Perception on Foods and Dietary Habits Among Autoimmune Patients

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ABSTRACT

The beginning of autoimmune diseases is becoming more prevalent globally and in India. Globally 1 out of 5 individuals are diagnosed with an autoimmune condition. Not many research, though, are being done in this field of science. This study was conducted to evaluate the perception on foods and dietary habits among autoimmune patients. The survey was conducted by interviewing 100 female subjects belonging to age group 25-70 years, individuals having a diagnosis of an autoimmune condition using a self-validated questionnaire. Information collected was statistically analysed and according to the findings, among 100 subjects, 57% from them were diagnosed with Rheumatoid Arthritis (RA) and a diagnosis of systemic lupus erythematosus was made in 23%. (SLE). There was a finding that the subjects had a positive perception on consuming turmeric, ginger and garlic but had negative perception on refined wheatflour or maida, milk and milk products, egg and especially on processed and fried foods. Thus, it may be concluded that perception of food can be influenced by previous experiences with the foods or advice given by family, peers or even by social media. The survey also included certain Environmental and lifestyle factors which influenced an increase in autoimmune disorders. These findings can be used to spread awareness on the several food varieties that, depending on the experiences and opinions of the study's participants, may either cause a weakened immune response or offer comfort.

Keywords: Autoimmune Diseases, Self-validated questionnaire, Rheumatoid Arthritis, Systemic Lupus Erythematosus, Perceptions, Negative immune response.

CHAPTER 1 INTRODUCTION

1. INTRODUCTION

The body is defended against illness and infection by a healthy immune system. Yet, an autoimmune illness is a situation where the body's own healthy tissues are targeted by immune system cells, which prompts the body to fight them. Almost every organ in the body is influenced by this disorder, particularly the heart, brain, nerves, muscles, and digestive system. Type 1 diabetes, multiple sclerosis, rheumatoid arthritis, systemic lupus erythematosus, Crohn's disease, psoriasis, and scleroderma are among the most prevalent autoimmune conditions.

1.1 Global Prevalence of autoimmune diseases

Of the world's total population 5% of the population develops an Autoimmune disease. Of this 5%, 80% of them are constituted by women. Despite the introduction of immunosuppressants, the estimated incidence of autoimmune disorders is 4.5% of the general population, and during the past few decades,

both the number of new cases and mortality rates have increased. (Lerner et al., 2015)

1.2 Types of autoimmune diseases

Multiple Sclerosis

The risk of cancer overall is lower in people with multiple sclerosis, but the risk of cancer of the central nervous system, particularly the brain, is higher. In the neurodegenerative condition known as multiple sclerosis (MS), the vital myelin sheath that surrounds brain neurons is attacked by T-cells, a particular type of immune cell. Due to reduced nervous system activity, inflammation and ultimately brain tumours are caused. (Frohman et al., 2006)

Rheumatoid Arthritis

Both lymphoproliferative malignancies and localised tumours across the body have weak but substantial relationships with rheumatoid arthritis. Cells that make up the joints and cartilages of the body invade other areas of the body and cause local inflammation in rheumatoid arthritis. Further malignant transformation of other cells is further encouraged by the milieu created by persistent inflammation and overactive immune system. This may help to explain the links between joint inflammation and malignancies of the lungs, skin, and other hematologic organs, none of which are directly impacted by joint inflammation. (Khurana & Berney, 2005)

Systemic Lupus Erythematosus

Cancers that are lymphoproliferative and focused in various parts of the body are linked to systemic lupus erythematosus. Many organ systems are affected by systemic lupus erythematosus, which is also characterised by a generalised loss of immunological tolerance. The chronic inflammation that permeates the entire body encourages the malignant transformation of other cells, increasing the risk of lymphoproliferative and systemic malignancies. On the other hand, systemic lupus erythematosus is linked to a drop in several malignancies. (Tsokos, 2011)

Coeliac Disease

The strongest correlations between coeliac disease and gastrointestinal and lymphoproliferative malignancies exist. Due to the body's decreased immune tolerance to consumed gluten, which is largely found in wheat, barley, and rye, coeliac disease results in an autoimmune reaction. This explains the elevated risk of gastrointestinal cancers since the digestive process for consumed gluten would pass through the oesophagus, stomach, small intestine, large intestine, rectum, and anus. (NH, 2009)

Inflammatory Bowel Disease

Gastrointestinal and a few lymphoproliferative malignancies are linked to inflammatory bowel disease (IBD). Crohn's disease and ulcerative colitis are additional classifications for IBD. Individuals with IBD lose immunological tolerance for common bacteria found in the gut microbiome in both situations. Here, the immune system fights the bacteria and causes chronic inflammation, which has been associated with an increased risk of developing cancer.

1.3 Physical and Clinical characteristics of autoimmune diseases

Autoimmune disease is primarily characterised by inflammation associated with redness on the skin, heat, pain and swelling. The symptoms manifested are usually organ specific, such as: Joints, which cause stiffness, pain, numbness, and loss of function like walking, and doing daily activities. Thyroid, leading to fatigue, weight gain (obesity) and general weakness. Skin, associated with rashes, blisters and change in colour. There is no distinct cause for the onset of the autoimmune disease but is triggered by

combination of various factors like genetics, environmental and even one's own way of life. Autoimmune disease can be treated with medications like corticosteroids or immunosuppressive drugs to reduce inflammation and the progression of the disease but there is no permanent cure found. (AutoimmuneDiseases, n.d.).

1.4 Pathophysiology of autoimmune diseases

The pathophysiology of autoimmune diseases is the damage induced by the T cells or B cells of the human immune system. The autoimmune phenotypes depend on the target cell and the affected organ. The onset of autoimmune diseases begins by the damage of tissues by the immune cells which kills the cells directly or indirectly by releasing the cytotoxic cytokines, prostaglandins, reactive nitrogen or oxygen intermediates. Theses tissue macrophages and monocytes act as antigen presenting cells to initiate an autoimmune response. Macrophages are killer cells that secrete Th1 cytokines which act ad protein signals between cells. These cytotoxic proteins damage the tissues. The damage of the tissues is associated with the inflammation of the tissue. Regulatory T cells secrete anti-inflammatory cytokines that inhibits Th1 immune responses. Disruption of these regulatory T cell secretions can also lead to autoimmunediseases. (Anaya, 2012).

1.5 Biomarkers of autoimmune condition

The most prevalent blood test for autoimmunity is the detection of antinuclear antibodies (ANA). Because they specifically target the nucleus—the large organelle that houses our chromosomes—in healthy cells, these antibodies are referred to as "antinuclear."

Several papers have suggested potential biomarkers for the autoimmune conditions rheumatoid arthritis and multiple sclerosis. The following markers are associated withrheumatoid arthritis:

1. Aggrecan fragments, C-propeptide of type II collagen, and cartilage oligomericmatrix protein.
2. Matrix metalloprotease (MMP)-1, MMP-3, and MMP-1/inhibitor complexes.
3. Thioredoxin, IL-16, and tumour necrosis factor (TNF)-alpha.

The biomarkers of multiple sclerosis are as follows

1. Neurofilament light protein and glial fibrillary acidic protein,
2. MMP-2 and MMP-9,
3. TNF-alpha and soluble vascular adhesion molecule-1,
4. MMP-2 and MMP-9 for multiple sclerosis.

Most of these indicators are restricted to somewhat inaccessible anatomic regions, which reduces their usefulness (synovial or cerebrospinal fluid). Hence, the most practicable autoimmune biomarkers will be those detectable in serum or plasma. (Prince, 2005).

1.6 The vulnerable groups of autoimmune condition

The females are also a risk factor for polyautoimmunity (Anaya, 2012). Polyautoimmunity is defined as the presence of more than one autoimmune disease in a single patient. When three or more autoimmune disease coexist, the condition is called multiple autoimmune syndromes. (Anaya, 2014)

A case control study was conducted to study the gender specific incidence of autoimmune diseases in Sweden. It was found that out of 403,757 individuals who were diagnosed with autoimmune disease between 1987 and 2010, the incidence of 32autoimmune disease was 60% higher in women than men. (Ji et al., 2016)

1.7 Environmental and Lifestyle factors influencing autoimmunecondition

There are certain environmental factors that can lead to autoimmune diseases such asinfectious agents, ultraviolet light, chemicals, occupational pollutants or drugs, lifestyle, or behavioural factors such as alcohol, smoking and most importantly diet. (Costenbader et al., 2012).

There are other external environmental and lifestyle factors like weather, stress, sleepas well as physical do have an influence on the autoimmune conditions.

1.8 Dietary and food Perceptions

Diet and eating habits have a significant impact on the emergence of autoimmune diseases. Some foods have the potential to cause autoimmune illness in those who areprone to having an immune response that results in an aberrant reaction against their own tissues. The intestine is where the body's lymphocytes and foreign antigens first interact, forming the main connection between food and the immune system. Researchhave revealed that wheat and soy enhanced the frequency of diabetes in mice. This observation suggested that foods contain auto immunogens. The auto immunogens arecells with receptors capable of binding self-antigens and constitute a normal component of the B cell. Cow's milk, wheat, soy are the possible sources of auto immunogens. (Scott et al., n.d.)

Low vitamin D levels have been associated with multiple sclerosis, systemic lupus erythematosus, rheumatoid arthritis, and other autoimmune diseases, according to studies. Other milk-related diseases including lactose intolerance are also linked to milk consumption.

It has also been established that eating processed meals with high salt content contributes to the rising prevalence of autoimmune illnesses. The innate immune system, and macrophage activity in particular, is impacted by salt. Through the stimulation of pathogenic Th17 cells, sodium chloride can cause autoimmune illness. With respect to wheat-based foods, studies show that there are certain circulating antibodies in autoimmune patients with non-celiac gluten sensitivity which interact with various food antigens that may also cause the formation of antigen antibody aggregates and triggers an inflammatory response.

Therefore, it is very important to identify the important triggers of autoimmunity which is associated with the development of new remedies and therapies for autoimmune diseases. (Vojdani, 2014).

The patient's knowledge and their attitude towards certain foods also play a major role in their food intake. Their personnel experience with certain foods also affects their intake. autoimmune patients also develop certain stigma on consuming certain foods.It can be a negative or a positive perception as well. They are convinced that on consuming certain foods they may have a flare up of the symptoms or even some foodscan give them a comfort as well.

The process of becoming aware of the food, its effect on the body and even the surrounding environment where the food is consumed is the perception of food. It is important to distinguish between the experience and beliefs of the patients on consuming certain foods so as to understand the type of food which actually cause thetrigger in the immune response. The participants perceived impact on consuming foodswhether the particular food pose a potential benefit or harm is based on the informationprovided by the medical professionals, peers, people with the same condition or even the media. An experienced impact is when the individuals have had a flare up of theirsymptoms on the consumption of the food. (Karnoe et al., 2020).

During the recent years, there has been an increased emphasis on a more personalised treatment for

autoimmune conditions. Many studies are conducted to find new and convenient methods to make life easy for the patients suffering from autoimmune diseases. There has been a development of various immune specialised diets like the Paleo diet, the Mediterranean diet which focuses on fruits and vegetables, whole grainsseeds and nuts which provide anti-inflammatory properties.

1.9 Rationale

Clinical data have long shown that autoimmune illness is becoming more common. Studies using systematic data are scarce, therefore it has been difficult to determine whether the apparent increase is just a result of evolving diagnostic and reporting practises.

It is also observed that the symptoms manifested by different autoimmune conditionsare overlapping and there are high chances of wrong or improper symptomatic diagnosis. There are limited biomarkers to detect specific autoimmune diseases.

1.10 Need for the study

Food plays a major role in regulating the immune responses in an autoimmune condition. Some foods can reduce the impact of the symptoms whereas some food could also increase the intensity. Therefore, it is very important to monitor the effect of consumption of each food for a person suffering from an autoimmune condition.

Doctors, line of treatment, family, peers and one's own choice of food have an impact/influence on the food consumed.

It is important to understand and analyse the various assumptions of people on the effect of certain foods on their condition as it forms a base of clarity to provide right information on the foods which caused the trigger the immune response and those which are only their assumptions.

1.11 Aim of the study

To analyse the perception quantitatively on the diet and dietary habits amongautoimmune female patients between the age of 25 years to 70 years.

1.12 Objectives

* To analyse the food perceptions of autoimmune patients in association withtheir symptoms.
* To assess the intake of foods and adequacy of nutrients by dietary recallmethod.
* To assess the various types of autoimmune diseases and impact on thequality of life.

CHAPTER 2 REVIEW OF LITERATURE
2. REVIEW OF LITERATURE

According to the following objectives:
* To analyse the food perceptions of autoimmune patients in association withtheir symptoms.
* To assess the intake of foods and adequacy of nutrients by dietary recallmethod.
* To assess the various types of autoimmune diseases and impact on the qualityof life.
  The literature is discussed under the following headings.
1. **Factors influencing autoimmune diseases**
2. **Deficiency of nutrients**
3. **Perception on food and diet**

4. 24-hour dietary recall

2.1 Factors influencing Autoimmune Diseases

Autoimmune disease is a term used to describe disorders where the body's immune system attacks its own cells and tissues. There are various factors that influence the onset and development of these autoimmune disorders. Genetics plays a central role in combination with external factors such as environment, lifestyle and even past infections and vaccinations in individuals.

Genetic predisposition

A great many of autoimmune diseases run in families. Studies revealed that a child's risk of multiple sclerosis (MS) increased from 0.1% in the general population to 2 percent if one of his or her parents had MS (Kular et al., 2018). Genetic patterns among ethnic groups suggested an autosomal recessive pattern of inheritance. This included type 1 diabetes, which was more common in whites, and lupus, which tended to be more severe in African- Americans and Hispanic populations (Manku et al., 2013). While the patterns of inheritance often appeared specific to certain mutations, there was evidence that a chromosomal factor could also predispose a person to autoimmunity. Therefore, it was seen that family members of individuals having lupus were sometimes reported to have rheumatoid arthritis, Hashimoto's or other autoimmune disorders unrelated to lupus (Gregersen & Olsson, 2009)

Research from the centres for Rheumatic diseases in Bucharest suggested that as many as 25% of people with an autoimmune disease would experience additional autoimmune disorders.

Infections and toxins

Viruses, bacteria, and other infectious pathogens were the major postulated environmental triggers of autoimmunity. Possible mechanisms linking infections and autoimmune disease included alterations in target cells, alterations in immune cells, immune response against the determinant shared by host and virus and cross reaction between idiotype and the antiviral antibody and respective autoantigens. A study was conducted to investigate whether hospitalisation for an infection was a risk factor for developing a range of autoimmune diseases. The total study population included 4.5 million persons born in Denmark between Jan 1, 1945, and December 31 2010, and who were alive and a resident of Denmark during the study. It was found that prior to the diagnosis of autoimmune diseases a total of 58,265 patients were diagnosed as having one or more infections in which 33,285 were females and 21980 were males. In this national cohort study, it was observed that individuals hospitalised for a serious infection were at increased risk of subsequent diagnosis of autoimmune diseases. (Nielsen et al., 2016)

Gut microbiota

Recent studies had reported that the increasing incidence of autoimmune diseases was due to considerable shifts in the gut microbiota among multifactorial reasons and widespread application of antibiotics. Dysbiosis of the gut microbiota had been identified as a potential factor that caused autoimmune diseases, which in humans were attributed to multiple factors. At the cellular level, translocation of live gut bacteria across a dysfunctional gut barrier provoked direct interactions with immune and tissue cells and subsequently instigated systemic autoimmunity. The gut microbiota could also interfere with immune sensing in discriminating between self and nonself, which might contribute to autoimmune diseases. (Xu et al., 2019).

Cigarette smoking

Certain lifestyle and environmental exposures could also cause autoimmune diseases. Cigarette smoking had been causally linked to the development of multiple autoimmune diseases, including rheumatoid

arthritis, systemic lupus erythematosus, multiple sclerosis, Graves' hyperthyroidism, and primary biliary cirrhosis. The pro- inflammatory effects of cigarette smoke were in relation to the risk of cardiovascular disease and emphysema. Cigarette smoking may be associated with increased rheumatoid arthritis severity as well, including rheumatoid nodule formation, increased joint destruction, increased pulmonary disease and decreased functional abilities. To date, three case-control studies had been reported significantly increasedodds ratio for the development of systemic lupus erythematosus (SLE) in smokers. A meta-analysis statistically combined the effect estimates from the seven case control studies and two cohort studies that had examined cigarette smoking as a risk factor forSLE revealed a modestly increased risk posed by current smoking, but no increased risk associated with past smoking. Cigarette smoking seemed to exacerbate multiple sclerosis (MS), both chronically and acutely. It also caused a transient worsening of motor functioning on a battery of tests in MS patients, compared to healthy controls. (Costenbader & Karlson, 2006).

Air pollution

Another major contributing environmental factor of autoimmune condition is the air pollution. The main sources of air pollution include industry, vehicle exhaust, forest fires, stationary fuel burners and solid fuel combustion. Experimental or population- based investigations explored the potential effect of air pollution on autoimmune diseases. It was noted that exposure to air pollution could elevate both the incidence and severity of autoimmune diseases. Exposure to silicon, which was found in ambientair could cause various immunological alterations. Air pollution exposure could influence autoimmunity by augmenting autoimmune responses and enhancing systemic inflammation. The hypothesis that exposure to polluted air could cause T cellimbalance, production of proinflammatory cytokines, local pulmonary inflammation, oxidative stress, and methylation changes which are deeply associated with the pathogenesis of autoimmune diseases. (Zhao et al., 2019)

Seasons and climate

Recent studies demonstrated the potential role of seasonality in the incidence and disease activity of various autoimmune diseases. In the first pioneering study on the influence of season on these disorders which was carried out in 1987, a higher susceptibility to developing MS was observed in individuals who were born in the spring, contrasted to births during the winter months. The association between the birth month and the occurrence of MS was stronger in patients possessing the HLADRB1 haplotype, which was a haplotype that conferred an increased risk of MS development.In a large prospective cohort study, 2102 patients were enrolled for the investigation of temporal relationship between SLE symptoms and seasons. Firstly, they demonstrated that photosensitive rash showed a significant increase in occurrence during the period between April – September. Secondly, arthritis exhibited seasonal variation with more episodes occurring during May to October. Thirdly, a decrease ofrenal flares could be noticed during summer. Fourthly, anti-DNA levels were significantly elevated during the months of October and November. Finally, serositis and neurological manifestations did not show any significant seasonal variation while flares were detected more frequently during the months of August – October. Type 1 diabetes mellitus (T1DM) was another autoimmune disease that showed seasonal variation. The first appearance of auto- antibodies in T1DM was found to be higher during autumn and winter versus spring and summer. In 1973, Jacoby et al. studied theearly stages of patients with classical rheumatoid arthritis. It highlighted an increaseddisease onset in the winter semester compared to other seasons with 43% of patients, presenting between December to February. (Watad et al., 2017).

Diet and food

Diet and the type of food ingested are also major contributors to the onset and development of autoimmune conditions. There are certain foods which on consumption can flare up a negative immune response. It was theorised that the consumption of processed foods containing high amounts of salt may in part be responsible for the increasing incidence of autoimmune diseases. Excess uptake of salt could affect the innate immune system that is the macrophage function. The amino acids present in milk mimic collagen that could induce rheumatoid arthritis and those that mimic neural cell antigens may induce multiple sclerosis. Epidemiological and ecological investigations suggested that early infant nutrition, particularly drinking cow's milk, could induce autoimmunity, leading to type 1 diabetes. Many other studies suggested that dysregulation of oral tolerance triggered a cellular and humoral immune response against various components of milk proteins, and cross reaction with B – cell molecules resulted in autoimmunity. (Vojdani, 2014). The increased incidence of celiac disease, an autoimmune disorder, as well as other non-celiac autoimmune diseases was linked to increased gluten consumption. Gliadin, a component of gluten is an ideal substrate for endogenous tissue transglutaminase and exogenous microbial transglutaminase. It was found that the luminal microbial transglutaminases, which originated in the dysbiome, were potential drivers of systemic autoimmunity (Lerner et al., 2017).

Eating Disorders

It was also found that immune system dysfunction may be associated with eating disorders. A study was conducted on individuals aged 0 – 35 years born in Sweden between January 1, 1979, and December 31, 2005. These individuals were followed until the diagnosis of first eating disorder, autoimmune disease first diagnosis, death or emigration from Sweden. It was observed that in males, any preceding autoimmune disease was associated with an 82% increased hazard on eating disorder and in females was 71%. (Hedman et al., 2019).

Physical Activity

All these above discussed factors were associated with negative feedback of the autoimmune conditions. However, certain lifestyle and behavioural changes did bring a positive impact on the condition. One of the lifestyle modifications was increased physical activity. By definition, physical activity is any skeletal muscle body movement that results in energy expenditure. Physical activity leads to a significant elevation in T – regulatory cells, decreased immunoglobulin secretion and produce a shift in the Th1/Th2 balance to a decreased Th1 cell production. Also, physical activity promotes the release of IL – 6 from muscles which shows to induce an anti- inflammatory response. Physically active rheumatoid arthritis patients were found to have a milder disease course. Physical activity also decreased fatigue, enhanced mood, cognitive abilities, and mobility in patients with multiple sclerosis. (Sharif et al., 2018).

2.2   Deficiency of nutrients

A healthy and balanced diet is necessary for overall wellbeing. An inadequate supply or deficiency of essential nutrients in the diet is known as the nutritional deficiency. Nutrients play a major role in the development and proper functioning of the body. A nutritional deficiency occurs when the body does not receive the necessary amount of nutrients in the form of food from the diet or the inability of the body to absorb nutrients can also result in nutrient deficiency. There are two types of nutritional deficiencies – primary and secondary.

The nutritional status of an individual is strongly associated with his immunological health. In the recent years, with the onset of the COVID- 19 pandemic, a relationship between immunity and nutrition was

observed. A study was done to assess the nutritional status of patients with coronavirus disease. It was conducted on adults with COVID- 19 admitted to Inha University Hospital, South Korea, from February to June 2020. According to the data, vitamin D deficiency was the most prevalent, with a deficiency in 76% of patients and a severe deficiency in 24%. Prevalence of selenium deficiency was observed in 42% of patients, pyridoxine in 6.1% and folate in 4.0%. No patients were deficient in B1, B12 or zinc. Of the 12 patients with respiratory distress, 11 were deficient in at least one nutrient. (Im et al., 2020)

Vitamin D

Vitamin D, a fat-soluble vitamin, plays a major role in the development of autoimmune diseases. Studies suggest that impairment in vitamin D signalling and genetic insufficiency of vitamin D may lead to vitamin D deficiency with subsequent onset and progression of autoimmune diseases. In 1974, Goldberg hypothesized that vitamin D and calcium were the possible environmental determinants of MS prevalence. In 1968, in one of the first clinical trials with cod liver oil capsules and magnesium supplements, he reported a beneficial effect on the number of relapses in a few patients who were diagnosed with multiple sclerosis, an autoimmune condition. Vitamin D deficiency is also associated with the occurrence of diabetes type 1. For instance, Hyppönen et al. showed that intake of vitamin D in infancy lowered the chance of T1D diagnosis later in life. Two other studies reported similar findings. A majority of trials on T1D have used supplementation with 1,25(OH)2D3 or its analogues, reporting not prevention but rather suppression of further beta cell destruction.

Dehghan et al. concluded that only one out of 10 patients with RA could be prevented from having a relapse with cholecalciferol supplementation. Supplementation with vitamin D in patients with systemic lupus erythematosus played an important role in mitigating the effect of the disease. Abou- Raya et al. reported promising and statistically significant improvement in 178 patients with SLE treated with cholecalciferol compared with 89 placebo controls. With the emergence of many autoimmune conditions, a tremendous research effort was made in testing the potential of vitamin D supplementation in improving the patients' quality of life. (Nagar et al., 2019).

Vitamin B12

Long term chronic autoimmune conditions are also associated with micronutrient deficiencies. A study was conducted to investigate the prevalence of micronutrient deficiencies in chronic atrophic autoimmune gastritis, in which individuals with this condition had a vitamin B12 deficiency. This study included 122 patients with previously or newly diagnosed CAAG. The presence of single nutrient deficiency was detected in 76 patients and 52 cases had multiple nutrient deficiencies. In particular 25-OH vit D was the main one detected. Regarding B12 deficiency, it was present in 34% of the cases. Anaemia was present in 16 patients. (Zilli et al., 2019)

Vitamin B12 plays an important role in red blood cell formation, metabolism and in the production of DNA. Elderly people, pregnant women and vegans are more susceptible to B12 deficiency. Studies suggested that initial clinical examination and screening tests did not identify the underlying cause of B12 deficiency. However, patients who were strictly vegan, had a lower than recommended dietary intake of B12.(Sukumar & Saravanan, 2019)

Vitamin D and Zinc

There are certain micronutrients like zinc and vitamin D which have a balancing effect on the immune system. Recent studies revealed significant benefits of nutrition related therapeutic approaches including prevention and treatment of established disease, which were cost effective and trigger- unspecific alternative which addressed balancing rather than suppressing the immune system. Zinc and vitamin D

are currently the best studied and most promising candidates for therapeutic intervention. (Wessels & Rink, 2020).

2.3 Perception on Food and Diet

The mind can only see what it is prepared to see.

- Edward de Bono

Every eating behaviour is influenced by how an individual perceives different kinds of food. Perception is the process by which one interprets and organises sensations to produce a meaningful experience of the world. It is the interpretation of a sensation or stimuli into something meaningful to him or her based on prior experience. Regarding foods and diets, some foods provide a negative experience while some of them give a comforting sensation on consumption. Perception of an individual can depend on his/ her existing beliefs, attitude, motivation, and personality characteristics. Certain negative perceptions can also lead to psychological anxiety, aversions as well as in worst scenario even phobias. Perceptions involve functioning of the human senses i.e., the vision/ sight, the olfactory senses like the smell and the taste as well as feel and touch stimulus. The process of perception involves three stages: selection, organisation, and interpretation. Perception process is also affected by physiological processes such as fatigue, hunger, age, health as well as biological cycles.

The impression people get from the sensory properties of food play a very important role in the way they select their food and quantity of consumption.

Visual

Visualisation play a major role in the process of perception. Visualisation is defined as an experience that resembles a perceptual experience, but which occurs in the absence of appropriate stimuli for relevant experience.

Even though food perception and categorisation are routed in multiple sensory modalities vision is the most investigated modality. In real life situations, food perception is usually done based on visual cues like food detection, purchase, choice etc. There is also evidence showing that food images may activate certain brain regions. (Foroni & Rumiati, 2017)

Taste

The extent to which variation in taste perception influenced food preferences was controversial. Bitterness in food triggers an innate aversion that is responsible for dietary restriction in children. A study was conducted to get a first baseline picture of taste sensitivity in healthy adults and their children and to explore taste sensitivity in a preliminary sample of obese children and in samples affected by functional gastrointestinal diseases. Individuals were recruited from the general population in southern Italy. Bitterness sensitivity was assessed by means of a suprathreshold method with 6- propyl- 2 thiouracil. The food intake was assessed by a food frequency questionnaire. It was found that children's taste sensation differed from that of adults. It was observed that a higher frequency of supertasters were children. Regarding the food choices, they found that a higher percentage of taster children avoided bitter vegetables or greens compared with taster adults. (Negri et al., 2012)

Odour

Odours are perceived retro nasally during eating when they enter the nose through the pharynx. As retro nasal sensations are frequently referred to as taste, so the smell taste perceptions are often being confused. The texture or taste of foods influences the perception of odours. Results obtained by Visschers et al. suggested that the intensity of aroma decreased with increased consistency of the consumed food. In

addition, it was shown that retronasal odorous stimuli increased the intensities of thickness and creaminess of oral stimuli. (Bojanowski & Hummel, 2012)

2.4   24 Hours Dietary Recall

A 24-hour diet recall is a dietary assessment tool that consists of a structured interview in which participants are asked to recall all food and drink they have consumed in the previous 24 hours. A key feature of the 24-hour is that when the respondent is asked for more detailed information than first reported. This open-ended response structure is designed to prompt respondents to provide a comprehensive and detailed report of all foods and beverages consumed. In addition to other detailed descriptors, such as time of day and source of food, portion size of each food and beverage is also captured. Food models, pictures, and other visual aids may be used to help respondents judge and report portion size which may improve accuracy. (24-Hour Dietary Recall (24HR) At a Glance, n.d.)

24-hour Recall

It is essential to check on the degree of reliability of these 24-hour recall as an important tool used to assess the nutritional status of an individual. A study was conducted to develop, test and evaluate a 24-hour recall procedure to assess the dietary intake of toddlers of Somali and Iraqi born mothers living in Norway. A protocol for a 24-hour multiple pass recall procedure, registration forms and visual tools were developed and tested in 12 mothers from Somalia and Iraq with children aged 10 – 21 months. The nutrient intake was calculated using Norwegian dietary calculation system. To help the mothers and field workers identify the correct foods given to the child, a library with pictures of food commonly eaten by children in Norway was developed. A hypothesis was developed which stated that the picture library would be a useful tool to identify the correct food and brand particularly for dietary assessment among immigrant mothers with varying levels of language and literacy skills (Grewal et al., 2014).

Food Frequency Questionnaire

A food frequency questionnaire (FFQ) is a finite list of foods and beverages with response categories to indicate usual frequency of consumption over the time period queried. FFQs are usually self-administered or sometimes interviewer administration is done occasionally. Completing a questionnaire aimed at capturing the total dietary intake usually requires 30 to 60 minutes (Food Frequency Questionnaire briefly, n.d.).

While developing a food frequency questionnaire it is important to assess the validity and reliability of the tool. A study was implemented to examine the validity and reliability of a food frequency questionnaire for the assessment of dietary intake among Lebanese children. Children aged 5 to 10 years were recruited from public and private schools of Beirut, Lebanon. Their mothers were asked to complete two FFQs, four weeks apart. Four 24-hour recalls were collected weekly during the duration of the study. Findings of this study showed that the developed FFQ was reliable and was also valid, when used with calibration factors. This FFQ was a useful tool in dietary assessment and evaluation of diet disease relationship in this age group (Moghames et al., 2016)

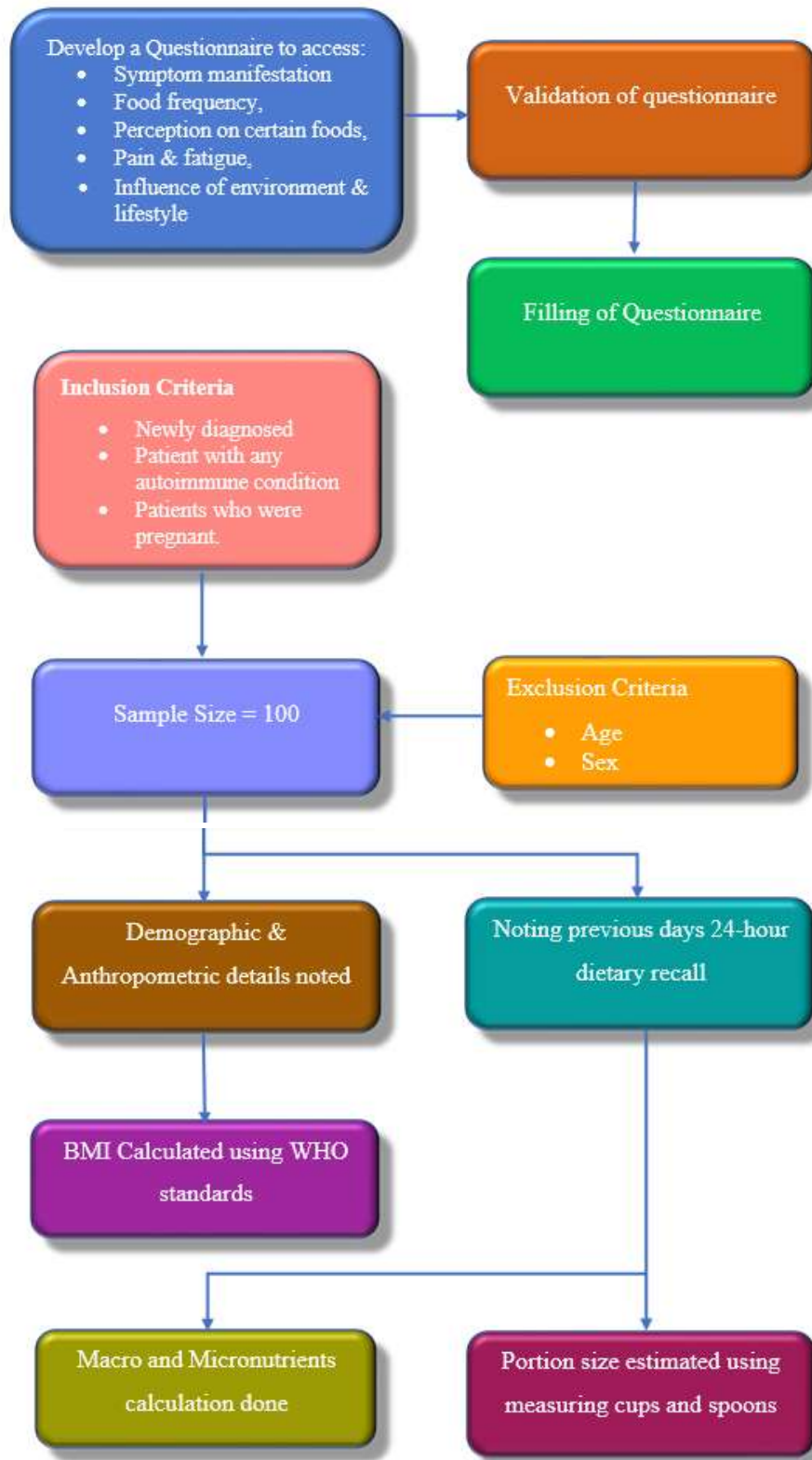# CHAPTER 3 METHODOLOGY
3. METHODOLOGY

Figure 3.1 Research Design Flow chart

3.1 Objectives of the study

The study's objectives are as follows:

- To analyse the food perceptions of autoimmune patients in association with their symptoms.
- To assess the intake of foods and adequacy of nutrients by dietary recall method.
- To assess the various types of autoimmune diseases and impact on the quality of life.

3.2 Research Design

The research design used in the study is the quantitative research design. The collected data is analysed using quantitative tools of analysis. The goal of quantitative research is to quantify the data collection and processing process.

3.3 Study Design

The present study was a cross sectional study with the subjects being selected based on purposive or judgement random sampling. The total subjects taken were 100 consisting of only females within the age group of 25-70 years. A cross sectional study is a type of observational study that aims to analyse data collected from a population or a representing subset at a specific point of time, called a cross sectional data.

3.4 Study Area

This study was done in Chan Re Rheumatology and Immunology Centre and Research. It is situated in Rajajinagar, the Western part of Bangalore, Karnataka. Chan Re Rheumatology and Immunology hospital is a unique one of its kind hospital in India, dedicated for management of patients suffering from Rheumatic Diseases and other Immunological diseases.

Plate 3.1 ChanRe Hospital with Staff   Plate 3.2 Location Map of ChanRe

3.5 Study Duration

The study was conducted for a period of 2 months.

3.6 Selection of Subjects

Inclusion Criteria

1. Newly diagnosed and follow up autoimmune disease patients.
2. Patients with any autoimmune condition.
3. Patients who are pregnant irrespective of their trimester.

Exclusion Criteria

1. Age – less than 25 years and more than 70 years
2. Sex – male

Sample Size

The following formula was used to determine the sample size:$(Z\ score)^2$ X standard deviation X $(1 -$ standard deviation)

$(Confidence\ interval)^2$ Therefore, the sample size is 100.

Types Of Sampling

The subjects of the present study were selected on the basis of purposive or judgement random sampling. Purposive or Judgement sampling also a convenience sampling is defined as one in which the researchers choose the subjects specifically based on whether the subject is a good representative of the population.

In this study the subjects were chosen based on their gender, the age group and if they were diagnosed with the autoimmune condition.

3.7 Study Tools

Vehicles that generally aid research and related activities are referred to as study tools. Research Tools make it possible for researchers to compile, arrange, analyse, illustrate, and disseminate the results of their work. The study tools involved in this study are:

- A validated self-developed questionnaire
- 24-hour dietary recall

A Validated Self Developed Questionnaire

A questionnaire was developed covering various domains of the autoimmune disease including the experience and perception of foods by the subjects. The questionnaire was further validated using 5 domain experts of various aspects such as academician, Research Scholar, former student, patient suffering from an autoimmune condition and a certified nutritionist. The questionnaire consisted of six components as follows –

- Sociodemographic Details
- Symptoms Manifestations
- Food Frequency Questionnaire
- Impact of Various Foods on the Disease
- Fatigue and Pain Assessment
- Lifestyle and Environmental Factors

- Sociodemographic Details – this section consisted of questions regarding the participant's age, socioeconomic status according to the Kuppuswamy scale 2022, their anthropometric status, and which condition they are diagnosed with.
- Symptoms Manifestation – This section contained 12 questions in the various common symptoms which are seen during the flare up of autoimmune condition.
- Food Frequency Questionnaire – this section consisted of questions on the patient's dietary and eating habits as well as their frequency of consuming a particular food group.
- Impact of Various Food on the Disease – this section consisted of a list of foods which were categorised into experienced +, experienced -, perceived +, and perceived – according to the participant's personal experience and perception.
- Fatigue and Pain Assessment – a fatigue severity scale and a pain measurement scale were used to assess the degree of fatigue and pain the participant suffer.
- Lifestyle and Environmental Factors – this section consisted of 11 questions in all. It included questions on family support and intervention, lifestyle behaviours like smoking, consumption of alcohol, physical activity, climatic adaptations and stress.

24 Hour Dietary Recall

A 24-hour dietary recall was taken on the participant's previous day consumption. The portion size was recorded by showing them various measuring cups and spoons and determining the accurate quantity consumed. Macronutrients like energy, proteins, carbohydrates, fat and two micronutrients, calcium and vitamin D were calculated for the entire day's intake.

3.8   Data Collection

Formation of Questionnaire

The questionnaire was developed by referring to research articles of the related fields and referring to many previously validated and standard quality of life questionnaires and scales. Considering the opinions of individuals who were diagnosed with autoimmune diseases helped in framing a more efficient questionnaire.

Validation of Questionnaire

Since it was self-developed questionnaire, it required validation. A 5-member panel of various domains were made to validate the questionnaire. The panel consisted of an academician, research scholar, a former student, patient diagnosed with an autoimmune condition (Multiple Sclerosis) and a certified nutritionist.

Ethical Clearance

The data collection which was conducted in Chan Re hospital had to undergo an initial ethical clearance from Chan Re research centre. The clearance was granted by the ethics committee head of Chan Re research centre and permission was granted by the Director of ChanRe hospital.

Preparation of questionnaire in Hard Copy format

100 copies of validated questionnaire were then printed for offline face to face interview with the subjects.

Choosing of Samples

According to the requirement of the study, only females belonging to age group of 25

– 70 years were chosen as the population group. The subjects must be diagnosed with any autoimmune condition. The sample size was 100.

Confidentiality and consent of the participants

The subject participants were assured that their details will be highly confidential and were made to sign a consent form, confirming their participation.

Conduction of survey

The survey was conducted on the spot on a face-to-face interview basis. The subjects were asked questions from the questionnaire and the questions were filled.

Plate 3.3 Patients in the waiting room

Plate 3.4 Conducting survey with the subjects

Plate 3.5 Measuring spoons

Plate 3.6 Measuring cups

The 24-hour recall of the subjects were recorded with the help of measuring cups and measuring spoons.

Data consolidation in MS Excel

The collected data of 100 subjects are then entered in MS excel as raw data and then coded respectively.

3.9 Statistical Analysis

The statistical analysis involved in this study are:

- Descriptive analysis of data
- Mean and standard deviation
- Bar graphs, pie charts and Radar graphs
- Scatter plot graphs

CHAPTER 4 RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

The overall study's aim was to analyse the perception qualitatively and quantitatively on the food and dietary habits among autoimmune female patients. The primary data was collected from 100 subjects belonging to the age group of 25-70 years. The study included analysis of the symptom manifestations, their food consumption frequency, 24-hour recall, fatigue and pain assessment and influence of environmental and lifestyle factors on the autoimmune conditions. The following are the objectives of the study:

- To analyse the food perceptions of autoimmune patients in association with their symptoms.
- To assess the intake of foods and adequacy of nutrients by dietary recall method.
- To assess the various types of autoimmune diseases and impact on the quality of life.

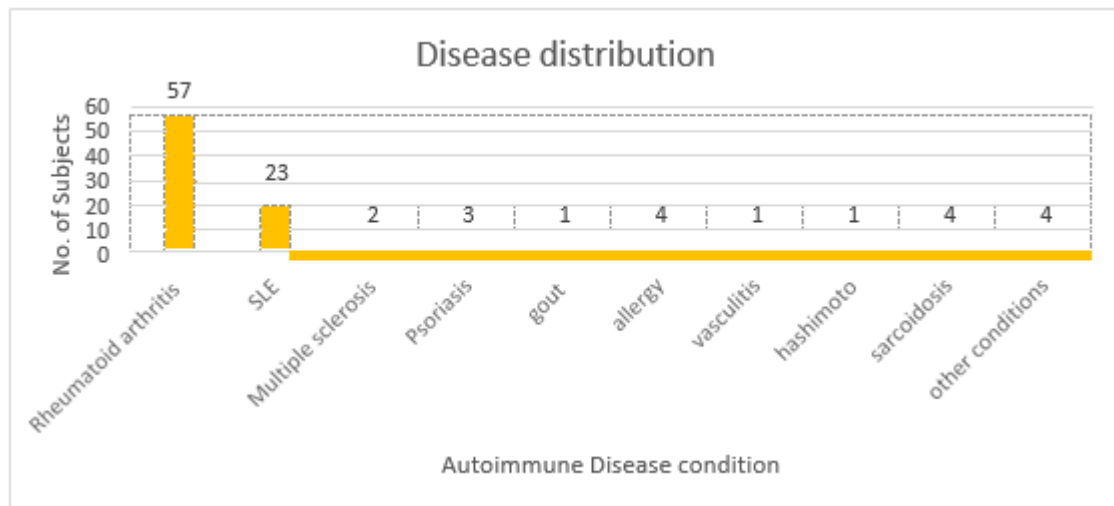The outcomes are discussed below:

4.1 Disease conditions

Figure 4.1 Autoimmune conditions of 100 subjects

Figure *4.1* throws light on the autoimmune disease distribution of the subjects (n=100). It is evident that 57% of the subjects were diagnosed with Rheumatoid Arthritis (RA). 23% of the subjects had Systemic Lupus Erythematosus (SLE). Other types of disease were few in numbers, so it was considered for the analysis of this study.

4.2 Education Qualification

Table 4.1 Education Qualification of all Subjects

Education	n	%
Graduate	53	53
Professional Degree	21	21
High School	12	12
Intermediate	9	9
Middle School	4	4

Primary School	1	1
Grand Total	**100**	**100**

Table 4.2 Education Qualification of Rheumatoid Arthritis (RA) diagnosedSubjects

Education	**n**	**%**
Graduate	31	54
Professional Degree	11	19
Intermediate	6	11
High School	5	9
Middle School	4	7
Grand Total	**57**	**100**

Table 4.3 Education Qualification of Systemic Lupus Erythematosus (SLE)diagnosed Subjects

Table *4.1* reveals the education qualifications of the 100-sample population taken for the study. most of the subjects were graduates (53%) followed by professional degreeholders (21%).

Table *4.2* and Table *4.3* elucidates the education qualification of subjects diagnosed with rheumatoid arthritis (57%) and systemic lupus erythematosus (23%) respectively It was inferred most of the subjects who were diagnosed with Rheumatoid Arthritis were graduates (54%) followed by professional degree holders. The subjects diagnosed with SLE were mostly graduates (48%) and high school pass out (26%).
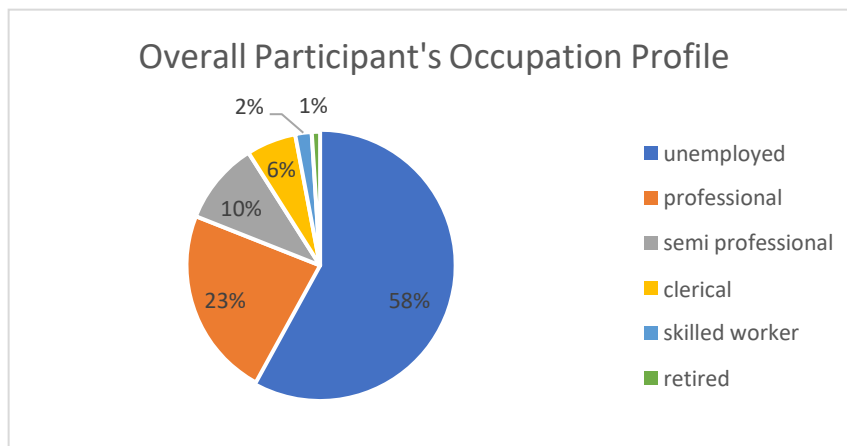
4.3 Occupation Level
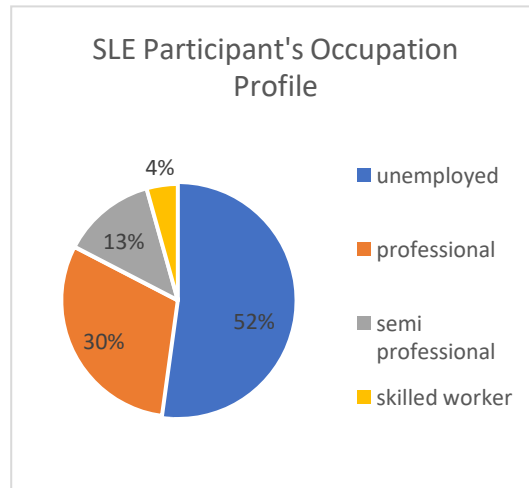

Figure 4.2 Occupation Level of all Subjects (n=100)

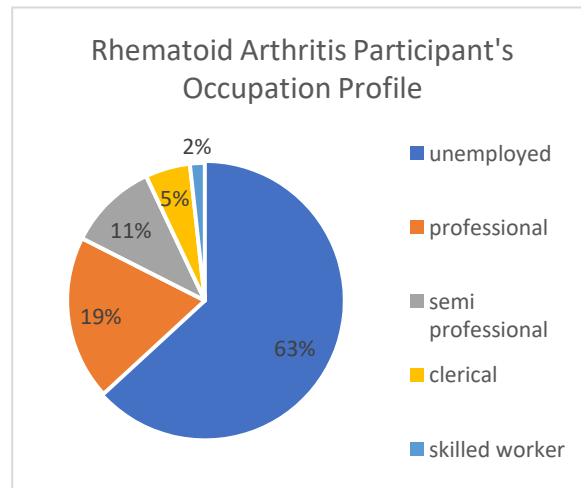**Figure 4.3 Occupation Level of RASubjects (n=57)**

Figure 4.4 Occupation Level of SLESubjects (n=23)

The above figures highlight the occupational status of the subjects involved. It was seen in all the three figures that the majority subjects were unemployed or were considered as home makers. The total subjects, subjects diagnosed with RA and subjects diagnosed with SLE who were home makers were 58%, 63% and 52% respectively. It was found that 6.3% of home makers who were diagnosed with rheumatoid arthritis were graduates and 21% of home makers who were diagnosed with SLE were graduates. Therefore, it can be noted that home maker has a greater chance of getting autoimmune disease as only women subjects who were homemakerspredominated the study population.

4.4   Body Mass Index (BMI)

Table 4.4 BMI of the Subjects

	Overall Subjects		Rheumatoid Arthritis Subjects		SLE Subjects	
BMI	**n**	**%**	**n**	**%**	**n**	**%**
Normal	54	54	26	46	18	78

obese class I	10	10	6	11	1	4
obese class III	2	2	1	2	-	-
Overweight	27	27	21	37	1	4
severely underweight	1	1	1	2	-	-
Underweight	6	6	2	4	3	13
Grand Total	**100**	**100**	**57**	**100**	**23**	**100**

With reference to the above Table *4.4*, normal BMI (18.5-24.9 kg/m^2) was reported among 54% total population. RA (46%) and SLE (78%). Overweight category reported 27% and among RA (37%) were reported. It was observed that most subjectsdiagnosed with autoimmune condition had a normal BMI.

4.5 Symptoms Manifestation
Table 4.5 Symptoms manifestations of All Subjects (n=100)

Overall Subject Symptoms	Always		Often		Sometimes		Rarely		Never	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Do you wake up tired, feel tired throughout the day?	8	8	30	30	29	29	14	14	19	19
Do you have joint pain or swelling unrelated to any injury?	24	24	35	35	17	17	14	14	10	10
Is your skin itchy, red, or swollen for no reason?	7	7	18	18	20	20	28	28	26	26
Do you get a lump on the side of your throat?	-	-	4	4	4	4	13	13	79	79
Have you been experiencing unexplained numbness in theextremities?	21	21	30	30	18	18	12	12	19	19
Do you have butterfly shapedrashes on your face?	17	17	13	13	8	8	10	10	52	52
Do you get frequent mouthulcers?	1	1	2	2	22	22	35	35	40	40
Do you face any difficulty walking?	10	10	31	31	17	17	14	14	28	28
Do you find difficulties in doing day today activities?	5	5	27	27	27	27	13	13	28	28
Are you able to concentrate?	64	64	15	15	8	8	10	10	3	3
Do you have patches that arered scaly which itch?	9	9	19	19	7	7	20	20	45	45
Do you experience any stiffness or pain in the	21	21	30	30	22	22	17	17	10	10

joints?										

Table 4.5 indicated symptoms manifestation (n=100), ability to concentrate (64%) followed by joint pain unrelated to injury (24%), unexplained numbness and stiffness of joints (21%) were the common symptoms manifested among the study subjects. The frequency of symptoms manifestations varied greatly among the study subjects.

Table 4.6 Symptoms manifestation of subjects diagnosed with Rheumatoid Arthritis(n=57)

RA Symptoms	Always		Often		Sometimes		Rarely		Never	
	n	%	n	%	n	%	n	%	n	%
Do you wake up tired, force yourself through your day feeling tired, and have trouble	4	7	18	32	20	35	7	12	8	14
Do you have jointpain or swelling unrelated to any injury or known cause?	20	35	25	44	5	9	6	11	1	2
Have you been experiencing unexplained pain or numbness, particularly in the extremities?	14	25	24	42	6	11	4	7	9	16
Do you face any difficulty walking?	8	14	25	44	7	12	3	5	14	25
Do you find difficulties in doing day today activities which involves yourmotor skills like holding, pushing pulling etc?	7	12	18	32	17	30	3	5	12	21
Do you experience any stiffness or pain in the joints especially your knees andfingers?	22	39	18	32	8	14	4	7	5	9

In Table *4.6* among RA, joint related symptoms were most commonly experienced joint pain (35%), stiffness of joints at knees and fingers (39%) were reported among the subjects diagnosed with RA.

Table 4.7 Symptoms manifestation of subjects diagnosed with SLE (n=23)

SLE Symptoms	Always		Often		Sometimes		Rarely		Never	
	n	%	n	%	n	%	n	%	n	%
Is your skin itchy,red or swollen forno apparent reasons	0	0	11	48	5	22	4	17	3	13

Do you have butterfly shapedrashes on your face?	10	43	10	43	2	9	0	0	1	4
Do you get frequent mouthulcers?	1	4	1	4	12	52	6	26	3	13
Do you have patches that are redscaly which itch badly on your body?	4	17	11	48	4	17	2	9	2	9

As discussed in Table *4.7*, it was concluded that subjects who had problems with their skin were associated with Systemic Lupus Erythematosus (SLE) condition. Among SLE patients, butterfly shaped rashes on face (43%) predominated among symptoms experienced

4.6 Dietary Habits
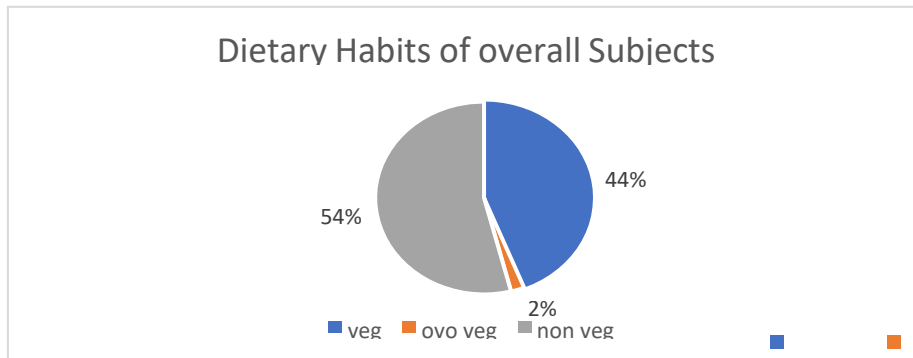
Figure 4.5 Dietary habits of all subjects (n=100)
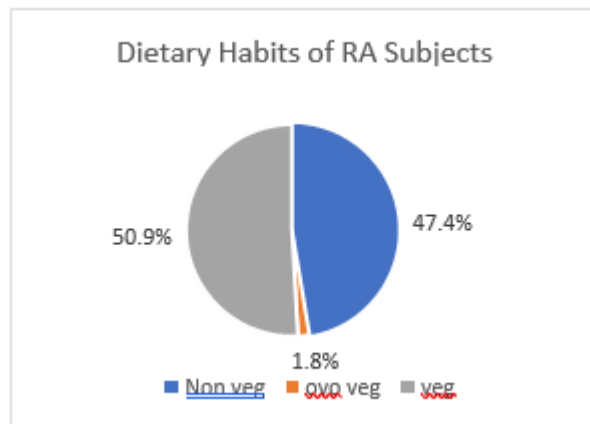
Figure 4.6 Dietary habits of all subjects(n=57)

Figure 4.7 Dietary habits of all subjects(n=23)

The above figures throw light on the dietary habits of all the 100 subjects and subjects who were diagnosed with RA and SLE. In Figure *4.5* it was seen that, 54% of subjects were non-vegetarians and 44% were vegetarians. A small percentage of subjects belonged to the ovo-vegetarian (2%) group.

Similarly, among subjects diagnosed with RA, 50.9% of subjects were vegetarians, 47.4% were non-vegetarians and 1.8% were ovo-vegetarians. As the distribution between vegetarian and non-vegetarian subjects were equally distributed, it was irrelevant to associate the RA autoimmune conditions with the dietary habits of the subjects.

In subjects diagnosed with SLE, the distributions were 39.1% vegetarian and 60.8% non-vegetarians. As the subject size is small, it is inconclusive to state the association of dietary habit of the SLE subjects.

4.7   Food frequency
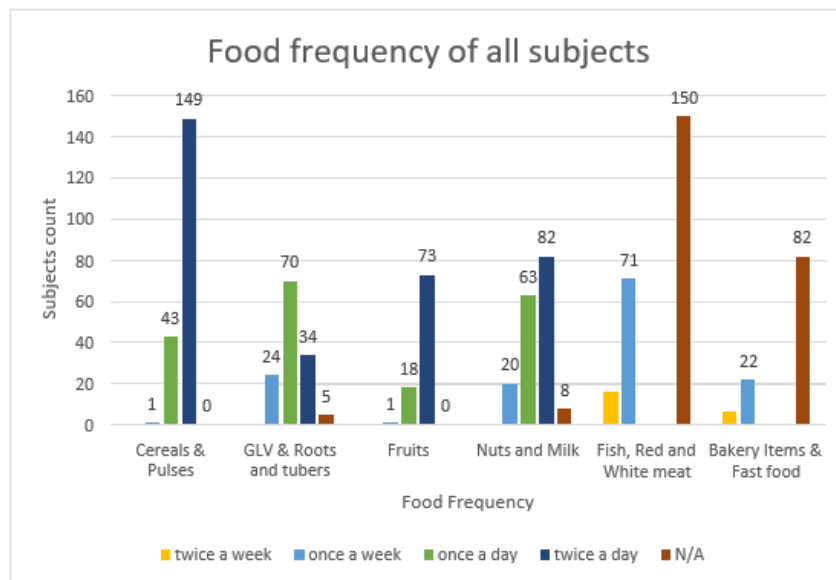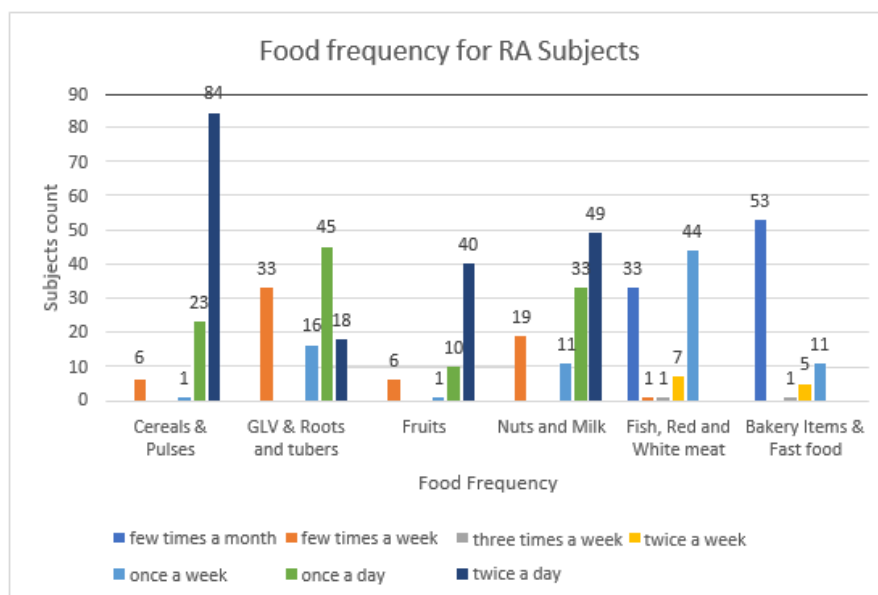

Figure 4.8 Food frequency of all subjects (n=100)

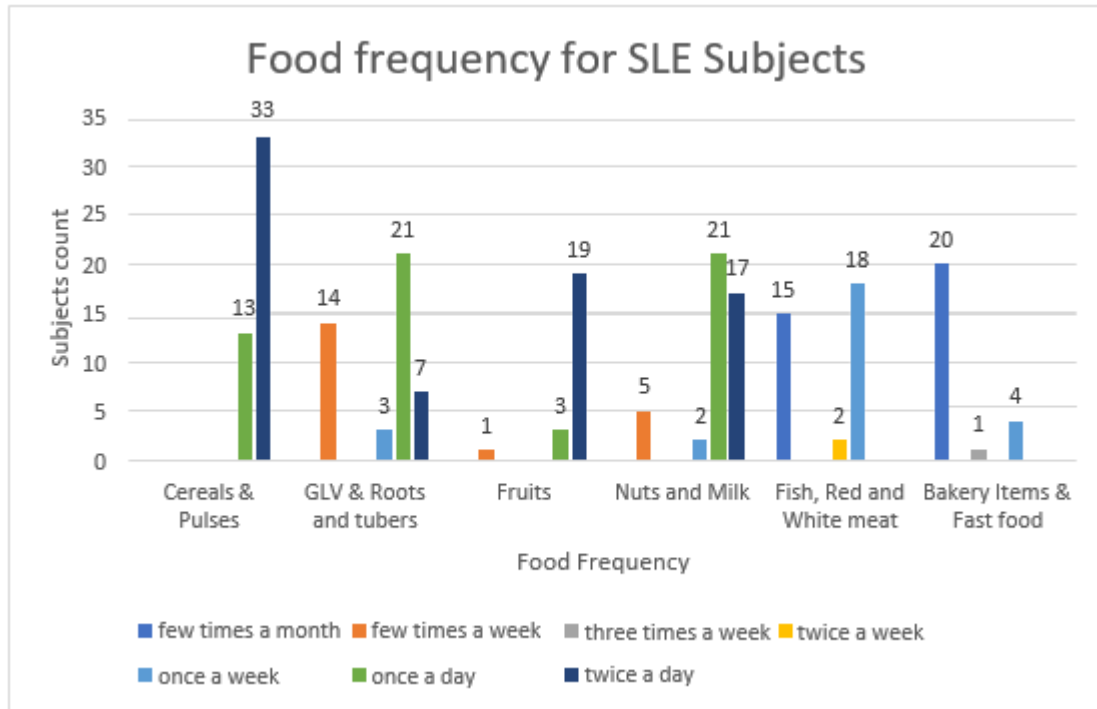**Figure 4.9 Food frequency of Rheumatoid arthritis Subjects (n=57)**

Figure 4.10 Food frequency of SLE Subjects (n=23)

The figures *Figure 4.8, Figure 4.9* and *Figure 4.10* represent food frequency of All, RA and SLE subjects. The food frequency pattern in all the three were having similar trends.

It was seen that cereals and pulses were consumed mostly twice a day, green leafy vegetables once a day, fruits twice a day, nuts and milk twice a day, fish, red and white meat once a week and bakery and fast foods once a week. It is observed in the study that consumption of meat was negligible among the subjects. Subjects not consuming bakery or fast food may indicate that the subjects may be more conscious or aware of the negative impacts of these foods on their conditions.
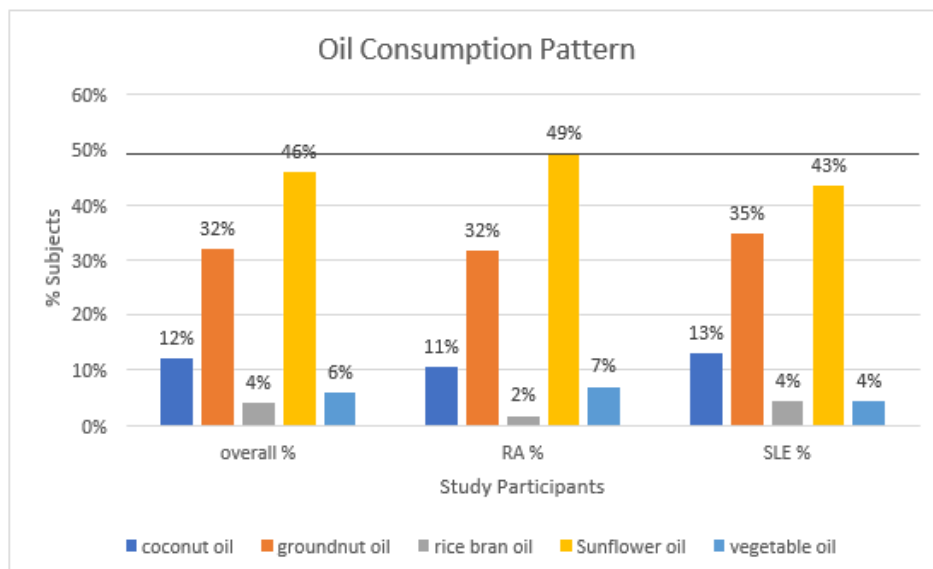
4.8 Oil consumption

Figure 4.11 Oil consumption pattern of all subjects, subjects diagnosed with RA and SLE

From the above figure it was seen that Oil consumption patterns are identical across all the subjects irrespective of their condition. Sunflower oil was the most used in household cooking followed by groundnut oil. Therefore, there is a possibility that consumption of Sunflower oil could influence the proinflammatory condition.

A study was found on the comparison autoimmune disorders with naturally occurring linoleic acid related genetic variants. It was found that linoleic acid protects against RA and SLE.(Zhao & Schooling, 2019).

4.9   Salt intake

Table 4.8 Salt intake of all subjects, subjects diagnosed with RA and SLE

Questions	Overall %		RA %		SLE %	
	Yes	No	Yes	No	Yes	No
Do you add salt to your food	96	4	96	4	100	0
Do you consciously avoid salty foods	32	68	35	65	39	61

In general, more than 95% of subjects include salt in their food. However, an average of 35% of subjects consciously avoid consuming salty food.

Using slow release NaCl pills in addition to their regular diets, eight subjects were given an increased salt intake for 14 days in a pilot trial. An increase in CD4+IL- 17A+TNF+Th17 cells was found after analysis of peripheral blood lymphocytes, which is a symptom that chronic immune-mediated illnesses are progressing.

4.10   Breakfast consumption pattern

Table 4.9 Frequency of breakfast intake of all subjects, subjects diagnosed with RA and SLE

Breakfast consumption	Overall		RA		SLE	
	n	%	n	%	n	%
Everyday	93	93	54	95	22	96
Almost everyday	4	4	2	4	1	4
Few times a week	2	2	1	2	-	-
Once a week	1	1	-	-	-	-

Feeling fatigued throughout the day was most often associated with not consuming breakfast every day. Among all the 100, 93% consumed breakfast and same was seen in RA (95%) and SLE (96%). Therefore, it can be concluded that the fatigue caused in these subjects was not due to lack of consumption of breakfast everyday but can be associated as one of the symptoms of autoimmune condition or even the effects of medications.

4.11   Nutrients recommendation analysis

The below graphs are analysed in four Quadrant viz. Q1, Q2, Q3, Q4 as indicated in each of the graph.
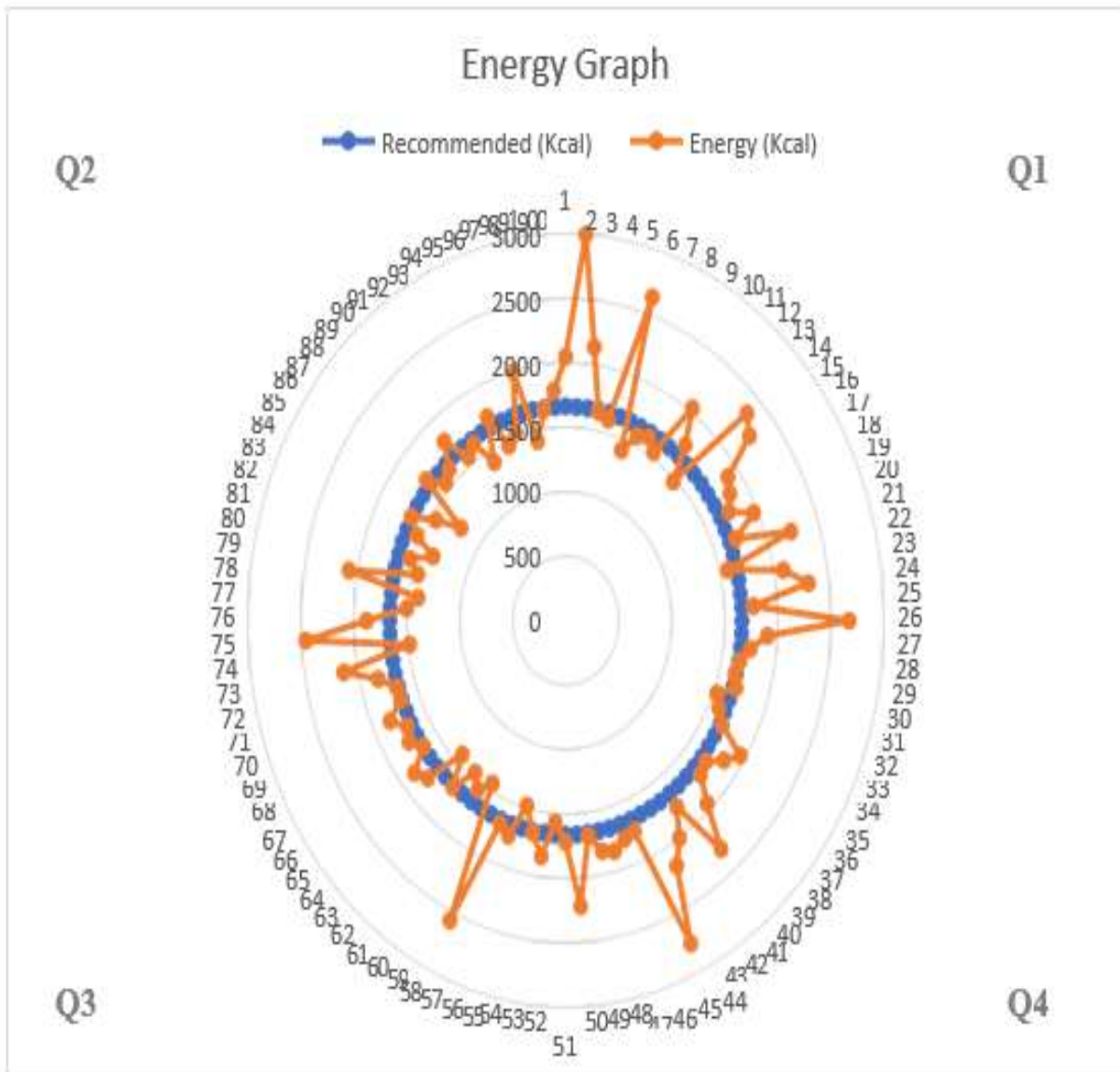
Energy recommendation analysis

Figure 4.12 Energy Consumption versus Recommendation (EAR 2020) (n=100)

The above Figure *4.12*, indicates the energy consumption of all the 100 Subjects against the energy recommendations according to the EAR 2020. In Q1, it was observed that the subject's energy intake was more than the recommended value. However, in Q2, Q3 and Q4, the subjects energy intake was much closer to the recommended value with few exceptions. 26% in Q1, 12% in Q2, 28% in Q3 and 34% in Q4 exceeds theirenergy intake when compared to EAR 2020. Overall, the subjects energy intake were in align with the recommended value and so energy intake did not have any association with the development of autoimmune disease.

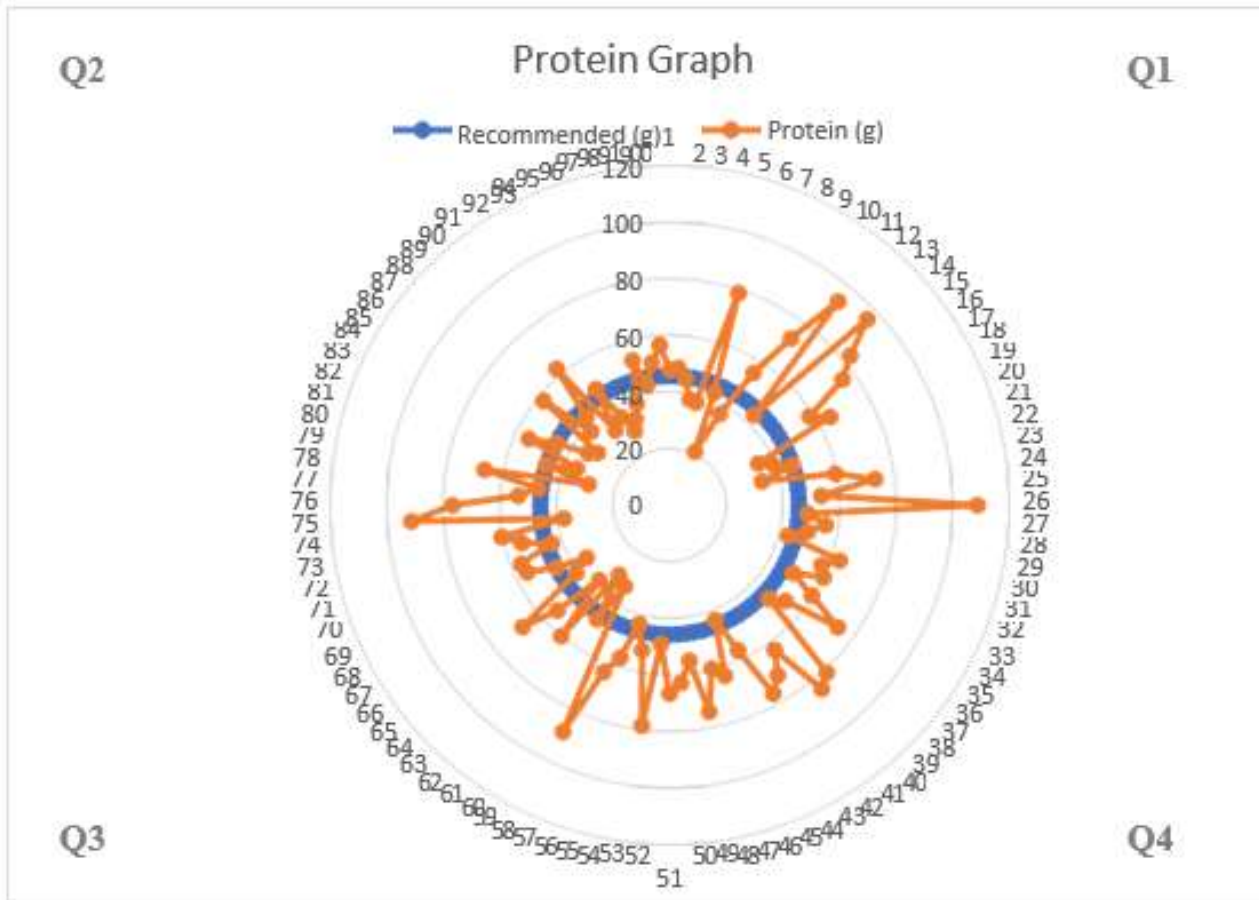**Protein recommendation analysis**

Figure 4.13 Protein Consumption versus Recommendation (RDA 2020) (n=100)

The above Figure *4.13*, indicated the protein consumption of all the 100 Subjects against the protein recommendations according to the RDA 2020. In Q1 and Q4, it was observed that the subject's protein intake was more than the recommended value. However, in Q2, and Q3, the subjects average protein intake was much closer to the recommended value with few exceptions. 32% in Q1, 38% in Q2, 24% in Q3 and 6% in Q4 subject's protein intake was below the recommended level of RDA 2020. Overall, the subjects protein intake were in 50% aligned and 50% exceeding the recommended value and so protein intake association with the development of autoimmune disease becomes inconclusive.

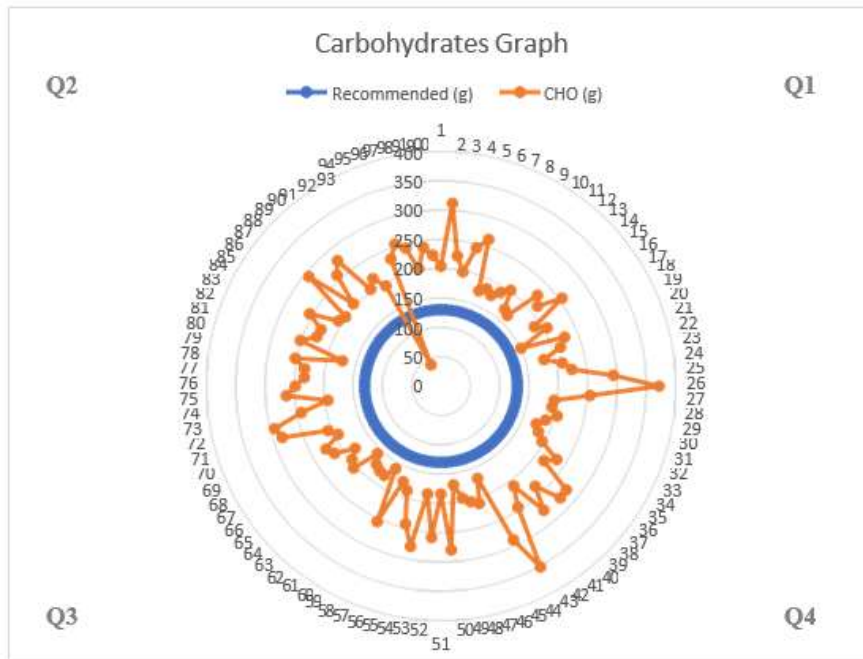## Carbohydrates recommendation analysis

Figure 4.14 Carbohydrates Consumption versus Recommendation (EAR 2020) (n=100)

The above Figure *4.14*, indicates the carbohydrates consumption of all the 100 Subjects against the carbohydrate recommendations according to the EAR 2020. Clearly the carbohydrates intake is above the recommended value. As carbohydrates is the staple food for the subjects, this is an expected trend. So, correlating this high consumption of carbohydrates to the autoimmune condition is not appropriate. However, considering gluten factor, which is the major constituent of carbohydrates, (which is responsible for the development of Celiac disease, Crohn's disease) there is a possibility association to autoimmune disease.
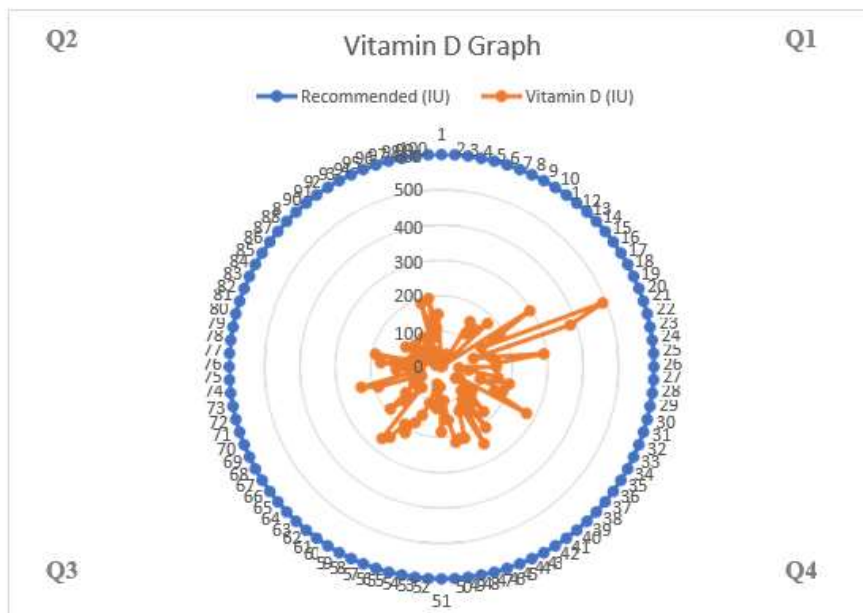
Vitamin D recommendation analysis

Figure 4.15 Vitamin D Consumption versus Recommendation (RDA 2020) (n=100)

The above Figure *4.15*, indicates the Vitamin D consumption of all the 100 Subjects against the Vitamin D recommendations according to the RDA 2020. Vitamin D status of all the subjects is extremely lower than the recommended value. It can be inferred that the deficiency of Vitamin D can be a major factor for the development and prevalence of autoimmune conditions.

Just one in ten RA patients could be kept from relapsing with cholecalciferol treatment, according to Dehghan et al. The effects of systemic lupus erythematosus were significantly reduced by vitamin D supplementation in the patients. 178 SLE patients receiving cholecalciferol treatment showed promising and statistically significant improvement compared to 89 placebo-controlled individuals.
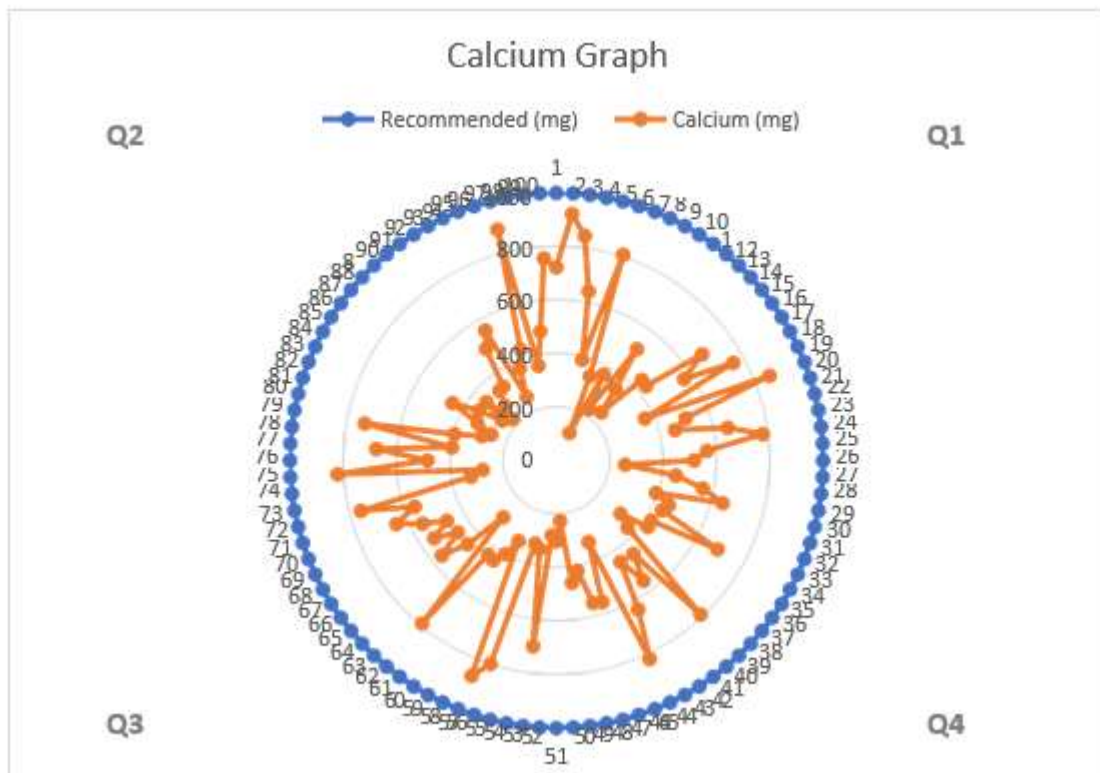
Calcium recommendation analysis

Figure 4.16 Calcium Consumption versus Recommendation (RDA 2020) (n=100)

The above Figure *4.16*, indicates the Calcium intake of all the 100 Subjects against the Calcium recommendations according to the RDA 2020. Normally Vitamin D helps in the absorption of Calcium. Therefore, it is expected that due to the deficiency of Vitamin D, there will also be a deficiency in calcium. This is evidently shown in the subjects' calcium level, as it is consistently lower than the recommended value. Calcium influences bone health, so there are high chance for prevalence of rheumatoid arthritis. Since vitamin D intake was insufficient, the absorption would definitely be challenged.
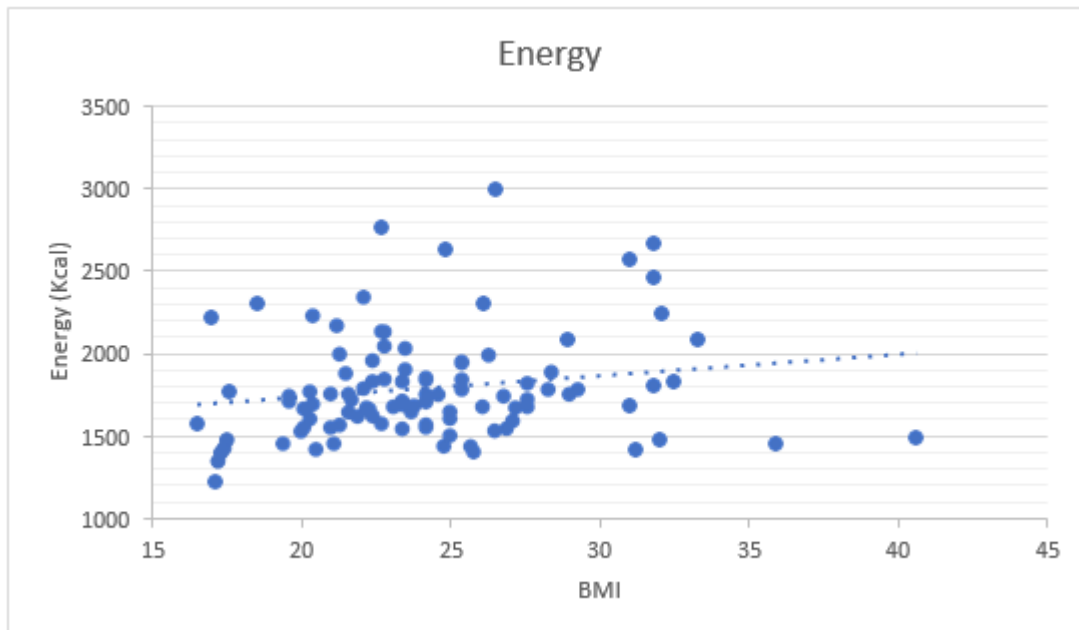
4.12 BMI versus Nutrients trends

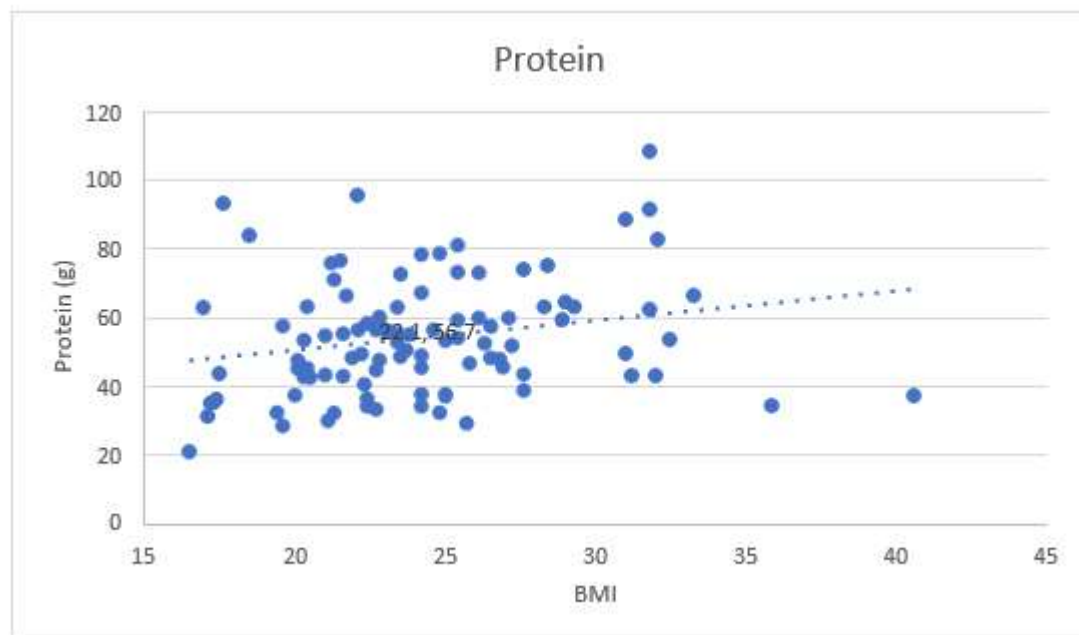**Figure 4.17 Energy consumption versus BMI (n=100)**

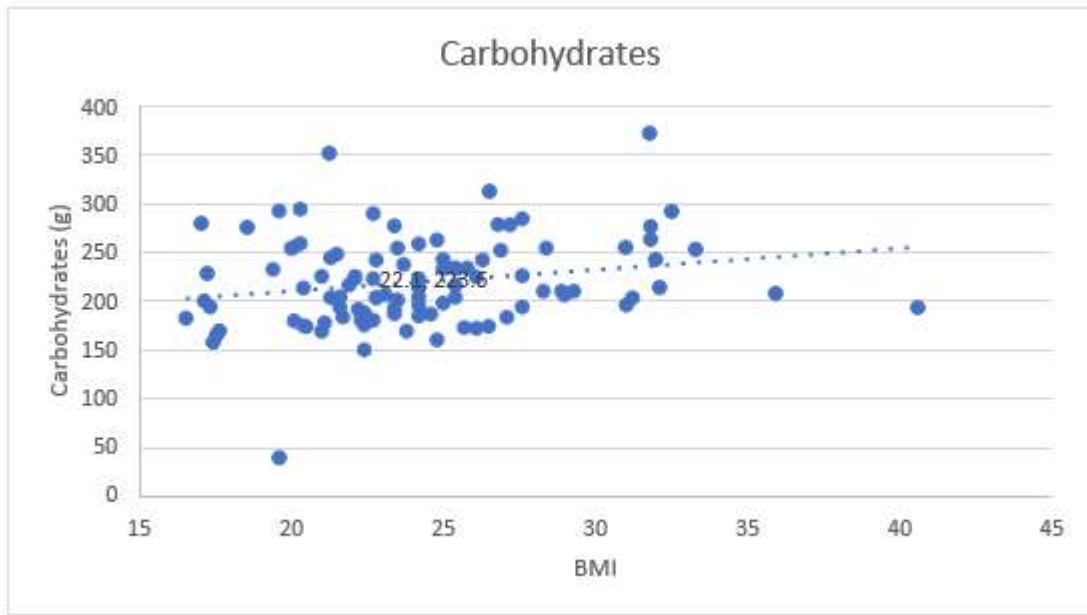**Figure 4.18 Protein consumption versus BMI (n=100)**

Figure 4.19 Carbohydrates consumption versus BMI (n=100)
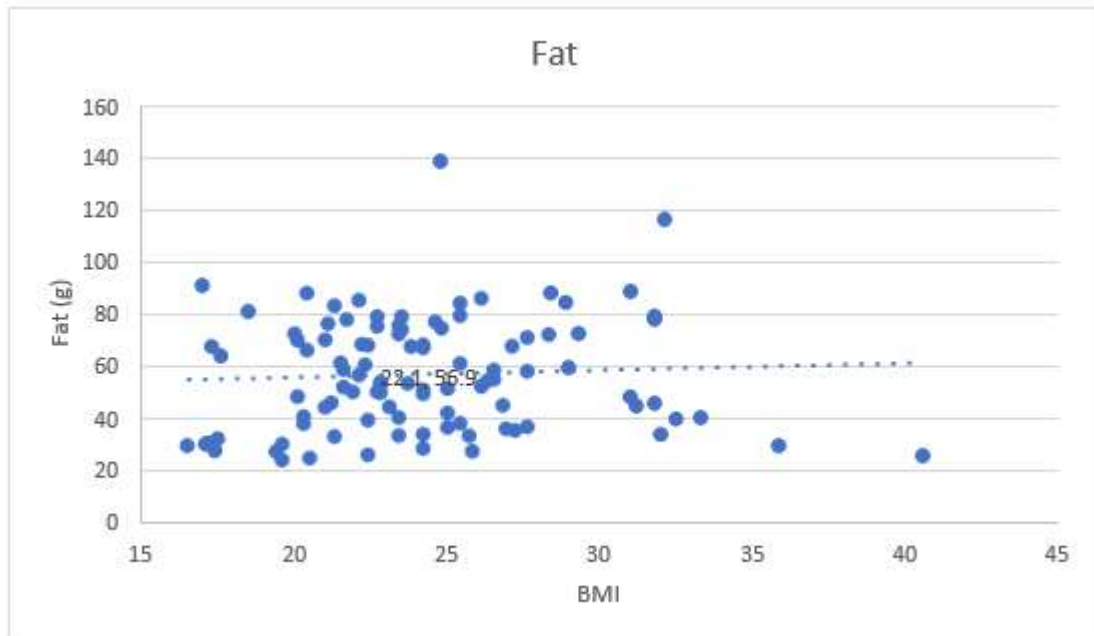
Figure 4.20 Fat consumption versus BMI (n=100)
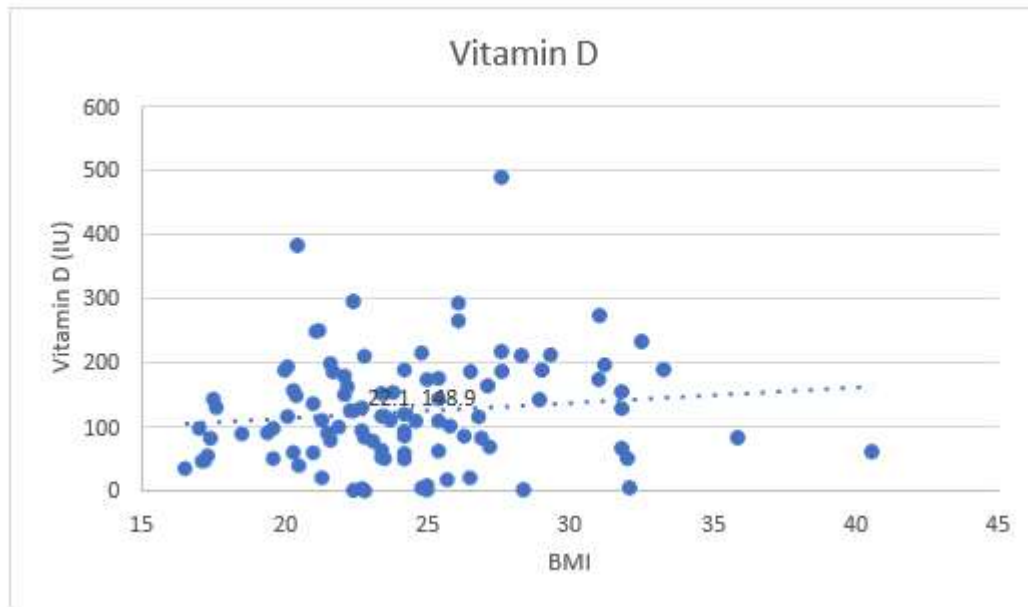
Figure 4.21 Vitamin D consumption versus BMI (n=100)
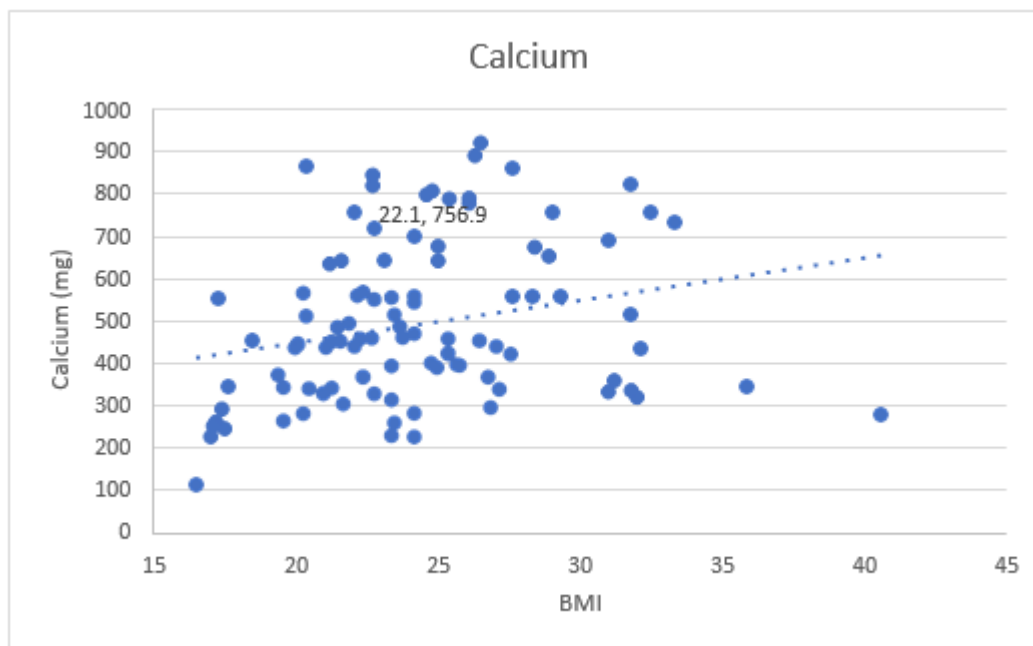
Figure 4.22 Calcium consumption versus BMI (n=100)

The above nutrient versus BMI graphs shows these following trends:

- Energy intake shows a linearly increasing trend as BMI increases.
- Similarly, protein intake shows a linearly increasing trend as BMIincreases.
- Carbohydrate intake exhibited a marginal increase in trend across BMI
- Fat intake was constant across BMI.
- Vitamin D intake also showed constant trend across BMI.
- Calcium intake showed a linearly increasing trend as BMI increases.

4.13 Impact of foods on the autoimmune condition

Table 4.10 Experiences and perceptions on certain foods among all Subjects (n=100)

Foods	Experienced Positive		Experienced Negative		Perceived Positive		Perceived Negative	
	n	%	n	%	n	%	n	%
Whole wheat	7	7	13	13	1	1	6	6
Maida	3	3	39	39	-	-	10	10
Channa dal	3	3	16	16	-	-	18	18
soya	1	1	7	7	-	-	22	22
Chicken	3	3	4	4	2	2	6	6
Egg	2	2	26	26	-	-	2	2
Milk	7	7	21	21	1	1	9	9
Ginger	13	13	3	3	1	1	9	9
Turmeric	18	18	-	-	10	10	-	-
Coffee	1	1	14	14	1	1	17	17
Fast food	-	-	17	17	-	-	21	21
Fried foods	1	1	23	23	-	-	23	23

The above Table *4.10* indicated the various impact and notions on particular foods (n=100). It was seen that 18% of subjects had a positive experience with consumption of turmeric and 13% of subjects had a positive experience with ginger intake. With respect to negative experience with food 39% of subjects had a flareup of symptoms on consuming Maida or refined wheat products and 26% of subjects had a negative experience on consumption of egg. 21% of subjects had an intolerance to milk and fried food (23%) as well. The subject's perception on food also played a major role. Turmeric (18%) and ginger (13%) predominated the foods that influenced a positive experience among the study subjects. Other foods like soya (22%), chana da (18%), coffee (17%) and maida (10%) had a negative impact on their disease condition. Consumption of fast food (21%) and fried foods (23%) could increase the intensity of their symptoms or can cause gastrointestinal discomfort.

Table 4.11 Experiences and perceptions on certain foods among RA Subjects (n=57)

Foods	Experienced Positive		Experienced Negative		Perceived Positive		Perceived Negative	
	n	%	n	%	n	%	n	%
Maida	19	33	-	-	-	-	-	-
Rice	-	-	5	9	-	-	-	-
Egg	12	21	-	-	-	-	-	-
Maida	-	-	-	-	8	14	-	-
Ginger	-	-	4	7	-	-	5	9
Soya	-	-	-	-	10	18	-	-
Milk	13	23	4	7	-	-	-	-
Chenna Dal	-	-	-	-	12	21	-	-

Foods	n	%	n	%	n	%	n	%
Garlic	-	-	4	7	-	-	7	12
Coffee	10	18	-	-	9	16	-	-
Turmeric	-	-	7	12	-	-	6	11
Tea	11	19	-	-	7	12	-	-
Whole Wheat	-	-	4	7	-	-	-	-
Fried foods	10	18	-	-	14	25	-	-
Honey	-	-	4	7	-	-	-	-
Fast food	-	-	-	-	10	18	2	4

The above Table *4.11* shows the various impact and notions on particular foods on subjects diagnosed with rheumatoid arthritis. It was seen that 33% of subjects had a negative experience with consumption of Maida or refined wheat flour products and 23% of subjects had a negative impact on the intake of milk. 12% of subjects had a positive impact on consumption of turmeric. The subjects also had a positive experience on consuming rice (9%). Most of the subjects had a negative perception with fried foods (25%) and Channa dal (21%) as they associated it with gastrointestinal problems like gas formation and bloating. Many of the subjects also had negative perception on consuming soya (18%) and fast foods (18%). The subjects had positive perception on few foods like ginger (9%), garlic (12%), turmeric (11%) and fast food (4%).

Table 4.12 Experiences and perceptions on certain foods among SLE Subjects(n=23)

Foods	Experienced Positive		Experienced Negative		Perceived Positive		Perceived Negative	
	n	%	n	%	n	%	n	%
Maida	12	52	-	-	-	-	-	-
Ginger	-	-	5	9	-	-	3	5
Channa Dal	8	35	-	-	4	7	-	-
Garlic	-	-	5	9	-	-	3	5
Egg	9	39	-	-	-	-	-	-
Soya	-	-	-	-	7	12	-	-
Milk	6	26	-	-	-	-	-	-
Honey	-	-	4	7	-	-	-	-
Fried foods	7	30	-	-	7	12	-	-
Fast food	-	-	-	-	8	14	-	-
Turmeric	-	-	6	11	-	-	2	4
Coffee	-	-	-	-	5	9	-	-
Tea	-	-	-	-	5	9	-	-

The above Table *4.12* shows the various impact and notions on particular foods on subjects diagnosed with systemic lupus erythematosus. It was seen that 52% of subjects had a negative experience with

consumption of Maida or refined wheat flour products and 39% of subjects had a negative impact on the intake of egg. Consumption of Channa dal also had a negative impact on 35% of subjects. 11% of subjects had a positive impact on consumption of turmeric. The subjects also had a positive experience on consuming ginger (9%) and garlic (9%). Most of the subjects had a negative perception with fast foods (14%) and soya (12%). The subjects had positive perception on few foods like ginger (5%), garlic (5%) and turmeric (5%)

4.14   Fatigue and Pain assessment

Table 4.13 Fatigue and Pain scale assessment (n=100)

Assessment Questions	Scale: 1 is Strongly Disagree and 7 is Strongly Agree
I am less motivated when I am tired.	3.73±1.67(1-7)
My fatigue increases after exercise	2.72±1.92(1-7)
I get tired quite easily	3.47±1.76(1-7)
Fatigue affects how I physically operate.	3.02±1.45(1-7)
Problems are frequently caused by fatigue.	3.01±1.40(1-7)
Fatigue limits the ability to maintain physical activity.	3.1±1.83(1-7)
Fatigue makes it difficult to do tasks.	2.57±1.74(1-7)
One of my most incapacitating symptoms is fatigue.	3.29±1.41(1-7)
My professional, family, and social lives are all impacted by my fatigue.	3.25±1.65(1-7)
Visual analogue fatigue severity (VAFS)	4.20±2.31(1-10)
Pain Measurement scale	4.1±2.1(1-9)

4.15   Family Influence

Table 4.14 Family influence on food choice of All Subjects, RA Subjects and SLE Subjects

	Overall		RA		SLE	
	n=100	%	n=57	%	n=23	%
Always	5	5	3	5	1	4
Often	13	13	6	11	4	17
Sometime	29	29	16	28	8	35
Rarely	26	26	16	28	5	22
Never	27	27	16	28	5	22

Table *4.14* throws light on the influence of family members on the food choices of subjects. The influence from the family members seldom (29% in total subjects) made on the food choices since the subjects decide their choice of food. The same trend is seen in subjects diagnosed with RA and SLE.

Table 4.15 Influence of a particular family member on subject's food choices

Family member	Overall		RA		SLE	
	n=100	%	n=57	%	n=23	%
None	27	27	16	28	5	22
Husband	42	42	24	42	11	48
Mother	15	15	6	11	4	17
Mother-in-law	11	11	7	12	2	9
Friend	1	1	1	2	-	-
Son	1	1	1	2	-	-
Daughter	2	2	2	4	-	-
Sister	1	1	-	-	1	4
Brother	-	-	-	-	-	-

If the family members are making the food choices for the subjects, it was mostly the Husbands (42% for total subjects and RA subjects, 48% for SLE subjects) This could be because of the subject's dependency on their husbands.
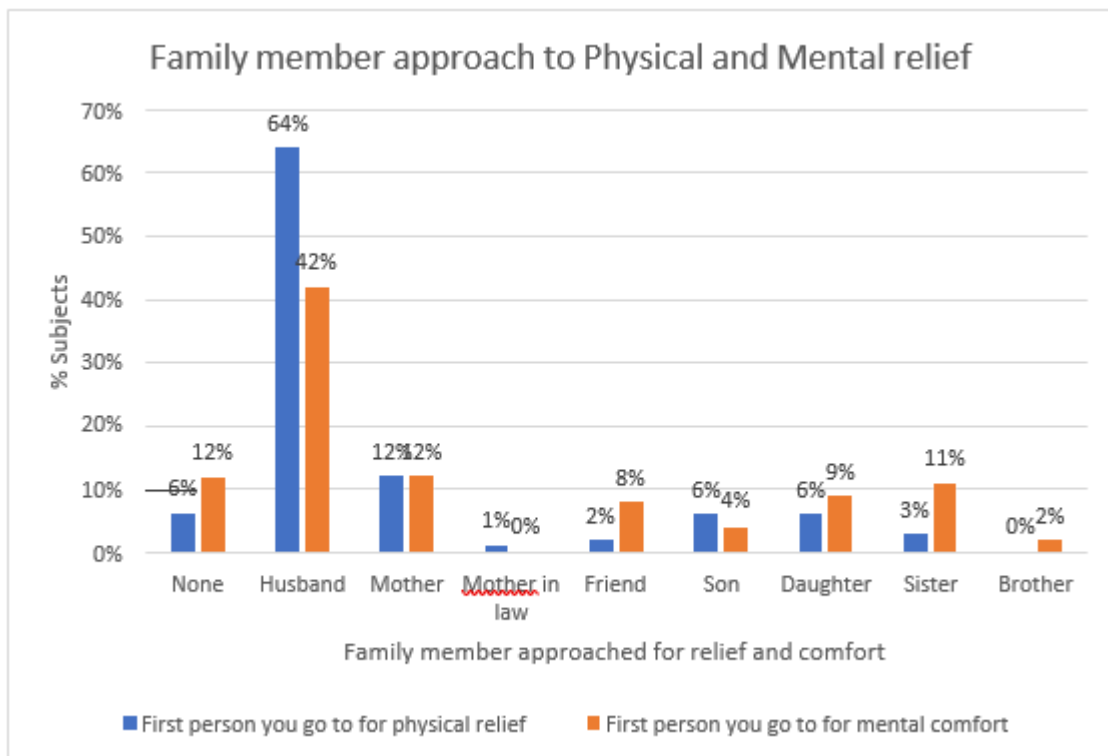

Figure 4.23 Influence of family members as a support to study subjects (n=100)

The above Figure *4.23* depicts the subject's approach to a family member for physical and mental relief. It is found that most of the subjects approach their husbands for physical (64%) and mental (42%) reliefs. This may be because the subjects live with their husbands and can share their physical and mental pain with them more freely.

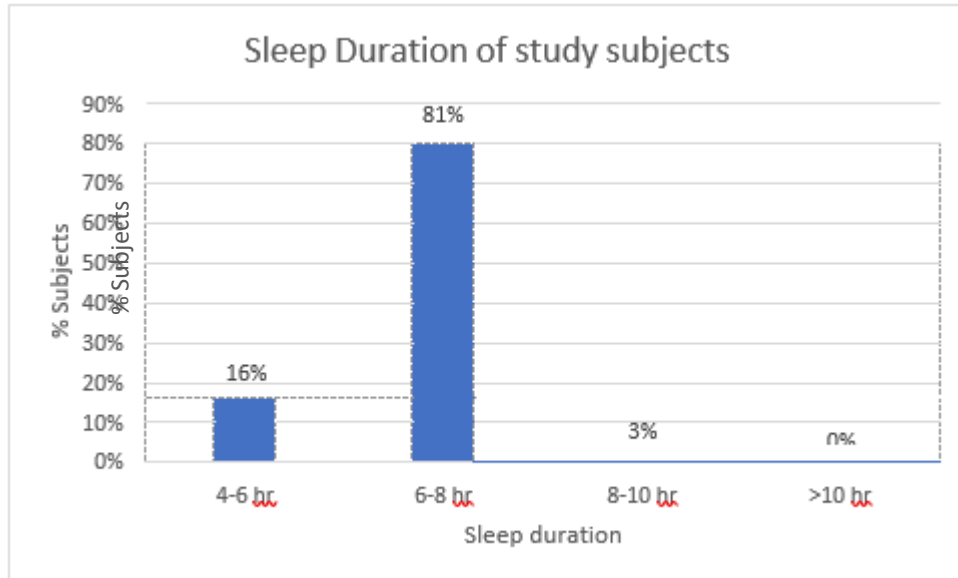## 4.16   Sleep, Exercise, Stress & Climate Influence

Figure 4.24 Sleep duration of Subjects (n=100)

It was observed from that the sleep duration from the above figure indicated that 81% of the subjects sleep for a duration of 6-8 hours which is adequate for a normal individual. However, the quality of sleep was not recorded as a part of this study.

This study also included drinking and smoking habits of the subjects. It was found that negligible number of subjects consumed alcohol, and none smoked. So, smoking and alcohol as a lifestyle habit was not reported among the study subjects.

A study was conducted in Taiwan where two cohorts were followed up for occurrence of autoimmune diseases among non-apnea sleep disorder (NSD) subjects. A cox proportional hazards regression model was used for multivariate adjustment. It was found that the risk of autoimmune diseases among NSD were significantly higher than in control. Therefore patients with non apnea sleep disorder were associated with a high risk for developing autoimmune diseases.(Hsiao et al., 2015)
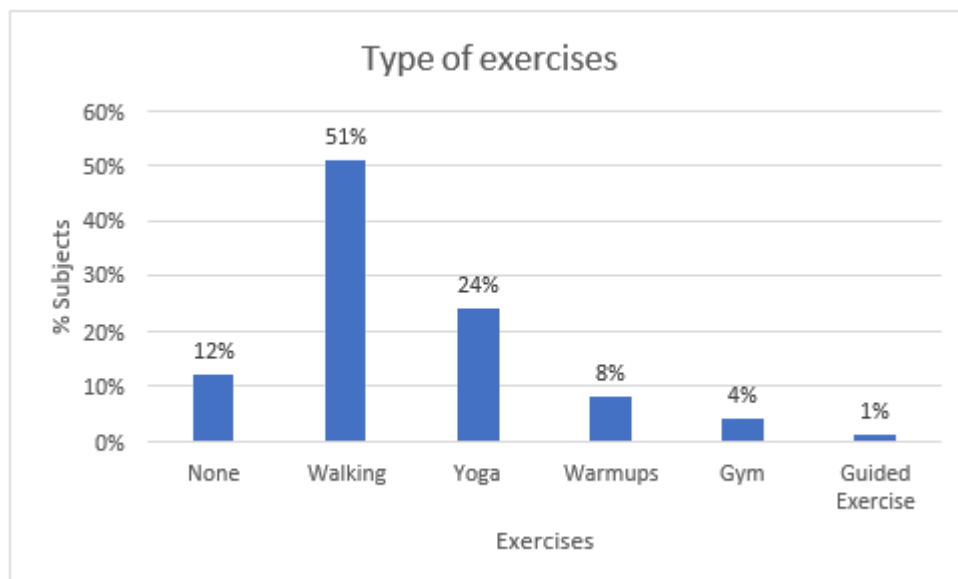

Figure 4.25 Types of exercise (n=100)

The above Figure *4.25*, it was observed that more than 80% of the subjects were involved in some form of exercise. Predominantly 51% of subjects were involved in walking and 24% of subjects took up yoga. Guided exercise for autoimmune study subjects was least undertaken.

In a study, two groups of C57BL/6J mice with EAE, an animal model of MS, were injected with an emulsion containing myelin oligodendrocyte glycoprotein and then randomly assigned to housing with a running wheel or a locked wheel. Compared to sedentary EAE animals, exercising EAE mice displayed a less severe neurological illness score and a delayed onset of disease.(Pryor et al., 2015)
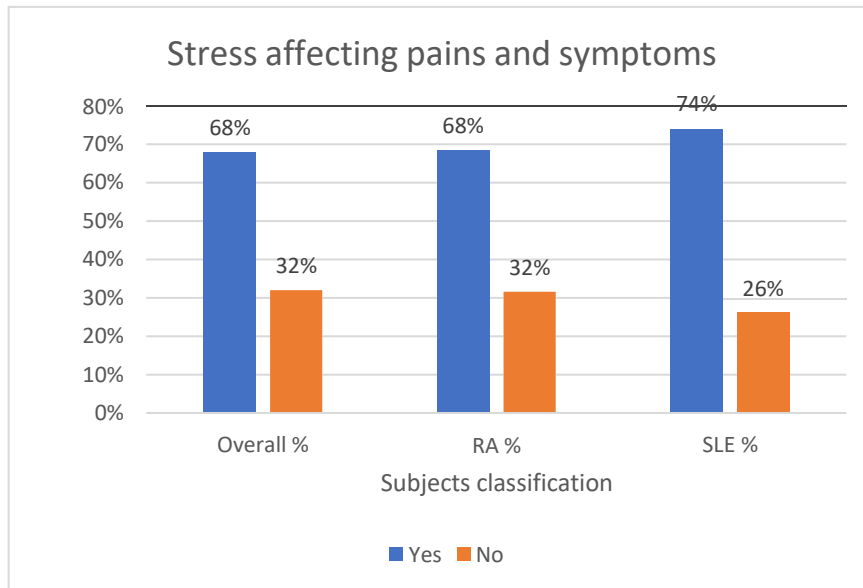

Figure 4.26 Influence of Stress on the Subjects (n=100)

From the above Figure *4.26*, it can be noted that stress play a major role in the onset of symptoms. On an average 70% of subjects experience a flareup in their pain and symptoms when they are stressed.

A retrospective cohort study was conducted on Iraq and Afghanistan veterans to study the association of posttraumatic stress disorder with the risk of developing autoimmune disorders. In comparison to veterans without a psychiatric diagnosis (ARR = 2.00; 95% confidence interval, 1.91-2.09) and to veterans with psychiatric disorders other than PTSD (ARR = 1.51; 95% confidence interval, 1.43-1.59; p .001), it was discovered that veterans with PTSD had a significantly higher adjusted relative risk (ARR) for diagnosis with any of the autoimmune disorders alone or in combination. As a result, autoimmune illnesses may be made more likely by trauma exposure and PTSD. (O'Donovan et al., 2015)
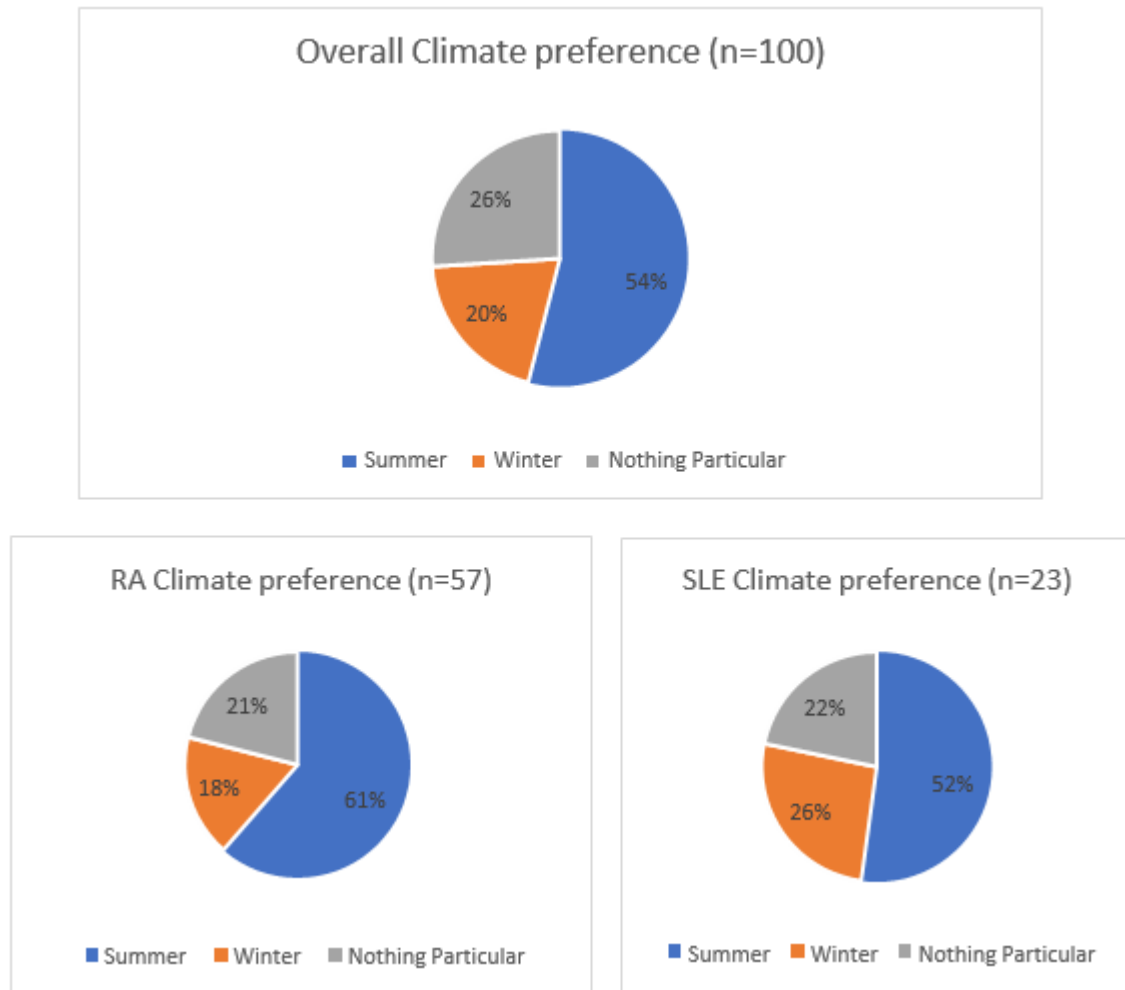
Figure 4.27 Preference of climate

The above Figure *4.27* depict the climate preferences of the subjects. Season impact was seen as summer (54%) was preferred and (61%) for RA and (52%) for SLE.

Jacoby et al. conducted research on patients with early-stage classical rheumatoid arthritis in 1973. When compared to other semesters, the winter semester had a higher rate of disease onset (43% of patients presented between December and February) (Watad et al., 2017)

CHAPTER 5 SUMMARY AND CONCLUSION
5. SUMMARY AND CONCLUSION

Autoimmune disease can be defined as the abnormal immune response where the immune system malfunctions and mistakenly attacks healthy cells, tissues, and organs. The third most common cause of chronic illness in the US is autoimmune illnesses. The National Institutes for Health (NIH) believes that while many autoimmune disorders are uncommon, they cumulatively affect between 5% and 8% of the U.S. population. Future autoimmune disease treatments will likely involve a combination of treatments, utilising various mechanisms of action and complimentary approaches to create the most efficient treatment with the least amount of redundancy.

The present study was conducted to assess the perception of food and dietary habits among autoimmune patients. The subjects were females between the age group of 25 70 years. The main objectives were to analyse the food perceptions of autoimmune patients in association with their symptoms, to assess the

intake of foods and adequacy of nutrients by dietary recall method and to assess the various autoimmune diseases and impact on the quality of life. The survey was carried out offline using a self- validated questionnaire and was conducted in Chan re rheumatology and immunology hospital, Rajajinagar, Bangalore. The major findings of the study are described below:

- The subjects were majorly diagnosed with Rheumatoid Arthritis (57%) and Systemic Lupus Erythematosus (23%). Most of the subjects were graduates (53%) and were unemployed or homemakers (58%). Through this study, it is observed that women who were not working were the ones mostly diagnosed with autoimmune condition.

- With respect to the Body Mass Index of the subjects, most of the subjects had a normal BMI (54%) irrespective of the autoimmune condition they have. It was observed that the body mass index did not have any relation to the onset of autoimmune diseases as there is a development of these conditions irrespective of their BMI.

- A series of symptoms were observed in these subjects. It was found that 35% of subjects often got joint pain or swelling and 30% of subjects had been experiencing numbness in extremities. 31% of them had difficulty in walking and 27% of the subjects were not able to perform day today activities. It is seen that subjects having these symptoms were diagnosed with rheumatoid arthritis. Subjects diagnosed with systemic lupus erythematosus showed symptoms like itchy, red, and swollen skin (28%), butterfly rashes on the face (17%).

- Most of the subjects were non vegetarians (54%) compared to the vegetarian population (44%). The subjects consumed cereals and pulses, fruits, nuts and milk twice a day. Most of the non-vegetarians usually consumed meat products only one a week. The frequency of the subjects consuming bakery and fast foods are comparatively low as the subjects may have become more conscious or aware of the negative impacts of these foods on their conditions.

- The most predominant oil used in the households of subjects is sunflower oil (46%) followed by groundnut oil (32%). No relationship between salt consumption and disease condition was observed. As most of the subjects had their breakfast every day (93%), the fatigue felt was not due to lack of breakfast consumption but can be associated to the autoimmune condition.

- When plotting a Radar graph, the subject's nutrient intake with its respective recommendations according to EAR and RDA 2020, it was found that the energy intake was in align with the recommended value. Protein intakes were in 50% aligned and 50% exceeding the recommended value. The carbohydrate intake was above the recommended value. There was great deficiency in the vitamin D and calcium intake compared to the recommended values. Since vitamin D and calcium are the two crucial micronutrients essential for autoimmune disorders, it can be inferred that the deficiency of these two nutrients may be a triggering point for the autoimmune disorder.

- Experiences and perception of food play a major role in the food choices and intake in the subjects. Several subjects experienced problems with Maida or gluten which they said had increased their prevailing symptoms. One of the participants had rheumatoid arthritis that was persistent claimed that on consuming products made of Maida her joint pains increased drastically. Some subjects had gastrointestinal discomfort on consuming egg and milk. They reported increased bloating and sometimes nausea and increased burning sensations. On contrast, certain foods did have a positive impact on the subjects. Consuming foods enriched with turmeric gave a comfort sensation to the subjects. Some of them had experienced a less occurrence of symptoms consuming turmeric-based products daily. Consuming ginger and garlic had a comforting impact on the gastrointestinal system. Many of the subjects reported that consuming ginger

reduced several discomforts like nausea, bloating, indigestion which is caused either by the medicines taken or even dueto the autoimmune conditions.

- The mental perception of subjects on food also affected the food intake. The subject's perceptions are influenced by their previous experiences with foods, with other's opinion and advice on certain foods especially family members and also the social media. Several of the subjects thought favourably of the turmeric as they believed that had medicinal properties and felt that it could heal the condition. They believed that consuming turmeric on a daily basis could reduce their symptoms and would improve their quality of life. However, the subjects also felt that consuming processed foods including fast foods, bakery products and fried foods could increase their symptoms and could maketheir condition even worse. many of the topics that are covered in postings or articles on social media convinced consumers consuming caffeine (coffee and tea) could worsen the autoimmune condition and their symptoms a well. The subjects are well informed about the standard trigger foods, and they make efforts to avoid them in their diet.

- Family plays a major role in regulating the food choices and helping the subjects tackle the effects of these conditions. With respect to food choices most of the subjects are independent to decide what they must eat. Sometimes husbands dominate the subject's food choices and tells them what to eat and what not to. Since most of the subjects live with their husbands, the husbands tend to take care of them and takes part in every decision the subject makes. Chronic autoimmune condition does bring a lot of physical as well as mental fatigue. During those times the subject approaches their husbands for physicalas well as mental reliefs. According to the study it was observed that most of the subjects were accompanied by their husbands to the hospital either for treatment or for follow up.

- Sleep and rest also play a major role in managing the condition. The majority of the individuals were found to have slept for between six and eight hours.. However, the quality of sleep also matters, which was not observed in the study. According to the analysis of the participants' drinking and smoking patterns, the majority of the subjects did not smoke or drink alcohol. As a result, neither drinking nor smoking is the main factor in the development of autoimmune diseases in the individuals.

- Studies shows that physical activity helps in improving the quality of life of people diagnosed with autoimmune conditions. In this study it was observed that 80% of subjects took up some form of physical activity. Many of them indulged in morning or evening walks for half an hour to 45 minutes every daywhile others did yoga to have a physical as well as mental peace.

- Climate plays a major role in regulating the intensities of the symptoms. In the study most of the subjects felt a relief of their symptoms during the summer season. Many of the subjects claim that they have a reduced knee or joint pain in the summer season compared to the winter season. The occurrence of skin rashes is also seemed to reduce during the summer season. It was observed thatthe subjects were more active and happier during the summer season as compared to the winter season.

- The autoimmune diseases were negatively impacted by the subjects' levels of stress. Other studies have suggested that chronic stress leads to the onset of autoimmune conditions. In this study it was observed that 70% of subjects experienced a flareup of their pain and symptoms when they are stressed.

  In conclusion, it was observed that perception of foods by the subjects along with otherexternal factors like family members, daily routines, and behaviours along with the symptoms manifested influenced the food intake of people diagnosed with autoimmune condition. Hence, it is crucial to provide these

individuals proper guidance with respect to leading a happy and peaceful life amidst their autoimmune condition and the challenges it poses.

RECOMMENDATIONS &LIMITATIONS
RECOMMENDATIONS
- An awareness program can be conducted to inform people on what areautoimmune diseases and the increasing onset of these diseases.
- More diagnosis interventions to be introduced in detecting these diseases.
- The mental perspectives of the people diagnosed with these diseases can befurther studied.
- It is important to make the individual having autoimmune disease aware about their daily habits and especially their food consumption and to watchwhich food triggers negative immune response.

LIMITATIONS
- A larger sample size could have been chosen.
- A more in-depth questionnaire could have been developed.
- Most of the subjects involved in the study were not aware of the effect orimpact of each food had on their disease. Therefore, they were not able toaccurately state which food had a negative or positive impact on their symptoms.

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