CHAPTER II

REVIEW OF LITERATURE

The review of literature is instrumental in the selection of the topic, formation of hypothesis and deductive reasoning to the problem. It helps to get a clear idea and supports the finding with regard to the problem under study.

The search for reference material is time consuming but fruitful phase of the graduate programme. A familiarity with the literature in any problem, area helps the students to discover what is already known, what others attempted to find out what method have been promising and problem remains to be solved. (Best, 1978)

An essential aspect of the research project is the review of related literature. Survey of the literature is a crucial aspect of the planning of the study area. The time spent in such a survey is a wise investment. The study of the relevant literature is an essential step to get a full picture of what has been done and said with regard to the problem under study such a review brings about deep insight and clear perspective of the overall field. (Bearge, 1963)

Based on the review collected this chapter has been subdivided into two main subsection namely;

a. Studies of Yoga on Diabetes

b. Studies of Physical Exercises on Diabetes
2.1 STUDIES OF YOGA ON DIABETES

Hegde SV, et al. (2013) studied the effectiveness of yoga intervention on oxidative stress, glycemic status, blood pressure and anthropometry in prediabetes. They selected twenty nine prediabetes subjects aged 30-75 years. Malondialdehyde, glutathione, vitamin C, vitamin E, superoxide dismutase, plasma glucose, glycated haemoglobin, BMI, waist circumference, waist-to-hip ratio and blood pressure were measured. Yoga intervention resulted in a significant decline in malondialdehyde (p<0.001), relative to the control group. In comparison with the control, there was a significant improvement in BMI, waist circumference, systolic blood pressure and fasting glucose levels at follow-up. No significant improvement in glycated haemoglobin, waist-to-hip ratio or any of the antioxidants was observed. Yoga intervention may be helpful in control of oxidative stress in prediabetes subjects. Yoga can also be beneficial in reduction in BMI, waist circumference, systolic blood pressure and fasting glucose. Effect of yoga on antioxidant parameters was not evident in this study. The findings of this study need to be confirmed in larger trials involving active control groups.

Thent ZC, Das S, and Henry LJ. (2013) documented that exercise training programs have emerged as a useful therapeutic regimen for the management of type 2 diabetes mellitus (T2DM). Majority of the Western studies highlighted the effective role of exercise in T2DM. Therefore, the main aim was to focus on the extent, type of exercise and its clinical significance in T2DM in order to educate the clinicians from developing countries, especially in Asians. Pubmed, Science Direct, Scopus, ISI Web of Knowledge and Google scholar were searched using the terms "type 2 diabetes
mellitus," "type 2 DM," "exercise," and/or "physical activity," and "type 2 diabetes mellitus with exercise." Only clinical or human studies published in English language between 2000 and 2012 were included. Certain criteria were assigned to achieve appropriate results. Twenty five studies met the selected criteria. The majority of the studies were randomized controlled trial study design (65%). Most of the aerobic exercise based studies showed a beneficial effect in T2DM. Resistance exercise also proved to have positive effect on T2DM patients. Minimal studies related to other types of exercises such as yoga classes, joba riding and endurance-type exercise were found. On the other hand, United States of America (USA) showed strong interest of exercise management towards T2DM. Aerobic exercise is more common in clinical practice compared to resistance exercise in managing T2DM. Treatment of T2DM with exercise training showed promising role in USA. A large number of researches are mandatory in the developing countries for incorporating exercise in the effective management of T2DM.

De G R Hansen E, and Innes KE. (2013) documented that Type 2 diabetes (T2DM) is a global public health crisis. Research suggests that yoga holds promise for T2DM management. This article summarizes evidence regarding the efficacy of yoga for T2DM management and encourages the development of an integrated research agenda and a collaborative work group to test it. We present a brief overview of the global rise in T2DM and its consequences and costs, review the evidence regarding the potential benefits of yoga for T2DM management, outline limitations in the literature, discuss possible mechanisms underlying the effects of yoga on T2DM, and suggest how a collaborative, multinational effort
by yoga therapist and research communities might contribute to research and inform clinical practice. Yoga protocols that serve T2DM patients and a research framework for creating an evidence base to support the use of yoga for T2DM management are clearly needed.

Vizcaino M. (2013) 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). Methods: 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. Results: 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. Conclusions: Preliminary findings support further investigation of the benefits of Hatha yoga as a complementary therapy for those with T2DM.

Jyotsna VP, et al. (2013) observed the effect comprehensive yogic breathing (Sudarshan Kriya Yoga [SKY] and Pranayam) had on cardiac autonomic functions in patients with diabetes. This is a prospective randomized controlled intervention trial. Cardiac autonomic functions were assessed in 64 diabetics. Patients were randomized into two groups, one group receiving standard therapy for diabetes and the other group receiving standard therapy for diabetes and comprehensive yogic breathing program.
Standard therapy included dietary advice, brisk walking for 45 min daily, and administration of oral antidiabetic drugs. Comprehensive yogic breathing program was introduced to the participants through a course of 12 h spread over 3 days. It was an interactive session in which SKY, a rhythmic cyclical breathing, preceded by Pranayam is taught under the guidance of a certified teacher. Cardiac autonomic function tests were done before and after 6 months of intervention. In the intervention group, after practicing the breathing techniques for 6 months, the improvement in sympathetic functions was statistically significant (P 0.04). The change in sympathetic functions in the standard therapy group was not significant (P 0.75). Parasympathetic functions did not show any significant change in either group. When both parasympathetic and sympathetic cardiac autonomic functions were considered, there was a trend toward improvement in patients following comprehensive yogic breathing program (P 0.06). In the standard therapy group, no change in cardiac autonomic functions was noted (P 0.99). Cardiac autonomic functions improved in patients with diabetes on standard treatment who followed the comprehensive yogic breathing program compared to patients who were on standard therapy alone.

Aswathy S, et al. (2013) documented that the prevalence of Diabetes is projected to increase to 80 million by 2030, placing an immense burden on the health care resources of our country. Thus, diabetes poses a challenge to health systems and the individual. Hence, it is necessary to look at adjuncts to effective management of Diabetes; adjuncts which are not resource intensive and are nearer to the community that people live in. Yoga holds promise as a therapeutic intervention and health
promotion measure. This brief communication explores the studies done to date on the beneficial effects of Yoga on Diabetes.

Rioux JG, and Ritenbaugh C. (2013) assessed the quantity and quality of clinical trials of yoga as an intervention for weight loss or as a means of risk reduction or treatment for obesity and diseases in which obesity is a causal factor. This review summarized the studies' research designs and evaluated the efficacy of yoga for weight loss via the current evidence base. The research team evaluated published studies to determine the appropriateness of research designs, comparability of programs' intervention elements, and standardization of outcome measures. The research team's literature search used the key terms yoga and obesity or yoga and weight loss in three primary medical-literature databases (PubMed, PsychInfo, and Web of Science). The study excluded clinical trials with no quantitative obesity related measure. Extracted data included each study's (1) design; (2) setting and population; (3) nature, duration, and frequency of interventions; (4) comparison groups; (5) recruitment strategies; (6) outcome measures; (7) data analysis and presentation; and (8) results and conclusions. The research team developed an overall evaluation parameter to compare disparate trials. The research team reviewed each study to determine its key features, each worth a specified number of points, with a maximum total of 20 points. The features included a study's (1) duration, (2) frequency of yoga practice, (3) intensity of (length of) each practice, (4) number of yogic elements, (5) inclusion of dietary modification, (6) inclusion of a residential component, (7) the number of weight-related outcome measures, and (8) a discussion of the details of the yogic elements. Overall, therapeutic yoga programs are frequently
effective in promoting weight loss and/or improvements in body composition. The effectiveness of yoga for weight loss is related to the following key features: (1) an increased frequency of practice; (2) a longer intervention duration (3) a yogic dietary component; (4) a residential component; (5) the comprehensive inclusion of yogic components; (5) and a home-practice component. Yoga appears to be an appropriate and potentially successful intervention for weight maintenance, prevention of obesity, and risk reduction for diseases in which obesity plays a significant causal role.

Shantakumari N, et al. (2013) assessed 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.

Beena RK, and Sreekumaran E. (2013) demonstrated 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 and 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 90(th) day. Seventy patients participated in a comparable control session. The participants in the test group showed statistically significant (P < 0.001) decrease in glucose, HbA(1c), 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.

Innes KE, et al. (2013) assessed the effects of yoga on restless leg syndrome (RLS) symptoms and related outcomes in women with RLS. Participants were 13 nonsmoking women with moderate to severe RLS, who did not have diabetes, sleep apnea, or other serious concomitant chronic conditions, and who were not pregnant. The intervention was a gentle, 8-week Iyengar yoga program. Core outcomes assessed pre- and post-treatment were RLS symptoms and symptom severity (International RLS Scale [IRLS] and RLS ordinal scale), sleep quality (Medical Outcomes Study Sleep Scale), mood (Profile of Mood States), and perceived stress (Perceived Stress Scale). Participants also completed yoga logs and a brief exit questionnaire regarding
their experience with the study. Ten (10) women, aged 32-66 years, completed the study. Participants attended an average 13.4±0.5 (of 16 possible) classes, and completed a mean of 4.1±0.3 (of 5 possible) homework sessions/week. At follow-up, participants demonstrated striking reductions in RLS symptoms and symptom severity, with symptoms decreasing to minimal/mild in all but 1 woman and no participant scoring in the severe range by week 8. Effect sizes (Cohen's d) were large: 1.6 for IRLS total, and 2.2 for RLS ordinal scale. IRLS scores declined significantly with increasing minutes of homework practice per session (r=0.70, p=0.025) and total homework minutes (r=0.64, p<0.05), suggesting a possible dose-response relation. Participants also showed significant improvements in sleep, perceived stress, and mood (all p's≤0.02), with effect sizes ranging from 1.0 to 1.6. These preliminary findings suggest that yoga may be effective in attenuating RLS symptoms and symptom severity, reducing perceived stress, and improving sleep and mood in women with RLS.

Balaji PA, Varne SR, and Ali SS. (2012) reported that Yoga is an ancient Indian way of life, which includes changes in mental attitude, diet, and the practice of specific techniques such as yogaasanas (postures), breathing practices (pranayamas), and meditation to attain the highest level of consciousness. Since a decade, there has been a surge in the research on yoga, but we do find very few reviews regarding yogic practices and transcendental meditation (TM) in health and disease. Keeping this in view, a Medline search was done to review relevant articles in English literature on evaluation of physiological effects of yogic practices and TM. Data were constructed; issues were reviewed and found that there were considerable health benefits, including
improved cognition, respiration, reduced cardiovascular risk, body mass index, blood pressure, and diabetes. Yoga also influenced immunity and ameliorated joint disorders.

Rakhshani A, et al. (2012) investigated the effects of yoga in prevention of pregnancy complications in high-risk pregnancies for the first time. 68 high-risk pregnant women were recruited from two maternity hospitals in Bengaluru, India and were randomized into yoga and control groups. The yoga group (n=30) received standard care plus one-hour yoga sessions, three times a week, from the 12th to the 28th week of gestation. The control group (n=38) received standard care plus conventional antenatal exercises (walking) during the same period. Significantly fewer pregnancy induced hypertension (PIH), preeclampsia, gestational diabetes (GDM) and intrauterine growth restriction (IUGR) cases were observed in the yoga group (p=0.018, 0.042, 0.049, 0.05 respectively). Significantly fewer Small for Gestational Age (SGA) babies and newborns with low APGAR scores (p=0.006) were born in the yoga group (p=0.033). This first randomized study of yoga in high-risk pregnancy has shown that yoga can potentially be an effective therapy in reducing hypertensive related complications of pregnancy and improving fetal outcomes. Additional data is needed to confirm these results and better explain the mechanism of action of yoga in this important area.

Jyotsna VP, et al. (2012) assessed the effect of a comprehensive yogic breathing program on glycemic control and quality of life (QOL) in patients with diabetes. This is a prospective randomized controlled intervention trial. Patients having HbA1c between 6 and 9% for at least 3 months with lifestyle modification and oral anti diabetic medication were included. They were followed-up and randomized
at 6 months into two groups: one group receiving standard treatment of diabetes and
the other group receiving standard treatment of diabetes and taught and told to
regularly practice the comprehensive yogic breathing program (Sudarshan
Kriya Yoga and Pranayam). Change in fasting and post-prandial blood sugars,
glycated hemoglobin and QOL as assessed by the World Health Organization QOL
WHOQOL BREF questionnaire were assessed. There was a trend toward
improvement in glycemic control in the group practicing the comprehensive yogic
breathing program compared with the group following standard treatment alone,
although this was not significant. There was significant improvement in physical,
psychological and social domains and total QOL post-intervention in the group
practicing the comprehensive yogic breathing program as compared with the group
following standard treatment alone. There was significant improvement in the QOL
and a non-significant trend toward improvement in glycemic control in the group
practicing the comprehensive yogic breathing program compared with the group that
was following standard treatment alone.

Madanmohan, et al. (2012) evaluated the effect of yoga therapy on reaction
time, biochemical parameters and wellness score of pre and post-menopausal diabetic
patients. 15 peri 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, and 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 b cells to glucose signals. Yoga improved the 'heart friendly' status of lipid profile in our subjects and as our participants were peri 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.

Alexander G, et al. (2012) described patterns of yoga practice and examined differences in physical activity over time between individuals with or at risk for type 2 diabetes who completed an 8-week yoga intervention compared with controls. A longitudinal comparative design measured the effect of a yoga intervention on yoga practice and physical activity, using data at baseline and post intervention
months 3, 6, and 15. Disparate patterns of yoga practice occurred between intervention and control participants over time, but the subjective definition of yoga practice limits interpretation. Multilevel model estimates indicated that treatment group did not have a significant influence in the rate of change in physical activity over the study period. While age and education were not significant individual predictors, the inclusion of these variables in the model did improve fit. Findings indicate that an 8-week yoga intervention had little effect on physical activity over time. Further research is necessary to explore the influence of yoga on behavioral health outcomes among individuals with or at risk for type 2 diabetes.

Malhotra V, et al. (2005) made a study on “The beneficial effect of yoga in diabetes.”. They selected twenty NIDDM subjects (mild to moderate diabetics) in the age group of 30-60 years 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 ≤ done by Type 2 Diabetes Patients included. Serum insulin, plasma fasting and one hour postprandial blood glucose levels and anthropometric parameters were measured before and after yoga asanas. 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.

Singh S, et al. (2004) studied on “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. 2. 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 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 out.

Malhotra V, et al. (2002) conducted a research entitled “Study of yoga asanas in assessment of pulmonary function in NIDDM patients.” The 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 were pursed 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 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.

Jain SC, et al. (1993) undertook a research on “A study of response pattern of non-insulin dependent diabetics to yoga therapy.” They reported that changes in blood glucose and glucose tolerance by oral glucose tolerance test (OGTT) after 40 days of yoga therapy in 149 non-insulin-dependent diabetics (NIDDM) were investigated. The response to yoga in these subjects was categorized according to a severity scale index (SSI) based on area index total (AIT) under OGTT curve. One hundred and four patients showed a fair to good response to the yoga therapy. There was a significant reduction in hyperglycemia and AIT with decrease in oral hypoglycemia and AIT with decrease in oral hypoglycemic drugs required for maintenance of normoglycemia. It is concluded that yoga, a simple and economical therapy, may be considered a beneficial adjuvant for NIDDM patients.

Manjunatha S, et al. (2005) made a 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.”. 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. 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
A 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 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.

Malhotra V, et al. (2002) undertook a study on “Effect of Yoga asanas on nerve conduction in type 2 diabetes.” 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. The Yoga exercises were performed for 30-40 minutes every day for 40 days in the above sequence. Their basal & post 40 day’s parameters were recorded for comparison. 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.

Sharma R, et al. (2008) in their study, “Effect of yoga based lifestyle intervention on subjective well-being”, selected 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.

Chaiopanont S. (2008) studied “Hypoglycemic effect of sitting breathing meditation exercise on type 2 diabetes at Wat Khae Nok Primary Health Center in Nonthaburi province.” To evaluate the hypoglycemic effect of Somporn Kantaradusdi-Triamchaisri technique 1 (SKT1) of sitting breathing meditation exercise on type 2 diabetic patients. This quasi experiment study was performed on type 2 diabetic patients at Wat Khae Nok primary health center from April to May 2007 for a two-week period every Tuesday of the week (3 visits). At the first visit, the patients were educated about diabetes self care after breakfast. At the second and third visit, the participants were trained to practice SKT1 as intervention after breakfast. Post prandial plasma glucose and blood pressure before and after the intervention were recorded. The present study showed that SKT1 practice in type 2 diabetic patients had a post prandial hypoglycemic effect and a slight reduction to systolic and diastolic blood pressure.

Singh RB, et al. (2004) made an attempt to find out “Can brain dysfunction be a predisposing factor for metabolic syndrome?” In their study they reviewed the
various mechanisms that may explain the association between brain dysfunction and the pathogenesis of metabolic syndrome (MS) leading to cardiovascular disease and type 2 diabetes. A Medline search was conducted until September 2003, and articles published in various national and international journals were reviewed. Epidemiological studies and intervention trials indicate that treatment with n-3 fatty acids may be adopted in clinical practice and used to direct therapy for prevention of type 2 diabetes, hypertension, coronary artery disease (CAD), and atherosclerosis, thereby indicating that MS may also respond to this treatment.

Tran, Holly, Iashbrook, Amsterdam (2001), had conducted a study on the effect of hatha yoga practice elicited improvement on the health – related aspects of physical fitness. Ten healthy, untrained volunteers (nine female and one male), ranging in age from 18-27 years, were tested on muscular strength and endurance, flexibility, cardiorespiratory fitness, body composition and pulmonary functions. Training was given two days in a week for a period of eight weeks. It was found out that regular hatha yoga can elicit improvement in the health – related aspects of physical fitness.

The effect of yoga training on reaction time, respiratory endurance and muscular strength was investigated by Madanmohan et al. (1993). Twenty seven subjects were given yoga training for 12 weeks to test the visual and auditory reaction time, maximum expiratory pressure, maximum inspiratory pressure, 40 mm kg test, breath holding time after expiration, breath holding time after inspiration, and hand grip strength. It was concluded that yoga practice for 12 weeks results in significant reduction in visual and auditory reaction times and significant increase in respiratory pressures, breath holding time and hand grip strength.
Lohan and Rajesh (2002) studied the effect of asanas and pranayamas on physical and physiological components of boys between age group 12-16 years. One hundred and twenty subjects were equally divided into asana, pranayama, combined and controlled groups. Ten weeks training programme was given to test the abdominal strength, speed, agility, power and endurance by using AAPHER Youth fitness test battery and blood pressure, heart rate, vital capacity and pulse rate. Pre test and post test scores were analysed by using ANACOVA. It was concluded that physical and physiological fitness was improved by the training of selected yogic exercise. The combined group of asanas and pranayama showed significant improvement in the physical and physiological fitness parameters.

Joshi, et al. (1996) selected thirty three normal male and forty two normal female subjects, of average age of 18.5 years, underwent six weeks course in 'Pranayam' and their ventilatory lung functions were studied before and after this practice. They had improved ventilatory functions in the form of lowered respiratory rate (RR), and increases in the forced vital capacity (FVC), forced expiratory volume at the end of 1st second (FEV1%), maximum voluntary ventilation (MVV), peak expiratory flow rate (PEFR-lit/sec), and prolongation of breath holding time.

Makwana et al. (1988) selected 25 normal male volunteers undergoing a ten weeks course in the practice of yoga have been studied by some parameters of ventilatory functions tests. The observations recorded at the end of ten weeks of the course have shown improved ventilatory functions in the form of lowered respiratory rate, increased forced vital capacity, FEV1, maximum breathing capacity and breath
holding time, while tidal volume and %FEV1, did not reveal any significant change. Thus, a combined practice of yoga seems to be beneficial on respiratory efficiency.

2.2 STUDIES OF PHYSICAL EXERCISES ON DIABETES PATIENTS

Sanghani NB et al. (2013) assessed the effect of structured exercise training and unstructured physical activity interventions on glycemic control. This was a randomized six-month exercise intervention study conducted with previously inactive 279 patients of type 2 diabetes mellitus. Before randomization, all enrolled T2DM participants (n: 300; 30 to 60 year old, having diabetes for more than a year with HbA1c levels of 6.5% or higher) entered a one-month run-in phase to reduce dropout and maintain adherence. A recommendation to increase physical activity was beneficial (0.14% HbA1c reduction; P = 0.12), but was not bringing significantly declines in HbA1c, whereas, structured exercise training is associated with a significant HbA1c decline of 0.59%. (P = 0.030). In a subgroup analysis limited to participants with a baseline HbA1c value > 7%, both the unstructured (0.48%; P = 0.04) and structured exercise training (0.77%; P < 0.01) groups experienced significant decline in HbA1c Vs the control, whereas among participants with baseline hemoglobin A1c values less than 7%, significant reduction occurred only in the structured exercise training group. Changes in blood pressure; total cholesterol, HDL-cholesterol (high-density lipoprotein), LDL-cholesterol (low-density lipoprotein) and the atherogenic index factors did not statistically significantly differ within (baseline to follow-up) and among groups. Supervised structured training was more efficacious than unstructured activity in achieving declines in HbA1c. Although both structured and unstructured training provide benefits, only the former was associated with
significant reductions in HbA1c levels. Therefore, T2DM patients should be stimulated to participate in specifically designed exercise intervention programs.

Ahmadizad S et al. (2013) compared the effects of non-periodized v. periodized resistance training (RT) on plasma adiponectin, leptin and insulin resistance index in overweight men. Thirty two sedentary overweight men (Mean±SD; age, 23.4±0.6 years) were allocated to one of the following (n=8) groups: Control group (CON), nonperiodized (NP), linear periodized (LP) and daily undulating periodized (DUP) training groups. Subjects in training groups performed RT protocols 3 days per week for 8 weeks. Blood samples were taken before and 72h after the training period and were analyzed for plasma adiponectin, leptin, glucose, and insulin. Insulin resistance decreased in all training groups but significant differences were only found between DUP and CON groups (P<0.05). However, after 8 weeks of RT no significant changes were observed in plasma adiponectin and leptin concentrations. Body fat percent and waist to hip ratio (WHR) decreased significantly (P<0.05) following training, whereas, no significant changes were detected in body mass and BMI (P>0.05). The maximum strength (1RM) for bench press and leg press increased after RT in all training groups (P<0.05). Short-term periodized RT protocols can be efficient training strategy for improving insulin resistance and muscular strength in overweight men, while, they have no significant influence on adiponectin and leptin.

Colberg SR, Castorino K, and Jovanovič L. (2013) documented that Gestational diabetes mellitus (GDM) is the most prevalent metabolic disorder during pregnancy. Women diagnosed with GDM have a substantially greater risk of
developing type 2 diabetes within 5-10 years after delivery, and the risk is increased by excess body weight. Uncontrolled hyperglycemia during pregnancy is potentially harmful to both mother and fetus, resulting in a greater need for Caesarian-section deliveries, delivery of larger infants with more excess body fat, a greater risk of infant death and stillbirth, and an elevated risk of infant hypoglycemia immediately after birth. Fortunately, engaging in physical activity prior to and during pregnancy may lower the risk of developing GDM. Pregnant women should also be advised how to safely increase their physical activity during pregnancy and the postpartum period. An initial approach to becoming more physically active can simply be to encourage women to incorporate more unstructured physical activity into daily living, both before and during pregnancy. Giving women an appropriate exercise prescription can encourage them to participate in physical activity safely and effectively throughout pregnancy to prevent and/or manage GDM. Engaging in 30 min of moderate intensity physical activity on most, if not all, days of the week has been adopted as a recommendation for all pregnant women.

Ndefo UA, Okoli O, and Erowele G.(2014) Reviewed the pharmacology, pharmacodynamics, pharmacokinetics, safety, efficacy, and place in therapy of alogliptin and its combinations for managing type 2 diabetes mellitus. Alogliptin is a selective, orally bioavailable inhibitor of the enzymatic activity of dipeptidyl peptidase-4 (DPP-4). It works by slowing the inactivation of the incretin hormones, thereby increasing their concentrations in the bloodstream and reducing fasting and postprandial glucose concentrations in a glucose-dependent manner in patients with type 2 diabetes mellitus. Alogliptin has a moderate degree of absorption, estimated to
exceed 75%, and its absorption is not affected by food. No drug interactions are known to be associated with alogliptin monotherapy. It is indicated as an adjunct to diet and exercise to improve glycemic control in adults with type 2 diabetes mellitus. The clinical efficacy and safety of alogliptin have been demonstrated in several clinical trials, reducing patients' glycosylated hemoglobin level by 0.4-1.0% in 26 weeks. Alogliptin does not require any dosage adjustment when coadministered with ketoconazole, fluconazole, gemfibrozil, warfarin, metformin, glyburide, and pioglitazone. Alogliptin selectively binds to and inhibits DPP-4 in vitro at concentrations approximating therapeutic exposures. The most common adverse events associated with alogliptin are nasopharyngitis, headache, and upper respiratory tract infection. As with the other DPP-4 inhibitors, use of alogliptin may be associated with the development of pancreatitis during therapy. Alogliptin, a selective DPP-4 inhibitor, does not differ greatly from the other DPP-4 inhibitors currently available. It can be used as monotherapy or in combination with metformin for the management of type 2 diabetes.

Desveaux L, et al. (2013) described the structure and delivery of CBE programs for chronic disease populations and compare their impact on FC and HRQL to standard care. Randomized trials examining CBE programs for individuals with stroke, chronic obstructive pulmonary disease, osteoarthritis, diabetes, and cardiovascular disease were identified. Quality was assessed using the Cochrane risk of bias tool. Meta-analyses were conducted using Review Manager 5.1. The protocol was registered on PROSPERO (CRD42012002786). Sixteen studies (2198 individuals, mean age 66.8±4.9 y) were included to describe program structures,
which were comparable in their design and components, irrespective of the chronic disease. Aerobic exercise and resistance training were the primary interventions in 85% of studies. Nine studies were included in the meta-analysis. The weighted mean difference for FC, evaluated using the 6-minute walk test, was 41.7 m (95% confidence interval [CI], 20.5-62.8). The standardized mean difference for all FC measures was 0.18 (95% CI, 0.05-0.3). The standardized mean difference for the physical component of HRQL measures was 0.21 (95% CI, 0.05-0.4) and 0.38 (95% CI, 0.04-0.7) for the total score. CBE programs across chronic disease populations have similar structures. These programs appear superior to standard care with respect to optimizing FC and HRQL in individuals with osteoarthritis; however, the effect beyond this population is unknown. Long-term sustainability of these programs remains to be established.

Mohler ER 3rd et al. (2013) documented that nitrite stores decrease after exercise in patients with peripheral artery disease (PAD) and diabetes represents decreased nitric oxide (NO) bioavailability that may contribute to endothelial dysfunction and limit exercise duration. The primary objective of this placebo-controlled study was the safety and tolerability of multiple doses of oral sodium nitrite in patients with PAD, predominantly with diabetes, over a period of 10 weeks. The primary efficacy endpoint was endothelial flow-mediated dilatation (FMD) and secondary efficacy endpoints included a 6-minute walk test and quality of life assessment. Of the 55 subjects, the most common side effects attributed to sodium nitrite were a composite of headache and dizziness occurring in 21% with the 40 mg dose and 44% with the 80 mg dose. There was no clinically significant elevation of
methemoglobin. FMD non-significantly worsened in the placebo and 40 mg groups, but was stable in the 80 mg group. Diabetic patients receiving 80 mg had significantly higher FMD compared with the placebo and 40 mg groups. There was no significant change in 6-minute walk test or quality of life parameters over time compared to placebo. In conclusion, sodium nitrite therapy is well tolerated in patients with PAD. The possible clinical benefit of sodium nitrite should be studied in a larger and fully powered trial.

Schreuder TH, et al. (2013) documented that short-to-moderate duration exercise training improves fitness and lowers cardiovascular risk in type 2 diabetes (T2DM). However, the impact of long-term compliance to an active lifestyle of T2DM patients on cardiovascular risk factors has never been studied but could provide information on the maximal achievable health effect of physical activity in T2DM. This study examined the impact of a life-long active lifestyle by comparing physical fitness, cardiovascular risk and vascular function between long-term physically active T2DM patients versus sedentary T2DM patients and controls. Fitness, HOMA-IR, brachial artery flow-mediated dilation (FMD) and lifetime risk for cardiovascular disease were assessed in 15 exercising T2DM patients, 12 age-, sex- and weight-matched sedentary T2DM patients and 9 sedentary men free of established cardiovascular and metabolic disease as controls. Long-term regular exercise was defined as self-reported participation of >2.5 h of (predominantly) endurance exercise per week, which was performed for 18-47 years. Sedentary T2DM patients showed lower fitness (21.8 ± 2.3, 32.6 ± 6.0 and 31.1 ± 3.2 ml O₂/kg/min), higher HOMA-IR (8.3 ± 5.0, 2.0 ± 1.8 and 1.1 ± 0.5 100/%S) and higher lifetime risk scores
(17.3 ± 5.4, 9.3 ± 5.0 and 8.9 ± 3.9 %) compared to active peers and controls, respectively. Brachial artery FMD was lower in sedentary T2DM patients compared with active peers, but not in controls (3.3 ± 1.2, 5.2 ± 2.1 and 3.8 ± 1.2 %). Life-long active T2DM patients have superior fitness levels, HOMA-IR, cardiovascular risk and FMD compared to sedentary peers, whilst no differences were found when compared to controls. This study provides evidence that a life-long active lifestyle, even in T2DM, may be able to effectively normalize cardiovascular risk.

Wang IK et al. (2013) reported that although the effect of exercise on health is well established, nephrologists seldom consider physical activity in the treatment of chronic kidney disease (CKD) or CKD in the presence of diabetes mellitus (DM/CKD). The aim of the present study was to analyze the benefits of leisure-time physical activity (LTPA) in DM/CKD. Methods: A total of 445,075 adult participants who underwent a medical screening program between 1996 and 2008 were prospectively recruited. Of these, 7,863 DM/CKD subjects were identified. Each participant was categorized according to LTPA level (a product of duration and intensity) as inactive, low-active or fully active. Hazard ratios (HRs) for mortality risk were calculated. Results: Fully active LTPA was associated with lower odds of DM/CKD development and lower risk of mortality among patients with DM/CKD in a dose-response relationship. The fully active and low-active DM/CKD groups had a 26% (HR 0.74, 95% CI 0.66-0.85) and 13% (HR 0.87, 95% CI 0.75-1.01) lower risk of all-cause mortality, respectively, in comparison to the inactive group. The association of exercise with mortality rate reduction was more pronounced among DM/CKD subjects (mortality rate reduction of 446.5 per 100,000 person-years) than among
subjects with diabetes alone or CKD alone. Conclusion: Exercise, at the recommended level or more, is associated not only with lower odds of DM/CKD but also with a 26% lower mortality risk among DM/CKD patients. Nephrologists should encourage all DM/CKD subjects to be physically active.

Allen JD et al. (2013) determined if type 2 diabetes mellitus (T2D) differentiates endothelial function and plasma nitrite response (a marker of nitric oxide bioavailability) during exercise in peripheral arterial disease (PAD) subjects prior to and following 3 months supervised exercise training (SET). In subjects with T2D+PAD (n=13) and PAD-only (n=14), endothelial function was measured using brachial artery flow-mediated dilation. On a separate day, venous blood draws were performed at rest and 10 min following a symptom-limited graded treadmill test (SL-GXT). Plasma samples were snap-frozen for analysis of nitrite by reductive chemiluminescence. All testing was repeated following 3 months of SET.

Prior to training both groups demonstrated endothelial dysfunction, which was correlated with a net decrease in plasma nitrite following a SL-GXT (p≤0.05). Following SET, the PAD-only group demonstrated an improvement in endothelial function (p≤0.05) and COT (p≤0.05), which was related to a net increase in plasma nitrite following the SL-GXT (both p≤0.05). The T2D+PAD group had none of these increases. T2D in the presence of PAD attenuated improvements in endothelial function, net plasma nitrite, and COT following SET. This suggests that T2D maybe associated with an inability to endogenously increase vascular NO bioavailability to SET.
Hayashino Y et al. (2013) performed a systematic review to assess effects of exercise interventions on inflammatory markers/cytokines and adipokines. We searched electronic databases (MEDLINE, EMBASE, and Cochrane Controlled Trials Registry) and reference lists in relevant papers for articles published in 1966-2013. We selected studies that evaluated the effects of exercise intervention on inflammatory markers/cytokines and adipokines in adult patients with type 2 diabetes. Weighted mean differences of exercise on outcomes were derived using fixed or random effect models; factors influencing heterogeneity were identified using meta-regression analysis. Fourteen randomized controlled trials (824 patients) were included in our meta-analysis. Exercise was associated with a significant change in CRP= -0.66mg/l (95% CI, -1.09 to -0.23mg/l; -14% from baseline) and interleukin-6 (IL-6)= -0.88pg/ml (95% CI, -1.44 to -0.32pg/ml; -18% from baseline) but did not alter adiponectin or resistin levels; aerobic exercise program was associated with a significant change in leptin=- 3.72ng/ml (95% CI, -6.26 to -1.18ng/ml; -24% from baseline). For IL-6, exercise was more effective in those with a longer duration in the program and larger number of sessions during study (p=0.001). Exercise decreases inflammatory cytokine (CRP and IL-6) in patients with type 2 diabetes. Exercise could be a therapeutic option for improving abnormalities in inflammation levels in patients with diabetes.

Balducci S et al. (2013) reported that many studies have highlighted the importance of physical activity for health and recent evidence now points to the positive improvements associated with exercise in type 2 diabetes mellitus (T2DM). However, few physicians are willing to prescribe exercise as a therapy for diabetic patients. In addition, there is a lack of information on how to
implement exercise therapy especially in long-term exercise regimens. The purpose of this manuscript is to summarize standards of exercise therapy for patients with T2DM, both in terms of prescribing and monitoring, according to the American College of Sports Medicine and the American Diabetes Association guidelines. We present details of the exercise therapies used in long-term studies, describing how the parameters for exercise prescription were applied in clinical practice. These parameters are described in terms of frequency, intensity, duration, mode and rate of progression in long-term therapeutic prescriptions. Individual responses to exercise dose are discussed and critical issues to be considered in patients with underlying disease and in T2DM patients are highlighted.

Stampfer MJ, et al. (2000) made a study on, “Primary prevention of coronary heart disease in women through diet and lifestyle.” They observed 84,129 women participating in the Nurses' Health Study who were free of diagnosed cardiovascular disease, cancer, and diabetes at base line in 1980. Information on diet and lifestyle was updated periodically. During 14 years of follow-up, we documented 1128 major coronary events (296 deaths from coronary heart disease and 832 nonfatal infarctions). Eighty-two percent of coronary events in the study cohort (95 percent confidence interval, 58 to 93 percent) could be attributed to lack of adherence to this low-risk pattern. Among women, adherence to lifestyle guidelines involving diet, exercise, and abstinence from smoking is associated with a very low risk of coronary heart disease.

Sclavo M. (2001) documented in their study, “Cardiovascular risk factors and prevention in women: similarities and differences“ that epidemiological evidence shows that among women, the incidence of all, including less severe, coronary events
is still increasing. However, owing both to diminished lethality as well as the reduction in the rate of acute myocardial infarction, mortality has globally decreased. The strong association observed between mortality and major cardiovascular risk factors as well as between their temporal changes and the occurrence of coronary disease makes the undertaking of multifactorial prevention strategies, including the formulation of risk charts for asymptomatic women and men, necessary. In spite of the proved detrimental effect of estrogen deficiency on LDL- and HDL-cholesterol, on arterial smooth muscle cell proliferation and on insulin secretion and in spite of the data of numerous observational studies and of the HERS trial (all, however, with methodological limitations), clinical evidence does not justify widespread estrogen prescription, not even for purposes of secondary prevention. Besides, the dosages and the route of administration are still subject of debate.

Doggrell SA. (2002) in their study, “Metformin & lifestyle intervention prevent Type 2 diabetes: lifestyle intervention has the greater effect.” Reported that Diabetes mellitus is now occurring in epidemic proportions in many countries. Owing to the limited effectiveness of drug prophylaxis of diabetic complications after diabetes has developed, it may be more appropriate to investigate ways to prevent the onset of diabetes. The intensive lifestyle intervention decreased plasma glycosylated haemoglobin levels to a greater extent than metformin. Both intensive lifestyle intervention and metformin reduced the incidence of diabetes, with the lifestyle intervention having the greater effect.

Chiriac S, et al. (2002) made a study on “The beneficial effect of physical training in hypertension” and reported that Hypertension is present in epidemic
proportion and is associated with a markedly increased risk of developing numerous cardiovascular disorders. All current treatment guidelines emphasise the role of nonpharmacological interventions, physical activity included, in the treatment of mild to moderate hypertension. In patients with diabetes, cardiovascular disease or with stage 2 or 3 hypertension, drug therapy should be initiated first. Dynamic exercise of moderate intensity, 50-75% VO2max, (e.g. brisk walking, cycling) for 50-60 minutes, 3-5 times per week, is preferable to vigorous exercise because it appears to be more effective in lowering blood pressure. In addition to reducing hypertension, physical activity improves other cardiovascular risk factors.

Lakka TA and Laaksonen DE. (2007) in their study, “Physical activity in prevention and treatment of the metabolic syndrome”, followed randomised controlled trials have shown that exercise training has a mild or moderate favourable effect on many metabolic and cardiovascular risk factors that constitute or are related to the metabolic syndrome (MetS). Epidemiological studies suggest that regular physical activity prevents type 2 diabetes, cardiovascular disease, and premature mortality in large part through these risk factors. The measurement of maximal oxygen consumption may provide an efficient means to target even individuals with relatively few metabolic risk factors who may benefit from more intensive intervention.

Böhm M, et al. (2008) investigated on “Treating to protect: current cardiovascular treatment approaches and remaining needs”, and documented that Current best practice to reduce cardiovascular disease involves evaluating patients' global cardiovascular risk profiles and devising treatment strategies accordingly. The ‘On Target’ Trial Program is designed to clarify the importance of this effect.
Educating patients, raising physicians' awareness, and implementing effective and safe treatment regimens are all necessary steps to bring about the much-needed improvements in cardiac health outcomes.

Praet et al. (2008), in their study, “Brisk walking compared with an individualised medical fitness programme for patients with type 2 diabetes: a randomised controlled trial” selected randomized 92 type II diabetic patients. Group-based brisk walking may represent an attractive alternative, but its long-term efficacy as compared with an individualised approach such as medical fitness intervention programmes is unknown. The prescription of group-based brisk walking represents an equally effective intervention to modulate glycaemic control and cardiovascular risk profile in type 2 diabetes patients when compared with more individualised medical fitness.

Yeater (1999) attempted for a study on “Coronary risk factors in type II diabetes response to low intensity aerobic exercise” Patients with non-insulin dependent diabetes are at greatly increased risk for coronary artery disease. Although exercise training has been shown to decrease risk factors, the presence of obesity, older age and a sedentary lifestyle make a high-intensity exercise program an unrealistic choice of therapy. Triglycerides decreased in the exercise group from 285 to 223 mg/dl Body weight, total and HDL cholesterol, glucose and insulin independent of dietary changes is an effective and feasible method of improving cardiovascular risk factors. Physical fitness, systolic blood pressure, plasma triglycerids and glycemic control in non-insulin dependent diabetic subjects.
Jankowski (1999) conducted a study on “Effect of exercise in post prandial insulin responses in Mexican American and non-Hispanic women” Postprandial insulin responses (integrated area under the curve) to an oral glucose load after a period of aerobic exercise and no exercise control were compared in sedentary normoglycemic Mexican American women have a high risk of developing type 2 diabetes and aerobic exercise may be valuable in the prevention or delay of onset of diabetes by reducing peripheral insulin resistance.

Green and Dowson (2002) studied the measurement of anaerobic capacity in human body. The study focuses on laboratory measures which attempts to quantify anaerobic capacities. Maximal blood lactate measure was used in both research and athletic settings to decrease anaerobic capacity. Its uses was supported by (a) the high correlations observed between maximal blood lactate and short duration exercise performance presumably dependant upon anaerobic capacity and (b) the higher maximal blood lactates values observed in sprint and power athletes (who would demonstrate higher anaerobic capacities) compared with endurance athletes or untrained people. The latter findings may be partially related to the confounding influence of blood volume which such high variability response to short and long term exercise demands. Maximal blood lactate was known to be influenced by the intensity and duration of the preceding exercise bout; therefore it was plausible that these factors may also influence the degree for which maximal blood lactate accurately reflects an aerobic capacity.

Sharma (1995) conducted a programme on Ujjayi and Bhashrika for forty- five minutes in three spells in morning for three months on 150 school children affected by
exposure to M.I.C. Gas. Resting pulse rate, vital capacity, blood pressure, hemoglobin percentage and cardio respiratory function as measured by Harvard step test increased to normal rate.

2.3 SUMMARY OF RELATED LITERATURE

In this chapter the investigator reviewed studies pertaining to effects of yogic practices and physical exercises on physiological and biochemical variables on different age groups and population on diabetics, type 2 diabetics and women diabetes. The reviews proved that there was further scope for research to find out effects of yogic practices and physical exercises on selected physiological variables, resting pulse rate, breath holding time, systolic blood pressure, diastolic blood pressure, and biochemical variables, blood sugar, total cholesterol, triglyceride, uric acid and high density lipoprotein. Hence, this research was undertaken. Based on the experience gained the investigator formulated suitable methodology to be adopted in this research, this is presented in Chapter III.