Chapter – II

Review of Related Literature

The phrase "Review of Literature" consists of two words "Review" and "Literature". In research methodology the term literature refers to the knowledge of a particular area of any discipline, which includes theoretical, practical and its research studies.

The literature in any field forms the foundation upon which all future work will be built. If one’s fail to build foundation of knowledge provided by the review of literature, one’s work is likely to be shadowed that has already been done better by someone else.

A search for the reference materials would assist the investigator to determine the effectiveness of various combinations of the variables, methodology used and the results obtained. The review of related literature may be used as an important adjusts to the investigator by assisting in the interpretation of his study (Clarke and Clarke, 1976). For this purpose, the investigator has traced out different types of research work such as unpublished theses, journals, research quartiles, abstract cum souvenirs, relevant studies and variety
of relevant books on physical education, sports sciences and internet sources to review related literature for this study.

_Agte et al, (2011)_ undertaken on 26 mild hypertensives and 26 apparently healthy adults (30–60 y), for the effect of Sudarshan Kriya Yoga practice for two months as complementary therapy. In the hypertensives, there was a significant decrease in diastolic blood pressure (P<0.01), serum urea (P<0.01) and plasma MDA (malondialdehyde adducts) as oxidative stress marker (P<0.05). Other parameters; viz.; plasma levels of cholesterol, triglycerides, glucose, did not change significantly (P>0.1). The pattern of change in most of the study parameters was such that values above normal range were lowered but values within normal range were unaltered. The action of Yoga on diastolic blood pressure, malondialdehyde adducts and kidney function in hypertensives was of counteractive nature and felt to be distinctly different than the effect of drugs.

_Pal, et al, (2011)_ find out the effect of regular yogic practices and self-discipline in reducing body fat and elevated lipids in CAD patients. In this study one hundred seventy (170) subjects, of both sexes having coronary artery disease were randomly selected form Department of Cardiology. Subjects
were divided into two groups randomly in yoga group and in non-yoga group, eighty five (85) in each group. Out of these (170 subjects), one hundred fifty four (154) completed the study protocol. TIME LINE: The yogic intervention consisted of 35-40min/day, five days in a week till six months in the Department of Physiology CSMMU UP Lucknow. Body fat testing and estimation of lipid profile were done of the both groups at zero time and after six months of yogic intervention in yoga group and without yogic intervention in non yoga group. In present study, BMI (p<0.04), fat % (p<0.0002), fat free mass (p<0.04), SBP (p<0.002), DBP (p<0.009), heart rate (p<0.0001), total cholesterol (p<0.0001), triglycerides (p<0.0001), HDL (p<0.0001) and low density lipoprotein (p<0.04) were changed significantly. Reduction of SBP, DBP, heart rate, body fat%, total cholesterol, triglycerides and LDL after regular yogic practices is beneficial for cardiac and hypertensive patients. Therefore yogic practices included in this study are helpful for the patients of coronary artery disease.

Gopal et al, (2011), evaluated the impact of stress on psychological, physiological parameters, and immune system during medical term -academic examination and the effect of yoga practices on the same. The study was carried out on sixty
first-year MBBS students randomly assigned to yoga group and control group (30 each). The yoga group underwent integrated yoga practices for 35 minutes daily in the presence of trained yoga teacher for 12 weeks. Control group did not undergo any kind of yoga practice or stress management. Physiological parameters like heart rate, respiratory rate, and blood pressure were measured. Global Assessment of Recent Stress Scale and Spielbergers State Anxiety score were assessed at baseline and during the examination. Serum cortisol levels, IL-4, and IFN-γ levels were determined by enzyme-linked immunosorbent assay technique. In the yoga group, no significant difference was observed in physiological parameters during the examination stress, whereas in the control group, a significant increase was observed. Likewise, the indicators of psychological stress showed highly significant difference in control group compared with significant difference in yoga group. During the examination, the increase in serum cortisol and decrease in serum IFN-γ in yoga group was less significant ($P<0.01$) than in the control group ($P<0.001$). Both the groups demonstrated an increase in serum IL-4 levels, the changes being insignificant for the duration of the study. Yoga resists the autonomic changes and impairment of cellular immunity seen in examination stress.
Tekur et al, (2010), pointed out the efficacy of a residential short term intensive yoga program on quality of life in CLBP. About 80 patients with CLBP (females 37) registered for a week long treatment at SVYASA Holistic Health Centre in Bengaluru, India. They were randomized into two groups (40 each). The yoga group practiced a specific module for CLBP comprising of asanas (physical postures), pranayama (breathing practices), meditation and lectures on yoga philosophy. The control group practiced physical therapy exercises for back pain. Perceived stress scale (PSS) was used to measure baseline stress levels. Outcome measures were WHOQOL Bref for quality of life and straight leg raising test (SLR) using a Goniometer. There were significant negative correlations (Pearson’s, \( P<0.005, r>0.30 \)) between baseline PSS with all four domains and the total score of WHOQOL Bref. All the four domains’ WHOQOL Bref improved in the yoga group (repeated measures ANOVA \( P=0.001 \)) with significant group*time interaction (\( P<0.05 \)) and differences between groups (\( P<0.01 \)). SLR increased in both groups (\( P=0.001 \)) with higher increase in yoga (31.1 % right, 28.4 % left) than control (18.7% right, 21.5 % left) group with significant group*time interaction (SLR right leg \( P=0.044 \)). In CLBP, a negative correlation exists between stress and quality
of life. Yoga increases quality of life and spinal flexibility better than physical therapy exercises.

Acharya et al, (2010), investigated the many styles of Pranayama (Voluntary Regulated Breathing) and Yogasana (Yoga Postures) that range from very dynamic, active movements that go from one posture to another (and result in a thorough aerobic workout) to more slow-paced practices that hold postures for several minutes and form an intense strength training and balanced workout. Twenty male junior footballers younger than 15 years of age, belonging to the Mohun Bagan Athletic Club, Kolkata, were selected for the study at Haridwar. They had to play in a Football Cup organized in UK and they were here to practice yoga sequences taught by Swami Ramdevji. They were of age 14.65±0.58 years and none of them had a history of lipid metabolism disorders. All the footballers were healthy with no history of smoking or alcohol consumption. The scope and objectives of the present study were explained to the subjects and their written consent was obtained for participation in the study. The institutional ethical committee had approved the study protocol and design. The subjects were asked to follow their routine diet and exercise pattern during the period of study. None of the subjects were
exposed to yogic practices before this yoga training session. There was a significant reduction in the levels of serum cholesterol, Low-density lipoprotein (LDL) cholesterol, serum triglycerides, and very-low-density lipoprotein (VLDL)-cholesterol at the end of the yoga session. The results indicated that the fasting blood sugar (FBS) level was positively elevated in junior footballers. The present study demonstrates the efficacy of SRY (Swami Ramdev Yoga)- Pranayama and Yogasana sequences on blood lipid profiles in normal healthy footballers. Pranayama and Yogasana can be used as supportive therapy in patients with lipid disorders, heart diseases and hypoglycemia.

Sayyed et al (2010) intended to study the effect of Sudarshan Kriya Yoga, a novel breathing technique conceived by the world renowned spiritual leader and founder of The Art of Living Foundation Sri Sri Ravishankar. Millions of followers all over the world are practicing and reporting positive well being and better health. To see the effect of Sudarshan Kriya Yoga on Lipid Profile, Pulmonary Function and Hemoglobin concentration, we conducted a workshop of 8 days consisting of 150 participants. Out of which 55 were included in the study group. Our results show that after practicing Sudarshan Kriya.
There is decrease in Total Cholesterol, LDL-Cholesterol along with significant increase in HDL-Cholesterol. There are significant changes in Pulmonary Function, but statistically non-significant changes in Hematological parameters. From the observation Sudarshan Kriya Yoga may play vital role in reducing Total Cholesterol (P<0.05), LDL-Cholesterol (P<0.001) and significantly increasing HDL-Cholesterol (P<0.001).

Spirometric Pulmonary Function Tests studied were Forced Vital Capacity, Forced Expiratory Volume in first second, Peak Expiratory Flow Rate and Maximum Voluntary Ventilation. The results showed improvement in all Pulmonary Function parameters in all subjects as compared to before practicing Sudarshan Kriya Yoga. Thus Sudarshan Kriya Yoga may have therapeutic implication in the adjunctive (non pharmacological) management of cardiovascular diseases and respiratory diseases. The present study confirmed the positive effect of Sudarshan Kriya Yoga on Lipid Profile and Pulmonary Function over a period of 8 days.

*Kyizom et al (2010)* examined sixty patients of type 2 diabetes were recruited from diabetic clinic and divided into two groups - control group on only conventional medical therapy and yoga-group on conventional medical therapy along with
pranayama and yoga-asana. Basal recordings of P300 and blood glucose were taken at the time of recruitment and second recordings repeated after forty five days for both the groups. P300 was recorded on Nihon Kohden Neuropack mu MEB 9100 using auditory "odd-ball paradigm". The data was analysed using repeated measure analysis of variance (ANOVA) followed by Tukey's test at 5 per cent level of significance. Statistically significant improvement in the latency and the amplitude of N200, P300 was observed in the yoga group as compared to the control group. Our data suggest that yoga has a beneficial effect on P300 and thus can be incorporated along with the conventional medical therapy for improving cognitive brain functions in diabetes.

Jimenez et al, (2009) found out Hatha Yoga (HY) can be an alternative to improve physical activity in middle-aged and older women. However, conventional HY (CHY) exercising may not result in enough training stimulus to improve cardiovascular fitness. The purpose of this study was to evaluate the effect of an intensive HY intervention (IHY) on cardiovascular risk factors in middle-aged and older women from Northern Mexico. In this prospective quasiexperimental design, four middle-aged and nine older CHY practicing females
(yoginis) were enrolled into an 11-week IHY program consisting of 5 sessions/week for 90 min (55 sessions). The program adherence, asana performance, and work intensity were assessed along the intervention. Anthropometric [body mass index (BMI), % body fat and Σ skin folds], cardiovascular fitness [maximal expired air volume (VE\textsubscript{max}), maximal O\textsubscript{2} consumption (VO\textsubscript{2max}), maximal heart rate (HR\textsubscript{max}), systolic (BPs) and diastolic blood pressure (BPd)], biochemical [glucose, triacylglycerols (TAG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C)], and dietary parameters were evaluated before and after IHY. Daily caloric intake (~1,916 kcal/day), program adherence (~85%), and exercising skills (asana performance) were similar in both middle-aged and older women. The IHY program did not modify any anthropometric measurements. However, it increased VO\textsubscript{2max} and VE\textsubscript{max} and HDL-C while TAG and LDL-C remained stable in both middle-aged and older groups (P < 0.01). The proposed IHY program improves different cardiovascular risk factors (namely VO\textsubscript{2max} and HDL-C) in middle-aged and older women.

Kondza et al, (2009), investigated the feasibility of researching community based yoga classes in Type 2 diabetes
with a view of informing the design of a definitive, multi-centre trial. The study design was an exploratory randomised controlled trial with in-depth process evaluation. The setting was two multi-ethnic boroughs in London, UK; one with average and one with low mean socio-economic deprivation score. Classes were held at a sports centre or GP surgery. Participants were 59 people with Type 2 diabetes not taking insulin, recruited from general practice lists or opportunistically by general practice staff. The intervention groups were offered 12 weeks of a twice-weekly 90-minute yoga class; the control group was a waiting list for the yoga classes. Both groups received advice and leaflets on healthy lifestyle and were encouraged to exercise. Primary outcome measure was HbA1c. Secondary outcome measures included attendance, weight, waist circumference, lipid levels, blood pressure, UKPDS cardiovascular risk score, diabetes-related quality of life (ADDQoL), and self-efficacy. Process measures were attendance at yoga sessions, self-reported frequency of practice between taught sessions, and qualitative data (interviews with patients and therapists, ethnographic observation of the yoga classes, and analysis of documents including minutes of meetings, correspondence, and exercise plans). Despite broad inclusion criteria, around two-thirds of the patients on GP diabetic
registers proved ineligible, and 90% of the remainder declined to participate. Mean age of participants was 60 +/- 10 years. Attendance at yoga classes was around 50%. Nobody did the exercises regularly at home. Yoga teachers felt that most participants were unsuitable for 'standard' yoga exercises because of limited flexibility, lack of basic fitness, co-morbidity, and lack of confidence. There was a small fall in HbA1c in the yoga group which was not statistically significant and which was not sustained six months later, and no significant change in other outcome measures. The benefits of yoga in type 2 diabetes suggested in some previous studies were not confirmed. Possible explanations (apart from lack of efficacy) include recruitment challenges; practical and motivational barriers to class attendance; physical and motivational barriers to engaged in exercises; inadequate intensity and/or duration of yoga intervention; and insufficient personalisation of exercises to individual needs. All these factors should be considered when designing future trials.

Decewicz et al, (2009) examined the Low-density lipoprotein (LDL) cholesterol lowering is a primary goal in clinical management of patients with cardiovascular disease, but traditional cholesterol levels may not accurately reflect the
true atherogenicity of plasma lipid profiles. The size and concentration of lipoprotein particles, which transport cholesterol and triglycerides, may provide additional information for accurately assessing cardiovascular risk. This study evaluated changes in plasma lipoprotein profiles determined by nuclear magnetic resonance (NMR) spectroscopy in patients participating in a prospective, nonrandomized lifestyle modification program designed to reverse or stabilize progression of coronary artery disease (CAD) to improve our understanding of lipoprotein management in cardiac patients. The lifestyle intervention was effective in producing significant changes in lipoprotein subclasses that contribute to CAD risk. There was a clear beneficial effect on the total number of LDL particles (-8.3%, p < 0.05 compared to matched controls), small dense LDL particles (-9.5%, p < 0.05), and LDL particle size (+0.8%; p < 0.05). Likewise, participants showed significant improvement in traditional CAD risk factors such as body mass index (-9.9%, p < 0.01 compared to controls), total cholesterol (-5.5%, p < 0.05), physical fitness (+37.2%, p < 0.01), and future risk for CAD (-7.9%, p < 0.01). Men and women responded differently to the program for all clinically relevant variables, with men deriving greater benefit in terms of lipoprotein atherogenicity. Plasma lipid and lipoprotein responses to the
lifestyle change program were not confounded by lipid lowering medications. At risk patients motivated to participate, an intensive lifestyle change program can effectively alter traditional CAD risk factors and plasma lipoprotein subclasses and may reduce risk for cardiovascular events. Improvements in lipoprotein subclasses are more evident in men.

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to individual needs. All these factors should be considered when designing future trials.

**Kosuri and Sridhar (2009)** examined 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) anxiety (6.20 +/- 3.72 to 4.29 +/- 4.46; P < 0.05) and improvement in total general well-being (48.6 +/- 11.13 to 52.66 +/- 52.66 +/- 12.87; P < 0.05). Participation of subjects with T2DM in yoga practice for 40 days resulted in reduced BMI, improved well-being, and reduced anxiety.

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

Mahapure et al, (2008) found out 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 *Pranayamas* (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 was analyzed by using 2 x 2 x 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.

*Danucalov (2008)* observed the changes in cardiorespiratory and metabolic intensity brought about by the practice of pranayamas (breathing exercises of yoga) and meditation during the same hatha-yoga session. The technique applied was the one advocated by the hatha-yoga system. Nine yoga instructors-five females and four males, mean age of 44+/−11, 6, were subjected to analysis of the gases expired during
three distinct periods of 30 min: rest, respiratory exercises and meditative practice. A metabolic open circuit computerized system was applied (VO2000, MedGraphics-USA). The oxygen uptake (VO(2)) and the carbon dioxide output (VCO(2)) were statistically different (P <or= 0.05) during meditation and pranayama practices when compared with rest. The heart rate also suffered relevant reductions when results at rest were compared with those during meditation. A smaller proportion of lipids were metabolized during meditation practice compared with rest. The results suggest that the meditation used in this study reduces the metabolic rate whereas the specific pranayama technique in this study increases it when compared with the rest state.

*Innes and Vincent*( 2007) observed 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-
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 was extracted during study design, setting, target population, intervention, comparison group or condition, outcome assessment, data analysis and 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 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.
**Yurtkuran et al, (2007)** evaluated the effects of a yoga-based exercise program on pain, fatigue, sleep disturbance, and biochemical markers in hemodialysis patients. In 2004 a randomized controlled trial was carried out in the outpatient hemodialysis unit of the Nephrology Department, Uludag University Faculty of Medicine. Clinically stable hemodialysis patients (n=37) were included and followed in two groups: the modified yoga-based exercise group (n=19) and the control group (n=18). Yoga-based exercises were done in groups for 30 min/day twice a week for 3 months. All of the patients in the yoga and control groups were given an active range of motion exercises to do for 10 min at home. The main outcome measures were pain intensity (measured by the visual analogue scale, VAS), fatigue (VAS), sleep disturbance (VAS), and grip strength (mmHg); biochemical variables-- urea, creatinine, calcium, alkaline phosphatase, phosphorus, cholesterol, HDL-cholesterol, triglyceride, erythrocyte, hematocrit--were evaluated. After a 12-week intervention, significant improvements were seen in the variables: pain -37%, fatigue -55%, sleep disturbance -25%, grip strength +15%, urea -29%, creatinine -14%, alkaline phosphatase -15%, cholesterol -15%, erythrocyte +11%, and hematocrit count +13%; no side-effects were seen. Improvement of the variables in the yoga-based
exercise program was found to be superior to that in the control group for all the variables except calcium, phosphorus, HDL-cholesterol and triglyceride levels. A simplified yoga-based rehabilitation program is a complementary, safe and effective clinical treatment modality in patients with end-stage renal disease.

*Sahay (2007)* investigated 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.

*Malhotra et al, (2005)* examined 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 < or = done by Type 2 Diabetes Patients included. Surya Namaskar, Trikonasana, Tadasana, Sukhasana, Padmasana, Bhastrika Pranayama, Pashimottanasana, Ardhmatsyendrasana, 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 utilisation 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 et al., (2005)* investigated 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 75g 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.

**Innes et al, (2005)** conducted a systematic review of published literature regarding the effects of yoga, a promising mind-body therapy, on specific anthropometric and physiologic indices of cardiovascular disease (CVD) risk and on related clinical endpoints. They performed a literature search using 4 computerized English and Indian scientific databases. The
search was restricted to original studies (1970 to 2004) evaluating the effects of yoga on CVD or indices of CVD risk associated with the insulin resistance syndrome (IRS). Randomized controlled trials (RCTs), nonrandomized controlled trials, uncontrolled (pre and post) clinical trials, and cross-sectional (observational) studies were included if they met specific criteria. Data was extracted regarding study design, setting, population size and characteristics, intervention type and duration, comparison group or condition, outcome assessment, data analysis and presentation, follow-up, and key results, and the quality of each study was evaluated according to specific predetermined criteria. They identified 70 eligible studies, including 1 observational study, 26 uncontrolled clinical trials, 21 nonrandomized controlled clinical trials, and 22 RCTs. Together, the reported results of these studies indicate beneficial changes overall in several IRS-related indices of CVD risk, including glucose tolerance and insulin sensitivity, lipid profiles, anthropometric characteristics, blood pressure, oxidative stress, coagulation profiles, sympathetic activation, and cardiovagal function, as well as improvement in several clinical endpoints. Collectively, these studies suggest that yoga may reduce many IRS-related risk factors for CVD, may improve clinical outcomes, and may aid in the management of
CVD and other IRS-related conditions. However, the methodologic and other limitations characterizing most of these studies preclude drawing firm conclusions. Additional high quality RCTs are needed to confirm and further elucidate the effects of standardized yoga programs on specific indices of CVD risk and related clinical endpoints.

_Bijlani et al, (2005)_ investigated 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.

Nesto (2005) examined the metabolic syndrome and type 2 diabetes mellitus are both becoming more prevalent and both increase the risk of cardiovascular disease. Many patients are not receiving appropriate treatment for the type of dyslipidemia
that commonly occurs in these disorders—the so-called 'atherogenic lipid triad' of high serum triglyceride levels, low serum high-density lipoprotein cholesterol (HDL-C) levels, and a preponderance of small, dense, low-density lipoprotein cholesterol (LDL-C) particles. All of the processes involved in atherogenesis can be exacerbated by insulin resistance and/or the metabolic syndrome. Hypertriglyceridemia is a strong predictor of coronary heart disease. There is also an inverse relationship between serum levels of HDL-C and triglycerides in diabetic patients, with low serum HDL-C levels possibly representing an independent risk factor for cardiovascular disease. Small, dense, LDL-C particles are also highly atherogenic as they are more likely to form oxidized LDL and are less readily cleared. Insulin resistance, which is central to the metabolic syndrome and type 2 diabetes mellitus, leads to high levels of very low-density lipoprotein (VLDL), which contain a high concentration of triglycerides, resulting in high serum triglyceride levels and low serum HDL-C levels. Even though modification of the atherogenic lipid triad is probably one of the most effective methods of reducing cardiovascular risk, therapy for diabetic dyslipidemia is often directed to first lowering serum LDL-C levels with a HMG-CoA reductase inhibitor. This may leave substantial excess risk for cardiovascular disease in
patients with these types of dyslipidemia. The results of recent trials evaluating HMG-CoA reductase inhibitors have been mixed, with two showing no significant effect on cardiovascular outcomes in subgroups of diabetic patients. The recent CARDS (Collaborative Atorvastatin Diabetes Study) showed that atorvastatin can reduce cardiovascular events in a trial specifically designed for a diabetic population, though the population had to have at least one other risk factor in addition to diabetes mellitus. Fibric acid derivatives, such as fenofibrate, bezafibrate and gemfibrozil, are potentially well suited to the treatment of dyslipidemia that is generally associated with type 2 diabetes mellitus and the metabolic syndrome, as they are usually more effective than HMG-CoA reductase inhibitors for normalizing serum levels of HDL-C and triglycerides. Promising results have been obtained from several trials of fibric acid derivatives including the BIP (Bezafibrate Infarction Prevention) study and the VA-HIT (Veterans Affairs Cooperative Studies Program HDL-C Intervention Trial; gemfibrozil). The FIELD (Fenofibrate Intervention and Event Lowering in Diabetes) trial, a clinical outcomes trial specifically designed to evaluate fenofibrate in a large population of patients with type 2 diabetes mellitus, many of whom have the metabolic syndrome, is underway. The FIELD trial results should shed light on the
efficacy and safety of fenofibrate in reducing cardiovascular morbidity in diabetic and metabolic syndrome patients and on the safety profile of combination therapy with fenofibrate and a HMG-CoA reductase inhibitor.

Singh et al, (2004) examined 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 +/- 0.29% to 7.83 +/- 0.53% after yoga regimen. The pulse rate, systolic and diastolic blood pressure decreased significantly (from 86.45 +/- 2.0 to 77.65 +/- 2.5 pulse/min, from 142.0 +/- 3.9 to 126.0 +/- 3.2 mm of Hg and from 86.7 +/- 2.5 mm of Hg to 75.5 +/- 2.1 mm of Hg after yoga regimen respectively). Corrected QT interval (QTc) decreased from 0.42 +/- 0.0 to 0.40 +/- 0.0. These findings suggest that better glycaemic control and stable autonomic functions can be obtained in Type 2 DM cases with yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing interact with somatoneuro-endocrine mechanism affecting metabolic and autonomic functions remains to be worked out.

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

Ray et al, (2001) observed any beneficial effect of yogic practices during training period on the young trainees.
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.

*Tooley et al, (2000)* determined whether a period of meditation could influence melatonin levels, two groups of meditators were tested in a repeated measures design for changes in plasma melatonin levels at midnight. Experienced meditators practising either TM-Sidhi or another internationally well known form of yoga showed significantly higher plasma melatonin levels in the period immediately following meditation compared with the same period at the same time on a control night. It is concluded that meditation, at least in the two forms studied here, can affect plasma melatonin levels. It remains to be determined whether this is achieved through decreased hepatic metabolism of the hormone or via a direct effect on pineal physiology. Either way, facilitation of higher physiological melatonin levels at appropriate times of day might be one avenue through which the claimed health promoting effects of meditation occur.

*Mahajan et al (1999)* investigated the effect of yogic lifestyle on the lipid status was studied in angina patients and normal subjects with risk factors of coronary artery disease. The parameters included the body weight, estimation of serum
cholesterol, triglycerides, HDL, LDL and the cholesterol - HDL ratio. A baseline evaluation was done and then the angina patients and risk factors subjects were randomly assigned as control (n = 41) and intervention (yoga) group (n = 52). Lifestyle advice was given to both the groups. An integrated course of yoga training was given for four days followed by practice at home. Serial evaluation of both the groups was done at four, 10 and 14 weeks. Dyslipidemia was a constant feature in all cases. An inconsistent pattern of change was observed in the control group of angina (n = 18) and risk factor subjects (n = 23). The subjects practising yoga showed a regular decrease in all lipid parameters except HDL. The effect started from four weeks and lasted for 14 weeks. Thus, the effect of yogic lifestyle on some of the modifiable risk factors could probably explain the preventive and therapeutic beneficial effect observed in coronary artery disease.

Gordon et al, (2008) examined the 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.

*Taludkar, et al (1996)* conducted a controlled study on effect of selected yoga practice in the control and management of 50 cases of essential hypertension and equal number of healthy (non hypertensive) controls. Free radical cellular damage is considered to be the underlying common biological factor in essential hypertension. We, therefore, investigated lipid profile lipid peroxidation and Na⁺K⁺ ATPase activities of plasma membrane of subjects with essential hypertension. It was found that hypertensive subjects had an elevated lipid peroxidation and decreased Na⁺K⁺ ATPase activity in plasma membrane as compared to normotensive healthy controls, the specific yoga training protocol which was administered not only
helped to decrease blood pressure but also retard the progression of cellular damage due to free radicals.

_Telles et al (1993)_ found out two groups of 45 children each, whose ages ranged from 9 to 13 years, were assessed on a steadiness test, at the beginning and again at the end of a 10-day period during which one group received training in yoga, while the other group did not. The steadiness test required insertion of and holding for 15 sec. a metal stylus without touching the sides of holes of decreasing sizes in a metal plate. The contacts were counted as 'errors'. During the 10-day period, one group (the 'Yoga' group) received training in special physical postures (asanas), voluntary regulation of breathing (Pranayama), maintenance of silence, as well as visual focussing exercises (tratakas) and games to improve the attention span and memory. The other group (control) carried out their usual routine. After 10 days, the 'Yoga' group showed a significant (Wilcoxon's paired signed-ranks test) decrease in errors, whereas the 'control' group showed no change.