ASSESSING KNOWLEDGE AND AWARENESS OF MULTIPLE SCLEROSIS AMONG ADULTS ATTENDING HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM) OUTPATIENT CLINICS

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by

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

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LIST OF ABBREVIATIONS

ADL	-	activity daily living
DIS	-	dissemination in space
DIT	-	dissemination in time
DMT	-	disease modifying therapy
EVB	-	Epstein-Barr virus
HBM	-	The Health Belief Model
HPUSM	-	Hospital Pakar Universiti Sains Malaysia
IV	-	intravenous
MRI	-	magnetic resonance imaging
MS	-	multiple sclerosis
MSKQ-25	-	The Multiple Sclerosis Knowledge Questions
PE	-	progressive-relapsing
PP	-	primary progressive
QoL	-	quality of life
RR	-	relapsing-remitting
SP	-	secondary progressive
SD	-	standard deviation
UVB	-	ultraviolet B
UVR	-	ultraviolet radiation
WHO	-	World Health Organization

LIST OF APPENDICES

MENILAI TAHAP PENGETAHUAN DAN KESEDARAN MENGENAI 'MULTIPLE SCLEROSIS' DALAM KALANGAN DEWASA YANG MENGHADIRI KLINIK PESAKIT LUAR HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM)

ABSTRAK

Multiple sclerosis (MS) atau sklerosis berganda ialah penyakit autoimun kronik yang tidak diketahui puncanya, dicirikan oleh keradangan sistem saraf pusat, disebabkan penyahmielinan dan kemerosotan akson, yang lazimnya menjejaskan golongan dewasa muda (Calabresi, 2004). Kajian ini bertujuan untuk menilai tahap pengetahuan dan kesedaran mengenai MS dalam kalangan individu dewasa yang menghadiri klinik pesakit luar di Hospital Pakar Universiti Sains Malaysia (HPUSM), serta mengenal pasti sama ada terdapat hubungan antara pengetahuan atau kesedaran dengan faktor sosio-demografi tertentu. Kajian ini melibatkan 147 orang peserta dewasa di klinik pesakit luar HPUSM dengan menggunakan soal selidik, iaitu Soal Selidik Pengetahuan MS (MSKQ-25) dan soal selidik kesedaran. Data dianalisis menggunakan statistik deskriptif dan ujian 'Chi-square' bagi mengenal pasti hubungan antara tahap pengetahuan dan kesedaran dengan pembolehubah sosio-demografi. Skor purata pengetahuan adalah 7.88 ± 4.626, dengan 84.4% peserta menunjukkan tahap pengetahuan yang rendah. Skor purata kesedaran pula ialah 2.90 ± 1.98, dan hanya 22.4% peserta mempunyai tahap kesedaran yang tinggi. Terdapat hubungan yang signifikan secara statistik antara sumber maklumat dengan tahap kesedaran ($p = 0.018$). Walaubagaimanapun, tiada hubungan yang signifikan ditemui antara tahap pengetahuan dengan umur ($p = 0.363$), jantina ($p = 0.076$), atau tahap pendidikan ($p = 0.119$). Kesimpulannya, hasil kajian ini menunjukkan tahap pengetahuan dan

kesedaran tentang MS dalam kalangan populasi yang dikaji adalah secara amnya rendah.

ASSESSING KNOWLEDGE AND AWARENESS OF MULTIPLE SCLEROSIS AMONG ADULTS ATTENDING HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM) OUTPATIENT CLINIC

ABSTRACT

Multiple sclerosis (MS) is a chronic, idiopathic autoimmune disease characterized by inflammation of the central nervous system, leading to demyelination and subsequent axonal degeneration, and typically affecting young adults (Calabresi, 2004). This study aimed to assess the level of knowledge and awareness of MS among adults attending the outpatient clinic at Hospital Pakar Universiti Sains Malaysia (HPUSM) and to determine whether there is any association between knowledge or awareness and selected socio-demographic factors. A cross-sectional study was conducted among 147 adult participants at HPUSM outpatient clinic using a validated self-administered questionnaire, the MS Knowledge Questionnaire (MSKQ-25) and awareness questionnaire. Data were analyzed using descriptive statistics and Chi-square tests to identify associations between knowledge and awareness levels and socio-demographic variables. The mean knowledge score was 7.88 ± 4.626 with 84.4% of participants demonstrating poor knowledge. The mean awareness score was 2.90 ± 1.98, and only 22.4% of participants had high awareness. There was a statistically significant association between source of information and awareness level ($p = 0.018$). However, no significant associations were found between knowledge and age ($p = 0.363$), gender ($p = 0.076$), or educational level ($p = 0.119$). In conclusion, the findings indicate a generally low level of knowledge and awareness about MS among the studied population.

CHAPTER 1

INTRODUCTION

1.1   Introduction

This chapter provides an overview of the research study including the background, problem statement, research questions, research objectives, research hypothesis, significance of the study and operational definitions.

1.2   Background of Study

Multiple sclerosis (MS) is an idiopathic, inflammatory disease of the central nervous system that typically affects young adults. The pathological hallmarks of MS include demyelination and subsequent axonal degeneration (Calabresi, 2004). It is also classified as a chronic autoimmune disease (Calabresi, 2020). The disease is characterized by an inflammatory response involving lymphocytes and activated macrophages or microglia, leading to demyelination, though some axonal preservation may occur (Lassmann et al., 2007).

MS affects individuals through a range of neurological symptoms, including impaired vision, tingling and numbness, focal weakness, bladder and bowel issues, and cognitive impairment (Calabresi, 2020). These symptoms significantly impact patients' and their families' quality of life (QoL), as they endure the burden of managing these challenges (Robertson & Moreo, 2016). The decline in QoL among MS patients is evident, particularly due to the physical and psychological challenges, such as fatigue and depression, which severely disrupt daily activities (Dehghani et al., 2019).

The expected number of patients with MS worldwide has risen to 2.8 million, with a prevalence of 35.9 per 100,000 individuals [95% CI: 35.87, 35.95] in 2020 (Walton et al., 2020). MS which affects females more than males, has a pooled total prevalence of 37.89 per 100,000 in Asia and Oceania (Forouhari et al., 2021). In Malaysia, MS is considered a rare disease, with a prevalence of 3.26 per 100,000 based on the capture–recapture method in 2017 (Viswanathan & Wah, 2019). While the exact cause of this inflammation is unknown, it is believed to be multifactorial, involving a combination of genetic and environmental factors that trigger an adaptive, T cell-mediated autoimmune response against the central nervous system (Robertson & Moreo, 2016).

Early diagnosis of MS during the initial stages of inflammation is crucial for initiating appropriate treatment, such as disease-modifying therapies, to prevent disability and disease progression, as well as to reduce relapses (Ministry of Health Malaysia, 2013). The primary goal of MS treatment is to mitigate long-term impairment by controlling inflammation and preventing neuroaxonal damage (Ömerhoca et al., 2018). Therefore, starting the appropriate treatment at the appropriate time and establishing an accurate, early diagnosis are two important elements that affect the outcome of treatment (Ömerhoca et al., 2018).

Several studies conducted in different regions of Saudi Arabia have reported that the public has a low level of knowledge about MS, with mean knowledge scores below average. In the western region, Farran et al. (2021) recorded the lowest mean knowledge score of 7.42 ± 4.57, while in the eastern region (Alarab et al., 2024) reported the highest mean knowledge score of 9.4 ± 4.2. Despite the high prevalence of MS in Saudi Arabia, at 40.40 per 100,000, which is significantly higher than in

Malaysia, the overall level of public knowledge remains low. In contrast, no studies have assessed the knowledge and awareness of MS among the Malaysian population.

Raising awareness and increasing knowledge of MS is crucial to help close the gap between the general public and MS patients (Rieckmann et al., 2018). By improving public understanding of the disease, individuals will be more likely to recognize early symptoms, seek timely medical advice, and reduce the stigma associated with neurological disorders (Farran et al. 2021). This, in turn, can lead to better support for MS patients, early diagnosis, and improved access to healthcare services, ultimately enhancing the quality of life for those affected by the condition. Hence, this study aims to evaluate the level of knowledge and awareness about MS among adults attending HPUSM outpatient clinic.

1.3 Problem Statement

Multiple sclerosis (MS) is a chronic inflammatory and immune-mediated demyelinating disease of the central nervous system (Jia et al., 2022). Since MS is a rare disease in Malaysia with a low prevalence as stated by Viswanathan et al. (2013), research and public health awareness focused on the disease is very limited. Study from China by Jia et al. (2022) reported 96.3% of patients had no prior knowledge of MS when they were diagnosed. This statement highlighting the limited awareness in China and potentially in Malaysia as well. The study from Viswanathan & Wah (2019) also stated that their study had limitations, including a limited sample size and lack of awareness about MS among patients and clinicians.

Beside, understanding how different factors influence this knowledge is essential in planning targeted health education (Abdulrhman et al.,2023). Previous studies have shown that socio-demographic variables such as age, gender, and level of education can significantly affect individuals' level of health knowledge. For example, the study by Farran et.al (2021) revealed those with higher education may have better knowledge to health information and greater health literacy. Therefore, identifying the association between knowledge of MS and these socio-demographic factors is crucial in recognizing which population groups may require more focused educational efforts.

In addition to socio-demographic factors, exposure-related factor also influence disease awareness. Individuals who know someone diagnosed with a specific illness or who receive information from certain sources such as healthcare providers or media may have increased awareness compared to those without such exposure. In the case of MS, knowing someone affected or having access to accurate sources of information may significantly enhance awareness of the disease (Al-Hamdan et al., 2021). Hence, evaluating the relationship between MS awareness and exposure-related factors such

as source of information and personal connection to someone with MS can provide valuable insight into how awareness is shaped within the community.

In Malaysia, no available studies had been carried out to assess knowledge and awareness among adult population. The prevalence of MS in Malaysia is relatively low compared to Western countries, public and even healthcare consumers' knowledge and awareness are often insufficient. To address this gap, a cross-sectional study was conducted among adults attending the outpatient clinic at Hospital Pakar Universiti Sains Malaysia (HPUSM) as the source population, with adults in Kubang Kerian serving as the reference population, to explore their understanding and awareness of MS. As HPUSM was a major healthcare provider, assessing the knowledge and awareness levels was crucial for developing effective educational strategies and promoting early intervention. Therefore, this study aimed to evaluate the knowledge and awareness of MS among adults attending the HPUSM outpatient clinic, with the goal of identifying knowledge gaps and guiding future educational initiatives to improve MS awareness.

1.4   Research Questions

The research questions for this study are as follows:

i.   What is the level of knowledge of multiple sclerosis among adults attending HPUSM outpatient clinic?

ii.   What is the level of awareness of multiple sclerosis among adults attending HPUSM outpatient clinic?

iii. Is there any relation between selected socio-demographic characteristics (age, gender, level of education) with the level of knowledge toward multiple sclerosis among adult attending HPUSM outpatient clinic?

iv.   Is there any relation between exposure-related factors (source of information and knowing someone has MS) with the level of awareness toward multiple sclerosis among adult attending HPUSM outpatient clinic?

1.5   Research Objectives

1.5.1   General Objective

The general objective of this study is to determine knowledge and awareness of multiple sclerosis among adults attending HPUSM outpatient clinic.

1.5.2   Specific Objectives

The specific objectives for this study are as follows:

i.   To assess the level of knowledge of multiple sclerosis among adults attending the HPUSM outpatient clinic.

ii.   To assess the level of awareness of multiple sclerosis among adults attending the HPUSM outpatient clinic.

iii. To determine the association between knowledge of multiple sclerosis and selected socio-demographic variable (age, gender, level of education).

iv.   To determine the association between awareness of multiple sclerosis and exposure-related factors (source of information and knowing someone having MS).

1.6   Research Hypothesis

Hypothesis 1

(H₀): There is no association between knowledge of multiple sclerosis and socio-demographic (educational level, age, gender) among adult attending HPUSM outpatient clinic

(H₁): There is an association between knowledge of multiple sclerosis and socio-demographic (age, gender, level of education) educational level among adult attending HPUSM outpatient clinic

Hypothesis 2

(H₀): There is no association between awareness of multiple sclerosis and exposure-related factors (source of information and knowing someone having MS) among adult attending HPUSM outpatient clinic

(H₁): There is an association between awareness of multiple sclerosis and exposure-related factors (source of information and knowing someone having MS) among adult attending HPUSM outpatient clinic

1.7   Significance of study

The findings from this study assessed the level of knowledge and awareness of MS among adults attending the outpatient clinic at HPUSM. It enabled nurses to provide more targeted education and interventions for high-risk clients with early symptoms of MS, thereby improving early diagnosis and treatment. Nurses played a crucial role in preventing MS-related complications and enhancing patients' quality of life. To effectively diagnose and provide nursing interventions for MS, it is essential to understand the specific needs of the disease (Eroglu & Temiz, 2022).

In addition, the results of this study identified awareness of MS in the adult population. These data were used as evidence to support public health campaigns aimed at increasing knowledge of MS symptoms, risk factors and complications associated with delayed treatment (Mohamed et al., 2024). Public education about MS enabled individuals to reduce stigma and improve awareness of chronic neurological and autoimmune diseases in the community (Alarab et al., 2024). As knowledge spread and awareness increased, people were more likely to seek medical attention when symptoms appear, leading to better disease outcomes.

In addition, due to the limited research on MS in Malaysia, this study provided valuable data for future researchers on the level of knowledge and awareness of MS among different populations in Malaysia. Future researchers could conduct larger-scale studies, evaluate MS interventions, or examine other factors that influence MS awareness, especially in the Malaysian context. The findings of this study could serve a basis for comparative research, such as comparing knowledge and awareness levels between different groups, like healthcare workers or medical students.

1.8 Definitions of Operational Terms

There operational terms used in this research proposal are shown below：

Table 1.1: Conceptual and operational definition

Terms	Conceptual Definition	Operational Definition
Multiple sclerosis	A condition when the immune system in the body attacks the brain and spinal cord (WHO,2023).	In this study, multiple sclerosis refers to neurological characterized by immune-mediated damage to the myelin sheath. In this study, participants' knowledge and awareness of MS had assessed using a structured questionnaire, designed to evaluate their understanding of various aspects of the condition, including its symptoms, causes, risk factors, and treatment options.
Knowledge	The state of knowing about a particular fact or situation (Oxford Learner's Dictionaries, 2024).	This study assessed the knowledge of adults attending the HPUSM outpatient clinic using The Multiple Sclerosis Knowledge Questionnaire (MSKQ-25) by Giordano et al. (2010), which includes questions on the nature of the disease, prevalence and predisposing factors, causation and genetic factors, diagnostic methods and procedures, and types of treatment.

Table 1.1: contiued

Awareness	Knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience (Cambridge Dictionary, 2024).	This study assessed the awareness of adults attending the HPUSM outpatient clinic using awareness questions adapted from Alnefaie et al. (2023).
Adults	A human being after an age (such as 21) specified by law (Merriam-Webster, 2024).	In this study, adults refer to individuals aged 18 to 60 years attending the HPUSM outpatient clinic and meet the inclusion criteria.

CHAPTER 2

LITERATURE REVIEW

2.1   Introduction

This chapter provided a general review of the literature about overview of MS, knowledge and awareness of MS and association between socio-demographic factors and their influence on knowledge and awareness level. The final section of this chapter described the theoretical and conceptual framework used in this study.

2.2   Overview of multiple sclerosis

This section gives an overview of MS, which is a chronic as well as progressive neurological disorder affecting the central nervous system. This summary contains the MS definition with its global and Malaysian prevalence, gender ratio, possible causes, MS types, common clinical signs and symptoms, diagnostic procedures, also current treatment and management strategies. It is necessary to build up a foundation for the purpose of exploring of public knowledge and also awareness of the disease. This study focuses centrally on the disease.

2.2.1   Definition

MS is defined as an idiopathic, inflammatory illness of the central nervous system. MS is pathologically caused by demyelination and subsequent axonal degeneration (Calabresi, 2004). According to the World Health Organization (WHO) (2023), MS can be defined as a condition when the immune system in the body attacks the brain and spinal cord. This definition aligns with the (Tafti et al., 2024), which has stated that MS is a chronic autoimmune disease of the central nervous system that causes inflammation, demyelination, gliosis, and neuronal death. According to the

National Cancer Institution (2024) this disease is believed to be an antibody attacks and destroys myelin specifically. Myelin, composed of proteins and fatty acids, is an insulating sheath that forms around nerves. It helps transmit impulses quickly between nerve cells (Calabresi,2020). The damage to the myelin sheath will cause MS.

2.2.2   Global prevalence

MS prevalence has risen in every region of the world since 2013 (Alarab et al., 2024). Over two million individuals worldwide suffer from this incurable condition, with no effective treatment to prevent or reverse the progression of neurological deterioration. (Dahlawi et al., 2022). According to Walton et al. (2020), the estimated number of people with MS worldwide has increased to 2.8 million, with a global prevalence of 35.9 per 100,000 people (95% CI: 35.87, 35.95) in 2020. Similarly, Alarab et al. (2024), reported that the nationwide prevalence of MS in Saudi Arabia is 40.40 per 100,000 for the general population and 61.95 per 100,000 for Saudi citizens.

Meanwhile, according to Forouhari et al. (2021), the total prevalence has been calculated to be 37.89/100,000 people, with Oceania nations having significantly greater rates than Asian countries (New Zealand and Australia). In New Zealand's Bay of Plenty region, where the population is 24% Māori and 69% European, the MS prevalence was 50 per 100,000 in 2001, and by 2010, it was estimated to have risen to 95.6 per 100,000 (Forouhari et al., 2021). Therefore, based on the data from various studies, the average global prevalence of MS appears to be approximately 38 per 100,000 persons with some countries such as New Zealand and Australia, reporting higher rates.

2.2.3 Malaysia prevalence

According to Forouhari et al. (2021), when comparing different regions of Asia, West Asia (Iran, Cryprus, Jordan, Kuwait, Qatar, Saudi Arabia, UAE, Turkey) had the highest prevalence rate, while Southeast Asia (Malaysia) had the lowest. This is supported by several studies on MS in Malaysia, ranging from older to more recent research. An early study by (Tan, 1988) estimated the prevalence of MS in Malaysia to be 2 per 100,000 people, encompassing the multiracial Malay, Chinese, Indian, and indigenous groups. In a latest study by (Viswanathan & Wah, 2019), the prevalence of MS slightly increased from 2.73 per 100,000 to 3.26 per 100,000 using the capture–recapture method in 2017. The MS group was ethnically diverse, with 456 Malays (59.4%), 127 Chinese (16.6%), 157 (20.5%) Indians, and 27 (3.5%) from indigenous and other groups, including Bidayuhs (4), Ibans (4), Bajaus (4), Melanaus (4), Kenyahs (1), Kayans (1), Muruts (1), Kadazans (4), and four of Eurasian descent. Therefore, MS was classified as an uncommon disease in Malaysia, with a low prevalence rate compared to West Asian countries.

2.2.4 Gender ratio

MS is most commonly observed among women aged 20–40 worldwide (Ministry of Health Malaysia, 2013). Globally, female prevalence is 68.70 per 100,000, significantly higher than males at 24.52 per 100,000, with rates higher in West Asia compared to East Asia (Forouhari et al., 2021). In Saudi nationals, the female-to-male ratio is 2:1, with higher prevalence among young, educated women (Alarab et al., 2024). Meanwhile in Malaysia, the study from Viswanathan & Wah (2019) in Kuala Lumpur reported a female-to-male ratio of 5:1. In some countries, the gender ratio is even more pronouced with ratio reaching as high as 4:1 (Walton et al., 2020).

2.2.5   Etiology

Genetic predisposition is a key MS risk factor, with a 2-4% higher risk for individuals with an affected first-degree relative (Forouhari et al., 2021).Besides, offspring of one affected parent have a 2% risk, but this increases to 20% for married partners with MS (Ministry of Health Malaysia, 2013). Meanwhile, the risk is 4% in dizygotic twins and 30% in monozygotic twins (Wesley et al., 2016). Over 200 gene variations, primarily linked to immunological pathways, have been identified, with the HLA-DRB1*1501 haplotype being the most significant.(Forouhari et al., 2021).

The other risk factor of MS is environment factor. Environmental factors like smoking, low vitamin D, Epstein-Barr virus (EBV) infection, childhood obesity, and lack of physical activity are some of the risk factors for MS (Nishanth et al., 2020). Tobacco, rich in free radicals, contributes to oxidative stress, which can cause genetic mutations and is linked to neurodegenerative disorders like Parkinson's disease and MS. It also increases the risk of autoimmune diseases, including systemic lupus erythematosus, rheumatoid arthritis, and MS (Nishanth et al., 2020).

Additionally, studies over the past decade show that early childhood and adolescent obesity are significant risk factors for MS, suggesting the rising prevalence of obesity may contribute to increased MS rates in both children and adults. (Gianfrancesco & Barcellos, 2016). Eliminating childhood obesity could prevent around 15% of MS cases, highlighting the importance of addressing obesity in childhood to reduce MS risk in the population.

MS prevalence is strongly linked to latitude, with higher rates observed in high-latitude regions, likely due to environmental factors like reduced ultraviolet B (UVB) exposure and lower vitamin D levels (Sabel et al., 2021). Up to 95% of vitamin D is synthesized through UVB exposure, and prevalence increases significantly with latitude,

as seen in Australia, where MS prevalence rises by 3% per degree of latitude (Sabel et al., 2021). Article by Jia et al. (2022), also stated that high-latitude locations have a greater incidence of MS in China.

Recent research highlights vitamin D's role in MS etiology, with higher levels, especially before age 20, linked to a reduced MS risk (Alfredsson & Olsson, 2019). Genetic evidence also supports the importance of vitamin D, as polymorphisms in the CYP27B1 gene, which is involved in vitamin D metabolism, have been linked to MS (Alfredsson & Olsson, 2019). Several studies further indicate that low vitamin D levels are associated with an increased relapse rate, greater disability, and a higher lesion burden, as seen on MRI (Feige et al., 2020). Additionally, Epstein-Barr virus (EBV) infection during adolescence or later, but not childhood, raises MS risk. Notably, individuals with low vitamin D levels and elevated anti-EBV nuclear antigen-1 (EBNA-1) IgG are at an even greater risk of developing MS (Feige et al., 2020).

2.2.6 Classification

There are seven classifications for MS, and the illness displays different courses (Tafti et al., 2024). The first four courses of MS are relapsing-remitting (RR), observed in 70% to 80% of patients; primary progressive (PP), presented in 15% to 20% of patients; secondary progressive (SP); and progressive-relapsing (PR), seen in 5% of patients (Tafti et al., 2024). RR involves symptom flare-ups followed by full or partial recovery (Australia, 2024).

The SP refers to a later stage of RR MS, where symptoms gradually worsen without periods of remission (Australia, 2024). PP is marked by gradual worsening without relapses. PR features steady decline with superimposed relapses (Tafti et al., 2024). Additional classifications include clinically isolated syndrome, the first

neurological episode due to CNS demyelination (Hudaif et al., 2014). Fulminant MS, a severe, rapidly disabling form with frequent relapses; and benign MS, characterized by minimal progression and few relapses (Tafti et al., 2024).

2.2.7 Signs and symptoms

MS presents a wide range of symptoms, developing either gradually or suddenly, depending on the severity of inflammation and the location and size of (National Institute of Neurological Disorders and Stroke, 2024). Common symptoms of MS include depression, dizziness or vertigo, fatigue, heat sensitivity, Lhermitte's sign, numbness, urinary bladder dysfunction, visual impairment such as monocular or diplopia, and weakness (Calabresi, 2004).

Meanwhile, the signs of MS include action tremors, decreased perception of pain or vibration, reduced strength, Babinski's sign, impaired coordination and balance, impaired visual acuity, and nystagmus (Calabresi, 2004). Consequently, MS often leads to decreased physical activity and a sedentary lifestyle, heightening the risk of osteoporosis, depression, fatigue, muscle loss, and cardiovascular mortality (Ministry of Health Malaysia, 2013).

MS progression disrupts work, family life, and psychosocial well-being, leading to fluctuating psychological and physical challenges (Kapucu & Akkus, 2011). This is supported by (Dehghani et al., 2019), which stated that signs and symptoms of the disease make it difficult for the affected individual to do activities of daily living (ADL). For instance, MS can cause movement problems, including tremors, slowed movements, walking abnormalities, and imbalance, significantly impacting patients' ability to perform daily activities. (Dehghani et al., 2019). Additionally, 30–65% of MS patients experience oropharyngeal dysphagia, increasing morbidity and mortality risks from

complications such as malnutrition and bronchopneumonia (Ministry of Health Malaysia, 2013).

2.2.8 Diagnostic investigation

The most convenient diagnostic test for confirming MS is brain magnetic resonance imaging (MRI), as it can detect structural pathologies in regions such as the posterior fossa, craniocervical junction, and cervical cord (Calabresi, 2004). When a patient is present with an attack, MRI with an intravenous (IV) gadolinium-containing contrast agent is the most important paraclinical test for establishing the diagnosis (Ömerhoca et al., 2018). This imaging can reveal the distribution of lesions throughout the central nervous system, providing evidence of dissemination in time (DIT) and space (DIS) based on the latest diagnostic criteria, as well as distinguishing the types of lesions, including inflammatory and demyelinating features, for differential diagnosis (Ömerhoca et al., 2018).

Besides, another diagnostic investigation for MS is lumbar puncture to perform cerebrospinal fluid (CSF) analysis. This test is used to assess basic CSF biochemistry, including glucose, protein, albumin, IgG, and lactate levels, as well as microbiological tests, such as cell counts and, if needed, microbial and ELISA tests. It also involves cytopathological evaluation to screen for malignant cells and tests for intrathecal immunoglobulin G (IgG) synthesis, both quantitatively (IgG index) and qualitatively (oligoclonal band [OCB] analysis) (Ömerhoca et al., 2018). CSF analysis is primarily used to rule out infectious or neoplastic disorders that mimic MS (Calabresi, 2004).

2.2.9   Treatment and management

There is treatment for acute attack and relapse that aim in reducing the duration and intensity of neurological impairment (Ministry of Health Malaysia, 2013). Glucocorticoid's medications, plasma exchange (plasmapheresis) and intravenous immunoglobulin (IVIG) are the treatment for acute attack and relapses (Ministry of Health Malaysia, 2013). Intravenous methylprednisolone or oral prednisone may be prescribed based on the patient's condition and symptoms (Tafti et al., 2024). Plasma exchange is considered for individuals who do not respond to the initial pulsed corticosteroid treatment (Ministry of Health Malaysia, 2013).

Disease-modifying therapy (DMT) is used to reduce relapse rates, delay disability progression, and decrease new brain lesions in MS patients, as seen on MRI (Ministry of Health Malaysia, 2013). In Malaysia, DMTs for RRMS include interferon beta (1a-1b), fingolimod, natalizumab, mitoxantrone, rituximab, and cyclophosphamide (Ministry of Health Malaysia, 2013). The choice of DMT depends on individual indications, with effectiveness ranging from significant benefits to limited impact on disease progression (Tafti et al., 2024). While no therapy cures MS or promotes neural repair or neuroprotection, DMT minimizes early clinical and subclinical disease activity, reducing long-term disability (Robertson & Moreo, 2016).

Rehabilitation programs, such as physiotherapy, are essential for managing MS symptoms. Physiotherapy aims to improve mobility, activate motor functions, and enhance overall behavior, reducing the effects of akinesia and increasing the functional capacity of body systems (Kubsik-Gidlewska et al., 2017). Rehabilitation manages fatigue with energy-saving strategies, lifestyle changes, and education, recommending avoiding mid-afternoon activity, staying cool, and using air conditioning (Ministry of Health Malaysia, 2013).

2.3   Knowledge and awareness

Although MS is a serious neurological disorder, knowledge and awareness about the disease remain low globally, especially in Southeast Asia, including Malaysia. Lack of understanding about its signs and symptoms can lead to delayed diagnosis and missed opportunities for better outcomes (Bahou et al., 2023). Demir et al. (2021) emphasized that early treatment, particularly in high-risk individuals, improves prognosis through disease-modifying therapies. This highlights the need for public understanding and awareness to support early detection and improve patient outcomes.

2.3.1   Level of knowledge

The lack of information of MS may be due to the disease's undetectable symptoms, making it difficult for many to comprehend (Farran et al.,2021). A study by Amer et al. (2016), revealed a lack of knowledge about MS among healthy individuals in Taif, Saudi Arabia, with a mean knowledge score is 8.74 ± 2.7. This is similar with the study by Farran et al. (2021) reported an extremely low level of MS knowledge in the western region of Saudi Arabia, with an average MSKQ score of 7.42 ± 4.57 with most participants understand the disease's basic, including the damaged organ and its non-contagious condition. This is quite similar to the findings by Bahou et al. (2023) which reported a mean MSKQ score of 7.16 among the general population in Jordan.

These findings contrast with a study in the eastern region of Saudi Arabia, where the mean knowledge score was slightly higher at 9.4 ± 4.2 (Alarab et al., 2024). Nevertheless, all studies indicate that the mean knowledge score remains below average, reflecting a general lack of knowledge about MS within the Saudi Arabian community. Only a few people understand that multiple sclerosis does not significantly lower life expectancy and that a parent with the condition does not pass it on to their offspring via chromosomes (Alarab et. Al, 2024).

A study conducted in the eastern region of Saudi Arabia found that 73.7% of participants had poor knowledge and 26.3% had a good knowledge of MS (Alarab et al., 2024). This is quite similar to findings from a study in Taif, where 74% of participants had poor knowledge and 26% had good knowledge (Amer et al., 2016). Another study in Jeddah, located in the western region where MS cases are most prevalent, also showed extremely low levels of knowledge among the community (Farran et al., 2021).

2.3.2   Level of awareness

Knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience (Cambridge Dictionary, 2024). The study in western region of Saudi Arabia stated that there was a significant correlation (p=0.003) between participants' level of awareness and whether they had previously heard of MS (Dahlawi et al., 2022). 65.2% of participants reported having heard of MS (Dahlawi et al., 2022). A majority of participants recognized that MS affects the nervous system (75.2%), progresses in stages (80.5%), is related to vitamin D (75.7%), is treatable (64.6%), and can cause disability (71.9%). Common symptoms agreed by the participants include visual disturbances, paresthesia, and weakness (Dahlawi et al., 2022).

The study from Alnefaie et al. (2023) assessed the general awareness of the population in Al-Madinah Al-Munawwarah, Saudi Arabia reported two-thirds of the participants (66.4%) reported awareness about MS disease and the similar number of participants answer correctly for system involve in MS. However, this study is not similar to a study by Hudaif et al. (2014), whereby less than a third of respondents (30.3%) reported being aware of MS.

2.4   Association between sociodemographic factors and their influence on knowledge level

2.4.1   Age

The relationship between age and knowledge of MS has been explored in various studies, with findings showing both consistent and contrasting results. The study from Bahou et al. (2023), found a significant difference in awareness levels between age groups, with participants aged 18-24 having lower awareness than those aged 25-44. These findings suggest that younger adults may have limited exposure to, or engagement with, MS information.Similarly, a recent study in Tobruk, Libya, reported a statistically significant association between age and MS knowledge ($p < 0.001$), with older participants achieving higher knowledge scores than younger ones (Mohamed et al., 2024). In this study, those scoring above 70% had a mean age of approximately 34.9 years, compared to around 27.6–27.3 years among those scoring below 50% (Mohamed et al., 2024).

In contrast, others studies report no age-related differences. For example, the findings of Farran et al. (2021) which found no significant difference in MS knowledge across age groups. Additionally, the study in Taif also reported no significant association between age and knowledge level (Amer et al.,2016). These mixed findings highlight the importance of assessing the association between age and knowledge in different populations. Including age as a variable in this study can help determine whether age-related knowledge gaps exist among adults attending the HUSM outpatient clinic, and whether age-specific education strategies are needed.

2.4.2   Gender

The association between gender and knowledge of MS has been widely explored, with several studies reporting significant gender-based differences. Giordano et al. (2010) found a positive correlation between female gender and higher MS knowledge scores, suggesting that women are more likely to seek and retain health information independently. Similarly, a study conducted in the Qassim region of Saudi Arabia by Al-Hamdan et al. (2021) reported that female participants had significantly higher levels of MS knowledge compared to males ($p = 0.02$). This finding aligns with Bahou et al. (2023), who also observed that females demonstrated significantly greater awareness of MS than their male counterparts. One possible explanation is the higher prevalence of MS among women, which may increase their exposure to the condition and stimulate personal interest in learning more about it. A more recent study in Tobruk, Libya also reported significantly higher knowledge scores among female respondents ($p < 0.05$), further supporting the link between gender and MS awareness (Mohamed et al., 2024)

However, this positive association is not consistent across all studies. Research by Hudaif, Bwardi, and Kojan (2014) found no significant differences in MS knowledge levels between genders in their respective populations. Similarly, a study in Jeddah, Saudi Arabia concluded that gender was not significantly associated with knowledge levels, with education being the only variable showing a strong relationship with MS knowledge (Farran et al., 2021). These mixed results suggest that while gender may play a role in influencing MS knowledge in some populations, it is not a universally consistent factor. Including gender as an analytical variable in this study may help to clarify whether similar patterns exist among adults attending the HUSM outpatient clinic and support the development of gender-sensitive health education strategies.

2.4.3   Level of educational

A strong and consistent association has been observed between higher educational attainment and greater knowledge of multiple sclerosis (MS). In a cross-sectional study of Lebanese MS patients, multivariate analysis identified higher education as a significant predictor of increased knowledge scores ($p = 0.004$) (Zeineddine ,2024). Similarly, a systematic review of MS knowledge among adult patients concluded that educational level was consistently associated with both disease knowledge and understanding of risks, even when other demographic factors showed mixed results. (Smith & Langdon, 2024)

Public population studies also support this relationship. The community survey in Jeddah showed a significant correlation between educational level and knowledge score among participants in Jeddah community (Farran et al., 2021). Education level was a key factor, with knowledge about MS increasing as education levels rose (Eroglu & Temiz, 2022). This aligns with the findings of Bahou et al. (2023), where participants with higher diplomas had a greater mean knowledge score compared to those with only high school diplomas or undergraduate degrees.

In contrast, the results by Dahlawi et al. (2022), who reported no association in the Western region of Saudi Arabia ($p = 0.272$). Similarly, research conducted in the Qassim region also found no significant relationship between education level and MS knowledge ($p = 0.87$) (Al-Hamdan et al., 2021). Additionally, the study in the Tobruk, Libya context reported no significant association between education level and MS knowledge, indicating possible regional differences or unique sociodemographic contexts (Mohamed et al., 2024). Some studies show inconsistent trend across many settings. Therefore, evaluating the influence of education level in the HPUSM