

CHAPTER – II

REVIEW OF RELATED LITERATURE

A survey of literature on the research topic makes the researcher familiar and more knowledgeable with the existing studies and provides further information, which helps to focus on a particular problem and lay the foundation for newer and greater knowledge.

Review of literature related to the field of study is essential to gain the background knowledge of the research topic and to identify the appropriate research design. The research has studied the literature which includes books, journals, magazines and research articles. Review of literature for the present study is to gather studies about following variables:

Studies on diabetics with Yoga

1. Studies on diabetics with health on yoga
2. Studies on diabetics with diet on yoga
3. Studies on diabetics with physiological variables on yoga
4. Studies on diabetics with biochemical variable on yoga
5. Studies on diabetics with psychological variables on yoga

2.1 STUDIES ON DIABETICS WITH YOGA

Gina K (2008) investigated the effects of yoga-based therapy on of type 2 diabetes mellitus and to examine the social context of physical activity. Findings from the review indicate that yoga has a positive short-term effect on multiple diabetes-related outcomes. However, long-term effects of yoga therapy on diabetes management remain unclear. The context of the social environment, including

interpersonal relationships, community characteristics, and discrimination, influences the adoption and maintenance of health behaviors such as physical activity, including yoga practice. Further research is necessary to determine the extent of this influence.

Kosuri M and Sridhar GR (2009) conducted a study in Yoga Practice on Physical and Psychological Outcomes. The aim of this study was to examine the effect of Yoga practice on clinical and psychological outcomes in subjects with type 2 diabetes mellitus (T2DM). In a 40-day yoga camp at the Institute of Yoga and Consciousness, ambulatory subjects with type 2 diabetes mellitus not having significant complications (n=35) participated in a 40-day yoga camp, where yogic practices were overseen by trained yoga teachers. Clinical, biochemical and psychological well-being were studied at baseline and at the end of the camp. At the end of the study, there was a reduction of body mass index (BMI) (26.514 +/-3.355 to 25.771 +/-3.40; $P < 0.001$) and anxiety (6.20 +/-3.72 to 4.29 +/-4.46; $P < 0.05$) and an improvement in total general well-being (48.6 +/-11.13 to 52.66 +/-12.87; $P < 0.05$). Participation of subjects with T2DM in yoga practice for 40 days resulted in reduced BMI, improved well-being, and reduced anxiety

Brown R.P and Gerbang P.L (2009) investigated the Yoga breathing is an important part of health and spiritual practices in Indo-Tibetan traditions. Considered fundamental for the development of physical well-being, meditation, awareness, and enlightenment, it is both a form of meditation in itself and a preparation for deep meditation. Yoga breathing (pranayama) can rapidly bring the mind to the present moment and reduce stress. In this paper, they reviewed data indicating how breath workout can affect longevity mechanisms in some ways that overlap with meditation and in other ways that are different form, but that synergistically enhance, the effects of meditation. They also provided clinical evidence for the use of yoga breathing in

the treatment of depression, anxiety, post-traumatic stress disorder, and for victims of mass disasters. By inducing stress resilience, breath work enabled them to rapidly and compassionately relieve many forms of suffering.

Chaya MS, et al., (1987) found that yoga is thought to reduce the risk of chronic non-communicable diseases such as diabetes, there are no studies on insulin sensitivity in long term practitioners of yoga. They assessed insulin sensitivity and cardiac autonomic function in long term practitioners of yoga. Fifteen healthy, young, male practitioners of yoga were compared with 15 young, healthy males who did not practice yoga matched for body-mass index. Fasting insulin sensitivity was measured in the fasting state by the hyperinsulinaemic-euglycaemic clamp. There were no significant differences between the groups in their anthropometry or body composition. However, the fasting plasma insulin was significantly lower in the yoga group. The yoga group was also more insulin sensitive (yoga 7.82 [2.29] v. control 4.86 [11.97] (mg/[kg.min]) (microU/ml), $p < 0.001$). While the body weight and waist circumference were negatively correlated with glucose disposal rate in the controls, there were no similar correlations in the yoga group. The yoga group had significantly higher low-frequency power and lower normalized high-frequency power. Long term yoga practice (for 1 year or more) is associated with increased insulin sensitivity and attenuates the negative relationship between body weight or waist circumference and insulin sensitivity.

Kyizom T, Singh et al., (2000) studied the effect of pranayama & yoga-asana on cognitive brain functions in type 2 diabetes-P3 event related evoked potential. Electrophysiological evidence of delayed cognition as measured by P300, an evoked potential is observed in Diabetes mellitus. P300 (or P3) is a component of endogenous cerebral evoked response that assesses higher functions of the brain. The study aims

to see the role of pranayama and yoga-asana on P300 latency and amplitude in type 2 diabetic patients. Sixty patients of type 2 diabetes were recruited from diabetic clinic and divided into two groups - control group on only conventional medical therapy and yoga group on conventional medical therapy along with pranayama and yoga asana. Basal recordings of P300 and blood glucose were taken at the time of recruitment and second recordings repeated after forty five days for both the groups. P300 was recorded on Nihon Kohden Neuropack mu MEB 9100 using auditory "odd-ball paradigm". The data were analysed using repeated measures analysis of variance (ANOVA) followed by Tukey's test at 5 per cent level of significance. Statistically significant improvement in the latency and the amplitude of N200, P300 was observed in the yoga group as compared to the control group. The data suggests that yoga has a beneficial effect on P300 and thus can be incorporated along with the conventional medical therapy for improving cognitive brain functions in diabetes.

Aljasir B, et al., (1992) studied the effect of practicing yoga for the management of type 2 diabetes. It was assessed in systematic review through searching related electronic databases and the grey literature to the end of May 2007 using Ovid. All randomized controlled clinical trials (RCTs) comparing yoga practice with other type of intervention or with regular practice or both, were included regardless of language or type of publication. Each study was assessed for quality by two independent reviewers. Mean difference was used for summarizing the effect of each study outcomes with 95% confidence intervals. Pooling of the studies did not take place due to the wide clinical variation between the studies. Publication bias was assessed by statistical methods. Five trials with 363 participants met the inclusion criteria with medium to high risk of bias and different intervention characteristics. The study results show improvement in outcomes among patients with diabetes type

2. These improvements were mainly among short term or immediate diabetes outcomes and not all were statistically significant. The results were inconclusive and not significant for the long-term outcomes. No adverse effects were reported in any of the included studies. Short-term benefits for patients with diabetes may be achieved from practicing yoga. Further research is needed in this area. Factors like quality of the trials and other methodological issues should be improved by large randomized control trials with allocation concealment to assess the effectiveness of yoga on diabetes type 2. A definitive recommendation for physicians to encourage their patients to practice yoga cannot be reached at present.

Selvalakshmi S and Yogaraj P (2009) conducted the study to find out the effect of Varied yogic Practices on Hemoglobin and Blood sugar among obese Women. For the purpose of the study 45 obese women, were divided into three groups based on their BMI, one as Asanas and Pranayama group, second group as Asanas and Meditation group, third group served as control group. The selected subjects were measured of their Hemoglobin and Blood sugar. The interventional training programmers for this study were six weeks. Analysis of covariance (ANCOVA) was used to find out whether the mean differences were significant or not. The results of this study proved that there was a significant improvement on Hemoglobin and Blood sugar due to Asana, Pranayama and Meditation.

Greenhalgh T, et al., (2008) done yoga as a popular therapy for diabetes but its efficacy is contested. The aim of this study was to explore the feasibility of researching community based yoga classes in Type 2 diabetes with a view to informing the design of a definitive, multi-centre. The material methods of study design was an exploratory randomized controlled trial with in depth process evaluation. The setting was two multi-ethnic boroughs in London, UK, one with

average and one with low mean socio-economic deprivation score. Classes were held at a sports centre or GP surgery. Participants were 59 people with Type 2 diabetes not taking insulin, recruited from general practice lists or opportunistically by general practice staff. The intervention group were offered 12 weeks of a twice-weekly 90-minute yoga class; the control group was a waiting list for the yoga classes. Both groups received advice and leaflets on healthy lifestyle and were encouraged to exercise. Primary outcome measure was HbA1c. Secondary outcome measures included attendance, weight, waist circumference, lipid levels, blood pressure, UKPDS cardiovascular risk score, diabetes related quality of life (ADDQoL), and self-efficacy. Process measures were attendance at yoga sessions, self-reported frequency of practice between taught sessions, and qualitative data (interviews with patients and therapists, ethnographic observation of the yoga classes, and analysis of documents including minutes of meetings, correspondence, and exercise plans). The result of the study was despite broad inclusion criteria, around two-thirds of the patients on GP diabetic registers proved ineligible, and 90% of the remainder declined to participate. Mean age of participants was 60 +/- 10 years. Attendance at yoga classes was around 50%. No one did the exercises regularly at home. Yoga teachers felt that most participants were unsuitable for 'standard' yoga exercises because of limited flexibility, lack of basic fitness, co-morbidity, and lack of confidence. There was a small fall in HbA1c in the yoga group which was not statistically significant and which was not sustained six months later, and no significant change in other outcome measures. The conclusion of the study was benefits of yoga in type 2 diabetes suggested in some previous studies were not confirmed. Possible explanations (apart from lack of efficacy) include recruitment challenges; practical and motivational barriers to class attendance; physical and motivational barriers to

engaging in the exercises inadequate intensity and/or duration of yoga intervention; and insufficient personalization of exercises to individual needs. All these factors should be considered when designing future trials.

Garrow D, et al., (2005) found that the association between complementary and alternative medicine (CAM) use, preventive care practices, and use of conventional medical services among adults with diabetes. The materials and methods include data on 2,474 adults with diabetes. It created an overall CAM-use category based on use of any of the following diets, herbs, chiropractic care, yoga, relaxation, acupuncture, ayurveda, biofeedback, chelating, energy healing, Reiki therapy, hypnosis, massage, naturopathy, and homeopathy. They used multiple logistic regression to assess the effect of CAM use on preventive care practices (receipt of influenza and pneumonia vaccines) and use of conventional medical services (number of primary care and emergency department visits). STATA was used for statistical analysis to account for the complex survey design. The Results of the study a total of 48% of adults with diabetes used some form of CAM. CAM use was independently associated with receipt of pneumonia vaccination (odds ratio 1.56 [95% CI 1.26-1.94]) but not significantly associated with receipt of influenza vaccination (1.17[0.92-1.48]). CAM use was independently associated with visiting the emergency department (1.34 [1.06-1.70]), having six or more primary care visits (1.44 [1.14-1.83]), and having eight or more primary care visits (1.66 [1.22-2.25]). The Conclusions of the study was in contrast to the findings of previous studies, CAM use appears to be associated with increased likelihood of receipt of preventive care services and increased emergency department and primary care visits. CAM use may not be a barrier to use of conventional medical services in adults with diabetes.

Talukdar B, et al., (2009) conducted the study to find out the changes in blood glucose and glucose tolerance by oral glucose tolerance test (OGTT) after 40 days of yoga therapy in 149 non-insulin-dependent diabetics (NIDDM) were investigated. The response to yoga in these subjects was categorized according to a severity scale index (SSI) based on area index total (AIT) under OGTT curve. One hundred and four patients showed a fair to good response to the yoga therapy. There was a significant reduction in hyperglycemia and AIT with decrease in oral hypoglycemia and AIT with decrease in oral hypoglycemic drugs required for maintenance of normal glycemia. It is concluded that yoga, a simple and economical therapy, may be considered a beneficial adjuvant for NIDDM patients.

2.2 STUDIES ON DIABETICS WITH HEALTH

Almamory , (2014) done on 65 Diabetes mellitus type II patients admitted to the Mergane Hospital and 40 apparently health controls with age range (30-60 yrs) , blood sample were collected from patients. The result shows that there is a significantly increased ($p < 0.05$) in glucose (180.22) compared to control in group (80.543) in age between 61-70 yrs while there is a significant increased ($p < 0.05$) in urea (39.14) compared to control in group 51-60 yrs appears to be 31.55. This study aims at evaluating the parameters of the levels of PCV, WBC, HB were determined. The parameters shows that there is a significantly increased ($p < 0.05$) in WBC in Diabetes mellitus patients (10231) compared to control group (5500) and where as HB and PCV levels decreased in their value specially with age between 41-50 yrs. The aim of the study is to measure serum urea and creatinine levels in diabetes and control and to establish relationship of blood sugar level with urea and creatinine levels. The study concluded that female are more susceptible to infection with

Diabetes mellitus than male and chronicity of the disease is directly associated with age increase.

Nnodim Johnkennedy, et al., (2012) done on Type 2 diabetes and Mycobacterium tuberculosis patients suffer electrolyte disturbances. The serum level of electrolyte and urea, levels were estimated in type 2 diabetes and Mycobacterium tuberculosis patients. Eighty type 2 diabetes, eighty Mycobacterium tuberculosis and eighty apparently healthy volunteers who were free from diabetes and Mycobacterium tuberculosis attending General Hospital Owerri were used in this study. The serum levels of some electrolytes were significantly lower in type II diabetes and Mycobacterium tuberculosis patients ($P < 0.05$) than in controls, but were much lower in type II diabetes than in Mycobacterium tuberculosis patients. While the level of urea in type II diabetes and Mycobacterium tuberculosis were significantly increased than in controls. These observations suggest that type II diabetes patients exhibit greater electrolyte disturbances than people with Mycobacterium tuberculosis. Also, patients with type II diabetes and Mycobacterium tuberculosis could be probably are prone to renal impairment. Hence monitoring of serum electrolyte and urea levels in the two conditions is very necessary as early detection and treatment of these abnormalities will enhance the quality of life of patients.

Alexander GK, et al., (2009) studied the effects of yoga-based therapy on the management of type 2 diabetes mellitus and to examine the social context of physical activity. Findings from the review indicate that yoga has a positive short-term effect on multiple diabetes-related outcomes; however, long-term effects of yoga therapy on diabetes management remain unclear. The context of the social environment, including interpersonal relationships, community characteristics, and discrimination, influences the adoption and maintenance of health behaviors such as physical activity,

including yoga practice. Further research is necessary to determine the extent of this influence.

Velupillai YN, (2007) found that disadvantaged communities suffer higher levels of physical and mental ill health than more advantaged communities. The purpose of the present study was to examine the psychosocial, behavioral and biological determinants of ill health with in population groups in Glasgow that differed in socioeconomic status and in their propensity to develop chronic disease especially coronary heart disease and Type 2 diabetes mellitus. The participants were selected at random from areas known to be at the extremes of the socioeconomic continuum in Glasgow. Within the categories of least deprived and most deprived, recruitment was stratified by sex and age to achieve an overall sample containing approximately equal numbers of males and females and an even distribution across the age categories 35-44, 45-54 and 55-64 yrs individuals were invited by letter to attend for assessment of their medical history, risk factor status, cognitive function and psychological profile, morbidity, and carotid intima-media thickness and plaque count as indices of atherosclerosis. Anonymised data on study subjects were collected from the General Practice Administration System for Scotland to analyses characteristics of participants and non-participants. The Results of the study was 700 subjects were recruited. The response (active participants per 100 invitation letters) in the least deprived group was 35.1% and in the most deprived group was 20.3%. Lowest response was seen in young males (least deprived 22.4% and most deprived 14.1%). The conclusion of the study of this cross-sectional study recruited the planned sample of subjects from least deprived and most deprived areas within Glasgow. As evident in other studies response differed between the most and least deprived areas. This study brought together researchers/academics from diverse disciplines to build a

more sophisticated understanding of the determinants of health inequalities than can be achieved through UN disciplinary approaches. Future analyses will enable an understanding of the relationships between the different types of measure, and of the pathways that link poverty, biology, behavior and psychology and lead to health inequalities.

Garrow D & Egede LE et al., (2007) conducted the study was to determine national patterns and correlation of complementary and alternative medicine (CAM) used among adults with diabetes. The authors compared CAM use in 2474 adults with and 28,625 adults without diabetes who participated in the most comprehensive national survey on CAM use (2002 National Health Interview Survey). Eight CAM use categories were created, including dietary, herbal, chiropractic, yoga, relaxation, vitamin, prayer, and other (acupuncture, Ayurveda, biofeedback, chelation, energy healing or Reiki therapy, hypnosis, massage, naturopathy, and homeopathy). An overall CAM use category was also created in which vitamins and prayer are excluded. Patterns of use were compared with chisquare and independent correlates of CAM use with multiple logistic regression controlling for relevant covariates. STATA was used for analysis to account for the complex survey design. The prevalence of overall use of CAM did not differ significantly by diabetes status (47.6 versus 47.9%, $p = 0.81$). Diabetes was not an independent predictor of overall use of CAM (OR 0.93, 95% confidence interval [CI] 0.83,1.05). However, persons with diabetes were more likely to use prayer (OR 1.19, 95% CI1.05, 1.36), but less likely to use herbs (OR 0.86, 95% CI 0.75, 0.99), yoga (OR 0.56, 95% CI0.43, 0.72), or vitamins (OR 0.82, 95% CI 0.72, 0.93) than people without diabetes after controlling for relevant covariates. Independent correlates of overall use of CAM differed by age, income, employment, comorbidity, and health status between people with and without

diabetes. The conclusions of the study found that there has been a dramatic increase in overall use of CAM in adults with diabetes. Diabetes was not an independent predictor of overall use of CAM and people with diabetes were more likely to use prayer, but less likely to use herbs, yoga, or vitamins compared to persons without diabetes.

2.3 STUDIES ON DIABETICS WITH DIET

Susan C. Mc Geochet et al., (2011) conducted the study with low glycaemic index (GI) diets which are beneficial in glycaemic control for patients with type 2 diabetes mellitus. There are limited data regarding the dietary GI in free-living adults with and without type 2 diabetes mellitus in UK population. We measured the energy and macronutrient intake and the dietary GI in a group (n = 19) of individuals with diet controlled type 2 diabetes mellitus and a group (n = 19) without diabetes, matched for age, BMI and gender. Subjects completed a three-day weighed dietary record. Patients with type 2 diabetes mellitus consumed more daily portions of whole grains (2.3 vs. 1.1, P = 0.003), more dietary fibre (32.1 vs. 20.9 g, P < 0.001) and had a lower diet GI (53.5 vs. 57.7, P = 0.009) than subjects without type 2 diabetes mellitus. Both groups had elevated fat and salt intake and low fruit and vegetable intake, relative to current UK recommendations. Patients with type 2 diabetes mellitus may already consume a lower GI diet than the general population but further efforts are needed to reduce dietary GI and achieve other nutrient targets.

Melissa M. Franks et al., (2012) investigated patients difficulties in managing their diet (i.e., diet set backs) and associations with change in disease-specific and general emotional distress (diabetes distress and depressive symptoms) among patients with type 2 diabetes and their spouses. The materials and method of the study was collected in couples' homes (N = 115 couples) using structured

interviews and self-administered questionnaires at three time points baseline (T1), six months after baseline (T2), and twelve months after baseline (T3). The result of the study was that the patient diet setbacks were associated with an increase in their diabetes distress in the shorter-term (over six months). Patient diet setbacks were not associated with longer-term change in diabetes distress or with change in depressive symptoms at either time point (six months or one year). In contrast, spouse perceptions of patient diet setbacks were associated with increases in their own diabetes distress at both time points (over six months and one year) and also with an increase in their depressive symptoms in the longer-term (over one year). The conclusion of the study was of patient diet no adherence for emotional well-being that extend to the well-being of their spouses.

Sharma SB, et al., (2002) conducted the study of yoga asanas in assessment of pulmonary function in NIDDM patients. The subject of the study were twenty four NIDDM patients of 30 to 60 yrs old, provides metabolic and clinical evidence of improvement in glycemic control and pulmonary functions. These middle-aged subjects were type II diabetics on anti- hyper glycemic and dietary regimen. Their baseline fasting and postprandial blood glucose and glycosylated Hb were monitored along with pulmonary function studies. The expert gave these patients training in yoga asanas and was pursued 30-40 min/day for 40 days under guidance. These asanas consisted of 13 well known postures, done in a sequence. After 40 days of yoga asanas regimen, the parameters were repeated. The results of the study there was significant decrease in fasting blood glucose levels. The postprandial blood glucose levels also decreased glycosylated hemoglobin showed a decrease. The FEV1, FVC, PEF, MVV increased significantly. FEV1/FVC% improved. The suggestion of the study was better glycemic control and pulmonary functions can be obtained in

NIDDM cases with yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing interact with somato-neuro-endocrine mechanism affecting metabolic and pulmonary functions remains to be worked out.

Malhotra V, (2002) done a research on effect of Yoga Asanas on nerve conduction in Type 2 diabetes. Twenty Type 2 diabetic subjects between the age group of 30-60 yrs were studied to observe the effect of 40 days of Yoga asanas on the nerve conduction velocity. The duration of diabetes ranged from 0-10 years. Subject suffering from cardiac, renal and proliferative retinal complications were excluded from the study Yoga asanas included Suryanamaskar, Tadasana, Konasan, Padmasan, Pranayama, Paschimottanasana, Ardhmatsyendrasan, Shavasan, Pavanmukthasan, Sarpasan and Shavasan. Subjects were called to the cardio-respiratory laboratory in the morning time and were given training by the Yoga expert. The Yoga exercises were performed for 30-40 minutes every day for 40 days in the above sequence. The subjects were prescribed certain medicines and diet. The basal blood glucose, nerve conduction velocity of the median nerve was measured and repeated after 40 days of Yogic regime. Another group of 20 Type 2 diabetes subjects of comparable age and severity, called the control group, were kept on prescribed medication and light physical exercises like walking. Their basal & post 40 days parameters were recorded for comparison. Right hand and left hand median nerve conduction velocity increased from 52.81 +/-1.1 m/sec to 53.87 +/-1.1 m/sec and 52.46 +/-1.0 to 54.75 +/-1/1 m/sec respectively. Control group nerve function parameters deteriorated over the period of study, indicating that diabetes is a slowly progressive disease involving the nerves. Yoga asanas have a beneficial effect on glycemic control and improve nerve function in mild to moderate Type 2 diabetes with sub-clinical neuropathy.

Sh.Dide Ras et al., (2014) conducted to examine the impact of 8 weeks of yoga training on blood glucose and lipid profile in patients with type 2 diabetics. In this quasi-experimental study, 30 women with type 2 diabetes and between 45 to 60 yrs old were randomly selected and divided into two (N=15) groups of experimental and control. Experimental group were subjected to regular yoga training for 8 weeks (3 sessions per week, 60 minutes per session), while the control group did not have any regular activity. The dependent variables were blood glucose, insulin and resting heart rate and were examined before and after exercise training in both groups. Results indicated a significant difference in the changed levels of blood glucose, insulin and resting heart rate between the control and experimental groups ($P \leq 0.05$). According to the findings, it can be concluded that regular practices of yoga with appropriate intensity can improve the effects of the illness and decrease the use of diabetes drugs and also the drugs for controlling the risk factors of coronary diseases in patients, along with having a diet, can use this type of sport to control the dangerous factors related to diabetes.

Singh S, et al., (2004) studied the effect of forty days of Yogic exercises on cardiac functions in Type 2 diabetics subjects the effect of forty days of Yogic exercises on blood glucose level, glycosylated hemoglobin was determined. The present study done in twenty-four Type 2 diabetics cases provides metabolic and clinical evidence of improvement in glycemic control and autonomic functions. These middle-aged subjects were type 2 diabetics on anti hyperglycemic and dietary regimen. Their baseline fasting and postprandial blood glucose and glycosylated Hb were monitored along with autonomic function studies. The expert gave these patients training in yoga asanas and they pursued those 30-40 min/day for 40 days under guidance. These asanas consisted of 13 well known postures, done in a sequence.

After 40 days of yoga asanas regimen, the parameters were repeated. The results indicate that there was significant decrease in fasting blood glucose levels from basal 190.08 +/- 18.54 in mg/dl to 141.5 +/- 16.3 in mg/dl after yoga regimen. The post prandial blood glucose levels decreased from 276.54 +/- 20.62 in mg/dl to 201.75 +/- 21.24 in mg/dl, glycosylated, Hb showed a decrease from 9.03 +/- 0.29% to 7.83 +/- 0.53% after yoga regimen. The pulse rate, systolic and diastolic blood pressure decreased significantly (from 86.45 +/- 2.0 to 77.65 +/- 2.5 pulse/min, from 142.0 +/- 3.9 to 126.0 +/- 3.2 mm of Hg and from 86.7 +/- 2.5 mm of Hg to 75.5 +/- 2.1 mm of Hg after yoga regimen respectively). Corrected QT interval (QTc) decreased from 0.42 +/- 0.0 to 0.40 +/- 0.0. These findings suggest that better glycaemic control and stable autonomic functions can be obtained in Type 2 diabetes mellitus cases with yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing interact with somato-neuro-endocrine mechanism affecting metabolic and autonomic functions remains to be worked out.

Malhotra V, et al., (2005) conducted the study of the beneficial effect of yoga in diabetes, the subjects of the study was twenty NIDDM subjects (mild to moderate diabetics) in the age group of 30-60 yrs were selected from the outpatient clinic of G.T.B. hospital. They were on a 40 days yoga asana regime under the supervision of a yoga expert. 13 specific Yoga asanas < or = done by Type 2 Diabetes Patients included. Surya Namaskar, Trikonasana, Tadasana, Sukhasana, Padmasana, Bhastrika Pranayama, Paschimottanasana, Ardha Matsyendrasana, Pawanmuktasana, Bhujangasana, Vajrasana, Dhanurasana and Shavasana are beneficial for diabetes mellitus. Serum insulin, plasma fasting and one hour post prandial blood glucose levels and anthropometric parameters were measured before and after yoga asanas. The results of the study indicated that there was significant decrease in fasting glucose

levels from basal 208.3 +/-20.0 to 171.7 +/-19.5 mg/dl and one hour postprandial blood glucose levels decreased from 295.3 +/-22.0 to 269.7 +/-19.9 mg/dl. The exact mechanism as to how these postures and controlled breathing interact with somatic endocrine mechanism affecting insulin kinetics was worked out. A significant decrease in waist-hip ratio and changes in insulin levels were also observed, the Suggestion of the study were a positive effect of yoga asanas on glucose utilization and fat redistribution in NIDDM. Yoga asanas may be used as an adjunct with diet and drugs in the management of Type 2 diabetes.

Telles S et al., (2010) studied the effects of yoga and diet change program, emphasizing breathing techniques practiced while seated, was assessed in obese persons. The methodology of the study was a single group of 47 persons were assessed on the first and last day of a yoga and diet change program, with 6 days of the intervention between assessments. The assessments were: body mass index (BMI), waist and hip circumferences, mid-arm circumference, body composition, hand grip strength, postural stability, serum lipid profile and fasting serum leptin levels. Participants practiced yoga for 5 hours every day and had a low fat, high fiber, vegetarian diet. Last and first day data were compared using a t-test for paired data. The results of the study were the 6-day residential program, participants showed a decrease in BMI (1.6 percent), waist and hip circumferences, fat-free mass, total cholesterol (7.7 percent decrease), high density lipoprotein (HDL) cholesterol (8.7 percent decrease), fasting serum leptin levels (44.2 percent decrease) and an increase in postural stability and hand grip strength ($p < 0.05$, all comparisons). The conclusion of the study was 6-day yoga and diet change program decreased the BMI and the fat-free mass. Total cholesterol also decreased due to reduced HDL levels. They suggested that, intensive yoga program with a change in diet can pose certain risks.

Benefits seen were better postural stability, grip strength reduced waist and hip circumferences and a decrease in serum leptin levels.

Yang K, et al., (2002) found that various modes of physical activity, combined with dieting, have been widely recommended to prevent or delay the onset of type 2 diabetes. Among these, yoga holds promise for reducing risk factors for type 2 diabetic by promoting weight loss, improving glucose levels and reducing blood pressure and lipid levels. This pilot study aimed to assess the feasibility of implementing a 12-week yoga program among adults at high risk for type 2 diabetes. Twenty-three adults (19 Whites and 4 non-Whites) were randomly assigned to the yoga intervention group or the educational group. The yoga group participated in a 3-month yoga intervention with sessions twice per week and the educational group received general health educational materials every 2 weeks. All participants completed questionnaires and had blood tests at baseline and at the end of 3 months. Effect sizes were reported to summarize the efficacy of the intervention. All participants assigned to the yoga intervention completed the yoga program without complication and expressed high satisfaction with the program (99.2%). Their yoga session attendance ranged from 58.3 to 100%. Compared with the education group, the yoga group experienced improvements in weight, blood pressure, insulin, triglycerides and exercise self-efficacy indicated by small to large effect sizes. This preliminary study indicates that a yoga program would be a possible risk reduction option for adults at high risk for type 2 diabetes. In addition, yoga holds promise as an approach to reducing cardio metabolic risk factors and increasing exercise self-efficacy for this group.

Shreelaxmi, et al., (2010) investigated the effect of yoga on anthropometry, blood pressure, glycemic control, and oxidative stress in type 2 diabetic patients on

standard care in comparison with standard care alone. The study involved 123 patients stratified according to groups with microvascular complications, macrovascular complications, and peripheral neuropathy and without complications and assigned to receive either standard care or standard care along with additional yoga for 3 months. The result of the study was a in comparison with standard care alone, yoga resulted in significant reduction in BMI, glycemic control, and malondialdehyde and increase in glutathione and vitamin C. There were no differences in waist circumference, waist-to-hip ratio, blood pressure, vitamin E, or superoxide dismutase in the yoga group at follow-up. The conclusion of the study was Yoga can be used as an effective therapy in reducing oxidative stress in type 2 diabetes subjects. Yoga in addition to standard care helps reduce BMI and improve glycemic control in type 2 diabetic patients.

Sahay BK et al., (2008) studied India has the largest diabetic population in the world. Change in eating habits, increasing weight and decreased physical activity are major factors leading to increased incidence of type 2 diabetes. Obesity is the most important modifiable risk factor. Smoking is an independent risk factor for type 2 diabetes mellitus. Diet and exercise are primary therapeutic options for its management. Dietary management should not only aim to achieve glycaemic control but to normalize dyslipidaemia. Smoking cessation reduces the risk of morbidity and mortality in CAD. Exercise improves the condition of a diabetic patient. Exercise includes yoga practices which have a role to play in the prevention of type 2 diabetes.

2.4 STUDIES ON DIABETICS WITH PHYSIOLOGICAL VARIABLES

Nisha Shantakumari, Sheifa Sequeira, and Rasha Eldeeb (2012) assessed the effectiveness of yoga as an intervention in the management of patients with Type 2 diabetes mellitus complicated with hypertension. This study was carried out in 2005

in Medical College Trivandrum, Kerala, India among 100 hypertensive Type 2 diabetics. They were randomized into control and yoga groups. The yoga group practiced yoga daily for one hour and given oral hypoglycemic drugs for 3 months. The control group did not perform yogic exercises but given oral hypoglycemic drugs. Comparisons were drawn between systolic blood pressure (SBP), diastolic blood pressure (DBP), Fasting blood sugar (FBS) and post prandial blood sugar (PPBS) in both the groups at the start and at the end of 3 months. Paired and unpaired t tests were performed. After intervention with yoga for 3 months the study group showed a significant decrease in SBP from 141.71 ± 9.79 to 132.23 ± 7.89 mm Hg, DBP from 90.57 ± 4.07 to 85.49 ± 5.03 mm Hg and FBS from 155.86 ± 60.53 to 126.63 ± 40.59 mg%. The reduction in PPBS from 240.31 ± 79.42 to 208.74 ± 73.05 mg% was however not proved to be significant statistically. These findings suggest that diabetics may benefit from yoga's ability to improve the disease status.

Hojjati, et al., (2004) conducted the study on effect of Yoga Training on blood glucose, insulin and resting heart rate in Type 2 diabetic Females, 8 weeks of yoga training on blood glucose and lipid profile in patients with type 2 diabetes. In this quasi-experimental study, 30 women with type 2 diabetes and between 45 to 60 yrs old were randomly selected and divided into two (N=15) groups of experimental and control . Experimental group were subjected to regular yoga training for 8 weeks (3 sessions per week, 60 minutes per session), while the control group did not have any regular activity. The dependent variables were blood glucose, Insulin and resting heart rate and were examined before and after exercise training in both groups. Results indicated a significant difference in the changed levels of blood glucose, insulin and resting heart rate between the control and experimental groups ($P \leq 0.05$). According to the findings, it can be concluded that regular practices of yoga with

appropriate intensity can improve the effects of the illness and decrease the use of diabetes drugs and also the drugs for controlling the risk factors of coronary diseases in patients, along with having a diet, can use this type of sport to control the dangerous factors related to diabetes.

Najmeh Habibi, et al., (2013) studied the Influence of Yoga-on Risk Profiles Programs in Women with diabetes type 2. The aim of the study was to the effect of 12-weeks yoga exercise on physiological factors and blood sugar of patients who suffer from diabetes type2. In this semi-experimental research, from the females who have diabetes in Isfahan Township, 26 women with age range of (45-60) yrs old and weight range of (60-91kg) voluntarily and in access choice and were put in two kinds of experimental (16patients) and control (10 patients) group. Experimental group within the period of 12weeks (3sessions in week, each session 75 minutes) did a selected yoga exercise, as control group had no regular and systematic physical activity. In this research, variables to be tested were blood sugar, plasma insulin level, leptin level, systolic blood pressure and also, weight, body mass index that before and after the exercise period these tested variables were measured. For analyzing the data from the descriptive and inferential statistics were used T-test for the difference between the means of the independent groups. A significant level ($p < 0/05$) was considered for all the examinees. The results of research show a significant difference between average of blood sugar, plasma insulin level and systolic blood pressure, among experimental and control groups, whereas this difference in leptin level, weight and BMI in experimental and control groups was not significant ($p < 0/05$). The conclusion of the study was yoga exercise which caused to significant improvement in blood sugar of patients having diabetes type 2.

Virtanen et al., (2003) conducted the study was on determine whether psychological factors are associated with heart rate variability (HRV), blood pressure variability (BPV), and bar ore flex sensitivity (BRS) among healthy middle-aged men and women. A population-based sample of 71 men and 79 women (35-64 years of age) was studied. Five-minute supine recordings of ECG and beat-to-beat photo plethysmographic finger systolic arterial pressure and diastolic arterial pressure were obtained during paced breathing. Power spectra were commuted using a fact Fourier transforms for low-frequency (0.01-0.15 Hz) and high-frequency (0.15-0.10 Hz) powers. BRS was calculated by cross-spectral analysis of R-R interval and systolic arterial pressure variability ties. Psychological factors were evaluated by three self-report questionnaires, the Brief Symptom Inventory, and the Toronto Alexithymia Scale. It was found anxiety and hostility is related to reduced BRS and increased low - frequency power of BPV. Reduced BRS reflects decreased parasympathetic outflow to the heart and may increase BPV through an increased sympathetic predominance.

Cohen BE, et al., (2008) studied metabolic syndrome increases the risk of diabetes and cardiovascular disease. Yoga improves some metabolic parameters, but it has not been studied in persons with metabolic syndrome. We conducted a randomized controlled pilot trial to determine whether a restorative yoga intervention was feasible and acceptable in underactive, overweight adults with metabolic syndrome. The materials methods of the study was a total Twenty six underactive, overweight adult men and women with metabolic syndrome were randomized to attend 15 yoga sessions of 90 minutes each over 10 weeks or to a wait-list control group. Feasibility was measured by recruitment rates, subject retention, and adherence. Acceptability was assessed by interview and questionnaires. Changes in metabolic outcomes and questionnaire measures from baseline to week 10 were

calculated. The results of the study was total of 280 people were screened by phone, and 93 with high likelihood of metabolic syndrome were invited to a screening visit. Of the 68 who attended screening visits, 26 (38%) were randomized, and 24 (92%) completed the trial. Attendance at yoga classes and adherence to home practice exceeded our goals. In the yoga group, all participants gave the study the highest possible satisfaction rating, and the majority (87%) felt that the yoga poses were easy to perform. There was trend to reduced blood pressure ($p = 0.07$), a significant increase in energy level ($p < 0.009$), and trends to improvement in well-being ($p < 0.12$) and stress ($p < 0.22$) in the yoga versus control group. The conclusions of the study was Restorative yoga was a feasible and acceptable intervention in overweight adults with metabolic syndrome. The efficacy of yoga for improving metabolic parameters in this population should be explored in a larger randomized controlled trial.

Balasubramanian K et al., (2011) conducted the study on physical training and yogic practices, on selected physiological variables and motor ability components among college men students Yoga plays an important role by bringing the therapeutic effect in Asthmas, Diabetes, Hypertension and Respiratory troubles. Some yoga has both preventive as well as curative values. Positive changes in the life style of the people can be brought through Yoga. During the period of education, Yoga can make them aware of their body and further make them realize the need of emotional and physical wellbeing. The present study has been mainly designed to find out the effect of selected yogic practices and physical training on motor ability and physiological variables of college men. To accomplish the purpose of this study, the experimental design, the subjects, the criterion variables and test of measuring them and their variables and methods to apply them have been systematically presented. Thirty

subjects were selected randomly from the Alagappa Arts College in Karaikudi. For the study, the average age of the subject was 18 to 21 yrs the selected students were further divided randomly into three group's namely yogic practices, Physical training and control groups. All the subjects were normal and healthy male students, the sample was considered as the true representative of population. The number of each group was ten.

Hojjati Z et al., (2014) conducted the study on yoga training on Blood Glucose, Insulin and Resting Heart Rate in type 2 diabetic females this work has been conducted to examine the impact of 8 weeks of yoga training on blood glucose and lipid profile in patients with type 2 diabetic. In this quasi-experimental study, 30 women with type II diabetes and between 45 to 60 years old were randomly selected and divided into two (N=15) groups of experimental and control. Experimental group were subjected to regular yoga training for 8 weeks (3 sessions per week, 60 minutes per session), while the control group did not have any regular activity. The dependent variables were blood glucose, Insulin and resting heart rate and were examined before and after exercise training in both groups. Results indicated a significant difference in the changed levels of blood glucose, Insulin and Resting heart rate between the control and experimental groups ($P \leq 0.05$). According to the findings, it can be concluded that regular practices of yoga with appropriate intensity can improve the effects of the illness and decrease the use of diabetes drugs and also the drugs for controlling the risk factors of coronary diseases in patients, along with having a diet, can use this type of sport to control the dangerous factors related to diabetes.

Smitha R Varne et al., (2012) conducted the study on physiological effects of Yogic practices and Transcendental Meditation in Health and Disease. Yoga is an ancient Indian way of life, which includes changes in mental attitude, diet, and the

practice of specific techniques such as yoga asanas (postures), breathing practices (pranayamas), and meditation to attain the highest level of consciousness. Since a decade, there has been a surge in the research on yoga, but we do find very few reviews regarding yogic practices and transcendental meditation (TM) in health and disease. Keeping this in view, a Medline search was done to review relevant articles in English literature on evaluation of physiological effects of yogic practices and TM. Data were constructed issues were reviewed and found that there were considerable health benefits, including improved cognition, respiration, reduced cardiovascular risk, body mass index, blood pressure, and diabetes. Yoga also influenced immunity and ameliorated joint disorders.

Amita S, et al., (2009) conducted the study of diabetes is a metabolic disorder, which has become a major health challenge worldwide. South East Asian countries have a highest burden of diabetes. In India the prevalence of diabetes is rising rapidly especially in the urban population because of increasing obesity and reduced physical activity. An objective of this study is to evaluate the effect of Yoga-Nidra on blood glucose level in diabetic patients. This study was conducted on 41, middle aged, type-2 diabetic patients, who were on oral hypoglycaemic. These patients were divided in to two groups: (a) 20 patients on oral hypoglycaemic with yoga-nidra, and (b) 21 were on oral hypoglycaemic alone. Yoga-nidra practiced for 30 minutes daily up to 90 days, parameters were recorded every. 30th day the study showed that most of the symptoms were subsided ($P < 0.004$, significant), and fall of mean blood glucose level was significant after 3-month of Yoga-nidra. This fall was 21.3 mg/dl, $P < 0.0007$, (from 159 +/- 12.27 to 137.7 +/- 23.15,) in fasting and 17.95 mg/dl, $P = 0.02$, (from 255.45 +/- 16.85 to 237.5 +/- 30.54) in post prandial glucose level. Results of this study suggest that subjects on Yoga-nidra with drug regimen had

better control in their fluctuating blood glucose and symptoms associated with diabetes, compared to those were on oral hypoglycaemics alone.

2.5 STUDIES ON DIABETICS WITH BIOCHEMICAL VARIABLE

Sh.Dide Rast (2013) studied the impact of 8 weeks of yoga training on blood glucose and lipid profile in patients with type 2 diabetes. In this quasi-experimental study, 30 women with type 2 diabetes and between 45 to 60 yrs old were randomly selected and divided into two (n= 15) groups of experimental and control. Experimental group were subjected to regular yoga training for 8weeks (3 sessions per week, 60 minutes per session), while the control group did not have any regular activity. The dependent variables were total cholesterol (TC), triglycerides (TG), LDL (low density lipoprotein), HDL (high density lipoprotein), and blood glucose and were examined before and after exercise training in both groups. Results indicated a significant difference in the changed levels of total cholesterol, triglycerides, LDL, HDL, and blood glucose between the control and experimental groups ($P \leq 0.05$). Based on our results, it can be said that, yoga is a non-drug, non-invasive and cost-effective method to improve the quality of life. In addition, the effects of yoga on the connection of mind and body and reducing stress hormones have been proved since long times. Therefore, it seems that, patients with type 2 diabetes, along with fully compliance with their diet, can benefit these exercises in order to control some risk factors associated with diabetes.

Tremblay et al., (2014) investigated the effects of sitagliptin therapy on the kinetics of triglyceride-rich lipoprotein (TRL) apolipoprotein (apo)B-48, VLDL apoB-100, apoE and apoC-III in patients with type 2 diabetes. The materials and methods of study was a twenty-two subjects with type 2 diabetes were recruited in

this double-blind crossover study, during which the subjects received sitagliptin (100 mg/day) or placebo for a 6-week period each. At the end of each phase of treatment, the in vivo kinetics of the different apolipoproteins were assessed using a primed-constant infusion of 1-[5,5,5-D³] leucine for 12 hrs, with the participants in a constantly fed state. The result of the study showed that Sitagliptin therapy significantly reduced fasting plasma triglyceride (−15.4%, $p = 0.03$), apoB-48 (−16.3%, $p = 0.03$) and free fatty acid concentrations (−9.5%, $p = 0.04$), as well as plasma HbA1c (placebo: 7.0% ± 0.8 vs. sitagliptin: 6.6% ± 0.7, $p < 0.0001$) and plasma glucose levels (−13.5%, $p = 0.001$), without any significant effect on insulin levels. Kinetic results showed that treatment with sitagliptin significantly reduced the pool size of TRL apoB-48 by −20.8% ($p = 0.03$), paralleled by a reduction in the production rate of these particles (−16.0%, $p = 0.03$). The VLDL apoB-100 pool size was also significantly decreased by sitagliptin therapy (−9.3%, $p = 0.03$), mainly because of a reduction in the hepatic secretion of these lipoproteins, although this difference did not reach statistical significance (−9.2%, $p = 0.06$). The conclusion of the study was treatment with sitagliptin for 6 weeks reduced triglyceride-rich apoB-containing lipoprotein levels by reducing the synthesis of these particles.

Lorenzo A Gordon, (2008) investigated the impact of Hatha yoga and conventional physical training (PT) exercise regimens on biochemical, oxidative stress indicators and oxidant status in patients with type 2 diabetes. The methods of the study consisted of 77 type 2 diabetic patients in the Hatha yoga exercise group that were matched with a similar number of type 2 diabetic patients in the conventional PT exercise and control groups. Biochemical parameters such as fasting blood glucose (FBG), serum total cholesterol (TC), triglycerides, low-density lipoprotein (LDL), very low-density lipoproteins (VLDL) and high-density

lipoprotein (HDL) were determined at baseline and at two consecutive three monthly intervals. The oxidative stress indicators (malondialdehyde – MDA, protein oxidation – POX, phospholipase A2 – PLA2 activity) and oxidative status [superoxide dismutase (SOD) and catalase activities] were measured. The results of FBG in the Hatha yoga and conventional PT exercise groups after six months decreased by 29.48% and 27.43% respectively ($P < 0.0001$) and there was a significant reduction in serum TC in both groups ($P < 0.0001$). The concentrations of VLDL in the managed groups after six months differed significantly from baseline values ($P = 0.036$). Lipid peroxidation as indicated by MDA significantly decreased by 19.9% and 18.1% in the Hatha yoga and conventional PT exercise groups respectively ($P < 0.0001$); whilst the activity of SOD significantly increased by 24.08% and 20.18% respectively ($P = 0.031$). There was no significant difference in the baseline and 6 months activities of PLA2 and catalase after six months although the latter increased by 13.68% and 13.19% in the Hatha yoga and conventional PT exercise groups respectively ($P = 0.144$). The conclusion of the study demonstrate the efficacy of Hatha yoga exercise on fasting blood glucose, lipid profile, oxidative stress markers and antioxidant status in patients with type 2 diabetes and suggest that Hatha yoga exercise and conventional PT exercise may have therapeutic preventative and protective effects on diabetes mellitus by decreasing oxidative stress and improving antioxidant status.

David Altshuler, (2007) found that new strategies for prevention and treatment of type 2 diabetes (T2D) require improved insight into disease aetiology. The study analyzed 386,731 common single-nucleotide polymorphisms (SNPs) in 1464 patients with type 2 diabetes and 1467 matched controls, each characterized for measures of glucose metabolism, lipids, obesity, and blood pressure. With collaborators (FUSION and WTCCC/UKT2D), we identified and confirmed three loci

associated with T2D—in a non coding region near CDKN2A and CDKN2B, in an intron of IGF2BP2, and an intron of CDKAL1—and replicated associations near HHEX and in SLC30A8 found by a recent whole-genome association study. We identified and confirmed association of a SNP in an introne of glucokinase regulatory protein (GCKR) with serum triglycerides. The discovery of associated variants in unsuspected genes and outside coding regions illustrates the ability of genome-wide association studies to provide potentially important clues to the pathogenesis of common diseases.

Tannock LR, (2002) investigated the retention of atherogenic apo lipoprotein (apo) B- and E- containing lipoproteins by their interaction with arterial wall proteoglycans is important in atherogenesis. Levels of triglyceride (TG)-rich lipoproteins, which contain both apo B and apo E, are increased in type 2 diabetes. Because increased retention of TG-rich lipoproteins in diabetes might explain, in part, the increased atherosclerosis in this disorder, TG-rich lipoproteins were isolated from fasting type 2 diabetic subjects and age-matched controls, and assessed for their ability to bind biglycan, a vascular smooth muscle cell-derived proteoglycan. The binding of TG-rich lipoproteins isolated from diabetic subjects to purified biglycan did not differ from lipoproteins isolated from control subjects. Moreover, contrary to previous reports, no difference in the apo E content of TG-rich lipoproteins was detected between the control and diabetic groups. Additionally, no difference in the binding affinity of TG-rich lipoproteins for the low-density lipoprotein receptor was observed between control and diabetic subjects. Thus, we were unable to confirm previous reports that TG-rich lipoproteins from subjects with diabetes are enriched in apo E compared with age-matched controls, consistent with the lack of difference in binding of these lipoproteins to either biglycan or the low-density lipoprotein

receptor. Therefore, increased affinity of TG-rich lipoproteins for biglycan is unlikely to explain the increased atherosclerosis in type 2 diabetes.

Fatma Huffman et al., (2014) investigated the cross sectional study examined the association between ghrelin and triglyceride levels in Haitian and African Americans with (n= 258) and without (n=239) type 2 diabetes. Participants were recruited from multiple sources from Miami-Dade and Broward Counties, Florida. Fasting blood samples were collected and ghrelin was analyzed from whole blood using Enzyme Immunometric Assay. Serum triglyceride levels were assayed by enzymatic methods. Dietary variables were collected using the Willett's food frequency questionnaire, and Healthy Eating Index 2005 (HEI-05) scores were calculated. Analyses included descriptive statistics, Pearson correlations and linear regressions. Participants with type 2 diabetes had significantly lower ghrelin ($P < 0.001$) and higher triglyceride levels ($p = 0.023$) as compared to those without type 2 diabetes. Ghrelin was inversely correlated with triglyceride levels in participants with type 2 diabetes ($P = 0.021$). Linear regression analysis indicated that after controlling for covariates, the association between Inghrelin and Intriglycerides was only significant for participants with type 2 diabetes ($\beta = -.181$, $SE = .042$, $P = 0.003$). Findings of this study suggested a potential role of ghrelin as a biomarker of cardiovascular disease risk in Blacks with type 2 diabetes.

Anupriya Sharma et al., (2011) studied the Urea & creatinine are the parameters to diagnose functioning of the kidney. Changes in serum creatinine concentration more reliably reflect changes in GFR than do changes in serum urea concentrations. High sugar in the blood can lead to serious health problems, including heart disease and damage to the nerves and kidneys. Study aimed to analyze the effect of hyperglycemic condition on the renal function parameter like serum urea and

serum creatinine. In present study a total of 33 hyperglycemic serum samples were analyzed for their urea & Creatinine for percent variation, from their reference range corresponding to blood sugar value. At blood sugar level I (130-190 mg %) the variation among Urea concentration were analyzed. Out of 33 hyperglycemic serum samples, 15 samples were found in this category. While 190-250 mg % hyperglycemic range the level of urea haven't showed significant variation from their reference range. Out of total 13 serum samples, 1 sample showed variation from their normal range which was also around 6.16%. for higher range of sugar concentration (250 –380 mg %) in blood serum, the urea concentration haven't showed much deviation only one sample found to be deflected from its normal value & the % variation for these sample was observed to be 2.22%. Creatinine level speckled in the range of 91.5–97.5% from its normal reference range. Thus study was concluded that too much sugar in the blood can lead to diverge the renal function parameter from their normal ranges and causes serious kidneys problems.

Shepal Amod-Shete Sanjay, et al., (2003) conducted the study on the effect of yoga on bio-markers linked with development of diabetes complications in type 2 diabetes patients. They have taken the subjects were Fourteen type 2 diabetic patients, aged 43-69 yrs with duration of diabetes ranged 1yr-10 yrs were randomly selected and intervened for three months of exclusive Yoga practices. Research design used was Quasi-experimental Single Group pre test and post test. The investigation show non-significant difference in mean HbA1c values, whereas plasma TNF- α , BMI, systolic, diastolic blood pressure and pulse rate were significantly reduced. Thus, integration of yoga practices in day to day lifestyle of type 2 diabetes mellitus patient can be beneficial in controlling and preventing the progression of the disease and its associated complications.

Skoro-Kondza L, et al., (2001) done an exploratory randomized controlled trial. Yoga is a popular therapy for diabetes but its efficacy is contested. The aim of this study was to explore the feasibility of researching community based yoga classes in Type 2 diabetes with a view to informing the design of a definitive, multi-centre trial. The study design was an exploratory randomized controlled trial with in-depth process evaluation. The setting was two multi-ethnic boroughs in London, UK; one with average and one with low mean socio-economic deprivation score. Classes were held at a sports centre or GP surgery. Participants were 59 people with Type 2 diabetes not taking insulin, recruited from general practice lists or opportunistically by general practice staff. The intervention groups were offered 12 weeks of a twice-weekly 90-minute yoga class; the control group was a waiting list for the yoga classes. Both groups received advice and leaflets on healthy lifestyle and were encouraged to exercise. Primary outcome measure was HbA1c. Secondary outcome measures included attendance, weight, waist circumference, lipid levels, blood pressure, UKPDS cardiovascular risk score, diabetes-related quality of life (ADDQoL), and self-efficacy. Process measures were attendance at yoga sessions, self-reported frequency of practice between taught sessions, and qualitative data (interviews with patients and therapists, ethnographic observation of the yoga classes, and analysis of documents including minutes of meetings, correspondence, and exercise plans). Despite broad inclusion criteria, around two-thirds of the patients on GP diabetic registers proved ineligible, and 90% of the remainder declined to participate. Mean age of participants was 60 +/- 10 years. Attendance at yoga classes was around 50%. Nobody did the exercises regularly at home. Yoga teachers felt that most participants were unsuitable for 'standard' yoga exercises because of limited flexibility, lack of basic fitness, co-morbidity, and lack of confidence. There was a

small fall in HbA1c in the yoga group which was not statistically significant and which was not sustained six months later, and no significant change in other outcome measures. The benefits of yoga in type 2 diabetes suggested in some previous studies were not confirmed. Possible explanations (apart from lack of efficacy) include recruitment challenges; practical and motivational barriers to class attendance; physical and motivational barriers to engaging in the exercises; inadequate intensity and/or duration of yoga intervention; and insufficient personalization of exercises to individual needs. All these factors should be considered when designing future trials.

Bijlani RL, et al., (2002) done a brief but comprehensive lifestyle education program based on yoga reduces risk factors for cardiovascular disease and diabetes mellitus. The objective of the study was to study the short-term impact of a brief lifestyle intervention based on yoga on some of the biochemical indicators of risk for cardiovascular disease and diabetes mellitus. The variables of interest were measured at the beginning (day 1) and end (day 10) of the intervention using a pre-post design. The study is the result of operational research carried out in our Integral Health Clinic (IHC). The IHC is an outpatient facility which conducts 8-day lifestyle modification programs based on yoga for prevention and management of chronic disease. A new course begins every alternate week of the year. The study is based on data collected on 98 subjects (67 male, 31 female), ages 20-74 yrs, who attended one of our programs. The subjects were a heterogeneous group of patients with hypertension, coronary artery disease, diabetes mellitus, and a variety of other illnesses. The intervention consisted of asanas (postures), pranayama (breathing exercises), relaxation techniques, group support, individualized advice, lectures and films on the philosophy of yoga and the place of yoga in daily life, meditation, stress management, nutrition, and knowledge about the illness. The outcome measures were fasting

plasma glucose and serum lipoprotein profile. These variables were determined in fasting blood samples, taken on the first and last day of the course. Fasting plasma glucose, serum total cholesterol, low-density lipoprotein (LDL) cholesterol, very-LDL cholesterol, the ratio of total cholesterol to high density lipoprotein (HDL) cholesterol, and total triglycerides were significantly lower, and HDL cholesterol significantly higher, on the last day of the course compared to the first day of the course. The changes were more marked in subjects with hyperglycemia or hypercholesterolemia.

Deepa.K et al., (2011) conducted the study was India as a developing country has more prevalence of diabetes and now has more people with type 2 diabetes (more than 50 million) than any other nation. Diabetes mellitus is a chronic metabolic disorder that can lead to cardiovascular, renal, neurologic and retinal complications. Type 2 diabetic has quickly become a global health problem due to rapidly increasing population growth, aging, urbanization and increasing prevalence of obesity and physical inactivity .A total of 40 diabetic patients of both sexes aged between 35 to 75 years attending medicine OPD were included in the study. After obtaining informed consent from the study group 5 ml of fasting venous blood sample was collected. Plasma glucose was estimated by GOD –POD method. Estimation of plasma creatinine was done by the modified Jaffe's method. Serum urea was estimated by Urease-Berthelot's method. There was significant increase in levels of serum urea, creatinine and FPG ($p < 0.001$) in diabetic patients compared to healthy controls. On applying Pearson's correlation serum urea correlated positively with creatinine ($p < 0.001$, $r = 0.910$) in cases and also in controls ($p < 0.001$, $r = 0.868$). Blood urea and creatinine is widely accepted to assess the renal functions. Good control of blood glucose level is absolute requirement to prevent progressive renal impairment.

Karen J. Sherman et al., (2012) conducted a study on the effects of yoga interventions on various components of mental and physical health, by focussing on the evidence described in review articles. Collectively, these reviews suggest a number of areas where yoga may well be beneficial, but more research is required for virtually all of them to firmly establish such benefits. The heterogeneity among interventions and conditions studied has hampered the use of meta-analysis as an appropriate tool for summarizing the current literature. Nevertheless, there are some meta-analyses which indicate beneficial effects of yoga interventions, and there are several randomized clinical trials (RCT's) of relatively high quality indicating beneficial effects of yoga for pain-associated disability and mental health. Yoga may well be effective as a supportive adjunct to mitigate some medical conditions, but not yet a proven stand-alone, curative treatment. Larger-scale and more rigorous research with higher methodological quality and adequate control interventions is highly encouraged because yoga may have potential to be implemented as a beneficial supportive/adjunct treatment that is relatively cost-effective, may be practiced at least in part as a self-care behavioural treatment, provides a life-long behavioural skill, enhances self-efficacy and self-confidence and is often associated with additional positive side effects.

Butler C et al., (2008) found that a 12-week yoga program helped reduce fasting blood glucose and HbA1C levels; the much larger Medicare Demonstration Project, which tracked more than 2,000 people with heart disease who did yoga and made other lifestyle changes for a year, saw similar results in participants who had diabetes, after both 12 weeks and 1 yr researchers at the University College of Medical Sciences in Delhi, India, have found, through various studies, that daily yoga

classes can decrease fasting blood glucose, blood glucose after meals, hemoglobin A1C, systolic and diastolic blood pressure, and also improve insulin resistance.

2.6 STUDIES ON DIABETICS WITH PSYCHOLOGICAL VARIABLES

Kelly A McDermott et al., (2014) conducted the study was Type 2 diabetes is a major health problem in many countries including India. Yoga may be an effective type 2 diabetes prevention strategy in India, particularly given its cultural familiarity. The study was a parallel, randomized controlled pilot study to collect feasibility and preliminary efficacy data on yoga for diabetes risk factors among people at high risk of diabetes. Primary outcomes included changes in BMI, waist circumference, fasting blood glucose, postprandial blood glucose, insulin, insulin resistance, blood pressure, and cholesterol. We also looked at measures of psychological well-being including changes in depression, anxiety, positive and negative affect and perceived stress. Forty-one participants with elevated fasting blood glucose in Bangalore, India were randomized to either yoga (n = 21) or a walking control (n = 20). Participants were asked to either attend yoga classes or complete monitored walking 3–6 days per week for eight weeks. Randomization and allocation was performed using computer-generated random numbers and group assignments delivered in sealed, opaque envelopes generated by off-site study staff. Data were analyzed based on intention to treat. The result of the study was feasible in terms of recruitment, retention and adherence. In addition, yoga participants had significantly greater reductions in weight, waist circumference and BMI versus control (weight -0.8 ± 2.1 vs. 1.4 ± 3.6 , $p = 0.02$; waist circumference -4.2 ± 4.8 vs. 0.7 ± 4.2 , $p < 0.01$; BMI -0.2 ± 0.8 vs. 0.6 ± 1.6 , $p = 0.05$). There were no between group differences in fasting blood glucose, postprandial blood glucose, insulin resistance or any other factors related to diabetes risk or psychological well-being. There were significant reductions in systolic and

diastolic blood pressure, total cholesterol, anxiety, depression, negative affect and perceived stress in both the yoga intervention and walking control over the course of the study. The conclusion of the study was Indians with elevated fasting blood glucose, we found that participation in an 8-week yoga intervention was feasible and resulted in greater weight loss and reduction in waist circumference when compared to a walking control. Yoga offers a promising lifestyle intervention for decreasing weight-related type 2 diabetes risk factors and potentially increasing psychological well-being.

Cohen BE, et al., (1980) found that restorative yoga in adults with metabolic syndrome: a randomized, controlled pilot trial. Department of General Internal Medicine, University of California, San Francisco, San Francisco Veterans Affairs Medical Center, San Francisco, California 94121, USA. Metabolic syndrome increases the risk of diabetes and cardiovascular disease. Yoga improves some metabolic parameters, but it has not been studied in persons with metabolic syndrome. The study conducted a randomized controlled pilot trial to determine whether a restorative yoga intervention was feasible and acceptable in underactive, overweight adults with metabolic syndrome. Twenty six underactive, overweight adult men and women with metabolic syndrome were randomized to attend 15 yoga sessions of 90 minutes each over 10 weeks or to a wait-list control group. Feasibility was measured by recruitment rates, subject retention, and adherence. Acceptability was assessed by interview and questionnaires. Changes in metabolic outcomes and questionnaire measures from baseline to week 10 were calculated. A total of 280 people were screened by phone, and 93 with high likelihood of metabolic syndrome were invited to a screening visit. Of the 68 who attended screening visits, 26 (38%) were randomized, and 24 (92%) completed the trial. Attendance at yoga classes and

adherence to home practice exceeded our goals. In the yoga group, all participants gave the study the highest possible satisfaction rating, and the majority (87%) felt that the yoga poses were easy to perform. There was trend to reduced blood pressure ($p = 0.07$), a significant increase in energy level ($p < 0.009$), and trends to improvement in well-being ($p < 0.12$) and stress ($p < 0.22$) in the yoga versus control group. Restorative yoga was a feasible and acceptable intervention in overweight adults with metabolic syndrome. The efficacy of yoga for improving metabolic parameters in this population should be explored in a larger randomized controlled trial.

Ellen Serber et al., (2007) conducted the study on Yoga and the stress response. Stress is a common condition, a response to a physical threat or psychological distress, that generates a host of chemical and hormonal reactions in the body. In essence, the body prepares to fight or flee, pumping more blood to the heart and muscles and shutting down all non-essential functions. As a temporary state, this reaction serves the body well to defend itself. However, were the stress reaction is attenuated, the normal physical functions that have been either exaggerated or shut down in response become dysfunctional in this extreme state. Many have noted the benefits of exercise in diminishing the stress response. A host of studies points to the benefits of such exercise. Yoga too has been recommended and studied in its relationship to stress, although the studies are less scientifically replicable. Nonetheless, several researchers claim highly beneficial results from Yoga practice in alleviating stress and its effects. The practices recommended range from intense to moderate to relaxed asana sequences, plus pranayama and meditation. In all these approaches to dealing with stress, one common element stands out: the process is as important as the activity undertaken. Because it fosters self-awareness, Yoga is a promising approach for dealing with the stress response.

Gordon L. A. et al., (2008) done a research on effect of exercise therapy on Lipid Profile and Oxidative Stress Indicators in Patients with Type 2 diabetes. Yoga has been shown to be a simple and economical therapeutic modality that may be considered as a beneficial adjuvant for type 2 diabetes mellitus. This study investigated the impact of Hatha yoga and conventional physical training (PT) exercise regimens on biochemical, oxidative stress indicators and oxidant status in patients with type 2 diabetes. This prospective randomized study consisted of 77 type 2 diabetic patients in the Hatha yoga exercise group that were matched with a similar number of type 2 diabetic patients in the conventional PT exercise and control groups. Biochemical parameters such as fasting blood glucose (FBG), serum total cholesterol (TC), triglycerides, low-density lipoprotein (LDL), very low-density lipoproteins (VLDL) and high-density lipoprotein (HDL) were determined at baseline and at two consecutive three monthly intervals. The oxidative stress indicators (malondialdehyde -MDA, protein oxidation -POX, phospholipase A2 -PLA2 activity) and oxidative status [superoxide dismutase (SOD) and catalase activities] were measured. The concentrations of FBG in the Hatha yoga and conventional PT exercise groups after six months decreased by 29.48% and 27.43% respectively ($P < 0.0001$) and there was a significant reduction in serum TC in both groups ($P < 0.0001$). The concentrations of VLDL in the managed groups after six months differed significantly from baseline values ($P = 0.036$). Lipid peroxidation as indicated by MDA significantly by 19.9% and 18.1% in the Hatha yoga and conventional PT exercise groups respectively ($P < 0.0001$); whilst the activity of SOD significantly increased by 24.08% and 20.18% respectively ($P = 0.031$). There was no significant difference in the baseline and 6 months activities of PLA2 and catalase after six months although the latter increased by 13.68% and 13.19% in the Hatha yoga and conventional PT exercise groups

respectively ($P = 0.144$). Conclusion: The study demonstrate the efficacy of Hatha yoga exercise on fasting blood glucose, lipid profile, oxidative stress markers and antioxidant status in patients with type 2 diabetes and suggest that Hatha yoga exercise and conventional PT exercise may have therapeutic preventative and protective effects on diabetes mellitus by decreasing oxidative stress and improving antioxidant status.

Alexander GK, et al., (2003) found that effects of yoga-based therapy on the management of type 2 diabetes mellitus and to examine the social context of physical activity. Findings from the review indicate that yoga has a positive short-term effect on multiple diabetes-related outcomes; however, long-term effects of yoga therapy on diabetes management remain unclear. The context of the social environment, including interpersonal relationships, community characteristics, and discrimination, influences the adoption and maintenance of health behaviors such as physical activity, including yoga practice. Further research is necessary to determine the extent of this influence.

Kosuri M, et al., (1990) found Yoga practice in diabetes improved physical and psychological outcomes. Yoga and diabetes Group, Institute of Yoga and Consciousness, Visakhapatnam, India. The aim of this study was to examine the effect of yoga practice on clinical and psychological outcomes in subjects with type 2 diabetes mellitus (T2DM). In a 40-day yoga camp at the Institute of Yoga and Consciousness, ambulatory subjects with type 2 diabetes mellitus not having significant complications ($n = 35$) participated in a 40-day yoga camp, where yogic practices were overseen by trained yoga teachers. Clinical, biochemical, and psychological well-being were studied at baseline and at the end of the camp. At the end of the study, there was a reduction of body mass index (BMI) (26.514 ± 3.355 to

25.771 +/- 3.40; $P < 0.001$) and anxiety (6.20 +/- 3.72 to 4.29 +/- 4.46; $P < 0.05$) and an improvement in total general well-being (48.6 +/- 11.13 to 52.66 +/- 52.66 +/- 12.87; $P < 0.05$). Participation of subjects with type 2 diabetes mellitus in yoga practice for 40 days resulted in reduced BMI, improved well-being, and reduced anxiety.

Yadav RK et al., (2004) conducted the study to find out the short-term impact of a brief lifestyle intervention based on yoga on some of the biochemical indicators of risk for cardiovascular disease and diabetes mellitus. The variables of interest were measured at the beginning (day 1) and end (day 10) of the intervention using a pre-post design. The study is the result of operational research carried out in our Integral Health Clinic (IHC). The IHC is an outpatient facility which conducts 8-day lifestyle modification programs based on yoga for prevention and management of chronic disease. A new course begins every alternate week of the year. The material of study is based on data collected on 98 subjects (67 male, 31 female), ages 20-74 years, who attended one of our programs. The subjects were a heterogeneous group of patients with hypertension, coronary artery disease, diabetes mellitus, and a variety of other illnesses. The intervention consisted of asanas (postures), pranayama (breathing exercises), relaxation techniques, group support, individualized advice, lectures and films on the philosophy of yoga and the place of yoga in daily life, meditation, stress management, nutrition, and knowledge about the illness. The outcome measures were fasting plasma glucose and serum lipoprotein profile. These variables were determined in fasting blood samples, taken on the first and last day of the course. The results of the study was a fasting plasma glucose, serum total cholesterol, low-density lipoprotein (LDL) cholesterol, very- LDL cholesterol, the ratio of total cholesterol to high density lipoprotein (HDL) cholesterol, and total triglycerides were significantly

lower, and HDL cholesterol significantly higher, on the last day of the course compared to the first day of course. The changes were more marked in subjects with hyperglycemia or hypercholesterolemia. The conclusions of the observations suggest that a short lifestyle and stress management education program leads to favorable metabolic effects within a period of 9 days.

Ramnathan Iyer S et al., (2012) conducted the study find out to the Sleep and Type 2 Diabetes Mellitus- Clinical Implications Sleep is essential for life. Body systems require sleep of good quantity and quality for their proper functioning. Glucose metabolism can be affected adversely by several sleep disorders. Obstructive sleep apnea (OSA) is one of the most important disorder identified in the last 50 years which has systemic effects including glucose metabolism. Aging process also has its effects on glucose metabolism. There is a close relation between sleep, aging and metabolic syndrome. OSA and Type 2 Diabetes Mellitus share several features in common. There is mounting evidence to show a close association between sleep deprivation, sleep disordered breathing-OSA, excessive sleepiness, insomnia, restless legs syndrome and Type 2 DM. The role of sleep deprivation, particularly REM sleep deprivation, in the genesis of obesity needs to be recognized. The close association of OSA with insulin resistance demands the recognition of OSA in fatty liver and polycystic ovary syndrome. Treatment of OSA by continuous positive airway pressure has been shown to increase insulin sensitivity. It is important for primary care physicians to have a high degree of suspicion of an underlying sleep disorder in patients with diabetes. Management of sleep disorder is highly rewarding.

2.7 SUMMARY OF THE LITERATURE

The investigator reviewed related literature on studies pertaining to Yogic practices with and without sattvic diet on Physiological, biochemical and psychological variables from the Internet web-pages, journal articles and Doctors guidance from experts all theses on the library of TNPESU to provide sufficient knowledge to the readers and for the effective analysis of the present study. It helps to get a clear idea and supports the finding with regard to the problem under study.

The reviews were collected from the areas Studies on diabetic with Yoga and health (n=16), and Studies on diabetic with diet on yoga (n=11), and Studies on diabetic with physiological variables on yoga (n=11), and Studies on diabetic with biochemical variables on yoga (n=12), and Studies on diabetic with psychological variables on yoga (n=10). All the research studies that are presented in this section proves that Yogic practices with and without sattvic diet contribute significantly for better improvement in all the criterion variables. The critical reviews are 60 and allied reviews are seven in total.