

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. It creates an accurate picture on the information presently available on the subject. 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 researcher 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:

1. Studies on physiological variables on yoga
2. Studies on biochemical variables on yoga
3. Studies on psychological variables on yoga

2.1 STUDIES ON PHYSIOLOGICAL VARIABLES

Tikhe AS et.al., (2015) conducted the study on yoga: managing overweight in mid-life T2DM. The dramatic rise in the prevalence of obesity and type 2 diabetes mellitus (T2DM) is associated with increased mortality, morbidity as well as public health care expenses worldwide. Previous research suggests that yoga holds promise for obesity and T2DM management. The objective of the present study was to assess the effect of intensive integrated approach of yoga therapy (IAYT) on body fat and body mass index (BMI) and resting metabolism in mid-life overweight patients with T2DM (BMI, Mean \pm SD, 27.05 \pm 4.51). Twenty-four mid-life patients

(6 females) with T2DM (Age, Mean \pm SD, 55.38 \pm 7.96 years) participated in the study and practiced IAYT for 7 days. The IAYT works at five layers of human existence (physical, vital, mental, intellectual and bliss) to bring positive health. The body fat and BMI and resting metabolism were recorded before and after IAYT using Karada Scan body composition monitor HBF-375 from Omron Healthcare Singapore PTE LTD.SPSS-16 was used to analyze the data. Shapiro-Wilk test showed that the data was not normally distributed. Further, the Wilcoxon signed-ranks test was used to analyze the change in means of pre- and post-measurements. Data analysis showed that there was a significant decrease in body fat and BMI and resting metabolism (in all assessments, $P < 0.001$). The present study suggests that 7 days practice of IAYT has a great promise for the management of overweight in mid-life patients with T2DM. Additional well-designed studies are needed before a strong recommendation can be made.

Yang K et.,al. (2011) conducted a pilot study on utilization of 3-month yoga program for adults at high risk for type 2 diabetes: a pilot study. Various modes of physical activity, combined with dieting, have been widely recommended to prevent or delay type 2 diabetes. Among these, yoga holds promise for reducing risk factors for type 2 diabetes 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.

Singh S et.al., (2004) conducted the study on the role of yoga in modifying certain cardiovascular functions in type 2 diabetic patients. To study the effect of forty days of Yogic exercises on cardiac functions in Type 2 Diabetics. To study the effect of forty days of Yogic exercises on blood glucose level, glycosylated hemoglobin. The present study done in twenty-four Type 2 DM cases provides metabolic and clinical evidence of improvement in glycaemic control and autonomic functions. These middle-aged subjects were type II diabetics on antihyperglycaemic 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 hemoglobin showed a decrease from $9.03 \pm 0.29\%$ to $7.83 \pm 0.53\%$ 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 DM 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.

Shantakumari et.al., (2012) conducted the study on effect of a yoga intervention on hypertensive diabetic patients. The concept of psychosomatic medicine has gained popularity, with yoga racing ahead in the field. The present study was conducted to assess 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.

Shepal Amod V et.al., (2013) conducted preliminary study on effect of yoga on bio-markers linked with development of diabetes complications in type 2

diabetes patients: a pilot study. Diabetes mellitus represents a metabolic disorder of multiple etiologies characterized by high level of glucose (hyperglycaemia) with disturbances in carbohydrate, fat and protein metabolism resulting from defects in either insulin secretion, or insulin action or both. Fourteen type 2 diabetic patients, aged 43-69 years with duration of diabetes ranged 1year- 10 years 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 T2DM patients can be beneficial in controlling and preventing the progression of the disease and its associated complications.

Netam R et.al., (2015) conducted the study on interleukin-6, vitamin D & diabetes risk-factors modified by a short-term yoga-based lifestyle intervention in overweight/obese individuals. Several diabetes prevention programme have demonstrated a reduction in incidence of diabetes in individuals with prediabetes through weight loss. Short-term yoga-based lifestyle intervention programs have also been shown to be efficacious in weight loss. This study was undertaken to investigate if interleukin (IL)-6, vitamin D, neopterin, vaspin, and diabetes risk factors can be modified by a short-term yoga-based lifestyle intervention in overweight/obese subjects. In this pilot study, 34 overweight/obese [body mass index (BMI) ≥ 23 to < 35 kg/m [2] per Asian cut-off values] individuals were enrolled and directly supervised intervention for 10 days. Thereafter, they were advised to follow this yoga-based lifestyle at home for one month and were reassessed for study variables at day 30. There was a reduction from baseline to day 10 in weight ($P < 0.001$), BMI ($P < 0.001$), waist/hip-ratio ($P < 0.05$), blood glucose ($P < 0.01$) and a significant improvement in lipid profile. There was a decrease in median fasting

insulin ($P < 0.05$), homeostatic model assessment-insulin resistance ($P < 0.01$) and IL-6 ($P < 0.05$). A non-significant increase in 25-OH-vitamin D and a decrease in neopterin and vaspin were observed. Twenty subjects returned for follow up assessments. At day 30, weight loss was sustained while systolic blood pressure also showed reduction ($P < 0.05$). Changes in vitamin D levels were significantly and negatively correlated with changes in weight, BMI and fasting blood glucose and positively with change in high density lipoprotein. Changes in body weight and BMI significantly and positively correlated with insulin. Changes in IL-6 levels positively and significantly correlated with change in neopterin levels. The findings showed that IL-6, vitamin D, and diabetes risk factors were favorably modified by a short-term yoga-based lifestyle intervention in obesity. This study also highlighted the challenges in compliance associated with the follow up of subjects following an aggressive supervised intervention of 10 days.

McDermott KA et.al., (2014) conducted the study on a yoga intervention for type 2 diabetes risk reduction: a pilot randomized controlled trial. Type 2 diabetes is a major health problem in many countries including India. Yoga may be effective type 2 diabetes prevention strategies in India, particularly given its cultural familiarity. This 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. This 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. Among 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.

Hegde SV et.al., (2011) conducted the study on effect of 3-month yoga on oxidative stress in type 2 diabetes with or without complications: a controlled clinical trial. To assess 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, macro vascular complications and peripheral neuropathy and without complications and assigned to receive either standard care or standard care along with additional yoga for 3 months. 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. Yoga can be used as an effective therapy in reducing oxidative stress in type 2 diabetes. Yoga in addition to standard care helps reduce BMI and improve glycemic control in type 2 diabetic patients.

Kim E. Innes et.al., (2006) conducted a systematic review study on the influence of yoga-based programs on risk profiles in adults with type 2 diabetes mellitus. There is growing evidence that yoga may offer a safe and cost-effective intervention for type 2 Diabetes mellitus (DM 2). However, systematic reviews are lacking. This article critically reviews the published literature regarding the effects of yoga-based programs on physiologic and anthropometric risk profiles and related clinical outcomes in adults with DM 2. We performed a comprehensive literature search using four computerized English and Indian scientific databases. The search was restricted to original studies (1970–2006) that evaluated the metabolic and clinical effects of yoga in adults with DM 2. Studies targeting clinical populations with cardiovascular disorders that included adults with comorbid DM were also evaluated. Data were extracted regarding study design, setting, target population, intervention, comparison group or condition, outcome assessment, data analysis, presentation, follow-up, key results and the quality of each study was evaluated according to specific predetermined criteria. We identified 25 eligible studies, including 15 uncontrolled trials, 6 non-randomized controlled trials and 4 randomized controlled trials (RCTs). Overall, these studies suggest beneficial changes in several risk indices, including glucose tolerance and insulin sensitivity, lipid profiles, anthropometric characteristics, blood pressure, oxidative stress, coagulation profiles, sympathetic activation and pulmonary function, as well as improvement in specific clinical outcomes. Yoga may improve risk profiles in adults with DM 2 and may have promise for the prevention and management of cardiovascular complications in this population. However, the limitations characterizing most studies preclude drawing

firm conclusions. Additional high-quality RCTs are needed to confirm and further elucidate the effects of standardized yoga programs in populations with DM 2.

Sahay BK et.al., (2002) conducted the study on lifestyle modification in management of diabetes mellitus. 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 dyslipidemia. 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.

Innes KE et.al., (2007) conducted the study on the influence of yoga-based programs on risk profiles in adults with type 2 diabetes mellitus: a systematic review. There is growing evidence that yoga may offer a safe and cost-effective intervention for type 2 Diabetes mellitus (DM 2). However, systematic reviews are lacking. This article critically reviews the published literature regarding the effects of yoga-based programs on physiologic and anthropometric risk profiles and related clinical outcomes in adults with DM 2. We performed a comprehensive literature search using four computerized English and Indian scientific databases. The search was restricted to original studies (1970-2006) that evaluated the metabolic and clinical effects of yoga in adults with DM 2. Studies targeting clinical populations with cardiovascular disorders that included adults with comorbid DM were also evaluated. Data were extracted regarding study design, setting, target population, intervention, comparison group or condition, outcome assessment, data analysis, presentation, follow-up and key results and the quality of each study was evaluated according to specific predetermined criteria. We identified 25 eligible studies, including 15

uncontrolled trials, 6 non-randomized controlled trials and 4 randomized controlled trials (RCTs). Overall, these studies suggest beneficial changes in several risk indices, including glucose tolerance, insulin sensitivity, lipid profiles, anthropometric characteristics, blood pressure, oxidative stress, coagulation profiles, sympathetic activation, pulmonary function, as well as improvement in specific clinical outcomes. Yoga may improve risk profiles in adults with DM 2, may have promise for the prevention and management of cardiovascular complications in this population. However, the limitations characterizing most studies preclude drawing firm conclusions. Additional high-quality RCTs are needed to confirm and further elucidate the effects of standardized yoga programs in populations with DM 2.

Sahay BK et.al., (2007) conducted the study on role of yoga in diabetes. The science of yoga is an ancient one. It is a rich heritage of our culture. Several older books make a mention of the usefulness of yoga in the treatment of certain diseases and preservation of health in normal individuals. The effect of yogic practices on the management of diabetes has not been investigated well. We carried out well designed studies in normal individuals and those with diabetes to assess the role of yogic practices on glycaemic control, insulin kinetics, body composition exercise tolerance and various co-morbidities like hypertension and dyslipidemia. These studies were both short term and long-term. These studies have confirmed the useful role of yoga in the control of diabetes mellitus. Fasting and postprandial blood glucose levels came down significantly. Good glycaemic status can be maintained for long periods of time. There was a lowering of drug requirement and the incidence of acute complications like infection and ketosis was significantly reduced. There were significant changes in the insulin kinetics and those of counter-regulatory hormones like cortisol. There was a decrease in free fatty acids. There was an increase in lean body mass and decrease in body fat percentage. The number of insulin receptors was also increased. There was an improvement in insulin sensitivity and decline in insulin resistance. All these

suggest that yogic practices have a role even in the prevention of diabetes. There is a beneficial effect on the co-morbid conditions like hypertension and dyslipidemia.

Balaji PA et.al., (2011) conducted the study on effects of yoga - pranayama practices on metabolic parameters and anthropometry in type 2 diabetes. India being the diabetic capital of the world, there is a rise in the incidence of type 2 diabetes with the increase in age, physical inactivity and sedentary lifestyle. So, the present study was undertaken to assess the strength of association of these factors and the effects of yoga-pranayama in type 2 diabetes. We selected 44 uncomplicated type 2 diabetic patients in the age group of 40-55 years with diabetes duration of 1-10 years. They were divided into test group and control groups with 22 patients in each group. The test group (T1 and T2) were taught yoga and pranayama for 3 continuous months, 1 hour every day in the morning by yoga expert. The results showed significant decrease in metabolic parameters, with $P < 0.001$ in FBS of both the T1 and T2 sub groups [T1 - 182.87 ± 45.55 to 135.77 ± 38.88 , T 2 - 160.64 ± 41.22 to 130.82 ± 36.11], PPBS with $P < 0.001$ [T1 - 270.64 ± 76.6 to 196.90 ± 64.67 , T 2 - 230.62 ± 71.32 to 183.46 ± 52.20], HbA1c with $P < 0.001$ in both the T1 and T2 sub groups, [T1 - $9.77 \pm 0.5\%$ to $7.68 \pm 0.4\%$ and T 2 - $8.46 \pm 0.3\%$ to $7.23 \pm 0.3\%$]. There was significant decrease with $p < 0.001$ in triglycerides of both the T1 and T2 sub groups, [T1 - 170 ± 70.55 to 132.2 ± 60.6 , T 2 - 164 ± 80.66 to 1143.1 ± 28.89]. There was significant decrease with $P < 0.001$ in LDL of both the T1 and T2 sub groups [T1 - 108 ± 36.24 to 98 ± 33.2 , T 2 - 101.28 ± 32.34 to 86.21 ± 27.2]. However, no significant change in HDL levels in test groups (T1 and T2). It also showed significant decrease in weight, BMI and waist- hip ratio in test group. Addition to above benefits there was significant decrease in the requirement of insulin per day in the T2, from 36.42 ± 4.2 units to 31.48 ± 3.2 units. There were no significant changes in the control group. Thereby concluding that, there are significant

benefits of yoga pranayama practices on metabolic parameters and anthropometric measurements in uncomplicated type 2 diabetes.

Johnsona P et.al., (2014) conducted the study on effects of practicing yogasanas and physical training on selected physiological variables. The study was intended to substantiate the relative effects of yogasana practices and physical training on selected physiological variables. To achieve the purpose sixty male students aged 15 through 18 years were selected as subjects from Govt. Junior College, Ponnalur, Prakasam District, Andhra Pradesh. The subjects selected were equated on the basis of their cardio-respiratory endurance and segregated them into two groups: Group I - yogasana practice group and Group II – physical training group of thirty subjects each. The criterion variables confined to this study were systolic blood pressure, diastolic blood pressure and pulse rate. The experimental programme is five days a week for eight weeks in the morning session. The one-way analysis of variance was used to test the statistical significance. The results of the study reveal that there was no significant difference among the yogasana practices and physical training on systolic blood pressure, diastolic blood pressure and pulse rate. It suggests that practicing yogasanas is better as compared to isometric exercise training in improving the blood pressure and pulse rate.

Pal GK et.al., (2012) conducted the study on the body mass index contributes to sympathovagal imbalance in pre-hypertensive. The present study was conducted to assess the nature of sympathovagal imbalance (SVI) in prehypertensives by short-term analysis of heart rate variability (HRV) to understand the alteration in autonomic modulation and the contribution of BMI to SVI in the genesis of pre hypertension. Body mass index (BMI), basal heart rate (BHR), blood pressure (BP), rate pressure product (RPP) and HRV indices such as total power (TP), low-frequency power (LF), normalized LF (LFnu), high-frequency power (HF), normalized HF (HFnu), LF-HF ratio, mean heart rate (mean RR), square root of the mean squared

differences of successive normal to normal intervals (RMSSD), standard deviation of normal to normal RR interval (SDNN), the number of interval differences of successive NN intervals greater than 50 ms (NN50) and the proportion derived by dividing NN50 by the total number of NN intervals (pNN50) were assessed in three groups of subjects: normotensives having normal BMI (Group 1), prehypertensives having normal BMI (Group 2) and prehypertensives having higher BMI (Group 3). SVI was assessed from LF-HF ratio and correlated with BMI, BHR, BP and RPP in all the groups by Pearson correlation. The contribution of BMI to SVI was assessed by multiple regression analysis. LF and LFnu were significantly increased and HF and HFnu were significantly decreased in prehypertensives subjects in comparison to normotensive subjects and the magnitude of these changes was more prominent in subjects with higher BMI compared to that of normal BMI. LF-HF ratio, the sensitive indicator of sympathovagal balance had significant correlation with BMI ($P=0.000$) and diastolic blood pressure (DBP) ($P=0.002$) in prehypertensives. BMI was found to be an independent contributing factor to SVI ($P=0.001$) in prehypertensives. It was concluded that autonomic imbalance in prehypertensives manifested in the form of increased sympathetic activity and vagal inhibition. In prehypertensives with higher BMI, vagal withdrawal was predominant than sympathetic over activity. Magnitude of SVI (alteration in LF-HF ratio) was linked to changes in BMI and DBP. BMI had an independent influence on LF-HF ratio. It was advised that life-style modifications such as yoga and exercise would enable achieve the sympathovagal balance and blood pressure homeostasis in prehypertensives.

Telles S et.al., (2010) conducted the study on short term health impact of a yoga and diet change program on obesity. Obese persons often find physical activity difficult. The effects of a yoga and diet change program, emphasizing breathing techniques practiced while seated, was assessed in obese persons. 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. Following 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). A 6-day yoga and diet change program decreased the BMI and the fat-free mass. Total cholesterol also decreased due to reduced HDL levels. This suggests that a brief, intensive yoga program with a change in diet can pose certain risks. Benefits seen were better postural stability, grip strength (though a 'practice effect' was not ruled out), reduced waist and hip circumferences and a decrease in serum leptin levels.

Prithviraj Karak et.al., (2014) conducted the study on holistic approach of yoga on blood pressure management. Yoga is an ancient Indian system of exercise and therapy is an art of righteous living or an integrated system for the benefit of the body, mind and inner spirit. Regular practice of yoga can help to decrease stress and anxiety. Forward bends such as the Paschimottana Asana help to increase blood flow to the brain, reduce stress, have a calming effect on the nervous system, and greatly help in reducing hypertension. The aim of yoga is the attainment of the physical, mental and spiritual health and to control the blood pressure. The present study was conducted to determine the effect of yoga training on confirmed coronary artery disease (CAD+) and without coronary artery disease (CAD-) patients. We examined the effects of yoga on hemodynamic and laboratory parameters in a 1-year pilot study. A course of yoga was given to all the subjects for 1.5 Hours six days in week. Systolic

and diastolic blood pressures, heart rate, body mass index (BMI) were all studied at before and after starting of yoga practice. This prospective cohort study included 200 subjects (mean age 52 ± 2 years), both with (50%) and without (50%) established coronary artery disease (CAD). Yoga training produces decrease in systolic blood pressure (SBP) (average 20%), mean arterial pressure (MAP) (11%), heart rate (HR) (average 12.5%) and BMI (8%). SBP, HR and BMI value shows statistically highly significant ($p < 0.05$). These results suggest that there is a significant reduction in blood pressure, heart rate, and BMI in the total cohort with yoga.

Satyanarayana P et.al., (2013) conducted the study on effect of yoga on heart rate, blood pressure, body mass index. Yoga is an ancient Indian system of exercise and therapy, is an art of righteous living or an integrated system for the benefit of the body, mind and inner spirit. Regular practice of Yoga can help to decrease stress and anxiety. Forward bends such as the Paschimottana Asana help to increase blood flow to the brain, reduce stress, have a calming effect on the nervous system, and greatly help in reducing hypertension. The aim of yoga is the attainment of the physical, mental and spiritual health and to control the blood pressure. The present study was conducted to determine the effect of yoga training on 50 male. We examined the effects of yoga on hemodynamic and laboratory parameters in a 6-months pilot study. A course in yoga was given to all the subjects for 1.5 Hours six days in week for twenty four weeks. Systolic and diastolic blood pressures, heart rate, body mass index (BMI) were all studied, before and after 6-months of yoga practice. This prospective cohort study included 50 subjects (mean age 52 ± 2 years) both with CAD (30%) and without established coronary artery disease (CAD) (70%). Yoga training causes decrease in systolic blood pressure (SBP) (average 20%), mean arterial pressure (MAP) (11%), heart rate (HR) (average 12.5%) and BMI (8%). SBP, HR and BMI value shows statistically highly significant ($P < 0.05$). These results

suggest that there is a significant reduction in blood pressure, heart rate, and BMI in the total cohort with yoga.

Telles S et.al., (2014) conducted the study on blood pressure and heart rate variability during yoga-based alternate nostril breathing practice and breath awareness. Previous research has shown a reduction in blood pressure (BP) immediately after the practice of alternate nostril yoga breathing (ANYB) in normal healthy male volunteers and in hypertensive patients of both sexes. The BP during ANYB has not been recorded. Participants were 26 male volunteers (group mean age \pm SD, 23.8 \pm 3.5 years). We assessed (1) heart rate variability, (2) non-invasive arterial BP, and (3) respiration rate, during (a) ANYB and (b) breath awareness (BAW) sessions. Each session was 25 minutes. We performed assessments at 3 time points: Pre (5 minutes), during (15 minutes; for ANYB or BAW) and Post (5 minutes). A naïve-to-yoga control group (n=15 males, mean age \pm SD 26.1 \pm 4.0 years) were assessed while seated quietly for 25 minutes. During ANYB there was a significant decrease (repeated measures ANOVA) in systolic BP and respiration rate; while RMSSD (the square root of the mean of the sum of squares of differences between adjacent NN intervals) and NN50 (the number of interval differences of successive normal to normal intervals greater than 50 ms) significantly increased. During BAW respiration rate decreased. In contrast, respiration rate increased during the control state. ANYB and BAW were significantly different (2-factor ANOVA) in RMSSD and respiration rate. BAW and control were different with respect to respiration rate. The results suggest that vagal activity increased during and after ANYB, which could have contributed to the decrease in BP and changes in the HRV.

Thiyagarajan R et.al., (2014) conducted the study on additional benefit of yoga to standard lifestyle modification on blood pressure in prehypertensives subjects: a randomized controlled study. High blood pressure (BP) is a known risk factor for cardiovascular disease morbidity. Considering the growing evidence of

nonpharmacological interventions in the management of high BP, we designed a randomized, parallel active-controlled study on the effect of yoga and standard lifestyle modification (LSM) on BP and heart rate in individuals with prehypertension (systolic BP 120-139 mm Hg and/or diastolic BP 80-89 mm Hg). Volunteers (20-60 years) of both genders without any known cardiovascular disease were randomized into either LSM group (n = 92) or LSM+yoga group (n = 92). Before the intervention, age, waist circumference, physical activity, BP and fasting plasma glucose and lipids were comparable between the groups. After 12 weeks of intervention, we observed a significant reduction in the BP and heart rate in both the groups. Further, the reduction in systolic BP was significantly more in LSM+yoga group (6 mm Hg) as compared with LSM group (4 mm Hg). In addition, 13 prehypertensives became normotensives in LSM+yoga group and four in LSM group. The results indicate efficacy of non-pharmacological intervention and the additional benefit of yoga to standard LSM. Further research in this field may add to the level of evidence on the benefit of yoga, in the reduction of BP in high BP subjects, in the scientific literature.

Bhavanani AB et.al., (2014) conducted the study on the comparative immediate effect of different yoga asanas on heart rate and blood pressure in healthy young volunteers. This study planned to compare immediate cardiovascular effects of different yoga asanas in healthy young volunteers. Heart rate (HR), systolic pressure (SP), and diastolic pressure (DP), blood pressure (BP), were recorded using the non-invasive blood pressure (NIBP) apparatus in 22 healthy young subjects, before and after the performance of Dhanurasana (DA), Vakrasana (VA) (both sides), Janusirasasana (JSA) (both sides), Matsyasana and Shavasana for 30 s. HR and BP were further recorded during supine recovery at 2, 4, 6, 8, and 10 min. A repeated measure of ANOVA was used for statistical analysis. There were significant changes in HR and BP both immediately after the Asanas as well as during the recovery period. Overall comparisons of changes immediately after the performance of the

Asanas revealed significant differences with regard to HR that increased significantly after DA. In the recovery phase, there were significant intergroup differences from 2 min onward in both SP and DP. The decrease of SP after VA (right side) (VA-R) was significantly greater than Shavasana (4th, 6th, and 8th min) and JSA (left side) (JSA-L) at 6th and 8th min. DP decreased significantly after performing JSA-L compared to VA-R at the 6th and 8th min. The cardiovascular changes immediately after the Asanas and during the recovery phase reveal inherent differences between the selected postures. The rise of HR in DA may be attributed to increased sympathetic response due to the relative difficulty of the posture as well as abdominal compression occurring in it. The effect of supine relaxation is more pronounced after the performance of the Asanas as compared to mere relaxation in Shavasana. This may be attributed to a normalization and resultant homeostatic effect occurring due to a greater, healthier de-activation of the autonomic nervous system occurring owing to the presence of prior activation. There were also subtle differences between the right sided and left sided performance of VA and JSA that may be occurring due to the different internal structures being either compressed or relaxed on either side. Our study provides initial evidence of differential cardiovascular effects of Asanas and subtle differences between right and left sided performance. Further, cardiovascular recovery is greater after the performance of the Asanas as compared to shavasana; thus, implying a better response when effort precedes relaxation.

Krishna BH et.al., (2014) conducted the study on the effect of yoga therapy on heart rate, blood pressure and cardiac autonomic function in heart failure. It is well known that a hall mark of heart failure is adverse changes in autonomic function. Elevated blood pressure is a powerful predictor of congestive heart failure and other Cardiovascular Disease (CVD) outcomes. In this study, we planned to examine the effects of a 12 week yoga therapy on blood pressure, heart rate, heart rate variability and rate pressure product (RPP). Out of 130 heart failure patients recruited

for the study, 65 patients were randomly selected to receive 12 week yoga therapy along with standard medical therapy (yoga group). Other patients (n=65) received only standard medical therapy (control group). Heart rate, blood pressure, cardiac autonomic function (by short-term heart-rate variability analysis) and myocardial oxygen consumption (by RPP) were assessed before and after 12 weeks. In the yoga group, 44 patients and in the control group, 48 patients completed the study. There was a significant decrease in heart rate, blood pressure and RPP in yoga group compared to control group. Also, LFnu and LF-HF ratio decreased significantly and HFnu increased significantly in yoga group compared to control group. Twelve-week yoga therapy significantly improved the parasympathetic activity and decreased the sympathetic activity in heart failure patients (NYHA I&II).

Hagins M et.al., (2014) conducted the study on a randomized controlled trial comparing the effects of yoga with an active control on ambulatory blood pressure in individuals with prehypertension and stage 1 hypertension. The purpose of this study was to compare the effects of yoga with an active control (nonaerobic exercise) in individuals with prehypertension and stage 1 hypertension. A randomized clinical trial was performed using two arms: (1) yoga and (2) active control. Primary outcomes were 24-hour day and night ambulatory systolic and diastolic blood pressures. Within-group and between-group analyses were performed using paired t tests and repeated-measures analysis of variance (time \times group), respectively. Eighty-four participants enrolled, with 68 participants completing the trial. Within-group analyses found 24-hour diastolic, night diastolic and mean arterial pressure all significantly reduced in the yoga group (-3.93, -4.7, -4.23 mm Hg, respectively) but no significant within-group changes in the active control group. Direct comparisons of the yoga intervention with the control group found a single blood pressure variable (diastolic night) to be significantly different ($P = 0.038$). This study has demonstrated that a yoga intervention can lower blood pressure in patients with mild hypertension.

Although this study was not adequately powered to show between-group differences, the size of the yoga-induced blood pressure reduction appears to justify performing a definitive trial of this intervention to test whether it can provide meaningful therapeutic value for the management of hypertension.

Mody BS et.al., (2010) conducted the study on the acute effects of Surya Namaskara on the cardiovascular and metabolic system. With the recent rise in obesity awareness and the increased understanding of the importance of physical activity in promoting overall health, greater emphasis has been placed on improving physical fitness to enhance quality of life. Surya Namaskara, a component of Hatha Yoga, has been practiced by Asian Indians for hundreds of years and is often used in place of a typical fitness program. It consists of a series of postures (asanas) that are repeated 12 times per round. Only one published study has looked specifically at Surya Namaskara, measuring the energy cost of individual asanas (Sinha et al., 2004). However, practitioners typically perform several rounds of the asanas during a session. To assess the cardiorespiratory and metabolic responses of four rounds of Surya Namaskara, a typical amount performed by practitioners, to determine its potential as a training and weight loss tool. Six healthy Asian Indian men and women (18-22 years) who had trained in Surya Namaskara for over two years participated in the study. Testing was completed in a single session lasting about 30 min. To measure heart rate and oxygen consumption while performing the four rounds, participants were connected to a heart rate monitor and the Oxycon Mobile Metabolic System. Participants exercised at 80% of age-predicted maximal heart rate (HRmax) during Round 2, 84% during Round 3 and 90% during Round 4. Average intensity during the four rounds was 80% HRmax, sufficient to elicit a cardio-respiratory training effect. Oxygen consumption averaged 26 ml/kg/min during each round, resulting in an energy expenditure of 230 kcals during a 30 min session for a 60 kg individual.

Regular practice of Surya Namaskara may maintain or improve cardio-respiratory fitness, as well as promote weight management.

Ebnezar J et.al., (2012) conducted the study on the effect of integrated yoga therapy on pain, morning stiffness and anxiety in osteoarthritis of the knee joint: A randomized control study, to study the effect of integrated yoga on pain, morning stiffness and anxiety in osteoarthritis of knees. Two hundred and fifty participants with OA knees (35-80 years) were randomly assigned to yoga or control group. Both groups had transcutaneous electrical stimulation and ultrasound treatment followed by intervention (40 min) for two weeks with follow up for three months. The integrated yoga consisted of yogic loosening and strengthening practices, asanas, relaxation, pranayama and meditation. The control group had physiotherapy exercises. Assessments were done on 15th (post 1) and 90th day (post 2). Resting pain (numerical rating scale) reduced better ($P < 0.001$, Mann-Whitney U test) in yoga group (post 1=33.6% and post 2=71.8%) than control group (post 1=13.4% and post 2=37.5%). Morning stiffness decreased more ($P < 0.001$) in yoga (post 1=68.6% and post 2=98.1%) than control group (post 1=38.6% and post 2=71.6%). State anxiety (STAI-1) reduced ($P < 0.001$) by 35.5% (post 1) and 58.4% (post 2) in the yoga group and 15.6% (post 1) and 38.8% (post 2) in the control group; trait anxiety (STAI 2) reduced ($P < 0.001$) better (post 1 = 34.6% and post 2 = 57.10%) in yoga than control group (post 1 = 14.12% and post 2 = 34.73%). Systolic blood pressure reduced ($P < 0.001$) better in yoga group (post 1 = -7.93% and post 2 = -15.7%) than the control group (post 1 = -1.8% and post 2 = -3.8%). Diastolic blood pressure reduced ($P < 0.001$) better in yoga group (post 1 = -7.6% and post 2=-16.4%) than the control group (post 1 = -2.1% and post 2=-5.0%). Pulse rate reduced ($P < 0.001$) better in yoga group (post 1 = -8.41% and post 2=-12.4%) than the control group (post 1 = -5.1% and post 2 = -7.1%). Integrated approach of yoga therapy is better than physiotherapy exercises as an adjunct to transcutaneous electrical stimulation and

ultrasound treatment in reducing pain, morning stiffness, state and trait anxiety, blood pressure and pulse rate in patients with OA knees.

Jyotsana R et.al., (2003) conducted the study to examine the effect of yoga on cardiovascular function in subjects above 40 years of age. Pulse rate, systolic and diastolic blood pressure and Valsalva ratio were studied in 50 control subjects (not doing any type of physical exercise) and 50 study subjects who had been practicing yoga for 5 years. From the study it was observed that significant reduction in the pulse rate occurs in subjects practicing yoga ($P < 0.001$). The difference in the mean values of systolic and diastolic blood pressure between study group and control group was also statistically significant ($P < 0.01$ and $P < 0.001$ respectively). The systolic and diastolic blood pressure showed significant positive correlation with age in the study group (r_1 systolic = 0.631 and r_1 diastolic = 0.610) as well as in the control group (r_2 systolic = 0.981 and r_2 diastolic = 0.864). The significance of difference between correlation coefficient of both the groups was also tested with the use of Z transformation and the difference was significant (Z systolic = 4.041 and Z diastolic = 2.901). Valsalva ratio was also found to be significantly higher in yoga practitioners than in controls ($P < 0.001$). Our results indicate that yoga reduces the age related deterioration in cardiovascular functions.

2.2 STUDIES ON BIOCHEMICAL VARIABLES

Madanmohan et.al., (2012) conducted the study on the effect of yoga therapy on reaction time, biochemical parameters and wellness score of pre and post-menopausal diabetic patients. Yogic practices may aid in the prevention and management of diabetes mellitus (DM) and reduce cardiovascular complications in the population. The present study has been undertaken to evaluate the effect of yoga therapy on reaction time, biochemical parameters and wellness score of pre and post-menopausal diabetic patients. 15 pre and post-menopausal patients receiving

standard medical treatment for type 2 DM were recruited and reaction time and biochemical investigations were done before and after a comprehensive yoga therapy program comprising of three times a week sessions for six weeks. A post-intervention, retrospective wellness questionnaire compiled by ACYTER was used to evaluate the comparative feelings of the patients after the therapy program. Yoga training reduced auditory reaction time (ART) from right as well as left hand, the decrease being statistically significant ($P < 0.05$) for ART from the right hand. There was a significant ($P < 0.01$) decrease in fasting and postprandial blood glucose levels as well as low density lipoprotein. The decrease in total cholesterol, triglycerides, very low density lipoprotein and increase in high density lipoprotein was also statistically significant ($P < 0.05$). All the lipid ratios showed desirable improvement with a decrease ($P < 0.01$) of TC/HDL and LDL/HDL ratios and increase ($P < 0.05$) in the HDL/LDL ratio. Shortening of RT implies an improvement in the information processing and reflexes and is the first such report in diabetic patients. This has clinical significance and is worth further exploration with wider, well controlled, randomized studies in the diabetic population. Changes in blood glucose levels may be due to improved insulin sensitivity, decline in insulin resistance and increased sensitivity of the pancreatic β cells to glucose signals. Yoga improved the 'heart friendly' status of lipid profile in our subjects and as our participants was pre and post-menopausal, the decrease in cardiovascular risk profile is of greater significance. A comprehensive yoga therapy program has the potential to enhance the beneficial effects of standard medical management of diabetes mellitus and can be used as an effective complementary or integrative therapy program.

Maninder Bindra et.al., (2013) conducted the study on influence of pranayama and yoga asanas on blood glucose, lipid profile and HbA1c in type 2 diabetes. Characteristic features of type II diabetes besides hyperlipidemia a hyperglycemia is impaired insulin secretion and obesity and is a major health hazard.

In this study we aimed to see whether pranayama and yoga asanas have any influence on certain parameters. 100 patients of type-II D.M. without complications (aged 35 to 65 years) were divided in to two groups. Group-I patients received conventional medicines alone while group II patients performed yoga along with conventional medicine. Duration of study was 90 days. Basal recordings of blood glucose, lipid profile and HbA1C were taken at the time of recruitment and second reading after 90 days of study. Results showed a significant improvement of all biochemical parameters except TG in group II patients while group I patients showed insignificant improvement thus broadcasting the beneficial effect of yoga regimen on these parameters in diabetic patients.

Shantakumari N et.al., (2013) conducted the study on the effects of a yoga intervention on lipid profiles of diabetes patients with dyslipidemia. The present study was conducted to assess the effectiveness of yoga in the management of dyslipidemia in patients of type 2 diabetes mellitus. This randomized parallel study was carried out in Medical College Trivandrum, Kerala, India. Hundred type 2 diabetics with dyslipidemia were randomized into control and yoga groups. The control group was prescribed oral hypoglycemic drugs. The yoga group practiced yoga daily for 1 h duration along with oral hypoglycemic drugs for 3 months. The lipid profiles of both the groups were compared at the start and at the end of 3 months. After intervention with yoga for a period of 3 months the study group showed a decrease in total cholesterol, triglycerides and LDL, with an improvement in HDL. Yoga, being a lifestyle incorporating exercise and stress management training, targets the elevated lipid levels in patients with diabetes through integrated approaches.

Sh.Dide Rast et.al., (2013) conducted the study on the effect of yoga training on lipid profile and blood glucose in type II 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 II diabetes. 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 total cholesterol (TC), triglycerides (TG), low density lipoprotein (LDL), high density lipoprotein (HDL), 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 II diabetes, along with fully compliance with their diet, can benefit these exercises in order to control some risk factors associated with diabetes.

Chimkode SM et.al., (2015) conducted the study on effect of yoga on blood glucose levels in patients with type 2 diabetes mellitus. In view of people embracing sedentary life style, and the effectiveness of treatment becoming less, the role of regular exercise especially 'yoga' seems to be a beneficial and economical adjuvant in the management of the type 2 diabetes mellitus (T2DM). To assess the beneficial effects of yoga on blood glucose levels in normal and T2DM volunteers. A prospective case-control study was conducted in the Department of Physiology and Diabetic clinic of a tertiary care teaching hospital over period of two years. The study subjects consisted of 30 male diabetic patients attending diabetic clinic and 30 non-diabetic male volunteers constituted control group. The patients in the age group of 36 to 55 years with T2DM of at least one year duration and those on diabetic diet and oral hypoglycemic agents were included in the study group. The age matched healthy male volunteers who had come to join yoga training at yoga centre were

included in the control group. All the participants were trained by yoga experts and subjected to regular practice under supervision for six months. In all the participants fasting (FBS) and post-prandial blood sugar (PPBS) was estimated before, during (at three months) and after (six months) yoga training. Paired Student t-test was used to estimate difference in means calculated before and after yoga training in a same group. A p-value of < 0.05 was considered as statistically significant. The distribution of age, mean height and mean weight among both the groups were comparable. The reduction in mean values of FBS and PPBS at the end of six months was highly significant ($P < 0.001$) in both the groups when compared with the mean values before and during (three months) yoga practice. The reduction in these values at three months during yoga was highly significant in T2DM group when compared with mean values before yoga ($P < 0.001$), but it was insignificant ($P < 0.05$) in control group. The results of the present study demonstrated that the yoga is effective in reducing the blood glucose levels in patients with T2DM.

Nagarathna R et.al., (2012) conducted the randomized control study on efficacy of yoga based life style modification program on medication score and lipid profile in type 2 diabetes. Several studies have documented the beneficial short term effects of yoga in type 2 diabetics. In this prospective two-armed interventional randomized control study, 277 type 2 diabetics of both genders aged above 28 years who satisfied the study criteria were recruited from 5 zones in and around Bengaluru, India. They were allocated to a yoga-based life style modification program or exercise-based life style modification program. Integrated yoga special technique for diabetes included yogasanas, pranayama, meditation and lectures on yogic life style. Control intervention included physical exercises and life style education. Medication score, blood glucose, HbA1c and lipid profile were assessed at baseline and after 9 months. Intention to treat analysis showed better reduction ($P < 0.05$, Mann-Whitney test) in the dose of oral hypoglycemic medication required (Yoga - 12.8 %) (Yoga-

12.3 %) and increase in HDL (Yoga-7 %) in Yoga as compared to the control group; FBG reduced (7.2 %, $P = 0.016$) only in the Yoga group. There was significant reduction within groups ($P < 0.01$) in PPBG (Yoga-14.6 %, Control-9 %), HbA1c (Yoga-14.1 %, Control-0.5 %), Triglycerides (Yoga-15.4 %, Control-16.3 %), VLDL (Yoga-21.5 %, Control-5.2 %) and total cholesterol (Yoga-11.3 %, Control-8.6 %). Thus, Yoga based life style modification program is similar to exercise-based life style modification in reducing blood glucose, HbA1c, triglycerides, total cholesterol and VLDL. Yoga is better than exercise in decreasing oral hypoglycemic medication requirement and LDL; and increasing HDL in type 2 diabetics.

Gordon LA et.al., (2008) conducted the study 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 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 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.

Malhotra V et.al., (2005) conducted the study on the beneficial effect of yoga in diabetes. Twenty NIDDM subjects (mild to moderate diabetics) in the age group of 30-60 years 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 \leq done by Type 2 Diabetes Patients included. Surya Namaskar, Trikonasana, Tadasana, Sukhasana, Padmasana, Bhastrika Pranayama, Pashimottanasana, Ardhamatsyendrasana, Pawanmuktasana, Bhujangasana, Vajrasana, Dhanurasana and Shavasana are beneficial for diabetes mellitus. Serum insulin, plasma fasting and one hour postprandial blood glucose levels and anthropometric parameters were measured before and after yoga asanas. The results indicate 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 somatoendocrine mechanism affecting insulin

kinetics was worked out. A significant decrease in waist-hip ratio and changes in insulin levels were also observed, suggesting 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.

Manjunatha S et.al., (2005) conducted the study on an investigation into the acute and long-term effects of selected yogic postures on fasting and postprandial glycemia and insulinemia in healthy young subjects. The study was conducted to examine the hypothesis that yogasanas help in the treatment of diabetes mellitus by releasing insulin from the pancreas. Twenty healthy young volunteers (17 male, 3 female; age 19-31 years) participated in the study. Each volunteer performed four sets of asanas in random order for 5 consecutive days each with a 2-day gap between consecutive sets of asanas. The four sets of asanas were: (I) dhanurasana + matsyendrasana, (II) halasana + vajrasana, (III) naukasana + bhujangasana, and (IV) setubandhasana + pavanamuktasana. Blood samples were collected on days 4 and 5 of each set of asanas for measurement of glucose and insulin levels before the asanas, within 10 min after performing the asanas, and 30 min after ingestion of 75 g glucose, which in turn was ingested immediately after the second blood sample. A standard 75 g oral glucose tolerance test (OGTT) was also done before and after the study. On the days of the pre-study or post-study OGTT, no asanas were done. The serum insulin levels after the asanas were lower ($P < 0.05$) than those before the asanas. However, the serum insulin level 0.5 h after the post-asana oral 75 g-glucose challenge was higher ($P < 0.05$) in Set IV than the 0.5 h postprandial insulin level in the pre-study OGTT; the same trend was observed in other sets as well although statistically not significant. The observations suggest that the performance of asanas led to increased sensitivity of the B cells of pancreas to the glucose signal. The increased sensitivity seems to be a sustained change resulting from a progressive

long-term effect of asanas. The study is significant in that it has for the first time attempted to probe the mechanism by which yogasanas help diabetes mellitus.

Bijlani RL et.al., (2005) conducted the study on 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 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. 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. The observations suggest that a short

lifestyle modification and stress management education program leads to favorable metabolic effects within a period of 9 days.

Chaya MS et.al., (2008) conducted the study on the insulin sensitivity and cardiac autonomic function in young male practitioners of yoga. While 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. We 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.

Malhotra V et.al., (2002) conducted the study on the yoga asanas in assessment of pulmonary function in NIDDM patients. Certain yoga asanas if practiced regularly are known to have beneficial effects on human body. These yoga practices might be interacting with various, somato-neuro-endocrine mechanisms to have therapeutic effects. The present study done in twenty four NIDDM patients of 30 to 60 year old, provides metabolic and clinical evidence of improvement in glycaemic control and pulmonary functions. These middle-aged subjects were type II diabetics

on antihyperglycaemic 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 indicate that there was significant decrease in fasting blood glucose levels (basal 190.08 ± 90.8 in mg/dl to 141.5 ± 79.8 in mg/dl). The postprandial blood glucose levels also decreased (276.54 ± 101.0 in mg/dl to 201.75 ± 104.1 in mg/dl), glycosylated hemoglobin showed a decrease ($9.03 \pm 1.4\%$ to $7.83 \pm 2.6\%$). The FEV₁, FVC, PEF_R, MVV increased significantly (1.81 ± 0.4 lt to 2.08 ± 0.4 lt, 2.20 ± 0.6 lt to 2.37 ± 0.5 lt, 3.30 ± 1.0 lt/s to 4.43 ± 1.4 lt/s and 64.59 ± 25.7 lt min to 76.28 ± 28.1 lt/min respectively). FEV₁/FVC% improved ($85 \pm 0.2\%$ to $89 \pm 0.1\%$). These findings suggest that better glycaemic 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.

Kanaya AM et.al., (2013) conducted the study on the restorative yoga and metabolic risk factors: the Practicing Restorative Yoga vs. Stretching for the Metabolic Syndrome (PRYSMS) randomized trial. Intensive lifestyle change prevents type 2 diabetes but is difficult to sustain. Preliminary evidence suggests that yoga may improve metabolic factors. We tested a restorative yoga intervention vs. active stretching for metabolic outcomes. In 2009-2012, we conducted a 48-week randomized trial comparing restorative yoga vs. stretching among underactive adults with the metabolic syndrome at the Universities of California, San Francisco and San Diego. We provided lifestyle counseling and a tapering series of 90-min group classes in the 24-week intervention period and 24-week maintenance period. Fasting and 2-h

glucose, HbA1c, triglycerides, HDL-cholesterol, insulin, systolic blood pressure, visceral fat and quality of life were assessed at baseline, 6- and 12-months. 180 participants were randomized and 135 (75%) completed the trial. At 12 months, fasting glucose decreased more in the yoga group than in the stretching group (-0.35 mmol/L vs. -0.03 mmol/L; $p=0.002$); there were no other significant differences between groups. At 6 months favorable changes within the yoga group included reductions in fasting glucose, insulin and HbA1c and an increase in HDL-cholesterol that were not sustained at 1 year except changes in fasting glucose. The stretching group had a significant reduction in triglycerides at 6 months which was not sustained at 1 year but had improved quality of life at both time-points. Restorative yoga was marginally better than stretching for improving fasting glucose but not other metabolic factors.

Singh S et.al., (2008) conducted the study on influence of pranayama and yoga-asanas on serum insulin, blood glucose and lipid profile in type 2 diabetes. A distinguishable feature of type 2 diabetes besides hyperglycemia and deranged lipid profile is an impaired insulin secretion, peripheral insulin resistance and obesity which has become a major health concern worldwide. India with estimated 31 million diabetics in 2000 and 79 millions by the yr 2030 has the highest number of type 2 diabetics in the world. In this study, we aimed to see if yoga-asanas and pranayama have any influence in modifying certain biochemical parameters. Sixty patients of uncomplicated type 2 diabetes (age 35-60 years of 1-10 years duration) were divided into two groups: Group 1 (n=30): performed yoga along with the conventional hypoglycemic medicines and group 2 (n=30): patients who only received conventional medicines. Duration of the study was 45 days. Basal recordings of blood glucose (fasting and post-prandial), lipid profile and serum insulin were taken at the time of recruitment and the second reading after forty five days. Results showed a significant improvement in all the biochemical parameters in group 1 while group 2

showed significant improvement in only few parameters, thus suggesting a beneficial effect of yoga regimen on these parameters in diabetic patients.

Mahapure HH et.al., (2008) conducted the study on Effect of yogic exercise on super oxide dismutase levels in diabetics. Reactive oxygen species are known to aggravate disease progression. To counteract their harmful effects, the body produces various antioxidant enzymes, viz, superoxide dismutase, glutathione reductase etc. Literature reviews revealed that exercises help to enhance antioxidant enzyme systems; hence, yogic exercises may be useful to combat various diseases. This study aims to record the efficacy of yoga on superoxide dismutase, glycosylated hemoglobin (Hb) and fasting blood glucose levels in diabetics. Forty diabetics aged 40-55 years were assigned to experimental (30) and control (10) groups. The experimental subjects underwent a Yoga program comprising of various Asanas (isometric type exercises) and Pranayama (breathing exercises) along with regular anti-diabetic therapy whereas the control group received anti-diabetic therapy only. Heparinized blood samples were used to determine erythrocyte superoxide dismutase (SOD) activity and glycosylated Hb levels and fasting blood specimens collected in fluoride Vacutainers were used for assessing blood glucose. Data were analyzed by using $2 \times 2 \times 3$ Factorial ANOVA followed by Scheffe's post hoc test. The results revealed that Yogic exercise enhanced the levels of Superoxide dismutase and reduced glycosylated Hb and glucose levels in the experimental group as compared to the control group. The findings conclude that Yogic exercises have enhanced the antioxidant defense mechanism in diabetics by reducing oxidative stress.

Bijlani RL et.al., (2005) conducted the study on 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 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. 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. The observations suggest that a short lifestyle modification and stress management education program leads to favorable metabolic effects within a period of 9 days.

Rajesh P. et.al., (2013) conducted the study on the effect of yoga therapy on anthropometry, metabolic parameters and cardiac autonomic function tests in type 2 diabetes mellitus patients. 120 known diabetic cases in the age group of 30- 60 years were selected. The total population was divided into two groups based on age, group I (GI) consisting of 30-45 years and group II (GII) consisting of 46-60 years. The yoga

therapy consisting of asana, Pranayama, bandhas and mudras was practiced by the patients enrolled in the study daily for one hour for 100 days. Fifty one subjects in group I and forty seven subjects in group II participated till the end of the study. Biochemical tests and cardiac autonomic function tests were performed before and after 100 days of therapy. The mean values of various parameters before and after the 100 days of therapy were as follows, fasting blood glucose changed from 155.6 ± 16.5 to 130.4 ± 14 in GI, 205.4 ± 48.9 to 174.6 ± 40 in GII, cardiac autonomic function score changed from 6.9 ± 1.37 to 4.8 ± 1.13 in GI, 7.06 ± 1.29 to 5.21 ± 1.71 in GII. From the study it is concluded that yoga therapy has a role in reduction of blood glucose and better cardiac autonomic functioning in patients with Type-2 diabetes mellitus in conjunction with medical therapy and the benefit is more pronounced when yoga therapy is started at an earlier age.

Youngwanichsetha S et.al., (2014) conducted the study on the effects of mindfulness eating and yoga exercise on blood sugar levels of pregnant women with gestational diabetes mellitus. This randomized controlled trial was carried out to investigate the effect of mindfulness eating and yoga exercise on blood sugar levels among pregnant Thai women with GDM. Interventions promoting achievement of good glycemic control result in desired pregnancy outcomes. Little is known about the health benefits of mindfulness eating and yoga exercise on blood sugar levels among pregnant with GDM. A randomized controlled trial was carried out. Main outcome measures were capillary fasting plasma glucose, 2-h postprandial blood glucose and hemoglobin A1c. The intervention group showed significantly reduced fasting plasma glucose, 2-h postprandial blood glucose and glycosylated hemoglobin (HbA1c) in the intervention group ($p < 0.05$). Mindfulness eating and yoga exercise had health benefits on glycemic control in pregnant women with GDM. It should be recommended in clinical and community health services.

Skoro-Kondza L et.al., (2009) conducted the study on the community based yoga classes for type 2 diabetes: 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-center 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-minutes 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.

Singh S et.al., (2001) conducted the study, a preliminary report on the role of yoga asanas on oxidative stress in non-insulin dependent diabetes mellitus. Nineteen subjects of non-insulin dependent diabetes mellitus (NIDDM) between the age group of 30-60 yrs were studied to see the effect of specific yoga asanas on fasting and postprandial blood glucose (FBG, PPG), serum malondialdehyde (MDA) and glycosylated hemoglobin (HbA1c) in addition to drug treatment and diet control. The duration of diabetes ranged from 1-10 years. Patients with renal, cardiac and proliferative retinal diseases were excluded from the study. The same patients served as their own control. Subjects were called in the morning to the cardio-respiratory laboratory and were given training by a yoga expert. Yoga asanas included Suryanamskar, Tadasan, TriKonasan, Padmasan, Pranayam, Paschimottanasan, Ardhmatsyendrasan, Pavanmukthasan, Sarpasan and Shavasana. The asanas were done every day for 40 days for 30-40 min. FBG, PPG, serum MDA and HbA1c were estimated before and after 40 days of yoga asanas regimen. Significant reduction was seen in FBG from 220 mg/dl to 162 mg/dl, PPG from 311 mg/dl to 255 mg/dl, MDA from 6 nmol/l to 3 nmol/l and HbA(1), from 8.8% to 6.4%. Subjects felt better and were relieved of their stresses and had an improvement in their day to day performance. The decrease was statistically significant ($P < 0.0001$ for FBG and PPG, $P < 0.001$ for MDA and for HbA1c).

Beena RK et.al., (2013) conducted the study on the yogic practice and diabetes mellitus in geriatric patients. Stress has negative effect on health and type 2

diabetes patients may be at an increased risk. Abnormally high levels of free radicals and the simultaneous decline of antioxidant defense mechanisms can increase lipid peroxidation and insulin resistance. The objective of the present study was to demonstrate the efficacy of yogic practice in geriatric patients with type 2 diabetes mellitus and also to compare the efficacy with the state of glycaemic control. Seventy three (73) healthy elderly patients of type 2 diabetes mellitus in the age group of 60 to 70 years with a history of diabetes for 5 to 10 years and with poor glycaemic control (HbA(1c) >8 %) residing in Kozhikode district were recruited for the study. The subjects were divided into three groups according to their glycaemic control. Group I with HbA(1c) 8.6-9.7 %, group II with HbA(1c) 9.8-10.7 % and group III with HbA(1c) 10.8-12.7 %. Participants did yogic practice under the supervision of experienced trainer, daily 90 minutes, for three months. Biochemical estimation of HbA(1c), glucose, lipid profile, cortisol, ferritin, malondialdehyde (MDA) and catalase activity were carried out on 0 day and 90th day. Seventy patients participated in a comparable control session. The participants in the test group showed statistically significant ($P < 0.001$) decrease in glucose, HbA1c, lipids, cortisol, ferritin, MDA and significant increase in catalase activity after yogic practice. Yoga may improve risk profiles induced by stress in geriatric patients with type 2 diabetes and may have promise for the prevention or delay in diabetes complications. And at all stages of the disease a significant improvement can be achieved by yogic practice in geriatric diabetes.

Sreedevi Aswathy et.al., (2013) conducted the study on effective management of type 2 DM in India: Looking at low-cost adjunctive therapy. A randomized study done in India found a significant improvement in fasting blood sugar, HbA1c and total cholesterol with yoga therapy. Significant improvements in scores of psychological assessment (satisfaction, impact, and worry) were also seen. Clinically significant reduction in the doses of hypoglycemic agents and insulin were

observed after yoga lifestyle intervention [18]. Another study (a more rigorous, inpatient yoga treatment accompanied by visceral cleansing procedures, in addition to Asanas and Pranayama) was undergone by 149 patients for 40 days. This study showed that, for type 2 diabetes of less than 10yrs duration and fasting glucose <140 mg/dl, hyperglycemia can be controlled by yoga alone. However, patients with very severe hyperglycemia/glucose intolerance would need a combination of yoga and hypoglycemic drugs [19]. Bijlani et al. within a short period of study for 10 days was able to show a significant reduction in fasting glucose, total cholesterol, LDL, VLDL, total cholesterol/HDL ratio with yoga therapy; these were more marked in those with hypercholesterolemia and hyperglycemia.[20] In addition to reporting a fall in fasting glucose and post-meal blood glucose. Thus, we suggest that yoga be considered as a candidate for community-based management programs in tackling the burden of type 2 diabetes. Yoga is a potential intervention that is not resource-intensive. If studies prove the effectiveness of yoga, the future may see the emergence of a “Yoga movement by the people with diabetes” to generate positive health. And finally, yoga, an innovation created in India, could find its way back to pre-eminence in this country, given its potential in the ever-increasing epidemic of diabetes and cardiovascular disease.

Maria Rosario (Happy) Araneta (2015) conducted the study on Restorative Yoga, Fat Distribution and Metabolic Risk Factors: Practicing Restorative Yoga vs. Stretching for the Metabolic Syndrome (PRYSMS) Intensive lifestyle interventions have prevented or delayed type 2 diabetes. Aerobic exercise is effective in overall and regional fat weight loss, but might not be feasible for obese, sedentary adults. The effects of gentle physical activity, such as restorative yoga and active stretching, on fat distribution and improving metabolic factors have not been evaluated. We conducted a 48-week randomized trial comparing restorative yoga vs. active stretching in overweight adults (ages 21-65 years) with the metabolic syndrome

(IDF criteria). Participants were underactive (<150 minutes/wk of exercise) and not taking anti-diabetes medications, niacin, fibrates and hormones. We provided lifestyle counseling and a tapering series of 90-min group classes in the 24-week intervention period and 24-week maintenance period. Weight, weight, visceral and subcutaneous fat (by computed tomography, fasting and 2-h glucose, HbA1c, triglycerides, HDL-cholesterol, insulin and systolic blood pressure were measured by computed tomography at baseline, 6 and 12 months. 180 participants were randomized and 135 (75%) completed the trial. Mean age was 55 years and mean BMI was 34 kg/m². Waist, weight and subcutaneous fat, decreased significantly after 6 and 12 months (by 2.1 cm, 1.7 kg, 34 cm²) in the yoga group, whereas waist decreased by 1.1 cm at 12 months, and weight decreased only at 6 months (by 0.7 kg) in the stretching group. Subcutaneous fat decreased significantly in the yoga vs. stretching group after 6 and 12 months, but visceral fat did not change in either group. At 12 months, fasting glucose decreased more in the yoga group than in the stretching group (-0.35 mmol/L vs. -0.03 mmol/L; p=0.002); there were no other significant differences between groups. At 6 months favorable changes within the yoga group included reductions in fasting glucose, insulin and HbA1c and an increase in HDL-cholesterol that were not sustained at 1 year except changes in fasting glucose. The stretching group had a significant reduction in triglycerides at 6 months which was not sustained at 1 year. Restorative yoga was effective in reducing and sustaining reduction in waist, weight, and subcutaneous fat and was marginally better than active stretching for improving fasting glucose.

Innes KE et.al., (2011) conducted the study on association of fructosamine to indices of dyslipidemia in older adults with type 2 diabetes. To evaluate the association of serum fructosamine values to lipid profiles and to other indices of glycemia both at baseline and over time in adults with type 2 diabetes (T2DM). Forty adults aged 45 or older with T2DM, not taking insulin and an HbA1c

of 6-10% were enrolled in a randomized controlled trial regarding the effects of an 8-week yoga program on glycemia and related cardiovascular disease risk indices in adults with T2DM. Fasting blood was drawn to assess glycemia (HbA1c, glucose and fructosamine) and dyslipidemia (LDL, HDL, total cholesterol, cholesterol:HDL ratio, LDL:HDL ratio and triglycerides) pre and post-intervention. Because the relation of fructosamine to other indices of glycemia and to lipid profiles did not differ between treatment groups either at baseline or over time, groups were pooled for analysis. Baseline fructosamine values were significantly correlated with HbA1c ($r = 0.77$, $P < 0.0001$), glucose ($r = 0.72$, $P < 0.0001$), LDL:HDL ratio ($r = 0.46$, $P = 0.01$), cholesterol:HDL ratio ($r = 0.55$, $P = 0.002$) and triglycerides ($r = 0.39$, $P = 0.032$), but not to other lipid indices at baseline. Change in fructosamine over 8 weeks was significantly correlated with change in HbA1c ($r = 0.63$, $P = 0.0001$), glucose ($r = 0.39$, $P = 0.029$), cholesterol ($r = 0.65$, $P < 0.0001$), LDL ($r = 0.55$, $P = 0.001$), LDL:HDL ratio ($r = 0.53$, $P = 0.003$) and cholesterol:HDL ratio ($r = 0.52$, $P = 0.002$) and was more strongly related to change in lipid values than were other indices of glycemia. Fructosamine was significantly correlated with measures of dyslipidemia and glycemia both at baseline and over time and may represent a relatively sensitive and low cost index of short to medium term change in both glycemia and certain lipid profiles. However, findings from this small pilot study should be interpreted with caution and warrant replication in larger prospective studies.

2.3 STUDIES ON PSYCHOLOGICAL VARIABLES

Kosuri M et.al., (2009) conducted the study on yoga practice in diabetes improves 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 T2DM 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 $52.66 \pm 52.66 \pm 12.87$; $P < 0.05$). Participation of subjects with T2DM in yoga practice for 40 days resulted in reduced BMI, improved well-being and reduced anxiety.

Mommersteeg PM et.al., (2012) conducted the study on higher levels of psychological distress are associated with a higher risk of incident diabetes during 18 year follow-up: results from the British household panel survey. Reviews have shown that depression is a risk factor for the development of type 2 diabetes. However, there is limited evidence for general psychological distress to be associated with incident diabetes. The aim of the present study was to test whether persons who report higher levels of psychological distress are at increased risk to develop type 2 diabetes during 18 years follow up, adjusted for confounders. A prospective analysis using data from 9,514 participants (41 years, SD = 14; 44% men) of the British Household Panel Survey. The General Health Questionnaire 12 item version was used to assess general psychological distress, diabetes was measured by means of self-report. Cox proportional hazards regression models were used to calculate the multivariate-adjusted hazard ratio (HR) of incident diabetes during 18 years follow up, comparing participants with low versus high psychological distress at baseline (1991). A total of 472 participants developed diabetes 18 year follow up. Those with a high level of psychological distress had a 33% higher hazard of developing diabetes (HR = 1.33, 95% CI 1.10-1.61), relative to those with a low level of psychological distress, adjusted for age, sex, education level and household income. After further adjustment for differences in level of energy, health status, health problems and activity level, higher psychological distress was no longer associated with incident diabetes

(HR = 1.10, 95% CI 0.91-1.34). Higher levels of psychological distress are a risk factor for the development of diabetes during an 18 year follow up period. This association may be potentially mediated by low energy level and impaired health status.

Benavides S et.al., (2009) conducted the study on the ashtanga yoga for children and adolescents for weight management and psychological well-being an uncontrolled open pilot study. The objective of this pilot study was to determine the effect of yoga on weight in youth at risk for developing type 2 diabetes. Secondly, the impact of participation in yoga on self-concept and psychiatric symptoms was measured. A 12-week prospective pilot Ashtanga yoga program enrolled twenty children and adolescents. Weight was measured before and after the program. All participants completed self-concept, anxiety and depression inventories at the initiation and completion of the program. Fourteen predominately Hispanic children, ages 8-15, completed the program. The average weight loss was 2kg. Weight decreased from 61.2 ± 20.2 kg to 59.2 ± 19.2 kg ($P = 0.01$). Four of five children with low self-esteem improved, although two had decreases in self-esteem. Anxiety symptoms improved in the study. Ashtanga yoga may be beneficial as a weight loss strategy in a predominately Hispanic population.

Vizcaino M (2013) conducted the study on the Hatha yoga practice for type 2 diabetes mellitus patients: a pilot study. This study was conducted to examine the impact of Hatha yoga on glycemic control, psychological and physiological stress and self-care for individuals with type 2 diabetes mellitus (T2DM). Ten sedentary individuals with T2DM who were non-insulin dependent, free of diabetes-related complications and had no previous yoga experience completed therapeutic yoga classes for 6 weeks, 3 times per week. Glycemic control measures included fasting blood glucose, glycated hemoglobin and fasting insulin. The State-Trait Anxiety Inventory, Perceived Stress Scale and salivary cortisol were used to assess levels of

stress and the Summary of Diabetes Self-care Activities questionnaire was used to assess regimen adherence. No significant changes in glucose control or physiological stress were found; however, significant changes in perceived stress, state anxiety and self-care behaviors were detected. Preliminary findings support further investigation of the benefits of Hatha yoga as a complementary therapy for those with T2DM.

Gupta N et.al., (2006) conducted the study on the effect of yoga based lifestyle intervention on state and trait anxiety. Considerable evidence exists for the place of mind body medicine in the treatment of anxiety disorders. Excessive anxiety is maladaptive. It is often considered to be the major component of unhealthy lifestyle that contributes significantly to the pathogenesis of not only psychiatric but also many other systemic disorders. Among the approaches to reduce the level of anxiety has been the search for healthy lifestyles. The aim of the study was to study the short-term impact of a comprehensive but brief lifestyle intervention, based on yoga, on anxiety levels in normal and diseased subjects. The study was the result of operational research carried out in the Integral Health Clinic (IHC) at the Department of Physiology of All India Institute of Medical Sciences. The subjects had history of hypertension, coronary artery disease, diabetes mellitus, obesity, psychiatric disorders (depression, anxiety, and 'stress'), gastrointestinal problems (non-ulcer dyspepsia, duodenal ulcers, irritable bowel disease, Crohn's disease, chronic constipation) and thyroid disorders (hyperthyroidism and hypothyroidism). The intervention consisted of asanas, pranayama, relaxation techniques, group support, individualized advice and lectures and films on philosophy of yoga, the place of yoga in daily life, meditation, stress management, nutrition and knowledge about the illness. The outcome measures were anxiety scores, taken on the first and last day of the course. Anxiety scores, both state and trait anxiety were significantly reduced. Among the diseased subjects significant improvement was seen in the anxiety levels of patients of hypertension, coronary artery disease, obesity, cervical spondylitis and those with psychiatric

disorders. The observations suggest that a short educational programme for lifestyle modification and stress management leads to remarkable reduction in the anxiety scores within a period of 10 days.

Kanojia S et.al., (2013) conducted the study on the effect of yoga on autonomic functions and psychological status during both phases of menstrual cycle in young healthy females. Premenstrual stress affects 75% of women of childbearing age and yoga has been found to be beneficial in many psycho-somatic disorders. To investigate the effect of integrated yoga on autonomic parameters and psychological well-being is during both pre and post phases of menstrual cycle in healthy young female subjects. Present study is a randomized control trial and was conducted in the Department of Physiology, Lady Hardinge Medical College, New Delhi, India. Fifty apparently healthy females in the age group of 18-20 years were randomized into two groups: Group I (n=25) consisted of subjects who practiced yoga 35-40 minutes per day, six times per week for the duration of three menstrual cycles. Training was given by qualified yoga instructor. Group II (n=25) subjects acted as controls. Following parameters were recorded at the beginning and after completion of three menstrual cycles in all the subjects: Height, weight (BW), Resting Heart Rate (HR), Resting Systolic (SBP), Diastolic Blood Pressure (DBP), parasympathetic reactivity tests including Expiration-Inspiration Ratio (E:I ratio) and 30:15 ratio, sympathetic reactivity tests including BP changes due to Isometric Hand Grip (IHG) exercise and Cold Pressor Test (CPT). Assessment of psychological status was done by administering Defense Institute of Physiology and Allied Sciences (DIPAS) inventories of Anger self-report scale, Trait Anxiety, Sense of well-being and Depression scale. Intra-group comparison of physiological parameters was done by using paired 't' test, whereas intra-group comparison of non-parametric data such as scores of anxiety, depression, anger and sense of well-being was done by Wilcoxon signed-rank test. Inter-group comparison of parameters was done by Students 't' test

for parametric tests and Mann-Whitney 'U' test for non-parametric tests. There was significantly higher BW, resting SBP, DBP, sympathetic activity and blunting of parasympathetic reactivity and also, significantly higher scores of anger, depression, anxiety and decreased score of well-being in premenstrual phase as compared to postmenstrual phase in both the groups in initial cycle. There was significantly higher percentage decrease in BW, HR, SBP & DBP in yoga group as compared to control group in both the phases from initial to second and onwards between second and third menstrual cycle. Also, decrease in anger, depression and anxiety and increase in well-being score was significant in yoga group as compared to control group from initial to second and third cycle in premenstrual phase while the change was significant only in depression score in postmenstrual phase. Our study shows that there was significant alteration of autonomic functions and psychological status in premenstrual phase when compared with postmenstrual phase in young healthy females. Also, regular practice of yoga has beneficial effects on both phases of menstrual cycle by bringing parasympatho dominance and psychological well-being probably by balancing neuro-endocrinal axis.

Vallath N (2010) conducted the study on the perspectives on yoga inputs in the management of chronic pain. Chronic pain is multi-dimensional. At the physical level itself, beyond the nociceptive pathway, there is hyper arousal state of the components of the nervous system, which negatively influences tension component of the muscles, patterns of breathing, energy levels and mindset, all of which exacerbate the distress and affect the quality of life of the individual and family. Beginning with the physical body, Yoga eventually influences all aspects of the person: vital, mental, emotional, intellectual and spiritual. It offers various levels and approaches to relax, energize, remodel and strengthen body and psyche. The asanas and pranayama harmonize the physiological system and initiate a "relaxation response" in the neuro endocrinal system. This consists of decreased metabolism,

quieter breathing, stable blood pressure, reduced muscle tension, lower heart rate and slow brain wave pattern. As the neural discharge pattern gets modulated, hyper arousal of the nervous system and the static load on postural muscle come down. The function of viscera improves with the sense of relaxation and sleep gets deeper and sustained; fatigue diminishes. Several subtle level notional corrections can happen in case the subject meditates and that changes the context of the disease, pain and the meaning of life. Meditation and pranayama, along with relaxing asanas, can help individuals deal with the emotional aspects of chronic pain, reduce anxiety and depression effectively and improve the quality of life perceived.

Telles S et.al., (2010) conducted the study on the post-traumatic stress symptoms and heart rate variability in Bihar flood survivors following yoga: a randomized controlled study. An earlier study showed that a week of yoga practice was useful in stress management after a natural calamity. Due to heavy rain and a rift on the banks of the Kosiriver, in the state of Bihar in north India, there were floods with loss of life and property. A week of yoga practice was given to the survivors a month after the event and the effect was assessed. Twenty-two volunteers (group average age \pm S.D, 31.5 ± 7.5 years; all of them were males) were randomly assigned to two groups, yoga and a non-yoga wait-list control group. The yoga group practiced yoga for an hour daily while the control group continued with their routine activities. Both groups' heart rate variability, breath rate and four symptoms of emotional distress using visual analog scales, were assessed on the first and eighth day of the program. There was a significant decrease in sadness in the yoga group ($p < 0.05$, paired t-test, post data compared to pre) and an increase in anxiety in the control group ($P < 0.05$, paired t-test, post data compared to pre). A week of yoga can reduce.

Ray US et.al., (2001) conducted the study on the effect of yogic exercises on physical and mental health of young fellowship course trainees. A study was undertaken to observe any beneficial effect of yogic practices during training period

on the young trainees. 54 trainees of 20-25 years age group were divided randomly in two groups i.e. yoga and control group. Yoga group (23 males and 5 females) was administered yogic practices for the first five months of the course while control group (21 males and 5 females) did not perform yogic exercises during this period. From the 6th to 10th month of training both the groups performed the yogic practices. Physiological parameters like heart rate, blood pressure, oral temperature, skin temperature in resting condition, responses to maximal and submaximal exercise, body flexibility were recorded. Psychological parameters like personality, learning, arithmetic and psychomotor ability, mental well-being were also recorded. Various parameters were taken before and during the 5th and 10th month of training period. Initially there was relatively higher sympathetic activity in both the groups due to the new work/training environment but gradually it subsided. Later on at the 5th and 10th month, yoga group had relatively lower sympathetic activity than the control group. There was improvement in performance at submaximal level of exercise and in anaerobic threshold in the yoga group. Shoulder, hip, trunk and neck flexibility improved in the yoga group. There was improvement in various psychological parameters like reduction in anxiety and depression and a better mental function after yogic practices.

Hoge EA et.al., (2013) conducted the study on the randomized controlled trial of mindfulness meditation for generalized anxiety disorder: effects on anxiety and stress reactivity. Mindfulness meditation has met increasing interest as a therapeutic strategy for anxiety disorders, but prior studies have been limited by methodological concerns, including a lack of an active comparison group. This is the first randomized, controlled trial comparing the minimalized Mindfulness-Based Stress Reduction (MBSR) program with an active control for generalized anxiety disorder (GAD), a disorder characterized by chronic worry and physiologic hyperarousal symptoms. Ninety-three individuals with DSM-IV-diagnosed GAD were

randomly assigned to an 8-week group intervention with MBSR or to an attention control, Stress Management Education (SME), between 2009 and 2011. Anxiety symptoms were measured with the Hamilton Anxiety Rating Scale (HAMA; primary outcome measure), the Clinical Global Impressions-Severity of Illness and Improvement scales (CGI-S and CGI-I) and the Beck Anxiety Inventory (BAI). Stress reactivity was assessed by comparing anxiety and distress during pretreatment and post treatment administration of the Trier Social Stress Test (TSST). A modified intent-to-treat analysis including participants who completed at least 1 session of MBSR (n = 48) or SME (n = 41) showed that both interventions led to significant ($P < .0001$) reductions in HAMA scores at endpoint, but did not significantly differ. MBSR, however, was associated with a significantly greater reduction in anxiety as measured by the CGI-S, the CGI-I, and the BAI (all P values $< .05$). MBSR was also associated with greater reductions than SME in anxiety and distress ratings in response to the TSST stress challenge ($P < .05$) and a greater increase in positive self-statements ($P = .004$). These results suggest that MBSR may have a beneficial effect on anxiety symptoms in GAD and may also improve stress reactivity and coping as measured in a laboratory stress challenge.

Shapiro D et.al., (2007) conducted the study on yoga as a complementary treatment of depression: effects of traits and moods on treatment outcome. Preliminary findings support the potential of yoga as a complementary treatment of depressed patients who are taking anti-depressant medications but who are only in partial remission. The purpose of this article is to present further data on the intervention, focusing on individual differences in psychological, emotional and biological processes affecting treatment outcome. Twenty-seven women and 10 men were enrolled in the study, of whom 17 completed the intervention and pre- and post-intervention assessment data. The intervention consisted of 20 classes led by senior Iyengar yoga teachers, in three courses of 20 yoga classes each. All participants were

diagnosed with unipolar major depression in partial remission. Psychological and biological characteristics were assessed pre and post-intervention and participants rated their mood states before and after each class. Significant reductions were shown for depression, anger, anxiety, neurotic symptoms and low frequency heart rate variability in the 17 completers. Eleven out of these completers achieved remission levels post-intervention. Participants who remitted differed from the non-remitters at intake on several traits and on physiological measures indicative of a greater capacity for emotional regulation. Moods improved from before to after the yoga classes. Yoga appears to be a promising intervention for depression; it is cost-effective and easy to implement. It produces many beneficial emotional, psychological and biological effects, as supported by observations in this study. The physiological methods are especially useful as they provide objective markers of the processes and effectiveness of treatment. These observations may help guide further clinical application of yoga in depression and other mental health disorders and future research on the processes and mechanisms.

Subbakrishna DK et.al., (2012) conducted the study on Quality of life in anxiety disorders: Its relation to work and social functioning and dysfunctional cognitions: An exploratory study from India. The aim of the study to examine quality of life, functioning, disability, work and social adjustment, depression, anxiety and dysfunctional cognitions in patients with anxiety disorders. One hundred patients with anxiety disorders and 98 non-clinical participants were recruited for the study. A cross sectional design was adopted. The participants were assessed on the WHOQoL-BREF, Global Assessment of Functioning (GAF), Sheehan Disability Scale (SDS), the Work and Social Adjustment Scale (WSAS) and Dysfunctional Attitudes Scale (DAS). Data was analyzed using descriptive statistics, Mann–Whitney test, Spearman's Rho and regression analysis. Patients with anxiety disorders reported significantly lower quality of life than the community sample ($df = 98, P < .001$). A

shorter duration of illness was associated with lower quality of life. QoL was significantly correlated with severity of anxiety, depression and stress as well as with measures of disability and adjustment. Partial correlations indicated that depression did not significantly impact the relationship between work and social adjustment and QoL. Work and social adjustment, depression and dysfunctional cognitions emerged as significant predictors of QoL. The findings of the study are discussed in the light of existing research and the implications for future interventions are highlighted.

Tamilselvi B et.al., (2013) conducted the study on Effects of Yoga on Adjustment Problems of School Teachers. Teaching is a very stressful job requiring a teacher to stand for many hours daily alone before a group of some alienated pupils. Moreover, the teacher has to play multiple roles such as supporting parent, disciplinary taskmaster, stimulating actor and informative resource person. Researchers have identified various causes of job related stress of teachers such as work load, insecurity of service, low status in the society, low physical health, lack of recreation and many more. This creates unnecessary stress and strain among teachers. Prolonged unhealthy stress can cause the following cognitive, emotional and behavioral effects. They tend to get lack of concentration and ability to think rationally, reduced memory, easily distracted, increased errors, increased tension, and change in personality, depression, loneliness, reduced self-esteem, less enthusiasm, lower energy levels, speech problems and sleeplessness. Their organization and planning ability deteriorate. They become aggressive and irritable. Apart from these, stress will lead to the other psychological disorders like anxiety, stress and adjustment disorders. The adjustment disorder caused by adjustment problems will definitely affect the professional efficiency of the school teachers. Moreover, the adjustment of a school teacher is an important factor in determining the mental health of the students. So there arises a need to find out a solution for reducing the adjustment problems of school teachers. The long search for a natural healing remedy for all

ailments finally lead to a scientifically proven technology called Yoga. The Inner Science makes wonders in the person's body mind and soul. So an attempt has been made in this study to use this Yogic Science, on school teachers to reduce their adjustment problems. A small experimental research has been done to find the effects of Yoga on Adjustment problems of school teachers by giving a regular practice of Yoga.

Himmat J. Narke et.al., (2015) conducted the study on Yoga practices for adolescents' adjustment in relation to their gender and inhabitation difference. As children grow from year to year, they develop greater complexity in their behavior. During adolescence period an individual acquires certain beliefs, values and social skills which determine their level of adjustment. The concern of present research was to investigate the effect of yoga practices, gender and inhabitation on students' adjustment. The initial sample comprised of 80 students from various sr. schools through random sampling technique. The whole sample was equally divided into two groups namely with yoga practices (n = 40) and without yoga practices (n = 40). These both groups constituted with equal number of students belong to urban (n = 20) and rural (n = 20) settings. All four subgroups were made with equal number of male (n = 10) and female (n = 10) students. To obtain the data Adjustment Inventory for School Students (AISS) by K.P. Sinha was administered on selected sample. As per requirement the present investigation deals with $2 \times 2 \times 2$ factorial design and data was analyzed using 3 Way ANOVA. The obtained result revealed that yoga practices, inhabitation and gender individually as well as interaction with each other to determine level of adjustment among students.

Lorenzo Cohen et.al., (2004) conducted the study on the psychological adjustment and sleep quality in a randomized trial of the effects of a Tibetan yoga intervention in patients with lymphoma. Research suggests that stress-reduction programs tailored to the cancer setting help patients cope with the effects of treatment

and improve their quality of life. Yoga, an ancient Eastern science, incorporates stress-reduction techniques that include regulated breathing, visual imaginary and meditation as well as various postures. The authors examined the effects of the Tibetan yoga (TY) practices of Tsa lung and Trulkhor, which incorporate controlled breathing and visualization, mindfulness techniques and low-impact postures in patients with lymphoma. Thirty-nine patients with lymphoma who were undergoing treatment or who had concluded treatment within the past 12 months were assigned to a TY group or to a wait-list control group. Patients in the TY group participated in 7 weekly yoga sessions, and patients in the wait-list control group were free to participate in the TY program after the 3-month follow-up assessment. Eighty nine percent of TY participants completed at least 2–3 three yoga sessions, and 58% completed at least 5 sessions. Patients in the TY group reported significantly lower sleep disturbance scores during follow-up compared with patients in the wait-list control group (5.8 vs. 8.1; $P < 0.004$). This included better subjective sleep quality ($P < 0.02$), faster sleep latency ($P < 0.01$), longer sleep duration ($P < 0.03$) and less use of sleep medications ($P < 0.02$). There were no significant differences between groups in terms of intrusion or avoidance, state anxiety, depression or fatigue. The participation rates suggested that a TY program is feasible for patients with cancer and that such a program significantly improves sleep-related outcomes.

Sreevani R et.al., (2013) conducted a pilot study on Effectiveness of integrated body-mind-spirit group intervention on the well-being of Indian patients with depression. Depression is a leading cause of disability worldwide. There is a need to develop effective strategies to treat depression and prevent recurrence. Treatments that combine pharmacological and psychotherapeutic approaches are preferred for treating severe forms of depression. The study assesses the effect of an integrated body-mind-spirit group intervention in patients with depression. This pilot study was a pretest-posttest design study. Thirty adult patients diagnosed with

depression attending the psychiatric outpatient department at a district hospital were randomly assigned to either the intervention group or comparison group. Each group had 15 patients. The intervention group received both the intervention and routine hospital treatment and underwent four group integrated body-mind-spirit group intervention therapy sessions. These sessions were held once per week on either Saturday or Sunday, with each session lasting more than 3 hours. Comparison group participants received routine hospital treatment only. Outcome measures, including level of depression, well-being and work & social adjustment, were measured using the Beck Depression Inventory-II, body-mind-spirit well-being scale and work & social adjustment scale. Both groups were evaluated at baseline, 1 month, 2 months, and 3 months. Results showed that both groups had significant reductions in the level of depression, improvements in well-being and work & social adjustment at 3-month follow-up compared with baseline. In addition, the intervention group showed significant mean differences in levels of depression, well-being and work & social adjustment compared with the comparison group. The integrated body-mind-spirituous intervention model appears to reduce depressive symptoms and improve well-being in patients with depression.

Manjit K Khalsa et.al., (2014) conducted the study on yoga-enhanced cognitive behavioral therapy (Y-CBT) for Anxiety Management: A Pilot Study. Cognitive behavioral therapy (CBT) is an effective treatment for generalized anxiety disorder, but there is still room for improvement. The aim of the present study was to examine the potential benefit of enriching CBT with kundalini yoga (Y-CBT). Participants consisted of treatment resistant clients at a community mental health clinic. A total of 32 participants enrolled in the study and 22 completed the programme. After the Y-CBT intervention, pre-post comparisons showed statistically significant improvements in state and trait anxiety, depression, panic, sleep and quality of life. Results from this preliminary study suggest that Y-CBT may have

potential as a promising treatment for those suffering from generalized anxiety disorder. Copyright © 2014 John Wiley & Sons, Ltd. Yoga-enhanced cognitive behavioral therapy (Y-CBT) may be a promising new treatment for those suffering from generalized anxiety disorder. Y-CBT may also reduce depression in those suffering from generalized anxiety. Y-CBT may reduce depression and anxiety in a clinic population where clients suffer from multiple diagnoses including generalized anxiety disorder.

Lakkireddy D et.al., (2013) conducted the study on effect of yoga on arrhythmia burden, anxiety, depression and quality of life in paroxysmal atrial fibrillation: the YOGA My Heart Study. The purpose of this study was to examine the impact of yoga on a trial fibrillation (AF) burden, quality of life (QoL), depression, and anxiety scores. Yoga is known to have significant benefit on cardiovascular health. The effect of yoga in reducing AF burden is unknown. This single-center, pre-post study enrolled patients with symptomatic paroxysmal AF with an initial 3-month non interventional observation period followed by twice-weekly 60-min yoga training for next 3 months. AF episodes during the control and study periods as well as SF-36, Zung self-rated anxiety and Zung self-rated depression scores at baseline, before and after the study phase were assessed. Yoga training reduced symptomatic AF episodes (3.8 ± 3 vs. 2.1 ± 2.6 , $P < 0.001$), symptomatic non-AF episodes (2.9 ± 3.4 vs. 1.4 ± 2.0 ; $P < 0.001$), asymptomatic AF episodes (0.12 ± 0.44 vs. 0.04 ± 0.20 ; $P < 0.001$), depression and anxiety ($P < 0.001$) and improved the QoL parameters of physical functioning, general health, vitality, social functioning and mental health domains on SF-36 ($P = 0.017$, $P < 0.001$, $P < 0.001$, $P = 0.019$, and $P < 0.001$, respectively). There was significant decrease in heart rate, systolic and diastolic blood pressure before and after yoga ($P < 0.001$). In patients with paroxysmal AF, yoga improves symptoms, arrhythmia burden, heart rate, blood pressure, anxiety, depression scores, and several domains of QoL.

Mamtani R et.al., (2005) conducted the study on the impact of Ayurveda and yoga in cardiovascular diseases. Ayurveda is derived from 2 Sanskrit words, namely, "Ayus" and "Veda," meaning life and knowledge, respectively. It literally means science of life. Ayurveda, of which yoga is an integral part, is widely practiced in India and is gaining acceptance in many countries around the world. It is a comprehensive and a holistic system, the focus of which is on the body, mind and consciousness. The Ayurvedic treatment consists of the use herbal preparations, diet, yoga, meditation and other practices. Based on the review of available studies, the evidence is not convincing that any Ayurvedic herbal treatment is effective in the treatment of heart disease or hypertension. However, the use of certain spices and herbs such as garlic and turmeric in an overall healthy diet is appropriate. Many herbs used by Ayurvedic practitioners show promise and could be appropriate for larger randomized trials. Yoga, an integral part of Ayurveda, has been shown to be useful to patients with heart disease and hypertension. Yoga reduces anxiety, promotes well-being and improves quality of life. Its safety profile is excellent. Its use as a complementary therapeutic regimen under medical supervision is appropriate and could be worth considering.

Yeung A et.al., (2014) conducted the study Randomized controlled trial of a 12 week yoga intervention on negative affective states, cardiovascular and cognitive function in post-cardiac rehabilitation patients. Negative affective states such as anxiety, depression and stress are significant risk factors for cardiovascular disease, particularly in cardiac and post-cardiac rehabilitation populations. Yoga is a balanced practice of physical exercise, breathing control and meditation that can reduce psychosocial symptoms as well as improve cardiovascular and cognitive function. It has the potential to positively affect multiple disease pathways and may prove to be a practical adjunct to cardiac rehabilitation in further reducing cardiac risk factors as well as improving self-efficacy and post-cardiac rehabilitation adherence to healthy

lifestyle behaviors. This is a parallel arm, multi-centre, randomized controlled trial that will assess the outcomes of post- phase 2 cardiac rehabilitation patients assigned to a yoga intervention in comparison to a no-treatment wait-list control group. Participants randomized to the yoga group will engage in a 12 week yoga program comprising of two group based sessions and one self-administered home session each week. Group based sessions will be led by an experienced yoga instructor. This will involve teaching beginner students a hatha yoga sequence that incorporates asana (poses and postures), pranayama (breathing control) and meditation. The primary outcomes of this study are negative affective states of anxiety, depression and stress assessed using the Depression Anxiety Stress Scale. Secondary outcomes include measures of quality of life and cardiovascular and cognitive function. The cardiovascular outcomes will include blood pressure, heart rate, heart rate variability, pulse wave velocity, carotid intima media thickness measurements, lipid/glucose profiles and C-reactive protein assays. Assessments will be conducted prior to (week 0), mid-way through (week 6) and following the intervention period (week 12) as well as at a four week follow-up (week 16). This study will determine the effect of yoga practice on negative affective states, cardiovascular and cognitive function in post-phase 2 cardiac rehabilitation patients. The findings may provide evidence to incorporate yoga into standardized cardiac rehabilitation programs as a practical adjunct to improve the management of psychosocial symptoms associated with cardiovascular events in addition to improving patients' cognitive and cardiovascular functions.

Schell FJ et.al., (1994) conducted the study on Physiological and psychological effects of Hatha-Yoga exercise in healthy women. Hatha-Yoga increasingly popular in western countries is a method for coping with stress. However, little is known about the physiological and psychological effects of yoga practice. We measured heart rate, blood pressure, the hormones cortisol, prolactin and

growth hormone and certain psychological parameters in a yoga practicing group and a control group of young female volunteers reading in a comfortable position during the experimental period. There were no substantial differences between the groups concerning endocrine parameters and blood pressure. The course of heart rate was significantly different; the yoga group had a decrease during the yoga practice. Significant differences between both groups were found in psychological parameters. In the personality inventory the yoga group showed markedly higher scores in life satisfaction and lower scores in excitability, aggressiveness, openness, emotionality and somatic complaints. Significant differences could also be observed concerning coping with stress and the mood at the end of the experiment. The yoga group had significant higher scores in high spirits.

Mahvash Shahidi et.al., (2010) conducted the study on Laughter yoga versus group exercise program in elderly depressed women: a randomized controlled trial. Laughter Yoga founded by M. Kataria is a combination of unconditioned laughter and yogic breathing. Its effect on mental and physical aspects of healthy individuals was shown to be beneficial. The objective of this study was to compare the effectiveness of Kataria's Laughter Yoga and group exercise therapy in decreasing depression and increasing life satisfaction in older adult women of a cultural community of Tehran, Iran. Seventy depressed old women who were members of a cultural community of Tehran were chosen by Geriatric depression scale (score>10). After completion of Life Satisfaction Scale pre-test and demographic questionnaire, subjects were randomized into three groups of laughter therapy, exercise therapy and control. Subsequently, depression post-test and life satisfaction post-test were done for all three groups. The data were analyzed using analysis of covariance and Bonferroni's correction. Sixty subjects completed the study. The analysis revealed a significant difference in decrease in depression scores of both Laughter Yoga and exercise therapy group in comparison to control group ($p<0.001$ and $p<0.01$,

respectively). There was no significant difference between Laughter Yoga and exercise therapy groups. The increase in life satisfaction of Laughter Yoga group showed a significant difference in comparison with control group ($P < 0.001$). No significant difference was found between exercise therapy and either control or Laughter Yoga group. Our findings showed that Laughter Yoga is at least as effective as group exercise program in improvement of depression and life satisfaction of elderly depressed women.

Allison A et.al., (2014) conducted the study on effects of Bikram yoga on psychological well-being. Bikram yoga is sometimes referred to as hot yoga and a typical class is 90-minutes in duration, consists of 26 Hatha yoga postures and 2 breathing exercises and is performed in a room heated to 41°C (105° F) with 40% humidity. This study examined the effects of Bikram yoga on two aspects of psychological well-being: core self-evaluation (CSE) and life satisfaction. Core self-evaluation is sometimes referred to as positive self-concept and is comprised of aspects of self-esteem, self-efficacy, locus of control and emotional stability. Life satisfaction is a holistic appraisal of one's life in which a comparison is made of one's current circumstances to what is thought to be an appropriate internally determined personal standard. Twenty-two subjects completed a 60-day Bikram yoga challenge. Self-report survey responses were gathered before and immediately after the challenge. A within-subjects one group pretest-posttest experimental design was used. Bonferroni-adjusted t-tests for change over time in CSE and life satisfaction were both statistically significant. Cohen's d statistic as a measure of effect size was .53 for core-self-evaluation and .40 for life satisfaction. Life satisfaction and CSE each improved over the course of the intervention. It is likely that the well-known effects of participating in intense physical exercise also contributed to improvements in psychological well-being.

Ratna Sharma et.al., (2008) conducted the study on effect on yoga based lifestyle intervention on subject well-being. Yoga is assuming importance in improving mental health and quality of life in the treatment of a number of psychiatric and psychosomatic disorders. The present study was a prospective controlled study to explore the short-term impact of a comprehensive but brief lifestyle intervention, based on yoga, on subjective well-being levels in normal and diseased subjects. Normal healthy individuals and subjects having hypertension, coronary artery disease, diabetes mellitus or a variety of other illnesses were included in the study. The outcome measures were 'subjective well-being inventory' (SUBI) scores, taken on the first and last day of the course. The inventory consists of questions related to one's feelings and attitude about various areas of life, such as happiness, achievement and interpersonal relationship. There was significant improvement in the subjective well-being scores of the 77 subjects within a period of 10 days as compared to controls. These observations suggest that a short lifestyle modification and stress management educational program leads to remarkable improvement in the subjective well-being scores of the subjects and can therefore make an appreciable contribution to primary prevention as well as management of lifestyle diseases.

Mahadzirah Mohamad et.al., (2012) conducted the study on a model of quality of work life, life satisfaction and service quality. The study was conducted with the purpose of identifying the impact of Quality of Work Life (QWL) on Life Satisfaction (LS) and Service Quality (SQ) among nurses in the public hospitals. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to examine the internal reliability of a measure and structural equation modeling (SEM) was used to test the goodness of the proposed hypothesised model. The findings of the study supported the first two proposed hypotheses that postulated firstly, that the higher the perceived QWL, the higher the LS, secondly, the higher the perceived QWL, the higher the perceived nursing SQ. The third hypothesis stated that

the higher the LS, the higher the nursing SQ were not supported. The implication of the study suggests that nursing staff with high QWL would deliver high SQ and at the same time achieve high LS.

2.4 SUMMARY OF THE LITERATURE

The investigator reviewed related literature on studies pertaining to Traditional yoga practices and Tibetan yoga practices on physiological, biochemical and psychological variables from various sources like books, journals, websites and guidance from experts.

The Reviews are presented as studies on physiological variables on yoga (n = 26), studies on biochemical variables on yoga (n = 24) and studies on psychological variables on yoga (n = 26). All the research studies that are presented in this section proves that Traditional yoga practices and Tibetan yoga practices contribute significantly for better improvement in all the criterion variables. The critical reviews are 69 and allied reviews are seven in total.

The Review of literature helped the researcher from the methodological point of view too. It was learnt that most of the research studies cited in this chapter on Analysis and experimental design as the appropriate methods for finding out the foundation and main ingredient for future research and investigate in training methods to guide and complete the study.