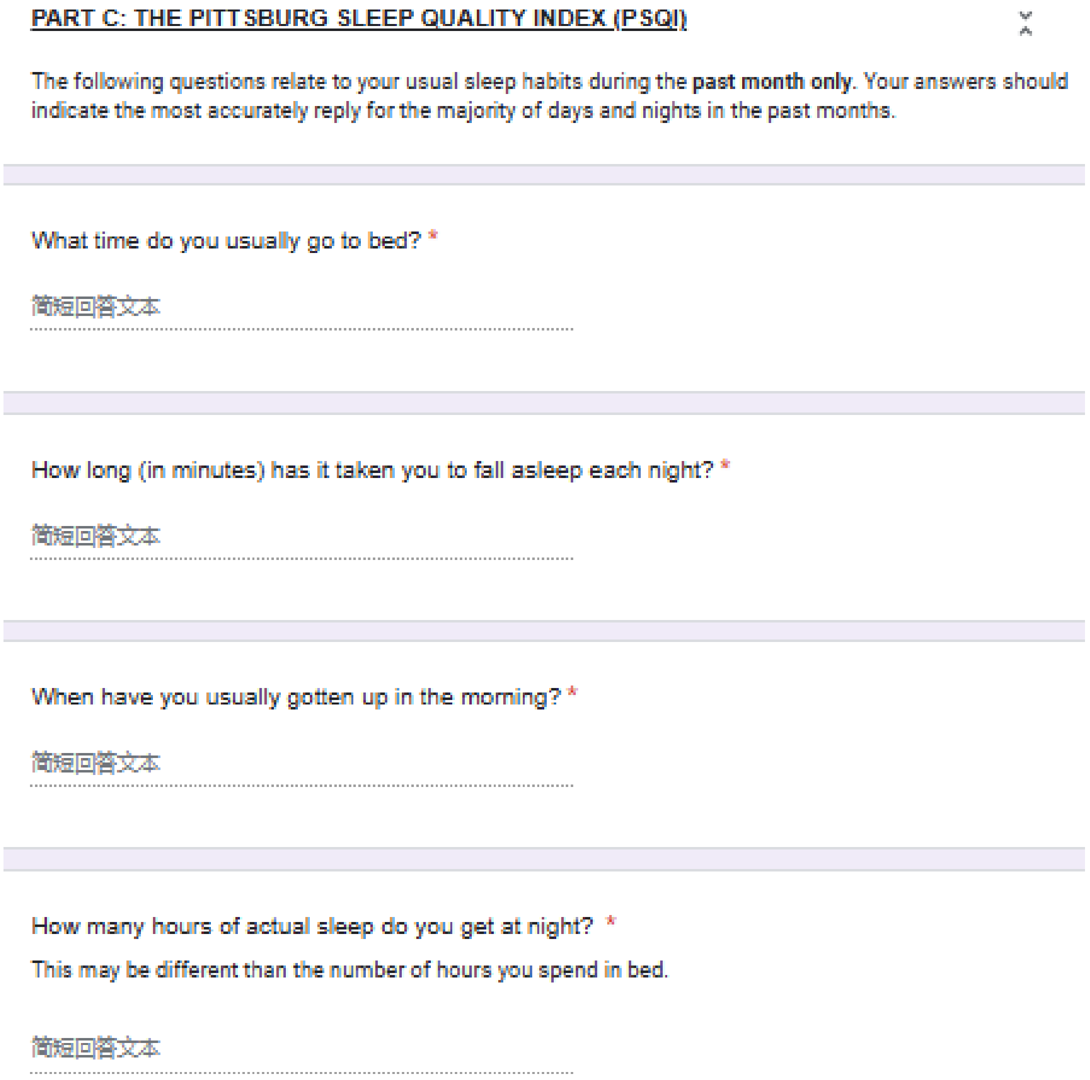
For each question, please give the answer that comes closest to the way you have been feeling for the **past 4 weeks**.

	All of the time	Most of the ...	A good bit o...	Some of the ...	Little of the t...	None of the ...
Did you feel ...	○	○	○	○	○	○
Have you be...	○	○	○	○	○	○
Have you fel...	○	○	○	○	○	○
Have you fel...	○	○	○	○	○	○
Did you have...	○	○	○	○	○	○
Have you fel...	○	○	○	○	○	○
Did you feel ...	○	○	○	○	○	○
Have you be...	○	○	○	○	○	○
Did you feel ...	○	○	○	○	○	○
How much o...	○	○	○	○	○	○



How TRUE or FALSE is each of the following statement for you?

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
I seem to get si...	○	○	○	○	○
I am as healthy...	○	○	○	○	○
I expect my he...	○	○	○	○	○
My health is ex...	○	○	○	○	○



PART C: THE PITTSBURG SLEEP QUALITY INDEX (PSQI)

The following questions relate to your usual sleep habits during the **past month only**. Your answers should indicate the most accurately reply for the majority of days and nights in the past months.

What time do you usually go to bed? *

简短回答文本

How long (in minutes) has it taken you to fall asleep each night? *

简短回答文本

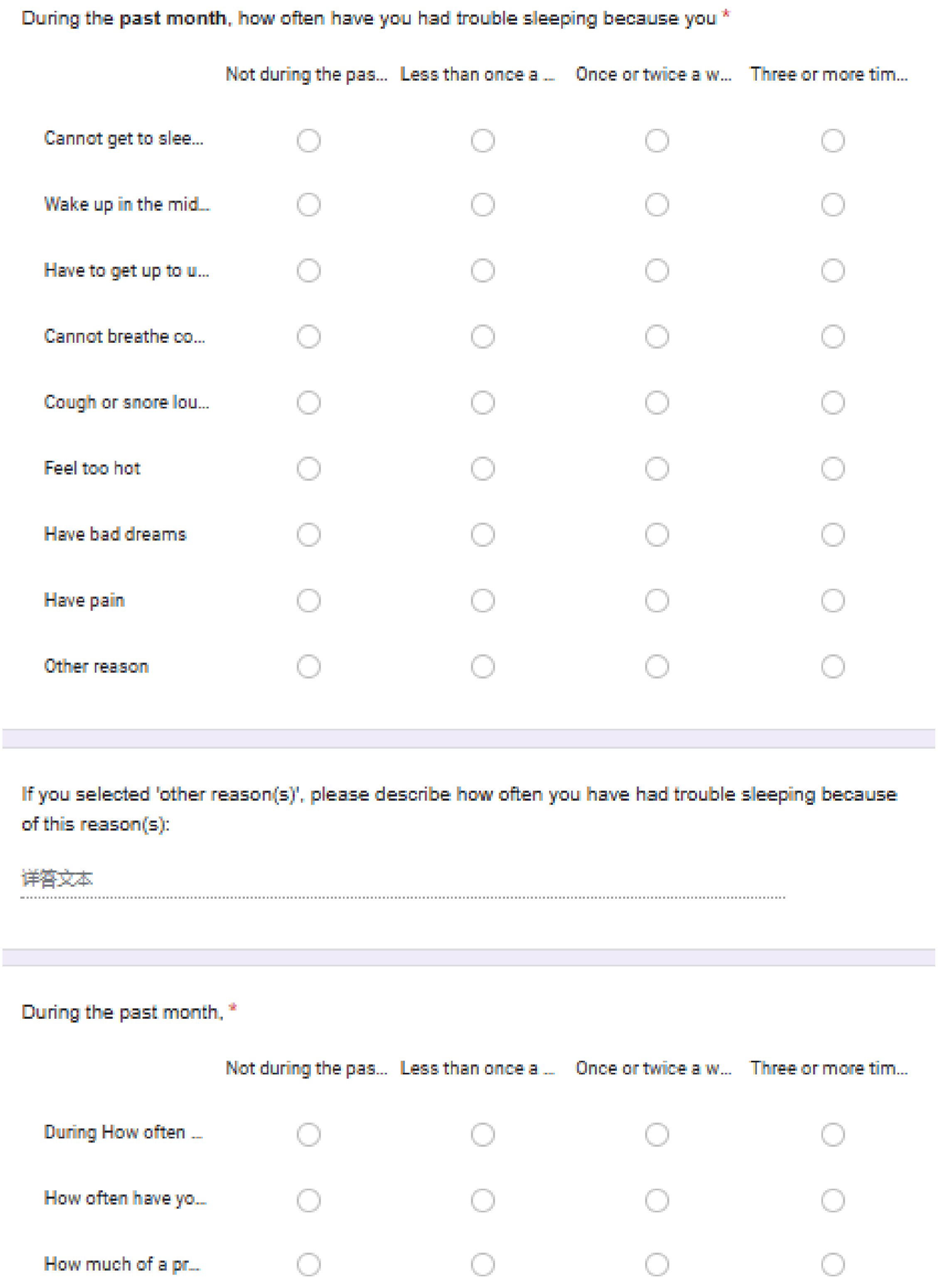
When have you usually gotten up in the morning? *

简短回答文本

How many hours of actual sleep do you get at night? *

This may be different than the number of hours you spend in bed.

简短回答文本



During the **past month**, how often have you had trouble sleeping because you *

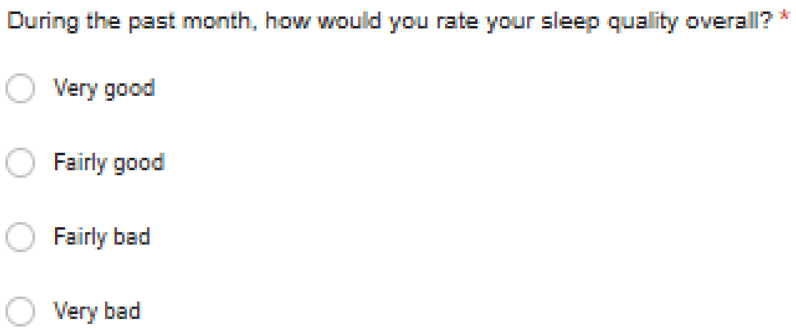
	Not during the pas...	Less than once a ...	Once or twice a w...	Three or more tim...
Cannot get to slee...	○	○	○	○
Wake up in the mid...	○	○	○	○
Have to get up to u...	○	○	○	○
Cannot breathe co...	○	○	○	○
Cough or snore lou...	○	○	○	○
Feel too hot	○	○	○	○
Have bad dreams	○	○	○	○
Have pain	○	○	○	○
Other reason	○	○	○	○

If you selected 'other reason(s)', please describe how often you have had trouble sleeping because of this reason(s):

详答文本

During the past month, *

	Not during the pas...	Less than once a ...	Once or twice a w...	Three or more tim...
During How often ...	○	○	○	○
How often have yo...	○	○	○	○
How much of a pr...	○	○	○	○



During the past month, how would you rate your sleep quality overall? *

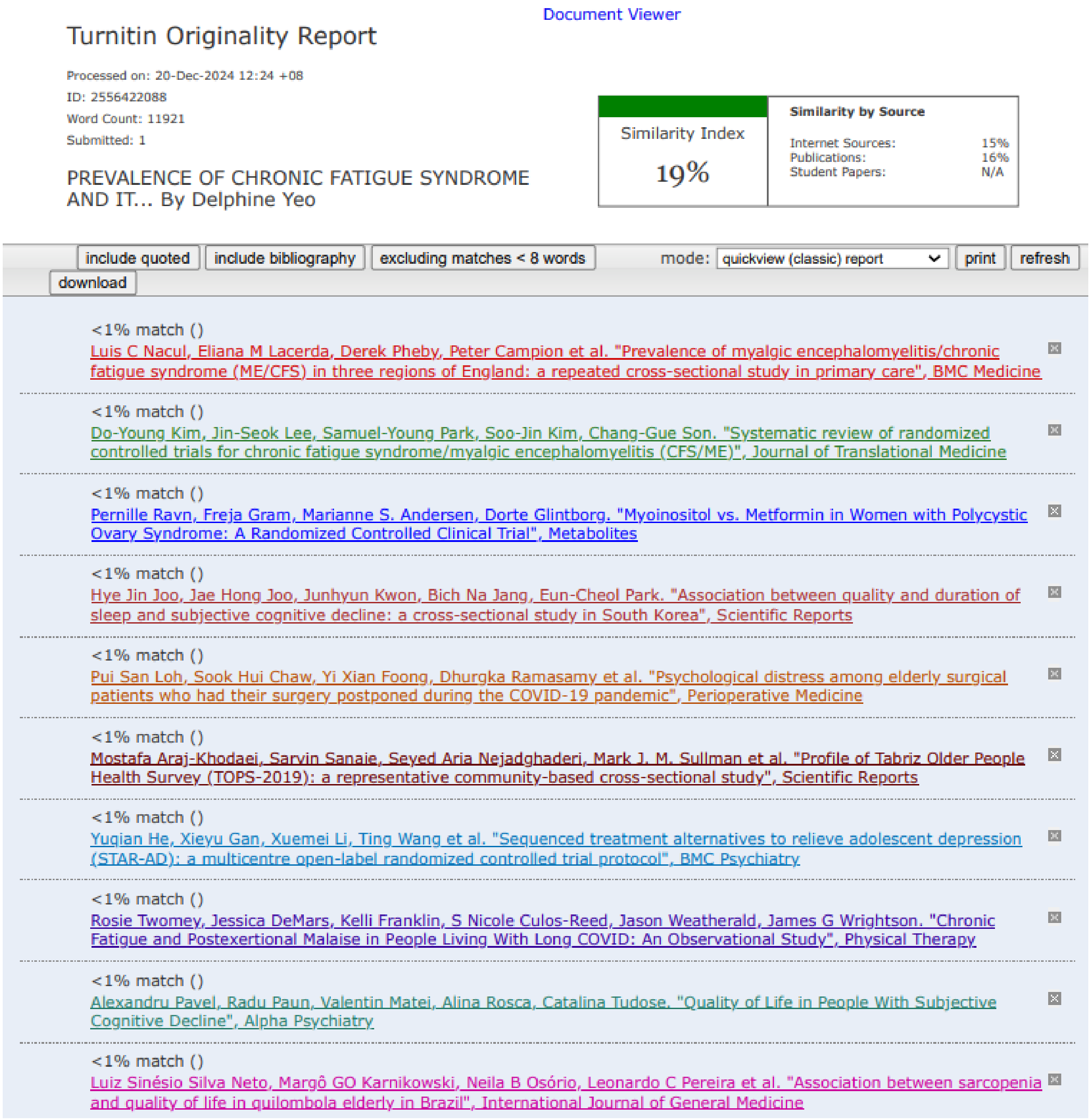
○ Very good

○ Fairly good

○ Fairly bad

○ Very bad

APPENDIX H – TURNITIN REPORT



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