CHAPTER 1

1.0 INTRODUCTION

1.1. TYPE 2 DIABETES MELLITUS

Type 2 Diabetes Mellitus (T2DM) is a non-communicable metabolic disorder caused by chronic high glucose level in the blood resulting from defects in insulin secretion, insulin action or both. In 2019, American Diabetes Association updates the leading cause of morbidity and mortality of individuals with diabetes is atherosclerotic cardiovascular disease.

1.2. GLOBAL SCENARIO OF T2DM

The T2DM has become a highly prevalent disease becoming a great Global concern. The severity of the disease in long run is affecting nearly every organ system such as blindness, cardiovascular disease, renal failure, stroke, hypertension, circulatory disorders leading to amputation of limbs ultimately causing premature death. The disease is increasing as an epidemic with the emergence of T2DM in children and adolescents (Turner et al., 1998).

According to American Diabetic Association, the prevalence of diabetes for all age groups worldwide was estimated to be 2.8 % in 2000 and projected to be 4.4 % in 2030 (Wild, Roglic, Green, Sicree, & King, 2004) The prevalence of this disease is higher in man than women, but there are more women with diabetes than men. The urban population in developing countries is projected to double between 2000 and 2030. An estimated 1.6 million deaths were directly by diabetes in 2016 and another 2.2 million deaths attributable to high blood glucose occur before the age of 70 years. Thus, it is estimated that diabetes was the seventh leading cause of death in 2016. The estimated economic burden due to diabetes is estimated to rise from $1.3 trillion to $ 2.5 trillion by 2030 (Bommer et al., 2018). It has been reported that certain racial and ethnic groups such as Asians, Native Americans, Pacific islanders and Latinos are more prone to T2DM (Shaw, Sicree, & Zimmet, 2010; Yoon et al., 2006). International Diabetes Federation, however, estimated that in 2017 there are 451 million (age 18- 99 years) people with diabetes worldwide. The figures are expected to increase to 693 million by 2045(Cho et al., 2018). The Federation has further elaborated that diabetes is not only a health crisis but is a global societal catastrophe causing devastating personal sufferings and poverty.

1.3. INCREASING BURDEN OF T2DM IN INDIA

India ranks second among the top 10 countries/territories with the largest number of diabetic adults affecting 61.3 million persons. The number is estimated to rise to 101.2 million by 2030 (Guariguata, Whiting, Weil, & Unwin, 2011). According to International Diabetes Federation (2019) however, mentioned that India had 77 million people with diabetes and is expected to enhance to 101 million by 2030 (Mishra et al., 2021). In view of the alarming rise in the incidence and prevalence of diabetics in India, the World Health Organisation (WHO) has declared India is going to be the global capital for diabetes in the next five to ten years (Gupta et al., 2003).

1.4. STATUS OF T2DM AT NORTH-EAST STATES OF INDIA

With regard to the North East States of India where more than 80 % of the population is mongoloid, the prevalence of Type 2 Diabetes Mellitus differs from State to State. The prevalence of T2DM in the Manipur State was 15.17 % of the population in 2013 which has been increased to 26.05% in 2015, an elevation of 10.88 % in two years (Beliya, Devi, Singh, & Singh, 2018; Devi, Singh, & S, 2019).

1.5. UNDERSTANDING T2DM

Before nineteen eighty, the research work on diabetes was found scratchy. After nineteen eighties, many professional Doctors, Scientists, and Researchers devoted their research works on the origin, types, causes, symptoms and the mode of treatments on diabetes. There were also reports in the changes in the biochemical parameters associated with diabetic patients affecting the other important organs in the body.

T2DM was previously called ‘non-insulin dependent diabetes mellitus’ (NIDDM) as the pancreas produces insulin but it is either not enough for the present need of the body or the cells of the body are unable to use it properly. It can usually be managed without the use of insulin injection. T2DM was also referred to as maturity onset diabetes, since it occurs most often in adults, 40 years of age and above. T2DM patients suffer from two major defects i.e. Insulin resistance and beta cell ‘burnout’. Insulin resistance typically precedes diabetes by several years, appearing in adults and children who are overweight, sedentary, and have a genetic

predisposition to diabetes. Patients with insulin resistance are often diagnosed with metabolic syndrome prior to T2DM and cardiovascular disease (Nagendra, 2014).

Diabetes disease is no longer associated with the affluent people. Low and middle (Raveendran, Deshpandae, & Joshi, 2018) income countries carry almost 80% of the diabetes burden. Rapid urbanization, unhealthy diet, increasing sedentary life style and lack of physical activities have resulted higher rates of obesity and diabetes (edition International Diabetes Federation, IDF Diabetes Atlas, 2017). Although race, age, and genetic predisposition are important factors for T2DM, psychological stress, obesity, depression, sedentary life style, addiction to smoking and alcohol are considered to be the most common risk factors for T2DM (Turner et al., 1998).Oral application of anti-hyperglycaemic agents or insulin injection are the main conventional treatment which targets on insulin resistance and insulin production. But a basic defect remains unattended as it is (Inzucchi, 2002). The diabetic dyslipidemia also leads to high plasma triglyceride (TG) concentration, low high-density lipoprotein (HDL) concentration, and increased concentration of low density lipoprotein (LDL). As a result of insulin resistance, more free fatty acids influx resulting changes in the lipid profile (Mooradian, 2009).

1.6. RISK FACTORS FOR T2DM

Although the exact cause of T2DM is not clearly known, some of the factors causing T2DM are identified as genetics and environmental factors which may be categorised as non-modifiable and modifiable factors (Gress, Nieto, Shahar, Wofford, & Brancati, 2000).

NON-MODIFIABLE RISK FACTORS

a. Genetics factor: Individuals having family history of T2DM have risks of developing the disease (Neel, 1962).

b. Ethnicity: African-Americans, Asian-Americans, Latino/Hipanic- Americans, those with Native Americans or Pacific Islander descents have more likelihood of developing diabetes ("The diabetes epidemic in full flight: Forecasting the future | Request PDF," n.d.; Yoon et al., 2006).

c. Age: Risk of T2DM increases as age advances. Generally, middle aged adults with 45 years or above are more prone to T2DM. However, in recent time, adolescents and even young children are also diagnosed with T2DM (Levitt et al., 1999; Turner et al., 1998).

1.6.1. MODIFIABLE RISK FACTORS FOR T2DM

While some factors contribute to development of T2DM beyond a person's control, there are some risk factors that can be modified. Life style changes can help in controlling or delaying diabetes development and improve overall quality of life (Hamman, 1992).

a. Obesity: It is reported that about 50 percent of men and 70 percent of women having diabetes are obese. Those individuals with 20 percent increase in weight from their optimal body weight have more chances of developing T2DM. However, by reducing the excess body weight by 5-7 percent and returning to optimal body weight, an individual can reduce the risk of developing pre-diabetes (Klonoff et al., 2008). Excess fat accumulation is also associated with increased insulin resistance.

b. PHYSICAL INACTIVITY (SEDENTARY HABIT): Physical inactivity or sedentary habit and unhealthy dietary pattern are also one of the top modifiable risk factors for pre-diabetes and T2DM. Lack of physical activity was found to increase the risk of diabetes by 3 times and the risk of coronary artery disease by 2.4 times (Raj Thangasami & Lal Chandani, 2015). Sedentary habit disturbs the energy turn over. This contributes to increase gluconeogenesis, and decrease glucose uptake at tissue level. Physical inactivity also shares to increased adiposity (Sigal, Kenny, Wasserman, Castaneda-Sceppa, & White, 2006). Dietary control and physical activities are established treatment modalities in patients with T2DM.

c. ABNORMAL LIPID LEVELS: High levels of triglycerides and low level of High-density lipoprotein can increase the risk of T2DM. A healthy dietary plan, sufficient aerobic exercises, and a healthy body weight can help correct these lipid abnormalities (Chung et al.,2006).

d. HYPERTENSION: In addition to causing damage to cardiovascular system, untreated high blood pressure has links to the development of diabetes (Barker et al., 1993).

e. STRESS AND DIABETES: Stress is the body's response to demanding situations which may be physical or emotional. Two major systems namely the nervous and the endocrine systems are actively involved in stress response system (SRS). The state of balance of the two systems is called homoeostasis. During stress, the homeostasis is disturbed and large quantities of stress chemicals, the adrenaline and nor-adrenaline are released. Stress also releases other hormones such as cortisol. All these chemicals actively increase the blood glucose levels and

thus during stress the blood glucose may shoot up much beyond the levels necessary. This creates an imbalance between the quantity released into the blood and that which is spent by the cells. This imbalance reduces after a physical exercise where there is no psychological stress. This is the reason why moderate exercise is the only good friend of inefficient or weak insulin and in turn, that of insulin receptors (Nagendra, 2014).

1.7. **PATHOPHYSIOLOGY OF T2DM**

The pathophysiology of Type 2 Diabetes Mellitus is indicated by peripheral insulin resistance, impaired regulation of hepatic glucose production, and reducing B cell function leading to B cell failure (Kahn, Cooper, & Del Prato, 2014).

In the past, it was indicated that Insulin- resistance and B-cell dysfunction were the primary abnormality for inability to secrete insulin resulting increased glucose production by the liver and decreased glucose uptake in muscles and adipose tissue located within the intra-abdominal cavity (Cnop et al., 2002; Reaven, 1993)

It is described that the deterioration of B-cell function accounts for evolving the disease from impaired glucose tolerance to type2 diabetes mellitus (Kahn et al., 2014; Weyer, Bogardus, Mott, & Pratley, 1999). Some research findings show that B cell function is heritable and responsible in determination of glucose intolerance with T2DM in different racial and ethnic groups. However, it is mentioned that the disease process depends on other pathogenic factors (Elbein, Hasstedt, Wegner, & Kahn, 1999; Jensen, Cnop, Hull, Fujimoto, & Kahn, 2002). Although, Insulin resistance and B cell dysfunction are mainly determined by the gene pool and the environment, environmental changes play critical role in determining the type2 diabetes epidemics (Opie, 1901).

A research finding shows that the vagal nerve distortion in man results in impaired insulin secretion as the vagus regulates the islets in pancreas (Miller, 1981).

It has been shown that eight basic pathologies involved in causing T2DM are i) Decreased insulin production ii) decreased insulin action iii) increased lipolysis, iv) increased glycogen production, v) increased glucose absorption from the kidneys, vi) increased glucose production from the liver vii) neurotransmitter dysfunction in the nervous system, and viii) decreased

glucose uptake in tissues. These eight factors eventually lead to sustained hyperglycaemia and T2DM (DeFronzo & Tripathy, 2009).

1.8. **HOLISTIC MANAGEMENT OF T2DM**

Regular physical exercise and control in the daily dietary regiment are established treatment modules in patients with T2DM and other lifestyle disorders, obesity and dyslipidemia. However, T2DM patients have less capacity to perform exercise because of overweight, sedentary lifestyle, limited joint mobility and other diabetic related complications. Findings of several studies have shown that poor dietary control and lack of regular exercise programs were major limitations in the management of non-pharmacological treatment of diabetes (Raveendran et al., 2018).

Between 1997 and 2007, the number of yoga practitioners significantly increased in USA. The 2007 National Health Interview Survey indicated that 6.1 % of US adults practiced yoga in the months immediately prior to the survey in 2007, compared with 3.7% in 1997 and 5% in 2002. In addition, adults participating in a yoga intervention found that yoga was easily learned and performed (Barnes, Bloom, & Nahin, 2008; Khalsa, 2004; Tindle, Davis, Phillips, & Eisenberg, 2005).

Yoga is considered a holistic science, discovered, and developed by ancient Indian sages around 5000 years back. It aims at balancing and harmonising the body, mind and emotions (Liu et al., 2014). Yoga is a tradition of lifestyle, health and spirituality. Previous findings suggest that yoga practice hold well the pathophysiologic mechanisms of diabetes and helps in controlling diabetes and its complications. There are evidences that yoga intervention may promote significant improvements in several parameters in T2DM management, including glycaemic control lipid levels, and other anthropometric characteristics (Innes & Selfe, 2016; C. K. Miller, Kristeller, Headings, Nagaraja, & Miser, 2012; Shantakumari, Sequeira, & El Deeb, 2013) . Yoga consists of several mind body practices including physical postures, breathing techniques, cleansing techniques, meditations, dietary changes, devotional sessions and relaxation (Bhanu, Shankar, & Kutty, 2016).

According to Yogic Science, stress-borne diseases such as Diabetes, Asthma, Hypertension, anxiety etc are called *Adhija Vyadhi* (Stress Born Diseased/NCD) originating in Manomaya

Kosa- the astral layer of human existence. Since the *Adhija Vyadhis* are multi-dimensional, it needs to be tackled holistically. Integrated yoga special technique for T2DM helps in bringing about balance at the level of all the five Kosas (layers) of human existence so that complete health can be restored (Nagendra, 2014). A yoga lifestyle program designed (Raghuram Nagarathna et al., 2019) specially to manage T2DM helps in reducing the co-morbidity of dyslipidemia in patients with T2DM.

In view of these observations, the present study was undertaken to assess the effect of 4-months yogic intervention on blood glucose, lipid parameters, health satisfaction and quality of life improvement of mongoloid men and women of different age group with T2DM.

1.9. **HEALTH SATISFACTION AND QUALITY OF LIFE IN HOLISTIC MANAGEMENT**

Health satisfaction is a concept that is affected by the concerns of people living with chronic disease such as T2DM. Health satisfaction is different from treatment satisfaction because it considers issues not specifically related to treatment. Treatment satisfaction is considered as a patient's evaluation of the process of taking a specific medication and outcomes associated with that medication. It has also link to adherence, compliance, and persistence with medication-taking. For the purpose of research, health satisfaction may be defined as the level of contentment one feels about the physical or emotional health such as body weight, current level of energy, or ability to have social interactions with family and friends.

On the other hand, poor health satisfaction has been associated with depression, anxiety, stress, reduced energy and physical activity levels, and impaired social functioning.

Health satisfaction relating to T2DM may be appropriately measured specifically on blood glucose, blood pressure levels, and body weight since the patients are living with these concerns thereby impacting on the patients' self-care activities to optimise disease outcomes. The Current Health Satisfaction- Questionnaire (CHES-Q) was designed to evaluate factors influencing T2DM patients' motivation to change behaviours (e.g., Diet and exercise habits) and measure knowledge of and satisfaction with health (Traina, Colwell, Crosby, & Mathias, 2015). The Questionnaire might bring a better understanding of health satisfaction at the individual level

which in turn may allow to develop more customised patient-centred management strategies consistent with current diabetes management guidelines.

Till date, no systematic study reports are available to show the effect of yoga therapy on health satisfaction and quality of life of adult mongoloid patients with T2DM.

According to Yogic Science, stress-borne diseases such as Diabetes, Asthma, Hypertension, anxiety etc are called *Adhija Vyadhi* (Stress Born Diseased/Non-Communicable Disease) originating in *Manomaya Kosa*- the astral layer of human existence. Since the *Adhija Vyadhis* are multi-dimensional, it needs to be tackled holistically. Integrated yoga special technique for T2DM helps in bringing about balance at the level of all the five *Kosas* (layers) of human existence so that complete health can be restored (Nagendra, 1985).

World Health Organisation (WHO), has defined 'Quality of life' as individuals' perceptions of their position in life in the context of the culture and value systems in which they live in relation to their goals, expectations, standards and concerns (Burroughs, Desikan, Waterman, Gilin, & McGill, 2004; McMillan, Honeyford, Datta, Madge, & Bradley, 2004; Skevington, Lotfy, & O'Connell, 2004) developed quality of life assessment tools and evaluated in diverse population settings specially in western population. A diabetes specific questionnaire was developed and validated in India restricting to the psychological aspect of quality of life(Rao et al., 2005). Yoga, a traditional mind-body medicine originated 4000 years ago in India has known history to manage diabetes conditions as yoga therapy includes physical postures (*asanas),* breathing exercises(*pranayama),* relaxation and meditation (Bali, n.d.; Nayak & Shankar, 2004).