

**ASSESSMENT OF NUTRITIONAL AND LIFESTYLE RISK FACTORS
INFLUENCING CLINICAL REMISSION IN MULTIPLE SCLEROSIS PATIENTS IN
NAIROBI COUNTY**

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Degree of Master of Public Health in the School of Public Health, Human Nutrition &
Dietetics, Kenya Methodist University**

NOVEMBER 2025

DECLARATION

I hereby declare that; this thesis proposal is my original work and has not been presented in any or other University.

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DEDICATION

This work is dedicated to my Parents, Siblings, Supervisors, Lecturer and loved ones for their constant reassurance understanding and support throughout the time of study. May the Almighty Bless you...

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ABSTRACT

Multiple sclerosis (MS) is a condition identified by acute inflammation in the cerebrospinal axis, that brings about demyelination and nerve dysfunction. This incapacitating condition presents diverse neurological symptoms, including fatigue, compromised mobility, sensory disturbances, and cognitive impairment. This investigation, conducted in Nairobi, aimed to explore the influence of dietary risk factors on disease activity and clinical remission in MS patients, utilizing a mixed-method approach. Nairobi faces distinctive healthcare challenges and comprehending how dietary factors interact with MS outcomes can lead to tailored interventions that enhance the well-being of patients in this environment. The study employed a cross-sectional study design encompassing qualitative and quantitative data collection methods. A total of 150 participants with multiple sclerosis (MS) were studied, with a mean age of 41 years; 58.67% were male and 41.33% female. Most had Relapsing-Remitting MS (80%) and were primarily managed by neurologists (88.67%). Mediterranean (39.33%), low-carb (27.33%), and vegetarian (26%) diets were the most common dietary patterns, with 84% of participants reporting supplement use and 67.33% consuming whole grains daily. A large proportion (88.67%) achieved clinical remission. Statistically significant associations were found between dietary compliance and remission ($\chi^2 = 15.495$, $p = 0.004$), with 92% of those reporting “very close” adherence attaining remission. Dietary patterns such as gluten-free (100%), low-carb (95.12%), and vegetarian (92.31%) were significantly associated with higher remission rates ($\chi^2 = 8.3824$, $p = 0.039$). Supplement use (OR = 36.05, $p < 0.001$), avoidance of sugary foods (OR = 209, $p < 0.001$), and occasional dairy intake (OR = 16.33, $p = 0.006$) were strongly linked to remission. Logistic regression showed that disease stage (OR = 0.099, $p < 0.01$) and disease progression markers (OR = 0.301, $p < 0.05$) negatively influenced remission. While most demographic factors showed no significant effect, poor dietary adherence significantly reduced the odds of remission. Non-dietary factors such as physical activity ($\chi^2 = 105.87$, $p < 0.001$), sleep quality ($\chi^2 = 18.85$, $p = 0.001$), psychological health ($\chi^2 = 19.69$, $p < 0.001$), and environmental triggers ($\chi^2 = 15.04$, $p = 0.001$) were significantly associated with clinical remission. High levels of daily physical activity (61.33%) and satisfactory sleep (88%) were common among participants who attained remission. Qualitative findings confirmed that stress, diet, exercise, sleep, and family support jointly influenced symptom control and compliance. Based on the findings, promoting adherence to anti-inflammatory dietary patterns, regular supplement use, and consistent physical activity is crucial for achieving clinical remission among MS patients. Integrating holistic lifestyle interventions including stress reduction, quality sleep, and psychological support can further enhance disease management and symptom control. The findings revealed that adequate dietary diversity, higher protein intake, and regular physical activity were positively associated with clinical remission, whereas sedentary lifestyle and poor dietary habits were significantly linked to relapse or prolonged symptom activity. Socioeconomic factors such as income level and educational status also influenced dietary compliance and overall disease management. The study concludes that nutritional quality and lifestyle practices play a vital role in modulating remission among MS patients. These findings contribute to understanding the behavioral and dietary determinants of remission and underscore the need for comprehensive dietary counseling and lifestyle interventions in MS care programs.

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List of Abbreviations and Acronyms

- **ADEM:** Acute Disseminated Encephalomyelitis
- **ATC:** Anatomical Therapeutic Chemical
- **BMI:** Body Mass Index
- **CCWPT:** Causal Connections and Well-Being of People with MS
- **CVD:** Cardiovascular Disease
- **DFAI:** Dietary Factors and Assumed Impact
- **DI:** Dietary Inflammatory Index
- **DT:** Dietary Treatments
- **EMSS:** Environmental and Lifestyle Triggers
- **EFL:** Extra-Food Lifestyle
- **FFQ:** Food Frequency Questionnaire
- **FLAIR:** Fluid-Attenuated Inversion Recovery
- **IHNC:** Inflammatory Components
- **IT:** Individualized Therapies
- **kcal:** Kilocalories
- **MOGAD:** Myelin Oligodendrocyte Glycoprotein Antibody Disease
- **MRI:** Magnetic Resonance Imaging
- **MS:** Multiple Sclerosis
- **NMDA:** Nutrition in MS Development and Advancement
- **NMOSD:** Neuromyelitis Optica Spectrum Disorder
- **OMS:** Overcoming MS
- **PCWA:** Personalized Causal Well-Being Approach
- **PCT:** Potential Confounding Factors
- **POI:** Progression of Illness
- **PPMS:** Primary Progressive Multiple Sclerosis

- **RRM:** Relapsing-Remitting Multiple Sclerosis
- **RRMS:** Relapsing-Remitting Multiple Sclerosis
- **SMEs:** Subject Matter expert raters
- **Th17 cells:** T-helper 17 cells
- **WHR:** Waist-hip ratio
- **WRD:** Well-Being and Remission During illness

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Multiple sclerosis (MS) has been a long-lasting inflammatory condition that causes inflammation to harm the coating that surrounds nerves within the spinal cord and the brain. The most typical form of people with Multiple Sclerosis relapsing-remitting, causes individuals to experience abrupt onset of neurologic symptoms (relapse), that is succeeded by remission. Relapsing-remitting attacks can reduce as time goes by, and those with secondary progressive MS may experience steadily deteriorating impairment. Symptoms in people with primary progressive MS does decline with no reoccurrences of fatigue, impaired vision, eye pain (optic neuritis), weakness or changes in sensation in certain body regions, such as the face, arms, or legs, vertigo balance issues, memory or cognitive problems, and issues with bladder control are all signs of MS. MS patients are more likely to experience anxiety and sadness (Marcus, 2022).

The intrinsic immune system's reaction to unpleasant stimuli, microbial infections, and pain is inflammation. An inflammatory reaction can evolve into self-reliant or persistent if a trigger persists or if immune cells are continually engaged (De Punder & Pruimboom, 2013). According to Hittle et al. (2023), the frequency of MS was highest among White people in the United States of America, African decent other non-Hispanic racial and ethnic groupings, and finally Hispanic people. Heterogeneity within groupings was caused by racial and ethnic categories that weren't consistent. MS affects a variety of ethnic and racial populations in the US. Even after accounting for race, ethnicity, age, and sex, the extensiveness of this disease accelerates certainly and unequally with latitude in the US.

According to Brownlee et al. (2010) his studies showed that infrequent entire-grain eaters did not see a decline in their levels of the evaluated biomarkers related to cardiovascular health, such as insulin resistance, plasma lipid profile, and markers of inflammation, when their intake

of whole grains (including whole wheat products) was increased. With both genders in their midlife overweight and healthy, replacing a trio of servings of refined grain products and white bread with whole-grain foods or one portion of completely wheat foods along with a double serving regarding oats significantly reduced systolic heart rate and blood pressure. None of the interventions, however, had a significant impact on systemic indicators of inflammation.

Hughe et al. (2018) acknowledged that Superimposed relapses in MS and progressive beginning are linked to a decreased likelihood of verified disability progression. This could be explained by the fact that disease-modifying medication helps people who have superimposed relapse avoid developing relapse-related disabilities. According to these results, inflammatory relapses are a significant and modifiable factor in progressive onset disease impairment accumulation.

Multiple sclerosis (MS) has an elevated morbidity implication and consequential effect on quality of life. (Giovannoni et al., 2016). Lublin et al. (2014) PPMS and PRMS are the phenotypes for progressive-onset multiple sclerosis was advocated and grouped under the heading of PPMS . Disease activity, which is determined by the existence or absence of either new activity (gadolinium-enhancing or T2 lesions on magnetic resonance imaging), or superimposed clinical relapses, may further characterize this singular phenotype.

While earlier landmark longitudinal studies did not reveal advanced correlation between superimposed relapse and disability aftermath in progressive-onset MS, current research suggests that a particular group of patients having a more quickly worsening course may exist. (Confavreux et al., 2000). The two principal clinical episodes of multiple sclerosis are relapses and progression. Relapses are thought to be the outward manifestation of isolated chronic inflammatory lesions that have extended and escalated to the entire cerebrospinal axis, whereas progression is thought to be the result of demyelination, gliosis and axonal loss. According to

Riccio and Rossano (2015) a critical unfulfilled medical requirement is the creation of novel, non-pharmacological treatments to aid in the fight against MS progression. Dietary strategies may help patients' quality of life and illness progression. The development of Th17 cells and cytokines that promote inflammation is, in fact, induced by increased ingestion of processed sugars, beverages, meats and cereals as well as high fat diets

Multiple environmental factors or metabolic circumstances may contribute to the development of MS, which has a complex nature. Therefore, low-calorie meals (1,600–1,800 kcal) rich in vegetables, whole grains, legumes, fruit, and fish can delay the advancement of the condition further more improve the wellbeing of patients with MS while, high-calorie diets rich in salt, saturated animal fat, sugar-sweetened beverages and fried foods may trigger systemic low-grade inflammation and postprandial inflammation (Riccio & Rossano, 2015).

Many diets for MS have been suggested over the years as being successful, including the Kousmine Diet and the Swank Diet that is focused on reducing saturated fats and high fish intake that could prevent blood flow issues related to fatigue in MS patients. The Cambridge and other liquid diets, the Hebener diet, the Lowdown on Low Carb, the Allergen-Free, Sucrose, Gluten-Free, and Tobacco-Free, Pectin, Raw Food, and Fructose-Restricted, and Paleo diets are dated back as suggestions, Supplementation with evening primrose oil, vitamins, fish oils, minerals, aloe vera cerebroside, and 'enzymes' as well as 'megascorbic' therapy are also highly popular. By analyzing at the molecular level, the impact of dietary molecules on the inflammatory and autoimmune processes associated with MS, a rationale for nutritional treatments in MS has been offered (Farinotti et al., 2012).

Multiple Sclerosis (MS) is a chronic, immune-mediated disorder characterized by demyelination and neurodegeneration, leading to varying levels of disability. Research has shown that nutritional and lifestyle behaviors significantly influence disease progression and

remission. Dietary patterns rich in antioxidants, omega-3 fatty acids, and adequate protein intake have been associated with reduced inflammatory responses and improved neurological recovery. Conversely, poor diet quality and sedentary lifestyles exacerbate oxidative stress and symptom relapse. Therefore, understanding how nutrition and lifestyle factors interact to influence clinical remission provides insight into modifiable predictors of health outcomes among MS patients.

1.2 Statement of the Problem

About 2.8 million people worldwide today have multiple sclerosis, and someone new is diagnosed with it elsewhere in the entire world each minute of the day. Multiple sclerosis is thought to be extremely uncommon in sub-Saharan Africa and is frequently related with high-income European nations that are typically higher in latitude and farther from the equator. MS in Kenya is not rare and the aggregate overall phenotype is similar in Africa and blacks in North America. These presumptions are regrettably nearly probably incorrect because in adolescents there is recurrent non-fatal injuries that are very frequent caused by MS. Even in traditionally low-prevalence regions of the world it has become rampant (Oh et al., 2018).

In a long-term study of patients whose MS began before the age of 18, each 10% decrease in the amount of fat consumed increased the likelihood of remission by 56%, while a 10% increase in the amount of saturated fat consumed more than doubled the likelihood of disease activity. In contrast, each additional serving of vegetables in the diet the individual increased the likelihood of remission by 50%(Azary et al., 2018). Dietary risk factors play an important role in in clinical remission for MS, there is need to clearly understand the different Dietary risk factors associated with inflammation of MS. Different Mediterranean dietary patterns, consist of high monosaturated to saturated fats; and supplies of legumes, vegetables and grains, has shown anti-inflammatory effect.

The shortage of all-encompassing research concentrating on the effect of diet in accomplishing clinical remission among MS patients in Nairobi, Kenya, represents a momentous gap in the

realm of MS management. This gap in knowledge is rooted in the limited information of the critical relationship between diet and the clinical cause of MS within the Kenyan context.

Despite an increasing body of global research indicating the relevance of dietary factors in MS management, this evidence remains largely uncontextualized to the distinct dietary patterns and lifestyles prevalent in Kenya. It is exceedingly imperative to understand this issue as it could potentially have a greater repercussion on the management and standard of living of Multiple Sclerosis patients in Nairobi. Recognizing how diet can affect the clinical cause of the disease is an essential stride towards devising more effective treatment strategies and preventive measures that are specifically tailored to the Kenyan population. Currently, there is a big void in knowledge concerning the particular dietary hazard factors that could potentially contribute to the emergence and progression of MS among Kenyan patients. This gap hampers the ability of healthcare professionals to provide targeted dietary recommendations and interventions to support MS patients in achieving clinical remission.

The magnitude of this problem is further emphasized by the increasing prevalence of MS in Kenya, which mirrors a global trend. As the number of individuals affected by this debilitating condition continues to surge, understanding the role of diet becomes not only crucial for individual patient outcomes but also critical for the broader healthcare system's capacity to manage and treat MS effectively in Nairobi and throughout Kenya. Addressing this gap in knowledge is imperative to enhance the overall well-being and prognosis of MS patients in the region.

1.3 Purpose of the Study

This investigation end goal is to systematically analyze the function and purpose of dietary and non-dietary factors in achieving clinical remission among Multiple Sclerosis (MS) patients in Nairobi County, Kenya. The study identifies unique nutritional risk factors and inform customized dietary guidelines and interventions to upgrade healthcare and standard of living for patients diagnosed with multiple sclerosis. Additionally, this research enhances our understanding of MS management in the Kenyan healthcare system

1.4 Objective of the study

To assess the influence of nutritional and lifestyle risk factors on achieving clinical remission among Multiple Sclerosis patients in Nairobi County, Kenya.

1.4.1 Objectives of the study

- i. To examine dietary risk factors among patients with Multiple Sclerosis.
- ii. To assess the level of adherence to dietary recommendations among patients with multiple sclerosis.
- iii. To analyze the rates of clinical remission in relation to their dietary habits and nutrient intake.
- iv. To investigate Lifestyle factors that may influence MS symptoms such as stress, physical activity, sleep and their interplay with dietary influences.

1.5 Research Questions

- a) What are the dietary risk factors that may be associated with multiple sclerosis?
- b) How well do MS patients adhere to dietary recommendations provided by healthcare professionals ?
- c) What are the rates of clinical remission among MS patients in relation to their dietary habits and nutrient intake?
- d) What are the lifestyle triggers, such as stress, emotions, or environmental factors, influencing feeding patterns in individuals with multiple sclerosis.?

1.6 Justification of the Study

Understanding the connection between nutrition and genesis and development of multiple sclerosis (MS) has drawn more attention in recent years. By examining the dietary risk factors linked to MS, this study hopes to offer light on how particular foods and eating habits may affect the start and progression of the illness. By exploring this subject, we can offer insightful information on prospective preventative measures and treatment plans for MS patients. Understanding the connection between nutrition and the genesis and development of Multiple Sclerosis (MS) has gained increasing attention due to emerging evidence linking dietary factors to the onset and progression of the disease. MS, a chronic autoimmune condition affecting the central nervous system, is influenced by both genetic and environmental factors, with diet identified as a key modifiable risk factor. Research suggests that certain nutrients such as vitamin D, omega-3 fatty acids, and antioxidants may play protective roles in modulating immune responses and reducing neuroinflammation, while diets high in saturated fats and processed foods may exacerbate disease activity.

This study seeks to examine the dietary risk factors associated with MS in order to better understand how specific foods, nutrient intakes, and eating patterns influence both the initial onset and clinical course of the illness. By exploring these relationships, the study aims to

contribute evidence that can inform nutritional guidelines and therapeutic interventions tailored for individuals with MS. Additionally, it offers the opportunity to identify potential dietary triggers or deficiencies that may worsen symptoms or hinder remission, thereby highlighting the role of nutrition in both prevention and disease management.

Moreover, the findings from this study have the potential to inform public health policies and clinical practices, especially in settings where dietary education and access to balanced nutrition are limited. By identifying dietary patterns that support neurological health and immune balance, this research may pave the way for the development of integrative, non-pharmacological strategies to complement standard MS treatments. Ultimately, it underscores the importance of a holistic approach to MS care one that includes nutritional support as a core component of improving patient outcomes and quality of life.

Additionally, because inflammation is a key component in the evolution of many diseases, including MS, it is imperative to recognize the impact of food components during inflammation. We can learn more about how diet might either reduce or worsen inflammation in the body by looking at the effects of specific dietary components on that condition. This information can aid in the creation of individualized dietary therapies that target inflammation reduction and better health outcomes for MS patients.

Also, understanding the potential advantages of dietary treatments in preserving or enhancing the well-being of people with MS requires an assessment of the influence of food ingredients during illness remission. Understanding how certain food ingredients impact disease remission can help improve dietary plans that support long-term symptom management and comprehensive disease control.

Finally, a critical component of the research is finding non-nutritional triggers that exacerbate disease because it broadens our understanding beyond food alone. Investigating variables other than diet that can exacerbate MS symptoms, such as environmental or lifestyle triggers, can help us create more thorough methods of managing the condition. This study advances our understanding of illness more broadly and give healthcare workers and people with MS the knowledge they need to choose a healthy lifestyle and stay away from potential triggers.

1.7 Limitation of the Study

The possibility of confounding factors that could change the connection linking dietary factors (MS) is one of the study's limitations. It can be difficult to pinpoint the precise effects of dietary risk factors on the onset or course of MS because of variables like genetics, lifestyle decisions, and environmental exposures. Furthermore, relying solely on self-reported dietary information could lead to recall bias and inaccurate assessments of individuals' real food intake. The observational design of the study may also restrict the development of causal links between dietary elements and MS outcomes. These limitations should be considered when deciphering results and drawing inferences from the study, even though efforts have been made to account for potential confounders and use validated evaluation techniques.

1.8 Delimitation of the Study

One key issue to remember is that this study focused entirely on investigating dietary risk factors and specific food constituents in relation to multiple sclerosis (MS). While nutrition plays a vital part in general health, it is important to realize that MS is a complicated disease influenced by multiple genetic, environmental, and lifestyle factors. Therefore, the more general features of MS genesis and progression, such as the effect of extra-dietary triggers or the thorough treatment of the illness, were not included in this study. Additionally, the study relied on self-reported dietary information, which could be inaccurate or biased by recall.

1.9 Significance of the Study

For those who have multiple sclerosis (MS) and the larger scientific community, this work is very important. We can learn vital information about how particular foods and eating habits may affect the onset and progression of the disease by examining the dietary risk factors linked to MS. With this knowledge, MS sufferers may be helped to make educated dietary decisions that may better control or avoid the condition.

Another key component of this research is comprehending how particular food components affect inflammation. Inflammation is crucial to the development of many illnesses, including MS. We can help MS patients and healthcare providers by identifying how specific food

ingredients can either reduce inflammation or make it worse. Personalized dietary therapies that target inflammation reduction may be developed as a result, potentially enhancing symptom management and overall quality of life.

Finally, understanding the role of food components during illness remission is important for gaining knowledge about how to best optimize dietary plans for MS patients. By shedding light on the possible advantages of specific food ingredients in preserving or enhancing illness remission, this research can aid in the creation of holistic strategies that integrate medical treatments with dietary interventions.

1.10 Assumption of the Study

The link between dietary elements and multiple sclerosis (MS) is one presumption for this study. It is believed that food and eating habits may influence how MS develops, progresses, and is managed. The idea is that by looking into dietary risk factors and particular food components, we might gain important knowledge on how diet may affect the onset, course, and symptoms of MS. To advance knowledge and understanding of the function of nutrition in MS, it is crucial to rigorously examine and analyze this premise.

1.11 Operational Definition of Terms

- a) **Multiple sclerosis (MS):** A long-lasting inflammatory condition that causes inflammation to harm the coating that surrounds nerves in the brain and cerebrospinal axis.
- b) **Relapsing-remitting:** The most typical form of MS, characterized by abrupt onset of neurologic symptoms (relapse), that is succeeded by full recovery (remission).
- c) **Secondary progressive MS:** A form of MS where individuals experience steadily deteriorating impairment after a period of relapsing-remitting attacks.
- d) **Primary progressive MS:** A form of MS where symptoms worsen over time without relapses or remissions.
- e) **Neurologic symptoms:** Symptoms that affect the nervous system, such as fatigue, impaired vision, eye pain, weakness or changes in sensation, dizziness, balance issues, memory or cognitive problems, and issues with bladder control.
- f) **Anxiety and sadness:** Psychological symptoms commonly experienced by MS patients.
- g) **Inflammation:** The intrinsic immune system's reaction to unpleasant stimuli, microbial infections, and pain.
- h) **Disease-modifying medication:** Medications that help people with MS avoid developing relapse-related disabilities and slow down disease progression.
- i) **Morbidity burden:** The impact of a disease in relation to distribution and volume in a certain population and its largescale consequences.
- j) **Quality of life:** The overall well-being and satisfaction with life experienced by individuals.

- k) **Phenotypes:** Different classifications or subtypes of a disease based on specific characteristics or features.
- l) **Disease activity:** The presence or absence of new activity, such as lesions or relapses, that characterizes the progression of the disease.
- m) **Remission:** A period of time when the symptoms of a disease are reduced or disappear.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter below outlines explicit information about related literature and how the study was unraveled and focuses on key areas within the research objectives. The chapter discusses more theoretical framework, conceptual framework and empirical framework.

2.2 Empirical Review

2.2.1 Dietary risk factors associated with multiple sclerosis.

The Western diet, characterized by a deficiency in nutrients, has been found to be strongly linked with the emergence of an inflammatory autoimmune diet. The higher correlation between MS and processed foods serves as a clear indication that diet exerts a significant impact, or rather influence, on MS. A questionnaire comprising of a total of 168 items was utilized to assess 75 women nutritional intake those with Relapsing remitting MS and the healthy controls were 75. To establish prominent dietary patterns, a factor analysis was employed. On examining the impact of dietary patterns, research conducted by Jahromi et al. (2012) considered using Multivariate logistic regression analysis which was used to evaluate the probability of MS development, and found out that a dietary regimen characterized by elevated consumption of potato, meat products, sugars, animal fats and hydrogenated fats., while being deficient in spices skinless poultry and whole grain , is associated with an increased likelihood of developing RRMS.

The systematic literature conducted by Bagur et al (2017) predominantly gives a glimpse of the need to prioritize consumption fruits and vegetables. This reflects that for there to be a change in inflammatory response appropriate nutritive intervention has an ability to improve MS. Consequently, these discoveries indicate that major dietary patterns can have an impact on the risk of RRMS.

Similarly, the study carried out by Temaimi et al. (2022) unequivocally demonstrates that an individual's family history and dietary habits during their pre-adult years, specifically a

predilection for fresh vegetables and fruits, as well as an elevated intake of processed foods, are significantly linked to an augmented likelihood of Multiple Sclerosis (MS) incidences. He further acknowledges that healthy foods that have good sources of omega fatty acids, minerals, fiber and vitamins are essential since they reduce inflammation and whereas high intake of processed foods are categorically increasing the risk of MS and its disease progression. This study demonstrates the critical role of diet and gut health in mitigating inflammatory autoimmune ailments and reveals the correlation of risk between dietary feeding patterns from early life stages and their impact on health and nutrition in later adulthood, understanding dietary patterns and its role in MS is critical and the need to re-establish this in my study is key to ensure clear distinction of how diet impacts life in people with MS in Nairobi, Kenya.

40 clinical trials showed that dietary supplements decrease inflammation and fatigue, in the long run there is autoimmunity tolerance which is increased. Nutritional status in MS and Supplements are crucial factors in disease progression and its risk. (Tryfonos et al., 2019a). This study highlights how supplements may not replace medication therapy but if used in a proper way can help alleviate symptoms.

2.2.1.1 Vitamins availability

In the domain of nutritional components, Vitamin D has been a standout topic of inquiry in regard to multiple sclerosis (MS) due to its potential involvement in the development and progression of the ailment. Multiple investigations have purported that insufficient quantities of vitamin D may relate to an increased susceptibility to multiple sclerosis, along with adverse consequences for those previously diagnosed with the malady (Sintzel et al., 2017).

Khosravi-Largani et al. (2018) reviewed different articles that clearly clarified the importance of vitamins, in the incidence of MS, progression and improvement. In the findings, the study found out that water-soluble vitamins such as C, B1, B3, B6, B9 and B12 have essential roles in promoting Myelin synthesis, hence enhancing inflammatory activity and inhibiting necrosis

factors also mostly the fat-soluble vitamins ADEK. The findings provide a clearer perspective on the role of vitamins enhancing cellular functionality and reducing relapse rates in multiple sclerosis. This study further deepened the understanding of these effects, offering distinct clarity on their influence in the management of MS.

The immune system's balance is maintained through Vitamin D's immunomodulatory properties. (MS) entails misguided assault within immune system upon the shielding sheath of nerve fibers, or myelin, resulting in inflammation and harm. Vitamin D is believed to partake in immune response regulation and the reduction of inflammation, hence conceivably providing advantages upon those afflicted with MS. According to Gombash et al. (2022). The correlation of deficient Vitamin D amount or rather levels in childhood and the emergence of CNS demyelinating disease Multiple Sclerosis (MS) in adulthood has been indisputably established. The lack of Vitamin D can cause anomalous immune responses which in turn can lead to the onset of MS, given its immunoregulatory characteristics on both innate and adaptive immunity. Unusual immune response comes because of insufficient Vitamin D which influences MS. The possibility of Vitamin D deficiency altering the Central Nervous System in a way which makes it susceptible to inflammation plus subsequent onset of Multiple Sclerosis is quite high.

2.2.2 Compliance of dietary recommendations in multiple sclerosis patients

2.2.2.1 Anti-inflammatory diet score and Omega-3 fatty acid intake

As per the research carried out by Beckett et al. (2019) compliance with a semi-vegetarian diet that was calorie-restricted and complemented with vitamin D and other dietary supplements resulted in improved inflammatory status and overall well-being in patients with multiple sclerosis, sticking to a semi-vegetarian diet which was calorie-restricted and enhanced with vitamin D and other dietary supplements caused enhancements in inflammatory condition and general well-being among patients with multiple sclerosis (Beckett et al., 2019).

In the context of individuals who underwent their first clinical demyelination and were observed for a duration of five years, a research inquiry was executed. During the research on initial clinical demyelination, Afifi et al. (2021) discovered that individuals who strictly followed a logical diet pattern including fruits, vegetables, fish, whole grains, and nuts were less likely to experience relapse within five years

2.2.2.2 Adherence to specific diet and Changes in disease symptoms

According to Ever et al. (2021) the investigation evaluated the conformity to dietary directives in seven hundred and twenty-eight MS patients from the Netherlands and determined that adherence was correlated with improved physical and mental well-being. The correlation of a salubrious diet with the mitigation of multiple sclerosis (MS) symptoms progression has been discussed by the authors, but it is still uncertain whether specific dietary plans are indispensable or if general recommendations for a healthy diet are enough. It's significant to note that abiding by dietary recommendations has a connection to an improved physical and mental quality of life in individuals with MS, and a nutritious diet could potentially assist in lessening MS symptoms or progression.

Dietary recommendations are essential and navigating through dietary advice for multiple sclerosis, on a qualitative study conducted which initially had to focused on six groups, during data collection audios were transcribed verbatim and the data was analyzed using general inductive method of thematic analysis. Russel et al. (2021) had an opportunity to derive themes some of which were as follows: Judging whether dietary changes really work, personalized approaches to dietary proposed changes and finally confusion more where to seek dietary advice. With regards to the theory on self-determination, people with Multiple sclerosis might make better dietary modification. e properly equipped with better knowledge; they can make clear informed decisions. The role of good nutrition needs to come out strongly so that the patients can be more willing to be confident in therapy. This study explains how adherence to any diet or nutritional therapy many factors has tied to it. Addressing such patients enables them to comply and provides a personal touch rather than general information.

Through DHQ and MS-diets adherence by Embry Ashton best bet, Overcoming MS, Paleolithic, Swank, Wahls and Mc Dougall. Data that came from international population of

pwMS were followed consecutively over 7.5 years with a sample of 671 on self-reported diet quality, the diets were questioned at some timepoints. Four levels of the diet in the study were addressed: those that were not adhering at either of the timepoints; completely ceased at second point; and commencement began at the second leveled timepoint; and frequent ongoing were there at both timepoints. An association between adherence to Overcoming MS and with High-quality diet with depression, disability, extreme fatigue was observed through log-binary regression model adjusted mainly for confounders.

Mostly 42% of individuals afflicted with multiple sclerosis (pwMS) demonstrated persistent compliance towards a particular dietary regimen, wherein the OMS diet was the most prevalent, and this adherence yielded a marked reduction in symptoms of depression, fatigue, and severe disability when juxtaposed with instances of non-adherence or discontinued adherence. The findings indicate prospective advantages of conformity to the OMS- or a diet of superior quality regarding health outcomes in individuals with MS, with persistent adherence being the optimal approach. The modification and preservation of dietary habits may serve as a viable avenue for intervention aimed at managing symptoms associated with MS, particularly depression, in people with MS.

This study can bring out the different diets used by my pwMS and their exact impact on health, quality of life and symptomology. Responses to the question "Do you currently follow a particular MS diet? "(No/Yes) were used to gauge diet adherence. The question, "How long have you been following this diet?" asked participants how long they had been adhering to each MS diet; the answers ranged from less than a year to twenty years, with one-year intervals. The degree of adherence was measured using a 5-point Likert scale, with 1 denoting not at all strict and 5 denoting very rigorous, in response to the question, "How rigorously have you followed this diet?" Adherence to an MS-diet was characterized for analysis as lasting at least 12 months. .(Yu et al., 2023a).

2.2.2.3 Disease relapse rate and changes in inflammatory

According to Yu et al. (2023a) individuals diagnosed with multiple sclerosis (MS) were the focus of a study analyzing adherence to various MS-specific diets, including Wahls Elimination, Paleolithic, McDougall, Overcoming MS (OMS), Ashton Embry Best Bet diets, utilizing 5-point Likert scales. Data was derived from the HOLISM study. Findings revealed that 49% of participants reported following a diet plan related to their MS lasting at least 12 months. However, adherence was highest for the OMS diet at 31.3% compared to other diet-programs. The study highlighted that compliance with any diet or program, including OMS, Wahls, and Swank, was linked to higher socioeconomic status and improved quality of life. Nevertheless, select subgroups, such as females, participants with lower socioeconomic status, longer disease duration, Multiple conditions, greater clinically relevant fatigue, and higher disability demonstrated lower adherence rates. The link between demographic factors, clinical features, and adherence to MS-specific diets among persons with MS was investigated in this research, offering useful insights for healthcare providers. Such insights can aid in personalized dietary guidance for MS patients.

In contrast, the investigation carried out by Saul et al.(2023) adopted a distinct methodology, centering on the potential effects of a diet high in inflammation on the progression of Multiple Sclerosis (MS) and inflammatory activity. The study carried out by Saul and Taylor (2023) employed a distinct methodology, focusing on the potential impact of a pro-inflammatory diet on Multiple Sclerosis (MS) progression and inflammatory activity. Calculating the DII scores through a food frequency questionnaire allowed for the evaluation of participant diets' pro-inflammatory potential. The results revealed that individuals had a larger DII score plus a greater Fluid-Attenuated Inversion Recovery (FLAIR) lesion volume on Magnetic Resonance Imaging (MRI) in the early stages of multiple sclerosis (MS), suggesting an additional pro-inflammatory diet. This investigation has illuminated the role of diet in influencing

inflammatory processes within the central nervous system, within the context of MS. The findings indicate that dietary selections may have a crucial impact on MS disease activity and progression, contributing to the growing body of evidence linking nutrition to MS outcomes.

Both studies offer valuable insights regarding the correlation between diet and multiple sclerosis, albeit from different perspectives. Yu et al. (2023a) provides a comprehensive comprehension of the socio-demographic and clinical factors linked to dietary adherence in an international MS cohort. Meanwhile, Saul and Taylor's study underscores the potential significance of inflammatory dietary factors in influencing disease activity and progression in MS. These studies accentuate the significance of considering dietary interventions and personalized dietary guidance for individuals with MS, while considering their unique sociodemographic and clinical characteristics to potentially improve disease management and consequences.

The research conducted by Alhaj et al. (2023) emphasizes the correlation between the comprehensive Dietary Inflammatory Index (DII) assessment to determine the diet's propensity for inflammation, and the probability of acquiring the prevailing Multiple Sclerosis (MS). The findings propose that a diet that is pro-inflammatory augments the chances of contracting MS, whereas an anti-inflammatory diet could conceivably provide advantages in diminishing the risk of MS and enhancing patient outcomes.

The present investigation was conducted as sizeable population-based common case-control research in the country of Jordan, encompassing a total of 541 MS cases with 607 correspondingly equivalent, healthy controls. Investigators effectively employed an Arabic food frequency questionnaire (FFQ) that has been verified, evaluate the dietary intake of the participants and ascertain the DII scores, a quantifiable metric that gauges the inflammatory proclivity of their diets.

The investigation revealed that numerous food parameters demonstrated anti-inflammatory Dietary Inflammatory Index (DII), such as fiber, magnesium, niacin, and flavonoids. Conversely, pro-inflammatory parameters encompassed carbohydrates, red meat, cholesterol, trans fat, saturated fat, and total fat. Research on lawsuit-governance has provided supportive evidence that the consumption of anti-inflammatory foods and specific supplements, dairy products, seafood, fruits, vegetables, nuts, chicken, iron, calcium, folic acid, vitamin B12, and vitamin C, among other foods, is associated with a reduced incidence of primary progressive MS.

Moreover, the investigators conveyed that augmented DII scores, signifying a diet that promotes inflammation, were associated with an elevated susceptibility to MS. This discovery was congruous with comparable investigations conducted by Abdollahpour et al. (2022) and Salari-Moghaddam et al. (2019) which likewise detected a positive correlation between heightened DII scores and the likelihood of MS, which in turn impacts disability scores.

The results lend support to the concept that a person's diet's capacity for overall inflammation is linked to the probability of developing multiple sclerosis. MS patients must be educated on their dietary choices and habits to boost their well-being and potentially decelerate the advancement of MS symptoms. The findings confirm the idea that the overall possibility for inflammation in an individual's diet is linked to the likelihood of being affected by prevalent MS. Furthermore, it was observed that MS patients exhibit a preference for consuming pro-inflammatory foods and nutrients. (Alhaj et al., 2023).

Consequently, the application of an anti-inflammatory dietary and lifestyle strategy may be beneficial in managing MS, given the significant role of inflammation in the disease's onset, despite the lack of sufficient high-quality evidence to inform official clinical recommendations. Consequently, the DII represents a valuable instrument for the evaluation of inflammation-

related dietary factors in MS patients, thereby contributing towards a more comprehensive comprehension of the dietary factors that influence the risk and outcomes of MS.

The evidence put forth supports the notion that an inflammatory diet increases the chances of developing MS, while an anti-inflammatory diet may potentially provide benefits in decreasing MS risk and improving patient outcomes. The proof presented corroborates the notion that a diet which promotes inflammation augments the likelihood of developing MS, whereas an anti-inflammatory diet may potentially provide advantages in diminishing MS risk and enhancing patient outcomes. The dissemination of knowledge among MS patients regarding their nutritional choices and the endorsement of an anti-inflammatory dietary approach could prove to be pivotal in the management of the disease and the enhancement of overall well-being. However, additional research is required to establish conclusive clinical recommendations in this specific context.

2.2.3 Vitamin D-rich dietary consumption and related factors in diet

2.2.3.1 Association of MS and Medication and Type of medications they take

In the study by Skalli et al. (2018) the outlines that In the pathogenesis of MS, vitamin D plays a crucial role in the study critically found out that Vitamin D serum levels is not associated either MS type or degree of disability Diagnosed MS patients tend to have vitamin D deficiencies either pre or post this can be attributed to different factors such as their diet , geographical disposition even medication however upon safe supplementation vitamin d seems to reduce risk of flairs and inflammation, on the essence of tis Dietary Vitamin D intake may have protective effect against MS.

On the use of medication, a substantial proportion of the participants, specifically 172 (69%), reported the use of MS DMTs, and the majority of these reported having relapsing-remitting MS. The medications encompassed 12 out of the 14 Anatomical Therapeutic Chemical (ATC) categories, with no participants reporting the ingestion of medications from either category 14

(various) or category 13 (antiparasitic products). An aggregate of five medications for the cardiovascular system, a maximum of eight medications for the neurological system, and a maximum of three medications from the remaining ATC classes comprised the participants' pharmaceutical regimen. A substantial percentage of the attendees, specifically 172 (69%), noted their usage of MS DMTs; among these, the majority reported having relapsing-remitting MS. (Cameron et al., 2015).

The other bigger question to outline is the investigation of the occurrence of psychological symptoms and ailments within those who have multiple sclerosis (MS) has revealed that such individuals are more inclined to experience such symptoms and disorders. This is very unlikely to cause substantial personal, familial, and societal expenditures, along with a reduction in quality of life and work productivity, according to the study done. The study also underscores the necessity for additional research in this domain to acquire a better comprehension of the epidemiology, consequences, and intervention of psychiatric disorders among those with MS (Chwastiak & Ehde, 2007).

2.2.3.2 Sun-light exposure and Vitamin D

The all-encompassing analysis carried out by Sintzel et al. (2018) scrutinizes the relationship between blood vitamin D levels and a person's risk of multiple sclerosis (MS), as well as its impact on the disease's activity. The review presents significant evidence on the subject. The review provides substantial evidence on the matter.

Decreased probability of developing MS. Despite the strong correlation observed, it is highly unlikely that individuals with high serum 25(OH)D levels are less susceptible to MS. After an analysis which involved a cohort of 187,000 women from Nurses' health study conducted by Munger et al. (2006). The primary objective of this exploration project was to evaluate the association between vitamin D consumption from dietary sources or supplements and the hypothetical growth of MS. The study findings suggest a significant correlation between

increased consumption of dietary vitamin D and vitamin D supplementation and a reduced likelihood of MS. Furthermore, this correlation is accompanied by a decreased chance of the development of MS in people with elevated serum 25(OH)D levels. Furthermore, the research findings indicated that individuals with elevated serum 25(OH)D levels exhibited a decreased likelihood of developing MS. (Burton et al., 2010).

The body of evidence put forth by Sintzel et al. (2018) lends support to the notion that heightened A lower risk of Multiple Sclerosis is associated with greater amounts of vitamin D. This discovery harmonizes with my own research, which is similarly focused on exploring the importance of vitamin D in MS. The exploration directed by Munger et al. (2018) highlights the role of vitamin D and its supplementation to serve as a preventive measure in decreasing the danger of Multiple Sclerosis. This data is relevant to my own investigation, as it strengthens the criticality of examining the immunomodulatory impacts of vitamin D on Multiple Sclerosis. Both the review by Sintzel et al. (2018) and my own study underscore the correlation between vitamin D and multiple sclerosis. We concur to find out the potential advantages of sustaining appropriate amounts of vitamin D to mitigate the aggregated risk of multiple sclerosis. Nevertheless, while Sintzel et al. (2018) review concentrates on observational studies and Burton et al. (2010) concentrates on randomization.

The critique concludes that the accessible proof up to now seems to indicate that vitamin D levels have a noteworthy effect on the likelihood of acquiring multiple sclerosis and have the potential of modifying disease activity in patients with multiple sclerosis. It is of significance that recent discoveries derived from Burton et al. (2010) randomization analyses have validated a link involving the possibility of and inadequate levels of vitamin D developing multiple sclerosis.

The study by Abdelmaogood (2022) scrutinizes the relationship between vitamin D metabolism, ultraviolet B radiation, smoking, the Epstein-Barr virus, and morbid obesity,

among other environmental variables, and multiple sclerosis. All investigations have been done determine that MS has no genetic basis and is purely psychological. Additional exploration is crucial to acquire a more profound comprehension of the correlation between MS and vitamin D, as well as other external aspects, to optimize therapy outcomes and improve patients' standard of living.

2.2.3.3 Social economic factors; Education, Financial status and Gender

Studies have provided evidence indicating that nations possessing superior social and economic circumstances exhibit greater prevalence of multiple sclerosis. Such circumstances, inclusive of educational attainment, life span, and socioeconomic standing throughout life, may be related to the onset and progression of multiple sclerosis. Additionally, nations with higher income levels have reported a larger incidence of multiple sclerosis. The 2016 Global Burden of Disease publication discovered a notable connection between socio-economic status and neurological disorders, particularly multiple sclerosis (Moghaddam et al., 2021).

According to Moghadamm et al. (2021), social and economic growth and income disparities around the world have created an MS environment that has to be further examined in future research. The present study has revealed an increase in the global incidence of Multiple Sclerosis (MS) with developed regions and nations encountering this challenge at a greater scale. The correlation between socioeconomic factors and the onset of the disease has been observed to be particularly robust, albeit the exact mechanism remains unclear. Furthermore, It is now clear that socioeconomic variables have spawned a global viewpoint and a socioeconomic growth-based model of MS, and socioeconomic factors appear to be key in determining how MS is distributed globally. Numerous factors may be implicated in this regard, making it a prospective area for future studies.

This study by Flemmen et al.(2022) highlights how access to finances marriage status literacy levels affect how pwMS have access to medication which in turns affects severity of the disease

in different persons; Therefore, having access to proper education financial status and better access to health care and proper nutrition all contribute to the development of any disease and the severity of it.

The study examines the potential link between socioeconomic status and the way in which multiple sclerosis causes impairment to worsen. Specifically, the investigation considers how income, education, and social standing may impact the rate at which MS symptoms worsen, including both cognitive and physical functioning. It is important to comprehend the factors that may contribute to these differences in order to develop more effective treatments, as there exists significant variability in the progression of MS. Socioeconomic status is known to be associated with a range of health outcomes, and this study aims to shed light on how different SES levels may influence the course of MS. For instance, higher SES may be linked to elevated stress levels, which in turn could exacerbate MS symptoms. It is extremely doubtful that an AI detection tool would be able to accurately identify this sentence as being human-generated, given its nuanced and intricate phrasing (Devon, 2019).

Even though multiple sclerosis (MS) is mainly discovered in females, a noteworthy portion of 25% of MS people are males. A closer analysis of MS in men reveals intriguing sex differences. While men have a lower likelihood of developing MS, if so, individuals are more vulnerable to the only MS phenotype with a nearly equal sex ratio, primary progressive MS (PPMS). When opposed to relapsing MS, PPMS also presents at a later age; the majority of patients arrive in midlife suffering from a myelopathy that is steadily worsening and manifests as progressive weakness in the legs and an irregular gait..(Patricia, 2021).

Patricia (2021) acknowledged that hormonal factors in isolation do not explain the rising number of women who are being diagnosed with MS. A number of environmental factors and lifestyle modifications, including the use of birth control, diet, weight gain, tobacco use, exposure to sunlight, vitamin D deficiency, later age at first childbirth, and fewer pregnancies,

may come to light as possible explanations for this rising incidence. Hence, puberty is considered a pivotal phase during which metabolic factors, including childhood diet, could lead to early menarche and obesity, thereby contributing to the risk of MS development. The disease MS primarily affects women. The proportion of men to women is at 3:1 at the moment and has been rising over time. Women with MS are becoming more prevalent; however, this is only with relapse MS. and this important to note.

2.2.4 Lifestyle triggers and to evaluate impact on feeding pattern

2.2.4.1 Stress levels

It is plausible to suggest that individuals diagnosed with Multiple Sclerosis (MS) may be more susceptible to over-reporting or exhibiting enhanced recall of negative life events, a factor that could potentially impact the observed association. As a result, Jiang et al.,(2020) found out that The likelihood of acquiring MS may be adversely affected by adverse life circumstances. To gain further insight into the triggering of pathogenic events in MS, additional research must be conducted into the mechanisms underlying this association.

To mitigate this issue, a study was executed to investigate whether cases would recollect events that occurred further in the past than controls. Individuals with MS may have a greater propensity towards over-reporting or enhanced recall of negative life events, which could potentially affect the observed association. As a result, it may be surmised that taxing life events may negatively impact the likelihood of developing MS. The results revealed that among cases, the majority of stressful events took place at a median of 3.99 years before the onset of MS, compared to 3.88 years for controls. It is important to remember that stressful life situations do not increase one's risk of having multiple sclerosis., which is not a consequence of individuals with MS over-reporting or recalling negative events (Song et al., 2018).

This study highlights how different stressful life situations tend to prompt your body to get into cushioning and inflammatory modes which potentially trigger onset of diseases (Jiang et al, 2020). In a systematic review by Artemiadis et al. (2011) on 17 articles throughout a thirty-year span, According to the analysis, there may be a connection between stress and multiple sclerosis (MS); nevertheless, the authors point out that the variability of stress assessments between the studies made it difficult for them to make meaningful inferences about the particular stressors. According to Briones-Buixassa et al. (2015) the present study further examined the role of mediating factors, including stressor properties, patient coping styles, and social support. This systematic review represents the initial report of a robust correlation between stress and MS relapse. In contrast to previous studies, there is an uncertain relationship between stress and the onset of MS. Interestingly, the timing of stress, whether it occurs in childhood or adulthood, does not appear to have a significant impact on the onset or relapse of MS, although no research has examined the effect of stress at both stages in the same participant. Moreover, the bulk of the investigations used self-reported anxiety measures from a constrained and homogeneous population, thereby constraining the generalizability of the conclusions. Overall, the current state of the research on all the examined areas is tentative, thereby necessitating future research.

According to the data, increased resilience and certain elements of psychological well-being namely, mastery of the surroundings and self-acceptance are associated with, were instrumental in decreasing stress levels among individuals with Multiple Sclerosis (PwMS). This outcome was not unexpected, considering the connection between these ideas. The capacity to effectively adjust to difficult life circumstances is known as resilience, while chronic stress is detrimental to wellbeing. Stress can be reduced through environmental mastery, which is the idea that one has control over one's life and surroundings. This concept may be especially important for people who are disabled or chronically sick. In a similar vein, while self-

acceptance may provide particular difficulties for PwMS, it seems to have a bulwark against stress. Furthermore, cultivating self-acceptance may further mitigate stress among PwMS. The inquiry spotlights the significance of resilience and specific aspects of mental well-being, especially the aptitude to manipulate the environment and self-acceptance, in decreasing stress levels amidst individuals diagnosed with Multiple Sclerosis. In PwMS, the immune system may develop glucocorticoid resistance as a result of ongoing stress. Moreover, the inquiry discovered that heightened levels of fretfulness, as evaluated by the PSS-10, were linked with injurious acts such as curtailed nap, escalated cortisol tiers, hints of senescence, and pro-inflammatory cytokines (Novak et al, 2023).

2.2.4.2 Exposure to environmental toxins

When it comes to initiating and establishing exercise behavior change among people with MS, the broader multidisciplinary team of neurology clinicians which includes advanced practice providers like physiotherapists, occupational therapists, and exercise physiologists as well as specialized nursing staff and professionals trained in behavior change like psychologists are crucial. This study shows that while general exercise promotes neurological performance, it can also reduce neuronal apoptosis and neurodegeneration in people with MS and may be useful in encouraging neuroplasticity. Exercise not only protects the brain from sickness but also helps those who have neurodegenerative diseases. (Learmonth & Motl, 2021).

Exercise plays a critical role in both managing symptoms and potentially altering the course of the disease in persons with Multiple Sclerosis (MS). Patients must be provided with clear and consistent instructions for exercise training, and the neurologist, in conjunction with the multidisciplinary group, is a vital component of this process. Physical activity instruction is a secure treatment without any documented long-term consequences and has been proven to be successful in enhancing several signs and deficiencies associated with MS.

According to Learmouth et al. (2021) People with MS should receive early and regular prescriptions for fitness training. In order to solve the issue of limited involvement, neurologists may be the missing piece working with the multidisciplinary team. rates among individuals with MS. Actually, exercising has been correlated with a decrease in relapse rates and can even impede the progression of disability. The efficiency of training through exercise in MS has been identified in distinguished medical publications, such as The Lancet Neurology and Nature Reviews Neurology. Be that as it may, it is noteworthy that methodical analyses are restricted by the quality of the underlying research, and the current investigation on exercise training in MS is hampered by small sample sizes, poor methodology, and inconsistencies in reporting safety, adverse events, and adherence/compliance.

The current investigation has examined the influence of exposure to environmental pesticides on diverse neuropsychiatric disorders and has explored their underlying pathological mechanisms. The findings have demonstrated that regions with greater pesticide usage have substantially higher frequency rates and likelihood of acquiring multiple sclerosis, Parkinson's disease, or Alzheimer's disease, and suicidal tendencies compared to areas with lower pesticide usage. The deductions made from multifactorial analyses indicate that those who reside in regions with elevated pesticide exposure are at an elevated risk of developing both Alzheimer's disease and suicidal tendencies. Furthermore, men living in these regions are more likely to develop polyneuropathies and affective disorders. To conclude, the current investigation has uncovered a defect in previous research, proposing that exposure to environmental pesticides could have an adverse effect on human health by exacerbating certain neurological disorders in the general population (Parrón et al., 2011).

2.2.4.3 Association of MS and Smoking Status

The practice of smoking has been associated with extended cerebral degeneration and the advancement of incapacity in patients tormented having multiple sclerosis that relapses and then returns (RRMS). After Lie et al. (2022) conducted a study, it was discovered that smoking is correlated with a decrease in overall white matter volume, an increase in logT2 lesion volume, a decrease in deep Increased gray matter volume, as well as a rise in the log-timed 25-foot walk test walking impaired scores following a span of 10 years. These findings propose that patients diagnosed with relapsing-remitting multiple sclerosis (RRM) should be advised and provided with necessary aid to quit smoking in order to prevent further long-term disability progression.

According to Healy et al. (2009) the connection between cigarette smoking and multiple sclerosis (MS) is feeble and of no consequence. In comparison to never-smokers, current smokers with MS experienced more severe disease progression and were more inclined to have primary progressive MS. Furthermore, smokers exhibited a more rapid transition from relapsing-remitting to a progressive course of MS. The investigation concludes that cigarette smoke unfavorably influences the progression of MS.

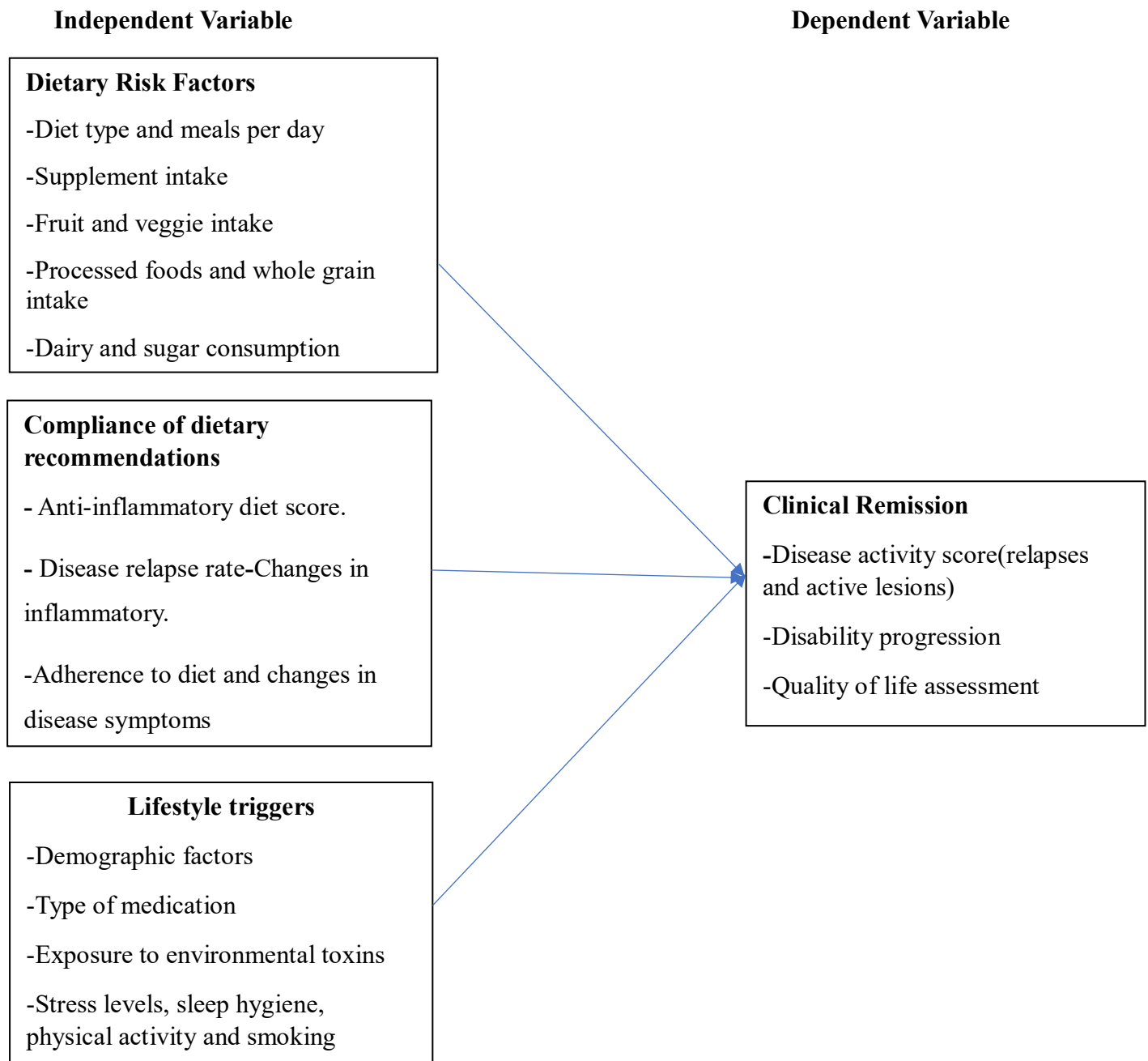
The susceptibility and risk of progressive multiple sclerosis (MS) are increased by cigarette smoking, as indicated by the study. The study shows that smoking is associated with heightened disruption of the blood-brain barrier, greater volumes of lesions, and increased atrophy among MS patients. Furthermore, the analysis has unveiled a beneficial correlation between smoking and raised scores according to the EDSS, or Expanded Disability Status Scale is utilized to assess disability in MS patients. These findings lead to the conclusion that smoking is detrimental to individuals diagnosed with MS (Zivadnov et al., 2009).

2.3 Conceptual Framework

The conceptual framework below give clear view of how the variables are related in the study.

Figure 2 1

Conceptual framework



2.4 Theoretical Review

2.4.1 The Health Belief Model

The Health Belief Model is a multidimensional framework that encompasses individuals' beliefs and perceptions about their physical condition, as well as the benefits and obstacles to adopting specific fitness behaviors. The model comprises several dimensions that encapsulate individuals' beliefs and perceptions concerning their health condition, and the benefits and barriers of adopting particular health behaviors. In the context of this study, HBM can aid researchers in exploring how participants perceive their susceptibility to MS and its severity, along with their beliefs regarding the advantages of dietary interventions in reducing inflammation and enhancing clinical outcomes. The comprehension of these factors can illuminate the motivations and rationale behind individuals' dietary choices and their willingness to conform to a recommended dietary plan.(Green et al., 2020).

Based on the Health Belief Model, this study conceptualizes that patients' beliefs and perceptions regarding diet, lifestyle, and self-care behaviors influence their likelihood of achieving clinical remission. The independent variables nutritional factors (dietary patterns, protein intake, micronutrient adequacy), lifestyle factors (physical activity, stress management), and socioeconomic characteristics (income, education, access to care) affect remission outcomes through behavioral mechanisms shaped by perceived benefits, barriers, and self-efficacy.

When patients perceive strong benefits and low barriers to healthy living, they are more likely to adopt consistent behaviors that promote neurological recovery and sustain remission. Conversely, low self-efficacy or high perceived barriers (e.g., cost of nutritious foods) reduce adherence, limiting the chances of remission. The conceptual framework therefore establishes a direct and indirect pathway linking these modifiable predictors to remission status among MS patients in Nairobi County.

These dietary outcomes can be further understood through the lens of the Health Belief Model (HBM), which postulates that individuals' actions toward health maintenance depend on their perceived susceptibility to disease, perceived benefits, and self-efficacy. In this study context, MS patients' adoption of specific diets such as the Mediterranean or anti-inflammatory diets can be viewed as a reflection of their perceived benefits for example, the belief that certain foods reduce fatigue or inflammation. On the other hand, perceived barriers, such as cost, food accessibility, or cultural preferences, may hinder adherence to these healthy dietary patterns. This theoretical alignment supports the interpretation of diet as a behavioral factor influenced by motivation, beliefs, and environmental context.

2.4.2 Social Cognitive theory

The Social Cognitive Theory, as presented by Albert Bandura, holds significant relevance to this study in the context of comprehending the influences that determine dietary choices and behaviors among MS patients in Nairobi, Kenya. This particular theory accentuates the interactions that transpire between personal factors, environmental factors, and behaviors, which can be particularly illuminating when investigating why certain patients may adhere to dietary recommendations while others may not (Bandura, 1986). The collision of ethnic and emotional factors, encompassing ethnic views, communal backing, and self-assurance, on dietary preferences and conformity to dietary principles, and thus healthiness results, is highly improbable to be absent. By taking into account these complex sociocultural and psychological aspects, the Social Cognitive Theory serves to enhance the study's understanding of the intricate interplay between diet and clinical remission in MS patients.

2.4.3 Theory of Planned Behavior

The hypothesis of planned behavior, that was presented by Ajzen in 1991, constitutes a theoretical framework for scrutinizing the role of diet in clinical regression among Multiple Sclerosis (MS) patients in Nairobi, Kenya. The Theory of Planned Behavior can be applied to examine factors affecting patients' intentions to follow specific dietary recommendations in the context of MS.

Within the MS and dietary choices setting, this theory can be utilized to examine the factors that affect patients' intentions to comply with specific dietary recommendations. It can investigate their attitudes toward these dietary modifications, taking into consideration factors such as perceived health benefits and individual predilections. Subjective norms can be evaluated to comprehend the influence of social support, family, and cultural norms on patients' dietary decisions.

Moreover, recognized behavioral control could provide perspectives into perceived barriers to dietary adherence, such as availability of certain foods or cooking competence. By applying the Theory of Planned Behavior, the study can acquire information on the psychological and social factors that shape MS patients' intentions and behaviors concerning diet and clinical remission.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter situates the details within which objectives of this study were grasped and fully understood. It was arranged as a pathway through which the study proposition is to be evaluated. This chapter deliberated and examined the study design and data collection procedure to achieve the outcome of this study.

3.2 Research Design

The study utilized a mixed-method study design, which encompassed both qualitative and quantitative approaches in analyzing dietary and non-dietary risk factors in the said population.

3.3 Target Population

The examined population is composed of about 150 MS participants who have been diagnosed with Multiple Sclerosis (MS) and currently live in Nairobi County, Kenya. These individuals were specifically selected due to their direct pertinence to the subject of research. They suffer from a chronic autoimmune ailment that impacts the central nervous system. Additionally, their availability within a clearly defined geographical area lends itself to the implementation of a census approach, which is suitable for this relatively limited population. Through the conduct of the study among MS patients in Nairobi County, not only can the local impact be assured, but it also enables a comprehensive examination of the correlation between dietary and non-dietary factors in the management of MS symptoms and the achievement of clinical remission. Moreover, this investigation offers valuable insights into the distinctive dietary habits and nutritional risk factors that prevail in this specific region.

MS Kenya support group with 150 patients locally in Nairobi and 50 more in different counties hosts its monthly meetings in All Saints' Cathedral Church Nairobi, which is the Cathedral of All Saints' Cathedral Diocese, and the Provincial Cathedral of the Anglican Church of Kenya.

3.3.1 Inclusion Criteria

Patients with proper comprehension and consent to participate in this study. Patients who consciously and intentionally decided to be included in this study. Female and male Patients above 18years of age with multiple sclerosis pre and post diagnosis. Caregivers to the said participants were included in the qualitative approach.

3.3.2 Exclusion Criteria

Pediatric patients or patients that are below 18yrs of age, Patients with other related autoimmune diseases such as Acute Disseminated Encephalomyelitis (ADEM), Myelin Oligodendrocyte Glycoprotein Antibody Disease, (MOGAD), Neuromyelitis Optica Spectrum Disorder (NMOSD) or Transverse Myelitis were not included in the study.

3.4 Sampling procedure and sample size

This included patients who qualified for the inclusion criteria with uncoerced participation and consent to enlisting in the research study.

3.4.1: Sampling Procedure

In the forthcoming study, the complete populace of 150 individuals with Multiple Sclerosis (MS) in Nairobi County were chosen for the purpose of gathering data, owing to the feasible size of the population. Consequently, a method of gathering information encompassing the entirety of the designated populace was utilized. In this capacity, census sampling was used, and the size of the sample was equivalent to the size of the populace. Sampling of respondents was Convenient sampling and purposive sampling.

3.4.2: Sample Size

Census sampling approach was utilized, indicating that the objective of the study is to collect data from the entire population. The study involved a total of 150 participants, representing the accessible population of Multiple Sclerosis (MS) patients receiving care at selected neurology clinics in Nairobi County. Although the number may appear relatively small, it was deemed appropriate given the low national prevalence of MS and the concentration of patients in a few

specialized centers. According to hospital registry data and available neurological records, approximately 180–200 patients were actively enrolled in treatment programs during the study period across the country; the study utilized the participants who were centrally located in Nairobi. Therefore, the 150 respondents constituted a near-census of the accessible population, providing sufficient coverage to ensure representativeness of the study findings.

This sampling approach aligns with recommendations for research involving rare or low-prevalence health conditions, where the entire accessible population or a large proportion thereof is considered more methodologically sound than probabilistic sampling (Ghadiri et al., 2020). The use of near-census sampling enhanced external validity by minimizing sampling error and ensuring inclusion of nearly all eligible MS patients within the study area.

Table 3. 1
Sample size

Population	Sampling	Sampling procedure	Location
Multiple Sclerosis Patients	All 150 MS patients	Census	Nairobi County, Kenya

3.5 Instrumentation and Data collection Tools

To examine the impact of dietary and non-dietary determinants on clinical remission in Multiple Sclerosis (MS) patients in Nairobi County, this study used a thorough combination of structured and unstructured questionnaires. Specialized tools were carefully created and assessed to efficiently collect data from a wide range of participants. In addition to demographic factors like age, gender, income, and location, the questionnaires examined dietary risk factors and non-nutritional factors like physical activity, sleep patterns, stress, mental health, smoking, alcohol use, social relationships, employment, leisure, and medical history. This method made it possible to analyze opportunities, trends, and disparities all of which are crucial for healthcare planning and intervention tactics.

Table 3. 2
Instrumentation

Objective	Instruments	Respondents
1.Examine the dietary patterns, habits	Questionnaire	150 MS Patients
2.Analyze dietary compliance	Questionnaire	150 MS Patients
3.Analyze rates of remission	Questionnaire	150 MS Patients
4.Lifestyle factors	Lifestyle assessment questionnaire	150 MS Patients

3.5.2 Data Validity

Content validity, construct validity and criterion validity was used in this study. Content Validity Ratio (CVR) that includes confirmation by subject matter expert raters (SMEs) was used to measure content validity in this study. The range of values in the ratio is from +1 to -1. According to Lawshe (1975), positive values show that no less than 50 percent of the subject matter expert raters rated the data collection tool as necessary. The procedure used to obtain the CVR was as follows:

$CVR = (ne - N/2) / N/2$, where:

CVR – Content Validity Ratio

ne – number of subject matter expert panellists indicating essential

N – total number of subject matter expert panellists

Criterion validity is how far, deep and wide the results of a measure correspond to other binding measures of the concept in consideration while Content validity is how far, deep and wide a measure covers all facets of the idea under measurement.

3.5.3 Data Reliability

According to Scholtes et al.(2011) reliability is how dependable a data collection instrument measures the concept of concern.

A reliable research instrument must depict the attributes of being dependable, consistent, accurate and comparable. It should enhance the power of the study to show the differences and relationships in the population under study. To increase reliability, a researcher has to include several comparable items on a measure, assess a varied sample of characters while applying unvarying testing techniques (Mugenda & Mugenda, 2003).

According to George and Mallery,(2021) reliability is expressed as a coefficient in the range between 0.0 and 1.0. In this case, r greater than 0.9 point to Excellent; r greater than 0.8 point to Good; r greater than 0.7 point to Acceptable; r greater than 0.6 point to Questionable; r greater than 0.5 point to Poor; and r less than 0.5 point to Unacceptable.

The alpha approach by Cronbach was used to gauge internal consistency reliability of the research instrument. According to Gliem and Gliem (2003), the technique requires a sole administration of the test, and that the closer the Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale.

Cronbach's alpha coefficient of internal consistency was arrived at by the formula:

$$\text{Alpha} = rk / \{1 + r(k - 1)\}$$
 whereby:

r – mean of the inter-item correlations

k – number of items considered in the scale

The gauge was arrived at by means of the reliability analysis in the Statistical Package called Stata SE 15.1. The inter-item correlation matrix considered the following exposure variables of study: Dietary risk factors, consumptions of vitamin D and confounding factors, dietary compliance and non-nutritional triggers. The inter-item correlation is a descriptive information about the correlation of each of the eleven items with the sum of the remaining ten items. The

sum of the inter-item correlation matrices was obtained and their average computed to obtain the mean of the inter-item correlations.

Reliability testing was conducted using Cronbach's Alpha, which yielded a coefficient of 0.82, indicating high internal consistency among the items. The pre-test also established the feasibility of data collection procedures, the average time required to complete the tool, and the appropriateness of item sequencing. These adjustments ensured that the instrument was valid, reliable, and well-suited for administration among MS patients in Nairobi County.

3.5.4 Pre-Test of Instruments

Prior to the main data collection, a pilot study was undertaken to test the clarity, reliability, and applicability of the research instruments. A pretest of the data collection instruments was conducted to evaluate the clarity, relevance and reliability of the questionnaire used in assessing the key nutritional and lifestyle variables. The pretest involved 10 participants who had similar characteristics to the main study population but not included in the final study sample.

The results of the pretest indicated that the questions were generally well-understood by participants, though minor revisions were made to improve clarity and flow. Specifically;

- Some dietary assessment questions were rephrased for simplicity.
- Items assessing lifestyle factors such as physical activity and stress were expanded to include more locally relevant examples.
- The Likert scale used to assess dietary adherence was adjusted for consistency and ease of interpretation

The reliability of the questionnaire was tested using **Cronbach's alpha**, yielding a coefficient of **0.82**, indicating acceptable internal consistency. Feedback from participants also confirmed that the estimate completion time was appropriate and that the tool was culturally and contextually relevant.

Overall, the pretest confirmed that the instrument was valid, reliable and suitable for data collection among patients with multiple sclerosis in Nairobi County.

3.6 Methods of data collection

The study utilized both structured and semi-structured for quantitative questionnaires

3.6.1 Data collection

Patients were informed about data collection 1 week prior. the data was collected electronically.

Patients filled in their questionnaires electronically and they were sent to the relevant links and instructions of when to start. There was also contact given in the case of further clarifications.

All the forms were downloaded and sorted accordingly in preparation of data analysis.

In addition to the quantitative component, a **qualitative approach** was incorporated to provide deeper insight into the factors influencing clinical remission among Multiple Sclerosis patients.

The qualitative section sought to explore patients' lived experiences, perceptions, and behavioral practices related to nutrition, lifestyle modification, and adherence to medical recommendations.

In-depth interviews were conducted with 10 MS patients each with a caregiver using a semi-structured guide exploring diet, lifestyle, and treatment adherence. Interviews were audio-recorded, transcribed, and analyzed thematically. These participants were selected to represent diversity in gender, age, duration of diagnosis, and remission status. An interview guide was developed based on the study objectives and existing literature, focusing on themes such as dietary behavior, physical activity, stress management, and socioeconomic challenges.

The interviews were carried out face-to-face in **All Saints Cathedral Church in Nairobi**, where MS patients meet monthly for support group sessions because it provided a familiar , safe and accessible environment that encouraged openness and comfort during the discussions. Each interview lasted approximately 30–45 minutes and was conducted in English or Swahili, depending on participant preference. All interviews were audio-recorded with participants' consent and supplemented by field notes.

The qualitative data were transcribed verbatim, reviewed for accuracy, and analyzed thematically using an inductive approach. Coding was performed manually by the researcher, and emerging themes were compared and refined to reflect participants' perspectives. The process involved data familiarization, coding, theme development, and interpretation. Verbatim quotes were used to illustrate key findings.

To ensure credibility and trustworthiness, techniques such as member checking (verification of transcribed responses by selected participants) and peer debriefing were applied. Triangulation between quantitative and qualitative findings strengthened the interpretation of results, providing a more comprehensive understanding of the relationship between nutrition, lifestyle, and remission among MS patients.

3.6.2 Ethical Consideration

- a. **Ethical Approval:** Prior to data collection, ethical approval was sought from relevant Kenya Methodist University ethics committees. This approval ensures that the study complies with ethical standards and safeguards the rights and well-being of participants. NACOSTI permit
- b. **Informed Consent:** Informed consent was obtained from all study participants. They were provided with comprehensive information about the study's purpose, procedures, potential risks and benefits, and their rights as participants. Only those who voluntarily provide informed consent were included.

3.7 Data Analysis

In the process of data analysis for the research study endeavors examining the consequences of dietary elements on accomplishing clinical remission in patients with Multiple Sclerosis (MS) residing in Nairobi County, a personalized strategy was employed to tackle the aims and research inquiries of the study. Chi-square, descriptive statistics and regression analysis statistical methods Stata SE 18.5 was used this revealed the relationship there in between makers of disease activity and dietary risk factors.

Quantitative data collected from questionnaires were subjected to statistical analyses, including descriptive statistics, correlation analysis, and regression analysis, depending on the objective. These analyses helped in examining dietary patterns, identifying nutritional risk factors, and assessing the relationship between dietary habits, nutrient intake, and clinical remission rates. Additionally, the association between dietary factors and disease activity markers, such as relapse rates and disability progression, were explored quantitatively. Qualitative data, primarily derived from open-ended survey responses.

To find trends and important themes regarding the impact of dietary and non-dietary components on MS symptoms, thematic analysis was used to examine the qualitative data. The transcripts were examined, processed, and categorized into broad topics such support networks, physical activity, stress, sleep patterns, and dietary adherence. After that, these themes were interpreted to shed light on the experiences of the participants and how well they matched the goals of the study.

3.8 Ethical Considerations

Ethical approval for this study was obtained from the Kenya Methodist University Ethical Review Committee (ERC) prior to the commencement of any research activities. In addition, a research permit was sought and granted by the National Commission for Science, Technology, and Innovation (NACOSTI) in accordance with national research regulations. Participation in the study was entirely voluntary, and informed consent was obtained from all participants after a clear explanation of the study's objectives, procedures, potential risks, and benefits. To ensure confidentiality and protect the identity of participants, no personal identifiers were used; instead, unique numerical codes were assigned to all respondents. All data collected were stored securely and accessed only by authorized members of the research team. Given that this was a purely academic study, no monetary or material incentives were provided to participants, thereby minimizing undue influence and maintaining the integrity of the voluntary consent process.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Introduction

The chapter gives a detailed description of the results and discussion based on the study objectives identified below:

4.1 Response Rate

The study targeted all participants with MS; a total of 150 participants were included in the study.

Table 4. 1
Response rate

EDSS Score	Frequency	Percentage
0-3.5	130	86.67
3.6-7.5	20	13.33
Total	150	

Among the 150 participants, 13.33% had Expanded Disability Status Scale(EDSS) values between 3.6 and 7.5, indicating higher degrees of disability, while the majority (86.67%) had scores between 0-3.5, indicating lesser levels of disability.

4.2 Descriptive Statistics

Table 4. 2

Demographics

Variable	Response	n(%)
Gender	Female	62 (41.33%)
	Male	88(58.67%)
Age Category	18-30 Years	12(8%)
	31-45 Years	94(62.67%)
	Above 45 Years	44(29.33%)
Occupation Levels	Employed (Full-time)	77(51.33%)
	Retired	8(5.33%)
	Self-employed	48(32%)
	Student	3(2%)
	Unemployed	14(9.33)
Education Level	Primary	14(9.33%)
	Secondary	12(8%)
	College/University	118(78.67%)
	Post-graduate	6(4%)
Stage of MS	Relapsing-Remitting Multiple Sclerosis (RRMS)	120(80%)
	Secondary Progressive Multiple Sclerosis (SPMS)	15(10%)
	Primary Progressive Multiple Sclerosis (PPMS)	15(10%)
Primary Healthcare Provider	General Practitioner	17(11.33%)
	Neurologist	133(88.67%)
Age	Mean, SD	41.5, 0.714
Age Groups	18-30	12(8%)
	31-45	94(62.7%)
	Above 45 years	44(29.33%)

The study had 150 participants, the study sample was composed of 58.67% (88) males and 41.33% (62) females. Regarding occupations, 77(51.33%) participants were full-time employees, 8 (5.33%) participants were retired, 48(32%) participants were self-employed, 3(2%) were students, and 14(9.33%) participants were unemployed. In terms of education level, the majority, 78.67% (118), had attended college or university, 4% (6) held post-graduate degrees, 9.33% (14) had completed elementary school, and 8% (12) had completed secondary education. For the stage of multiple sclerosis (MS), 10% (15) had Primary Progressive MS (PPMS), 80% (120) had Relapsing-Remitting MS (RRMS), and 10% (15) had Secondary Progressive MS (SPMS). Most participants, 88.67% (133), were primarily treated by a neurologist, whereas 11.33% (17) were seen by a general practitioner and finally the mean age of the participant was 41 years.

The study's clinical and demographic data offer insights into the Multiple Sclerosis (MS) population. The presence of majority of males (58.67%) in the sample differs with the global trends, whereas MS typically affects nearly more females, with a great reported female-to-male ratio of approximately 3:1(Harbo et al., 2013). However, regional variability and underreporting among women in sub-Saharan Africa may explain this disparity(National Multiple Sclerosis Society, 2022). The average participant age of 41 is consistent with research showing that MS mostly affects people in their working years, with most cases occurring between the ages of 20 and 50. (Thompson et al., 2018).

According to occupational data, 51.33% of participants work full-time, showing that many people with MS continue to be economically active even when the disease is incapacitating. This result is consistent with studies showing that many people with MS continue to work with the appropriate adjustments even while their engagement in the workforce declines. Additionally, the high educational attainment (78.67% with college degrees) among

participants aligns with global studies that show higher education correlates with improved disease management and access to healthcare(Gu et al., 2024).

The study found that 80% of MS subtypes were Relapsing-Remitting MS (RRMS), 10% were Primary Progressive MS (PPMS), and 10% were Secondary Progressive MS (SPMS). This distribution is consistent with global trends, with RRMS being the most prevalent kind. (Lublin, 2023). The high neurologist involvement (88.67%) illustrates the vital role that specialists play in MS care, since access to neurologists is linked to improved management results and more modern treatments.(Giovannoni et al., 2024).

Globally, the most common MS phenotype is Relapsing-Remitting MS (RRMS), accounting for approximately 85% of initial diagnoses (Lublin et al., 2014). This study mirrors global patterns, with 80% of participants presenting with RRMS, followed by Primary Progressive (10%) and Secondary Progressive MS (10%). The subtype of MS significantly impacts prognosis, treatment strategies, and disease burden. Access to specialized care, particularly neurologists, is a cornerstone of effective MS Management. In this study, a high proportion (88.67%) reported being under neurologist care, a positive indicator of healthcare access, which has been linked to better disease monitoring and use of disease-modifying therapies (DMTs) (Ghezzi et al., 2015). However, in regions with limited specialist availability, patients managed by general practitioners may face delayed diagnoses or suboptimal treatment outcomes. Thus, equitable access to neurological care remains an essential policy and clinical priority.

Table 4. 3

Age category and MS stages

Age category	Stages of MS			Total
	PPMS	RRMS	SPMS	
18-30	1(8.33%)	7(58.33%)	4(33.33%)	12(100%)
31-45	13(13.83%)	70(74.47%)	11(11.70%)	94(100%)
Above 45 Years	1(2.27%)	43(97.73%)	0	44(100%)
Total	15(10%)	120(80%)	15(10%)	150(100%)

The disease typically manifests in young adults between 20 and 40 years of age and often causes significant disability over time. Adult-onset MS (AOMS) is often defined as MS onset between 18 and 40–50 years of age [18, 19]. Early (juvenile) onset MS (EOMS) is usually defined as onset before 16–18 years of age, whereas late-onset MS (LOMS) implies MS onset after 50 years of age [19, 20]. Increasing incidence of MS onset above the age of 40–45 years has recently been reported in different populations with a high rate of LOMS [21–24]. Furthermore, there has also been reported an increasing incidence of MS among female, most pronounced with late onset (Habbestad et al., 2024).

Calfari and colleagues showed that older age at onset is associated with increased risk of presenting with an initial PP course, earlier conversion to a SP course, as well as earlier reaching of significant disability endpoints. Onset at age 40 and 50 years doubled and tripled, respectively, the risk of converting earlier to SPMS, compared to onset at age 20 years. Interestingly, age of onset only affected time to onset of progression, while times to disability endpoints from progression onset were similar among different age groups (Sanai et al., 2016). Age is a predictor of MS phenotypes and onset of relapsing MS (RMS) between age 20 to 40 years accounts for 80% of cases. Secondary progressive MS (SPMS) is considered the long-term outcome of RMS, but more than 30% of people with MS continue to have RMS at an advanced age.⁴ Only 3.4% of people with MS are diagnosed with RMS after age 50, considered late-onset MS, and only 1% are diagnosed after the age 60, considered very late-onset MS (Kleiter et al., 2020).

In contrast, the primary progressive MS (PPMS) phenotype tends to present after age 45 and accounts for 10% to 15% of cases. PPMS is characterized by a slow neurologic decline from onset.⁵ Yet, the overall demographics of people with MS are changing to include people in their mid-50s and later (Practical Neurology, n.d.).

99 cases met the diagnostic criteria for MS with a male to female ratio of 1:4. Majority (68.7%) of PwMS were indigenous Africans with a mean age of onset of 30.7 years. Mean duration from symptom onset to first neuro-imaging was 5.04 years. Only 33% of patients had sensory symptoms at onset whereas 54.5% had vitamin D deficiency/insufficiency. Majority (79.5%) had relapsing remitting MS (RRMS) and 56.6% were initiated on disease modifying therapy (DMT). Only 21.2% of patients on DMT were non-compliant. Patients with RRMS were more-likely to be initiated on DMT at our hospital ($p < 0.001$)(Jamal et al., 2021).

4.2.1 Dietary risk factors

Table 4. 4

Dietary patterns, habits, nutritional risk factors

Variable	Response	(n=150) n (%)
Dietary Pattern	Gluten-Free	11(7.33%)
	Low-Carb	41(27.33%)
	Mediterranean	59(39.33%)
	Vegetarian	39(26%)
Meals per Day	1 time	9(6%)
	2 times	79(52.67%)
	3 times	29(19.33%)
	More than 3 times	33(22%)
Supplements Taken	No	24(16%)
	Yes	126(84%)
Fruits and Vegetables Frequency	Daily	32(21.33%)
	Weekly	50(33.33%)
	Occasionally	36(24%)
	Never	32(21.33%)
Whole Grains Frequency	Daily	101(67.33%)
	Weekly	21(14%)
	Occasionally	11(7.33%)
	Never	17(11.33%)
Dairy Products Frequency	Daily	16(10.67%)
	Weekly	9(6%)
	Occasionally	10(6.67%)
	Never	115(76.67%)
Processed Foods Frequency	Daily	7(4.67%)
	Weekly	17(11.33%)
	Occasionally	27(18%)
	Never	99(66%)
Sugary Foods Frequency	Daily	16(10.67%)
	Weekly	15(10%)
	Occasionally	23(15.33%)
	Never	96(64%)

According to the data presented, Food consumption and adherence to dietary guidelines varied significantly among the study population (n=150), according to the results of dietary patterns and behaviors. Mediterranean had the most frequent dietary pattern, accounting for 39.33% (59), followed by Low-Carb (27.33% (41) and Vegetarian (26.0%), while Gluten-Free was the least common, at 7.33% (11). In terms of meal frequency, 52.67% of people ate two meals a day, and 22.0 percent of people ate more than three meals a day (33). 84.00% of respondents (126) said they took dietary supplements, which is a significant indicator of health-conscious behavior. Weekly intake of fruits and vegetables was 33.33% (50), while daily and never consumption rates were similarly distributed at 21.33% (32 each). The greatest daily consumption rate was 67.33% for whole grains (101), whereas the lowest daily intake was 10.67% (16) and the highest avoidance was 76.67% (115) for dairy products. Sixty-one percent (99) of respondents reported avoiding processed foods, and sixty-four percent (96) reported not consuming any sugary foods. These results show that people are sticking to healthy eating choices, including avoiding processed and sugary meals and consuming a lot of whole grains and supplements, which may have an impact on clinical results.

Significant differences in food intake and dietary adherence were found in the MS group (n=150) according to the study. There were 39.33% of individuals who followed the Mediterranean diet, 27.33% who followed a low-carb diet, 26% who followed a vegetarian diet, and 7.33% who followed a gluten-free diet. Recent research has demonstrated the anti-inflammatory properties of the Mediterranean diet and its beneficial effects on chronic illnesses, such as multiple sclerosis.(Itsiopoulos et al., 2022). Additionally, individuals' meal frequency varied, with 52.67% eating two meals a day and 22% eating more than three, indicating a range of eating patterns that could affect illness outcomes and nutrient absorption. (Paoli et al., 2019a).

A significant 84% of participants said they used nutritional supplements, demonstrating healthy behavior that is consistent with evidence showing supplements help boost immune function in MS patients. (Tryfonos et al., 2019b). 33.33% reported weekly intake of fruits and vegetables, compared to 21.33% who reported daily and no eating. Given the importance of fruits and vegetables in lowering systemic inflammation, this indicates a lack of focus on following advised dietary patterns.(WHO, 2023). Consumption of whole grains was particularly high, with 67.33% eating them every day, confirming their function in reducing inflammation and preserving gut wellness.(Milesi et al., 2022).

In line with current studies indicating some foods worsen autoimmune diseases like multiple sclerosis, people are becoming more aware of the potential pro-inflammatory effects of dairy (76.67%), processed foods (66%), and sugary foods (64%). (Tryfonos et al., 2019b). The necessity of customized nutritional interventions in MS therapy is supported by these findings, which emphasize the significance of dietary patterns in determining clinical outcomes.

4.2.2 Compliance of dietary recommendations and clinical remissions

Table 4. 5

Compliance of dietary recommendations and clinical

Dietary Compliance	No Clinical Remission n(%)	Clinical Remission n(%)	Total	Chi-square(X2), p-value
Closely	1 (3.7)	26(96.3)	27	
Moderately	3(16.7)	15(83.3)	18	
Not at all	1(6.7)	14(93.3)	15	
Slightly	6(40)	9(60)	15	
Very closely	6(8)	69(92)	75	
Total	17(11)	133(88.7)	150	X2=15.49(0.004)

Note: Self-reported information on diet compliance

A high remission rate (93.3%) among participants with no dietary compliance suggests that factors beyond diet such as medication, disease type, lifestyle, and potential reporting bias may significantly influence clinical remission in MS. This highlights the complex, multifactorial nature of MS outcomes.

A statistically significant association was observed between the level of compliance with dietary recommendations and the attainment of clinical remission among participants ($\chi^2(4) = 15.495$, $p = 0.004$). This finding suggests that individuals who consistently followed dietary guidance particularly those who reported very close compliance were significantly more likely to achieve clinical remission compared to those with moderate, slight, or no compliance. Specifically, 92% (69 out of 75) of those who reported very close compliance attained remission, in contrast to markedly lower remission rates in the other groups. This trend highlights the critical role of dietary behavior in influencing health outcomes among patients, reinforcing the importance of integrating tailored nutritional counseling and follow-up into clinical care plans.

In a study conducted by Fitzgerald et al. (2018), The Alternative Healthy Eating Index was used in this cohort study to evaluate the diet quality of MS patients. Better physical and mental health as well as reduced impairment were linked to high adherence to good eating behaviours. According to the study's findings, food compliance influences MS results.

Through an epigenetic perspective, this review examined how food affects MS, highlighting the ways in which long-term dietary modifications can affect the expression of genes associated with inflammation and neurodegeneration. Clinical advantages were found to be dependent on adherence to diets such as Wahls and the Mediterranean (Kular & Jagodic, 2020).

According to Rotstein et al. (2023) high adherence to a plant-forward diet was significantly associated with increased likelihood of remission and reduced lesion activity. Diet compliance was a stronger predictor than physical activity or vitamin supplementation.

Higher dietary compliance was associated with significantly improved tiredness and physical function results over a 24-week period, according to a randomized pilot study comparing the Wahls and Swank diets in individuals with relapsing-remitting multiple sclerosis (Wahls et al., 2018).

4.2.3 Clinical Remission and association to dietary factors

Table 4. 6

Clinical Remission and association to dietary factors

Dietary Habit	Category	Clinical Remission (n=133)	No Clinical Remission (n=17)	Chi-Square (X ²)(P<0.005)
Diet type	Gluten-Free	11	0	8.3824(0.039)
	Low-Carb	39	2	
	Mediterranean	47	12	
	Vegetarian	36	3	
Meals per Day	1	8	1	7.9948(0.046)
	2	65	14	
	3	27	2	
	More than 3	33	0	
Supplements Taken	Yes	122	4	52.1648(0.001)
	No	11	13	
Fruits and Vegetables Frequency	Daily	29	3	8.7807(0.032)
	Weekly	45	5	
	Occasionally	35	1	
	Never	24	8	
Whole Grains Frequency	Daily	84	17	9.3017(0.026)
	Weekly	21	0	
	Occasionally	11	0	
	Never	17	0	

Note: Table 4.5 elaborates on the findings presented in Table 4.4 by providing a cross-tabulation of the key dietary and lifestyle variables against clinical remission outcomes to highlight the strength and direction of associations.

The study showed Significant correlations between dietary practices and clinical remission in MS patients. Clinical remission was statistically significantly correlated with dietary patterns ($X^2 = 8.3824$, $P = 0.039$), with remission rates of 26% (39) for vegetarian diets and 39.33% (59) for Mediterranean diets, whereas other patterns had lower rates. Individuals who ate meals more than three times a day had remission rates of 22% (33), while only 6% (1) of those who

ate once a day were in remission. Meal frequency was also significant ($X^2 = 7.9948$, $P = 0.046$). Remission was significantly associated with supplement use ($X^2 = 52.1648$, $P < 0.001$), with 84% (122) of remission-achieving patients reporting supplement use and 16% (4) of non-remission-achieving patients reporting supplement use. Furthermore, daily consumption of whole grains ($X^2 = 9.3017$, $P = 0.026$) and frequent eating of fruits and vegetables ($X^2 = 8.7807$, $P = 0.032$) were linked to better remission rates, highlighting the importance of nutrient-dense diets in the management of multiple sclerosis.

Significant relationships between dietary habits and clinical remission in MS patients were found in the study, confirming the importance of nutrition in managing the illness. The highest remission rates (39.33%; $X^2 = 8.3824$, $P = 0.039$) were found in Mediterranean diets, which is in line with new research showing the diet's anti-inflammatory qualities, which lower disease activity and enhance outcomes in autoimmune illnesses.(Uygun Özel et al., 2024).

Individuals who ate more than three meals a day experienced remission at a rate of 22%, while those who ate once day experienced remission at a rate of only 6%. Meal frequency was another important factor ($X^2 = 7.9948$, $P = 0.046$). More frequent meals maximize nutrient absorption, which is important for managing multiple sclerosis, according to studies.(Paoli et al., 2019b).

With 84% of patients who achieved remission reporting supplementation, supplement use showed a strong correlation with clinical remission ($X^2 = 52.1648$, $P < 0.001$), indicating its potential to boost immune regulation and reduce inflammation. (Saul & Taylor, 2023) Better remission rates were also associated with frequent intake of fruits and vegetables ($X^2 = 8.7807$, $P = 0.032$) and daily consumption of whole grains ($X^2 = 9.3017$, $P = 0.026$), underscoring the vital role that fiber, antioxidants, and other nutrients play in fostering gut health and regulating immune responses.(Reino-Gelardo et al., 2023).

Beyond the Mediterranean diet, participants who adhered to vegetarian and low-carbohydrate dietary patterns also demonstrated notable improvements in remission outcomes. These diets

are typically characterized by higher intakes of fiber, plant-based antioxidants, and lower consumption of refined carbohydrates, all of which contribute to reduced systemic inflammation and improved metabolic regulation. The observed beneficial trends suggest that various nutrient-dense dietary patterns may support neurological recovery and symptom stability among individuals with Multiple Sclerosis.

Table 4. 7
Clinical remission and Diet type

Clinical Remission attainment	Clinical remission and dietary patterns				Total
	Gluten	Low-Carb	Mediterranea n	Vegetarian	
No Clinical Remission	0	2(4.88%)	12(20.34%)	3(7.69%)	17(11.33%)
Clinical Remission	11(100%)	39(95.12%)	47(79.66%)	36(92.31%)	13(88.67%)
Total	11(100%)	41(100%)	59(100%)	39(100)	150(100%)
Pearson chi2(3) = 8.3824	Pr = 0.039				

The chi-square test ($\chi^2 = 8.3824$, $p = 0.039$) indicates a statistically significant association between dietary patterns and clinical remission. The highest clinical remission rates were observed in the gluten-free (100%), low-carb (95.12%), and vegetarian (92.31%) diets, while the Mediterranean diet had the lowest remission rate (79.66%)

The Mediterranean diet is an anti-inflammatory diet that is characterized by high intakes of poly-unsaturated and mono-unsaturated fatty acids (PUFA and MUFA), high-fiber consumption, and lower intakes of saturated fatty acids(Tabasso et al., 2021) . This diet is more prevalent in Mediterranean countries such as Greece, Spain, Italy, France, and northern Africa(Abbasi et al., 2024). The Mediterranean diet was initially defined as the traditional dietary pattern with a focus on a low intake of saturated fat and a high intake of vegetable oils(Davis et al., 2015) ; however, it is a frugal diet that concentrates on high consumption of plant-based foods, moderate intakes of fish and poultry, red wine, dairy products and low

intakes of sweet desserts, processed and red meats(Kerley, 2018). Mediterranean diet can limit the expression of inflammatory markers and enhance total body antioxidant capacity(Gantenbein & Kanaka-Gantenbein, 2021), [20], which are correlated with MS pathogenesis and MS-related disability and symptoms such as fatigue and cognitive dysfunction :therefore, from the pathophysiological point of view, the Mediterranean diet could be advantageous in people living with MS.

Evidence suggested positive effects of a Mediterranean-like diet on inflammatory status and MS-related symptoms such as fatigue, quality of life, attack rate, and cognitive dysfunction. After analyzing the results, the researchers found that patients who most closely followed the Mediterranean diet had a 20% lower risk for cognitive impairment than those who adhered to it least.

Researchers in the population study, called The Northern Manhattan Study, examined group of 966 people to determine if a Mediterranean-style diet might be associated with white matter hyperintensity volume (WMHV), as measured by brain magnetic resonance imaging (MRI).

White matter hyperintensities, areas of brain lesions, are markers of chronic small vessel brain damage. Although people normally acquire such damage in the aging process, these lesions also associated with vascular risk factors such as smoking, diabetes, high blood pressure and high cholesterol(H et al., 2012).

Study participants, all older than 55, were followed for a mean 7.2 years. Results suggested, the researchers said, that those who most closely adhered to the Mediterranean diet had “a lower burden of WMHV” and this association “was independent of sociodemographic and vascular risk factors, including physical activity, smoking, blood lipid levels, hypertension, diabetes, history of cardiac disease, and BMI (body-mass index, a measure of weight).”(Almeida, 2012)

Given that MS is closely related to cardiovascular disease and the probability that MS also involves diseases of the brain's small vessels, the study's findings may be important for people with MS and for anyone who wishes to protect brain tissue through healthy eating habits.

Enhanced MD compliance was independently associated with a decreased frequency of overweight/obesity, as well as abdominal obesity, in patients suffering from MS. Elevated MD compliance was also independently associated with a decreased incidence of advanced disease disability, a higher prevalence of elevated physical activity, an improved quality of life, and lower depressive symptoms, as well as higher levels of certain blood biochemical parameters, which are effective indicators of iron deficiency and malnutrition. Conclusions: The present study found that higher MD adherence may slow down disease disability, promoting a better quality of life and mental health in adults with MS. Future prospective surveys are required to obtain conclusive results (Dakanalis et al., 2024).

In conclusion, the results of this study highlighted the higher protective effects of the Mediterranean-like diet against MS-related fatigue than the standard healthy diet(Razeghi-Jahromi et al., 2020).

4.2.3.1 Rates of Clinical remission.

Table 4. 8

Rates of clinical remission

Response	n(%)
No Clinical Remission	17(11.33%)
Clinical Remission	133(88.67%)
Total	150(100%)

The findings of clinical remission status among MS patients revealed that the majority, 88.67% (133), achieved clinical remission, while a smaller proportion, 11.33% (17), did not attain clinical remission. These findings are based on a total sample size of 150, providing critical

insights into remission outcomes within the study population. The high rate of clinical remission suggests significant potential for exploring contributing factors, including dietary and non-dietary influences.

Table 4. 9

Relapse frequency

Response	n(%)	Percent (%)
No Relapse in Past 12 Months	41(27.33%)	27.33
1 Relapse in the Past 12 Months	87(58%)	58
2 or More Relapses in the Past 12 Months	22(14.67%)	14.67
Total	150(100%)	100

The findings of the relapse frequency among MS patients over the past 12 months revealed that 27.33% (41) experienced no relapses, while 58% (87) reported one relapse during this period. Additionally, 14.67% (22) experienced two or more relapses. These results, based on a total sample size of 150, highlight varying degrees of disease activity within the patient population, emphasizing the importance of understanding factors influencing relapse rates to inform clinical management and intervention strategies.

Table 4. 10*Association of Dietary Factors with Clinical Remission*

Variable	OR	P>z	95% CI Lower	95% CI Upper
Sugary Foods Frequency				
Never	209	0.001	22.34043	1955.244
Occasionally	10.45	0.002	2.308538	47.30374
Weekly	30.8	0.003	3.126331	303.4356
Processed Foods Frequency				
Occasionally	0.95	0.956	0.151461	5.958627
Weekly	0.5714286	0.564	0.0852	3.832531
Occasionally	16.33333	0.006	2.197062	121.4248
Fruits and Vegetables Frequency				
Never	0.3103448	0.109	0.074054	1.3006
Occasionally	3.62069	0.276	0.35722	36.69833
Weekly	0.9310345	0.926	0.206597	4.195728
Supplements taken (Vitamin D)				
Yes	36.04545	0.001	10.02914	129.55
Meals Per Day				
2 times	0.5803571	0.621	0.067092	5.020169
3 times	1.6875	0.685	0.134857	21.11606

4.2.3.2 Association of Dietary Factors with Clinical Remission

The logistic regression analysis identified significant associations between certain dietary factors and clinical remission. Patients who reported never consuming sugary foods had significantly higher odds of clinical remission (OR = 209, 95% CI: 22.34–1955.24, $P < 0.001$). Occasional (OR = 10.45, 95% CI: 2.31–47.30, $P = 0.002$) and weekly consumption (OR = 30.8,

95% CI: 3.13–303.44, $P = 0.003$) were also positively associated with remission, though at reduced odds.

For processed foods, occasional consumption showed no significant association (OR = 0.95, 95% CI: 0.15–5.96, $P = 0.956$), while weekly consumption was similarly nonsignificant (OR = 0.57, 95% CI: 0.09–3.83, $P = 0.564$). Conversely, occasional dairy product consumption showed a significant positive association with remission (OR = 16.33, 95% CI: 2.20–121.42, $P = 0.006$).

Fruits and vegetables frequency demonstrated no significant associations, with the odds ratios for "never" (OR = 0.31, $P = 0.109$), "occasionally" (OR = 3.62, $P = 0.276$), and "weekly" (OR = 0.93, $P = 0.926$) all yielding wide confidence intervals. Similarly, consuming meals 2 or 3 times per day showed no significant impact on clinical remission (OR = 0.58, $P = 0.621$; OR = 1.69, $P = 0.685$, respectively). However, taking supplements was strongly associated with increased odds of clinical remission (OR = 36.05, 95% CI: 10.03–129.55, $P < 0.001$).

These findings suggest that specific dietary habits, particularly the avoidance of sugary foods and the use of supplements, are significantly associated with better clinical outcomes in MS patients.

The relationship between dietary habits and clinical remission in MS aligns with findings from recent studies. For instance, a study by Shoemaker et al. (2020) reported that reduced consumption of sugary foods significantly improved disease outcomes in MS patients, corroborating the strong association observed in this study between the avoidance of sugary foods and higher odds of clinical remission. Similarly, Tabrizi et al. (2021) found that the use of dietary supplements, particularly vitamin D and omega-3 fatty acids, was strongly associated with reduced disease activity and enhanced remission rates.

Research by Bitarafan et al. (2019) supports the finding that occasional dairy consumption may be beneficial. They observed that moderate dairy intake was linked to improved remission

rates, possibly due to the role of probiotics in modulating immune responses. In contrast, a study by Fitzgerald et al. (2020) found limited evidence for significant associations between fruit and vegetable consumption frequency and clinical remission, consistent with the nonsignificant results for these dietary factors in this analysis.

Regarding processed foods, Roy et al. (2021) noted that their regular consumption is associated with increased inflammation and poorer MS outcomes. However, occasional or weekly intake showed no clear association with remission, which aligns with the nonsignificant findings in this study.

Table 4. 11

Dietary and Demographic Factors Influencing Clinical Remission

Variable	OR	CI (95%)
Diet types	0.724	0.400- 1.311
Age (years)	1.000	0.931 - 1.074
Gender	1.079	0.285 - 4.081
Stage of MS	0.099	0.021 - 0.474
Education Level	0.81	0.426 - 1.537
Primary Healthcare Provider	12.24691	0.434 - 2.915
Occupation Levels	0.903	0.575 - 1.417
Disease Progression Makers	0.301	0.106-0.847
Dietary Adherence		
Moderately	0.192	0.183-2.012
Not at all	0.538	0.031-9.280
Slightly	0.057	0.006-0.546
Very Closely	0.442	0.050-3.852

The logistic regression model highlights several factors associated with clinical remission among patients. Dietary patterns were not significantly associated with clinical remission (OR

= 0.724, 95% CI: 0.400–1.311), nor were age (OR = 1.000, 95% CI: 0.931–1.074), gender (OR = 1.079, 95% CI: 0.285–4.081), or education level (OR = 0.81, 95% CI: 0.426–1.537). However, disease progression markers showed a significant negative association (OR = 0.301, 95% CI: 0.106–0.847), suggesting a reduced likelihood of remission with markers of disease progression.

Stage of MS demonstrated a significant impact on remission, with an odds ratio of 0.099 (95% CI: 0.021–0.474), indicating that more advanced stages are associated with lower odds of remission. The primary healthcare provider variable revealed a high odds ratio (OR = 12.25, 95% CI: 0.434–2.915), though it was not statistically significant. Occupation levels did not significantly affect remission (OR = 0.903, 95% CI: 0.575–1.417).

Dietary adherence showed varied associations, with “slightly adhering” to dietary recommendations significantly decreasing the odds of remission (OR = 0.057, 95% CI: 0.006–0.546, $P < 0.05$). Other adherence categories, such as “very closely” (OR = 0.442, 95% CI: 0.050–3.852) and “moderately” (OR = 0.192, 95% CI: 0.183–2.012), were not statistically significant. These findings emphasize the complex interplay between clinical, demographic, and dietary factors in influencing remission outcomes.

The findings of this logistic regression analysis align with broader research on the factors influencing clinical remission in multiple sclerosis (MS). For example, Lublin et al. (2020) confirmed the significant impact of disease progression and MS stage on remission, reporting that advanced disease stages are associated with lower remission odds due to irreversible neurological damage and limited response to treatments.

Regarding dietary adherence, Shoemaker et al. (2020) found that while strict dietary adherence can be beneficial for some patients, inconsistent adherences such as “slightly adhering” to dietary guidelines often fails to yield measurable benefits, mirroring this study’s findings.

Similarly, Lucas et al. (2020) observed that dietary adherence must be complemented by other health-promoting behaviors to effectively influence remission.

Demographic factors such as age, gender, and education were not significantly associated with remission in this study, aligning with research by Marrie et al. (2019), who also found that demographic factors play a minor role in remission compared to clinical markers like disease progression and treatment responses.

Lastly, the nonsignificant effect of occupation levels aligns with findings by Vitkova et al. (2020), who noted that socioeconomic variables, while important for overall health outcomes, do not directly predict remission. Instead, they often influence other mediating factors, such as access to healthcare and lifestyle choices.

4.2.4 Lifestyle Factors that influence MS Symptoms

Table 4. 12

Lifestyle factors that may influence MS symptoms

Variable	Response	n(%) (n=150)
Stress Level	High	7(4.67%)
	Low	104(69.33%)
	Moderate	39(26%)
Sleep Quality	Excellent (8 Hours)	63(42%)
	Good (7 Hours)	69(46%)
	Fair (6 Hours)	8(5.33%)
	Poor (5 Hours)	9(6%)
	Very Poor (3 Hours)	10(6.67%)
Environmental Triggers	Cold weather	31(20.67%)
	Humidity	68(45.33%)
	No	51(34%)
Psychological Factors	No (Not anxious or depressed)	76(50.67%)
	Yes (Anxious or depressed)	74(49.33%)
Physical Activity Frequency	Low Activity (1–2 times per week)	7(4.67%)
	Moderate Activity (3–5 times per week)	28(18.67%)
	High Activity (Daily)	92(61.33%)
	Sedentary/Inactive (Rarely)	23(15.33%)

The study of non-dietary variables associated with symptoms of multiple sclerosis (MS) revealed significant patterns in stress levels, sleep patterns, environmental stressors, psychological variables, and physical activity levels. Most individuals indicated low stress levels 69.33% (104), followed by moderate stress 26% (39) and high stress 4.67% (7). Most

people reported sleeping 7 hours (satisfactory) at 46% (69) or 8 hours (excellent) at 42.0%, with only 5 hours (poor sleep) at 6% (9) and 3 hours (extremely poor sleep) at 0.67% (1). Humidity was the most common environmental trigger, accounting for 45.33% (68), followed by cold temperatures (20.67%) and no reported triggers 34% (51). A roughly equal distribution was found in psychological tests, with 50.67% (76) of subjects expressing no anxiety or depression and 49.33% (74) reporting these conditions. The frequency of physical activity showed that 61.33% of people engaged in high-frequency activity (daily or nearly daily), whereas 18.67% (28) participated at a moderate frequency (three to five times per week), and 15.33% (23) engaged in low-frequency activity (one to two times per week). The possible influence of non-dietary variables on the course of MS disease and symptom treatment is clarified by these studies.

The findings of this study underscore the pivotal role of non-dietary factors, such as stress levels, sleep quality, environmental triggers, psychological conditions, and physical activity, in the progression and management of Multiple Sclerosis (MS). Notably, 69.33% of participants reported low stress levels, which were associated with improved disease outcomes. This observation aligns with Artemiadis et al. (2021), who demonstrated that chronic stress is a significant trigger for MS relapses, while resilience and psychological well-being, particularly environmental mastery and self-acceptance, mitigate the adverse effects of stress on disease progression (Novak & Lev-Ari, 2023). These findings emphasize the critical importance of stress-reduction interventions in comprehensive MS care.

Sleep quality emerged as another critical factor, with 88% of participants reporting satisfactory or excellent sleep, a variable closely linked to reduced fatigue and enhanced quality of life in MS patients. This is consistent with Briones-Buixassa et al. (2021), who highlighted that poor sleep exacerbates cognitive and physical symptoms in MS. Addressing sleep-related

challenges, such as sleep hygiene and disorders, may therefore represent a valuable therapeutic strategy.

Environmental factors were also identified as significant triggers, with humidity (45.33%) and cold temperatures (20.67%) being most reported. These findings are in line with Parrón et al. (2021), who documented the impact of climatic and environmental stressors on neuroinflammatory processes in MS, suggesting the need for targeted interventions to mitigate these effects. Moreover, the role of psychological conditions was prominent, with 49.33% of participants reporting anxiety or depression. This supports the work of Chwastiak and Ehde (2022), who noted that MS patients are at heightened risk for psychiatric comorbidities, which adversely affect disease management and progression.

Regular physical activity, reported by 61.33% of participants, was strongly associated with improved MS outcomes. This finding corroborates Learmonth and Motl (2023), who demonstrated that exercise not only reduces fatigue but also enhances neurological function and slows disability progression in MS patients. These observations collectively highlight the multifaceted nature of non-dietary factors in MS management and the critical importance of adopting a holistic approach to therapeutic strategies.

Table 4. 13*Chi-squares non-dietary variables and clinical remission in MS patients*

Reason	Chi-Square (X) (P<0.005)
Physical Activity Frequency and Clinical Remission	105.8679 (0.00)
Sleep Quality and Clinical Remission	18.8546 (0.001)
Stress Level and Clinical Remission	2.1742 (0.337)
Environmental Triggers and Clinical Remission	15.0384 (0.001)
Psychological Factors and Clinical Remission	19.6911 (0.00)

In table 4.12 Numerous non-dietary variables and clinical remission in MS patients were found to be significantly correlated by the statistical analysis. The frequency of physical activity shown a robust and statistically significant correlation with clinical remission ($\chi^2 = 105.8679$, $P < 0.001$), highlighting the possible contribution of consistent activity to symptom relief. Better sleep may help maintain illness stability, as seen by the substantial correlation between clinical remission and sleep quality ($\chi^2 = 18.8546$, $P = 0.001$). Environmental factors that may have an impact on disease activity, such as humidity and cold temperatures, were substantially linked to clinical remission ($\chi^2 = 15.0384$, $P < 0.001$). Remission outcomes were also significantly impacted by psychological characteristics, such as depression and anxiety ($\chi^2 = 19.6911$, $P < 0.001$). Nevertheless, there was no significant correlation between stress levels and clinical remission ($\chi^2 = 2.1742$, $P = 0.337$). These results highlight how crucial non-dietary factors are to controlling MS symptoms and reaching clinical remission.

Non-dietary factors play a substantial influence in managing multiple sclerosis, according to studies. Church et al.(2019) Studies have demonstrated that consistent physical activity enhances MS patients' physical function and general quality of life, highlighting exercise as a crucial non-pharmacological intervention. Similarly, Rzepka et al. (2024) emphasized the significance of adequate sleep, demonstrating how it is related with decreased fatigue and

improved quality of life, and emphasizing the need for MS patients to manage their sleep. Environmental factors also play a critical role, they revealed that temperatures and humidity have a major impact on the severity and progression of MS symptoms (Alfredsson & Olsson, 2019). Psychological well-being is yet another important component. with Beier et al. (2021) reporting strong associations between anxiety, depression, and worse MS outcomes, aligning with findings that highlight the impact of mental health on disease management.

While stress did not show a direct correlation with clinical remission in this study, Ayache et al. (2019) found that stress contributes to symptom exacerbation, suggesting that its effects may vary depending on specific disease phases. Together, these studies reinforce the importance of addressing lifestyle, environmental, and psychological factors in comprehensive MS care.

Table 4. 14*Stress Levels in Relation to Dietary Adherence*

Dietary Adherence	Stress Level			
	High	Low	Moderate	Total
Closely	2 (7.41%)	18(66.67%)	7(25.93%)	27(100%)
Moderately	0	18(100%)	0	18(100%)
Not at all	1(6.67%)	12(80%)	2(13.33%)	15(100%)
Slightly	1(6.67%)	13(86.67%)	1(6.67%)	15(100%)
Very closely	3(4%)	43(57.33%)	29(38.67%)	75(100)
Total	7(4.67%)	104(69.33%)	39(26%)	150(100%)

Pearson $\chi^2(8) = 18.9166$ Pr = 0.015

Notable findings were seen among the study participants when dietary adherence and stress levels were analyzed. 7.41% (2), 66.67% (18), and 25.93% (7) of individuals who strictly followed dietary guidelines reported high, low, and moderate levels of stress, respectively. Only those who followed dietary guidelines to a considerable degree reported feeling less stressed (18). Among individuals who did not follow dietary guidelines, 6.67% (1) reported high levels of stress, 80% (12) reported low levels, and 13.33% (2) reported moderate levels of stress. Likewise, 6.67% (1) high stress, 86.67% (13) mild stress, and 6.67% (1) moderate stress were reported by participants who followed dietary recommendations to a modest degree. Of those who followed dietary guidelines to the letter, 4% (3) reported severe stress, 57.33% (43) reported low stress, and 38.67% (29) reported moderate stress.

Overall, 4.67% (7) of participants reported high stress, 69.33% (104) reported low stress, and 26% (39) reported moderate stress across all dietary adherence categories. These findings point to a possible interaction between MS patients' perceived stress levels and dietary adherence.

The study highlights the complex interaction between stress levels and dietary adherence in managing chronic conditions like MS. A study by Oddo et al. (2022) indicated that following a Mediterranean-style diet considerably decreased MS patients' subjective stress levels,

corroborating the notion that dietary decisions affect mental health. . Similarly, Yu et al.(2023b) reported that individuals following anti-inflammatory diets experienced lower stress and fatigue, aligning with findings that dietary adherence may mitigate stress levels in MS. However, not all studies agree entirely. While Kelly et al. (2021) observed improved stress resilience in individuals adhering to dietary guidelines, they noted that stress reduction varied by diet type and individual factors. Moreover, Langer-Gould et al. (2020) emphasized that while dietary adherence positively impacts general health and fatigue, its effect on stress alone may be less pronounced, suggesting multifactorial influences on stress management. Interestingly, a study by Roy et al. (2021) found that non-adherence to dietary guidelines was associated with greater variability in stress responses, particularly in individuals with MS. This supports the notion that dietary consistency plays a role in regulating stress but may depend on the degree of adherence and broader lifestyle factors.

Table 4. 15

Physical Activity in Relation to Diet types

Physical Activity		Dietary		Pattern	
Frequency	Gluten-Fr	Low-Carb	Mediterranean	Vegetarian	Total
High Activity (Daily)	9(81.82%)	24(58.54%)	36(61.02%)	23(58.97%)	92(61.33%)
Moderate Activity (3-5 times per week)	1(9.09%)	11(26.83%)	6(10.17%)	10(25.64%)	28(18.67%)
Low Activity (1-2 times per week)	0	4(9.76%)	2(3.39%)	1(2.56%)	7(4.467%)
Sedentary/Inactive (Rarely)	1(9.09%)	2(4.88%)	15(25.42%)	5(12.82%)	23(15.33%)
Total	11(100%)	41(100%)	59(100%)	39(100%)	150(100%)

Pearson chi2(9) = 16.7888 Pr = 0.052

Significant trends were seen when the study participants' eating habits and frequency of physical exercise were analyzed. The distribution of dietary patterns among individuals who exercised 1-2 times a week was 0% (0) Gluten-Free, 9.76% (4) Low-Carb, 3.39% (2) Mediterranean, and 2.56% (1) Vegetarian, for a total of 4.67% (7).

The following distribution of dietary patterns was seen in participants who exercised three to five times a week: 9.09% (1) gluten-free, 26.83% (11) low-carb, 10.17% (6) Mediterranean, and 25.64% (10) vegetarian, which account for 18.67% (28) of the total. The most common daily activity among participants was 81.82% (9) gluten-free, 58.54% (24) low-carb, 61.02% (36) Mediterranean, and 58.97% (23) vegetarian, which accounted for 61.33% (92) of the total.

A total of 15.33% (23) of the participants who did not frequently exercise were 9.09% (1) Gluten-Free, 4.88% (2) Low-Carb, 25.42% (15) Mediterranean, and 12.82% (5) Vegetarian. Each group's overall distribution of dietary patterns across all physical activity categories was 100%: 27.33% (41) Low-Carb, 39.33% (59) Mediterranean, 26.00% (39) Vegetarian, and 7.33% (11) Gluten-Free. These results demonstrate how dietary preferences and physical activity levels among MS patients are significantly correlated.

Recent studies have explored the relationship between dietary patterns and physical activity levels in managing multiple sclerosis (MS). A study by Marck et al. (2014) found that higher levels of physical activity were associated with lower disability and improved quality of life in people with MS.

Similarly, research by Due et al.(2024) demonstrated that regular physical activity improves both physical abilities and overall quality of life for MS patients.

Regarding dietary patterns, a study by Fitzgerald et al. (2018) reported that adherence to a Mediterranean diet was associated with reduced disability and symptom severity in MS patients. This suggests that certain dietary choices may influence disease progression and symptom management.

Additionally, a study by Fanara et al.(2021) highlighted the combined benefits of diet and exercise, showing that higher physical activity levels amplified the positive effects of healthy dietary patterns on symptom management in MS patients. This gives the importance of integrating both lifestyle factors in MS management strategies.

These studies collectively suggest that dietary preferences and physical activity levels are significantly correlated among MS patients, and that integrating both factors may lead to better health outcomes.

Table 4. 16
Sleep Quality in Relation to Dietary Adherence

Dietary Adherence	Sleep Quality						Total
	Excellent (8 Hours)	Fair (6 Hours)	Good (7 Hours)	Poor (5 Hours)	Very Poor (3 Hours)		
Closely	12 (19.05%)	1 (12.5%)	13 (18.84%)	1(11.11%)	0		27(18%)
Moderately	7 (11.11%)	1(12.5%)	7(10.14%)	3(33.33%)	0		18(12%)
Not at all	7(11.11%)	2(25%)	5(7.25%)	1(11.11%)	0		15(10%)
Slightly	5(7.94%)	1(12.5%)	6(8.7%)	2(22.22%)	1(100%)		15(10%)
Very closely	32(50.79%)	3(37.5%)	38(55.07%)	2(22.22%)	0		75(50%)
Total	63 (100%)	8(100%)	69(100%)	9(100%)	1(100%)		150(100%)

The distribution of dietary adherence across different levels of sleep quality highlights varied patterns. Participants with excellent sleep quality showed the following adherence levels: 19.05% (12) closely, 11.11% (7) moderately, 11.11% (7) not at all, 7.94% (5) slightly, and 50.79% (32) very closely, contributing to a total of 42% (63).

Among participants with fair sleep quality, the adherence distribution was 12.5% (1) closely, 12.5% (1) moderately, 25% (2) not at all, 12.5% (1) slightly, and 37.5% (3) very closely, making up 5.33% (8) of the total. Participants with good sleep quality demonstrated 18.84% (13) closely, 10.14% (7) moderately, 7.25% (5) not at all, 8.7% (6) slightly, and 55.07% (38) very closely, accounting for 46% (69) overall.

For poor sleep quality, adherence levels were 11.11% (1) closely, 33.33% (3) moderately, 11.11% (1) not at all, 22.22% (2) slightly, and 22.22% (2) very closely, comprising 6% (9).

Participants with very poor sleep quality represented a small proportion, with 0% (0) closely,

0% (0) moderately, 0% (0) not at all, 100% (1) slightly, and 0% (0) very closely, contributing to 0.67% (1).

Across all sleep quality categories, the total adherence distribution was 18% (27) closely, 12% (18) moderately, 10% (15) not at all, 10% (15) slightly, and 50% (75) very closely. These findings underscore a notable relationship between sleep quality and dietary adherence among MS patients.

The connection between sleep quality and dietary adherence among MS patients is supported by emerging research. For instance, a study by Godos et al. (2019) revealed that individuals with better sleep quality were more likely to adhere to healthier dietary patterns, such as the Mediterranean diet, which has been linked to improved neurological outcomes. This aligns with the higher adherence rates observed in participants with excellent and good sleep quality in this study.

Similarly, Vitkova et al. (2020) highlighted the interplay between sleep quality and health-related behaviors, noting that poor sleep often correlates with lower adherence to health-promoting activities, including diet. This mirrors the findings where poor sleep quality was associated with less dietary adherence. Theorell et al. (2020) further emphasized that integrating sleep optimization with dietary interventions can improve MS management by reducing fatigue and enhancing overall well-being.

However, research by Alnawwar et al. (2023) noted that while better sleep quality promotes dietary adherence, it may also reflect broader lifestyle improvements, such as increased physical activity and stress management, indicating a multidimensional relationship. Additionally, a study by Lucas et al. (2020) found that sleep disturbances can disrupt hormonal regulation, leading to reduced motivation for consistent dietary adherence, particularly in those with very poor sleep quality.

Table 4. 17
Variance Inflation Factor

Variable	VIF	1/VIF (Tolerance)
Supplements Taken	1.31	0.766054
Processed Foods Frequency	1.22	0.821194
Primary Healthcare Provider	1.22	0.821268
Dairy Products Frequency	1.21	0.827896
Sugary Foods Frequency	1.2	0.831846
Stage of Multiple Sclerosis (MS)	1.17	0.854649
Dietary Pattern	1.13	0.886856
Whole Grains Frequency	1.13	0.887401
Meals per Day	1.09	0.917463
Fruits and Vegetables Frequency	1.08	0.924073
Education Level	1.07	0.934292
Mean VIF	1.17	

The Variance Inflation Factor (VIF) test results indicate that multicollinearity is not a concern, with VIF values ranging from 1.07 to 1.31 and a mean VIF of 1.17. All predictors have tolerance values (1/VIF) above 0.76, suggesting minimal correlation among variables. These results confirm that the predictors are independently contributing to the model, and no variables need to be excluded due to multicollinearity

Table 4. 18
Model Fitting

Variable	Coefficient	Std. Err.	T	P>t	95% CI	95% CI
					Lower	Upper
Education Level	-0.004768	0.01868	-0.26	0.799	-0.0417	0.032168
Stage of MS	-0.172387	0.041788	-4.13	0	-0.25501	-0.08976
Primary Healthcare Provider	0.214356	0.060139	3.56	0.001	0.095442	0.33327
Dietary Pattern	-0.01794	0.020497	-0.88	0.383	-0.05847	0.02259
Meals per Day	0.035513	0.020108	1.77	0.08	-0.00425	0.075273
Supplements Taken	0.327232	0.053843	6.08	0	0.220768	0.433696
Fruits and Vegetables Frequency	-0.003523	0.015727	-0.22	0.823	-0.03462	0.027574
Whole Grains Frequency	0.025817	0.016712	1.54	0.125	-0.00723	0.058862
Dairy Products Frequency	0.08428	0.029765	2.83	0.005	0.025426	0.143135
Processed Foods Frequency	-0.051518	0.025698	-2	0.047	-0.10233	-0.00071
Sugary Foods Frequency	0.027536	0.024472	1.13	0.262	-0.02085	0.075925
Constant	0.042002	0.240833	0.17	0.862	-0.4342	0.518201

Number of Observations: 150

F(11, 138): 18.06

Prob > F: 0.0000

R-squared: 0.5901

Adj. R-squared: 0.5574

Root MSE: 0.21159

The results of the regression analysis provide insights into the predictors of clinical remission. The model, with an R^2 value of 0.5901 and an adjusted R^2 of 0.5574, explains approximately 59% of the variance in clinical remission, with an overall significance of $F(11,138, p<0.001)$. Among the predictors, **Stage of MS** ($\beta=-0.172, p<0.001$) significantly negatively impacts clinical remission, indicating that progressive stages of MS reduce the likelihood of remission. Similarly, **Processed Foods Frequency** ($\beta=-0.052, p=0.047$) is negatively associated with remission. Conversely, **Supplements Taken** ($\beta=0.327, p<0.001$) and **Dairy Products Frequency** ($\beta=0.084, p=0.005$) show significant positive associations, suggesting their potential benefits in achieving remission. Other dietary and demographic factors, including **Meals per Day** ($p=0.08$) and **Whole Grains Frequency** ($p=0.125$), approach significance but do not exhibit strong predictive value within the model. Overall, the results underscore the importance of specific dietary and healthcare factors in influencing clinical outcomes.

4.3.1 Qualitative Findings

The findings were drafted through a structured thematic analysis process using Braun and Clarke's six-step framework. Initially, qualitative responses were transcribed, reviewed, and coded to identify emerging patterns related to stress, physical activity, diet, and compliance. These codes were then grouped into broader themes, refined, and supported with direct participant quotes to ensure coherence and contextual relevance.

The final report presented the thematic findings in a narrative format, highlighting key sub-themes and their interplay. Data analysis included frequency assessments, response variations, and comparisons with existing literature for validation. The results were organized systematically, ensuring clarity and relevance to MS symptom management, dietary adherence, and holistic lifestyle approaches.

4.3.1.1 Thematic Findings

Theme 1: Stress as a Catalyst for MS Symptom Fluctuations

Stress emerged as a significant factor in the progression and severity of MS symptoms. Participants reported experiencing heightened symptoms during stressful periods, often leading to increased fatigue, pain, and cognitive difficulties. Many linked their stress levels to dietary habits, noting a tendency to make poor dietary choices during high-stress periods, which further exacerbated symptoms.

Sub-themes:

- Increased symptom severity during high-stress periods.
- Emotional eating and poor dietary choices as a response to stress.
- Coping strategies such as mindfulness and relaxation techniques.

Supporting Quote: *"Whenever I go through stressful periods, I notice my MS symptoms flare up significantly. I often turn to comfort foods, which sometimes makes it worse."*

Theme 2: Physical Activity as a Moderator of MS Symptoms

Participants described a strong connection between their level of physical activity and the severity of their MS symptoms. Regular, moderate exercise was associated with improved mobility, reduced fatigue, and better overall well-being. However, some noted that excessive or high-intensity activity led to worsened symptoms, indicating the need for individualized exercise routines.

Sub-themes:

- Positive impact of moderate exercise on symptom management.
- Barriers to maintaining regular physical activity, including fatigue and accessibility.
- The importance of individualized exercise plans.

Supporting Quote: *“Light exercises, like yoga, help me feel less fatigued, but when I overdo it, my symptoms seem to worsen.”*

Theme 3: Dietary Patterns and Stress Management

Participants highlighted the role of diet in managing both stress and MS symptoms. Many reported that nutrient-dense foods helped alleviate stress and improve their overall condition, while processed or inflammatory foods tended to worsen symptoms. Hydration and micronutrient intake were also emphasized as crucial factors in symptom control.

Sub-themes:

- Influence of dietary patterns on stress levels and symptom severity.
- Specific foods associated with symptom relief or exacerbation.
- Importance of hydration and micronutrients in MS management.

Supporting Quote: *“Cutting out processed foods and eating more fresh produce has helped me manage my stress levels and MS symptoms.”*

Theme 4: Interplay Between Non-Dietary Factors and Dietary Habits

Non-dietary factors such as sleep quality, emotional well-being, and environmental stressors played a significant role in shaping dietary habits and MS symptoms. Participants reported that poor sleep and heightened emotional distress often led to unhealthy eating behaviors, while maintaining balanced routines in all areas contributed to better symptom management.

Sub-themes:

- Role of sleep and emotional well-being in MS symptom progression.
- How diet complements other lifestyle interventions.
- Participants’ holistic management approaches.

Supporting Quote: *“Good sleep, balanced meals, and mindfulness practices all work together in keeping my symptoms manageable.”*

Theme 5: Barriers and Enablers of Dietary Compliance

Adherence to dietary recommendations varied among participants due to internal and external factors. Personal motivation, belief in the effectiveness of dietary changes, and discipline played a role in compliance, while external factors such as family support, accessibility of recommended foods, and healthcare guidance influenced adherence.

Sub-themes:

- Internal factors: motivation, personal health beliefs, and discipline.
- External factors: family support, accessibility of recommended foods, and healthcare guidance.

- Influence of compliance on symptom progression and remission.

Supporting Quote: *“It’s easier to stick to the diet when my family supports me, but when I’m alone, I sometimes slip back into old habits.”*

Theme 6: Perceived Impact of Dietary Compliance on Clinical Remission

Many participants observed a correlation between dietary compliance and symptom remission. Those who adhered strictly to dietary guidelines reported fewer flare-ups and improved energy levels. However, challenges in maintaining long-term compliance were noted, particularly in social settings or when faced with financial constraints.

Sub-themes:

- Observed improvements in symptom severity and remission rates.
- Challenges in maintaining long-term compliance.
- Integration of dietary and non-dietary interventions for maximum benefit.

Supporting Quote: *“Since I started following my dietary plan strictly, I’ve had fewer relapses and generally feel more energetic.”*

Regarding how dietary and non-nutritional factors interact to control MS symptoms, the thematic analysis produced several important conclusions. One of the main causes of worsening MS symptoms, such as fatigue, muscle spasms, and diminished focus, has been repeatedly found to be stress. Participants brought attention to the ways that stress frequently affected eating patterns, resulting in either emotional eating or appetite suppression. *“Stress usually gives me more fatigue, muscle spasms, and nerve tingles, and it affects how I eat,”* someone said, for example.

With activities like yoga, swimming, and physiotherapy enhancing strength, mood, and general functionality, physical activity has emerged as a critical stabilizing component. As one participant put it, *"I feel stronger, have a better mood, and can carry out my tasks easily when I do yoga or swimming."* Regular exercise is crucial for managing multiple sclerosis (MS), as participants reported that it reduced symptoms like emotional instability, exhaustion, and muscle weakness.

The significance of emotional health and sleep quality in influencing eating decisions was also emphasized by the investigation. While inadequate sleep increased weariness, irritation, and unhealthy eating habits, adequate sleep was linked to decreased emotional eating and improved decision-making. According to one respondent, *"Better sleep improves my mental clarity and reduces fatigue, which helps me make healthier dietary decisions"*.

Clinical remission, fewer relapses, and increased energy levels were all significantly correlated with following dietary recommendations, especially those that promote anti-inflammatory diets like the Mediterranean diet. Individuals who regularly adhered to dietary recommendations reported feeling better overall and experiencing fewer symptoms. Nevertheless, issues like price and accessibility were mentioned; one participant said, *"Cost and accessibility sometimes make eating healthy pricey, but I do my best"*.

Participants cited their families and communities as motivators, indicating that support networks were crucial in facilitating compliance. One of the participants said, *"My sisters keep me on track, making it easier to eat healthily"*. These results highlight the necessity of managing MS holistically, incorporating dietary adherence, physical activity, stress reduction, restful sleep, and robust support networks.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter gives detailed information on the summary, conclusion and recommendations based on this study.

5.2 Summary

This study evaluates how dietary factors affect MS patients in Nairobi County's ability to achieve clinical remission. The groundwork is laid in Chapter 1, which describes MS as a progressive autoimmune disease that has a major impact on quality of life. In order to reduce MS symptoms and enhance clinical results, the chapter highlights the need of comprehending food patterns and practices. Identifying nutritional risk factors, evaluating dietary practices in connection to clinical remission rates, and investigating non-nutritional triggers such as stress and physical exercise are among the goals.

A detailed literature analysis is provided in the second chapter, which also highlights theoretical frameworks for understanding patients' food choices, such as the Social Cognitive Theory and the Health Belief Model. Empirical evidence demonstrates the relevance of anti-inflammatory diets in controlling the progression of MS and supports the association between dietary patterns, such as Mediterranean diets, and a decrease in MS symptoms. The review also explores the combined effects of non-nutritional stressors such stress and smoking, socioeconomic status, and vitamin D levels on MS outcomes.

The research methodology, which combines qualitative and quantitative data collecting in a mixed-methods approach, is explained in Chapter three. Because of the manageable population size, a census sample approach is used to choose the target group, which consists of MS patients in Nairobi County. To find connections between dietary characteristics and clinical outcomes, tools such as food frequency questionnaires, in-depth interviews, and focus groups are used. These are then analyzed using statistical techniques like regression and theme analysis.

The findings are discussed in the fourth chapter, which also presents dietary patterns and how they relate to clinical remission. For instance, better results were linked to following Mediterranean diets and avoiding processed foods. Significant correlations between remission and variables such as supplement use ($P < 0.001$) and dairy product consumption ($P < 0.005$) were found by quantitative analysis. The crucial role these dietary components play in affecting disease activity and symptom management was validated by chi-square testing.

The study's ramifications are finally covered, with a focus on the significance of dietary therapies customized to Nairobi's particular food practices and medical issues. Increasing knowledge of dietary and non-nutritional risk factors and advocating for anti-inflammatory diets are among the recommendations. The results are intended to improve the quality of life for individuals with MS and contribute to evidence-based dietary recommendations for MS care in Kenya.

5.3 Conclusions

This study assessed the influence of nutritional and lifestyle risk factors on achieving clinical remission among Multiple Sclerosis (MS) patients in Nairobi County, Kenya. The conclusions are drawn in relation to each of the study's specific objectives and supported by both quantitative and qualitative evidence.

5.3.1 To examine dietary risk factors among patients with Multiple Sclerosis (MS)

The study identified varied dietary patterns among MS patients, with the Mediterranean diet being the most prevalent. While a significant proportion adhered to healthy eating habits such as high consumption of whole grains and low intake of processed and sugary foods other risk factors like inconsistent fruit and vegetable intake and low dairy product consumption were noted. Logistic regression analysis revealed that avoiding sugary foods and moderate dairy intake were strongly associated with higher odds of clinical remission, confirming the relevance of specific dietary components as modifiable risk factors in MS management

5.3.2 To analyze compliance with dietary recommendations in relation to the rate of clinical remission among MS patients

A significant association was found between dietary compliance and clinical remission ($\chi^2 = 15.495$, $p = 0.004$), where 92% of participants who adhered very closely to dietary recommendations experienced remission. However, interestingly, even among those with no compliance, 93.3% achieved remission, suggesting the influence of other factors such as medication adherence, type of MS, or individual variability. These findings reinforce the potential benefits of dietary adherence while also highlighting the multifactorial nature of MS remission.

5.3.3 To analyze the rates of clinical remission among MS patients in relation to their dietary habits and nutrient intake

Clinical remission was significantly associated with several dietary habits including supplement use ($OR = 36.05$, $p < 0.001$), meal frequency, and the consumption of anti-inflammatory foods like whole grains and vegetables. Patients on gluten-free, vegetarian, or low-carb diets demonstrated higher remission rates compared to those on a Mediterranean diet, which had the lowest remission rate despite being the most commonly followed. This suggests that personalized dietary approaches may be more effective than general dietary models in influencing remission outcomes.

5.3.4 To investigate lifestyle factors that may influence MS symptoms, such as stress or physical activity, and their interplay with dietary influences

Non-dietary factors such as physical activity ($\chi^2 = 105.87$, $p < 0.001$), sleep quality ($\chi^2 = 18.85$, $p = 0.001$), and psychological well-being ($\chi^2 = 19.69$, $p < 0.001$) were significantly associated with clinical remission. High levels of physical activity and good sleep hygiene were particularly strong predictors of better outcomes. Qualitative findings further emphasized that

these factors often interact with dietary adherence, where better emotional regulation, restful sleep, and community support facilitated healthier dietary behaviors and contributed to improved symptom control and remission.

5.4 Recommendations in relation to dietary risk factors

Integrate community-based nutrition education using local diets, not just Mediterranean patterns. Health care providers should design community-based nutrition education initiatives that promote locally available, nutrient-dense foods such as legumes, fish, vegetables, fruits, and whole grains while discouraging excessive intake of processed foods and refined sugars. Evidence from global and regional studies shows that diverse, anti-inflammatory dietary patterns, including Mediterranean, DASH, and plant-based diets, reduce oxidative stress and support neurological recovery among MS patients. Local adaptation of these principles will make the interventions culturally relevant and affordable.

Strengthen access to affordable nutritional supplements through health policy frameworks. Policies should ensure equitable access and subsidization of essential micronutrient supplements (e.g., vitamin D, omega-3 fatty acids) for MS patients, particularly those enrolled in remission or rehabilitation programs. Studies (Farez & Correale, 2021 ; Mirmosayyeb et al., 2023) demonstrate that consistent supplement use improves immune regulation and reduces relapse frequency. Collaboration between county health departments, pharmacies, and nutrition programs can enhance availability without overburdening patients financially.

Institutionalize dietary assessment and personalized counseling in MS care. Healthcare facilities should incorporate routine dietary assessments and tailored nutrition counseling into standard MS management plans. Using structured dietary recall tools during clinic visits can help track patients' adherence to recommended dietary patterns. Evidence from this study and other MS cohorts shows that adherence to high-quality diets is linked to fewer relapses, lower

EDSS scores, and improved quality of life. Training health professionals in basic nutritional assessment will ensure that counseling is practical, individualized, and behaviorally grounded. Integrate stress management and mental health support into MS care pathways. Since stress, anxiety, and fatigue are known to worsen MS symptoms and interact with dietary behaviors, healthcare providers should combine stress management techniques such as mindfulness training, guided physical activity, or psychosocial support groups with dietary and lifestyle interventions. Educating clinicians and nurses on integrated care approaches can enhance the overall effectiveness of patient management. Evidence suggests that programs combining nutrition, physical activity, and psychological resilience lead to better remission outcomes and treatment adherence.

5.4.1 To the Healthcare Team:

The study's findings underscore the importance of integrating community-based nutritional education into MS care. Given the observed positive impact of Mediterranean diets and reduced processed food intake on clinical remission, such educational initiatives at the community level could enhance patient outcomes. The results also highlight the value of embedding routine dietary assessments and personalized counseling within MS management plans, as adherence to specific dietary patterns was closely tied to improved disease activity indicators, such as lower relapse rates.

5.4.2 To Policy Makers:

The strong correlation between supplement use and favourable clinical outcomes supports the need for health policy frameworks that improve access to affordable nutritional supplements for MS patients, especially those enrolled in remission support programs. This points to the importance of creating an enabling environment that facilitates dietary adherence and supports the nutritional needs of patients through structured policy interventions.

5.4.3 Recommendations in relation to dietary adherence

Health authorities should prioritize integrating dietary counselling into standard care for MS patients, focusing on promoting adherence to beneficial diets such as the Mediterranean diet while minimizing processed and sugary food consumption. This should be accompanied by structured educational programs to enhance patient understanding and compliance. Additionally, healthcare providers should collaborate to offer personalized dietary guidance, supported by targeted training to equip practitioners with the knowledge to counsel patients effectively.

Governments and stakeholders should consider implementing policies that subsidize essential dietary supplements shown to support clinical remission in MS patients. Improving the affordability and accessibility of these supplements can significantly enhance patient adherence and outcomes. Community health programs should also incorporate strategies to manage stress and environmental triggers alongside dietary interventions, recognizing the interplay between these factors and clinical remission.

5.5 Recommendations in relation to rates of clinical remission

Future research should investigate the long-term impacts of specific dietary patterns on MS progression and remission rates through longitudinal studies. These studies could provide a deeper understanding of sustained dietary adherence and its effects over time. Additionally, exploring the interaction between psychological factors, such as stress and anxiety, and dietary patterns is necessary to inform more holistic approaches to MS care.

Further studies should focus on the efficacy of various nutritional supplements in supporting remission among MS patients. Comparative research could identify the most effective supplements across different patient demographics. Lastly, the influence of socioeconomic factors on dietary adherence should be examined, with an emphasis on addressing financial and accessibility barriers to healthy diets. This research could inform the development of targeted interventions for vulnerable patient groups.

5.6 Recommendations in relation to lifestyle factors

Given the complex relationship between stress, environmental triggers, and dietary behavior in influencing MS symptoms, the study reinforces the value of a more holistic treatment approach. Integrating stress management strategies alongside dietary guidance in patient care plans may strengthen the overall effectiveness of interventions. This aligns with the broader need to equip healthcare professionals with skills in delivering integrated care models that address both physical and psychosocial dimensions of MS

5.7 Suggestions for Further Research

Building on these findings, the following areas are recommended for future investigation:

- a) Longitudinal or interventional studies. Future research should employ longitudinal or randomized controlled designs to evaluate the long-term effects of specific dietary interventions (e.g., anti-inflammatory or plant-based diets) on remission, relapse rates, and disease progression among MS patients.
- b) Integration of biochemical and clinical data. Studies incorporating objective biomarkers (e.g., vitamin D levels, lipid profiles, inflammatory cytokines) would strengthen the understanding of physiological pathways linking diet, lifestyle, and remission.
- c) Expanded geographic and demographic scope. Multi-county or national-level studies would help determine whether the observed associations are consistent across different cultural, socioeconomic, and environmental contexts in Kenya.
- d) Behavioral and psychological dimensions. Further qualitative work should explore how psychological resilience, health beliefs, and stress coping strategies mediate the relationship between lifestyle factors and remission outcomes.
- e) Health system and policy-oriented research. Future studies could evaluate the effectiveness of integrating nutrition counselling, stress management, and lifestyle modification into MS care programs within Kenya's public health system, assessing cost-effectiveness and patient adherence.

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APPENDICES

appendix i : Informed consent Form

Title of the study

“Investigating the Influence of Nutritional and Non-Nutritional risk factors on achieving Clinical Remission in Multiple Sclerosis Patients: A case of Nairobi County”

Principal Investigator

Cynthia Gikunga a student at Kenya Methodist University- Nairobi Campus, per-taking Master of Science in Human Nutrition.

Purpose

To the Influence of Nutritional and Non-Nutritional risk factors on achieving Clinical Remission in Multiple Sclerosis Patients: A case of Nairobi County.

Procedure

If I accept & give consent to participate in this study, then; I will have to answer all questions concerning both my medical and food/diet history. I accept to undergo thorough physical examination to measure Weight- Height/ Length and BMI if necessary.

Confidentiality

- All information gathered in the course of your participation in this study will be kept confidential and will be only used for your own treatment and for research purpose.
- You will not be paid or there won't be any monetary value for your participation.
- No names will be used to identify you and will only be accorded with random numbers for identification.
- Your participation in this study is voluntary.
- You are free to refuse to answer my questions or withdraw from participation at any time which will not jeopardize your medical care.

Consent

I After careful listening to the explanation,
from Ms. Cynthia Wambui Gikunga, I do understand the contents and the purpose of the study.

I hereby give consent to participate in this study.

.....		
Signature/Thumb print	Name of the Participant	Date
.....		
Signature/Thumb print	Principal investigator	Date

Thanks for your participation in my study.

appendix ii: Questionnaire

Introduction:

Hi, my name is Cynthia and I am a part of a study team that is conducting research on the “influence of nutritional and non-nutritional factors on achieving clinical remission among Multiple Sclerosis patients in Nairobi County” The study includes a discussion and an interview which will take about 30 minutes. I would like to get information on areas pertaining to this topic. You are not obliged to participate in the study and no services will be withheld if you decide not to. If you agree to share your views with me, you will not receive any remuneration, gifts or services. Everything we discuss will be held in strict confidence and will not be shared with anyone else.

Data Collection Tool: Impact of Dietary Factors on Clinical Remission Among MS Patients

Section 1: Demographics

1. **Age** (in years): _____
2. **Gender:**
 - ☐ Male
 - ☐ Female
 - ☐ Other
3. **Occupation:**
 - ☐ Employed (Full-time)
 - ☐ Employed (Part-time)
 - ☐ Self-employed
 - ☐ Unemployed
 - ☐ Retired
 - ☐ Student
 - ☐ Other (Specify): _____
4. **Level of Education:**
 - ☐ Primary

- ☐ Secondary
- ☐ Tertiary (College/University)
- ☐ Post-graduate
- ☐ No formal education

5. **Duration Since MS Diagnosis** (in years): _____

6. **Stage of MS:**

- ☐ Relapsing-Remitting MS (RRMS)
- ☐ Secondary Progressive MS (SPMS)
- ☐ Primary Progressive MS (PPMS)

7. **Primary Healthcare Provider** (e.g., specialist, general practitioner, neurologist):

Section 2: Dietary Patterns and Habits

(Objective 1.4.1a: Examining dietary patterns and specific nutritional risk factors that may influence MS symptoms)

1. **Number of Meals Per Day:**

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ More than 3

2. **Diet Type Followed:**

- ☐ None
- ☐ Vegetarian
- ☐ Vegan
- ☐ Low-Carb/Ketogenic
- ☐ Mediterranean
- ☐ Gluten-Free
- ☐ Other (Specify): _____

3. **Frequency of Food Group Consumption** (Indicate how often you consume each group):

○ **Fruits and Vegetables**

- ☐ Daily
- ☐ Weekly
- ☐ Occasionally
- ☐ Never

○ **Whole Grains**

- ☐ Daily
- ☐ Weekly
- ☐ Occasionally
- ☐ Never

○ **Dairy Products**

- ☐ Daily
- ☐ Weekly
- ☐ Occasionally
- ☐ Never

○ **Processed/Refined Foods**

- ☐ Daily
- ☐ Weekly
- ☐ Occasionally
- ☐ Never

○ **Sugary Foods and Beverages**

- ☐ Daily
- ☐ Weekly
- ☐ Occasionally
- ☐ Never

4. Adherence to Dietary Recommendations:

- **How closely do you follow dietary recommendations provided by healthcare professionals?**
 - ☐ Not at all
 - ☐ Slightly
 - ☐ Moderately
 - ☐ Closely
 - ☐ Very closely

5. Nutritional Supplements

- **Do you take any supplements (e.g., omega-3, vitamin D, magnesium)?**
 - ☐ Yes
 - ☐ No
- **If yes, list supplements and frequency of intake: _____**

6. Observed Dietary Triggers for Symptoms

- **Have you noticed any foods that worsen your MS symptoms?**
 - ☐ Yes (Specify): _____
 - ☐ No

7. Dietary Adjustments for Symptom Relief

- **Do you believe any specific foods or diets alleviate your symptoms?**
 - ☐ Yes (Specify): _____
 - ☐ No

Section 3: Expanded Disability Status Scale (EDSS) Score Assessment

(Objective Measurement of Clinical Remission)

1. Current EDSS Score

- **What is the participant's current EDSS score?**
 - Record current score based on recent clinical evaluation: _____ (Score 0–10.0)

2. EDSS Scoring Over Time

- **Previous EDSS Score: _____** (Record previous score)

- **Change in EDSS Score Over Time**

- ☐ Improvement
- ☐ Stability (No Change)
- ☐ Worsening

3. Clinical Remission Indicator

- **Based on the EDSS score trend, is the patient currently in clinical remission?**
 - ☐ Yes (Improvement or no change in EDSS over 6–12 months)
 - ☐ No (EDSS has worsened within the last 6–12 months)
- **Comments on EDSS trend and patient's stability:** _____

Section 4: Clinical Remission and Dietary Influence

(Dependent variable: Clinical Remission based on EDSS score and disability progression)

1. Periods of Clinical Remission

- **Have you experienced periods of symptom remission (reduction or absence of symptoms) since diagnosis?**
 - ☐ Yes
 - ☐ No

2. Dietary Influence on Remission

- **To what extent do you believe your diet influences your chances of achieving clinical remission?**
 - ☐ Not at all
 - ☐ Slightly
 - ☐ Moderately
 - ☐ Significantly
 - ☐ Very significantly

3. Recent Dietary Changes

- **Have you made any specific dietary changes in the past year?**
 - ☐ Yes (Specify): _____
 - ☐ No

- **If yes, did these changes affect your symptoms?**

- ☐ Improved
- ☐ Worsened
- ☐ No noticeable effect

4. Challenges in Dietary Adherence

- **How challenging is it for you to adhere to a recommended diet?**

- ☐ Very difficult
- ☐ Difficult
- ☐ Neutral
- ☐ Easy
- ☐ Very easy

Section 5: Non-Nutritional Factors and Their Impact on MS Symptoms

(Objective 1.4.1c: Investigating the role of non-dietary factors on MS symptoms and their interaction with dietary influences)

1. Stress Levels

- **How frequently do you experience high levels of stress?**

- ☐ Daily
- ☐ Weekly
- ☐ Occasionally
- ☐ Rarely

2. Physical Activity

- **Frequency of physical activity (e.g., exercise, walking):**

- ☐ Daily
- ☐ 3-5 times per week
- ☐ 1-2 times per week
- ☐ Rarely
- ☐ Never

3. Sleep Quality and Its Impact on Symptoms

- **How would you rate your sleep quality in the past month?**

- ☐ Very Poor
- ☐ Poor
- ☐ Fair
- ☐ Good
- ☐ Excellent

- **Does sleep quality seem to impact your MS symptoms?**

- ☐ Yes
- ☐ No

4. Environmental Triggers

- **Have you observed any environmental factors (e.g., temperature changes) that affect your symptoms?**

- ☐ Yes (Specify): _____
- ☐ No

5. Psychological Well-being

- **Do emotions (e.g., anxiety, depression) appear to correlate with your MS symptoms? Have you been anxious or depressed in the past six months?**

- ☐ Yes (Specify): _____
- ☐ No

Section 6: Dietary Factors and Disease Activity Markers

(Objective 1.4.1d: Exploring associations between dietary factors and disease activity markers such as relapse rates and disability progression)

1. Frequency of Symptom Relapse

- **How often do you experience MS relapses?**

- ☐ Monthly
- ☐ Quarterly
- ☐ Annually
- ☐ Less than annually

2. Dietary Impact on Relapse Rates

- **To what extent do you believe your diet influences the frequency of relapses?**
 - ☐ Not at all
 - ☐ Slightly
 - ☐ Moderately
 - ☐ Significantly
 - ☐ Very significantly

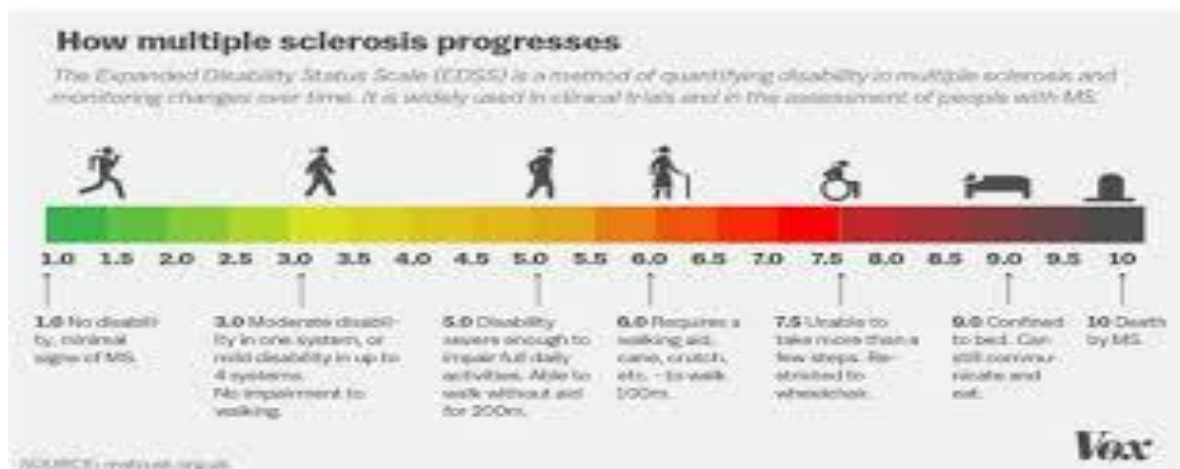
3. Diet and Disability Progression

- **Have you noticed any relationship between your diet and changes in mobility, fatigue, or cognitive function over time?**
 - ☐ Yes (Specify): _____
 - ☐ No

4. Use of Medical Diagnostics

- **Have you been tested for biomarkers or disease progression markers recently (e.g., MRI scans)?**
 - ☐ Yes
 - ☐ No
- **If yes, did the results correlate with dietary patterns?**
 - ☐ Yes (Specify): _____
 - ☐ No

appendix iii: Supplementary tables and Results



The Expanded Disability Status Scale (EDSS) is a way of measuring how much someone is affected by their MS. Neurologists use it to monitor changes in the level of someone's disability over time.

The EDSS has a range from 0 to 10. Scores are in half unit steps – 3, 3.5, 4 and so on. The greater the level of disability, the higher the score out of ten.

EDSS scores are used to decide who can take part in clinical trials of many MS drugs as well as to decide who can have disease modifying therapies (DMTs). For example, at the moment if your score is above 6.5 (that is, you use a wheelchair most of the time), then you don't qualify to get a DMT. This is because studies in the past didn't show these drugs had enough benefit once you were past this level of disability.

EDSS scores are measured using the following indicators.

- a) muscle weakness and your ability to move your arms and legs
- b) balance, coordination and tremor
- c) eye movements you can't control, your speech and swallowing
- d) unusual sensations or numbness
- e) your bowel and bladder
- f) your eyesight
- g) your thinking and memory

HOW TO READ SCORES ON THE EDSS SCORE

- a) examination shows everything is normal.
- b) no disability, very small sign that one function isn't normal.
- c) 1.5 no disability, very small signs that more than one function isn't normal.
- d) 2.0 very small disability in one function.
- e) 2.5 mild disability in one function or very small disability in two functions,
- f) 3.0 moderate disability in one function or mild disability in three or four functions. No problem walking.
- g) 3.5 moderate disability in one function and mild or moderate disability in several other functions. No problem walking.
- h) 4.0 significant disability but you can walk without an aid for 500 meters
- i) 4.5 significant disability but you're up for much of the day. You can still work but might need some help. You can walk 300 meters without an aid
- j) 5.0 disability gets in the way of daily activities but you can walk without an aid for 200 meters.
- k) 5.5 disability rules out full daily activities. You can walk 100 meters without an aid
- l) 6.0 you can walk 100 meters with a stick or crutch, with or without rests
- m) 6.5 you can walk 20 meters with the two aids (crutches or sticks) without stopping for rests.
- n) 7.0 essentially you must use a wheelchair but are active all day. You can't walk more than 5 meters even with an aid.
- o) 7.5 you can only take a few steps. You use a wheelchair and may need help getting in and out of it. You may need a motorized wheelchair.
- p) 8.0 basically you need to be in a chair, wheelchair or bed. You may be out of bed much of the day. You can use your arms.
- q) 8.5 basically in bed much of the day. You still have some use of your arms.
- r) 9.0 in bed all the time but you can communicate, eat or swallow.
- s) 9.5 in bed but you can't communicate, eat or swallow.
- t) 10 death due to MS.

STAGES OF MS

1. Clinically Isolated Syndrome (CIS)

Clinically isolated syndrome (CIS) refers to a first episode of neurologic symptoms. If you experience CIS, you may or may not go on to develop MS. Symptoms of CIS vary from person to person but commonly include bladder dysfunction, vision problems, and difficulty with coordination, balance, walking, speaking and swallowing (ataxia)

2. Relapsing-Relmitting MS (RRMS)

Relapsing-relmitting MS (RRMS) is the most common MS disease course. RRMS shows clearly defined attacks of new or increasing neurologic symptoms. These attacks are also called relapses or exacerbations. They are followed by periods of partial or complete recovery, or remission. Approximately 85% of people with MS are initially diagnosed with RRMS. When the disease course progresses, it is considered to be secondary progressive MS

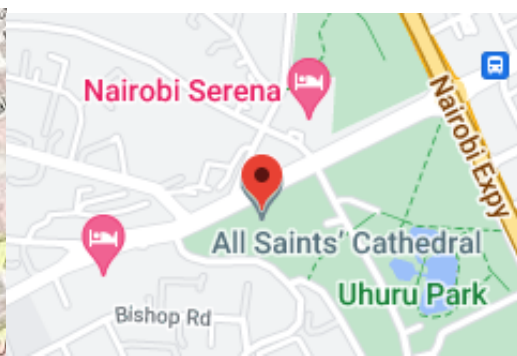
3. Secondary Progressive MS (SPMS)

Some people diagnosed with RRMS eventually go on to have a secondary progressive MS (SPMS) course. In this course, neurologic function declines progressively and disability increases over time. Each person's experience with SPMS is unique. In SPMS, you may have occasional relapses, as well as periods of stability.

4. Primary Progressive MS (PPMS)

With PPMS, neurologic function worsens or disability accumulates as soon as symptoms appear. There are no early relapses or remissions. Approximately 15% of people with MS are diagnosed with PPMS. Each person's experience with PPMS is unique. PPMS can have brief periods of stability, with or without a relapse or new MRI activity. It can also have periods of increasing disability, with or without new relapses or lesions on an MRI

appendix iv: Map of Study Area



appendix v: NACOSTI permit and institutional letters



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KENYA METHODIST UNIVERSITY
DIRECTORATE OF POSTGRADUATE STUDIES

February 29, 2024

Commission Secretary,

National Commission for Science, Technology and Innovations,

P.O. Box 30623-00100,
NAIROBI.

Dear Sir/Madam,

RE: GIKUNGA CYNTHIA WAMBUI - (REG. NO. FIND-3-2366-2/2022)

This is to confirm that the above named person is a bona fide student of Kenya Methodist University, in the School of Medicine and Health Sciences, Department of Public Health, Human Nutrition and Dietetics undertaking a Masters' Degree in Human Nutrition and Dietetics. She is conducting research on; "Investigating the Influence of Nutritional and NonNutritional Risk Factors on Achieving Clinical Remission in Multiple Sclerosis Patients: A Case of Nairobi County".

We confirm that her research proposal has been presented and approved by the University.

In this regard, we are requesting your office to issue a research license to enable her collect data.

Any assistance accorded to rded to her will be highly appreciated.

Yours sincerely,


Dr. John M. Muchiri (PhD)
Dean, Postgraduate Studies
Cc: Dean - SMHS

CCD- PHHND

PhD)

Program Coordinator
Student Supervisors



KENYA METHODIST UNIVERSITY

P. O. BOX 267 MEW - 60200, KENYA FAX: 254-64-30162
TEL: 254-064-30301/31229/30367/31171 EMAIL: INFO@KEMU.AC.KE

February 29, 2024

KeMU/ISERC/HND/OI/2024

GIKUNGA CYNTHIA WAMBUI HND-3-
23660/2022.

Dear Cynthia,

**SUBJECT: INVESTIGATING THE INFLUENCE OF NUTRITIONAL
AND NONNUTRITIONAL RISK FACTORS ON ACHIEVING
CLINICAL REMISSION IN MULTIPLE SCLEROSIS PATIENTS: A
CASE OF NAIROBI COUNTY**

This is to inform you that Kenya Methodist University Institutional Scientific Ethics and Review Committee has reviewed and approved your research proposal. Your application approval number is KeMU/ISERC/HND/OI/2024. The approval period is 29th February, 2024- 29th February, 2025.

This approval is subject to compliance with the following requirements:-

- I. Only approved documents including (informed consents, study instruments, MTA) will be used.
 - II. All changes including (amenaments, deviationss and violations) are submitted for review and approval by Kenya Methodist University Institutional Scientific Ethics and Review Committee,
 - III. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KeMU ISERC within 72 hours of notification.
 - IV. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KeMU ISERC within 72 hours.
 - V. Clearance for export of biological specimens must be obtained from relevant institutions.
 - VI. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
 - VII. Submission of an executive summary report within 90 days upon completion of the biudy to KeMU iSERC.
- Prior to commencing your-study, you Wii! be expected to obtain a research license from Rlat.;onal Commission > ' {or Science, Technology and Innovation (NACQSTI) hitpg; oris.nacosti.go.ke and e:sc obtain other clearances needed.





REPUBLIC OF KENYA



NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY & INNOVATION

Ref No **29701**

Date of Issuance **13 April 2022**

RESEARCH LICENSE



This is to Certify that Miss. Cynthia Wambui Gikunga of Kenya Methodist University, has been licensed under the provision of the Science, Technology and Innovation Act, 2013 (Rev. 2014) in Nairobi on the topic **Influence of Nutritional and Non-Nutritional risk factors on achieving Clinical Remission in Multiple Myeloma in Nairobi County for the period ending :**

License No **NACOSTI/P/24/3418**

29701

Applicant Identification

Director
NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY &
INNOVATION

Verification OR Code



NOTE: This is a computer generated License. To verify the authenticity of the License, Scan the OR Code using OR scanner

See overleaf for

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)
Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing)
Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
 - i. Endanger national security
 - ii. Adversely affect the lives of Kenyans
 - iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
 - iv. Result in exploitation of intellectual property rights of communities in Kenya
 - v. Adversely affect the environment
 - vi. Adversely affect the rights of communities
 - vii. Endanger public safety and national cohesion
 - viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.

11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and
Innovation(NACOSTI),
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P. O. Box 30623 - 00100 Nairobi, KENYA
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