

**MANAGEMENT OF OBESITY AND DIABETES MELLITUS THROUGH
YOGA AND NATUROPATHY**

Thesis Submitted By

Prashanth Shetty B.N.Y.S., M. Sc. (Yoga)

Towards partial fulfilment of

DOCTOR OF PHILOSOPHY (YOGA)



**SWAMI VIVEKANANDA YOGA ANUSANDHANA SAMSTHANA
(Declared as Deemed University under Section 3 of the UGC Act, 1956)**

BANGALORE - 560 019

INDIA

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By

PRASHANTH SHETTY, BNYS M.Sc(Yoga)

Under the Guidance of

HONGASANDRA R. NAGENDRA M.E., Ph.D.

SWAMI VIVEKANANDA YOGA ANUSANDHANA SAMSTHANA

(Declared as Deemed University under Section 3 of the UGC Act, 1956)

BANGALORE - 560 019

I N D I A



स्वामी विवेकानन्द योग अनुसंधान संस्थान
Swami Vivekananda Yoga Anusandhāna Samsthāna

(Declared as Deemed-to-be University under Section 3 of the UGC Act, 1956)

Eknath Bhavan, # 19, Gavipuram Circle, Kemppegowda Nagar, Bangalore - 560 019

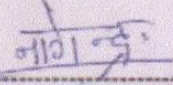
Ph: 080 - 2661 2669, Telefax: 080 - 2660 8645

E-mail: svyasa@svyasa.org Website: www.svyasa.org

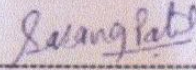
CERTIFICATE

The Doctoral Committee approves and affirms that this is an authentic copy of the thesis titled
"Management of Obesity and Diabetes Mellitus through Yoga and Naturopathy". The
committee recommends the award of Ph.D. Degree to:

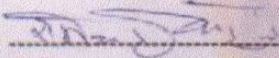
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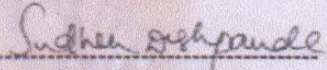
Dr. H. R. Nagendra,
Chancellor,
S-VYASA University, Bengaluru.
(Guide)



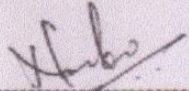
Dr. Sarang S Patil,
Medical Director,
Anandkunj Holistic Health Home,
Shivambu Naturopathy and Yoga
Asharam, Kolhapur,
(External Examiner - National)



Prof. Ramachandra G Bhat,
Vice-Chancellor,
S-VYASA University, Bengaluru.



Dr. Sudheer Deshpande,
Registrar,
S-VYASA Yoga University, Bengaluru.



Dr. Naveen K. Visweswaraiyah,
Joint Director of Research,
S-VYASA University, Bengaluru.



Dr. Manjunath N K,
Joint Director (R & D),
S-VYASA University, Bengaluru.

DECLARATION

I, hereby declare that this study was conducted by me at SwamiVivekananda Yoga Anusandhana Samsthana (S-VYASA), Bangalore, under the guidance Dr.H.R. Nagendra, Chancellor Swami Vivekananda Yoga Anusandhana Samsthana, Deemed University, Bengaluru.

I also declare that the subject matter of my thesis entitled “MANAGEMENT OF OBESITY AND DIABETES MELLITUS THROUGH YOGA AND NATUROPATHY” has not previously formed the basis of the award of any degree, diploma, associate-ship, fellowship or similar titles.

Date:

Place: Bengaluru

PRASHANTH SHETTY

(Candidate)

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Dr. Prashanth Shetty

LIST OF ABBREVIATIONS USED

ADA – American Diabetic Association

ATP - Adenosine Tri Phosphate

ATP III -Adult Treatment Panel III

BMI – Body Mass Index

CAM – Complementary and Alternative Medicine

CVD – Cardio-Vascular Disease

DM – Diabetes Mellitus

FFA – Free Fatty Acids

FPG – Fasting Plasma Glucose

GH – Gastro Hepatic

HbA1c – Glycated Haemoglobin

HDL – High Density Lipoproteins

HNF - Hepatocyte Nuclear Transcription Factor

HSG - Heat and Steam generating sheet

HOMA- IR -Homeostatic Model Assessment Insulin resistance

IFG - Impaired Fasting Glucose

IGT - Impaired Glucose Tolerance

IPF - Insulin Promoter Factor

LDL – Low Density Lipoproteins

MS - Metabolic Syndrome

ND – Naturopathic Doctor

NHANES - National Health and Nutrition Examination Survey

OGTT - Oral Glucose Tolerance Test

PCOS – Poly Cystic Ovarian Syndrome

PPPG – Post Prandial Plasma Glucose

SSA -Sub Saharan Africa

T2DM – Type 2 Diabetes Mellitus

USA -United States of America

VLDL – Very Low Density Lipoproteins

WHO – World Health Organization

FFM- Free Fat Mass

TBW-Total Body Water

MM- Muscle Mass

TSTG- Total Serum Triglyceride

TSCH- Total Serum Cholesterol

ABSTRACT

Background

Metabolic syndrome is a disorder of energy utilization and storage, diagnosed by a co-occurrence of three out of five of the following medical conditions: abdominal (central) obesity, elevated blood pressure, elevated fasting plasma glucose, high serum triglycerides, and low high-density cholesterol (HDL) levels. Non-communicable diseases, which include Diabetes mellitus and cardiovascular disease, are world's biggest killer diseases, estimated to cause 3.5 million deaths each year. Eighty percent of them are found in the low and middle-income countries. The WHO has developed an action plan for implementation of global strategies in prevention and control of non-communicable diseases. One of the objectives of this plan is to develop simple strategies to identify those at risks together with appropriate and cost effective interventions.

The naturopathic treatment approach frequently includes important dietary and lifestyle recommendations included in current medical treatment guidelines for diabetes, hypertension, and hyperlipidemia, although improvements can be made on the precision of recommendations. A study shown a naturopathic dietary approach to diabetes appears to be feasible to implement among NIDDM patients. The intervention may also improve self-management, glycemic control, and have influences in other domains of self-care behaviors. HbA1c improved by an average of 0.5%, which is clinically meaningful.

Aim:

To investigate the effect of Yoga and Naturopathy in Obesity and Diabetes Mellitus.

Objectives:

The present study aimed at ascertaining the effect of Yoga and naturopathy on

1. To compile the concept of Yoga and Naturopathy on Diabetes mellitus and obesity from different ancient scriptures of India.
2. To Evaluate the effect of 10days Yoga and Naturopathy treatment in Type 2 Diabetes patients
3. To assess the changes due to 10days of Yoga and Naturopathy treatment on Obesity individuals.
4. To Study the usefulness of Naturopathy fasting on healthy individuals

Methods

This study comprised three different sub studies. All the studies were approved by the Institutional Ethics Committee and informed consent were obtained by the subjects.

For Fasting study, we identified a congruent group of 70 healthy volunteers of both genders from a college in south India. The participants ages ranged from 19-21 years (group mean age \pm SD; 20 ± 0.8 years) and were assigned to fasting group ($n=35$; 20 ± 0.4 years) and a control group with normal vegetarian diet ($n = 35$; 23 ± 4.6 years). This was a group of students belonging to the same class and therefore were matched for age, education and routines. The study adopts matched controlled design (two groups pre-post) and Urine pH assessed dialy.

A total of two hundred Diabetes patients who admitted for 10 days in Naturopathy and Yoga Hospital, Shantivana, Dharmasthala were screened and Hundred($n=100$) participants for the study. The study adopts a pre-post design. Diagnosed subjects of NIDDM, who are on oral hypoglycaemic drugs for the past two years were included and

uncontrolled NIDDM who are on Insulin therapy with systemic complications were excluded from the study. Subjects were assessed with FBG and PPBG on Day 1 and Day 10 during which they received Yoga practice, Naturopathic treatment and Diet therapy.

For obesity study, Hundred (n=100) obese adults from the same Hospital of age 38.48 ± 10.86 years, BMI was more than 30 Kg/m² and stable weight over the previous year without fluctuations of more than 2 kg as observed through their past medical records were recruited. Obesity associated with systemic complications, epilepsy, any psychological conditions and with any other co-morbid medical conditions and on weight loss medications were excluded from the study. The study adopts a pre-post design. Subjects were assessed with Lipid profile and Body composition on Day 1 and Day 10 during which they received Yoga practice, Naturopathic treatment and Diet therapy.

Results and Discussion

In Healthy volunteers Urine pH was significantly higher in the fasting group following the administration of Naturopathic Fasting Therapy (paired samples t-test, $t=3.91$, $p < 0.05$). The control group (Normal Vegetarian Diet) showed no significant changes during the study period (paired samples t-test, $t = -0.62$) while significant reduction in weight, BMI, FM, FFM, MM, TBW and TSTG in study-group compared to baseline. In sub-group analysis significant reduction in weight, BMI, FM, FFM, MM, TBW and TSTG in females was observed similar to study group, whereas in males, significant reduction was observed only in weight, BMI, FFM and MM. Reductions in fat % and TSCH were observed both in study-group as well as in sub-groups compared to baseline but none of the groups showed significant reduction.

In Obesity Patients there was reduction of 3.77% weight ($p < 0.001$), 4.02% of BMI ($p < 0.001$), 10.51% of total cholesterol ($p < 0.001$), 29.33% of serum triglycerides

($p < 0.001$), 7.97% of LDL ($p < 0.001$), and 30.31% of VLDL ($p < 0.001$) were observed following the 10 days Yoga and Nature cure lifestyle intervention. Also, a reduction of 2.75% of fat mass ($p < 0.001$), 4.72% of free fat mass ($p < 0.001$), 4.68% of muscle mass ($p < 0.001$), 4.28% of bone mass ($p < 0.001$), 4.54% of estimated BMR ($p < 0.001$), and 13.64% of estimated reduction in degree of obesity in participants when corrected for their BMI were observed. Interestingly there was a 1.55% increase in the fat indicated by the body composition. However, there were no changes in the HDL levels ($p < 0.001$) following the intervention.

In Diabetes patients alpha level of statistical significance was set at $p < 0.05$. Both FBG and PPBG levels showed significant reduction were observed following the 10 days Yoga and Nature cure lifestyle intervention.

Conclusion

These results suggest Yoga and Nature cure as a life style intervention improves the obesity and diabetes state of the individual and may potentially alleviate associated complications of obesity and cardiovascular disorders. The Fasting study suggests Naturopathic based Fasting therapy is useful for enhancing liver and Kidney functions and reducing weight among healthy individuals.

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1.0 Introduction

Metabolic syndrome is a disorder of energy utilization and storage, diagnosed by a co-occurrence of three out of five of the following medical conditions: abdominal (central) obesity, elevated blood pressure, elevated fasting plasma glucose, high serum triglycerides, and low high-density lipoprotein (HDL) levels. Noncommunicable diseases, which include diabetes mellitus and cardiovascular diseases, are the world's biggest killer diseases, estimated to cause 3.5 million deaths each year. Eighty percent of them are found in the low- and middle-income countries. The WHO has developed an action plan for implementation of global strategies in prevention and control of noncommunicable diseases.¹ One of the objectives of this plan is to develop simple strategies to identify those at risks, together with appropriate and cost-effective interventions.

Metabolic syndrome has been advocated as a simple clinical tool for predicting diabetes mellitus and cardiovascular diseases. It also forms a conceptual base for understanding some of the pathophysiological links between metabolic risks, diabetes mellitus, and cardiovascular disease (CVD). The clustering of metabolic syndrome risks with cardiovascular disease and diabetes mellitus has been recognized for more than 80 years, but the modern concept of metabolic syndrome began when Reaven proposed a conceptual framework that links biological events in a single pathophysiological construct.² Reaven construct suggested that insulin resistance provides common mechanisms underlying the associated abnormalities such as blood pressure, lipid abnormalities, and glucose intolerance. In 1947, Vague, a physician from Marseilles, observed that upper body obesity was significantly associated with diabetes mellitus, atherosclerosis, gout, and calculi; and all these conditions were improved by eating a low-carbohydrate diet.³⁻⁴ Haller in 1977 described metabolic syndrome to be associated with obesity,

diabetic mellitus, hyperlipoproteinemia, hyperuricemia, and hepatic stenosis. In the same year, Singer added that hypertension and gout could also be associated with the syndrome.⁵⁻⁶

Later on, Reaven in 1988 proposed that insulin resistance was the underlying factor for metabolic syndrome and also termed the disease as a syndrome X. He did not include obesity as one of the factors in the syndrome, as the previous authors did. However, obesity, in particular central obesity, came to be later recognized as one of the important underlying factors of metabolic syndrome.⁷ The terms *metabolic syndrome*, *insulin resistance syndrome*, and *syndrome X* were used to define the clustering of factors that increase the risk for cardiovascular disease and type 2 diabetic mellitus. There has been a lot of debate about whether metabolic syndrome should be considered a syndrome at all; as it was well known that a syndrome defines a group of signs and symptoms with a common underlying pathology, but the real pathology of metabolic syndrome is not yet fully known.⁸ Some authors argue that although the symptoms of metabolic syndrome often appear together, they may reflect diverse disease processes. Kahn, for instance, argues that the risks of metabolic syndrome were real even if the terminology is questionable. He proposed that using the term metabolic risk or cardiometabolic risk could be a better way to describe the syndrome. He also ends up saying that it is useful as a concept rather than using the word *syndrome*.⁸ In 2005 American Diabetes Association (ADA) and European Association on the Study of Diabetes (EASD) pointed out specific controversies in the diagnosis of metabolic syndrome.⁹ For instance, the value of including diabetes in the definition was questionable. Also the use of insulin resistance as the unifying etiology was considered to be uncertain. The ADA/EASD committee also pointed out that there was no clear basis for including or excluding CVD risk factors in the diagnosis of metabolic syndrome. There are still a lot of arguments, and the debate regarding the definition and diagnosis of metabolic syndrome

continues. There are several existing criteria in use for defining metabolic syndrome, like the definition used by the American Heart Association (AHA), European Group for the Study of Insulin Resistance EGIR, National Cholesterol Education Program-Adult Treatment Panel III (NCEP/ATP III), World Health Organization, and International Diabetes Federation (IDF). The most commonly used definition of metabolic syndrome (MS) was described by the WHO and ATP III criteria.⁹ Regardless of the existing controversies in diagnosis and definition, the metabolic syndrome is still considered to be a useful diagnostic tool in primary care prevention. It gives opportunity for early patient identification and education on proper and early health behavioral changes implicated in the development of the deadly cardiovascular diseases like hypertension and diabetes. Patients could be educated early about the connection between their lifestyle, health risks, and medical outcomes. For instance, the (NCEP/ATP III) identifies metabolic syndrome as an indication for vigorous lifestyle intervention. Effective interventions include diet, exercise, and judicious use of pharmacologic agents to address specific risk factors. Weight loss will significantly improve all aspects of metabolic syndrome. Increase in physical activity and decrease in calorie intake by reducing portion sizes have been found to improve metabolic syndrome abnormalities, even in the absence of weight loss. Specific dietary changes that are appropriate for addressing different aspects of the syndrome include reducing saturated fat intake to lower insulin resistance, reducing sodium intake to lower blood pressure, and reducing high-glycemic-index carbohydrate intake to lower triglyceride levels. Primary health care workers could be more effective in helping patients to change their lifestyle behaviors by assessing each patient for the presence of specific risk factors, clearly communicating these risk factors to patients, identifying appropriate interventions to address specific risks, and assisting patients in identifying barriers to behavioral changes.

1.1 Prevalence of Metabolic Syndrome

This syndrome has a worldwide prevalence as a consequence of increasing prevalence of obesity. Most studies have used the ATP III definition of the syndrome; and some, with modifications to the criteria. Some studies have used the WHO criteria, and some have used other criteria. The recently used datasets (family history of diabetes mellitus, body weight >20% of the ideal weight, history of diabetes mellitus during pregnancy or having a baby weighing over 9 pounds [4 kg], sedentary life, and additional questions related to MS, i.e., hypertension, dyslipidemia and race/ethnicity) were employed to derive the current global prevalence of diabetes⁹ and to estimate global prevalence of metabolic syndrome among adults aged >20 years.

The estimated current global prevalence of metabolic syndrome is approximately 16% (95% CI = 10-23).¹⁰ The metabolic syndrome affects 44% of the U.S. population older than age 20. A greater percentage of women older than 50 years have the syndrome as compared to men.¹¹ Studies from Europe, North America, and Australia report the prevalence of metabolic syndrome to be between 12% and 25%,¹²⁻¹⁸ while studies in Asia have mostly found a lower prevalence, viz., 5%.¹⁹⁻²¹ Using the 2005 version of NCEP/ATP III, the prevalence of metabolic syndrome in China, Taiwan, Hong Kong, and Thailand²² was in the range 10%-15%, but it was much lower (around 5%) in southern rural China.²³ On other hand, rates among the Koreans were higher than those of the Chinese and Thai even though their body mass indices were similar to that in other East Asian countries. India had a strikingly high prevalence rate compared to the rest of Asia.

In Sub-Saharan Africa (SSA), a study done in South Africa using International Diabetes Federation (IDF) criteria to diagnose metabolic syndrome found the absence of metabolic syndrome in rural men and low prevalence in rural (0.3%) and urban (1.5%) women, while in

urban men it was 1.2%. Similarly, using ATP III definition of metabolic syndrome, it was found that there was absence of metabolic syndrome in rural men and women and very low prevalence in urban men (0.5%) and urban women (0.2%). Higher rates were found when the WHO criteria were used, being 1.8% (rural) and (5.9%) urban women and 1.9% (rural) and 7.3% (urban) men.

Using any of the two criteria, i.e., WHO and IDF, urban rates were higher, both in women and men compared to rural rates. However, the general prevalence of the metabolic syndrome was low. The explanation for the lower rate was the high level of physical activity in SSA countries.²⁴ Analysis of the prevalence of individual risk factors for metabolic syndrome in Sub-Saharan Africa showed that elevated serum triglyceride was the least frequent for both women (0.3%) and men (1.4%). In men, the most frequent abnormality was elevated blood pressure (37.7%). Central obesity was the most frequent component in both rural and urban populations, viz., 58.6% and 49.5% respectively. The prevalence of all components was higher in urban samples.²⁴

In Cameroon, in a study done in a community population aged 24-74 years, the highest prevalence of metabolic syndrome was found using WHO criteria; and the lowest, using NCEP/ATP III criteria. Central obesity was the more prevalent component of metabolic syndrome than HOMA-IR.²⁵ The study also found that the prevalence of MS varies greatly between urban and rural populations with the definition used. A study done among Zimbabwean type 2 diabetic patients to determine the prevalence of metabolic syndrome showed that 43% of the participants had metabolic syndrome.²⁶

Metabolic syndrome was also seen in 25.2% of type 2 diabetic patients in Nigeria. However, systemic hypertension was found to be the most common component of metabolic

syndrome, with a prevalence of 38.5%. This study concluded that metabolic syndrome is associated with a higher risk of stroke, peripheral vascular disease, and microalbuminuria.²⁷

In Temeke Municipality Dar es Salaam, Tanzania, risk factors of metabolic syndrome like central obesity, low HDL-cholesterol and high fasting blood glucose (FBG) were found to be more prevalent in women. This made the women to have threefold greater odds of having metabolic syndrome compared to men.²⁸

1.2 Diabetes Mellitus

Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action, or both. The effects of diabetes mellitus include long-term damage, dysfunction, and failure of various organs (WHO Report, 1999). Type 2 diabetes constitutes the common major form of diabetes mellitus, which results from defect(s) in insulin secretion, almost always with a major contribution from insulin resistance (WHO, 1999).

The prevalence of diabetes mellitus for all age groups worldwide was estimated to be 2.8% in 2000 and projected to be 4.4% in 2030. The total number of people with diabetes was projected to rise from 171 million in 2000 to 366 million in 2030.²⁹

Non-insulin-dependent diabetes mellitus (NIDDM) is a costly, complex, chronic disease that is expected to increase in prevalence in the coming decades.³⁰ This is a major cause of morbidity and mortality in the United States, and its incidence is rising. There are over 16 million people in the United States with type 2 diabetes, and 800,000 new cases are diagnosed annually.^{31,32} It is estimated that one in three Americans will have diabetes by 2025. The estimated annual cost of diabetes-related medical expenses was \$132 billion in 2002, accounting for more than 12% of the U.S. healthcare budget.³³ Despite this expenditure, national statistics

show that only 37% of diabetics are in a state of good glycemic control as defined by a glycosylated hemoglobin (HbA1c) <7%, the standard set by the American Diabetes Association (ADA).³¹

A major part of the diabetes burden (75%) will be borne by developing countries³⁴; and next only to China, India has the second largest number (>61 million) of individuals with NIDDM in the world, and this is expected to nearly double by 2030.³⁵ The national NIDDM prevalence in 2011 was already 8.3%.³⁵ Furthermore, a large proportion of individuals are at “high risk” of progression to diabetes,³⁵ which occurs more quickly than in most developed countries.³⁶ These observations, together with the high rates of complications and mortality³⁷ associated with NIDDM, demonstrate that diabetes prevention should be an urgent priority for the government and other organizations in India. Indian studies have shown the prevalence rate of diabetes mellitus to be 2.4% in the rural population and 4%-11% among the urban population due to industrialization and urbanization. Previously a disease of middle-aged and elderly individuals, NIDDM has escalated in all age groups and is now being seen in younger age groups, including adolescents, especially high-risk population.³⁸

In addition to the worrisome increase in the prevalence of diabetes mellitus, the society at large will be further burdened with problems associated with complications of diabetes mellitus, such as neuropathy, nephropathy, ischemic heart disease, and exotic infections with multidrug-resistant organisms; compounding factors like high prevalence of tuberculosis, unfavorable patterns of central obesity, and inadequate health facilities add to the difficult survival of diabetics in India.³⁴ Clinical risk factor control is poor in patients with NIDDM in the United States. According to 1999–2004 National Health and Nutrition Examination Survey (NHANES)

data, only 52.2% of adults with NIDDM met the American Diabetes Association (ADA) goal for HbA1c control (<7.0%).³⁹

Increasingly complex pharmaceutical strategies are contributing minimally; only 32% of patients on triple oral therapy (sulfonylurea and metformin) have an HbA1c less than 7%.³⁹ The prevalence of risk factors for diabetic complications, such as hypertension, obesity, and physical inactivity, is also high. In 2007, 67.0% of adults with diabetes in the United States reported having hypertension, 83.5% were overweight or obese, and 38.2% reported being physically inactive.⁴⁰

Cardiovascular complications are the leading cause of morbidity and mortality among patients with NIDDM, and cardiovascular disease (CVD) risk is twofold to eightfold higher in the diabetic population than it is in non-diabetic individuals of similar age, sex, and ethnicity.^{41,42} Furthermore, macrovascular complications are the largest contributors to the direct and indirect costs of diabetes.⁴³ NIDDM patients frequently have significant carotid stenosis and multiple atherosclerotic plaques, and have higher mortality rates, worse neurologic outcome, and more severe disability when they suffer a stroke than those without diabetes.⁴⁴⁻⁴⁶ Micro-albuminuria and retinopathy are indicators of microvascular dysfunction, and both predict a poorer outcome in patients with diabetes.⁴⁷⁻⁴⁹

Complementary and alternative medicine (CAM) may offer novel approaches to addressing lifestyle behavioral changes for prevention and control of chronic diseases such as diabetes. Naturopathic medicine is of greatest interest as it is a whole system of CAM most closely resembling conventional primary care in scope of practice but with greater delivery of healthy lifestyle counselling.⁵⁰ According to observational studies, healthy lifestyle interventions

are routine in naturopathic clinical care for NIDDM, with diet, physical activity, and stress management counseling incorporated into the majority of clinical encounters (80%-100%).⁵¹ Use of CAM has been associated with engaging in positive health behaviors and self-care; however, these findings may only apply to uniquely motivated patients.⁵²⁻⁵⁴ Stress is also a causative factor for NIDDM, and it can be managed by the practice of yoga and diet.⁵⁵

Care provided by naturopathic doctors is a particularly promising form of CAM practice for diabetes, because the training for naturopathic doctors emphasizes assessment and understanding of medical risk, intensive dietary and lifestyle counseling, and routine laboratory testing necessary for ongoing management.⁵⁶⁻⁵⁹ In a survey conducted in the United States, approximately 48% of individuals with diabetes reported using CAM. Several CAM modalities like naturopathy, acupuncture, therapeutic massage, reflexology, dietetics, etc., are found to be effective in the management of NIDDM.⁶⁰

A small, uncontrolled 3-month clinical trial of naturopathic approaches to nutrition counseling for NIDDM demonstrated statistically significant reductions in HbA1c and several concurrent improvements in self-care, including improved dietary adherence and improved eating behaviors.⁵⁸ Retrospective observational studies also suggest naturopathic care reduces risk for NIDDM and hypertension and results in improved glucose control and reduced blood pressure, respectively.^{55,56}

Naturopathy is a system of man-building in harmony with the constructive principles of nature on physical, mental, moral, and spiritual planes of living and consists of noninvasive treatment modalities like diet therapy, fasting therapy, mud therapy, hydrotherapy, massage therapy, acupressure, acupuncture, chromotherapy, air therapy, and magnet therapy.⁶¹ Effect of

hydrotherapy on the cardiovascular hemodynamics, cellular immunity, psychological parameters; and neonatal growth has been studied earlier.⁶²⁻⁶⁵

The first line of naturopathic management in treating NIDDM is naturopathy treatment, cold hip bath, and mud application over abdomen, cold abdominal pack, and partial massage to abdomen. Gastro-hepatic (GH) pack (naturopathic treatment) is a treatment modality in hydrotherapy that uses a combination of hot and cold temperatures for treatment. The hot and cold treatment modality has opposite effects on tissue metabolism, blood flow, inflammation, edema, and connective tissue extensibility.⁶⁶ The application of hot or warm compresses to the abdomen or lumbar region is often used in Japan as a traditional medicine to produce improvements in the physical condition of patients.⁶⁷

Ice is a therapeutic agent used in medicine as an integral part of injury treatment and rehabilitation. Ice packs can be made with any form of ice; however, two commonly used forms are cubed ice and crushed ice. Ice has shown to effectively reduce pain and swelling during the inflammatory response after injury.^{68,69} Ice is believed to help control pain by inducing local anesthesia around the treatment area.⁴² Investigators have also shown that it decreases edema,⁷⁰ nerve conduction velocity,⁷¹ cellular metabolism,⁷² and local blood flow.⁷¹ Thus, as in combining hot and cold temperatures together like in GH pack, they may have a different effect. However, GH pack (a part of naturopathic treatment) has been found more effective in the management of NIDDM, based on clinical experience of several naturopaths; however, there is no scientific evidence published on the use of GH pack. For having a strong clinical background for the role of naturopathy treatment in the management of NIDDM, it is essential to have a standard protocol for the same.

Hence the present study is planned to find out if there is any relationship between gastro-hepatic pack (naturopathic treatment) and NIDDM based on scientific clinical evidence.

1.3 Obesity

World Health Organization defines overweight as a BMI greater than or equal to 25 kg/m² and obesity as BMI greater than or equal to 30 kg/m².⁷³ Obesity is considered to be a growing global epidemic, with an estimate of 1.5 billion adults aged 20 years and older to be overweight and over 200 million men and 300 million women, constituting approximately 10% of adults, were obese. Also, as per estimates in 2010, about 43 million children less than 5 years of age were overweight.⁷⁴ Statistics suggest a steep increase in obesity incidence in low- and middle-income countries since 1980.⁷⁵

Obesity in India is posing a serious threat with changing food habits and lifestyle, increasing morbidity and complications.⁷⁶ As per the statistics of the National Family Health Survey-3 [NFHS-3]⁷⁷ study, amongst the 15-49 years age group, 14.8% of women and 12.1% of men were overweight or obese, and 33% of women and 28.1% of men had BMI below normal levels NFHS-3.⁷⁸ The prevalence of obesity is higher amongst women than amongst men and is more prevalent in the states of Punjab (30%), Kerala (28%), and Delhi (26%), the states in India that are relatively richer compared to other states.⁷⁹ These prevalence ratios are expected to increase in NFHS-4 survey. In older adults, obesity exacerbates age-related decline in physical function, which causes frailty, impairs quality of life, and results in increases in hospitalization.⁸⁰⁻⁸² Given the increasing prevalence of obesity and overweight, the most common phenotype may be the obese, disabled, older adult.⁸³ With an understanding that heredity plays an important role in influencing body weight, the recent upsurge in the increase of obesity incidence can also be attributed to the shift in diet towards energy-rich dense food rich in

fat and sugars but low in vitamins and other micronutrients, thereby drastically increasing the calorie intake.³ There are epidemiological datasets indicating the increased risk of obesity incidence with chronic intake of fatty diet and frequent consumption of fast food.⁸⁴⁻⁸⁷ In association with high calorie intake, sedentary lifestyle is a major contributor to obesity.⁸⁸ Prolonged working hours with shorter sleep duration and night shift working tend to cause uninhibited eating behavior trait, significantly increasing the risk of overeating and gaining weight.⁸⁹

Studies have shown that people consume excess food while watching television than while eating normally.⁹⁰⁻⁹¹ The same behavior has been shown to have a direct association with increasing incidence of obesity and other metabolic disorders.⁹²⁻⁹³ National Health and Nutrition Examination Survey shows a close relationship between low levels of physical activity and weight gain in both men and women.⁹⁴⁻⁹⁵ Although obesity has reached a state that is drawing the attention of policy makers related to healthcare delivery systems across the world, there exists very little evidence from trials regarding the efficacy of weight loss interventions.⁹⁶ However, there are confounding studies suggesting weight loss in the elderly people might not be beneficial unless there are complications associated with weight. But scientific studies suggest that weight loss in the elderly also helps in minimizing morbidity from arthritis, diabetes and associated cardiovascular risk factors and in improving well-being.⁹⁷ Also, weight loss has been shown to produce beneficial effects on muscle strength, endurance, and well-being.⁹⁷

Nature cure is alternatively termed as *Naturopathy* and as stated in the Oxford Dictionary, “It is a system of alternative medicine based on the theory that diseases can be successfully treated or prevented without use of drugs, by techniques such as diet, exercise and massage.”⁹⁸ Henry Lindlahr, a naturopath, defines Nature Cure as “a system of building the

entire being in harmony with the constructive principles in Nature on the physical, mental, moral and spiritual planes of being.” He defines chronic disease as a condition of the organism “in which lowered vitality due to accumulation of waste matter and poisons, with the consequent destruction of vital parts and organs, has progressed to such an extent that Nature’s healing forces are no longer able to react against the disease conditions by acute corrective efforts (acute reactions like fever, common cold, etc.).”⁹⁹ The above principles of nature cure are in tune with the principles of altruism, which are now slowly being understood by modern science. A recent discovery about the altruistic nature of stem cells (hESCs) safeguarding a group of cells maintains their “stemness” just by regulating themselves into three paths: they differentiate, they die, or they repair the damage in the cell so that they continue their living.¹⁰⁰ This phenomenon of altruism is expected to be enhanced by nature cure. Classical naturopaths have stated, “Body has got its own recuperative power, through which it can heal itself when left alone,” which has been accepted by western scientists as it has been demonstrated through the efficacy of intermittent fasting¹⁰¹ and calorie restriction.¹⁰²⁻¹⁰³ However, most of the beneficial effects obtained by virtue of Yoga and Naturopathy treatments remain un-elucidated.

Therefore, this present study has been designed to explore the effectiveness of Naturopathy and Yogic lifestyle in metabolic disorders.

LITERARY RESEARCH

2.1 Introduction

It is a universally accepted principle that human beings and diseases were born simultaneously. In Veda, detailed description of disease, drug, and therapies is found. As such, Veda is the foundation of medical science. Knowledge of Naturopathy has been derived from *vaidik* literature. Those drugs that are mentioned in *vaidik* literature became the base for further advancement of medical science. Researchers are advising the use of *vaidik* drugs for cure of modern diseases. By keen observation, one can see that *vaidik* medical science comprises not only drug-based treatment modality but also has a holistic approach to disease cure, including chanting of *mantras* and other procedures of *prakrutik chikitsa*. So *vaidik* system of medicine is termed *magico-religious-medical treatment system*. In the *vaidik* period, treatment was based on nature (*prakṛti*). *Prakṛti* includes *pañcamahabhutas* along with plant-based remedies and minerals. Hence plant-based remedies play an important role in *vaidik* system of medicine, because all parts of plants have medicinal properties. Every plant on this planet is important from the medicinal point of view. *Vaidik* system of medicine is the root of Ayurveda, and Ayurveda is the science of all aspects of life.

2.2 Aims and Objectives

- To search for the Indian roots for Naturopathy and Yoga as a holistic medicine, in ancient literatures.
- To compile concepts of Yoga and Naturopathy as described in different ancient scriptures of India.
- To study commonalities among various texts of Naturopathy and Yoga.

2.3 Methodology

2.3.1 Source Material

This literary research is based on information collected from

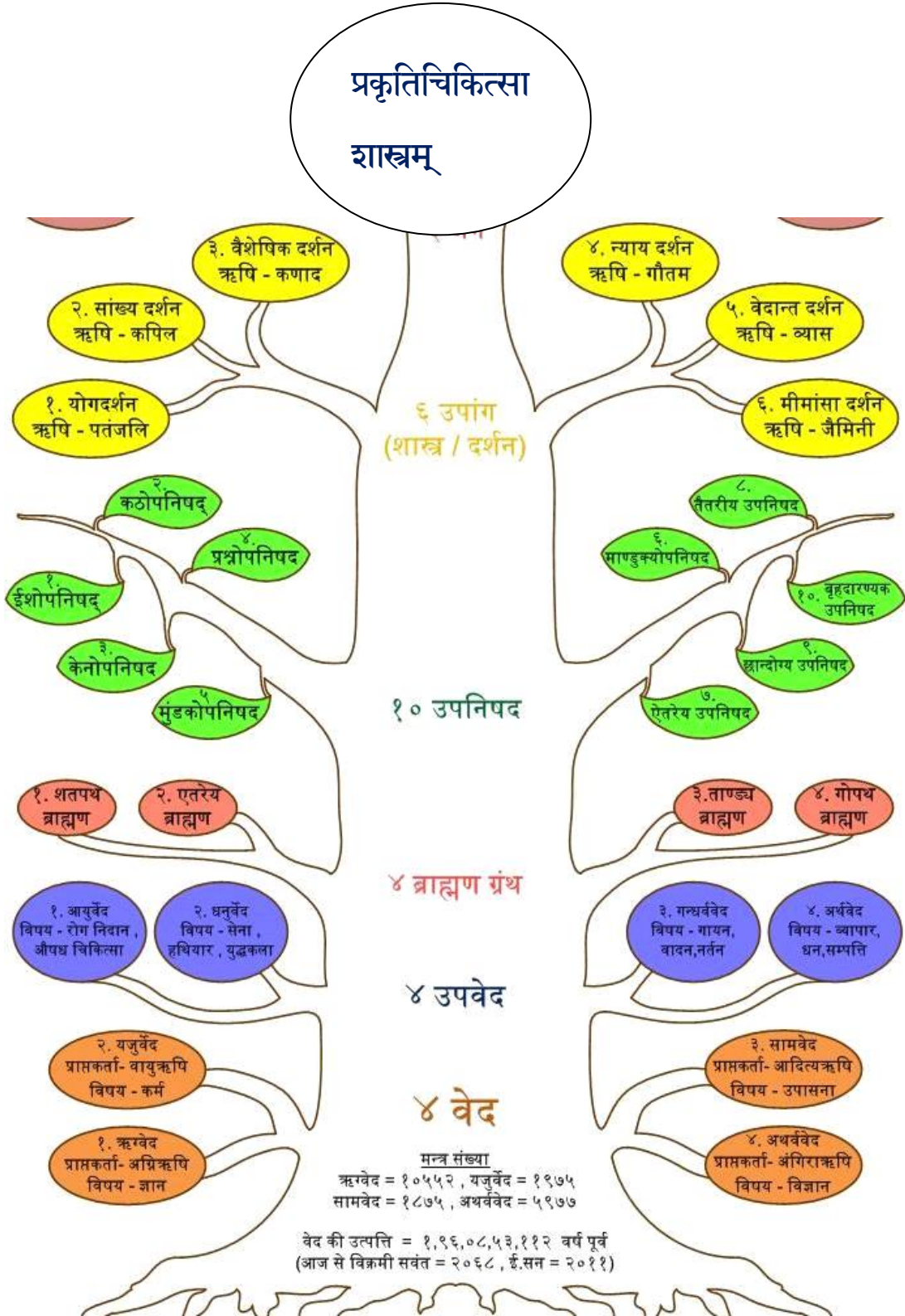
- ancient Indian scriptures and
- experts in the field of yoga and spiritual lore.

Table 1: Traditional Scriptures and Yogic & Spiritual Literature

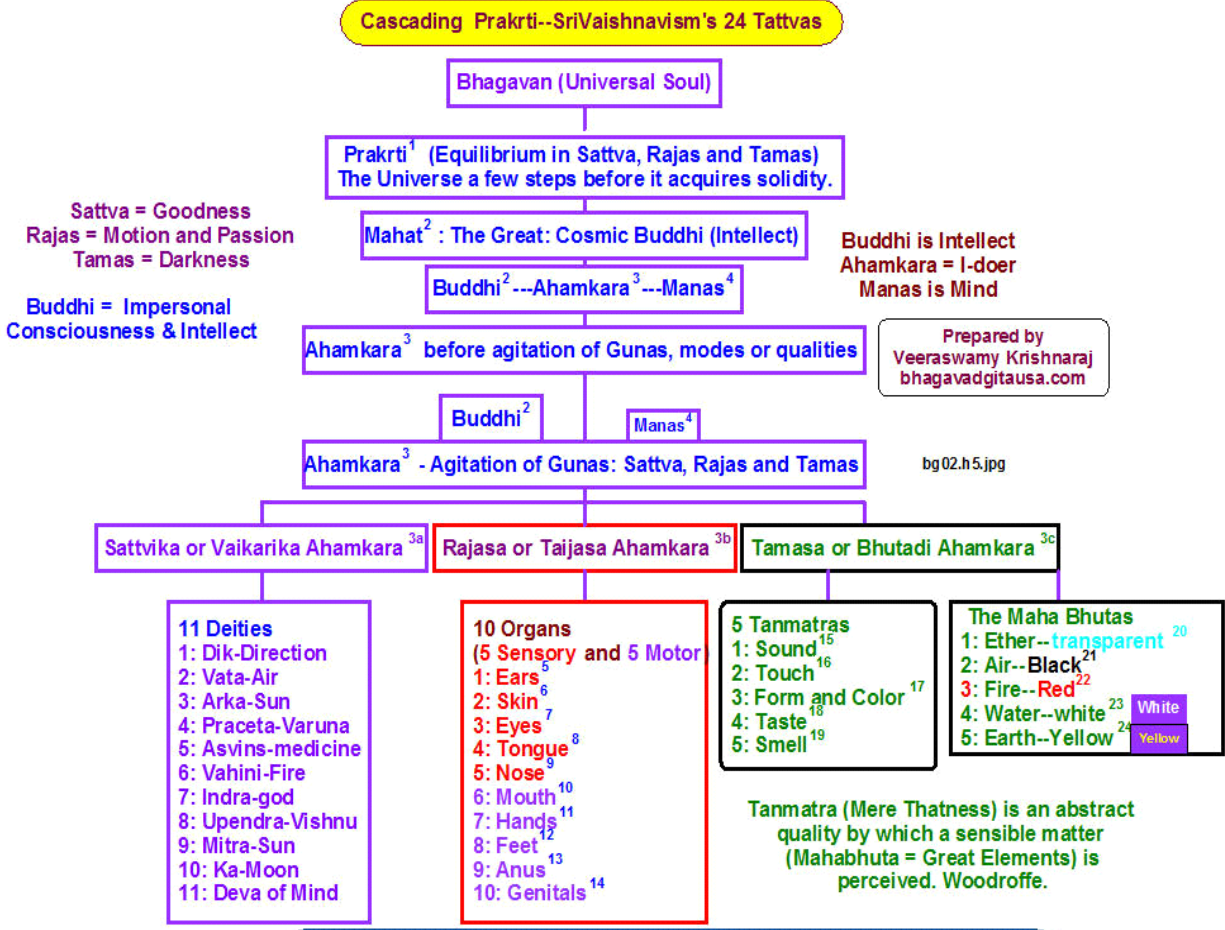
Major Upanishads	<i>Kena Upanishads</i>
	<i>Katha Upanishads</i>
	<i>Mandukya Upanishads</i>
	<i>Taittiraya Upanishads</i>
	<i>Chhandogya Upanishads</i>
Ancient yogic texts	<i>Yoga Vasista</i>
	<i>Patanjali's Yoga Sutras, Vyasa Bhashya on Patanjali's Yoga Sutras</i>
	<i>Bhagavadgita</i>
	<i>Hatha Yoga Pradipika</i>
	<i>Sankhya</i>

<i>Darshanas</i> (systems of philosophies)	<i>Nyaya</i>
	<i>Vaisheshika</i>
	<i>Purva Mimamsa</i>
	<i>Uttara Mimamsa</i>
<i>Samhitas</i>	<i>Rigveda Samhita</i>
	<i>Charaka Samhita</i>
Other classical texts	<i>Tarka Sangraha</i>
	<i>Panini Sutras and Nyaya shastra</i> (<i>prakarana granthas</i>)
	<i>Sutras of Shankaracharya, Yajurveda</i>
	<i>Amarakosha</i>
	<i>Parijatakosha</i>
	<i>Sahitya Darpana</i>

2.4 Theoretical Model



The Vedic hymns of migrant Aryan tribes are the earliest literary source of information about healing practices in the subcontinent. These hymns provide insights into diseases prevalent during the period and their perceived causes. Most ailments, both physical and mental, were attributed to malevolent spirits, and cures consisted of rituals, charms, *mantras*, medicines, and surgical intervention. The hymns in *Atharvaveda*, last of the four Vedas, were largely composed after the Aryans were well settled in the subcontinent; they indicate that indigenous non-Aryan healing practices had influenced Vedic Aryan healers. Vedic medicine has a long history; and it has a continuous and comprehensive knowledge, skills and practices that are based on the theories, beliefs, and experiences indigenous to different cultures. Vedic medicinal system is used in the maintenance of health, as well as in the prevention, diagnosis, and treatment of physical and mental illnesses.



20-24: Ether is transparent, air black, fire red, water white and earth yellow.

Buddhi is just Impersonal consciousness before Ahankara pervades it. Buddhi with Ahankara, the I-doer, experiences the world with the Mind through the body's sense organs. Impersonal consciousness of Buddhi morphs into Personal Consciousness of Ahankara for the purpose of experiencing the world.

24 Tattvas
 Prakrti Tattva¹, Mahat/Buddhi², Ahankara³,
 Manas⁴, ear⁵, skin⁶, eyes⁷, tongue⁸, nose⁹,
 mouth¹⁰, hands¹¹, feet¹², anus¹³, genitals¹⁴, sound¹⁵,
 touch¹⁶, form¹⁷, taste¹⁸, odor¹⁹, ether²⁰, air²¹, fire²², water²³, Earth²⁴

All these 24 Tattvas were created for the use of the 25th Tattva, We the people.

The 24 truths or realities of *prakriti* are as follows:

- 1) *Mula Prakruti* (Unmanifest Primordial Matter).
- 2) *Mahat Tattva* (The Great Principle, i.e., *Buddhi* or Intelligence).
- 3) *Ahankâra* (the ego).

Next are the five *tanmâtras* (subtle sensations generated by the five gross elements perceivable by the sense organs).

- 4) *Shabda tanmâtra* (sound).
- 5) *Sparsha tanmâtra* (touch).
- 6) *Rupa tanmâtra* (light).
- 7) *Rasa tanmâtra* (taste).
- 8) *Gandha tanmâtra* (smell).

Next are the five sense organs.

- 9) *Shrotra* (hearing).
- 10) *Tvak* (touching).
- 11) *Chakshu* (seeing).
- 12) *Rasna* (tasting).
- 13) *Grâna* (smelling).

Then we have the five organs of action.

- 14) *Vâk* (speaking).
- 15) *Pâni* (grasping).
- 16) *Pâda* (locomotion).
- 17) *Pâyû* (excretion).
- 18) *Upastha* (reproduction).

19) *Mana* (mind).

Lastly, we have the *panchamahabhutas* (five gross elements of matter).

20) *Prithvi* (Earth).

21) *Jal* (Water).

22) *Tej* (Fire).

23) *Vayu* (Air).

24) *Akasha* (Ether).

In this manner, primordial nature (insentient matter) itself plus the 23 Truths evolved out of it together make up the 24 Truths, and the 25th is the *Purusha* or the *Âtma* (Self) or Pure Consciousness). Thus we have 25 Truths in all.

2.5 Literature Review

2.5. Introduction to Veda

Veda is one of the most ancient literatures of the world. Veda is a non-decaying and continuously flowing source of knowledge. The area of *vaidik* literature is vast and descriptive. The main sources of Ayurveda are the *Rigveda* and the *Atharvaveda*. Along with drugs, there are a number of *mantras* that deal with diseases, drugs, and therapies. Basically there are four Vedas. They are the *Rigveda*, the *Yajurveda*, the *Samaveda*, and the *Atharvaveda*.

Rigveda

It is the most ancient literature. Fundamental ideas of philosophy and nature have an important place in *Rigveda*.

Yajurveda

This forms the basis of *vaidik karmakaṇḍa*. The aims of its *mantras* are related to *yajna* and other related activity.

Samaveda

It is related to singing.

Atharvaveda

Most of the *mantras* of this Veda are related to cure of disease. Ayurveda is considered to be a subdivision of *Atharvaveda*, because it includes drugs, therapies, and other procedures that help live a long life. Aims of *vaidik* medical science are to avoid the causes of death and diseases and to achieve longevity and maintain holistic thoughts and behavior, leading to a happy and healthy life, along with removal of evil spirits.

Naturopathy is an alternative system of medicine comprising of drugless treatment modalities using the elements of nature, namely, earth, water, fire, air, and space. Hence this

system of medicine is termed *naturopathy* or *natural hygiene*. These five elements find their reference in the ancient scriptures as the five great elements or पञ्चमहाभूतानि.

Using these elements, various treatment modalities are developed, which are mud therapy, massage therapy, hydrotherapy, heliotherapy, aero-therapy, and fasting therapy. Naturopathy believes that the healers should help the healing force within, and all treatments are designed to do the same.

In Sanskrit, nature is termed प्रकृति, and there are umpteen numbers of references to the healing forces of nature. Thus it is but just to call this system प्रकृतिचिकित्सा.

पञ्चमहाभूतानि

पञ्चमहाभूतानि, or the five great elements, are believed to be the building blocks of every creation in the universe. Kapila Muni's *Sankhya* philosophy explains the origin of *panchamahabhutas* and creation of the universe from the two primeval entities: *Purusha* and *Prakriti*. *Purusha*, the Supreme Consciousness, unites with *Prakriti*, the female entity or the changeable aspect of being, and brings about changes in the *gunas*, viz., *sattva*, *rajas*, and *tamas*. Therefrom come into being the subtle *tanmatras*, viz., *shabda*, *sparsha*, *rupa*, *rasa*, and *gandha*, which further give rise to *panchamahabhutas*, viz., *prithvi*, *aap*, *tej*, *vayu*, and *akasha*.

These five elements form the building blocks of everything that exists, including the human body. In the sixth chapter of *Chhandogya Upanishad*, Uddalaka, instructing his disciple and son Svetaketu, pronounces a great statement:

सदेव सोम्य इदमग्र आसीत् ।

छान्दोग्योपनिषत् ।६।२।१

sadeva somya idamagra āsit ।

chāndogyopaniṣat।6।2।1

“Being alone was.” To understand the meaning of the statement “Being alone was” (i.e., being alone before the creation of this world), we have to conduct an analysis of the involvement of Being in creation through the study of the five elements that are the stuff of this world, viz., the *panchamahabhutas*, the five elements: earth, water, fire, air, and ether. A study of the inner constitution of these five elements will also enable us to know what kind of involvement there is of this Pure Being in these five elements. Therefore, for the sake of understanding the true meaning of the proclamation “Existence alone was”, we will try now to go into an investigation of the nature of the five elements. The gross elements are space or sky (*akasha*), air, fire, water, earth; and the inner constituents are *shabda*, *sparsha*, *rupa*, *rasa*, *gandha*.

The qualities of these elements are, in respective order, sound, which is the quality of space; touch, which is the quality of air; form, which is the quality of fire; taste, which is the quality of water; and smell, which is the quality of earth. These are the qualities of the five elements. Only one quality can be seen in space: it can reverberate sound, but we cannot touch it, taste it, smell it, etc. Space can only cause an atmosphere for creating a vibration of sound; therefore, as nothing else is possible there, sound alone is the quality of space. But of air, there are two qualities: air can make sound, and also it can be felt. It can be touched. Sound is the quality of space; sound and touch are the qualities of air. But fire has sound, touch, and form, as we can also see it. About water, we know that we can hear its sound, we can touch it, we can see

it, and we can taste it. But we cannot taste fire, air, space, etc. Earth has five qualities: it can create sound, it can be touched, it can be seen, it can be tasted, and it can be smelled.

॥तासां त्रिवृतं त्रिवृतमेकैकां करवाणीति सेयं देवतास्तिस्त्रो देवता अनेनैव जीवेन ऽऽत्मनाऽ नुप्रविश्य नामरूपे
व्याकरोत् ।

छान्दोग्योपनिषत् ॥६॥३॥३

tāsām trivṛtaṁ trivṛtamekaikāṁ karavāṇīti seyaṁ devatāstisro devatā anenaiva jīvena
"tmanā' nupraviśya nāmarūpe vyākaroṭ ।
chāndogyopaniṣat|6|3|3

तासां त्रिवृतं त्रिवृतमेकैकामकरोत्तथा तु खलु सोम्येमास्तिस्त्रो देवताः त्रिवृत् त्रिवृदेकैका भवति तन्मे विजानीहीति ।

छान्दोग्योपनिषत् ॥६॥३॥४

tāsām trivṛtaṁ trivṛtamekaikāmakarotdyathā tu khalu somyemāstisro devatāḥ trivṛt
trivṛdekaikā bhavati tanme vijānīhīti ।
chāndogyopaniṣat|6|3|4

सत्वरजस्तमसां साम्यावस्था प्रकृतिः प्रकृतेः महान् महतोऽहङ्कारःअहङ्कारात् पञ्चतन्मात्राणि उभयमिन्द्रियं तन्मात्रेभ्यः
स्थूलभूतानि पुरुष इति पञ्चविंशतिर्गणाः ।

साङ्ख्यदर्शनम्-१-६१ ।

satvarajastmasām sām्यāvasthā prakṛtiḥ prakṛteḥ mahān mahato'haṅkāraḥahaṅkārat
pañcatanmātrāṇi ubhayamindriyaṁ tanmātrebhyaḥ sthūlabhūtāni puruṣa iti
pañcaviṁśatirgaṇāḥ ।

sāṅkhyadarśanam-1-61 ।

Three, air has two, and space has only one quality. This is the meaning of the second half of the verse:

एक द्वि त्रि गुणाः व्योमादिषु क्रमात् प्रतिध्वनि वियच्छब्दो वायौ बीसिति शब्दानाम् । अनुष्णशीतसंस्पर्शो वन्हौ भुगु
भुगु ध्वनिः ।

पञ्चदशी । २ । ३ ।

eka dvi tri guṇāḥ vyomādiṣu kramāt pratidhvani viyacchabdo vāyau bīsiti śabdānām
lanuṣṇaśītasam̐sparśo vanhau bhugu bhugu dhvaniḥ ।
pañcadaśī । 2 । 3 ।

उष्णस्पर्षप्रभारूपम् जले बुलु बुलु ध्वनिः । शितस्पर्शः शुक्लरूपं रसो माधुर्यमीरितम् ॥

पञ्चदशी । २ । ४ ।

uṣṇasparśaprabhārūpaṁ jale bulu bulu dhvaniḥ । śītasparśaḥ śuklarūpaṁ raso
mādhuryamīritam ॥

pañcadaśī । 2 । 4 ।

भूमौ कङ् कङ् शब्दः काठिण्यं स्पर्श इष्यते । नीलादिकं चित्ररूपं मधुराम्लादिको रसः ।

पञ्चदशी । २ । ५ ।

bhūmau kaṅ kaṅ śabdaḥ kāṭhiṇyaṁ sparśa iṣyate । nīlādikaṁ citrarūpaṁ
madhurāmlādiko rasaḥ ।

pañcadaśī । 2 । 5 ।

Now it is said that certain of these elements make sound, etc. What kind of sound do they make? Space does not make sound by itself. It causes refraction and reverberation of sound — an echo. Echo is the sound that is produced by space. And what kind of sound is made by air? It goes whoosh. He has put ‘veees’ here: bīsītīśabdanam. And what is touch? It is neither hot nor cold. Air has no quality of this kind. It is hot when it is charged with heat; it is cold when it is charged with cold: anuṣṇā-śītasam̐sparśaḥ. And fire can also make sound. When it and what is the quality of fire? Heat: uṣṇa-sparśaḥ. The touch of fire is heat, and its form is radiance: prabhārūpaṁ. And what is the sound that water makes? *Bulu-bulu*: jalebulu-buludhaniḥ. Its quality is cold when we touch it, and its quality is also white. White is the color of water, and its taste is

very sweet. That is why we drink water. What is the sound that earth makes? *Kada-kada* is the sound it will make if something breaks, something falls. *Bhūmaukaḍakaḍā-śabdaḥ*: this is the earth sound. And hardness is its touch, and its color is green, blue, yellow, etc. There is a variety of colors of objects made of earth: *citra-rūpaṁ*. And its taste — sweetness, bitterness, and other things are all qualities of objects, things made of earthly substance. It has also got a smell — a good smell, a bad smell, a fragrance, or a very bad odor. These are the qualities of earth — five in number.

There are five qualities in earth, four in water, three in fire, two in air, and one in space. This is how we have to understand the manner of functioning of these elements. Only earth has all the qualities of the original source from where it has come into existence.

This group of five elements can be perceived only through the sense organs that are correspondingly connected with these elements. The sense organs connected with these elements respectively are as follows:

सुरभितरगन्धौ द्वौ गुणौ सम्यग्विवेचितौ ।श्रोत्रं त्वक्क्षुषी जिह्वा घ्राणं चेन्द्रियपञ्चकम् ॥

पञ्चदशी ।२।५

surabhitaraḅandhau dvau guṇau samyagvivecitau ।śrotraṁ tvakkaḅṣuṣī jihvā ghraṇaṁ
cendriyapañcakam ॥

pañcadaśī ।2।5

Sound can be heard only by the ear, touch can be felt by the skin, form can be seen by the eyes, taste can be savored by the tongue, and fragrance or smell can be received by the nose, through the nostrils. These are the five sense organs.

There is a connection of the sense organs with the five elements. In the *Bhagavadgita* there is a statement, beautifully made:

गुणगुणेषु वर्तन्ते ॥

भगवद्गीता ३।२८

guṇāguṇeṣu vartante ॥

bhagavadgītā 3|28

Qualities, or properties, of *prakriti* move among the qualities of *prakriti* when any perception takes place. The *sabda tanmatra*, the potential of sound that is outside in space, comes in contact with the very same *tanmatra* in the eardrum, and then there is a correspondence between the two and we hear the reverberation of sound.

So is the case with the other sense organs. In each case, an object of sensory perception corresponds to, or can be perceived by, the sense organ that is made up of the same element as that present in that object. So it is as if waves are dashing on waves in the body of the ocean. The element inside in the form of sense organs dashes against, or comes in contact with, the same element outside in objects. So *prakriti* is perceiving *prakriti*. Sense organs come in contact with the objects. We generally say, “I am seeing the objects.” This statement shows there is confusion in the mind of the person making it. So do not make such a statement. It is not ‘I’. It is the sense organs that come in contact, as the *Bhagavadgita* says. The principles of matter constituting outside objects as well as internal sense organs bring about the feeling of these sensations of heat, cold, sound, touch, etc.

These senses are located in certain organs that are physical in their nature. The sense of sight is in the eyeballs. The sense of hearing is in the eardrums, and so on. All the senses are subtle forces that are operating through physical media that are called sense organs. The eardrum does not hear. The eyes do not see. They are only the media of expression of a force which causes the perception of color, sound, and the like. These senses cannot be seen with the eyes. As

we have studied in the first chapter, these senses of knowledge are constituted of subtle potentials of the *sattvaguna* of *prakriti*; therefore, *sattva* not being an object of perception, the senses cannot be seen. They are the perceivers and, therefore, the question is “who will perceive them?” The eye cannot see itself and the ear cannot hear itself on account of the intense subtlety of these senses, because of their being made of *sukshma tattvas*, that is, *tanmatras*. *Tanmatras* cannot be seen. They are subtle. They are made of the *sattva* portion of the cosmic *prakriti*. *Sattva* is an equilibrium of force; therefore, it cannot be seen. Equilibrium cannot be seen. Only distraction, objectivity, can be seen with the eyes. Therefore, on account of the subtlety of the senses involved, due to their being constituted of the *sattvaguna* of *prakriti*, they cannot be seen as we see objects. What is the actual function of the senses? Running outwards, formed by the supreme God Lord Brahman.

पराञ्चिखानि व्यतृणत् स्वयंभूः ।

कठोपनिषत् । २ । १ । १

parāñcikhāni vyatṛṇat svayambhūḥ ।

kāthopaniṣat । 2 । 1 । 1

They have only one work and, like dogs running here and there, they will never keep quiet. The senses run continuously from morning to night. Right from the time we wake up till we go to sleep; the senses run outwards and compel our consciousness to lodge itself in things that are other than its own Self. The *Atman* becomes the *anatman*, as it were, due to the force of the senses that drag the mind and the consciousness outside in space and time. They are totally extroverted.

कदाचित् पिहिते कर्णे श्रूयते शब्द आन्तरः । प्राणवायौ जाठराग्नौ जलपानेऽन्नभक्षणे ॥

पञ्चदशी २।८

kadācit pihite karṇe śrūyate śabda āntaraḥ |prāṇavāyau jāṭharāgnau
jalapāne'nnabhakṣaṇe ||

pañcadaśī 2|8

Sometimes when we close the nostrils and both the ears, we can hear the internal sound. This is a kind of *mudra* in yoga; and if we go on doing this for a long time, we will hear a kind of subtle vibration-like sound from inside the body; it is called *anahata sabda*. It is not a sound created by contact of one thing with another thing. It is a sound automatically created by the movement of *prana* inside. We can hear this by closing the nostrils and the eyes and the ears for a few minutes. When the *pranas* move inside, when the gastric juice is operating, when we drink water or eat food, we can feel some sound. It is an internal sound. We can feel it when we eat or drink, or when the gastric juice is acting or when the *pranas* are moving.

व्यज्यन्तेह्यन्तराः स्पर्शा मीलने चन्तरं तमः ।

उदरे रसगन्धौ चेत्यक्षाणामन्तरग्रहः ।

पञ्चदशी २।९

vyajyantehyantarāḥ sparśā mīlane cantaram̐ tamaḥ |udgare rasagandhau
cetyakṣāṇāmantaragrahaḥ |

pañcadaśī 2|9

We can see darkness when we close our eyes and press our eyeballs. There is a kind of perception — a perception of not color, but of absence of color, just as in sleep there is perception not of anything but of nothing. We can also have taste inside, by belching or hiccough. When we belch, sometimes there is some taste coming up from the stomach. There is also smell — so, taste and *gandha* both.

These are descriptions of the manner in which we can also see the operation of senses inside, apart from their operation outside.

पञ्चोक्त्याऽदानगमनविसर्गानन्दकाःक्रियाः । कृषिवाणिज्यसेवाद्याःपञ्चस्यान्तभवन्ति हि ॥

पञ्चदशी २ ।१०

pañcoktyā'dānagamanavisargānandakāḥkriyāḥ । kṛṣivāṇijyasevādyāḥpañcasyāntabavan
ti hi ।
pañcadaśī 2 ।10

Whatever we have spoken of just now refers to the senses of knowledge. But there are senses of action also, namely: grasping with the hands, moving with the legs, excretion through the aperture, etc. All actions such as agriculture, industry, and office work also come under these categories of the actions of five active organs: speaking, walking or locomotion, grasping, excretion and generation — these are the external actions. And every other work that we do is included in these five action categories. Even when we do office work, we are only grasping something or moving, etc. So nothing in the world can be outside the purview of these five activities of the five *karmendriyas*, or active organs, apart from the five senses of knowledge.

The five senses of knowledge give us knowledge of things outside; they cognize things or see things. The five organs of action create movement of varieties, as mentioned; and so we have ten organs — five of knowledge and five of action. Every activity comes under one or the other of these. The whole world is nothing but a huge conglomeration, permutation and combination of the activities of these sense organs. They are ten in number. The whole world is this much only — made up entirely of sensors.

वाक्पाणिपादपायूपस्थैःआकाशैः तत्क्रियाज्ञानैः

मुखादि गोलकेषु ते तत् कर्मेन्द्रिय पञ्चकम् ॥

पञ्चदशी ।२ ।११

vākpāṇipādapāyūpasthaiḥākāśaiḥ tatkriyājñānaiḥ
mukhādi golakeṣu te tat karmendriya pañcakam ||

pañcadaśī|2|11

The organs of action are located, as in the case of the senses of knowledge, in certain parts of the body. Grasping is of the hands; locomotion, of the feet; speech, of the tongue; and excretion and generation, of the lower organs. They are forces in the same way as are the senses of knowledge, but lodged in certain parts of the body; that is, the physiological system. The physiological system is the location for the action of both the senses of knowledge and the organs of action. They are all situated in the face, eye, etc., as it has been already described.

The mind is something very strange. It is different from the sense organs, which give us knowledge and which also act. It is the king. It is Indra. Allegorically explained, the gods are actually the senses. Indra, the ruler of the gods, is the mind.

मनोदशेन्द्रियाध्यक्षं हृत्पद्मगोलके स्थितम् । तच्चान्तःकरणं बह्येष्वतन्व्याद्विनेन्द्रियैः ॥

पञ्चदशी २ । १२

manodaśendriyādhyakṣaṁ hr̥tpadmago lake sthitam |taccāntaḥkaraṇaṁ
bahyeṣvātavyādvīnendriyaiḥ ||

pañcadaśī 2|12|

The mind is the ruler of the ten senses. The senses of knowledge and the organs of action are ruled, controlled, and directed by the mind:

मनोदशेन्द्रियाध्यक्षम्. manodaśendriyādhyakṣaṁ

And where is the mind situated, mostly? In the heart. It is actually pervading the whole body, as light pervades the entire room here. Yet it has a location, just as the light is in the bulb.

Though the bulb is the location of light, it nevertheless pervades the entire room. So also the mind has a temporary location in the heart, but it actually pervades the entire body.

It is called ‘internal organ.

बाह्येष्वस्वातव्याद्विनेन्द्रियैः | bahyeṣvātavyādvīnendriyaiḥ

As it cannot operate without the assistance of the senses with respect to objects outside — it cannot act directly with respect to objects without the help of the senses — it is called an internal organ. The senses are external organs; the mind is the internal organ. That is why it is called *antahkarana*.

Antahkarana, internal organ, generally known as the mind or the psyche, has mostly four functions to perform, and accordingly it is called *manas-buddhi-ahankara-chitta*. Thinking is a mental process. Intellection is the process of *buddhi*. Arrogance, self-affirmation, is the work of the ego, *ahankara*. *Chitta* does the work of memorizing. So, thinking, understanding, affirmation or arrogance, and remembering are the functions of these four aspects of the internal organ, known as *manas-buddhi-ahankara-chitta*.

अक्षेष्वर्थापितेष्वेतत्गुणदोषविचारकम् । सत्त्वं रजस्तमश्चास्य गुणा विक्रियते हि तैः ।

पञ्चदशी २।१३।

akṣeṣvarthāpīteṣvetatguṇadoṣavicāarakam | satvaṁ rajastamaścāsyā guṇā vikriyate hi taiḥ |

pañcadaśī 2|13|

When the mind is lodged in the sense organs and it operates through any particular sense at a particular time, it begins to judge the pros and cons of objects outside. “This is something; this is not something. This object is like this; this is not like this. This is the quality of this object; this is

the quality of that object.” It begins to argue, ascertain, and differentiate values associated with the various things in the world when it operates through the sense organs.

Internally the mind has the properties of *sattva*, *rajas* and *tamas*. Therefore, it modifies itself continuously. The mind is *chanchala*, as they say. It is very fickle. It is fickle because it is constituted of the *gunas* of *prakriti*, viz., *sattva*, *rajas*, and *tamas*. *Sattva* is very rarely experienced by the mind because if the *sattva* is really revealed, we will be happy. But how many times in the day are we happy? If we count the minutes of real happiness, we will find that it is so fragmentary, so negligible. Our moments of joy in this life on a particular day are so few that we may say that *sattva* is practically not operating at all in our mind. We are always distracted, worried, and thinking of something. That is the reason why it is said that mostly only *rajas* and *tamas* are operating in the mind, though *sattva* also exists in the mind. Sometimes when we are calm and quiet, we are philosophically inclined and very charitable, very good natured and dispassionate; and at that time, we experience happiness within ourselves. So it is not that *sattva* is not operative at all. But it rarely manifests; mostly it is *rajas* and *tamas*. These qualities are *sattva*, *rajas*, and *tamas*; with these it changes its condition moment to moment. It is fickle due to this reason.

वैराग्यं क्षान्तिरौदार्यं इत्याद्याःसत्वसंभवाः ।कामक्रोधौ लोभयत्नवित्याद्याः रजसोत्थिता ॥

पञ्चदशी २ ।१४ ।

vairāgyam kṣāntiraudāryam ityādyāḥsatvasambhavāḥ |kāmakrodhau
lobhayatnavityādyāḥ rajasotthitā ||

pañcadaśī 2|14|

What are the characteristics of the *sattvaguna*? Suppose we are endowed with *sattva*; how do we behave? Our behavior under the influence of *sattva* is explained here by the word *dispassion*. The more are we *sattvik* in our mind, the less is the desire for things. Dispassion is *vairagya*.

This is one quality that will be uppermost in the mind as *sattva* predominates. Also, forbearance, tolerance, and absence of impulsive reaction to external happenings are the qualities of *sattva*. Under the influence of *sattva*, there is magnanimity, charitableness, compassion, and a feeling of kindness towards people, as well as many other virtuous qualities.

The above-mentioned qualities are those that manifest in us on account of the preponderance of the *sattvaguna*. But if *rajas* is predominant in the mind, what is the state of such a mind? *Kāma* and *krodhau* (passionate desire and anger) take control of the mind. Suddenly some desire inside us erupts: “I want this.” And if we cannot get it, we are angry, i.e., *krodhit*. First there is desire, and anger follows when there is no chance for the fulfillment of desire. Anger, desire, and greed (*lobha*) are the characteristics of *rajas*. Desire of a passionate nature is called *kama*. Irascibility, or anger, is called *krodha*. Greed for material wealth, money, land, house, etc., is called *lobha*. *Kama*, *krodha*, *lobha* — these are the qualities that we reveal in ourselves when *rajas* predominates. Apart from this, under the influence of *rajas*, we become hyperactive, very agitated, and distracted; we cannot keep quiet even for a minute and always run around here and there, helter-skelter, and tremendously excited. That is our nature when *rajas* is predominant.

आलस्य भ्रान्ति तन्द्राद्याः विकारः तमसोत्थिताः । सात्त्विकैः पुण्यनिष्पत्तिः पापोत्पत्तिश्च राजसैः ।

पञ्चदशी २ । १५

ālasya bhrānti tandrādyāḥ vikāraḥ tamasoṭthitāḥ । sātvikaiḥ puṇyanisṭpattiḥ
pāpotṭattiśca rājasaiḥ ।

pañcadaśī 2 | 15

When *tamas* is predominant, *alasyam* (lethargy) takes control of the mind. For example, a *tamasik* persons think like this: “Meditating doesn't matter. Let us see tomorrow. What is the

urgency about it? The day after tomorrow is all right. Why worry? Go slow, go slow.” We simply keep brooding. That is *alasyam*, or lethargy; and *bhranti* is another attribute of *tamas*. When *bhranti* takes over, we do not perceive things properly and in the right perspective; we wrongly interpret situations, misconceive facts, and misjudge persons. All these are the qualities of *tamas*, in addition to excessive sleep.

So here it is. He tells us how we will behave in this world when we are under the subjection of one or the other of these *gunas*, properties of *prakriti*, viz., *sattva*, *raja* and *tamas* respectively. If we are *sattvikly* endowed, we will be a virtuous and righteous person: *sāttvikaiḥpuṇyaniṣpattiḥ*. Good deeds are not possible when we are *rajasik* in nature. We will always act wrongly. When we are in the state of *sattva*, we have an inclination to do virtuous deeds; we become righteous in our behavior. But if we are *rajasik*, we do sinful actions, erroneous deeds: *pāpotpattiścarājasaiḥ*.

तामसैर्नोभयं किंतु वृथायुःक्षपणं भवेत् । अत्राहंप्रत्ययी कर्तेत्येवं लोकव्यवस्थितिः ।

पञ्चदशी २ । १६

tāmasairnobhayaṁ kintu vṛthāyuhkṣapaṇaṁ bhavet । atrāhampratyayī kartetyevam
lokavyavasthitiḥ ।

pañcadaśī 2|16

But under the influence of *tamas*, we do no action. It is a waste of time: *vṛthāyuhkṣapaṇaṁbhavet*. In *rajas*, we do something; in *sattva*, we do something greater. But in *tamas*, we do nothing; so the author says that under the influence of *tamas*, we are really wasting our life.

In the above-described characteristics, through the manifestation of *sattva*, *rajas* or *tamas*, there is an entity within that says, “I am like this. I am happy. I am unhappy. I am full of

desire. I am angry. I am torpid in my mind. I am righteous. I do this action. I do that action.” This entity of consciousness that is asserting these movements through the three qualities of *sattva*, *rajas* and *tamas* is called *karta*, or the doer of action, the agent of action, *ahankara*, ego, intellect, reason — whatever we call it. Intellect, reason, ego all go together. Basically it is the knower, the doer, the entity that assumes and assigns everything unto itself. The agency in action is attributable to this particular principle of egoism and its associated intellect. This is how we can explain the nature of the sense functions, the organs of action; as well as the properties of *prakriti*, viz., *sattva-rajas-tamas*, how they act upon us and how they are all appropriated into our own personality by a principle in us called ego: *kartritvabhavana*.

स्पष्टशब्दादियुक्तेषु भौतिकत्वमतिस्फुटम् । अक्षादावपि तच्छास्त्रयुक्तिभ्यांमवर्धताम् ॥

पञ्चदशी २ । १७

spaṣṭaśabdādiyukteṣu bhautikatvamatisphuṭam lakṣādāvapi
tacchāstrayuktibhyāmmavardhatām ॥

pañcadaśī 2|17

We know that all the objects of the world are actually physical in their nature. There is no need to argue on this matter. How do we know that objects are material? We can touch them, see them, taste them, smell them, and the like. They are solid substances. That the world is made up of physical matter is something obvious. But how do we know that the sense organs are also made up of the same category of materiality?

As mentioned earlier above, we cannot actually perceive the materiality of the sense organs because here, in the case of the senses of knowledge at least, the materiality is of a *sattvik* nature — rarefied matter. Rarefied matter is *sattva*; distracted matter is *rajas*; and stable, fixed matter is *tamas*. Because of their internality and the constituency being totally inside, we are unable to know that they exist at all. But by inference, we can know that they do exist, because if

there is no correspondence between the sense of perception (sense of seeing) and color or light, light would not be seen. In as much as there is a possibility of coming in contact with light, it is necessary to infer that there is something in us which is corresponding in frequency to the principle of light in our own selves.

So is the case with hearing. We cannot hear every kind of sound. Only a particular frequency of sound can be heard by the eardrums. Similarly, taste — our tongue cannot savor every kind of taste. We are placed in a particular frequency band of the world. High-frequency actions cannot be perceived, and lower frequency actions also cannot be perceived. Neither can we see heaven, nor can we see hell. We can see only the earth, because heaven is a high-frequency existence. It is not within the band of the frequency of our mind and intellect. And we cannot see hell, because we are superior to it. We see only the middle portion, which is corresponding to the frequency of the objects of the world, the world as a whole. By inference, we can conclude that the senses of knowledge and also the mind are constituted of a similar material substance, because similar attracts similar; dissimilar repels. The fact of there being such a thing called sensory perception should prove that the senses are also made up of the same categories of materiality as the objects themselves. By inference we can know it.

एकादशेन्द्रियैर्युक्ता शास्त्रेणाप्यवगम्यते । यावत्किञ्चित्भवेदिदं शब्दोदितं जगत् ॥

पञ्चदशी । २ । १९

ekādaśendriyairyuktā śāstreṇāpyavagamyate । yāvatkicñcitbhavedidaṁ śabdoditaṁ
jagat ॥

pañcadaśī । 2 । 19

It was mentioned that Sage Uddalaka declared that all this was Pure Being alone. *Idam* means *all this*; what do we mean by *all this*? The word *this* is explained in this, eighteenth, verse. Whatever is cognizable by the senses of knowledge, whatever is contactable through the five organs of

action, whatever is conceivable by the mind, whatever can be known through scriptures or instruction from a teacher — all this put together, this whole universe of perception and knowledge, is called *idam*. The entire universe of cognition, perception, and action — *nama, rupa, kriya, prapancha* — name, form, action, world — everything, whatever is conceivable, contactable, measurable or worth dealing with in any way whatsoever, is included within this vast inclusiveness, the whole world of *jagat*; and the term used to demonstrate this vast universe is *idam*. This wonderful thing, this whole thing that we can see and conceive, is Pure Existence. Thus having seen the properties of the five great elements, we shall explore their relation to the human body.

2.5.2 The Human Body and Its Relation to Panchamahabhutas

Bhuta has been defined as a substance bearing one of the five special qualities perceptible by their respective senses. Being eternal, i.e., having no origin and no destruction, it comes into the component factor of a substance and is thus called *bhuta*.

पञ्चभिर्निमित्ते देहे .

रत्नावली-२।२।१२

pañcabhīrnirmite dehe –

ratnāvalī-2|2|12

पञ्चीकृतेभ्यो भूतेभ्यः स्थूलेभ्यः पूर्वकर्मणा ।समुत्पन्नमिदं स्थूलं भोगायतनमात्मनः ॥

विवेकचूडामणिः श्लोकः ।८८

pañcīkṛtebhyo bhūtebhyaḥ sthūlebhyaḥ pūrvakarmanā ।samutpannamidaṁ sthūlaṁ
bhogāyatanamātmanaḥ ॥

vivekacūḍāmaṇiḥ ślokaḥ|88

The possession of a single special quality by each *bhuta* gives a base for its individual definition. Some other qualities pertaining to *gurutvadi* group have been attributed to them, such as

kharatva (hardness), *gurutva* (heaviness) for *prithvi*; *sansiddhikadravatva* (natural liquidity), *snigdhatva* (stickiness), and *shitatva* (coldness) for *aap*; *ushnatva* (hotness) and *tikshnatva* (property of emitting radiance) for *tejas*; *chalatva* (mobility) and *rukshatva* (dryness) for *vayu*; and lastly *apratighata* (non-resistance) and *laghutva* (lightness) for *akasha*. On the basis of these qualities also, the *bhutas* may be defined.

Sharira

In so far as *sharira* is concerned, the authors of all the ancient medical classics have described it “as the basis of life and animation and that it is composed of substances belonging to the five different species of matter, the *panchamahabhutas*.” — *Sushruta Samhita* 46/ 526

In this view, *panchamahabhutas*, in their several affectations, combine in different modes, under specific conditions, to compose the different basic structural and functional factors of the body — *saptadhatus* and *tridoshas*. Not only is the body the material basis of life but the food that nourishes it is also similarly composed of *panchamahabhutas*.

Charaka has said that whatever substances you find in the universe or cosmos, you find the same in the body. This means that there is no difference in quality between the macrocosm and the microcosm except one of degree only. To understand the body properly, therefore, one should study the physical constitution of the universe.

The *vedantists* believe *maya* to be the material cause (*upadana karana*) of the world. The power of *maya* is the power to realize the unreal — to impart practical reality or mediate existence to that which does not and cannot possess absolute intelligence and absolute bliss. The alienation of the absolute, acting through *maya*, produces in the beginning *akasha* — one infinite, ubiquitous, imponderable, inert, and all pervasive entity. The world, thus begun, goes on evolving, in increasing complexity.

The other *sukshma bhutas*, classes of subtle matter, evolve from *akasha* in an ascending order — *akasha* giving off *vayu*, *vayu* giving off *tejas*, *tejas* giving off *aap*, *aap* giving off *prithvi*. *Akasha* has the capacity of sound. *Vayu* emanates from the universal *akasha* and is instilled with the potential of mechanical energy.

Tejas emanates from *vayu* and contains in the energy of light and heat. *Aap* is the transformation of *tejas* and is instilled with the energy that stimulates the nerve of taste; and lastly *prithvi*, or earth, which is the transformation of *aap*, possesses the latent energy of smell.

But the subtle rudiments of matter must be compounded in various ways to give rise to the gross constituent matter of this world. These forms of gross matter are called *mahabhutas*.

हिरण्यचक्षुः नेत्याह नह्यात्मा रजस स्मृतः नतन्द्रिणां मनस्सन्ति रोगःशब्दादिजस्तथा षड्धातुजस्तु पुरुषो
रोगःषड्धातुजस्तथा रसैः षड्धातुजो ह्येषा ।

चरकसूत्र-२५।१४।१५

hiraṇyacakṣattu netyāha nahyātmā rajasa smṛtaḥ natandriṇāṃ manassanti
rogaḥśabdādijastathā ṣaḍdhātujustu puruṣo rogaḥṣaḍdhātujustathā rasaiḥ ṣaḍdhātujo
hyeṣā|

carakasūtra-25|14|15

The sage Hiranyaksha said no, for the spirit is not said to be born of *rasas*, nor even the mind, which is super-sensual. Besides, there are diseases that spring from sound, etc., from the *hina*, *mithya*, and *atiyogas* of the objects of the sense organs. Man, then, is the result of the objects of the sense organs. Man, then, is the result of the six elements. The diseases, too, arise from the six elements. Thus, adi Sankhyas declared that the individual is the aggregate resulting from the union of the six elements (five elements and consciousness).

According to *vedantic* scientists, each of the five gross *bhutas* is derived from the corresponding subtle *bhuta*; these may be taken to correspond to the five *tanmatras* of the *Sankhya*, which are, as has been stated above, proton elements charged with energies of various

kinds. This may be taken as proton electron bricks that go to build up the *paramanus* of the five gross *bhutas*. The *vedantists* hold that, into the structure of the atom of every gross *bhuta*, all the five subtle *bhutas* enter in certain definite proportions. In the evolution of the atom of any particular gross *bhuta*, say, the *mahabhuta prithvi*, the corresponding subtle *bhuta* acts as the central radicle corresponding to the proton brick; while all the other four subtle *bhutas* go to form the peripheral electron bricks of our *paramanu* brick block. The process of transformation of a gross *bhuta* from the subtle *bhutas* is technically known as *panchikarana*, which is illustrated thus: The *mahabhuta prithvi*, gross earth matter, is composed of four parts of subtle earth matter and one part each of the other forms of subtle matter. The *mahabhuta vayu* is composed of four parts of subtle gaseous matter and one part each of the other forms of subtle matter; and similarly with other *mahabhutas*. Hence if *akasha*, *vayu*, *tejas*, *aap*, *prithvi* represent the five forms of subtle matter and AK, VA, TE, AP, PR stand for the corresponding *mahabhutas*, we may represent the constitution of the *mahabhutas* as follows:

AK=ak⁴ (v,t,a,p) ak⁴ being the radicle

VA=v⁴ (ak,t,a,p) v⁴ being the radicle

TE=t⁴ (ak,v,a,p) t⁴ being the radicle

AP= a⁴ (ak,v,t,p) a⁴ being the radicle

P= p⁴ (ak,v,t,a) p⁴ being the radicle

As to the origin of these subtle *bhutas* themselves, the vedantic scientists hold that each is derived from one which is higher in the scale. Thus, subtle *prithvi* comes from subtle *aap*, which comes from subtle *tejas*, which comes from subtle *vayu*, which again comes from subtle *akasha*; and all these subtle *bhutas* are essentially proto- matters charged with specific energies of various kinds. From the above formula of evolution, it will be seen that, according to the

Vedantic scientists, the content of the central radicle is equal to the contents of all the peripheral units put together.

The phenomenon of the universe follows the law of causation. The physical or material aspect of each and every effect, whether animate or inanimate, visible or invisible, simple or complex, arises out of the five *bhutas* or their derivatives, because every effect shows the presence of certain specific *shabdadi* and general *gurutvadi* qualities of the *bhutas*. It is only the qualities — both primary and secondary — that make the *dravyas* capable of being perceived by the senses and at the same time give an impression of their *pentabhautik* composition.

पञ्चभुतात्मत्मकं तत्तु क्षमामाधिक्षया जायते । अम्बुयोन्यग्निपवनाभासं सम्भयात् तन्निवृत्तिविशेषश्च व्यपदेशस्तु भूयसा ॥
वसिष्ठसूत्रम्-६ । १ । २ ।

pañcabhutātmatmakam tatttu kṣamāmādhikṣayā jāyate । ambuyonyagnipavanābhāsam
sambhayāt tannivṛttiviśeṣaśca vyapadeśastu bhūyasā ॥
vasiṣṭhasūtram-6|1|2|

Only the five *bhutas* or *bhuta paramanus* are productive of other substances. In this context, Vagbhatta gives a sketch of the *bhautika* structure of compound substances. He states that in the construction of *pentabhautik* substance, *prithvi* takes the place of a mass or nucleus around which the other *bhutas* align themselves in different patterns to form various kinds of substances. *Aap* (as a principle of viscosity and cohesion) causes them to cohere or maintain the moving things in their path.

अचेतनं क्रिया वाचा मनश्चेतैत्परःयुक्तस्य मनसा तस्य निर्दिश्यन्ते विभोःक्रिया ।

चरक संहिता । १ । ६५

acetanam kriyā vācā manaśchetaitparahyuktasya manasā tasya nirdīśyante vibhoḥkriyā ।
caraka saṁhitā 1|65

Hence these five *bhutas* are stated to compose all the diverse materials of the universe. On the other hand, *atman* and *manas* are said to play their part in the phenomenon of life in *chetana* group of *karya dravyas*.

Hence we see, in substance, the human body is itself composed of the five great elements; and for proper health, there should be a balance of the elements. Imbalance in the same can be corrected by using these elements to restore the balance. Healing powers of the elements are referred to frequently in ancient scriptures.

2.5.3 Role of the Elements in Healing

Elements are believed to have inherent capacity to heal. The science of Ayurveda as delineated in scriptures like *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya* is replete with references to the healing effects of natural elements.

हिताहितं सुखं दुःखं आयुस्तस्य हिताहितम् । मानं च तत्र यत्रोक्तम् आयुर्वेदःस उच्यते ॥

चरकसंहिता सू ११।४१।

hitāhitam sukham duḥkham āyustasya hitāhitam | mānaṁ ca tatra yatroktam
āyurvedaḥsa ucyate ||

carakasamhitā sū|1|41|

The science that deals with *hita-ayuh* (useful life) *ahita-ayuh* (harmful life) *sukha-ayuh* (happy life) and *dukha-ayuh* (unhappy or miserable life), along with *dravya guna* and *karma* that is advantageous and disadvantageous to the span of life, is designated as Ayurveda.

स्वस्ति न इन्द्रो वृद्धश्रवाः स्वस्ति नःपूषा विश्ववेदा । स्वस्ति नस्तार्क्ष्यो अरिष्टनेमिः स्वस्ति नो बृहस्पतिर्दधातु ॥

ऋग्वेदः १।८९।६

svasti na indro vṛddhaśravāḥ svasti naḥpūṣā viśvavedā | svasti nastārksyo ariṣṭanemiḥ
svasti no bṛhaspatirdadhātu ||

ṛigvedaḥ 1|89|6

Without offering prayers to God and without one's endeavors, one cannot attain the happiness of sensory organs and soul. So one must begin every work with the name of God.

Mantras in suktas, viz., 2/28, 3/11, 4/9/10, 5/30, 7/53, 8/1, and 19/26, have descriptions for good health and long span of life.

ओ३म् इ॒षे त्वो॒र्जे त्वा वा॒यवस्त दे॒वोवः स॒विता प्रार्प॑यतु श्रेष्ठ॒तमाय॑ कर्म॒ण आप्या॑यध्वम॒घ्निया
दे॒वभा॒गमूर्ज॑स्वतीःप॒यस्वतीःप्र॒जाव॑तीर॒नमी॒वा अ॒यक्ष॑मा मावःस्तेन ई॒शत माऽघ॑षगं॒सोरु॒द्रस्य॑ हे॒तिःपरि॑वो वृ॒णक्तु॑ ध्रु॒वा
अस्मिन् गो॒पतौ॑ स्या॒त ब॒ह्वीर्ज॑मानस्य पशु॒न्पाहि॑ ।

यजुर्वेदसंहिता ।१ ।१ ।

o3m iṣe tvorje tvā vāyavasta devovaḥ savitā prārpayatu śreṣṭhatamāya karmaṇa
āpyāyadhvamaghniyā devabhāgamūrjasvatīḥpayasvatīḥprajāvatīranamīvā ayakṣmā
māvaḥstena īśata mā'ghaṣagaṁsorudrasya hetīḥparivo vṛṇaktu dhruvā asmin gopatau
syāta bahvīryjamānasya paśunpāhi ।

yajurvedasamhitā ।1।1।

Learned people should always study the *Rigveda*, while keeping themselves in the shelter of God and make righteous endeavors and perform good deeds for accomplishing their endeavors so that all human beings may achieve happiness and opulence with the blessings of God.

It is expected of everyone to protect the community of human beings with his good deeds and to make arrangements for the education of their sons, so that all human beings and their sons could be protected against all kinds of diseases and great obstacles and prosperity is achieved.

पृथ्व॑प्तेजोऽ॒निल॑खे स॒मित्थि॑ते पञ्चा॒त्मके॑ यो॒गगु॑णे प्रवृ॒त्ते । न॒तस्य॑ रोगो न॒जरा॑ न मृ॒त्युः प्रा॑प्तस्य यो॒गाग्नि॑मयं शरी॒रम् ॥

श्वेताश्व॑तरोपनिषत् ।२ ।१२

prthvaptejo'nilakhe samitthite pañcātmake yogagūṇe pravṛtte । natasya rogo najarā na
mrtyuḥ prāptasya yogāgnimayaṁ śarīram ॥

śvetāśvataropaniṣat ।2।12

After the practice of *dhyana yoga*, when the aspirant gains mastery over the five elements, viz., *prithvi, aap, tej, vayu, and akasha*, spiritual powers relating to these elements will be gained and this spiritual body full of yogic aura is free of disease, ageing, and death.

लघुत्वमारोग्यमलोलुपत्वं वर्णप्रसादं स्वरसौष्टवं च ।गन्धःशुभो मूत्रपुरीषमाम्लं योगप्रवृत्तिं प्रथमां वदन्ति ॥

श्वेताश्वतरोपनिषत् ।२ ।१३

laghutvamārogyamalolupatvaṁ varṇaprasādaṁ svarasausṭhavaṁ ca ।gandhaḥśubho
mūtrapurīṣamāmlaṁ yogapravṛttiṁ prathamāṁ vadanti ॥

śvetāśvataropaniṣat ।2 ।13

After gaining mastery over the five great elements, the yogi acquires many powers. His body becomes light, and there is no trace of lethargy or heaviness in the body. He is always free of diseases. He is unaffected by any material object. His skin begins to glow, and his voice becomes melodious. There will be a sweet smell emanating from his body. His bodily waste will be reduced in quantity.

त्रिबन्धुरेण त्रिवृता रथेन यतमश्विना मध्वःसोमस्य पीतये ।

ऋग्वेग ।८ ।८५ ।८ ।

tribandhureṇa trivṛtā rathena yatamaśvinā madhvaḥsomasya pītaye ।ṛigvega ।8 ।85 ।8 ।

Combined with the attributes of energizing *prana* and *apana* and sweetness having three kinds of bindings, *vata, pita, and kapha* may be attained by this body in the chariot form with the *gunas-sattva, rajas* and *tamas* associated with it.

ओषधीःप्रति मोदध्वं पुष्पवती प्रसूवती ।अश्व इव सजित्वरी वीरुधःपारयिष्णवः ॥

ऋग्वेदः १० ।९७ ।३ ।

oṣadhīḥprati modadhvaṁ puṣpavatī prasūvatī ।aśvā iva sajitvarī
vīrudhaḥpārayiṣṇavaḥ ॥

The medicines that consist of flower, fruit and which register their victory over diseases like the horses do, and the medicines consisting of creepers are effective on patients.

Prithvi

Prithvi or earth is referred to as mother as it is believed to play the role of one who nourishes and protects. Several references are found in the Vedas, relating to this concept.

इष्कृतिर्नाम वो माता य्यं स्थ निष्कृतीः ।सीराः पतत्रिणीस्थ यदमयति निष्कृतिः ।

ऋग्वेदः १० ।९७ ।९

iṣkṛtirnāma vo mātā yyaṁ stha niṣkṛtīḥ |sīrāḥ patatrinīstha yadamayati niṣkṛtīḥ
|ṛgvedaḥ 10|97|9

The mother of these medicines is the earth. These medicines move with great speed through the veins and remove the diseases from the body.

Surya

In the *Rigveda*, it is said that among the gods, *Surya* is symbolic of the corporeal sun. *Surya* has been offered prayers in ten *suktas* in the *Rigveda*. The other synonyms of *Surya* are *savita*, *mitra*, *pooshan*, *vishnu*, and *aditya*, of which a mention can be found in the *Rigveda*.

Surya is that god who destroys darkness and provides light and leads a person to perform his *karma* in the morning. Seeing the brilliant celestial body in the sky, the *rishis* and *munis* have sung in praise of its power and energy. They saw it as a form of god. It destroys all diseases.

आरोग्यं भास्करादिच्छेत् श्रियमिच्छेत् हुताशनात् । ज्ञानं महेश्वरादिच्छेत् मुक्तिमिच्छेत् जनार्दनात् ।

मत्स्यपुराणम् ६ । १८

ārogyaṁ bhāskarādichet śriyamichet hutāśanāt । jñānaṁ maheśvarādichet muktimichet
janārdanāt ।

matsyapurāṇam 6|18

Suryadevata grants health, *agni* grants wealth, *shankar* grants knowledge, and *vishnu* grants liberation.

Aap-Varuna

The god *Varuna* is one among the supreme gods mentioned in the *Rigveda*. He has been considered the god of water. Twelve *suktas* have been written on *Varunadev*.

O sages please get rid of diseases from among the human beings. Remove obstacles and get rid of enemies.

आ वां रथो अश्विना श्येनपत्वा सुमृळीकः स्ववां यत्ववाङ् । यो मत्स्यस्य मनसो जवीयान् त्रिवंधुरो वृषणा वातरंहाः

ऋग्वेदः १ । ११८ । १

ā vāṁ ratho aśvināa śyenapatvā sumṛḷīkaḥ svavāṁ yatvavāṅ । yo matsyasya manaso
javīyān trivandhuro vṛṣaṇā vātaramhāḥ

ṛgvedaḥ 1|118|1

O embodiment of power Ashwinoudev, built with the best craftsmanship, your chariot consisting of three parts, which moves as fast as a hawk, is a giver of extreme happiness. There are so many precious and useful medicines available in it. Bring this chariot, which moves through the sky down and makes us happy by providing us health.

यत्पर्जन्य कनिक्रद्त्स्तनयन् हंसि दुष्कृतः ।प्रतीदं विश्वं मोदते विश्व मोदते यत्किञ्च पृथिव्यामधि ॥

ऋग्वेदः ५।८३।९।

yatparjanya kanikradtstanayan haṁsi duṣkṛtaḥ |pratīdaṁ viśvaṁ modate vśvaṁ
modate yatkiñca pṛthivyāmadhi ||

ṛgvedaḥ 5|83|9|

The cloud that rains with the loud sound of thunder brings an end to all kinds of distresses and afflictions. All the living beings that exist on earth become extremely happy to see the rain falling.

In the *Atharvaveda*, there is mention of various kinds of specific medicinal herbs that can be used for remedying all kinds of diseases. In the *mantras* of the *suktas*, viz., 6/25, 6/91, 19/44, of the *Atharvaveda*, it has been told as to how to cure diseases through water and herbs.

अप्स्वन्तरमप्सु भेषजम् ।

माध्यन्दिन शुक्ल यजुर्वेदसम्हिता १९।८

apsvantaramapsu bheṣajam|

mādhyandina śukla yajurvedasamhitā|9|8

Water has the properties of treatment for various kinds of diseases. Water is the base of life, so it is necessary to maintain its balance in the body. Water can wash out disease-producing agents from the body. *Yajurveda* describes water as being good for eye-related problems and is energizing.

“Water Therapy,” which is very popular today, uses water — अपो याचामि भेषजम्. Use of water as a therapy takes us to a reference in *Atharvaveda*, which seeks healing medicinal quality stored in water.

अप्सु मे सोमो अब्रवीदन्तविश्वानि भेषजा (1-1-5-4)]।

In his exhortation, Somadeva describes water as containing in its centre the disease-ridding medicines.

आपहृणीत भेषजं वरूथं तन्वे मम ज्योक्क सूर्यं दृशे ।१ ।१ ।६ ।२

āpahṛṇīta bheṣajam varūtham tanve mama jyokca sūryam dṛśe ।1।1।6।2

He exclaims, “O waters! Let me see the Sun for getting long age (longevity). Drive out all disease and render my body strong. (1-1-6-3)

River waters cure diseases. Water is the basis of all life on earth. Of the *panchamahabhutas*, or the five natural elements, water is considered to be the key to life. Human beings feel a close affinity to it, since three-fourths of the human body is constituted of water. The rivers are generally female divinities, food- and life-bestowing mothers. The holiest of rivers, the best known and the most honored, is the Ganga. Devotees traverse long distances to partake and procure the *Gangajal* (water of Ganga), because the *Gangajal* procured from the “Har ki Pauri” in Hardwar perennially remains fresh. The Ganga is a living presence, a protector, a healer of ills.

The *Mahakumbha* is the biggest spiritual event in the globe. It is extraordinary to witness such mass spiritual communion between so many people and the river. The varied images from *Kumbha Mela* attract everyone from Boston to Benaras. The *Kumbha* occurs every 12 years. The most sacred, or auspicious, time is calculated on the basis of a specific planetary configuration, considering its cosmobiological effect on the human body and mind. The ritual bath, or *snan*, on specific days, viz., full moon day, new moon day, and *Basant Panchami*, has been specifically prescribed on the basis of the bio-effects of lunar phases. The imposed electromagnetic fields on

water are transmitted into the human beings taking bath in the holy *Prayag*, giving them great health benefits.

Our natural environment — comprising mountains and hills, rivers and dales, trees and plants — is considered auspicious enough to provide space for meditation. Evergreen trees were regarded as symbols of eternal life and to cut them down was to invite the wrath of the gods. Groves in forests were looked upon as habitations of gods. It was always kept in mind that human survival was possible only with the conservation of entire flora and fauna. Planting and preservation of trees are considered sacred in religious functions. This is the reason for establishing the practice of taking bath at the *Sandhikala* during *Vaisakha*, *Ashada*, and *Kartika* months.

Agni

Vedic philosophy promoted “environmental friendliness” thousands of centuries before the concept was developed by the modern world. Respect for nature and all natural resources was the first message of Vedic philosophy to mankind.

Environmental friendliness not only included nature and human beings but also animals, tiny creatures, plants, and all living things, as well as all nonliving things like land, air, water, fire, sun, moon, planets, etc. We can say that the Vedic society was the first “Environmental Protection Agency” in the history of mankind. It perceives that there is life in all kinds of things — biotic or non-biotic material.

There is greater emphasis on mutual dependence where living in isolation was not possible.

Environment has been perceived as a friendly abode.

अग्निर्हिमस्य भेषजम् ।

तैत्तरीय ब्राह्मणम्-३-१२

agnirhimasya bheṣajam ।

taitarīya brāhmaṇam-3-12

Yajurveda has described *agni* as medicine for winter diseases.

अग्निमतिभ्यो रक्षतु ।

तैत्तरीयब्राह्मणम् । २१ ।१८८ ।

agnirmātebhyo rakṣatu ।

taitarīyabrāhmaṇam| 21|188|

Fire is the remedy for cold-induced diseases.

अग्निरायुष्मान् ।

अग्निर्भूतानामधिपतिः । स मामवतु ।

तैत्तरीयसंहिता ।४ ।२ ।१३

agnirāyuṣmān ।

agnirbhūtānāmadhipatiḥ । sa māmavatu ।

taitarīyasamhitā |4|2|13

Agni has been described as possessing remedial properties.

Here, *agni* is prayed to for protection.

अग्निःशुचिव्रततमाहुः ।

तैत्तरीयसंहिता ।७ ।२ ।१५

agniḥśucivratatamāhuḥ ।

taitarīyasamhitā |7|2|15

अग्ने नय सुपथाराये अस्मान् विश्वानि देव वयुनानि विद्वान् ।

ईशावास्योपनिषत् ।१४ ।

agne naya supathārāye asmān viśvāni deva vayunāni vidvān ।

īśāvāsyopaniṣat|14|

अग्नये ज्योतिष्मते । अग्न आयुःपवसे ।

तैत्तरीय संहिता । ३ । २१

agnaye jyotiṣmate | agna āyuhpavase |

taitarīya saṁhitā | 3 | 21

Agni is the one who provides us with longevity.

Agni fills one with brilliance and vigour.

रोगःसर्वोऽपि मन्दाग्नौ ।

चरकसूत्रम् । २ । १८ । १४

rogaḥsarvo'pi mandāgnau |

carakasūtram | 2 | 18 | 14

Here, Charaka says all diseases are caused by diminished fire in the body.

Vayu

ये शुभ्रा घोरवर्षसः सुक्षत्रासो रिशदासः मरुद्भिरग्न आ गहि ।

ye śubhrā ghoravarpaṣaḥ sukṣatrāso riśadāsaḥ marudbhiragna ā gahi |

वयुर्भूत्वा पवते ।

तैत्तरीय ब्रह्मणम्-३-१२-१६

vayurbhūtvā pavate |

taitarīya brahmaṇam-3-12-16

Vayu that has been purified through the smoke rising from the *yajnas* destroys diseases and defects.

O air! You are the healer of all diseases, one who can get rid of all ailments.

प्राणायामेन युक्तेन सर्वरोगक्षयो भवेत् । अयुक्ताभ्यासयोगेन सर्वरोगसमुद्भवः

हठयोगप्रदीपिका । २ । १६ ।

prāṇāyāmena yuktena sarvarogakṣayo bhavet | ayuktābhyāsayogena

sarvarogasamudbhavaḥ

haṭhayogapradīpikā | 2 | 16

If done as instructed, in the proper manner, *pranayama* (regulation of breathing) destroys all diseases. But if done in a wrong manner, it could bring about diseases.

***Akasha* (space)**

The medicine to avoid miscarriage 8/6/3 is *baja*. The *Atharvaveda* is a great storehouse of “*bheshaj*” *suktas*.

A detailed and thorough investigation of *ashwasana*, *upachar*, *surya kiran*, *jal*, *agni*, *keshroga*, *shiroroga*, *bhutonmad*, *netraroga*, and *kasaroga* has been described in this Veda.

2.5.4 Co-relation of Ancient References and Modern Naturopathy Modalities

The Vedic Hymn to the Earth, the *Prithvi Sukta*, in *Atharvaveda* is the oldest and the most evocative environmental invocation. In it, the Vedic seer solemnly declares the enduring filial allegiance of humankind to Mother Earth — माता भूमिः पुत्रोऽहं पृथिव्याः:

Earth is my mother; I am her son. Mother Earth is celebrated for all her natural bounties and particularly for her gifts of herbs and vegetation. The Vedas, traditionally believed to have been written around 3000 B.C. and considered sacred in Hinduism, contain 1028 hymns dedicated to 33 different gods, out of which the most often addressed gods are nature gods: *Surya* (Sun God), *Indra* (Rain God and King of Heavens), *Agni* (Fire God). The Indian thought greatly emphasizes upon a very cordial relationship among all the elements of our world, for which various rituals have been institutionalized. These rituals ensure that we treat even the nonliving world with great care and maintain harmony. For example, fire is conceived as a messenger of God. Earth has been considered as mother goddess. Sky is worshipped as father.

Changes occur in nature at the time of change of seasons, and this could cause ill health (*aswasthyam*). In the *vaidik* period, treatment was based on nature (*prakṛti*). *Prakṛti* includes *pañcamahabhutas*, plant-based remedies, and minerals.

Treatment through *pañcatatva* or any element of *pañcatatva* is known as natural therapy. Natural elements are helpful in the treatment of various diseases. Natural therapy includes solar therapy, soil therapy, as well as treatments using water, *vata* (air), *agni* (fire), etc.

Solar therapy

Treatment using sunrays and sunlight is known as solar therapy. It has an important role in natural therapy. Veda described bactericidal properties of sunlight. *Rigveda* described sun as *sociṣkesam*, which means healthiness and happiness in life. That is why sun is known as the soul of the world. In *Rigveda*, prayers are offered to the sun for treatment of heart diseases and jaundice. *Samaveda* showed the relationship of long life with sunrays.

Atharvaveda described the rising sun as having the power of destroying harmful agents like bacteria, virus, etc. Elsewhere, sun is denoted as a curing agent for heart diseases and jaundice. Sun can treat neurological diseases and body ache. *Atharvaveda* has enlisted treatment for some of the bone diseases, *vata* diseases (neurological disorders), poisonous effects, etc. *Atharvaveda* indicates treatment with high-, medium-, and low-frequency sun rays.

Water therapy

Treatment by water is known as water therapy.

अपो याचामि भेषजम् । तैत्तरीय आरण्यक महानारायणोपनिषत् ।

अनु । ८७

apo yācāmi bheṣajam । taitarīya āraṇyaka mahānarāyaṇopaniṣat । anul87

अप्स्वन्तरमृतमप्सु भेषजम् । अथर्व । १ । ४ । ४ apsvantaramṛtamapsu bheṣajam ।

atharva । 1 । 4 । 4

Many facts related to water therapy have been stated in the Vedas. Water is denoted as a “mine of drugs: in the *Rigveda*. Even today using water as a home remedy, most of the eye-related minor disorders are cured by rinsing the affected eye with water. Veda says water is a medicine

for heart diseases. Water is foremost as a curative agent amongst *panchamahabhutas*. Water is best for health. Water has energy-providing properties, like ghee. In *Atharvaveda*, rain water is termed *satvr̥ṣya* (100 times more aphrodisiac). Bathing in water is believed to grant grace, stamina, and health, according to sage Yajnavalkya.

स्नानमूलाःक्रिया सर्वे स्मृतिश्रुत्यादिता नृणाम् ।

तस्मात् स्नानं निशेवेत् शर्द्धपुष्ट्यारोग्यवर्धनम् ।

याज्ञवल्क्य स्मृति २।१३

snamulāḥkriyā sarve smṛtiśrutyaḍitā nṛṇām |
tasmāt snānaṁ niśevet śr̥ipuṣṭyārogyavardhanam |

yājñyavalkya smṛti|2|13

In the Mahabharata, it is mentioned that among all kinds of cleansing, cleansing done with water is the most important.

सर्वामिव स्नानानं विशिष्टं तत्र वरुणम् ।महभारतम् ।

sarvāmeva snānānaṁ viśiṣṭm̄ tatra varuṇam |mahabhāratam|

Bathing in natural water bodies like river, lakes, small streams, and waterfall gives good health. Preferably bathing should be done in cold water and in the open. This is in agreement with the modern concept of hydrotherapy, which says, mildly cold water is stimulating and activating in nature.

नदीषु देवखातेषु तडागेषु सरेषु च ।स्नानं समाचरेन्नित्यं गात्रप्रस्तरणेषु च ।

मनुस्मृतिः-४-२०३

nadīṣu devakhāteṣu taḍāgeṣu sareṣuca|snānaṁ samācarennityaṁ gātraprastaraṇeṣu
ca |

manusṛtiḥ-4-203

It is also said that bathing in water gives health and rejuvenates all the tissues of the body. Sponging or sponge bath as used in modern hydrotherapy finds reference in *Jabalasmriti*.

आशीर्शकं भवेत्स्नानं स्नानशक्तौ तु कर्मिणाम् । आर्द्रेण वासा वा स्यान्मार्जनं दैनिकं विदुः ।

जाबालसृतिः ।

āśīrśakam bhavetsnānam snānaśaktau tu karminām | ārdreṇ vāsā vā syānmārjanam
dainikam viduḥ |

jābālasṛtiḥ |

During illness, weakness, and old age and resulting incapability, if a person is unable to bathe, then he should be bathed from neck down, or a cloth dipped in water should be wiped on the body.

अजीर्णे भोजनं वारि जीर्णे वारि बलप्रदम् । भोजने चामृतं वारि भोजनान्ते विषप्रदम् ॥

चाणक्यनीतिः ।

ajīrṇe bhojanam vāri jīrṇe vāri balapradam | bhojane cāmṛtam vāri bhojanānte
viṣapradam ||

cāṇakyanītiḥ |

If water is taken internally without eating anything, it acts like medicine.

आपो विश्वस्य भेषजी । अथर्ववेदः ।

āpo viśvasya bheṣajī | atharvavedaḥ |

Water is a universal healer. This is in agreement with the rationale of hydrotherapy.

Vata therapy or vital therapy

In Vedas there is detailed description about yoga and *vata* therapy. Treatment of diseases by *vata* and yoga is described at various places.

Two types of *vata* are mentioned in *Rigveda*, and both of them provide health and energy to human being and remove *mala dosha*.

Two types of wind currents exist: one starts from sea and the other from earth. One of these provide energy for life and the other throws out bacteria and wastes of the body. Hence *vata* is equivalent to *amrita* (nectar), and it is life saving and the best medicine.

Pure air is healthy for life. One of the main elements of *vata* therapy is *pranayama*. *Pranayama* improves vital capacity, which in turn cures diseases and improves immune system. It is well known that polluted air produces diseases; if air is fresh, diseases cannot easily invade the body. However, environmental purity nowadays is substandard.

All open spaces are cleansed and made pure (free of microbes) by the rays of the sun and by air.

पन्थानश्च विशुध्यन्ति सोमसूर्यांशुमारुतैः ।

याज्ञवल्क्य स्मृतिः ।

panthānaśca viśudhyanti somasūryāṁśumārutaiḥ।

yājñavalkya smṛtiḥ ।

Agni, or Heat, therapy

Treatment by heat is known as *agni* therapy. It occupies special place in natural therapy. There are various kinds of *agni* therapies, like application of heat to various parts of the body; consumption of elements that have *agneya* (heat) properties; massage; fumigation with bactericidal and statics like *neem* (*Azadirachta indica*), *gugglu* (*Commiphora mukul*), *guduchi* (*Tinospora cordifolia*), etc. Burning of medicinal plants in *yajna* is helpful in purification of atmosphere and prevention of diseases. *Rigveda* has described *agni* as *visvabheshaja* (capable of curing all diseases).

Atharvaveda accepted *agni* as medicine for all kinds of diseases. *Agni* can treat diseases caused by poisonous agents; for example, the area affected by snakebite is treated by burning the part by red hot iron. It is described elsewhere that tuberculosis and idiopathic diseases can be treated by *yajna karma*. A person with short life span or a person who is nearing death can be treated by *havan* (sacred fire). *Yajnas* are performed in the period of interaction of two seasons because this period is favorable for curing diseases.

यथा सूर्याशुभिःस्पृष्टं सर्वं शुचिभविष्यति । तथा त्वदग्निर्दग्धं सर्वं शुचिर्भविष्यति ।

महाभारतम् ।वनपर्व-२-१३

yathā sūryāṁśubhiḥspṛṣṭam sarvaṁ śucibhaviṣyati | tathā tvadagnirdagdham sarvaṁ
śucirbhaviṣyati | mahābhāratam |

vanaparva-2-13

Just as sun's ray sterilizes all objects, fire also cleanses all objects.

Fasting therapy

Charaka says:

लंघनम् परमौषधम् ॥ चरकसंहिता सूत्रस्थानं ज्वरविज्ञानीयम् ।१ ।१

Food should be consumed in minimal quantity, and abstention of food is the best remedy. This forms the reference for the concept of उपवासः, or fasting therapy. An important principle of naturopathy is that fasting provides the opportunity to the body to heal itself. The same concept is reiterated here by चरक.

एतत्समस्त ज्वरपीडितानां महौषधम् लंघनमादिशन्ति ।

माधवचिकित्सा-२३ ।३७

etatsamasta jvarapīḍitānām mahauṣadham laṅghanamādiśanti |

mādhvacikitsā-23|37

For every fever, fasting is the best remedy.

ज्वरं यतस्ततो विधेयं प्रथमं च लंघनम् ॥ लोलिम्बराज ।

वैद्यकीयसुभाषितम् । पृ । २४५ ।

jvaram yatastato vidheyam prathamam ca langhanam ॥ lolimbaraja

vaidyakīyasubhāṣitamṣṣ|245|

One should fast during fever as it is the best therapy.

ज्वरादौ लंघनं प्रोक्तम् ।

योगरत्नाकरः । १ । ५४ ।

jvarādaū langhanam proktam ।

yogaratnākaraḥ|1|54|

It is said that for the febrile condition, fasting is the only remedy.

Diet therapy

Regarding diet, references are found in scriptures like the *Bhagavadgita*, wherein Shri Krishna describes the diet that is the most preferable, calling it a *sattvik* diet.

आयुस्सत्व बलारोग्यं सुखप्रीतिविवर्धनाः ।

रस्यास्निग्धास्थिराहृद्याः आहाराःसात्विकप्रियाः ।

श्रीमद्भगवद्गीता । १७ । १८ ।

āyussatva balārogyam sukhaprītivivardhanāḥ|

rasyāsnigdghāsthīrāhṛdyāḥ āhārāḥsātvikapriyāḥ|

śrīmadbhagavadgītā|17|18|

The foods that promote life, vitality, strength, health, joy, and cheerfulness; and are juicy, bland, nourishing, and agreeable are dear to the *sattvik* type of people.

Shri Krishna also describes foods called *rajasik*, which are to be avoided.

कट्वम्ललवणात्युष्णरीक्षविदाहिनः आहारा रजस्येष्टा दुःखशोकमयप्रदः ।

श्रीमद्भगवद्गीता ।१७ ।१९ ।

kaṭvamlalavaṇātyuṣṇarīkṣavidāhinaḥ āhārā rajasyeṣṭā duḥkhaśokamayapradaḥ ।

śrīmadbhagavadgītā ।17।19।

Foods that are bitter, sour, salty, very hot, pungent, dry, and pain- and disease-producing are liked by the *rajasik* type of people.

Further mention is made of *tamasik* diet, which is also to be avoided:

यातयामं गतरसं पूतीपर्युषितं च यत् ।उच्छिष्टं चात्यमेद्यं च भोजनं तामसप्रियम् ।

श्रीमद्भगवद्गीता ।१७ ।२० ।

yātayāmaṁ gatarasaṁ pūtiparyuṣitaṁ ca yat ।uccīṣṭaṁ cātyamedyaṁ ca bhojanaṁ

tāmasapriyam ।

śrīmadbhagavadgītā ।17।20।

That which is half cooked or half ripe, insipid, putrid, stale, polluted, and impure is the food dear to *tamasik* people.

He also describes two other types of diets that are not desirable, viz., those that are *rajasik* and *tamasik*. This can be further compared to the concept of *pathya* and *apathya* of *Hatha Yoga Pradipika*.

Hatha Yoga Pradipika describes *mitahara*, or ideal food, as follows:

सुस्निग्धमधुराहारचतुर्थांशविवर्जितः भुज्यते शिवसंप्रीत्यै मिताहारः स उच्यते ।

हठयोगप्रदीपिका ।१ ।५८

susnigdhamadhurāharacaturthāṁśavivarjitaḥ bhujyate śivasamprītyai mitāhāraḥ sa

ucyate ।

haṭhayogapradīpikā ।1।58

Mitahara is defined as agreeable and sweet food, to be eaten in a manner so as to leave one-fourth of the stomach empty and as if offered to please Lord Shiva.

There is further description of *pathya* (desirable food) and *apathya* (food to be avoided):

कट्वाम्लतीक्ष्णलवणोष्णहरीतशाका सौवीरतैलतिलसर्षपमद्यमत्स्यान् ।

हठयोगप्रदीपिका ११ । ६१

kaṭvāmlatīkṣṇalavaṇoṣṇaharītaśakā sauvīratailatilasarsapamadyamatsyān
|haṭhayogapradīpikā |1|61

A similar reference can be found in *Gheranda Samhita*.

शुद्धं सुमधुरं स्निग्धमुदरार्धविवर्जितम् । भुज्यते सुरसम्प्रीत्या मिताहारमिमं विदुः ।

घेरण्डसंहिता-५-२०

śuddhaṁ sumadhuraṁ snigdhamudarārdhavivarjitaṁ |bhujyate surasamprītyā
mitāhāramimaṁ viduḥ|

gheraṇḍasaṁhitā-5-20

They call that *mitahara* which is pure, sweet, lubricated, and fills only half the stomach and which is palatable and is eaten to please God.

कट्वाम्ललवणं तिक्तं भ्रिष्टं च दधितकम् । शाकोत्कटं तथा मद्यं तालं च पनसं तथा ।

घेरण्डसंहिता ५ । २३

kaṭvāmlalavaṇaṁ tiktāṁ bhriṣṭāṁ ca dadhitakam |śākotkaṭaṁ tathā madyaṁ tālaṁ ca
panasaṁ tathā |

gheraṇḍasaṁhitā|5|23

In the beginning of yoga practice, one should avoid bitter, sour, salty, pungent, burnt food; and curd, buttermilk, heavy vegetables, liquor, jackfruit.

नवनीतं घृतं क्षीरं गुडं शर्करादि चैक्ष्वमिम्बमसिवासवम् । द्राक्षाङ्गुलवनी धात्रीरसमाम्लवर्जितम् ।

घेरण्डसंहिता ५ । २७ ।

navanītam gḥṛtam kṣīram guḍam śarkarādi caikṣavamimbamasivāsavam
|drākṣāṅgulavanī dhātrīrasamāmlavarjitam |

gheraṇḍasamhitā 5|27|

Fresh butter, ghee, milk, sugar, sugarcane, jaggery, ripe plantain, coconut, pomegranate, grapes, *lavali*, *dhatri*, and juice that is not sour are to be consumed.

In a similar fashion, it is also said that health depends on food.

आरोग्यं भोजनाधीनम् । काश्यपसंहिता ।

ārogyam bhojanādhīnam |kāśyapasamhitā |

An ancient epic gives instruction as to how to eat. It says:

Solid food should fill half the stomach. Water or fluids should fill a quarter of the stomach. And the remaining quarter should be filled with air. This gives ideal space for digestion.

अन्नेन पूरयेदर्धतोयेन तु तृतीयकम् । उदरस्य तुरीयांशं संरक्षेत्वायुचारणम् ।

घेरण्डसंहिता । ५ । २२ ।

jaṭharam purayedardham annairbhāgam jalena ca |
annena pūrayedardhantoyena tu tṛṭiyakam | udarasya turīyāṁśam
samrakṣetvāyucāraṇam |

gheraṇḍasamhitā | 5 | 22 |

In the same line, *Gheranda Samhita* also says that half the stomach should be filled with food; and the other half, with water and air. It says that food eaten in the right quantity with proper timings will give health.

मितभोजनम् स्वास्थ्यम् । चरकसंहिता ।

mitabhojanam svāस्थ्यam | kālabhojanam | | carakasamhitā |

Charaka says food eaten at the right time gives health.

कालभोजनमारोग्यकरं श्रेष्ठम् ।चरकसंहिता

विनापि भेषज्यैर्व्याधिःपथ्यदेव विवर्तते । नतु पथ्यविहीनस्य भेषज्यानां शतैरपि ॥ माधवचिकित्सा ॥

vināpi bheṣajyairvyādhiḥpathyadeva vivartate | natu pathyavihīnasya bheṣajyānām
śatairapi || mādhavacikitsā ||

Even without using medicine, diseases can be cured with only right diet. But it is impossible to treat a disease with only medicine without correcting diet. This happens to be the essence of dietetics, which is an important branch of naturopathy.

Soil/Mud therapy

Soil is an important part of the *panchamahabhutas*. Soil therapy is mainly used in modern naturopathy. All types of physical and chemical elements and minerals are present in soil, hence external application of soil is good for health. *Atharvaveda* describes *valmika* soil with hemostatic properties, which can also treat acne. Mud therapy is found to be beneficial for several conditions. Mud, which is called *mrittika*, is said to have healing capacity, as cited in *Atharvaveda*.

Touch therapy

Many examples of touch therapy are found in the Vedas. It is similar to modern hypnotism and mesmerism. In this therapy, the therapist firstly assures the patient and explains to him the therapy, and then touches the diseased area, simultaneously chanting *mantras*.

Psychotherapy

It is an independent therapy; it is not dependent on drugs. This therapy improves the psychological state and willpower of the patient. Improved willpower of patients helps in self-healing of diseases. *Shiva sankalpa sukta* of *Yajurveda* describes the intrinsic power of the

human mind, which supports the principles of psychotherapy. This therapy emphasizes holistic thought and purity of *manas* (mind).

Mantra therapy (Chanting)

In this therapy, along with drugs, chanting of *mantras* is prescribed. Through chanting of *mantras*, micro sound waves are produced, which along with sun power and air enter the body and positively affect health.

Mani dharana therapy (Wearing ornaments)

For the treatment of diseases and to achieve different aims, this therapy includes wearing of *mani*. *Mani* is developed from medicinal elements, and its power is enhanced by chanting of *mantras*. Each *mani* was named on the basis of the source from which it originated; for example, *Udumbar mani* is produced from *Audumbar* (*Ficus glomerulata*). Different *mani*'s are used for the cure of different diseases; for example, *Anjana mani* is helpful in increasing lifespan of a human being and promoting peace in life. This *mani* cures diseases like jaundice, body ache, erysipelas, etc. *Udumbar mani* gives energy to human beings. Names of other *mani*'s are *Darbh mani*, *Parn mani*, *Pata mani*, *Asrit mani*, etc. They all have their own special functioning and effects.

Hygiene:

Hygiene or cleanliness of body and mind is a basic tenet of naturopathy. Reference to bodily and mental hygiene is found in plenty in the ancient scriptures.

अमृतम् वा आपः । अमृतस्यानन्तरितय् । नाप्सु मूत्रपुरीषम् कुर्यात् । न निष्ठीवेत् । न विवसन स्नायात् । ।

यजुर्वेदारण्यकम् । १ । ११२ ।

amṛtam vā āpaḥ | amṛtasyānantaritam | nāpsu mūtrapuriṣam kuryāt | na niṣṭhīvet | na
vivasana snāyāt | |

yajurvedāraṇyakam | 1 | 112 |

Do not urinate on water; do not spit on the road; do not bathe wearing only one piece of clothing; do not bathe without any clothes.

ग्रामावसथथीर्थाणां क्षेत्राणां चैव वर्त्मनि विण्मूत्रं नानुतिष्ठःएत न कृष्टे नच गोव्रजे ।आर्कण्डेयपुराणम् ॥

grāmāvasathathīrthāṇāṃ kṣetrāṇāṃ caiva vartmani viṇmūtraṃ nānutiṣṭheta na kṛṣṭe
naca govraje ।māarkaṇḍeyapurāṇam ।।

One should not defecate or urinate in the village, in places of pilgrimage, on the road, or in the cowshed.

उपानहौ च वासश्च धृतुमन्यैर्नधारयेत् ।उपवीतमलङ्कारं स्रजं करकमेव च ।

मनुस्मृतिः ।४ ।६६ ।

upānahau ca vāsaśca dhṛtumanyairnadhārayet ।upavītamalaṅkāraṃ srajaṃ
karakameva ca ।

manusmṛtiḥ ।4 ।66 ।

One should not share shoes, clothes, sacred thread, ornaments, necklace, and utensils. This instruction is given in order to prevent infection from spreading from one individual to another and to maintain personal hygiene.

क्लृप्तकेशनखष्मश्रुदन्तःशुक्लांबरःशुचिः ॥ नजीर्णमलवद्वासा भवेच्च विभवे सति ।

मनुस्मृति ।४ ।३५

klṛptakeśanakhaṣmaśrudantaḥśuklāmbaraḥśuciḥ ।। najirṇamalavadvāsā bhavecca
vibhavesati

manusmṛti ।4 ।35

One should cut hair and nails, shave one's beard, wear clean clothes, and refrain from wearing torn and dirty clothes.

सत्वशुद्धिसौमनस्यैकाग्रता इन्द्रिय जयात्मदर्शन योग्यत्वानि च

पातञ्जलयोगसूत्रम्-साधनापादः २।४१

satvaśuddhisāumanasyaikāgratā indriya jayāatmadarśana yogyatvāni ca

pātañjalayogasūtram-sāadhanāpādaḥ 2|41

If one practices cleanliness, one achieves mental purity, peace, concentration, victory over the senses, and liberation of the soul.

2.6 Conclusion

Thus from the above discussion, it can be concluded that references to naturopathy are found galore in the ancient scriptures of India. It is a system indigenous to India, much alike the Aryan race of the Indus Valley Civilization. The references given here prove that naturopathy in spirit originated in India much earlier than the European advent in the 18th and 19th century. The scriptures mentioned here date back to 3000-4000 B.C. and hence the antiquity of naturopathy is as old as the Vedas.

REVIEW OF SCIENTIFIC LITERATURE

3.1 History of Diabetes Mellitus

The ancient Hindus coined the term *honey urine* a thousand years before the Europeans recognized it in patients with diabetes. The Indian physician Sushruta described polyuria and glycosuria. He noted the attraction of flies and ants to the urine of those affected by this ailment. He describes diabetes (*madhumeha*) as a disease characterized by passage of large amount of urine sweet in taste, hence the name *madhumeha* — honey-like urine. He also said that diabetes primarily affects obese people and those who are sedentary and emphasized the role of physical activity in eliminating diabetes.¹⁰⁴

3.1.1 Definition of Diabetes Mellitus

Diabetes mellitus is a metabolic syndrome, clinically characterized by polyuria, polyphagia, polydypsia, and glycosuria due to absolute or relative deficiency of hormone insulin (caused by either defective action or defective secretion or both, resulting in type 1 or non-insulin-dependent diabetes mellitus (NIDDM) respectively), which controls the metabolism of carbohydrate, protein, fat, and electrolytes.

Once regarded as a single disease entity, diabetes is now seen as a heterogeneous group of diseases characterized by a state of chronic hyperglycemia, resulting from a diversity of etiologies, environmental and genetic, acting jointly. The underlying cause of diabetes is the defective production or defective action of insulin, a hormone that controls glucose, fat, and amino acid metabolism.

Characteristically diabetes is a long-term disease with variable clinical manifestations and progression. Chronic hyperglycemia from whatever cause leads to a number of complications: cardiovascular, renal, neurological, ocular, and others such as recurrent infections.¹⁰⁵ Diabetes mellitus refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of diabetes mellitus exist and are caused by a complex interaction of genetic and environmental factors.

Depending on the etiology of diabetes mellitus, factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilization, and increased glucose production. The metabolic dysregulation associated with diabetes mellitus causes secondary pathophysiologic changes in multiple organ systems, which imposes a tremendous burden on the individual with diabetes and on the healthcare system.¹⁰⁶

3.1.2 Epidemiology in India:

Figure 1: Number of Diabetic Subjects in India¹⁰⁷⁻¹⁰⁸

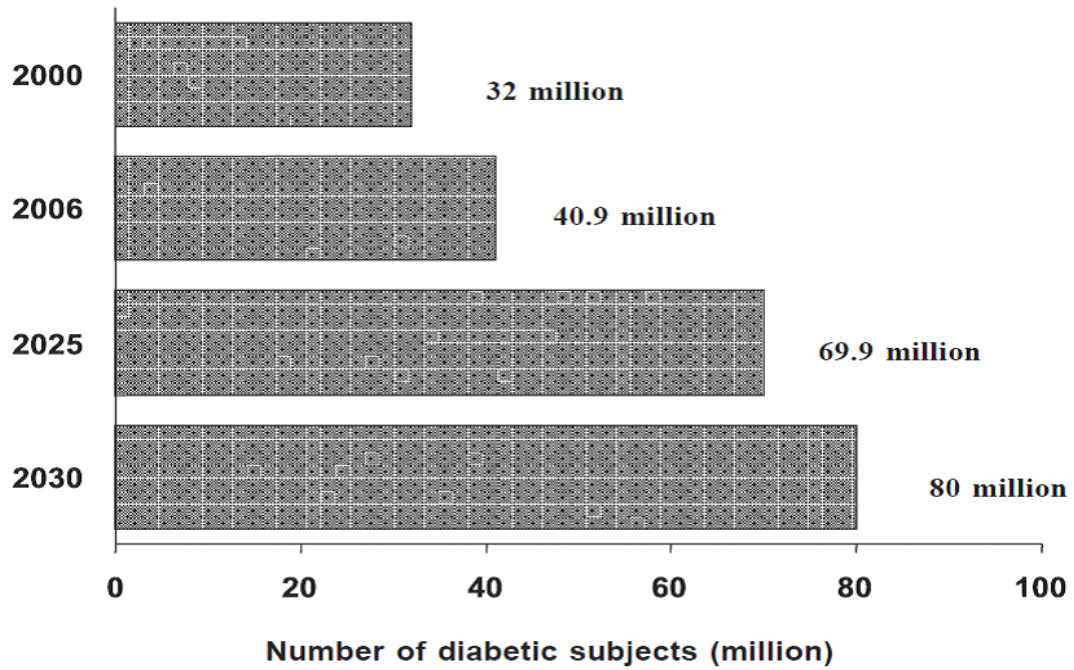
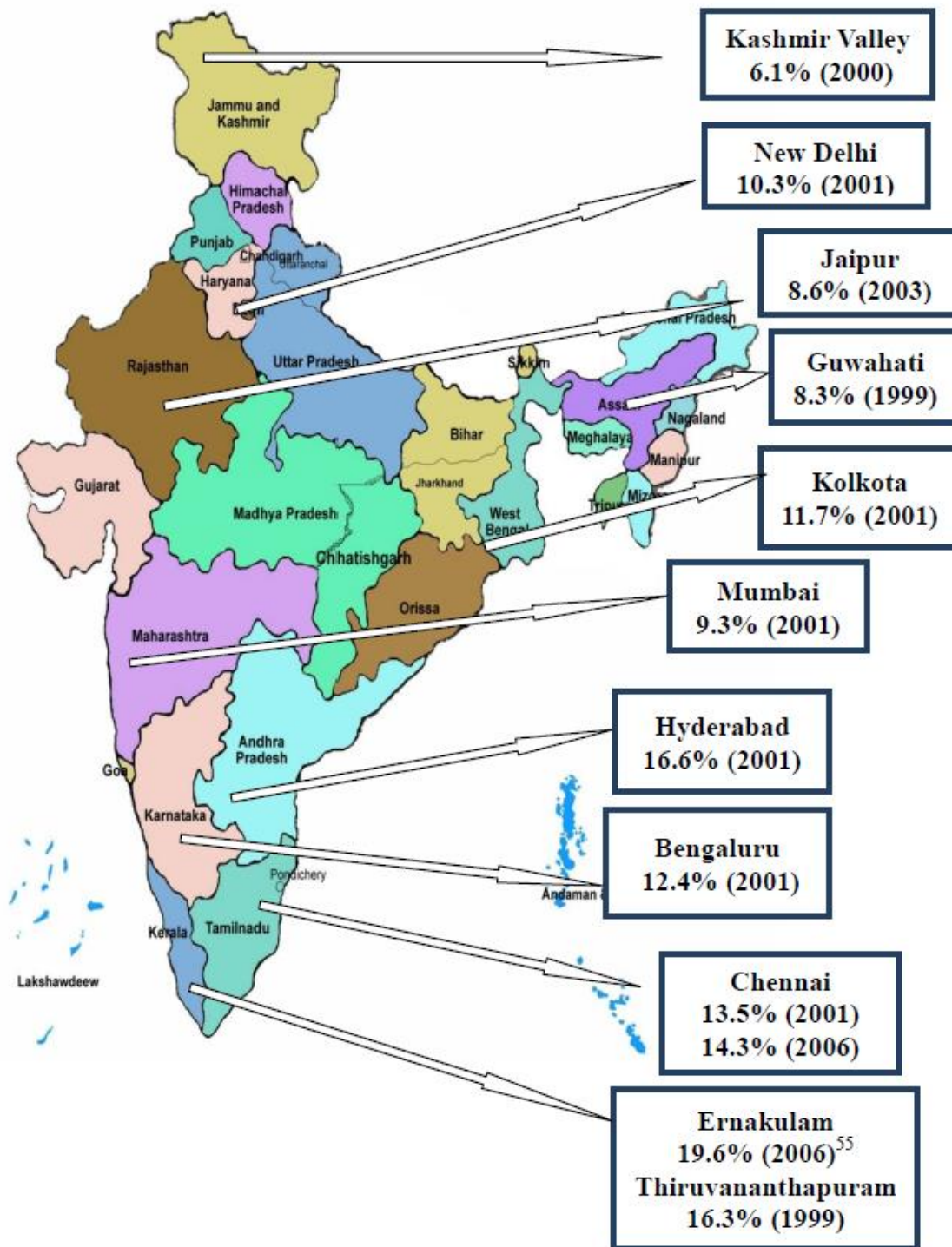


Fig. 1. Estimated number of diabetic subjects in India.

Number of Diabetic Subjects in Millions

Figure 2: Recent population based studies showing the prevalence of type2 diabetes in different parts of India¹⁰⁹⁻¹¹⁴



3.1.2 Classification

Diabetes mellitus is classified on the basis of the pathogenic process that leads to hyperglycemia, as opposed to earlier criteria such as age at onset or type of therapy. The two broad categories of diabetes mellitus are designated insulin-dependent diabetes mellitus and non-insulin-dependent diabetes mellitus. Both types of diabetes are preceded by a phase of abnormal glucose homeostasis as the pathogenic processes progress. Insulin-dependent diabetes mellitus is the result of complete or near-total insulin deficiency. NIDDM is a heterogeneous group of disorders characterized by variable degrees of insulin resistance, impaired insulin secretion, and increased glucose production.

Distinct genetic and metabolic defects in insulin action and/or secretion give rise to the common phenotype of hyperglycemia in NIDDM and have important potential therapeutic implications, now that pharmacologic agents are available to target specific metabolic derangements. NIDDM is preceded by a period of abnormal glucose homeostasis classified as impaired fasting glucose (IFG) or impaired glucose tolerance (IGT).⁷²

Table 2: Spectrum of Glucose Homeostasis and Diabetes Mellitus⁷²



Type of Diabetes	Normal glucose tolerance	Hyperglycemia				
		Pre – diabetes		Diabetes Mellitus		
		Impaired fasting glucose or impaired glucose tolerance	Not insulin requiring	Insulin required for control	Insulin required for survival	
ID Mellitus						
NIDDM						

Table 3: Etiological Classification of Diabetes Mellitus¹¹⁵

<p>I. IDDM (cell destruction, usually leading to absolute insulin deficiency)</p> <p style="margin-left: 40px;">A. Immune-mediated</p> <p style="margin-left: 40px;">B. Idiopathic</p>
<p>II. NIDDM (may range from predominantly insulin resistant with relative insulin deficiency to a predominantly insulin secretory defect with insulin resistance)</p>
<p>III. Other specific types of diabetes mellitus</p>

A. Genetic defects of cell function characterized by mutations in:

1. Hepatocyte nuclear transcription factor (HNF)
2. Glucokinase
3. HNF-1
4. Insulin promoter factor-1 (IPF-1)
5. HNF-1
6. NeuroD1
7. Mitochondrial DNA
8. Subunits of ATP (adenosine triphosphate)-sensitive potassium channel

9. Pro-insulin or insulin conversion

B. Genetic defects in insulin action

1. Type A insulin resistance
2. Leprechaunism
3. Rabson-Mendenhall syndrome
4. Lipodystrophy syndrome

C. Diseases of the exocrine pancreas — pancreatitis, pancreatectomy, neoplasia, cystic

fibrosis, hemochromatosis, fibrocalculous pancreatopathy, mutations in carboxyl ester lipase
D. Endocrinopathies — acromegaly, Cushing’s syndrome, glucagonoma, pheochromocytoma, hyperthyroidism, somatostatinoma, aldosteronoma
E. Drug- or chemical-induced — Vacor, pentamidine, nicotinic acid, glucocorticoids, thyroid hormone, diazoxide, adrenergic agonists, thiazides, phenytoin, interferon, protease inhibitors, clozapine
F. Infections — congenital rubella, cytomegalovirus, Coxsackie virus
G. Uncommon forms of immune-mediated diabetes: “stiff-person” syndrome, anti-insulin receptor antibodies

Table 4: Comparison of IDDM and NIDDM¹¹⁶

FEATURES	IDDM	NIDDM
Onset	Sudden	Gradual
Age at onset	Mostly in children	Mostly in adults
Body habitus	Thin or normal	Often obese
Ketoacidosis	Common	Rare
Autoantibodies	Usually present	Absent
Endogenous insulin	Low or absent	Normal, decreased, or

		increased
Concordance in identical twins	50%	90%
Prevalence	~10%	~90%

Table 5: Signs and Symptoms¹¹⁷

Classical Symptoms	Other Symptoms Might Include
Polyphagia (frequently hungry)	Blurred vision
Polyuria (frequently urinating)	Fatigue
Polydypsia (frequently thirsty)	Weight loss
	Poor wound healing
	Dry mouth
	Dry or itchy skin
	Impotence (male)
	Recurrent

It is important to remember that not everyone with diabetes will have all these symptoms. In fact, many people with NIDDM may not have any of them.

Table 6: Diagnostic Criteria of Diabetes Mellitus

	Normal Glucose Tolerance	Pre-Diabetes	Diabetes Mellitus
FPG	<5.6 mmol/L (100 mg/dL)	5.6-6.9 mmol/L (100-125 mg/dL)	≥7.0 mmol/L (126 mg/dL)
PPPG	<7.8 mmol/L (140 mg/dL)	7.8-11.1 mmol/L (140-199 mg/dL)	≥11.1 mmol/L (200 mg/dL)

3.1.3 Screening

Widespread use of the FPG as a screening test for NIDDM is recommended because of the following reasons:

- (1) A large number of individuals who meet the current criteria for diabetes mellitus are asymptomatic and unaware that they have the disorder.
- (2) Epidemiologic studies suggest that NIDDM may be present for up to a decade before diagnosis.
- (3) As many as 50% of individuals with NIDDM have one or more diabetes-specific complications at the time of their diagnosis.
- (4) Treatment of NIDDM may favorably alter the natural history of diabetes mellitus.⁷²

The ADA recommends screening all individuals >45 years of age every 3 years and screening individuals at an earlier age if they are overweight [body mass index (BMI) >25 kg/m²] and have one additional risk factor for diabetes. In contrast to NIDDM, a long asymptomatic period of hyperglycemia is rare prior to the diagnosis of IDDM. A number of immunologic markers for IDDM are becoming available, but their routine use is discouraged pending the identification of clinically beneficial interventions for individuals at high risk for developing IDDM.

3.1.4 Pathogenesis

Insulin resistance and abnormal insulin secretion are central to the development of NIDDM. Although the primary defect is controversial, most studies support the view that insulin resistance precedes an insulin secretory defect but that diabetes develops only when insulin secretion becomes inadequate.⁷²

3.1.5 Genetic Considerations

NIDDM has a strong genetic component. The concordance of NIDDM in identical twins is between 70% and 90%. Individuals with a parent with NIDDM have an increased risk of diabetes; if both parents have NIDDM, the risk approaches 40%. Insulin resistance, as demonstrated by reduced glucose utilization in skeletal muscle, is present in many nondiabetic first-degree relatives of individuals with NIDDM.

The disease is polygenic and multifactorial since in addition to genetic susceptibility, environmental factors (such as obesity, nutrition, and physical activity) modulate the phenotype. The genes that predispose to NIDDM are incompletely identified, but recent genome-wide association studies have identified several genes that convey a relatively small risk for NIDDM.

Most prominent is a variant of the transcription factor 7-like 2 gene that has been associated with NIDDM in several populations and with impaired glucose tolerance in one population at high risk for diabetes. Genetic polymorphisms associated with NIDDM have also been found in the genes encoding the peroxisome proliferators-activated receptor, inward rectifying potassium channel expressed in beta cells, zinc transporter expressed in beta cells and calpain. The mechanisms by which these genetic alterations increase the susceptibility to NIDDM are not clear, but several are predicted to alter insulin secretion. Investigation using genome-wide scanning for polymorphisms associated with NIDDM is ongoing.

3.1.6 Pathophysiology

NIDDM is characterized by impaired insulin secretion, insulin resistance, excessive hepatic glucose production, and abnormal fat metabolism. Obesity, particularly visceral or central, is very common in NIDDM. In the early stages of the disorder, glucose tolerance remains near-normal, despite insulin resistance, because the pancreatic beta cells compensate by increasing insulin output. As insulin resistance and compensatory hyperinsulinemia progress, the pancreatic islets in certain individuals are unable to sustain the hyperinsulinemic state. IGT, characterized by elevations in postprandial glucose, then develops. A further decline in insulin secretion and an increase in hepatic glucose production lead to overt diabetes with fasting hyperglycemia. Ultimately, beta cell failure may ensue.

3.2 Obesity

3.2.1 Metabolic Abnormalities, Mainly of Obesity and Fat: Abnormal Muscle and Fat Metabolism

Insulin resistance, the decreased ability of insulin to act effectively on target tissues (especially muscle, liver, and fat), is a prominent feature of NIDDM and results from a combination of genetic susceptibility and obesity. Insulin resistance is relative, however, since supernormal levels of circulating insulin will normalize the plasma glucose. Insulin dose-response curves exhibit a rightward shift, indicating reduced sensitivity, and a reduced maximal response, indicating an overall decrease in maximum glucose utilization (30%-60% lower than in normal individuals). Insulin resistance impairs glucose utilization by insulin-sensitive tissues and increases hepatic glucose output; both effects contribute to hyperglycemia. Increased hepatic glucose output predominantly accounts for increased FPG levels, whereas decreased peripheral glucose usage results in postprandial hyperglycemia. In skeletal muscle, there is a greater impairment in non-oxidative glucose usage (glycogen formation) than in oxidative glucose metabolism through glycolysis. Glucose metabolism in insulin-independent tissues is not altered in NIDDM.

The precise molecular mechanism leading to insulin resistance in NIDDM has not been elucidated. Insulin receptor levels and tyrosine kinase activity in skeletal muscle are reduced, but these alterations are most likely secondary to hyperinsulinemia and are not a primary defect. Therefore, "postreceptor" defects in insulin-regulated phosphorylation/dephosphorylation may play a predominant role in insulin resistance. Other abnormalities include the accumulation of lipid within skeletal myocytes, which may impair mitochondrial oxidative phosphorylation and

reduce insulin-stimulated mitochondrial ATP production. Impaired fatty acid oxidation and lipid accumulation within skeletal myocytes may generate reactive oxygen species such as lipid peroxides. Of note, not all insulin signal transduction pathways are resistant to the effects of insulin (e.g., those controlling cell growth and differentiation using the mitogenic-activated protein kinase pathway). Consequently, hyperinsulinemia may increase the insulin action through these pathways, potentially accelerating diabetes-related conditions such as atherosclerosis. The obesity accompanying NIDDM, particularly in a central or visceral location, is thought to be part of the pathogenic process.

The increased adipocyte mass leads to increased levels of circulating free fatty acids and other fat cell products. For example, adipocytes secrete a number of biologic products (nonesterified free fatty acids, retinol-binding protein 4, leptin, and adiponectin). In addition to regulating body weight, appetite, and energy expenditure, adipokines also modulate insulin sensitivity.

The increased production of free fatty acids and some adipokines may cause insulin resistance in skeletal muscle and liver. For example, free fatty acids impair glucose utilization in skeletal muscle, promote glucose production by the liver, and impair beta cell function. In contrast, the production by adipocytes of adiponectin, an insulin-sensitizing peptide, is reduced in obesity, and this may contribute to hepatic insulin resistance. Adipocyte products and adipokines also produce an inflammatory state and may explain why markers of inflammation such as Interleukin-6 and C-reactive protein are often elevated in NIDDM. Inhibition of inflammatory signaling pathways such as the nuclear factor B pathway appears to reduce insulin resistance and improve hyperglycemia in animal models.

3.2.2 Risk Factors for NIDDM and Obesity

- Family history of diabetes (i.e., parent or sibling with NIDDM)
- Obesity (BMI ≥ 25 kg/m²)
- Habitual physical inactivity
- Race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
- Previously identified IFG or IGT
- History of delivery of baby >4 kg (>9 lb)
- Hypertension (blood pressure $\geq 140/90$ mmHg)
- cholesterol level ≥ 160 mg/dL (4.14 mmol/L) and/or a triglyceride level ≥ 150 mg/dL (1.67 mmol/L)
- Polycystic ovary syndrome or acanthosis nigricans
- History of vascular disease¹⁰⁶

Figure 3: Major Complications of NIDDM



3.2.3 Diabetes Mellitus and Naturopathy

A clinical outcome study has provided the first prospectively collected estimates of change in outcomes during and following the delivery of naturopathic care to people with NIDDM. Provision of ANC was associated with a variety of improvements in diabetes self-management, including increased self-monitoring of blood glucose, improved diet, increased physical activity, greater self-efficacy, improved mood, and reduced problem areas in diabetes. Glucose control also improved in the ANC cohort, while it remained unchanged in the usual-care cohort.⁸⁷ Another study provides a description of risk-factor changes that occur during long-term naturopathic care for NIDDM. Traditional clinical biomarkers HbA1c, systolic blood pressure, and diastolic blood pressure were improved, on an average, during the course of naturopathic care, with notable percentages of patients achieving improvements in all measures.⁴² A retrospective study suggests naturopathic medicine is a philosophy-based, whole medical system. This description of naturopathic care can serve other health professionals in their referral recommendations. Naturopathic care for diabetes at this representative academic facility remains mostly adjunctive, although physicians possess the training and skills necessary to participate as primary care providers. The naturopathic treatment approach frequently includes important dietary and lifestyle recommendations that are included even in the current medical treatment guidelines for diabetes, hypertension, and hyperlipidemia; however, there is scope for improvements in the naturopathic approach with regard to the precision of recommendations.⁴³ A study shows a naturopathic dietary approach to diabetes appears to be feasible to implement among NIDDM patients. The intervention may also improve self-management, glycemic control, and have influences in other domains of self-care behaviors. HbA1c improved by an average of 0.5%, which is clinically meaningful.⁵⁰

Also, diet and exercise are primary therapeutic options for management of diabetes. Dietary management should not only aim at achieving glycemic control but also normalize dyslipidemia. Smoking cessation reduces the risk of morbidity and mortality in coronary artery disease (CAD). Exercise improves the condition of a diabetic patient. Exercise includes yoga practices that play an important role in the prevention of type 2 diabetes.¹⁶⁴ A study suggests that a small lifestyle modification and stress management educational program can lead to remarkable improvement in subjective well-being scores of patients and can therefore make an appreciable contribution in primary prevention and management of lifestyle diseases.¹⁶⁵ Yoga has a positive short-term effect on multiple diabetes-related outcomes; however, long-term effects of yoga therapy on diabetes management remains unclear. The context of the social environment, including interpersonal relationships, community characteristics, and discrimination, influences the adoption and maintenance of health behaviors such as physical activity, which includes yoga practice.¹⁶⁶ Long-term yoga practice, for more than a year, is associated with increased insulin sensitivity and attenuates the negative relationship between body weight or waist circumference and insulin sensitivity.¹⁶⁷ One of the studies demonstrated the efficacy of *Hatha Yoga* exercise in improving fasting blood glucose, lipid profile, oxidative stress markers, and antioxidant status in patients with type 2 diabetes and suggests 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.¹⁶⁸ Daily yoga practices can decrease fasting blood glucose, blood glucose after meals, hemoglobin A1C, systolic and diastolic blood pressure, and also improve insulin resistance.¹⁶⁹ There has also been a dramatic increase in overall use of CAM in adults with diabetes; diabetes was not an independent predictor of overall use of CAM, and people with diabetes were more likely to use prayer and but

less likely to use herbs, yoga, or vitamins compared to persons without diabetes.¹⁷⁰ An investigation into the effects of practice of *yogasanas* revealed 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 the practice of *yogaasana*.¹⁷¹

3.2.4 Obesity and Naturopathy

World Health Organization defines overweight as BMI greater than or equal to 25 kg/m² and obesity as BMI greater than or equal to 30 kg/m².¹¹⁸ Obesity is considered a growing global epidemic, with an estimate of 1.5 billion adults aged 20 years and older to be overweight and over 200 million men and 300 million women, constituting approximately 10% of adults, were obese. Also, as per estimates in 2010, about 43 million children less than 5 years of age were overweight.¹¹⁹ Statistics suggest a steep increase in obesity incidence in low- and middle-income countries since 1980.¹²⁰

Obesity in India is becoming a serious threat with changing food habits and lifestyle, increasing morbidity and complications.¹²¹ As per the statistics of the National Family Health Survey-3 [NFHS-3]¹²² study, amongst the 15-49 years age group, 14.8% of women and 12.1% of men were overweight or obese, and 33% of women and 28.1% of men had BMI below normal levels NFHS-3.¹²³ The prevalence of obesity is higher amongst women than amongst men and is more prevalent in the states of Punjab (30%), Kerala (28%), and Delhi (26%), the states in India that are relatively richer compared to other states.¹²⁴ These prevalence ratios are expected to increase in NFHS-4 survey. In older adults, obesity exacerbates age-related decline in physical function, which causes frailty, impairs quality of life, and results in increases in hospitalization.¹²⁵⁻¹²⁸ Given the increasing prevalence of obesity and overweight, the most common phenotype may be the obese, disabled, older adult.¹²⁹

With an understanding that heredity plays an important role in influencing body weight, the recent upsurge in the increase of obesity incidence can also be attributed to the shift in diet towards energy-rich dense food rich in fat and sugars but low in vitamins and other

micronutrients, thereby drastically increasing the calorie intake 3. There are epidemiological ⁴¹ datasets indicating the increased risk of obesity incidence with chronic intake of fatty diet and frequent consumption of fast food.¹³⁰⁻¹³³

In association with high calorie intake, sedentary lifestyle is a major contributor to obesity. Prolonged working hours with shorter sleep duration and night shift working tend to cause uninhibited eating behavior trait, significantly increasing the risk of overeating and gaining weight¹⁰⁴. Studies have shown that, people consume excess food while watching television than while eating normally.¹³⁴⁻¹³⁷ The same behavior has been shown to have a direct association with increasing incidence of obesity and other metabolic disorders.¹³⁸⁻¹³⁹ National Health and Nutrition Examination Survey shows a close relationship between low levels of physical activity and weight gain in both men and women.¹⁴⁰⁻¹⁴¹

Suryanamaskara alone was effective in weight and physical fitness management and improving body flexibility as compared to Circuit training and Exercise Training.¹⁷² Supervised yoga and supervised walking favorably and similarly influence multiple outcomes in overweight and obese adults. However, yoga increased serum leptin levels, and walking reduced serum adiponectin levels.¹⁷³ The naturopathic philosophy of healing, including focus on treating the whole person and preventative care, suggests that it is ideally suited for the treatment and prevention of obesity.¹⁷⁴ Restorative yoga was found to be a feasible and acceptable intervention in overweight adults with metabolic syndrome.¹⁷⁵ Alkaline diet, higher intake of fruits and vegetables, and lower meat intake were related to more alkaline urine with a magnitude similar to that demonstrated by intervention studies.¹⁷⁶ Supplementation with a plant-based dietary product for at least seven days increases urinary pH, potentially increasing the alkalinity of the body.¹⁷⁷

4.0 AIM AND OBJECTIVES OF THE STUDY

4.1 Aim

- The present study was designed with the aim to study the effects of Yoga and Naturopathic treatment in patients with type 2 diabetes mellitus and obesity.

4.2 Objectives

The objectives of the present study were as follows.

4.2.1 Objectives of Our Study in Relation to Patients with Type 2 Diabetes Mellitus

- To study the influence of Yoga and Naturopathic treatment in patients with type 2 diabetes mellitus on -
 - Fasting blood glucose and
 - Postprandial blood glucose

4.2.2 Objectives of Our Study in Relation to Patients with Obesity

- To study the influence of naturopathic treatment in patients with obesity on -
 - Body mass index
 - Body composition
 - Lipid profile and
 - Urine pH

4.3 Rationale of the Study

There have been several studies on the treatment of diabetes and obesity using yoga, other physical exercises, caloric restrictions, herbal medicine, and other methods of complementary

and alternative systems of medicines; however, there is a lack of studies in evaluating the influence of naturopathic treatment in patients with diabetes mellitus and obesity. Hence the present study was designed to evaluate the influence of Naturopathic and Yoga treatment in patients with diabetes and obesity.

4.4 Hypothesis

We hypothesized that the treatment with Naturopathy- and Yoga-based interventions may lower fasting and postprandial blood glucose levels; and reduce body weight and improve blood pH in patients with diabetes and obesity respectively.

4.5 Relevance and Benefits of the Study

Diabetes and obesity are major public health problems and leading causes of cardiovascular diseases and other health impairments. Yoga and Naturopathy constitute a drugless system of treating and preventing diseases. Improvement in the disorders such as diabetes and obesity by using naturopathy and yogic treatments would help prevent their complications and development of other associated diseases such as hypertension and cardiovascular diseases.

5.0 SUBJECTS AND METHODS

There were four studies conducted under this doctoral work, which includes the studies conducted in patients with diabetes mellitus and obesity as follows:

- Effect of Yoga and Naturopathy treatment on type 2 diabetes mellitus.
- Yoga- and Naturopathy-Based Lifestyle Interventions in the Management of Obesity.
- Effect of Juice Fasting on urine pH: A controlled study.
- Short-Term Effect of “Lemon Juice with Honey” Fasting on Lipid Profile and Body Composition in Healthy Individuals.

Methodology of the research has been described under the following subheadings:

5.1. Participants

5.2. Design

5.3. Variables Studied

5.4. Intervention Used

5.1 Participants

5.1.1 Sample Size

- **Study 1:** A total of 100 subjects (both genders).
- **Study 2:** A total of 100 subjects (both genders) with an average age of 38.48 ± 10.86 years.
- **Study 3:** A total of 70 subjects (both genders) with ages in the range 19-21 years with a mean age of 20 ± 0.8 years.
- **Study 4:** A total of 50 subjects (both genders) with ages in the range 18-29 years.

5.1.2 Source of the Subjects

- **Studies 1 and 2:** Nature Cure and Yoga Therapy Hospital, Shanthivana, Dharmasthala.
- **Studies 3 and 4:** Residential college located in south India.

5.1.3 Inclusion Criteria

Study 1

- Subjects diagnosed with NIDDM who were on oral hypoglycemic drugs for the past two years.
- Above the age of 35 years and below the age of 85 years.
- Both genders were included.

Study 2

- Subjects with well-established diagnosis of obesity based on National Health and Nutrition Examination Survey (NHANES).
- Young adults in the age group 21-35 years who were moderately to severely obese (≥ 30 BMI ≤ 45).
- Those who gave written consent form and expressed willingness to participate in the study.

Study 3

- Age range 18-29 years.
- Healthy volunteers who willingly accepted to fast.

Study 4

- Age range 18-29 years.
- Healthy volunteers who willingly accepted to fast.

5.1.4 Exclusion Criteria

Study 1

- Uncontrolled NIDDM
- NIDDM patients who were on insulin therapy.
- Diabetes associated with systemic complications.

- Those who did not submit written consent forms.

Study 2

- Subjects were excluded if severely obese (BMI ≥ 45) or if unable to perform yoga and physical activity.
- Obesity associated with systemic complications, epilepsy, any psychological conditions and with any other co-morbid medical conditions.
- Individuals on weight loss medications.
- Significant behavioral problems.

Study 3

- Obesity associated with systemic complications, epilepsy, any psychological conditions and with any other co-morbid medical conditions.
- Individuals on weight loss medications.
- Significant behavioral problems.

Study 4

- Obesity associated with systemic complications, epilepsy, any psychological conditions and with any other co-morbid medical conditions.
- Individuals on weight loss medications.
- Significant behavioral problems.

Ethical consideration

Protocols for all the four studies were approved by the institutional ethics committee, and written informed consent was obtained from all the subjects.

5.2 Design of the Study

Study 1

The study adopted a pre-post design. The institutional ethical committee approval was obtained for conducting the study. Subjects were assessed on Day 1 and Day 10, during which they practiced yoga, and received naturopathic treatment and diet therapy.

Study 2

The study adopted a pre-post design. The institutional ethical committee approval was obtained for conducting the study. Subjects were assessed on Day 1 and Day 10, during which they practiced yoga and received naturopathic treatment and diet therapy.

Study 3

We executed a matched controlled design comprising two groups, carrying out pre-post assessments using the pH meter to test urine pH daily during Naturopathy Fasting Therapy (NF) for the fasting group and, similarly, daily for control group.

Study 4

This is a single group pre and post comparative study in which baseline assessments were done ($n=50$) before intervention. Forty-four subjects completed the study and contributed to the

second assessment after four days of intervention. The reason for dropouts in the study group ($n=6$) were unwillingness to continue fasting due to personal problems ($n=5$) and abdominal pain ($n=1$).

5.3 Variables Studied

Study 1

The primary outcome measures were fasting blood glucose (FBG) and postprandial blood glucose (PPBG).

Fasting Blood Glucose

This test requires at least eight hours of fasting, and is usually done in early mornings. A suitable vein is identified and a tourniquet applied to distend the vein for puncture. The skin over the vein is antiseptically cleaned. A sterile needle and syringe are used to draw about 10 mL of blood from the vein; and the tourniquet is removed, the needle withdrawn, and the puncture site compressed for a few minutes and then covered with a clean dressing. The blood sample is used for analysis.

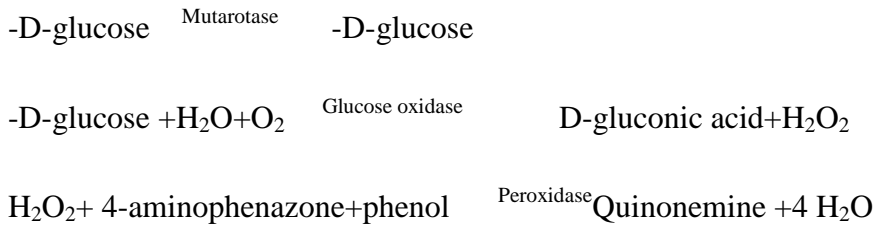
Postprandial Blood Glucose

After two hours of meal a suitable vein is identified, and a tourniquet applied to distend the vein for puncture. The skin over the vein is antiseptically cleaned. A sterile needle and syringe are used to draw about 10 mL of blood from the vein, the tourniquet is removed, the needle is withdrawn, and the puncture site is compressed for a few minutes and then covered with a clean dressing. The blood sample is used for analysis.

Estimation of FBG and PPBG through GOD-POD Test Method

Glucose oxidase (GOD) catalyses the oxidation of glucose to gluconic acid. The formed hydrogen peroxide (H₂O₂) is detected by a chromogenic oxygen acceptor, phenol-aminophenazone in the presence of peroxidase (POD).¹⁴²

Test Principle (Trinder's method)



The intensity of the color formed is proportional to the glucose concentration in the sample.

Test Procedure

1. Assay conditions

Wavelength: 505 nm (490-550)

Cuvette: 1 cm light path

Temperature 37°C / 15-25°C

2. Adjust the instrument to zero with distilled water.

3. Pipette into a cuvette:

	Blank	Standard	Sample
WR (mL)	1.0	1.0	1.0
Standard (μL)	--	10	--
Sample (μL)	--	--	10

4. Mix and incubate for 10 min at 37°C or 15-20 min at room temperature (15-25°C).

5. Read the absorbance (A) of the samples and standard, against the Blank. The color is stable for at least 30 minutes.

Calculations

(A) Sample x 100 (standard conc.) = mg/dL glucose in the sample.

(A) Standard conversion factor: mg/dL x 0.0555= mmol/L.

Normal Range: Blood glucose... Fasting = 70-110 mg/dL and Postprandial = 110-140 mg/dL

Study 2

Body Mass Index

BMI is the primary measure of overweight, defined as weight in kilograms divided by height in meters square. BMI was calculated from self-reported data on height and weight. $\text{BMI} = \text{Weight (kg)} / \text{Height (m}^2\text{)}$

Body Composition

To assess the body composition, the TANITA body composition analyzer was used. The subject was made to stand on the TANITA body composition analyzer instrument by connecting through the use of eight polar electrodes. Different measures related to body composition were displayed, and the same was recorded for further analysis.

Lipid Profile

This test was done in early mornings. A suitable vein is identified, and a tourniquet applied to distend the vein for puncture. The skin over the vein is antiseptically cleaned. A sterile needle and syringe are used to draw about 10 mL of blood from the vein, the tourniquet is removed, the needle is withdrawn, and the puncture site is compressed for a few minutes and then covered with a clean dressing. The blood sample is used for analysis.

Study 3

We assessed urine pH using pH meter. Subjects were provided with 20 mL urine sample bottles, in which they collected, first void midstream urine every morning and handed them over. The samples were then taken to the biochemistry lab for analysis.

A pH meter that was calibrated to pH 5 was used. The electrode was completely dipped in each sample and the meter was switched on, the reading displayed being taken as accurate to one significant figure. After analysis of each sample, the meter was switched off and the electrode thoroughly washed and wiped before analysis of the next sample.

Study 4

Assessments were done before and after four days of intervention. Body composition was measured by the method of bio-electrical impedance analysis with the use of TANITA body

composition analyzer SC-330 (Japan), which is an automatic instrument. TANITA analyzer is used to measure body composition, especially when monitoring modest changes in fat.¹⁵⁰ The measurement was taken by asking the subjects to stand barefoot, erect on the foot plate of the analyzer. Total serum triglyceride and total serum cholesterol were measured by an institutionally qualified and well-experienced technician with the use of BA-4545 semiautomatic biochemistry analyzer (India).

5.4 Intervention

Study 1

Lifestyle components adopted suiting the study period for Diabetes and Obesity

Table 7: Yoga-based Physical Activity

INTERVENTION	COMPONENTS
<p><i>Suryanamaskara</i></p> <p><i>(sun salutations)</i></p> <p>4 rounds</p>	<ul style="list-style-type: none"> • <i>Namaskarasana</i> • <i>Uttithapadasana Padahastasana</i> • <i>Ekapadasanchalanasana</i> • <i>Dwipadasanchalanasana</i> • <i>Shashankasana</i> • <i>Ashtangapanipadasana</i>

	<ul style="list-style-type: none"> • <i>Urdwamuka swanasana</i> • <i>Adhomukha swanasana</i> • <i>Ekapadasanchalanasana</i> • <i>Padahastasana</i> • <i>Uttithapadasana</i> • <i>Namaskarasana</i>
IRT (Instant Relaxation Technique)	
<i>Asanas</i>	
<i>Standing Asanas</i>	<ul style="list-style-type: none"> • <i>Trikonasana</i> • <i>Padahastasana</i> • <i>Ardha chakrasana</i> • <i>Ardha kati chakrasana</i>
<i>Supine Asanas</i>	<ul style="list-style-type: none"> • <i>Uttithapadasana</i>

	<ul style="list-style-type: none"> • <i>Pavana muktasana</i> • <i>Navasana</i> • <i>Shavasana</i>
QRT (Quick Relaxation Technique)	
<i>Prone Asanas</i>	<ul style="list-style-type: none"> • <i>Bhujangasana</i> • <i>Dhanurasana</i> • <i>Naukasana</i> • <i>Shalabasana</i>
<i>Sitting Asanas</i>	<ul style="list-style-type: none"> • <i>Vajrasana</i> • <i>Vakrasana</i> • <i>Ardha Matsyendrasana</i> • <i>Yoga mudrasana</i>
DRT (Deep Relaxation Technique)	

Table 8: Yoga-based Stress Management

<i>Pranayamas</i>	<ul style="list-style-type: none"> • <i>Nadishodhana</i> • <i>Suryabhedhana</i> • <i>Kapalabhati</i> • <i>Brahmari</i>
Meditation	<ul style="list-style-type: none"> • <i>Om</i> meditation

Table9: Naturopathy-based Diet Plan

TIMINGS	DIET REGIMEN
7:30 a.m.	Bitter gourd juice (200 mL)
9:00 a.m.	Ragi <i>ganji</i> (250 mL)
12:00 noon	<i>Khichdi</i> + boiled vegetables + buttermilk (50 mL) + papaya (200 g) + <i>methi</i> powder (1-2 tsp)
2:00 p.m.	<i>Knolkhol</i> juice (200 mL)
4:00 p.m.	Barley water (200 mL)
7:00 p.m.	2 <i>rotis</i> + boiled vegetables + papaya (200 g) + soup (150 mL) + <i>methi</i> powder (1-2 tsp)

9:00 p.m. (If necessary)	Fruit (Apple)
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Table 10: Naturopathy Treatments

TREATMENT MODALITIES	DURATION
Steam bath	10 min
Full body oil massage	45 min
Sauna bath	10 min
Underwater massage	10 min
Cold hip bath	20 min
Gastro-hepatic pack	20 min
Neutral immersion bath	20 min
Cold circular jet	20 min
Douche	20 min

Study 2

The participants recruited in the study were prescribed a balanced diet that provided an energy deficiency of 500 to 800 kcal (2100 to 3360 kJ) per day with regard to their daily energy requirement.¹⁴³ Apart from the dietary intervention, they were given yoga sessions comprising of physical postures (*asanas*) and voluntary breath regulation practices (*pranayama*) for a period of 60 min and 20 min respectively daily for 10 days and, also, naturopathic interventions comprising of steam bath and sauna bath to promote peripheral circulation¹⁴⁴ and metabolism; massage therapy was administered to promote relaxation and metabolism. All participants were advised to sunbathe (expose themselves to the sun) for 20 min in the morning hours (7:00 a.m.) to meet their vitamin D requirements.¹⁴⁵ Mud bath was given to participants; mud bath involves application of sun-dried, finely powdered clay from the river beds over the body. It is known to promote free electron transfer from the earth to the human body, thereby neutralizing free radicals and alleviating inflammation.¹⁴⁵ Cold water treatments were employed to activate the thermal centers of the body to stimulate heat production and increase the catabolic activity.¹⁴⁶

Study 3

The Naturopathic Fasting Therapy group subjects were provided with vegetarian diet on the first day; raw diet on the second day; fruit mono diet on the third day; lemon juice with honey on the fourth, fifth, sixth, and seventh days; grape juice on the eighth day; fruit mono diet on the ninth day; raw diet on the tenth day; and vegetarian diet on the eleventh day. The quantity of each feed of lemon juice with honey was 250 mL. Following is the diet schedule followed by the fasting therapy group:

Table 11: Diet Given to the Naturopathic Fasting Therapy Group

Day	Breakfast	Lunch	Evening Snack	Dinner
Day 1	Normal Vegetarian Breakfast	Normal Vegetarian Lunch	-	Normal Vegetarian Dinner
Day 2	Lemon Juice with Honey	Pineapple, Watermelon, Papaya, Banana, Tomato, Cucumber, Carrot, Onion	Lemon Juice with Honey	Pineapple, Watermelon, Papaya, Banana, Tomato, Cucumber, Carrot, Onion
Day 3	Lemon Juice with Honey	Watermelon	Lemon Juice with Honey	Watermelon
Day 4	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey
Day 5	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey
Day 6	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey
Day 7	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey
Day 8	Lemon Juice	Grape Juice	Lemon Juice	Grape Juice

	with Honey		with Honey	
Day 9	Lemon Juice with Honey	Watermelon	Lemon Juice with Honey	Watermelon
Day 10	Lemon Juice with Honey	Pineapple, Watermelon, Pomegranate, Papaya, Mango, Sapodilla, Banana, Tomato, Cucumber, Carrot, Onion	Lemon Juice with Honey	Pineapple, Watermelon, Pomegranate, Papaya, Mango, Sapodilla, Banana, Tomato, Cucumber, Carrot, Onion
Day 11	Khichdi [rice and <i>moong dal</i> porridge with minimal salt]	Banana, Tomato, Boiled Ashgourd and Spinach seasoned with a little salt, fennel seed powder, coriander seed powder, and grated coconut		Banana, Tomato, Boiled Ridge Gourd seasoned with a little salt, fennel seed powder, coriander seed powder, and grated coconut

Apart from these juices, the subjects were asked to drink a minimum of 2 liters of water daily, to ensure that they remained hydrated.

The subjects' daily schedule included the following:

- Enema with 300-500 mL pure water twice a day, every morning and evening.
- Yoga practice for an hour in the morning and an hour in the evening, consisting of light physical exercises and *asanas*, breathing practices and *pranayamas*, meditation and relaxation.
- Prayer session in the earlier part of every evening, with half an hour of *bhajans* and chants.

Study 4

To prepare the subjects for fasting, they were kept away from daily routine to avoid interference by thoughts and emotions.¹⁴⁷ Subjects received only 300 mL of lemon juice with honey (LJH, made out of half a lemon and a teaspoon of honey with 290 mL of water)¹⁴⁷ during each feed, 4 feeds a day (8-8:30 a.m., 11:30-12 noon, 3-3:30 p.m., and 6:30-7 p.m.) for 4 successive days of fasting. We used honey procured from the Western Ghats of Karnataka (Dharmasthala), which is a multifloral honey, dark yellow in color, and has a mixed flavor and aroma compared to unifloral honey. Its physicochemical analysis was as follows: pH = 3.48, Ash (%) = 0.60, Moisture (%) = 15.54, Acidity (mEq/kg) = 20.0, total sugar (%) = 75, protein (mg/g) = 0.80, phenol (mg/g) = 0.67, alkaloid (%) = 10.6. This honey has been reported to have good quality and can be used in traditional medicine.¹⁴⁸ Minimal physical activity, such as moderate walking, was maintained during fasting; excessive physical activities were avoided due to higher risk of hypoglycemia.¹⁴⁹ On day 5, the fast was broken with 300 mL of sweet lime juice (morning) followed by fruit diet (papaya 200 g) at afternoon, raw diet (sprouts 50 g, and raw vegetables 100 g and fruit salad 100 g) at night; and normal routine boiled diet from the next day.¹⁴⁷

6.0 COLLECTION ANALYSIS

Study 1

The present study was conducted to assess the efficacy of Naturopathy and Yoga in reducing fasting blood glucose levels and postprandial blood glucose values. The results were analyzed by using SPSS version 16.

Study 2

The statistical analysis was performed using SPSS version 16. Baseline characteristics were compared with the use of analysis of variance. Longitudinal changes were elucidated with the use of repeated measures analysis of variance, with adjustment for baseline values.

Study 3

Data was analyzed using IBM SPSS 20. The data was checked for normality and then the Student paired-samples *t* test was performed to investigate statistically significant differences within-group in urine pH of the fasting group and control group. For all analyses, we present 95% confidence intervals and considered $P < .05$ as significant.

Study 4

Data was statistically analyzed using SPSS version 16 (2007, USA). Descriptive analysis was done for demographic variables of the study group [both male and female ($n=44$)] and subgroups [male ($n=14$) and female ($n=30$)]. Student paired-samples *t* test was used to analyze baseline and post assessments of both — the study group and the subgroups. P value $< .05$ was considered as significant.

7.0 RESULTS

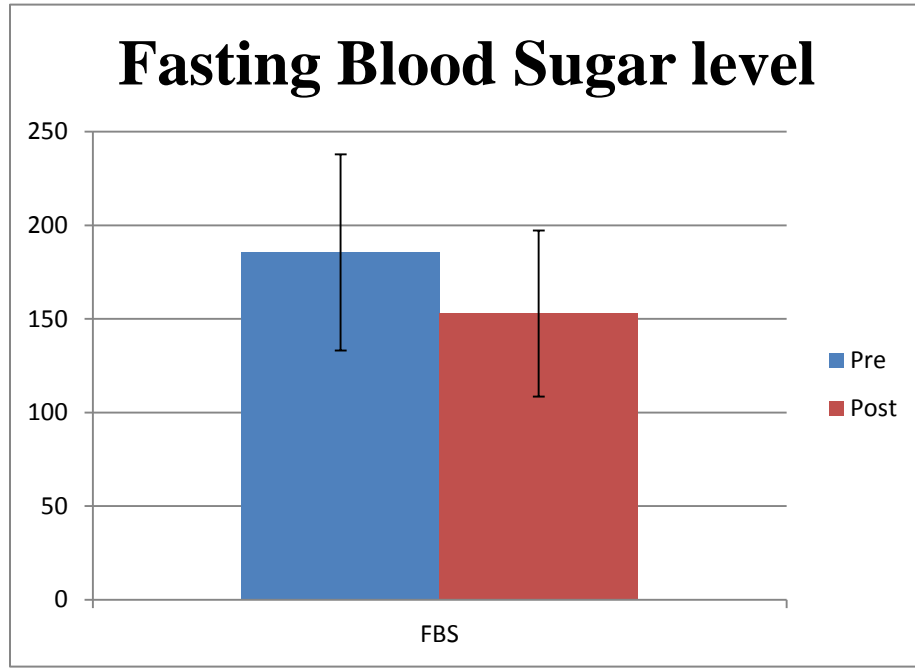
Study 1

The present study was conducted to assess the efficacy of Naturopathy and Yoga in reducing fasting blood glucose levels and postprandial blood glucose values. The alpha level of statistical significance was set at $P < .05$. Both FBG and PPBG levels showed significant reduction at the end of the intervention.

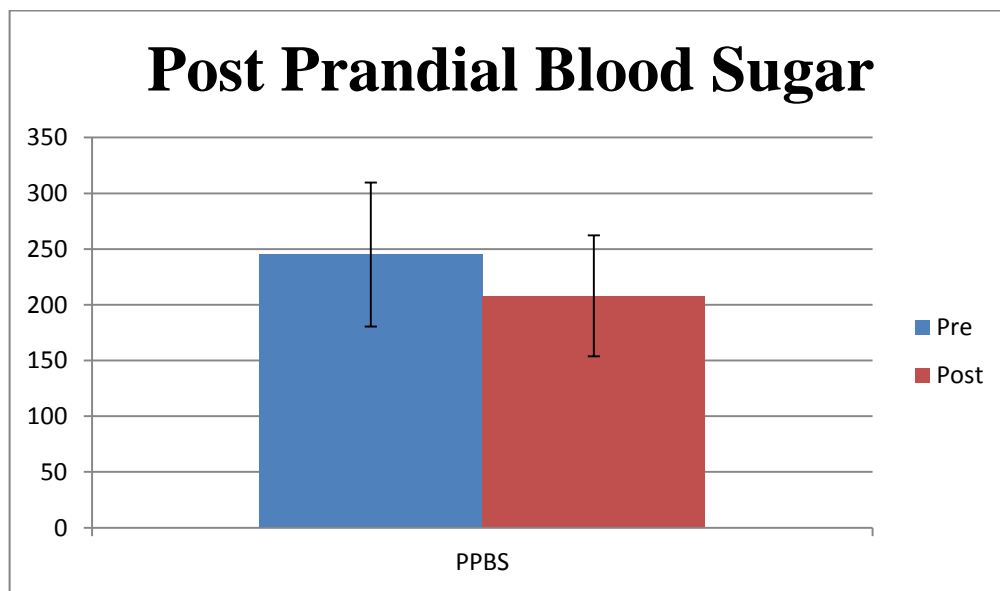
Table 12: Mean Pre-Post Values of FBG and PPBG

	PRE	POST	<i>P</i> value
FBG (mg/dL)	176.43±31.62	152.65±25.81 [#]	$P < .001$
PPBG (mg/dL)	246.96±44.84	204.14±33.41 [#]	$P < .001$

Graph 1: Mean pre-post intervention of FBG



Graph 2: Mean pre-post intervention of PPBG



Study 2

A total of 100 subjects were recruited and monitored. As the subjects were offered intervention in an inpatient setup, the attendance at all the sessions was complete (100%). There was no adverse effect observed throughout the duration of the study. A reduction of 3.77% in weight ($P < .001$), 4.02% in BMI ($P < .001$), 10.51% in total cholesterol ($P < .001$), 29.33% in serum triglycerides ($P < .001$), 7.97% in low-density lipoprotein (LDL) ($P < .001$), and 30.31% in very low density lipoprotein (VLDL) ($P < .001$) was observed following the 10-day nature cure lifestyle intervention. Also, a reduction of 2.75% in fat mass ($P < .001$), 4.72% in free fat mass ($P < .001$), 4.68% in muscle mass ($P < .001$), 4.28% in bone mass ($P < .001$), 4.54% in estimated BMR ($P < .001$), and 13.64% in estimated reduction in degree of obesity in participants when corrected for their BMI was observed. Interestingly there was a 1.55% increase in the fat indicated by the body composition. However, there were no changes in the HDL levels ($P < .001$) following the intervention.

Table 13: Mean \pm SD Values of the Variables Measured on Day 1 and Day 11

	Pre	Post	Significance	% difference
	Mean \pm SD	Mean \pm SD		
Height (m)	1.62 \pm 0.08			
Weight (kg)	79.48 \pm 13.41	76.54 \pm 12.88 [#]	$P < .001$	↓ 3.77%
Fat (%)	34.67 \pm 7.14	35.21 \pm 7.49	$P = .019$	↑ 1.55%

Fat Mass (kg)	27.97±8.80	27.21±8.63 [#]	<i>P</i> < .001	↓ 2.75%
Free Fat Mass (kg)	51.70±9.37	49.32±8.69 [#]	<i>P</i> < .001	↓ 4.72%
Muscle Mass (kg)	49.19±9.03	46.94±8.22 [#]	<i>P</i> < .001	↓ 4.68%
Total Cholesterol (mg/dL)	191.62±38.14	172.49±32.94 [#]	<i>P</i> < .001	↓ 10.51%
Serum Triglyceride (mg/dL)	171.86±70.61	127.90±52.76 [#]	<i>P</i> < .001	↓ 29.33%
HDL (mg/dL)	39.60±5.93	39.60±7.49	<i>P</i> = 1.00	↔ 0%
LDL (mg/dL)	114.99±37.58	106.18±32.40 [#]	<i>P</i> < .001	↓ 7.97%
VLDL (mg/dL)	35.60±15.49	26.23±10.81 [#]	<i>P</i> < .001	↓ 30.31%
Bone Mass	2.604±0.45	2.50±0.41 [#]	<i>P</i> < .001	↓ 4.28%
BMR	1573.91±268.77	1503.99±243.25 [#]	<i>P</i> < .001	↓ 4.54%
BMI (kg/m ²)	30.25±4.60	29.06±4.38 [#]	<i>P</i> < .001	↓ 4.02%
Degree of Obesity	37.39±20.64	32.62±20.01 [#]	<i>P</i> < .001	↓ 13.64%

* *P* < .01; ** *P* < .05; # *P* < .001

Study 3

Urine pH was significantly higher in the fasting group following the administration of Naturopathic Fasting Therapy (Student paired-samples *t* test, $t = -3.91$, $P < .05$). The control group (Normal Vegetarian Diet) showed no significant changes during the study period (Student paired-samples *t* test, $t = -0.62$).

Table 14: Means and Standard Deviations for Urine pH for Fasting and Control Groups

Groups	Pre	Post	<i>t</i> value	<i>P</i> value
Fasting Group (<i>n</i>=30)	5.24±0.36	5.48*±0.22	-3.91	.01
Control Group (<i>n</i>=30)	5.32±0.35	5.31±0.27	-0.62	0.73

* $P < .05$, Student paired-samples *t* test

Study 4

Of the 50 subjects, 44 successfully completed the study. Data assessments were done before and after intervention. Demographic variables were age in years [both genders (20.68±1.95), male (20.71±1.59), female (20.67±2.12)] and height in centimeters [both genders (162.43±8.45), male (171.79±6.74), female (158.07±4.86)]. Baseline assessments with post-test assessments of study group ($n=44$) and subgroup [male ($n=14$) and female ($n=30$)] are shown in Tables 1 and 2 respectively.

Our study showed significant reduction in weight, BMI, fat mass (FM), free fat mass (FFM), muscle mass (MM), total body water (TBW), and total serum triglycerides (TSTG) in the study group compared to baseline. In the subgroup analysis, significant reduction in weight, BMI, FM, FFM, MM, TBW, and TSTG in females was observed, which was similar to the study group;

whereas in males, significant reduction was observed only in weight, BMI, FFM, and MM. Reductions in fat % and total serum cholesterol (TSCH) were observed both in the study group and in the sub-groups compared to baseline, but none of the groups showed significant reduction.

Table 15: Baseline and Post Assessments of Study Group (n=44) (Student paired-samples *t* test)

Parameters	Baseline Assessment	Post Assessment	<i>t</i> value	<i>P</i> value
Weight (kg)	54.28±12.93	52.11±12.65	13.334	0**
BMI (kg/m ²)	20.46±3.57	19.64±3.54	11.749	0**
Fat (%)	17.26±8.30	16.69±8.97	1.565	.125
FM (kg)	9.93±7.46	9.33±7.84	2.999	.004*
FFM (kg)	44.35±7.68	42.78±7.30	6.337	.000**
MM (kg)	42.10±7.32	40.60±6.94	6.300	0**
TBW (kg)	31.16±6.08	30.09±6.05	5.758	0**
TSTG (mg/dL)	95.50±30.65	78.18±20.44	3.889	0**
TSCH (mg/dL)	147.77±24.91	143.07±23.63	1.646	.107

Note: All values are in mean average ± standard deviation. *= *P* < .01, **= *P* < .001

BMI= body mass index; FM= fat mass; FFM= free fat mass; MM= muscle mass; TBW= total body water; TSTG= total serum triglycerides; TSCH= total serum cholesterol.

Table 16: Baseline and Post Assessments of Study Group (Student paired-samples *t* test)

Parameter	Gender	Baseline Assessment	Post Assessment	<i>t</i> value	<i>P</i> value
Weight (kg)	Male	62.48±18.23	60.10±17.54	9.804	0****
	Female	50.47±7.17	48.39±7.35	9.852	0****
BMI (kg/m ²)	Male	21.09±5.22	20.30±5.02	10.290	0****
	Female	20.17±2.53	1.934±2.65	8.599	0****
Fat (%)	Male	12.80±8.73	11.58±10.36	1.211	.247
	Female	19.35±7.35	19.09±7.26	1.036	.309
FM (kg)	Male	9.35±11.03	8.54±12.11	1.413	.181
	Female	10.20±5.28	9.71±5.01	3.932	0****
FFM (kg)	Male	53.13±7.83	51.56±6.15	2.355	.035*
	Female	40.27±2.37	38.68±2.73	7.688	0****
MM (kg)	Male	50.45±7.46	48.94±5.86	2.388	.033*
	Female	38.20±2.25	36.71±2.60	7.506	0****
TBW (kg)	Male	38.14±6.08	37.32±5.30	1.620	.129
	Female	27.91±1.93	26.72±2.17	8.412	0****
TSTG (mg/dL)	Male	100.57±32.38	83.71±19.28	1.842	.088
	Female	93.13±30.08	75.60±20.76	3.465	.002**
TSCH (mg/dL)	Male	153.14±24.26	147.57±27.66	0.804	.436
	Female	145.27±25.22	140.97±21.70	1.551	.132

Note: All values are in mean average ± standard deviation. *= *P* < .05, **= *P* < .01, ***= *P* < .001. BMI= body mass index; FM= fat mass; FFM= free fat mass; MM= muscle mass; TBW= total body water; TSTG= total serum triglycerides; TSCH= total serum cholesterol.

8.0 DISCUSSION

8.1 Naturopathy and Yogic Lifestyle in Diabetes Mellitus

The study results show that FBG and PPBG have significantly reduced subsequent to the intervention. The Naturopathy and Yoga intervention facilitates better clinical outcomes in the management of type 2 diabetes mellitus.

Previous studies have shown decrease in the levels of FPG, PPPG, and HbA1c by the intervention of yoga, diet, and naturopathy. A clinical study has shown that naturopathic care provided to people with type 2 diabetes mellitus (T2DM) significantly improved glycemic control, increased self-monitoring of blood glucose, improved diet, increased physical activity, demonstrated greater self-efficacy, improved mood, and reduced problem areas in patients with diabetes.¹⁵¹ Another study demonstrated the positive changes in risk factors that occurred with long-term naturopathic care for T2DM, with notable percentages of patients achieving improvements in glucose levels as measured by HbA1c and blood pressure levels.¹⁵²

A retrospective study suggests naturopathic medicine is a philosophy-based complete medical system. This description of naturopathic care can serve other health professionals in their referral recommendations. Naturopathic care for diabetes at representative academic facility remains mostly adjunctive, although physicians possess the training and skills necessary to participate as primary care providers.

The naturopathic treatment approach frequently includes important dietary and lifestyle recommendations that are included even in the current medical treatment guidelines for diabetes, hypertension, and hyperlipidemia; however, there is scope for improvements in the naturopathic

approach with regard to the precision of recommendations.¹⁵³ Both the experimental and control groups showed improvement in type 2 diabetes mellitus.

The present study also demonstrated results similar to those of the previous study in that the naturopathy and Yoga interventions reduce both fasting blood glucose levels and postprandial glucose levels.

8.2 Naturopathy and Yogic Lifestyle in Obesity

A potential adverse effect of our interventions was the reductions in muscle mass and bone mass, which was also observed in other studies having exercise and diet as interventions. In order to combat the loss of bone mass as observed in the earlier studies, we had included sun bath in our intervention. However, the efficacy of sun bath in our study remains un-elucidated. The strengths of our study include a controlled design, comprehensive diet and Yoga programs with subjects having higher adherence rates and use of objective tools to measure physical functions and present metabolic status. Limitations of our study were that the subject recruitment was un-randomized, and there was lack of follow-up to verify if the obtained weight loss was maintained over a period of time.

The reductions in the LDL, VLDL, and total cholesterol levels in this study show grossly that the interventions should have a downstream effect in the alleviation of associated complications and progression of the disease. Also, we speculate that the observed effects might be mediated through leptin, currently believed to control body composition largely through hypothalamic receptors that regulate food intake and thermogenesis, which might have contributed to lowering triglyceride formation from free fatty acid and increasing free fatty acid

oxidation. However, further studies are warranted to evaluate the efficacy of the interventions in improving physical performance in obese individuals.

8.3 Fasting and Urine pH

In this study, we investigated whether ` Therapy is associated with any change in urine pH. We found that the fasting group demonstrated higher urine pH as compared to those eating a normal vegetarian diet for five days.

An index to predict the effect of a particular food on the acid-base balance in the body is PRAL (potential renal acid load), which is an indicator of the amount of diet-derived acid the kidneys have to dispose off. An estimate of PRAL based on consumption of four nutrients viz., proteins, phosphorous, potassium, and magnesium, gives a good estimate of net acid excretion.¹⁵⁴

Potential renal acid load during one day of lemon juice fasting

- $PRAL \text{ (mEq/d)} = 0.49 \times \text{protein (g/d)} + 0.037 \times P \text{ (mg/d)} - 0.021 \times K \text{ (mg/d)} - 0.026 \times Mg \text{ (mg/d)} - 0.013 \times Ca \text{ (mg/d)}$
- $PRAL \text{ (mEq/d)} = 0.49 \times 0.46 + 0.037 \times 6.89 - 0.021 \times 116.6 - 0.026 \times 5.21 - 0.013 \times 9.16$
- $PRAL \text{ (mEq/d)} = 0.23 + 0.25 - 2.45 - 0.14 - 0.12 = -2.28 \text{ mEq/day}$

A PRAL of -2.28 mEq/day indicates that the amount of acid that the kidneys have to dispose off will reduce, thereby reducing the acidity of, and increasing the pH of, urine and blood. On the other hand, there is one factor that would indicate a shift in urine pH towards acidity. During prolonged periods of starvation, there is an increase in protein catabolism, and the body utilizes increasing amounts of protein as an energy source. With an increase in the concentration of the products of protein breakdown in the blood, there could be a rise in the

acidity of the blood. However, there are juices provided during Naturopathic Fasting Therapy, which could prevent this protein utilization by providing a source of energy from simple sugars such as those present in fruits and honey. In order to understand the overall effect of this complex mechanism of acid-base balance, we looked at urine pH readings during the first eight days of the study till the last day of Naturopathic Fasting Therapy.

First void urine pH increased by 0.24 ± 0.49 pH units ($P < .05$), showing a trend towards alkalinity, in conformation with the PRAL of -2.28 mEq/day of the diet provided to the Naturopathic Fasting Therapy group. Net acid excretion, thus, reduced during an intervention of Naturopathic Fasting Therapy, showing that protein utilization did not significantly increase.

8.3.1 Conclusion

These findings suggest that a five-day Naturopathic Fasting Therapy regimen can lead to a reduction in acidity of the ECF in healthy individuals. Further studies are warranted in all age groups and conditions to ascertain this effect of Naturopathic Fasting Therapy.

8.4 Fasting and Body Composition and Lipid Profile

The results of our study showed significant reduction in weight, BMI, FM, FFM, MM, TBW, and TSTG in the study group compared to baseline. Significant reduction in weight and BMI could be attributed to reduction in FM and FFM during fasting. Reduction in weight could also be promoted by LJH due to its vitamin C content, which has been shown to have association with weight loss.¹⁵⁵

Reduction in FM (significant), fat (%) (insignificant), and TSTG (significant) compared to baseline indicates its utilization during fasting, because it is the major source of body's energy during food deprivation. This result could be attributed to the effect of fasting on plasma insulin

concentration, which has been reported to have an inverse correlation to antilipolytic activity in adipose tissue during fasting¹⁵⁶; to the effect of vitamin C, an essential factor for biosynthesis of carnitine, useful for subsequent fat oxidation by shuttling long chain fatty acids across the mitochondrial membrane¹⁵⁵; and to the effect of honey, which is lipid-lowering in normal and hyperlipidemic subjects.¹⁵⁷

Significant reduction in FFM, like in MM and TBW, indicates the utilization of muscle tissues and body fluids for energy requirement during the later phase of fasting, wherein normal food intake was restricted. Though normal food intake was restricted, none of the subjects reported any adverse effects except a few who reported mild tiredness and mild giddiness, which indicates the harmlessness of short-term lemon juice with honey fasting (LJHF) among healthy individuals.

TSCH reduced insignificantly compared to baseline, which indicates LJHF may be useful to maintain TSCH level. This result is supported by a previous study on administration of ascorbic acid to individuals with TSCH level <200 mg/dL, wherein it did not produce consistent effect.¹⁵⁸

Vitamin C accounted for 35%-75% of antioxidant power of food¹⁵⁹ and thus was shown to have protective effect on lipid-peroxide-induced endothelial injury¹⁶⁰ and oxidative damage, which are believed to play a key role in cardiovascular disease, cancer initiation, inflammatory diseases, neurologic disorders, and aging process in general.¹⁵⁹

In subgroup analysis, reduction in various parameters such as FM, TBW, and TSTG was observed in both genders but was significant only in females, indicating LJHF may be more beneficial to females than males in reducing FM and TSCH, which in turn may be useful for

prevention of major diseases such as obesity, hypertension, and other cardiovascular diseases. Previous studies on intake of vitamin C in American men and women appeared to benefit only women.^{160,161} A similar study among Finnish men and women showed that such intake was associated with a reduced risk of death from coronary heart diseases in Finnish women and not in Finnish men.^{160,162} These evidences support the result of our study that LJHF was more beneficial to females than males.

8.4.1 Conclusion

The results of our study suggest that four days of lemon juice with honey fasting may be considered as an effective and safe method to reduce body weight, BMI, FM, and TSTG in healthy individuals, especially in females, which may be useful in preventing obesity and hypertriglyceridemia.

9.0 APPRAISAL

9.1 Summary

The present studies were conducted to evaluate the influence of Naturopathy and Yoga on the blood glucose levels in type 2 diabetes patients. A total of 100 subjects were recruited for the study, selected based on the inclusion and exclusion criteria. Subjects were assessed for fasting plasma glucose, postprandial plasma glucose before and after 10 days of intervention. During this period, the experimental group received different naturopathic treatments twice a day along with yoga and prescribed diet. The results suggested that naturopathic treatment along with yoga and diet reduced significantly the levels of FPG and PPPG.

Another study on obesity recruited 100 obese adults of age 38.48 ± 10.86 years, both males and females, after getting a written informed consent. The participants were considered eligible for the study if their BMI was more than 30 kg/m^2 and if their weight was stable for the previous year without fluctuations of more than 2 kg as observed from their past medical records. All patients who had BMI of more than or equal to 45 kg/m^2 or were unable to perform any physical activity and yoga or were diagnosed with systemic complications like epilepsy, hypertension, and other psychological conditions or persons who were receiving drugs that affect bone health and metabolism or those who were current smokers were excluded.

The present studies suggest that the participants were able to make significant changes in their eating behaviors, following a naturopathic diet prescription and yoga practice as a regimen, along with naturopathic treatment, with corresponding improvements in NIDDM and obesity. Given the economic, social, and public health burden of NIDDM, along with its projected

increased prevalence worldwide, this study warrants a follow-up with a larger randomized controlled trial or comparative effectiveness trial.

9.2 Conclusion

All four studies showed significant changes in glucose levels, lipid changes, pH of the blood, and urine pH. The present study suggests that Naturopathic Treatment along with yoga and diet has reduced significantly the levels of FPG and PPPG. Addition of gastro-hepatic (GH) pack treatment (a part of naturopathic treatment), along with prescribed diet and yoga, augments the positive effects on type 2 diabetes. Even in case of GH pack, the application of heat on the anterior abdominal wall could result in increase in the muscle tissue blood oxygen saturation in the anterior abdominal region at the site of the hot bag application and also increase in the peripheral skin blood flow; and help in the utilization of plasma glucose from the bloodstream by periphery, which indirectly reduces the blood sugar levels in T2DM whereas insulin levels remain normal. A study on the usage of low-dose metformin showed that such usage significantly reduced hepatic glucose production in Japanese patients with type 2 diabetes mellitus. The efficacy of metformin in correcting fasting hyperglycemia was strongly associated with reduced hepatic glucose production. Gastro-hepatic pack is named so because it acts on the liver and stomach. The present results also suggest that naturopathic treatment in T2DM decreases FPG more than PPPG.

Another study on Naturopathy and Yogic Lifestyle in cases of obesity suggests that nature cure as a lifestyle intervention improves the obesity state of the individual and may potentially alleviate associated complications of obesity. The fasting study suggests naturopathy-based fasting therapy is useful for enhancing liver function and reducing weight among healthy individuals.

The reductions in the LDL, VLDL, and total cholesterol levels in this study show grossly that the interventions should have a downstream effect in the alleviation of associated complications and progression of the disease. Also, we speculate that the observed effects might be mediated through leptin, currently believed to control body composition largely through hypothalamic receptors that regulate food intake and thermogenesis, which might have contributed to lowering triglyceride formation from free fatty acid and increasing free fatty acid oxidation. However, further studies are warranted to evaluate the efficacy of the interventions in improving physical performance in obese individuals.

9.3 Limitations of the Study

Hormones like plasma insulin and norepinephrine, which are shown to play an important role in lipolysis in various studies,¹⁶³ or free fatty acid level to rule out increased lipolysis. Glycated hemoglobin was not used as a parameter in the diabetes study.

9.4 Strengths of the Study

Intervention is cost effective; and of short duration, which is easily acceptable, adaptable, and feasible to practice even at home. There were no serious adverse effects. It may be used as a preventive measure for most common public health problems such as obesity, hypertriglyceridemia, diabetes, etc.

9.5 Future Directions

Further studies (randomized control trials) are required with a large sample size and more parameters to warrant these effects and to evaluate the mechanism.

BIBLIOGRAPHY:

1. Action plan for global strategic for prevention and control of non-communicable diseases. WHO ;2008, Geneva
2. Reaven G.M: The metabolic syndrome: Requiescat in pace.Clin Chem 51:931–938, 2005
3. Vague J. Sexual differentiation, determinant factors of different forms of obesity. Presse Med 1947;30:339-40.
4. Avogadro A, Crepaldi G, Enzi G, Tiengo A. The association between dyslipidemia, Diabetic mellitus and moderate obesity. Acta Diabetol Lat 1967;4:572-590
5. Haller H. [Epidemiology and associated risk factors of hyperlipoproteinemia] (German). Z Gesamte Inn Med 1977;32(8):124-8.
6. Singer P. [Diagnosis of primary hyperlipoproteinemias] (German). Z Gesamte Inn Med 1977;32(9):129-33.
7. Reaven GM. Banting lecture 1988. Role of insulin resistance in human disease. Diabetes 1988; 37:1595-607.
8. Kahn R, Buse J, Ferrannini E, et al.The metabolic syndrome: Time for a critical appraisal: Joint statement from the American Diabetes Association and the European Association for the Study of Diabetes. Diabetes Care 28:2289–2304, 2005.

9. Expert Panel on the Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults: Executive summary of the third report of the National Cholesterol Education Program (NCEP) (Adult Treatment Panel III). *JAMA* 285:2486–2497, 200.
10. Wild S.H, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030 - Response to Rathman and Giani. *Diabetes Care* 2004; 27:2569.
11. Ervin R.B .Prevalence of metabolic syndrome and among, adults 20 years of age and over, by sex, age, race and ethnicity United States, 2003-2006.
12. Sattar N, Gaw A, Scherbakova O, Ford I, O'Reilly DS, Haffner SM, et al. Metabolic syndrome with and without C-reactive protein as a predictor of coronary heart disease and diabetes in the West of Scotland Coronary Prevention Study *Circulation Int J Epidemiol* 2003 29; 108(4):414-9.
13. Rennie KL, McCarthy N, Yazdgerdi S, Marmot M, Brunner E. Association of the metabolic syndrome with both vigorous and moderate physical activity. *Int J Epidemiol* 2003; 32:600-6.
14. Laaksonen DE, Lakka HM, Niskanen LK, Kaplan GA, Salonen JT, Lakka TA. Metabolic syndrome and development of diabetes mellitus: application and validation of recently suggested definitions of the metabolic syndrome in a prospective cohort study. *Am J Epidemiol* 2002; 156:1070-7.
15. Villegas R, Perry I.J, Creagh D, Hinchion R, O'Halloran D. Prevalence of the metabolic syndrome in middle-aged men and women. *Diabetes Care* 2003;26:3198

16. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. *JAMA* 2002 16;287:356-9
17. Ridker P.M, Buring J.E, Cook N.R, Rifai N. C-reactive protein, the metabolic syndrome, and risk of incident cardiovascular events: an 8-year follow-up of 14 719 initially healthy American women. *Circulation* 2003;107:391-7
18. Cameron A.J, Shaw J.E, Zimmet P.Z, et al. Comparison of metabolic syndrome definitions in the prediction of diabetes over 5 years in Mauritius. *Diabetologia* 2003;46:A145-A146
19. Holloszy JO, Schultz J, Kusnjerkiewicz J, Hagberg JM, Ehsani AA Effect of exercise on glucose tolerance and insulin resistance, Brief review and some preliminary result *Act Med Scand* 1986; suppl 711: 55-56.
20. Gupta A, Gupta R, Sarna M, Rastogi S, Gupta VP, Kothari K. Prevalence of diabetes, impaired fasting glucose and insulin resistance syndrome in an urban Indian population. *Diabetes Res Clin Pract* 2003;61:69-76
21. Lee W.Y, Park J.S, Noh S.Y, Rhee E.J, Kim S.W, Zimmet P.Z. Prevalence of the metabolic syndrome among 40,698 Korean metropolitan subjects. *Diabetes Res Clin Pract* 2004; 65:143-9.
22. Lohsoonthorn V, Dhanamun B, Williams M A. Prevalence of Metabolic syndrome & its relationship to white blood cell count in population of Thai men & women receiving routine health examinations. *Am J Hypertens* 2006; 19: 339-45.

23. Feng Y, Hong X, Li Z, Zhang W, Jin D, Li UX, Zhang Y, Hu FB, Wei LJ, Zang T, Xux. Prevalence of metabolic syndrome & its relation to body composition in a Chinese rural population obesity. *silver spring, med* 2006;2089-98.
24. Motala A, Mbanya JC, Ramaiya K, Metabolic Syndrome in Sub-Saharan Africa. *Ethn Dis.* 2009;Suppl 2:S2-8-S2-10).
25. Fezeu L, Balkau B, et al Metabolic syndrome in a Sub-Saharan Africa setting, central obesity may be the key determinant Atherosclerosis 2007; 193:70-76.
26. Makuyana D, Gomo Zar, Munyombwe T, Matenga JA, Hakim JG. Metabolic syndrome disorders in urban black Zimbabweans with type 2 Diabetes mellitus. *Cent Afr J Med.* 2004 Mar-Apr; 50(3-4):24-29.
27. Alebiosu Christopher Olutayo, Odusan B Olatunde. Metabolic syndrome in subjects with type-2 diabetes mellitus. *J Natl Med Assoc.* 2004 Jun; 96(6):817-821.
28. Njelekela MA, Negishi H, Nara Y, Sato T, Tomohiro M, Kuga S, Noguchi T, Kanda T, Yamori M, Mashalla Y, Liu L Jian, Ikeda K, Mtabaji J, Yamori Y. Obesity and lipid profiles in middle aged men and women in Tanzania. *East Afr Med J.* 2002;79:58-64.
29. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of Diabetes estimation for the year 2000 and projections for 2030. *Diabetes Care* 2004; 27(5):1047-53.

30. American Diabetes Association. Economic costs of diabetes in the U.S. in 2007. *Diabetes Care* 2008; 31:597.
31. Saydah SH, Fradkin J, Cowie CC. Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. *JAMA* 2004; 291:335–342.
32. Yeh GY, Eisenberg DM, Davis RB, Phillips RS. Use of complementary and alternative medicine among persons with diabetes mellitus: results of a national survey. *Am J Public Health* 2002; 92:1648– 1652.
33. Hogan P, Dall T, Nikolov P. American Diabetes Association. Economic costs of diabetes in the US in 2002. *Diabetes Care* 2003; 26:917–932.
34. Arora MM, Chander Y, Rai R. Diabetes Mellitus in India Y2K not ok. *Medical Journal Armed forces India* 2000; 56(1):1-2.
35. International Diabetes Federation. *Diabetes Atlas*. 5th Ed., Brussels, Belgium. International Diabetes Federation 2011.
36. Mohan V, Deepa M, Deepa R, Shanthirani CS, Farooq S, Ganesan A, Datta M. Secular trends in the prevalence of diabetes and impaired glucose tolerance in urban South India – the Chennai Urban Rural Epidemiology Study (CURES-17). *Diabetologia* 2006; 49:1175–1178.
37. Ramachandran A, Wan Ma RC, Snehalatha C. Diabetes in Asia. *Lancet* 2010; 375:408–418.
38. W.H.O Expert Committee on DM. Technical Report Series 646. Geneva 1980; 312.

39. Dodd AH, Colby MS, Boye KS, Fahlman C, Kim S, Briefel RR. Treatment approach and HbA1c control among US adults with type 2 diabetes. *Curr Med Res Opin* 2009; 25:1605–1613.
40. Atlanta GA. Department of Health and Human Services 2009. Chronic Disease Prevention and Health Promotion.
41. Haffner SM, Lehto S, Ronnema T, Pyorala K, Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. *N Engl J Med* 1999; 339:229–234.
42. Brun E, Nelson NG, Bennett PH, Imperatore G, Zoppini G, Verlato G. Diabetes duration and cause-specific mortality in the Verona Diabetes Study. *Diabetes Care* 2000; 23:1119–1123.
43. American Diabetes Association. Economic costs of diabetes in the U.S. in 2007. *Diabetes Care* 2008; 31(3):596–615.
44. Oppenheimer SM, Hoffbrand BI, Oswald GA, Yudkin JS. Diabetes mellitus and early mortality from stroke. *Br Med J (Clin Res Ed)* 1985; 291:1014–1015.
45. Kushner M, Nencini P, Reivich M, Rango M, Jamieson D, Fazekas F, Zimmerman R, Chawluk J, Alavi A, Alves W. Relation of hyperglycemia early in ischemic brain infarction to cerebral anatomy, metabolism, and clinical outcome. *Ann Neurol* 1990; 28:129–135.

46. Kiers L, Davis SM, Larkins R, Hopper J, Tress B, Rossiter SC, Carlin J, Ratnaike S. Stroke topography and outcome in relation to hyperglycaemia and diabetes. *J Neurol Neurosurg Psychiatry* 1992; 55:263–270.
47. The Diabetes Control and Complications Trial research group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 1993; 329:977–986.
48. Rajala U, Pajunpaa H, Koskela P, Keinanen-Kiukaanniemi S. High cardiovascular disease mortality in subjects with visual impairment caused by diabetic retinopathy. *Diabetes Care* 2000; 23:957–961.
49. Klein R, Klein BE, Moss SE, Cruickshanks KJ. Association of ocular disease and mortality in a diabetic population. *Arch Ophthalmol* 1999; 117:1487–1495.
50. Bradley R, Kozura E, Buckle H, Kaltunas J, Tais S, Standish LJ. Description of clinical risk factor changes during naturopathic care for type 2 diabetes. *J Altern Complement Med* 2009; 15:633–638.
51. Bradley R, Oberg EB. Naturopathic medicine and type 2 diabetes: a retrospective analysis from an academic clinic. *Altern Med Rev* 2006; 11:30–39.
52. Nahin RL, Dahlhamer JM, Taylor BL. Health behaviors and risk factors in those who use complementary and alternative medicine. *BMC Public Health* 2007; 7:217.

53. Sasagawa M, Martzen MR, Kelleher WJ, Wenner CA. Positive correlation between the use of complementary and alternative medicine and internal health locus of control. *Explore (NY)* 2008; 4:38–41.
54. Thorne S, Paterson B, Russell C, Schultz A. Complementary/alternative medicine in chronic illness as informed self-care decision making. *Int J Nurs Stud* 2002; 39:671–683.
55. Ellen seber. Stress management through Yoga. *International journal of yoga therapy* 2000; no; 10.
56. Bradley, R. et al. Observed Changes in Risk during Naturopathic Treatment of Hypertension. *Evid Based Complement Alternat Med* 2011; 826751.
57. Bradley R, Oberg EB. Naturopathic medicine and type 2 diabetes: a retrospective analysis from an academic clinic. *Altern Med Rev* 2006; 11(1):30–39.
58. Oberg EB, et al. CAM: Naturopathic dietary interventions for patients with Type 2 diabetes. *Complement Ther Clin Pract* 2011; 17(3):157–161.
59. Hawk C, Ndetan H, Evans MW. Potential role of complementary and alternative health care providers in chronic disease prevention and health promotion: An analysis of National Health Interview Survey data. *Prev Med* 2012; 51(1):18–22.
60. Donald Garrow, Leonard Egede E. Association between Complementary and Alternative Medicine Use, Preventive Care Practices, and Use of Conventional Medical Services among adults with diabetes. *Diabetes Care* 2006; 29(1):15–19.

61. Dept. of AYUSH, Govt. of India.
<http://indianmedicine.nic.in/index3.asp?sslid=187&subsublinkid=36&lang=1>.
62. Digiesi V, Cerchiai G, Mannini L, Masi F, Nassi F. Hemorheologic & blood cell changes in humans during partial immersion with a therapeutic method, in 38° C water. *Minerva Med* 1986; 77(30-31):1407-11.
63. Blazicková S, Rovenský J, Koska J, Vígás M. Effect of hyperthermic water bath on parameters on cellular immunity. *Int J Clin Pharmacol Res* 2000; 20(1-2):41-6.
64. Robiner WN. Psychological & physical reactions to whirlpool baths. *J Behav Med* 1990; 13(12):157-73.
65. Zhao S, Xie L, Hu H, Xia J, Zhang W, Ye N, Chen B. A study of neonatal swimming (water therapy) applied in clinical obstetrics. *J Matern Fetal Neonatal Med* 2005; 17(1):59-62.
66. Scott Nadler F, Kurt Weingand, Roger Kruse J. The Physiologic Basis and Clinical Applications of Cryotherapy and Thermotherapy for the Pain Practitioner. *Pain Physician* 2004; (7):395-399.
67. Yoshinao Nagashima, Michihito Igaki, Atsushi Suzuki, Shuichi Tsuchiya, Yoshimi Yamazaki, Michiko Hishinuma, Sachiko Oh-ishi, MasatakaMajima. Application of a Heat- and Steam-Generating Sheet Increases Peripheral Blood Flow and Induces Parasympathetic Predominance. *Evidence-Based Complementary and Alternative Medicine* 2011; (13):1-13.

68. Bugaj R. The cooling, analgesic, and rewarming effects of ice massage on localized skin. *Phys Therapy* 1975; 55(1):11–19.
69. Dolan MG, Thornton RM, Fish DR, Mendel FC. Effects of cold water immersion on edema formation after blunt injury to the hind limbs of rats. *J Athl Train* 1997; 32(3):233–237.
70. Drez D, Faust DC, Evans JP. Cryotherapy and nerve palsy. *Am J Sports Med* 1981; 9(4):256–257.
71. Hocutt JE, Jaffe R, Rylander CR, Beebe JK. Cryotherapy in ankle sprains. *Am J Sports Med* 1982; 10(5):316–319.
72. Halar EM, DeLisa JA, Brozovich FV. Nerve conduction velocity: relationship of skin, subcutaneous and intramuscular temperatures. *Arch Phys Med Rehabil.* 1980; 61(5):199–203.
73. World Health Organization, *Obesity: Preventing and Managing the Global Epidemic.* Geneva, Switzerland. 2000
74. World Health Organization. *Obesity and Overweight.* 2014 [Cited Sep 01] <http://www.who.int/mediacentre/factsheets/fs311/en/>.
75. Finucane MM, Stevens, GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, & Ezzati, M. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9· 1 million participants. *The Lancet.* 2011; 377(9765): 557-567.

76. DIaMoND J. Medicine: diabetes in India. *Nature*. 2011; 469(7331): 478-479.
77. NFHS-3: Key indicators for India from NFHS-3. Retrieved from <http://www.rchiips.org/nfhs/factsheet.shtml>, accessed on May 25, 2014.
78. Kalra S, and Unnikrishnan AG. Obesity in India: The weight of the nation. *JMNN*. 2012; 1(1): 37.
79. Kihara T, Biro S, Imamura M, Yoshifuku S, Takasaki K, Ikeda Y, et al. Repeated sauna treatment improves vascular endothelial and cardiac function in patients with chronic heart failure. *J Am Clin Car*. 2002; 39(5): 754-759.
80. Blaum CS, Xue QL, Michelon E, Semba RD, Fried LP. The association between obesity and the frailty syndrome in older women: the Women's Health and Aging Studies. *J Am Geriatr Soc*, 53(6), 927-934.
81. Elkins JS, Whitmer RA, Sidney S, Sorel M, Yaffe K, Johnston SC. Midlife Obesity and Long- Term Risk of Nursing Home Admission. *Obesity*. 2006; 14(8): 1472-1478.
82. Villareal DT, Banks M, Siener C, Sinacore DR, Klein S. Physical frailty and body composition in obese elderly men and women. *Obesity Res*. 2004; 12(6): 913-920.
83. Alley DE, Ferrucci L, Barbagallo M, Studenski SA, Harris TB. A research agenda: the changing relationship between body weight and health in aging. *J Gerontol A Biol Sci Med Sci*. 2008; 63(11): 1257-1259.
84. Wing RR. Changing diet and exercise behaviors in individuals at risk for weight gain. *Obesity Res*. 1995; 3(S2), 277s-282s.

85. Kestens Y, Daniel M. Social inequalities in food exposure around schools in an urban area. *Am J Prev Med.* 2010; 39(1), 33-40.
86. Gross LS, Li L, Ford ES, Liu S. Increased consumption of refined carbohydrates and the epidemic of type 2 diabetes in the United States: an ecologic assessment. *Am. J. Clin. Nutr.* 2004; 79(5), 774-779.
87. Malik VS, Popkin BM, Bray GA, Després JP, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation.* 2010; 121(11), 1356-1364.
88. Tremblay MS, Colley RC, Saunders TJ, Healy GN, Owen N. Physiological and health implications of a sedentary lifestyle. *Appl Physiol Nutr Metab.* 2010; 35(6), 725-740.
89. Chaput JP, Després JP, Bouchard, C, Tremblay A. The association between short sleep duration and weight gain is dependent on disinhibited eating behavior in adults. *Sleep.* 2011; 34(10), 1291.
90. Braude L, Stevenson RJ. Watching television while eating increases energy intake: Examining the mechanisms in female participants. *Appetite.* 2014;
91. Lazarou C, Soteriades ES. Children's physical activity, TV watching and obesity in Cyprus: the CYKIDS study. *Eur J Public Health.* 2010; 20(1), 70-77.
92. Thorp AA, Healy GN, Owen N, Salmon J, Ball K, Shaw JE, Dunstan DW. Deleterious Associations of Sitting Time and Television Viewing Time with Cardiometabolic Risk

- Biomarkers Australian Diabetes, Obesity and Lifestyle (AusDiab) study 2004–2005. *Diabetes care*. 2010; 33(2), 327-334.
93. Gupta, R., & Gupta, V. P. (2008). Obesity is major determinant of coronary risk factors in India: Jaipur Heart Watch studies. *Indian Heart J*, 60, 26-33.
94. Smith DE, Lewis CE, Caveny JL, Perkins LL, Burke GL, Bild DE. Longitudinal changes in adiposity associated with pregnancy: The CARDIA study. *JAMA*. 1994; 271(22), 1747-1751
95. Yaemsiri S, Slining MM, Agarwal SK. Perceived weight status, overweight diagnosis, and weight control among US adults: the NHANES 2003–2008 Study. *Int J Obes*. 2011; 35(8), 1063-1070.
96. Witham MD, Avenell A. Interventions to achieve long-term weight loss in obese older people: A systematic review and meta-analysis. *Age Ageing*. 2010; 39(2), 176-184.
97. Elia M. Obesity in the elderly. *Obesity Res*. 2001; 9(S11), 244S-248S.
98. Oxford Dictionary. Retrieved from <http://www.oxforddictionaries.com/definition/english/naturopathy>
99. Lindlahr H. *Nature Cure: Philosophy & Practice based on the Unity of Disease & Cure*. Chicago: The Nature Cure Publishing Company. 1922.

100. Das B, Bayat- Mokhtari R, Tsui M, Lotfi S, Tsuchida R, Felsher DW, Yeger H. HIF-2 α Suppresses p53 to Enhance the Stemness and Regenerative Potential of Human Embryonic Stem Cells. *Stem Cells*. 2012; 30(8), 1685-1695.
101. Varady KA, Hellerstein MK. Alternate-day fasting and chronic disease prevention: a review of human and animal trials. *Am. J. Clin. Nutr.* 2007; 86(1), 7-13.
102. Heilbronn LK, Ravussin E. Calorie restriction and aging: review of the literature and implications for studies in humans. *Am. J. Clin. Nutr.* 2003; 78(3), 361-369.
103. Hursting SD, Lavigne JA, Berrigan D, Perkins SN, Barrett JC. Calorie Restriction, Aging, and Cancer Prevention: Mechanisms of Action and Applicability to Humans*. *Annu Rev Med.* 2003; 54(1), 131-152.
104. Curl WW, Smith BP, Marr A, Rosencrance E, Holden M, Smith TL. The effect of contusion and cryotherapy on skeletal muscle microcirculation. *J Sports Med Phys Fitness* 1997; 37(4):279– 286.
105. Dwivedi G, Dwivedi S. Sushruta – the clinician – Teacher par Excellence. *Indian J Chest Dis Allied Sci* 2007; 49:243-244.
106. Park K. *Textbook of Preventive and Social Medicine*. 19th Edition, Banarasidas Bhanot Publishers 2007; 311.
107. Fauci, Braunwald, Kasper, Hauser, Longo, Jameson. *Harrison's Principles of Internal Medicine*. 17th Edition, McGraw Hill Medical Publishing Division.

108. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004; 27:1047-53.
109. Sicree R, Shaw J, Zimmet P. Diabetes and impaired glucose tolerance. *Diabetes Atlas*. International Diabetes Federation. 3rd ed. Belgium: International Diabetes Federation; 2006:15-103.
110. Raman Kutty V, Joseph A, Soman CR. High prevalence of type 2 diabetes in an urban settlement in Kerala, India. *Ethn Health* 1999; 4:231-9.
111. Shah SK, Saikia M, Burman NN, Snehalatha C, Ramachandran A. High prevalence of type 2 diabetes in urban population in north eastern India. *Int J Diabetes Dev Countries* 1999; 19:144-7.
112. Zargar AH, Khan AK, Masoodi SR, Laway BA, Wani AI, Bashir MI. Prevalence of type 2 diabetes mellitus and impaired glucose tolerance in the Kashmir Valley of the Indian subcontinent. *Diabetes Res Clin Pract* 2000; 47:135-6.
113. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das AK. Diabetes Epidemiology Study Group in India (DESI). High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia* 2001; 44:1094-101.
114. Menon VU, Kumar KV, Gilchrist A, Sugathan TN, Sundaram KR, Nair V. Prevalence of known and undetected diabetes and associated risk factors in central Kerala - ADEPS. *Diabetes Res Clin Pract* 2006; 74:289-94.

115. Mohan V, Deepa M, Deepa R, Shantirani CS, Farooq S, Ganesan A. Secular trends in the prevalence of diabetes and glucose tolerance in urban South India - the Chennai Urban Rural Epidemiology Study (CURES-17). *Diabetologia* 2006; 49:1175-8.
116. American Diabetic Association- 2007.
117. Williams's textbook of endocrinology. 12th Ed., Elsevier/Saunders, Philadelphia pp. 1371–1435.
118. Diabetic research centre – World Diabetes Foundation. Training module for Medical Officers.
119. Jindal SR. Nature Cure Treatments. 8th Revised Ed., Jindal Nature Cure Institute, Bengaluru 1998.
120. World Health Organization, Obesity: Preventing and Managing the Global Epidemic. Geneva, Switzerland. 2000.
121. World Health Organization. Obesity and Overweight. 2014 [Cited Sep 01] <http://www.who.int/mediacentre/factsheets/fs311/en/>.
122. Finucane MM, Stevens, GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, & Ezzati, M. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9• 1 million participants. *The Lancet*. 2011; 377(9765): 557-567.
123. DIaMoND J. Medicine: diabetes in India. *Nature*. 2011; 469(7331): 478-479.

124. Kalra S, and Unnikrishnan AG. Obesity in India: The weight of the nation. *JMNN*. 2012; 1(1): 37.
125. Kihara T, Biro S, Imamura M, Yoshifuku S, Takasaki K, Ikeda Y, et al. Repeated sauna treatment improves vascular endothelial and cardiac function in patients with chronic heart failure. *J Am Clin Car*. 2002; 39(5): 754-759.
126. Blaum CS, Xue QL, Michelon E, Semba RD, Fried LP. The association between obesity and the frailty syndrome in older women: the Women's Health and Aging Studies. *J Am Geriatr Soc*, 53(6), 927-934.
127. Elkins JS, Whitmer RA, Sidney S, Sorel M, Yaffe K, Johnston SC. Midlife Obesity and Long- Term Risk of Nursing Home Admission. *Obesity*. 2006; 14(8): 1472-1478.
128. Villareal DT, Banks M, Siener C, Sinacore DR, Klein S. Physical frailty and body composition in obese elderly men and women. *Obesity Res*. 2004; 12(6): 913-920.
129. Alley DE, Ferrucci L, Barbagallo M, Studenski SA, Harris TB. A research agenda: the changing relationship between body weight and health in aging. *J Gerontol A Biol Sci Med Sci*. 2008; 63(11): 1257- 1259.
130. Wing RR. Changing diet and exercise behaviors in individuals at risk for weight gain. *Obesity Res*. 1995; 3(S2), 277s-282s.
131. Kestens Y, Daniel M. Social inequalities in food exposure around schools in an urban area. *Am J Prev Med*. 2010; 39(1), 33-40.

132. Gross LS, Li L, Ford ES, Liu S. Increased consumption of refined carbohydrates and the epidemic of type 2 diabetes in the United States: an ecologic assessment. *Am. J. Clin. Nutr.* 2004; 79(5), 774-779.
133. Malik VS, Popkin BM, Bray GA, Després JP, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation.* 2010; 121(11), 1356-1364.
134. Tremblay MS, Colley RC, Saunders TJ, Healy GN, Owen N. Physiological and health implications of a sedentary lifestyle. *Appl Physiol Nutr Metab.* 2010; 35(6), 725-740.
135. Chaput JP, Després JP, Bouchard, C, Tremblay A. The association between short sleep duration and weight gain is dependent on disinhibited eating behavior in adults. *Sleep.* 2011; 34(10), 1291.
136. Braude L, Stevenson RJ. Watching television while eating increases energy intake: Examining the mechanisms in female participants. *Appetite.* 2014;
137. Lazarou C, Soteriades ES. Children's physical activity, TV watching and obesity in Cyprus: the CYKIDS study. *Eur J Public Health.* 2010; 20(1), 70-77.
138. Thorp AA, Healy GN, Owen N, Salmon J, Ball K, Shaw JE, Dunstan DW. Deleterious Associations of Sitting Time and Television Viewing Time with Cardiometabolic Risk Biomarkers Australian Diabetes, Obesity and Lifestyle (AusDiab) study 2004–2005. *Diabetes care.* 2010; 33(2), 327-334.

139. Gupta, R., & Gupta, V. P. (2008). Obesity is major determinant of coronary risk factors in India: Jaipur Heart Watch studies. *Indian Heart J*, 60, 26-33.
140. Smith DE, Lewis CE, Caveny JL, Perkins LL, Burke GL, Bild DE. Longitudinal changes in adiposity associated with pregnancy: The CARDIA study. *JAMA*. 1994; 271(22), 1747-1751.
141. Yaemsiri S, Slining MM, Agarwal SK. Perceived weight status, overweight diagnosis, and weight control among US adults: the NHANES 2003–2008 Study. *Int J Obes*. 2011; 35(8), 1063-1070.
142. Estimation of blood glucose. <https://uqu.edu.sa/.../Diagnostic%20Biochemistry>.
143. Tei C, Horikiri Y, Park JC, Jeong JW, Chang KS, Toyama Y, Tanaka N. Acute hemodynamic improvement by thermal vasodilation in congestive heart failure. *Circulation*. 1995; 91(10), 2582-2590.
144. Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. *Am. J. Clin. Nutr*. 2004; 80(6), 1678S-1688S.
145. Ober AC. Grounding the human body to earth reduces chronic inflammation and related chronic pain. *ESD Journal*. 2003; July.
146. Nadler SF, Weingand K, Kruse RJ. The physiologic basis and clinical applications of cryotherapy and thermotherapy for the pain practitioner. *Pain Physician*. 2004; 7(3), 395-400.

147. Naveen GH, Shetty P, Goutham MP, Ganesh PB, Chethan R, Sangram P. Effect of Naturopathic Based Fasting Therapy on Liver Enzymes, Electrolytes, Fasting Blood Glucose, Weight And Perceived Stress Among Healthy Individuals -A Randomized Controlled Trial. *Int J Yoga Allied Sci* 2014;3:10311.
148. Ramnath S, Venkataramegowda S. Physicochemical and Pollen Analysis of Western Ghats Honey of Karnataka, South India. *International Journal of Science and Nature*. 2012;3:831-5.
149. Al-Arouj M, Bouguerra R, Buse J, Hafez S, Hassanein M, Ibrahim MA, et al. Recommendations for management of diabetes during Ramadan. *Diabetes Care* 2005;28:2305-11.
150. [Wouters EJ](#), [Van Nunen AM](#), [Geenen R](#), [Kolotkin RL](#), [Vingerhoets AJ](#). Effects of Aquajogging in Obese Adults: A Pilot Study. *J Obes* 2010;2010:231074.
151. Ryan Bradley, Karen J Sherman, Sheryl Catz, Carlo Calabrese, Erica B Oberg, Luesa Jordan, Lou Grothaus, Dan Cherkin. Adjunctive naturopathic care for type 2 diabetes: patient-reported and clinical outcomes after one year. *BMC Complementary and Alternative Medicine* 2012;12:44.
152. Bradley R, Kozura E, Buckle H, Kaltunas J, Tais S, Standish LJ. Description of clinical risk factor changes during naturopathic care for type 2 diabetes. *J Altern Complement Med* 2009;15:633–638.
153. Bradley R, Oberg EB. Naturopathic medicine and type 2 diabetes: a retrospective analysis from an academic clinic. *Altern Med Rev* 2006;11:30–39.

154. Remer, T. & Manz, F. Potential renal acid load of foods and its influence on urine pH. *Journal of the American Dietetic Association* 95, 791–797 (1995).
155. Johnston CS. Strategies for healthy weight loss: from vitamin C to the glyceemic response. *J Am Coll Nutr* 2005;24:158-65.
156. Horowitz JF, Coppack SW, Paramore D, Cryer PE, Zhao G, Klein S. Effect of short-term fasting on lipid kinetics in lean and obese women. *Am J Physiol* 1999;276:E278-84.
157. Al-Waili NS. Natural honey lowers plasma glucose, C-reactive protein, homocysteine, and blood lipids in healthy, diabetic, and hyperlipidemic subjects: comparison with dextrose and sucrose. *J Med Food* 2004;7:100-7.
158. Simon JA, Hudes ES. Relation of serum ascorbic acid to serum lipids and lipoproteins in US adults. *J Am Coll Nutr* 1998;17:250-5.
159. Johnston CS, Dancho CL, Strong GM. Orange juice ingestion and supplemental vitamin C are equally effective at reducing plasma lipid peroxidation in healthy adult women. *J Am Coll Nutr* 2003;22:519-23.
160. Naidu KA. Vitamin C in human health and disease is still a mystery? An overview. *Nutr J* 2003;2:7.
161. Rimm EB, Stampfer MJ, Ascherio A, Giovannucci E, Colditz GA, Willett WC. Vitamin E consumption and the risk of coronary heart disease in men. *N Engl J Med* 1993;328:1450-6.

162. Knekt P, Reunanen A, Järvinen R, Seppänen R, Heliövaara M, Aromaa A. Antioxidant vitamin intake and coronary mortality in a longitudinal population study. [Am J Epidemiol](#) 1994;139:1180-9.
163. Horowitz JF, Coppack SW, Paramore D, Cryer PE, Zhao G, Klein S. Effect of short-term fasting on lipid kinetics in lean and obese women. *Am J Physiol* 1999;276:E278-84.
164. Sahay BK1, Sahay RK. Lifestyle modification in management of diabetes mellitus *J Indian Med Assoc.* 2002 Mar;100(3):178-80.
165. Sharma R1, Gupta N, Bijlani RL. Effect of yoga based lifestyle intervention on subjective well-being. *Indian J Physiol Pharmacol.* 2008 Apr-Jun;52(2):123-31.
166. Alexander GK1, Taylor AG, Innes KE, Kulbok P, Selfe TK. Contextualizing the effects of yoga therapy on diabetes management: a review of the social determinants of physical activity. *Fam Community Health.* 2008 Jul-Sep;31(3):228-39. doi: 10.1097/01.FCH.0000324480.40459.20.
167. Chaya MS1, Ramakrishnan G, Shastry S, Kishore RP, Nagendra H, Nagarathna R, Raj T, Thomas T, Vaz M, Kurpad AV. Insulin sensitivity and cardiac autonomic function in young male practitioners of yoga. *Natl Med J India.* 2008 Sept- Oct, 21(5) : 217- 21
168. Gordon LA1, Morrison EY, McGrowder DA, Young R, Fraser YT, Zamora EM, Alexander-Lindo RL, Irving RR. Effect of exercise therapy on lipid profile and oxidative stress indicators in patients with Type- 2 diabetes. *BMC Complement Altern Med.* 2008 May 12; 8 : 21
169. Butler C. Twisting without shouting. A gentle introduction to the joys of yoga *Diabetes Forecast.* 2008 Mar;61(3):30-4.

170. Garrow D1, Egede LE. National patterns and correlates of complementary and alternative medicine use in adults with diabetes. *J Altern Complement Med.* 2006 Nov;12(9):895-902.
171. Manjunatha S1, Vempati RP, Ghosh D, Bijlani RL. An investigation into the acute and long-term effects of selected yogic postures on fasting and postprandial glycemia and insulinemia in healthy young subjects. *Indian J Physiol Pharmacol.* 2005 Jul-Sep;49(3):319-24.
172. Jakhotia KA1, Shimpi AP1, Rairikar SA1, Mhendale P1, Hatekar R1, Shyam A2, Sancheti PK2. Suryanamaskar: An equivalent approach towards management of physical fitness in obese females. *Int J Yoga.* 2015 Jan;8(1):27-36. doi: 10.4103/0973-6131.146053.
173. Telles S1, Sharma SK1, Yadav A1, Singh N1, Balkrishna A1. A comparative controlled trial comparing the effects of yoga and walking for overweight and obese adults. *Med Sci Monit.* 2014 May 31;20:894-904. doi: 10.12659/MSM.889805.
174. Koithan M1, Sutherland E.. Naturopathic Treatment of Obesity. *J Nurse Pract.* 2009 Oct;5(9):693-694.
175. Cohen BE1, Chang AA, Grady D, Kanaya AM. Restorative yoga in adults with metabolic syndrome: a randomized, controlled pilot trial. *Metab Syndr Relat Disord.* 2008 Sep;6(3):223-9. doi: 10.1089/met.2008.0016.
176. Welch AA1, Mulligan A, Bingham SA, Khaw KT. Urine pH is an indicator of dietary acid-base load, fruit and vegetables and meat intakes: results from the European Prospective Investigation into Cancer and Nutrition (EPIC)-Norfolk population study. *Br J Nutr.* 2008 Jun;99(6):1335-43. Epub 2007 Nov 28.

177. Berardi JM1, Logan AC, Rao AV. Plant based dietary supplement increases urinary pH.

J Int Soc Sports Nutr. 2008 Nov 6;5:20. doi: 10.1186/1550-2783-5-20.

Appendix 1

Informed Consent form

Title of Project	:	Effect of Naturopathy & Yoga Intervention on Non-Insulin Dependent Diabetes Mellitus
Name of Researcher	:	Dr. Prashanth Shetty {Principal, SDMCNYS, Ujire. Email: sdmcnys@gmail.com , Cell phone: +919448252696}

I confirm that I have completely understood the research study - Effect of Naturopathy & Yoga Intervention on Non-Insulin Dependent Diabetes Mellitus explained by the researcher.

I have been invited to participate in research of 'Effect of Naturopathy & Yoga Intervention on Non-Insulin Dependent Diabetes Mellitus'. I understand that it will involve the practice of Naturopathy treatments, Yoga therapy and Naturopathy diet for the duration of ten days.

I am aware that there may be no benefit to me personally and that I will not be compensated whatsoever.

I have been provided with the name of a researcher who can be easily contacted using the telephone number and address, I was given for that person. I understood that I need to give 2 times blood samples (10 ml/time) for checking my pre and post Fasting plasma glucose and postprandial plasma glucose levels. I had the opportunity to ask questions about the research study and any questions that I have asked have been answered to my satisfaction.

I consent voluntarily to participate as a participant in this research and understand that I have the right to withdraw from the research at any time without my medical care or legal rights being affected in any way.

Name of Participant: _____

Date:

Signature:

Place:

I witness the accurate understanding of the consent form to the potential participant, and the individual had the opportunity to ask questions. I confirm that the individual has given consent freely.

Researcher:

Date:

Signature:

Place:

Informed Consent form

Title of Project	:	Effect of Naturopathy & Yoga Intervention on Obesity
Name of Researcher	:	Dr. Prashanth Shetty {Principal, SDMCNYS, Ujire. Email: sdmcnys@gmail.com , Cell phone: +919448252696}

.....

I confirm that I have completely understood the research study - Effect of Naturopathy & Yoga intervention on Obesity explained by the researcher.

I have been invited to participate in research of 'Effect of Naturopathy & Yoga intervention on Obesity'. I understand that it will involve the practice of Naturopathy treatments, Yoga therapy and Naturopathy diet for the duration of ten days.

I am aware that there may be no benefit to me personally and that I will not be compensated whatsoever.

I have been provided with the name of a researcher who can be easily contacted using the telephone number and address, I was given for that person. I understood that my Body composition will be checked by fat analyser machine and I need to give 2 times blood samples (10 ml/time) for checking my pre and post serum lipid levels. I had the opportunity to ask questions about the research study and any questions that I have asked have been answered to my satisfaction.

I consent voluntarily to participate as a participant in this research and understand that I have the right to withdraw from the research at any time without my medical care or legal rights being affected in any way.

Name of Participant: _____

Date:
Place:

Signature:

I witness the accurate understanding of the consent form to the potential participant, and the individual had the opportunity to ask questions. I confirm that the individual has given consent freely.

Researcher:

Date:
Place:

Signature:

Informed Consent form

Participant Identification Number: _____

Title of Project	:	Effect Of Juice Fasting On Urine pH: A Controlled Study
Researchers	:	Prashanth Shetty, Achyuthan Eswar, Rajkumari Roshni Raj Lakshmi, H.R.Nagendra, Balakrishna Shetty, Nithin and Suhas Vinchurkar

.....

Hereby, I confirm that I have understood the above study.

I have been invited to participate in the research of '*Effect Of Juice Fasting On Urine pH: A Controlled Study*'. I understand that it will involve the practice of juice fasting for the duration of 5 days.

I have been informed that urine pH will be tested every day during the study.

I am aware that there may be no benefit to me personally and that I will not be compensated whatsoever.

I have been provided with the name of a researcher who can be easily contacted using the telephone number and address I was given for that person.

I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction.

I consent voluntarily to participate as a participant in this research and understand that I have the right to withdraw from the research at any time without in any way affecting my medical care or legal rights.

.....

Name of Participant: _____

Date:

Signature:

.....

I have accurately read or witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely. A copy of this Informed Consent Form has been provided to the participant.

Researcher:

Date:

Signature:

Appendix 2

Raw Data of Fasting and Body Composition

SL. NO	AGE	SEX	HEIGHT	PREWEIGHT	POSTWEIGHT	PREBMI	POSTBMI	PREFATPERCENT	POSTFATPERCENT	PREFATMASS	POSTFATMASS	PREFREEFATMASS	POSTFREEFATMASS	PREMUSCLEMASS	POSTMUSCLEMASS	PRETOTALBODYWATER	POSTTOTALBODYWATER	PRETRIGLYCERIDES
1	20	M	177	70.1	67.6	22.4	21.6	14.8	14.8	10.4	10	59.7	57.6	56.7	54.7	41.5	39.8	8
2	19	M	170	60.6	58.1	21	20.1	10.7	11.3	6.5	6.6	54.1	51.5	51.4	48.9	39.1	36.8	13
3	18	F	159	47.3	44.6	18.7	17.6	13.2	14.1	6.2	6.3	41.1	38.3	39	36.3	28.4	26.3	8
4	24	F	150	42.8	41.2	19	18.3	13.8	13.7	5.9	5.6	36.9	35.6	35	33.8	25.1	24.1	6
5	20	F	153	44.2	42	18.9	17.9	13.3	13.6	5.9	5.7	38.3	36.3	36.3	34.4	26.3	24.8	12
6	20	F	154	47.2	46	19.9	19.4	19	17.5	9	8	38.2	38	36.2	36.1	26.3	26.1	6
7	20	F	157	48.4	47.2	19.6	19.1	17.7	17.6	8.6	8.3	39.8	38.9	37.8	36.9	27.5	26.8	7
8	19	M	163	61.3	58.9	23.1	22.2	15.2	16.4	9.3	9.7	52	49.2	49.4	46.7	38.1	36	16
9	21	M	174	61.4	58.8	20.3	19.4	10.4	8.7	6.4	5.1	55	53.7	52.2	51	39	38.3	13
10	20	F	151	50.8	49.3	22.3	21.6	22.1	23.4	11.2	11.5	39.6	37.8	37.6	35.9	27.5	26.1	11
11	21	F	159	52.5	49.9	20.8	19.7	26	25.1	13.6	12.5	38.9	37.4	36.9	35.5	27	25.8	4
12	20	F	158	43.1	42.9	17.2	17.1	6.5	5.3	2.8	2.3	40.3	40.6	38.2	38.5	27.6	27.9	5
13	21	M	164	54	51.9	20.1	19.3	11.5	10.9	6.2	5.7	47.8	46.2	45.4	43.8	34.9	33.6	8
14	20	M	176	51.2	49.3	16.5	15.9	3.9	3.2	2	1.6	49.2	47.7	46.7	45.3	35	33.5	7
15	20	F	161	40.8	39.4	15.7	15.2	10.2	10.7	4.2	4.2	36.6	35.2	34.7	33.4	25	23.9	6
16	23	M	163	68.5	66.1	25.8	24.9	21.6	22.2	14.8	14.7	53.7	51.4	51	48.8	39.3	37.7	14
17	21	M	172	55.9	52.4	18.9	17.7	5.3	3.4	3	1.8	52.9	50.6	50.2	48	36.7	35.3	7
18	21	M	161	47.2	45.8	18.2	17.7	8.5	7.3	4	3.3	43.2	42.5	41	40.3	32	31.5	10
19	20	F	152	46.7	44.9	20.2	19.4	16.9	16.4	7.9	7.4	38.8	37.5	36.8	35.6	26.7	25.8	13
20	20	F	161	59.2	57.1	22.8	22	29.9	26.5	16.5	15.1	42.7	42	40.5	39.9	30	29.4	16
21	20	M	174	62.5	60.1	20.6	19.9	12.7	12.5	7.9	7.5	54.6	52.6	51.8	49.9	38.2	36.5	12
22	21	F	157	54.5	52.2	22.1	21.2	20.5	23.3	11.2	12.2	43.3	40	41.1	38	30.2	27.8	7
23	20	F	167	54.7	52	19.6	18.6	24.1	23.1	13.2	12	41.5	40	39.4	38	29	27.8	10
24	20	F	160	51	48.9	19.9	19.1	16.1	17.1	8.2	8.4	42.8	40.5	40.6	38.4	29.7	28.1	9
25	20	M	181	55	52.4	16.8	16	16.1	3	8.9	1.6	46.1	50.8	43.8	48.2	32.2	36.2	6
26	20	F	155	50.6	48.7	21.1	20.3	22.3	22.4	11.3	10.9	39.3	37.8	37.3	35.9	27.3	26.1	6
27	23	F	161	49.9	48.1	19.3	18.6	19.2	18.5	9.6	8.9	40.3	39.2	38.2	37.2	27.9	27	10

28	19	F	160	55.4	52.5	21.6	20.5	24.3	22.8	13.5	12	41.9	40.5	39.8	38.4	29.3	28.2	11
29	19	F	159	73.1	71.5	28.9	28.6	36.5	35.2	26.7	25.2	46.4	46.3	44	43.9	33.2	33.1	11
30	20	F	155	41.1	39.9	17.1	16.6	10.8	12	4.4	4.8	36.7	35.1	34.8	33.3	25	23.8	9
31	20	M	175	56.9	55.1	18.6	18	7	4	4	2.2	52.9	52.9	50.2	50.2	37.9	40.2	6
32	20	F	163	42.6	40.7	16	15.3	8.4	7.1	3.6	2.9	39	37.8	37	35.9	26.7	25.8	7
33	19	F	169	64.8	62.7	22.7	22	30.9	29.7	20	18.6	44.8	44.1	42.5	41.9	31.7	31.1	7
34	20	F	149	40.7	33.4	18.3	15	6.8	3	2.8	1	37.9	32.4	36	30.7	25.9	22.3	8
35	20	F	162	45.7	43.1	17.4	16.4	15.7	16	7.2	6.9	38.5	36.2	36.5	34.3	26.5	24.7	7
36	20	F	163	51.7	50.5	19.5	19	20.7	20.2	10.7	10.2	41	40.3	38.9	38.2	28.5	27.9	11
37	22	F	155	50.3	48.9	20.9	20.4	23.7	23.9	11.9	11.7	38.4	37.2	36.4	35.3	26.5	25.6	6
38	20	F	162	52.4	50.2	20	19.1	24.2	24.4	12.7	12.2	39.7	38	37.7	36.1	27.6	26.3	13
39	29	F	158	57.3	55.1	23	22.1	27.4	27.1	15.7	14.9	41.6	40.2	39.5	38.1	29	27.9	13
40	25	F	151	48.5	46.5	21.3	20.4	18.3	19.7	8.9	9.2	39.6	37.3	37.6	35.4	27.3	25.6	9
41	20	F	160	51.3	48.5	20	18.9	15.3	17.3	7.8	8.4	43.5	40.1	41.3	38.1	30.2	27.7	5
42	20	F	161	55.4	53.8	21.4	20.8	26.8	25.9	14.8	13.9	40.6	39.9	38.5	37.9	28.3	27.8	12
43	20	M	173	48.7	48.1	16.3	16.1	3.9	3.1	1.9	1.5	46.8	46.6	44.4	44.2	33.3	33.5	7
44	25	M	182	121.4	116.9	36.7	35.3	37.6	41.3	45.6	48.3	75.8	68.6	72.1	65.2	56.8	53.6	8

Raw Data of lipid profile in obesity

Name	Age	T.CHOLESTR OL		S.TRIGLYCERI DE		S.HDL		S.LDL	
		PRE	POST	PRE	POST	PRE	POST	PRE	POST
SUBADRA DEVI	49	221	198	146	80	44	40	148	142
SWATHI.V	23	167	160	134	98	33	30	107	104
CHANDRASHEKA R	24	195	172	233	203	39	34	109	103
CHIDANANDA.H. S	34	206	186	189	163	41	37	67	61
KAVITHA RAVI	33	164	160	79	62	33	32	113	112
SHIVAJI	46	238	212	106	88	48	42	169	165
RAMAKRISHNA	45	139	123	131	116	28	26	85	81
A.V HARI	44	177	162	130	96	35	33	116	110
KUMUDA.K.N	31	261	246	180	123	52	49	173	172
SUJATHA	48	145	144	70	70	29	29	102	101
SUNIL GUPTA	30	146	132	154	116	29	25	86	83
SHANTABAI	53	148	139	213	179	30	26	75	73
DIVYA.S.	25	136	132	79	65	27	24	93	85
BHAGYALAKSH MI	48	242	195	156	103	48	39	173	164
VINUTHA	33	185	160	127	113	37	35	123	115
RESHMA	23	156	146	79	73	31	29	109	107
DECHAKKA	43	196	163	78	72	39	33	141	116
JESVIN KARIAPPA	45	175	167	76	70	35	33	125	120
KARTHIK	23	148	143	79	71	30	27	102	96
VASUDEV	25	192	186	140	122	38	35	126	122
AMARNATH	42	202	185	210	153	40	37	120	116
SOWMYA PRADEEP	30	150	142	75	63	30	23	105	102
CHANDA	47	241	211	163	129	48	42	160	143
LATHA.S.N	45	146	133	126	109	29	21	92	88
VENKATRAM	47	156	141	181	163	31	29	89	76
ASHOK	47	189	163	209	192	38	33	109	103
ANIL REDDY	39	142	126	80	66	28	26	98	91
ARCHANA	28	201	174	163	159	40	36	128	119
RAGAVENDRA	31	146	133	79	72	29	27	101	97
RAKESH .B.P	30	145	136	74	65	29	26	101	93
DR.	33	177	163	85	69	35	33	125	121

RAGAVENDRA									
DR.N. GAYATHRI	30	147	138	135	123	29	24	91	79
UMA.S.RAJU	51	250	224	88	76	50	43	182	176
KOUSHAL	25	225	201	66	61	45	41	167	153
RAMESH	40	177	165	96	85	35	33	123	116
PUNEETHA	26	195	178	78	69	39	36	140	133
PUNEETH	52	189	176	209	195	38	33	109	106
DEEPIKA N.S	23	197	175	115	103	41	44	133	110
ANITHA L SHETTY	40	250	151	189	90	38	47	174	86
KUSHALA SHETTY	58	239	230	303	240	37	38	141	144
SUDHA	35	258	230	154	81	37	39	190	175
AKBAR REHMAN BASHA	49	283	270	188	120	35	36	199	156
N.S.AYYAN GOWDA	56	157	150	181	155	47	47	74	72
VEERENDRA.V.T	55	233	228	248	240	38	38	145	142
G.C MAHESH CHANDRA	55	186	162	214	132	42	46	101	90
RADHA REDDY	22	229	184	141	95	38	43	163	122
M.V RAJESHWARI	60	207	199	80	70	40	41	151	144
G.B PUSHPA	27	224	192	105	80	39	41	164	135
SAROJA.K	53	211	178	141	123	40	45	143	108
AMANI JAYARAJ	40	263	258	135	77	37	39	199	184
SHWETHA	42	234	196	180	122	38	42	160	130
SANDESH.K	38	164	160	218	210	46	46	74	72
GANGA.V	37	175	145	98	87	45	48	112	80
SHARADHA.N	24	158	155	168	77	47	47	77	63
JAYARAJ	56	169	165	188	152	46	46	85	89
AMAR KATTY	37	213	207	220	151	39	40	130	137
SANDEEP.M	28	168	165	247	180	46	46	73	83
VEENA.V	24	256	240	336	263	37	37	180	150
KAVITHA JAIN	34	193	190	377	312	42	42	76	86
CHANDRA JAIN	42	258	250	167	121	39	40	186	186
GIRIJA	53	250	185	78	69	38	43	196	122
SUMANA	42	252	223	221	152	37	39	171	154
SUJATHA	46	183	178	229	165	41	43	76	102
RACHELLE	30	248	205	155	86	38	40	79	48
MAHALAKSHMI	42	233	203	181	145	39	40	158	134
ASHARANI	42	180	150	94	79	50	47	61	87
KARTHIK	38	150	143	83	80	47	48	86	79
USHA.A.S	42	170	152	80	75	34	30	120	107
DIVYA	22	236	180	190	108	38	43	160	115

PARIMALA.B	24	158	140	181	154	42	48	75	61
PANKAJA.K	36	163	160	214	116	46	46	74	61
NARAYAN	28	149	145	180	123	48	49	65	71
KRISHNAMOORTHY	26	160	149	195	190	46	48	75	63
REKHA	40	162	160	171	108	46	46	98	92
SOWMYA KRISHNA	29	167	160	189	104	46	46	83	93
SHOBHA.K.S	45	156	154	222	180	42	47	64	71
BABITHA.K.N	37	239	162	386	212	37	46	85	74
ROOPA CHANDRASHEKAR	52	152	148	220	182	48	48	60	84
MALATHI.R	31	154	151	235	213	47	47	60	61
BHAGYA.H.S	49	207	179	283	186	40	45	110	97
GEETHA.B.KORE	38	186	162	214	132	42	46	101	90
RADHA	47	170	139	190	102	45	50	87	69
SUNITHA REDDY	38	195	177	245	150	41	45	105	102
MEGHA	27	198	172	124	120	43	45	130	104
KALAVATHI	56	230	220	265	214	39	39	138	158
RATHNA	59	251	226	306	167	36	38	157	155
PRANATHI	23	112	110	187	180	39	39	96	100
PREMA	49	226	180	255	140	37	43	118	109
RUKMINI	32	195	190	283	187	40	41	98	112
VENUGOPAL	36	154	130	214	85	47	50	64	63
DINAKAR	58	179	164	196	82	44	46	96	102
SHANKARAPPA	56	159	138	188	142	47	49	74	61
VANI	34	184	180	219	188	42	43	98	99
GAYATHRI	35	228	190	224	191	38	42	125	110
PUSHPAKALA	31	143	136	163	98	44	50	66	66
VIJAYALAKSHMI	50	161	140	148	121	47	48	64	68
KRUTHIKA	21	182	148	263	202	43	46	66	62
CHAITRA	27	218	206	302	176	39	40	114	131
MANJULA	48	171	131	152	72	45	49	96	68
SHRUTHI	26	211	188	172	101	39	43	138	125

Raw Data of FBG and PPBG in Type 2 Diabetes Patients

Name	Sex	Age	FBS pre	FBS post	PPBS pre	PPBS post
Roopa	F	35	256	184	322	266
Vijayalakshmi	F	50	146	133	227	224
Rekha	F	32	169	140	218	190
sanjeev murthy	M	45	120	103	240	162
Prabhakar	M	43	175	177	246	216
narasimha murthy	M	42	141	125	123	137
srinivasa murthy	M	34	186	136	268	195
Hemalatha	F	54	201	180	220	200
Chinnamma	F	34	109	77	282	193
Jayamma	F	56	161	145	237	158
Parvatamma	F	45	183	201	241	218
laxmi narayan	M	42	132	108	141	146
Nanjaiah	M	39	132	108	166	170
Obamma	F	40	243	200	289	240
T.S gowda	M	46	171	152	276	195
Ratnamma	F	45	150	109	200	145
Ramachandran	M	62	185	150	256	200
Sarojamma	F	56	183	150	223	190
jagadish nayak	M	53	218	151	392	300
Sowbhagya	F	42	184	150	319	250
Arunadevi	F	45	269	244	364	265
Sandeep	M	51	150	125	200	185
Jayamma	F	53	250	207	207	214
Prathiba	F	43	180	150	300	292
Bheemarathi	F	40	243	200	252	190
Anupama	F	35	242	108	260	190
Nancy	F	34	247	145	323	318
Jayaprakash	M	48	138	122	149	133
Berchmans	M	50	105	112	168	135
joseph balachandra	M	51	217	180	260	200
Jansi	F	46	176	150	232	190
Thimmappa	M	61	151	104	210	137
dilip singh	M	35	187	140	192	174
Savitramma	F	52	330	284	343	350
Gowramma	F	39	220	172	400	282
rama reddy	M	40	170	119	249	151
Sharanappa	M	51	155	138	240	146
Chamu	M	39	160	150	178	180
nimma reddy	M	47	117	87	126	213
Nagamma	F	48	240	171	200	197

Chandrashekar	M	41	148	120	166	140
Bhavani	F	45	130	95	156	113
Madhu	F	46	322	258	342	280
Ravi	M	49	219	174	270	240
Chandrashekar	M	51	177	140	270	192
narayan reddy	M	57	176	137	252	146
poornachandra reddy	M	37	147	155	164	169
Prabhakar	M	53	124	140	219	180
jayanth Prasad	M	59	140	152	194	209
Padmavathi	F	42	193	164	249	172
Jagadeesh	M	47	162	139	263	263
Saraswathi	F	45	165	142	228	203
Narayana	M	51	177	158	243	210
HCV reddy	M	57	144	83	158	190
hari Prasad	M	52	220	142	257	230
Shriram	M	39	270	250	362	300
Krishnaveni	F	48	190	150	223	200
Matai	M	51	198	174	300	253
Vanaja	F	35	203	112	284	222
Gangamma	F	46	206	157	257	271
Nagaratnamma	F	44	170	127	183	251
Suma	F	55	258	201	266	229
Nethravathi	F	32	250	217	350	348
venkatramana reddy	M	46	150	104	250	252
sankar gowda	M	57	136	82	209	181
Laxmikanth	M	38	230	195	261	286
Vasudha	F	40	130	124	230	216
Rajappa	M	42	200	150	225	200
Satyavathi	F	53	226	145	320	154
kishor kumar	M	37	150	125	200	140
rammohan rao	M	48	330	300	354	280
rame gowda	M	52	131	118	187	140
Balaram	M	60	240	140	268	170
Jayaram	M	52	200	199	300	238
shantha bai	F	51	198	150	216	200
krishna kumar	M	43	132	130	146	144
Lakshmikanth	M	47	250	230	280	261
saheb gowda	M	61	231	232	248	258
Vijayalakshmi	F	42	151	100	213	180
Mahashwarappa	M	45	194	110	279	258
nage gowda	M	49	97	85	197	154
Roopa	F	39	284	210	296	242
Dinakar	M	38	104	98	170	118
Rajashekar	M	51	152	186	257	271
hari A.V	M	40	242	146	319	164

Madappa	M	45	153	150	215	179
Jayarama	M	46	125	129	141	138
Purushottam	M	49	150	115	200	133
Satyanarayana	M	51	241	164	353	300
Bharathi	F	44	233	216	255	236
Nagesha	M	39	130	122	140	138
narayana murthy	M	42	136	134	286	221
Pushpavathi	F	48	110	105	170	164
Jayanthi	F	52	162	198	184	226
Usha	F	36	180	172	250	217
Nagaraj	M	39	166	150	250	207
Anand	M	41	196	196	350	322
Kanthraju	M	46	120	118	200	181
Latha	F	38	200	157	250	172
Premalatha	F	40	311	223	449	316

Raw Data of Case Group Urine pH Data

Sl No	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
1	5.6	5	5.2	5.3	5.3	5.4	5.4	5.4
2	5.6	4.8	4.9	5.1	5.2	5.2	5.4	5.5
3	5.2	5.3	5.5	5.3	5.1	5.1	5.9	5.8
4	4.9	5.3	5.9	5.3	5.1	5.6	5.5	5.5
5	5	5.1	5.5	5.5	5	5.4	5.4	5.5
6	5.9	5.2	5.2	5.2	5.4	5.2	5.2	5.2
7	5.3	4.9	4.8	4.9	4.8	4.8	5	5.2
8	4.8	4.7	4.8	5.1	5.2	5.2	5.2	5.2
9	4.8	4.5	5.7	5.4	5.6	5.5	5.6	5.7
10	4.7	4.9	5.4	5.7	5.7	5.7	6	5.8
11	5	5	5.5	5.5	5.7	5.5	5.5	5.7
12	5.5	5.1	5.3	5.9	5.5	5.3	5.4	5.5
13	5	5.1	5.1	5.8	5.6	5.5	5.6	5.8
14	5	5	5.1	5.2	5.6	5.4	5.4	5.5
15	5.2	5.1	5.2	5.5	5.6	5.6	5.5	5.2
16	5.3	5	5.1	5.2	5.5	5.3	5.4	5.4
17	5.3	5.1	5.1	5	5.3	5.2	5.2	5.3
18	5	4.5	4.8	5.3	5.4	5.3	5.4	5.4
19	5.7	5	4.7	4.9	5	5	5.1	5.1
20	5.6	5.5	4.9	5.2	5.6	5.7	5.8	5.8
21	5.8	5.6	6	5.3	5.6	5.4	5.5	5.5
22	4.7	4.6	5.7	5.6	5.6	5.5	5.6	5.7
23	4.6	4.9	5.4	5.7	5.7	5.6	6	5.8
24	5.2	5.2	5.2	5.7	5.6	5.3	5.6	5.8

25	5	5	5.1	5.3	5.7	5.4	5.4	5.5
26	4.9	5.3	5.9	5.4	5.1	5.6	5.5	5.5
27	5.6	5.2	5.6	5.5	5.1	5.4	5.4	5.5
28	4.9	5	5.2	5.3	5.3	5.4	5.4	5.4
29	5.6	4.8	4.9	5.1	5.4	5.2	5.4	5.5
30	5.4	5.1	5.1	5	5.3	5.2	5.2	5.3
31	4.9	4.5	4.8	5.4	5.5	5.3	5.4	5.4
32	5.6	5	4.7	5	5.2	5	5.1	5.1
33	5.7	5	4.7	5.1	5.1	5	5.1	5.1
34	5.7	5.5	4.9	5.3	5.6	5.7	5.8	5.8
35	5.4	5.4	6	5.4	5.7	5.4	5.5	5.5

Raw Data of Control Group Urine pH Data

SI No	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
1	4.7	5	5.2	5.1	5.1	5.9	5.4	5.6
2	4.9	5.1	5.4	5.5	5.7	5.6	5.4	5.8
3	5	5.4	5.7	5.5	5.7	5.5	5	5
4	5.3	5	5.5	5.5	5.4	5.6	5	5.4
5	5.8	6.1	6.1	5.9	5.6	5.8	6	5.6
6	5	4.7	5.1	5.3	5.1	5.4	5.5	5.2
7	4.9	4.5	4.4	4.8	5	5.5	5.7	5.7
8	5.2	5.2	5.3	5.3	5.2	5.2	5.3	5.2
9	5.7	5.9	5.2	5.5	5.6	5.5	5.4	5.4
10	5.8	5.7	5.4	5	5.1	5.4	5.5	5.2
11	5.9	6.1	5.8	5.3	5.6	5	4.8	4.8
12	5.3	4.3	5.3	5.3	5.3	5	5.2	5.1
13	5.3	5.9	5.6	5.3	5.4	5.4	5.6	5.5
14	5.8	5.3	5.2	5.2	5.5	5.2	5	5.3
15	5.2	5.8	5.8	5.7	5.1	5	5.5	5.3
16	5.2	4.7	5.3	5.4	5.1	5.2	5.7	5
17	5	5.7	5.1	5.7	4.9	5.2	5.1	5.6
18	5.3	5.4	5.6	5.5	5.3	5.1	4.9	5.4
19	5.2	5.5	5.7	5.5	5.1	5	4.9	5
20	5.5	4.8	5.2	5.1	5.3	5.4	4.9	5.3
21	5.3	5.8	5.5	5.4	5.2	5.1	5.2	5.1
22	5.7	4.8	5	4.6	4.9	5	5.8	5.3
23	4.9	5	5.2	5.1	5	5.7	5.3	5.5
24	5.1	5.1	5.4	5.5	5.6	5.5	5.4	5.8

25	5.2	5.4	5.7	5.5	5.6	5.3	5	4.9
26	5.6	5	5.5	5.5	5.3	5.5	5	5.4
27	6	6.1	6.1	6	5.5	5.7	5.9	5.6
28	5.2	4.7	5.1	5.4	5	5.3	5.4	5.1
29	5.2	4.6	4.3	4.8	4.9	5.3	5.6	5.7
30	4.9	5.2	5.3	5.3	5.1	5.1	5.3	5.2
31	5.1	5.9	5.2	5.5	5.5	5.4	5.3	5.4
32	5.2	5.7	5.4	5	5	5.2	5.5	5.1
33	5.6	6.1	5.8	5.3	5.5	4.9	4.8	4.8
34	6	4.3	5.3	5.3	5.2	4.8	5.2	5.1
35	5.2	5.9	5.6	5.4	5.3	5.2	5.5	5.4

Appendix 3

List of Publications from this thesis

Papers under Review:

- Prashanth Shetty, Krishnamuthy, Manjunath, Balakrishnan, Ragavendrasamy, Gangadhar Verma. Yoga and Naturopathy Based Lifestyle Interventions in the Management of Obesity, *Journal of Complementary and Integrative Medicine*.
- Prashanth Shetty, H R Nagendra, Gangadhara Varma B.R, Pailoor Subramanya Effect Of Naturopathy And Yoga Intervention On Patients With Diabetes Mellitus Type II, *online International interdisciplinary Research Journal*.
- Prashanth Shetty, Achyuthan Eswar, Rajkumari Roshni Raj Lakshmi, H.R.Nagendra Balakrishna Shetty, Nithin and Suhas Vinchurkar. Effect of Juice Fasting on Urine pH: A Controlled Study, *International Journal of Health and Wellbeing*.
- Prashanth Shetty ,Moovanthan A, Nagendra HR. Short Term Effect of Lemon Honey Juice Fasting on Lipid profile and Body Composition in Healthy Individuals, *Journal of Ayurveda and Integrative Medicine*.

Effect of Naturopathy and Yoga Intervention on Patients with Type II Diabetes Mellitus

Shetty Prashanth^a, H R Nagendra^b, Gangadhara Varma B.R^c, Pailoor Subramanya^d,

^aPh.D. Scholar, Division of Yoga and Life Sciences, S-VYASA Yoga University, Bengaluru, India

^bChancellor, S-VYASA Yoga University, Bengaluru, India

^cPost graduate (M.D Naturopathy), S.D.M College of Naturopathy and Yogic Sciences, Ujire, Karnataka, India

^dDivision of Yoga and Life Sciences, S-VYASA Yoga University, Bengaluru, India

Corresponding Author: Gangadhara Varma B.R

Abstract

Background and Objectives: A major part of Diabetes burden (75%) will be borne by developing countries and India will be having the dubious honour of being host to the maximum number of diabetics numbering about 57 millions. Complementary and Alternative Medicine (CAM) modalities are found to be effective in the management of Diabetes Mellitus type 2. While Naturopathy and Yoga is a part of CAM which is used in the management of Diabetes Mellitus type 2, the scientific literature to support its' judicious usage is inadequate. Hence the present study evaluated the effect of Naturopathy and Yoga on the Fasting blood glucose (FBG) and postprandial blood glucose (PPBG) levels in patients with Type 2 Diabetes Mellitus.

Methods: Subjects were recruited from the Yoga and Naturopathy Hospital, Shanthivana, Dharmastala, Karnataka. Two Hundred patients diagnosed for Diabetes Mellitus type 2 were screened. One Hundred subjects were recruited for the single pre-post design study, selected based on the inclusion and exclusion criteria. Subjects were assessed for FBG and PPPG levels before and after 10 days of intervention.

Results: The results suggested the significant changes in the levels of FBG and PPBG with the $p < 0.001$.

Interpretation & Conclusion: Naturopathy and Yoga is one of the major treatment modality in controlling type II Diabetes Mellitus.

KEYWORDS: Type II Diabetes mellitus; Complimentary & Alternative Medicine; Yoga ; Naturopathy

INTRODUCTION

The prevalence of Type 2 Diabetes Mellitus (T2DM) is projected to rise from 171 million in 2000 to 366 million in 2030 (Wild, Roglic, Green, Sicree, & King, 2004). T2DM is a

costly, complex, chronic disease that is expected to increase in prevalence in the coming decades (“Economic costs of diabetes in the U.S. in 2007.,” 2008). The estimated annual cost of diabetes-related medical expenses was \$132 billion in 2002, accounting for more than 12 per cent of the U.S. health care budget(Hogan, Dall, & Nikolov, 2003). A major part of Diabetes burden (75%) will be borne by developing countries(Arora MM, Chander Y, Rai R,2000) and India has the second largest number (>61 million) of individuals with T2DM in the world and this is expected to nearly double by 2030(Brussels, 2011).

The prevalence of risk factors for diabetic complications, such as hypertension, obesity, and physical inactivity are also high. In 2007 67.0% of United States adults with diabetes reported having hypertension, 83.5% were overweight or obese, and 38.2% reported 0 being physically inactive. Cardiovascular complications are the leading cause of morbidity and mortality among patients with T2DM, and cardiovascular disease (CVD) risk is 2 to 8 fold higher in the diabetic population than it is in non-diabetic individuals of a similar age, sex and ethnicity(Haffner, Lehto, Rönnemaa, Pyörälä, & Laakso, 1998)(Brun et al., 2000). Furthermore, macro vascular complications are the largest contributor to the direct and indirect costs of diabetes (“Economic costs of diabetes in the U.S. In 2007.,” 2008). Micro albuminuria and retinopathy are indicators of micro vascular dysfunction, and both predict a poorer outcome in patients with diabetes(Rajala, Pajunpää, Koskela, & Keinänen-Kiukaanniemi, 2000)(Klein, Klein, Moss, & Cruickshanks, 1999).

Complementary and alternative medicine (CAM) may offer novel approaches to address lifestyle,behaviour change for prevention and control of chronic diseases such as T2DM.

Naturopathic medicine is of greatest interest as it is a whole-system of CAM most closely resembling conventional primary care in scope of practice, but with greater delivery of healthy lifestyle counselling(Bradley et al., 2009). According to observational studies, healthy lifestyle interventions are routine in naturopathic clinical care for T2DM ,with diet, physical activity, and stress management counselling incorporated into the majority of clinical encounters (80– 100%)(Bradley & Oberg, 2006)(Bradley & Oberg, 2006). Care provided by Naturopathic Doctors (ND) is a particularly promising form of CAM practice for diabetes, because the ND training emphasizes assessment and understanding of medical risk, intensive dietary and lifestyle counselling, and the routine laboratory testing necessary for on-going management(Bradley & Oberg, 2006; Bradley et al., 2011; Oberg, Bradley, Allen, & McCrory, 2011).

In a survey conducted in United States, approximately 48% of individuals with diabetes reported using CAM. Several CAM modalities like naturopathy, acupuncture, therapeutic massage, reflexology, dietetics etc. are found to be effective in the management of T2DM(Donald Garrow, Leonard Egede E, 2006). Retrospective observational studies also suggest ND care reduces risk for T2DM and hypertension, including improved glucose control and reduced blood pressure, respectively(Ellen seber,2000).

Hence the present study is planned to find the effect of 10 days Naturopathy and Yoga on Type II Diabetes Mellitus.

AIM AND OBJECTIVES

AIM

- To study the effect of Naturopathy and Yoga on patients with T2DM.

OBJECTIVES

- To study the effect of Naturopathy and Yoga on Type 2 Diabetes patients with:
 - Fasting Blood Glucose
 - Post Prandial Blood Glucose

MATERIALS AND METHODS

Subjects: A total of two hundred patients who admitted 10 days Naturopathy and Yoga Hospital, were screened to obtain hundred participants for the study. They were recruited from Nature cure and Yoga therapy Hospital, Shanthivana, Dharmastala.

Inclusion Criteria:

- Diagnosed subjects of type 2 Diabetes Mellitus, who are on oral hypoglycaemic drugs for the past two years.
- Above the age of 35 years and below the age of 85 years.
- Both genders were included.

Exclusion criteria:

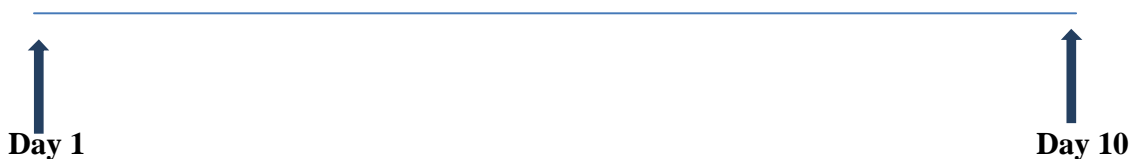
- Uncontrolled type 2 Diabetes Mellitus.
- Type 2 Diabetes Mellitus who are on Insulin therapy.
- Diabetes associated with systemic complications.

The signed consent forms were obtained from all subjects for their participation.

Setting: Study conducted in the Yoga and Nature cure Hospital, Shanthivana, Dharmastala, Karnataka. The study was approved by the Institutional ethics committee.

Study Design: The study adopts a pre-post design. The institutional ethical committee approval was obtained for conducting the study. Subjects were assessed on Day 1 and Day 10 during which they received Yoga practice, Naturopathic treatment and Diet therapy.

Experimental group



Assessments: The primary outcome measure was Fasting blood glucose (FBG) and Post prandial blood glucose (PPBG).

Fasting Blood Glucose: This test requires at least eight hours of fasting, and is usually done in early mornings. A suitable vein is identified, and a tourniquet applied to distend the vein for puncture. The skin over the vein is antiseptically cleaned. A sterile needle and syringe are used to draw about 10ml of blood from the vein, the tourniquet is removed, the needle withdrawn, and the puncture site compressed for a few minutes, then covered with a clean dressing. The blood sample was used for analysis.

Intervention

Yoga based physical activity:

INTERVENTION	COMPONENTS
<p>Surya Namaskara <i>(sun salutations)</i> 4 rounds</p>	<ul style="list-style-type: none"> • Namaskarasana, • UttithapadasanaPadahastasana, • Ekapadasanchalanasana, • Dwipadasanchalanasana, • Shashankasana, • Ashtangapanipadasana, • Urdwamukashwanasana, • AdhomukhaSwanasana, • Ekapadasanchalanasana, • Padahastasana, • Uttithapadasana, • Namaskarasana
<p>IRT</p>	<p>Instant Relaxation Technique</p>
<p>Asanas</p>	
<p><i>Standing Asanas</i></p>	<ul style="list-style-type: none"> • Trikonasana, • Padahastasana, • Ardchakrasana,

	<ul style="list-style-type: none"> • Ardhakatichakrasana
<i>Supine Asanas</i>	<ul style="list-style-type: none"> • uttitapadasana, • Pavanamuktasana, • Navasana, • Shavasana
QRT	Quick Relaxation Technique
<i>Prone Asanas</i>	<ul style="list-style-type: none"> • Bhujangasana, • Dhanurasana, • Naukasana, • Shalabasana
<i>Sitting Asanas</i>	<ul style="list-style-type: none"> • Vajrasana, • Vakrasana, • ArdhaMatsyendrasana, • Yoga mudrasana
DRT	Deep Relaxation Technique

Yoga based stress management:

Pranayamas	Nadishodana, Surya bedhana, Kapalabhati, Brahmari
Meditation	Omkaara meditation

Naturopathy based diet plan:

7:30 am	Bitter gourd juice (200 ml)
9:00am	Ragigangi (250 ml)
12:00 noon	Kichadi + boiled vegetables+ buttermilk (50 ml) + papaya (200 gms) + methi powder (1-2 tsp)

2:00pm	Knolkhol juice (200 ml)
4:00pm	Barley water (200 ml)
7:00pm	2 roti + boiled vegetables + papaya (200 gms) + soup (150 ml) + methi powder (1-2 tsp)
9:00pm (If necessary)	Fruit (Apple)

Naturopathy Treatments:

Steam bath (10 min), Full body oil Massage(45 min), Sauna bath(10 min), under water massage(20 min), Cold hip bath(20 min), Gastro Hepatic pack(20 min), neutral immersion bath(20 min), cold circular jet(20 min), douche(20 min).

Data Analysis:

The present study was conducted to assess the effect of Naturopathy & Yoga in reducing Fasting blood glucose level and postprandial blood glucose values. The results were analysed by using SPSS (16.0).

RESULTS

The present study was conducted to assess the effect of Naturopathy & Yoga in reducing Fasting blood glucose level and postprandial blood glucose values.

The alpha level of statistical significance was set at $p < 0.05$. Both FBG and PPBG levels showed significant reduction at the end of the intervention.

Fig. 1 Mean pre-post intervention of FBG

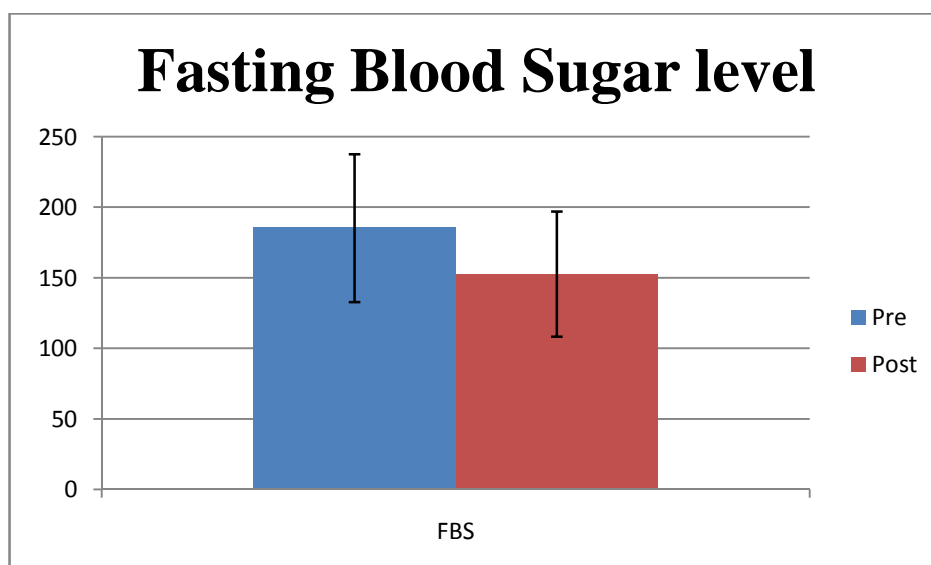
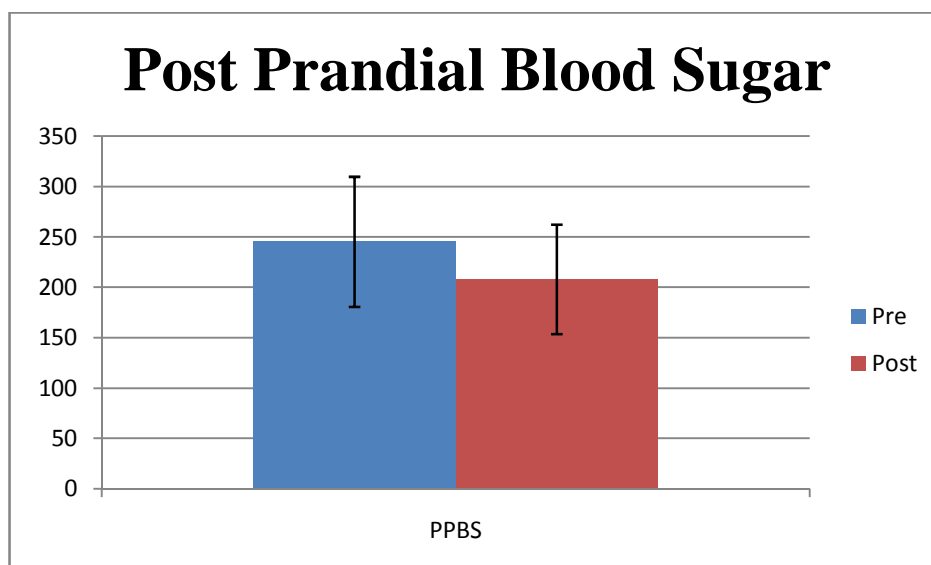


Fig. 2 Mean pre-post intervention of PPBG



DISCUSSIONS

The study result shows that FBG and PPBG have significantly reduced subsequent to the intervention. The Naturopathy and Yoga intervention facilitates better clinical outcomes in the management of T2DM.

Previous studies have shown decrease in the levels of FPG, PPPG and HbA1c by the intervention of Yoga, Diet and Naturopathic intervention. A clinical study has shown that the Naturopathic care to people with T2DM significantly improved glycemic control, increased self-monitoring of blood glucose, improved diet, increased physical activity, greater self-efficacy, improved mood and reduced problem areas in diabetes (Bradley et al., 2012). Another study demonstrates the modifications in risk-factors that occur with long-term naturopathic care for T2DM with notable percentages of patients achieving improvements in glucose levels as measured by HbA1c and blood pressure measures (Bradley et al., 2009).

A retrospective study suggests Naturopathic medicine is a philosophy-based, complete medical system. This description of naturopathic care can serve other health professionals in their referral recommendations. Naturopathic care for diabetes at this representative academic facility remains mostly adjunctive, although physicians possess the training and skills necessary to participate as primary care providers.

The naturopathic treatment approach frequently includes important dietary and lifestyle recommendations included in current medical treatment guidelines for diabetes, hypertension, and hyperlipidaemia, although improvements can be made on the precision of recommendations (Bradley & Oberg, 2006).

The present study also suggested the similar results of the previous study that the Naturopathy and Yoga intervention reduces both Fasting blood glucose level and Post-prandial glucose levels.

Limitation of the study:

- There is no control group in the study.
- Compared to other intervention based studies, the duration of this study is considerably short.
- The study was limited to a fixed period of intervention. Post intervention follow up was not done which is critical in evaluating a non-pharmacological therapy in the management of a chronic disease like T2DM.

CONCLUSION

The present study suggested that Naturopathy and Yoga intervention has reduced significantly the levels of FBG and PPBG in patients with Type II Diabetes Mellitus. The Naturopathy and Yoga intervention is the main stream of management in treating Type II Diabetes Mellitus.

Acknowledgement:

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References:

- Bradley, R., Kozura, E., Buckle, H., Kaltunas, J., Tais, S., & Standish, L. J. (2009). Description of clinical risk factor changes during naturopathic care for type 2 diabetes. *Journal of Alternative and Complementary Medicine (New York, N.Y.)*, 15(6), 633–8. doi:10.1089/acm.2008.0249
- Bradley, R., Kozura, E., Kaltunas, J., Oberg, E. B., Probstfield, J., & Fitzpatrick, A. L. (2011). Observed Changes in Risk during Naturopathic Treatment of Hypertension. *Evidence-Based Complementary and Alternative Medicine : eCAM*, 2011, 826751. doi:10.1093/ecam/nep219
- Bradley, R., & Oberg, E. B. (2006). Naturopathic medicine and type 2 diabetes: a retrospective analysis from an academic clinic. *Alternative Medicine Review : A Journal of Clinical Therapeutic*, 11(1), 30–9. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2943666&tool=pmcentrez&rendertype=abstract>
- Bradley, R., Sherman, K. J., Catz, S., Calabrese, C., Oberg, E. B., Jordan, L., ... Cherkin, D. (2012). Adjunctive naturopathic care for type 2 diabetes: patient-reported and clinical outcomes after one year. *BMC Complementary and Alternative Medicine*, 12, 44. doi:10.1186/1472-6882-12-44
- Brun, E., Nelson, R. G., Bennett, P. H., Imperatore, G., Zoppini, G., Verlato, G., & Muggeo, M. (2000). Diabetes duration and cause-specific mortality in the Verona Diabetes Study. *Diabetes Care*, 23(8), 1119–23. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/10937508>
- Brussels. (2011). *No Title* (5th editio.). Belgium: International Diabetes Federation. doi:2011
- Economic costs of diabetes in the U.S. In 2007. (2008). *Diabetes Care*, 31(3), 596–615. doi:10.2337/dc08-9017
- Haffner, S. M., Lehto, S., Rönnemaa, T., Pyörälä, K., & Laakso, M. (1998). Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. *The New England Journal of Medicine*, 339(4), 229–34. doi:10.1056/NEJM199807233390404
- Hogan, P., Dall, T., & Nikolov, P. (2003). Economic costs of diabetes in the US in 2002. *Diabetes Care*, 26(3), 917–32. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/12610059>
- Klein, R., Klein, B. E., Moss, S. E., & Cruickshanks, K. J. (1999). Association of ocular disease and mortality in a diabetic population. *Archives of Ophthalmology*, 117(11), 1487–95. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/10565517>

- Malhotra, V., Singh, S., Tandon, O. P., & Sharma, S. B. (2005). The beneficial effect of yoga in diabetes. *Nepal Medical College Journal: NMCJ*, 7(2), 145–7. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16519085>
- Oberg, E. B., Bradley, R. D., Allen, J., & McCrory, M. A. (2011). CAM: naturopathic dietary interventions for patients with type 2 diabetes. *Complementary Therapies in Clinical Practice*, 17(3), 157–61. doi:10.1016/j.ctcp.2011.02.007
- Rajala, U., Pajunpää, H., Koskela, P., & Keinänen-Kiukaanniemi, S. (2000). High cardiovascular disease mortality in subjects with visual impairment caused by diabetic retinopathy. *Diabetes Care*, 23(7), 957–61. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/10895846>
- Sahay, B. K. (2007). Role of yoga in diabetes. *The Journal of the Association of Physicians of India*, 55, 121–6. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/17571741>
- Sperandei, S. (2012). Comment on: Hegde et al. effect of 3-month yoga on oxidative stress in type 2 diabetes with or without complications: a controlled clinical trial. *Diabetes Care* 2011;34: 2208-2210. *Diabetes Care*, 35(6), e42; author reply e43. doi:10.2337/dc11-2379
- Wild, S., Roglic, G., Green, A., Sicree, R., & King, H. (2004). Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care*, 27(5), 1047–53. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/15111519>

Effect of juice fasting on urine ph: A controlled study

Prashanth Shetty, Achyuthan Eswar, Rajkumari
Roshni Raj Lakshmi, Balakrishna Shetty and Nithin
Sri Dharmasthala Manjunatheswara College of
Naturopathy and Yogic Sciences, Ujire

H.R.Nagendra and Suhas Vinchurkar
Swami Vivekananda Yoga Anusandhana
Samsthana (S-VYASA), Bengaluru

Naturopathic Fasting Therapy is the cornerstone of most Naturopathic therapy protocols. It has been claimed to reduce the acidity of the body, but this has not been conclusively proven. The present study was designed to assess the effect of Naturopathic Fasting Therapy on Urine pH young healthy volunteers. Seventy participants with ages ranging from 19-21 years (group mean age \pm SD; 20 ± 0.8 years) were assigned to either a fasting group (n=35) or a vegetarian diet group (n=35). The two groups were matched for age, education and routines. Fasting was conducted for a period of five days under supervision by project coordinators. We executed a matched controlled design with urine pH assessed by testing first void midstream urine using pH meter at baseline and every day subsequently until the period of fasting ended. Data were analyzed using IBM SPSS 20. The data were checked for normality. The data was checked for normality and then a Paired samples t-test was performed to investigate statistically significant difference within-group in urine pH of fasting group and control group. Urine pH increased by 0.24 ± 0.49 pH units ($p < 0.05$) after five days' Naturopathic Fasting Therapy. Naturopathic Fasting Therapy significantly increases Urine pH. This signifies that acidity of the plasma is reduced, which can be linked to many health benefits.

Keywords: naturopathic fasting therapy, urine ph, acidity

Naturopathy is a drugless system of medicine, which comprises of non-invasive treatment modalities drawn from natural elements viz., earth, water, fire, air and space. It is based on the principles that the body can heal itself of any disease, if provided with the right opportunity. Naturopathic theories state that when a wrong lifestyle is followed, the different functions of the body are compromised, causing disease, and therefore, following the right lifestyle may cure any disease.

Yoga in addition to being a preventive health practice is also a therapeutic science, which works on the intricate mechanisms of mind and body. It is a science of living that prescribes certain rules and regulations to be followed on a moral basis, control of body, breath and mind, withdrawal of the senses inwards, and mental training of concentration to reach meditative states and absorption.

Among the therapeutic modalities utilized in Naturopathic medicine, fasting therapy is the foremost and most important modality. Abstaining from food altogether or a specific type of food for a specific period of time is said to be associated with myriad health benefits and is said to be effective in treating any disease. Calorie restriction, a therapy similar to fasting therapy, has been found to have numerous health benefits and has been associated with a number of biochemical changes in the body's metabolic markers. A type of fasting therapy is juice fasting, where the patient remains on liquids for a certain period of time.

Naturopathic Fasting Therapy involves a gradual shift from regular food habits to a natural (raw fruits and vegetables) diet, then to a mono fruit diet, following which the patient is given different fruit and/or vegetable juices, which are generally citrus fruit juices. For our study, case group subjects were provided lemon juice with honey four times during the complete fasting days. Breaking the fast was done the same way, in reverse order: from lemon juice to a

thicker juice (in this case, pineapple juice), to mono fruit diet, to natural diet, to a vegetarian diet on successive days.

However, there has been very limited research conducted on fasting therapy to establish the metabolic changes in the body affected by it. The physiological changes that occur during fasting are not completely understood, regardless of the cause for fasting (for example, medical, lifestyle, religious, political or famine).[1]

The pH of plasma is determined by the concentration and chemical properties of the acids and bases dissolved in it. Three classes of acids and bases can be identified:

- Carbonic Acid, formed by intermediary metabolism and disposed off principally by pulmonary ventilation - variation in the rate of pulmonary ventilation controls the plasma concentration of Carbonic Acid.
- Metabolizable acids are either absorbed from diet or arise in the process of intermediary metabolism and are mainly disposed off by intermediary metabolism
- Non-metabolizable acids are disposed off by renal mechanisms, which also control their concentration in plasma [2]. All acids except those formed by CO₂ are termed non-volatile acids, as they cannot be disposed off by respiratory mechanisms, lactic acid and uric acid for example.

There are four main factors that influence the pH of the ECF, and therefore, urine: Protein, Phosphorous, Potassium and Magnesium. The intake of these four factors is directly proportional to the acid load on the kidneys, and they have been used to formulate an index called PRAL (Potential Renal Acid Load).

Urine pH is determined primarily by a combination of body surface and dietary intake, where fruits and vegetables contribute to alkalinizing urine pH, whereas meat, fish and dairy products contribute to lowering urine pH.[3]

There has been considerable change from the hunter gatherer civilization to the present in the type of food consumed and thereby pH and net acid load in the human diet.[4]

With the agricultural revolution (last 10,000 years) and even more recently with industrialization (last 200 years), there has been a decrease in potassium (K) compared to sodium (Na) and an increase in chloride compared to bicarbonate found in the diet. It is generally accepted that agricultural humans today have a diet poor in magnesium and potassium as well as fiber and rich in saturated fat, simple sugars, sodium, and chloride as compared to the preagricultural period.[5]

The ratio of potassium to sodium has reversed, K/Na previously was 10 to 1 whereas the modern diet has a ratio of 1 to 3.[6] This results in a diet that may induce metabolic acidosis which is mismatched to the genetically determined nutritional requirements.[7] With aging, there is a gradual loss of renal acid-base regulatory function and a resultant increase in diet-induced metabolic acidosis while on the modern diet [8]

A low-carbohydrate high-protein diet with its increased acid load results in many changes in urinary chemistry. Urinary magnesium levels, urinary citrate and pH are decreased, urinary calcium, undissociated uric acid, and phosphates are increased. All of these result in an increased risk for kidney stones.[9]

Urine pH relates to dietary acid-base load. Higher fruit and vegetable intake, and lower meat intake are related to more alkaline urine.[10] An index to predict the effect of a particular food on the acid-base balance in the body is PRAL (Potential Renal Acid Load), which is an indicator of the amount of diet-derived acid the kidneys have to dispose off. An estimate of PRAL based on consumption of 4 nutrients - proteins, phosphorous, potassium and magnesium - gives a good estimate of Net Acid Excretion.[11]

Acidic urine, and thus acidic plasma, has been found to have many detrimental effects on health:

- Acidic Urine has been found to have a significantly increased bladder cancer risk.[12]
- Extracellular (Interstitial) pH (pHe) of solid tumors is significantly more acidic, compared to normal tissues.[13] The more acidic the extracellular fluid, the more efficiently a cancer can generate ATP [14]
- Children who have a higher Potential Renal Acid Load are prone to have a higher systolic blood pressure.[15]

Increasing fruit/vegetable servings has been found to increase urine pH and significantly decrease estimated dietary Net Endogenous Acid Production, thus reducing the risk of osteoporosis in midlife women.

Calorie Restriction (CR) and Naturopathic Fasting Therapy (NF) have been shown to be effective in improving outcomes in a number of disease pathologies. There are also a number of molecular mechanisms that have been identified to explain the reason behind the same.

- Fasting therapy may be a potential therapeutic intervention for cancer, due to its ability to influence a wide range of cellular mechanisms that promote healing.[16]
- NF reduces pain in RA patients and increases SCFA production in the gut.[17]
- NF enhances immunity, as measured by increased levels of secretory Immunoglobulin. [18]

With this background, we aimed at finding if a five-day Naturopathic Fasting Therapy protocol would influence the body's acidity. Therefore, the current study was designed to evaluate the effect of Naturopathic Fasting Therapy on Urine pH.

Method

Participants

We identified a congruent group of 60 healthy volunteers of both genders from a college in south India. Students who have had a history of anxiety or depression or any other psychiatric problem or were under any psychiatric or psychedelic drugs or who have indulged in substance abuse were excluded from the study. Also, students who have a history of kidney disease were excluded. The participants' ages ranged from 19-21 years (group mean age \pm SD; 20 \pm 0.8 years) and were assigned to fasting group (n=30; 20 \pm 0.4 years) and a control group with normal vegetarian diet (n = 30; 23 \pm 4.6 years). This was a group of students belonging to the same class and therefore were matched for age, education and routines. The Institutional ethics committee approved this study and a signed informed consent was obtained from all the subjects following explanation of the study.

The Naturopathic Fasting Therapy Group subjects were provided with vegetarian diet on the first day, raw diet on the second day, fruit mono diet on the third day, lemon honey juice on the fourth, fifth, sixth and seventh days, grape juice on the eighth day, fruit mono diet on the ninth day, raw diet on the tenth day and vegetarian diet on eleventh day. The quantity of lemon honey juice provided was 250 ml. Following is the diet schedule followed for the fasting therapy group:

Table 1: Diet given to the Naturopathic Fasting Therapy group

Day	Breakfast	Lunch	Evening snack	Dinner
Day 1	Normal Vegetarian Breakfast	Normal Vegetarian Lunch	-	Normal Vegetarian Dinner
Day 2	Lemon Juice with Honey	Pineapple, Watermelon, Papaya, Banana, Tomato, Cucumber, Carrot, Onion	Lemon Juice with Honey	Pineapple, Watermelon, Papaya, Banana, Tomato, Cucumber, Carrot, Onion
Day 3	Lemon Juice with Honey	Watermelon	Lemon Juice with Honey	Watermelon
Day 4	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey
Day 5	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey
Day 6	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey
Day 7	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey	Lemon Juice with Honey
Day 8	Lemon Juice with Honey	Grape Juice	Lemon Juice with Honey	Grape Juice
Day 9	Lemon Juice with Honey	Watermelon	Lemon Juice with Honey	Watermelon
Day 10	Lemon Juice with Honey	Pineapple, Watermelon,	Lemon Juice with Honey	Pineapple, Watermelon,

		Pomegranate, Papaya, Mango, Sapodilla, Banana, Tomato, Cucumber, Carrot, Onion	Pomegranate, Papaya, Mango, Sapodilla, Banana, Tomato, Cucumber, Carrot, Onion
Day 11	Khichdi [rice and moong dal porridge with minimal salt]	Banana, Tomato, boiled ashgourd and spinach seasoned with a little salt, fennel seed powder, coriander seed powder and grated coconut.	Banana, Tomato, boiled ridge gourd seasoned with a little salt, fennel seed powder, coriander seed powder and grated coconut

Apart from these juices, the subjects were asked to drink a minimum of 2 liters of water daily, to ensure that they remain hydrated.

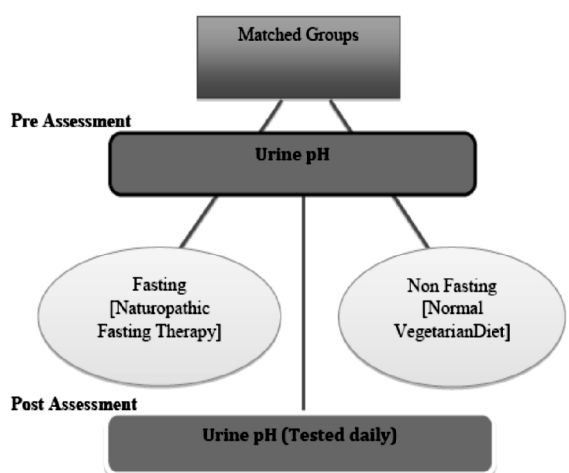
The subjects' daily schedule included:

- Enema with 300-500 ml pure water twice a day, every morning and evening.
- Yoga practice for an hour in the morning and an hour in the evening, consisting of light physical exercises and asana, breathing practices and pranayamas, meditation and relaxation.
- Prayer session every early evening, with a half hour of Bhajans and chants.

Research design

We executed a matched controlled design comprising two groups pre-post assessments using the pH meter to test urine pH daily during Naturopathy Fasting Therapy (NF) for the fasting group and similarly, daily for Control group. A schematic presentation of the design is presented in Figure 1.

Figure 1: Schematic presentation of the study design



Assessments

We assessed urine pH using pH meter. Subjects were provided with 20 ml urine sample bottles, in which they collected, first void midstream urine every morning and handed them over. The samples were then taken to the Biochemistry lab for analysis.

A pH meter that was calibrated to pH 5 was used. The electrode was completely dipped in each sample and the meter was switched on, the reading displayed being taken as accurate to 1 significant figure. After analysis of each sample, the meter was switched off and the electrode thoroughly washed and wiped before analysis of the next sample.

Data analysis

Data were analyzed using IBM SPSS 20. The data was checked for normality and then a Paired samples t-test was performed to

investigate statistically significant difference within group in urine pH of fasting group and control group.

For all the analysis, we present 95% confidence intervals and considered $p < 0.05$ as significant.

Results

Urine pH was significantly higher in the fasting group following the administration of Naturopathic Fasting Therapy (paired samples t-test, $t = -3.91, p < 0.05$). The control group (Normal Vegetarian Diet) showed no significant changes ring the study period (paired samples t-test, $t = -0.62$).

Group mean values \pm S. D. and are given in Table 2.

Table 2: Means and standard deviations for Urine pH for fasting and control groups

Groups	Pre	Post	t-value	P-value
Fasting group (n=30)	5.24 \pm 0.36	5.48* \pm 0.22	-3.91	0.01
Control group (n=30)	5.32 \pm 0.35	5.31 \pm 0.27	-0.62	0.73

* $p < 0.05$, Paired Samples t-test

Discussion

In the present study, we investigated whether Naturopathic Fasting Therapy is associated with any change in urine pH. We found that the fasting group demonstrated higher urine pH against those eating a normal vegetarian diet for 5 days.

An acidic Urine and ECF are associated with negative outcomes in a number of diseases, such as bladder cancer, solid tumors and high systolic blood pressure.[12, 13, 14] One of the most important indicators of Urine pH is diet. Diet-derived acid causes a shift in pH towards an acidic one, and higher fruit and vegetable intake as well as lower meat are associated with a more alkaline urine pH.[10]

An index to predict the effect of a particular food on the acid-base balance in the body is PRAL (Potential Renal Acid Load), which is an indicator of the amount of diet-derived acid the kidneys have to dispose off.[11] An estimate of PRAL based on consumption of 4 nutrients - proteins, phosphorous, potassium and magnesium - gives a good estimate of Net Acid Excretion.[11]

Potential Renal Acid Load during one day of Lemon Juice Fasting, inclusive of four glasses of lemon juice:

- $PRAL (mEq/d) = 0.49 \times \text{protein (g/d)} + 0.037 \times P (mg/d) - 0.021 \times K (mg/d) - 0.026 \times Mg (mg/d) - 0.013 \times Ca (mg/d)$
- $PRAL (mEq/d) = 0.49 \times 0.46 + 0.037 \times 6.89 - 0.021 \times 116.6 - 0.026 \times 5.21 - 0.013 \times 9.16$
- $PRAL (mEq/d) = 0.23 + 0.25 - 2.45 - 0.14 - 0.12 = -2.28 mEq/day$

A PRAL of -2.28 mEq/day indicates that the amount of the acid that the kidneys have to dispose off will reduce, thereby reducing the

acidity of, and increasing the pH of the urine and the blood. On the other hand, there is one factor that would indicate a shift in urine pH towards acidity. During prolonged periods of starvation, there is an shift from glycolysis to lipolysis and other metabolic adaptations to low calorie intake, causing a shift in blood pH towards an acidic one. However, there are juices provided during NF Therapy that might prevent this from occurring, by providing a source of energy from simple sugars such as those present in fruits and honey.[19] In order to understand the overall effect of this complex mechanism of acid-base balance, we looked at urine pH readings during the first eight days of the study, till the last day of NF Therapy.

First Void Urine pH increased by 0.24 ± 0.49 pH units, ($p < 0.05$), showing a trend towards alkalinity, in conformation with the PRAL of -2.28 mEq/day of the diet provided to the Naturopathic Fasting Therapy group. Net Acid Excretion, thus, reduced during an intervention of NF Therapy, showing that the acidosis associated with a shift in metabolism to lipolysis and protein utilisation is countered effectively and overcome by Naturopathic Fasting Therapy.

These findings suggest that a five-day Naturopathic Fasting Therapy regimen can lead to a reduction in acidity of the ECF in healthy individuals. Thus, fasting can have important uses in the background of modern day diets, in which net acid load is considerably high compared to hunter-gatherer civilizations[4], due to higher sodium:potassium and chloride:bicarbonate consumption ratio,[6] reduced magnesium, potassium and fiber, and increased fat and simple sugars.[5] Also, fasting may be a potentially effective tool to use in geriatric care, as renal acid-base regulatory function reduces with age, resulting in an increased diet-induced metabolic acidosis.[8]

Further studies are warranted in all age groups and conditions to ascertain this effect of Naturopathic Fasting Therapy.

References

- Mazurak, N. Günther, A., Grau, F.S., Muth, E.R., Pustovoyt, M., Bischoff, S.C., Zipfel, S., Enck, P. Effects of a 48-h fast on heart rate variability and cortisol levels in healthy female subjects. *European Journal of Clinical Nutrition* 67, 4016 (2013).
- Shaw, J. C. Nonmetabolizable base balance: effect of diet composition on plasma pH. *The Journal of Nutrition* 119, 1789-1798 (1989).
- Remer, T. & Manz, F. Potential renal acid load of foods and its influence on urine pH. *Journal of the American Dietetic Association* 95, 791-797 (1995).
- Ströhle, A., Hahn, A. & Sebastian, A. Estimation of the diet-dependent net acid load in 229 worldwide historically studied hunter-gatherer societies. *American Journal of Clinical Nutrition* 91, 406-412 (2010).
- Sebastian, A., Frassetto, L. A., Sellmeyer, D. E., Merriam, R. L. & Morris, R. C. Estimation of the net acid load of the diet of ancestral preagricultural Homo sapiens and their hominid ancestors. *American Journal of Clinical Nutrition* 76, 1308-1316 (2002).
- Frassetto, L., Morris, Jr., R. C., Sellmeyer, D. E., Todd, K. & Sebastian, A. Diet, evolution and aging. *European Journal of Nutrition* 40, 200-213 (2001).
- Konner, M. & Eaton, S.B. Paleolithic nutrition: twenty-five years later. *Nutrition in clinical practice : official publication of the American Society for Parenteral and Enteral Nutrition* 25, 594-602 (2010).
- Lindeman, R.D. & Goldman, R. Anatomic and physiologic age changes in the kidney. *Experimental Gerontology* 21, 379-406 (1986).
- Reddy, S.T., Wang, C.Y., Sakhaee, K., Brinkley, L. & Pak, C.Y.C. Effect of low-carbohydrate high-protein diets on acid-base balance, stone-forming propensity, and calcium metabolism. *American Journal of Kidney Diseases* 40, 265-274 (2002).
- Welch, A.A., Mulligan, A., Bingham, S.A., Khaw, K.T. Urine pH is an indicator of dietary acid-base load, fruit and vegetables and meat intakes: results from the European Prospective Investigation into Cancer and Nutrition (EPIC)-Norfolk population study. *British Journal of Nutrition* 99, 1335-1343 (2007).
- Remer, T., Dimitriou, T. & Manz, F. Dietary potential renal acid load and renal net acid excretion in healthy, free-living children and adolescents. *American Journal of Clinical Nutrition* 77, 1255-1260 (2003).
- Alguacil, J., Kogevinas, M., Silverman, D.T., Malats, N., Real, F.X., Garcia-Closas, M., Tardón, A., Rivas, M., Torà, M., Garcia-Closas, R., Serra, C., Carrato, A., Pfeiffer, R.M., Fortuny, J., Samanic, C., Rothman, N. Urinary pH, cigarette smoking and bladder cancer risk. *Carcinogenesis* 32, 843-847 (2011).
- Raghuand, N., He, X., vanSluis, R., Mahoney, B., Baggett, B., Taylor, C.W., Paine-Murrieta, G., Roe, D., Bhujwalla, Z.M., Gillies, R.J. Enhancement of chemotherapy by manipulation of tumour pH. *British Journal of Cancer* 80, 1005-1011 (1999).
- Damaghi, M., Wojtkowiak, J.W. & Gillies, R.J. pH sensing and regulation in cancer. *Frontiers in Physiology* 4 DEC, (2013).
- Krupp, D., Shi, L. & Remer, T. Longitudinal relationships between diet-dependent renal acid load and blood pressure development in healthy children. *Kidney international* 85, 204-10 (2014).
- Lee, C. & Longo, V.D. Fasting vs dietary restriction in cellular protection and cancer treatment: from model organisms to patients. *Oncogene* 30, 3305-3316 (2011).
- Abendroth, A., Michalsen, A., Lüdtker, R., Ruffer, A., Musial, F., Dobos, G.J. Changes of Intestinal Microflora in Patients with Rheumatoid Arthritis during Fasting or a Mediterranean Diet. *Forschende Komplementärmedizin (2006)* 17, 307-313 (2010).
- Beer, A.M., Ruffer, A., Balles, J. & Ostermann, T. Progression of intestinal secretory immunoglobulin A and the condition of the patients during naturopathic therapy and fasting therapy. *Forschende Komplementärmedizin und klassische Naturheilkunde = Research in Complementary and Natural Classical Medicine* 8, 346-353 (2001).
- Manninen, A.H. Metabolic effects of the very-low-carbohydrate diets: misunderstood "villains" of human metabolism. *Journal of the International Society of Sports Nutrition* 1, 7-11 (2004).



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Yoga and Naturopathy Based Lifestyle Interventions in the Management of Obesity

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Abstract:

Obesity and its associated comorbidities represent one of the biggest public health challenges facing the world today. Recent understanding states the heritability of body weight is high. The problem of obesity is worried for its multiple morbidities, including increased risk of diabetes, hypertension, heart disease, sleep apnea and cancer. It is known to exacerbate the age-related decline in the physical function and causes frailty in older adults. The available treatments in the allopathic system of medicine integrate lifestyle interventions as one of the major components. In the present study, we evaluated the effect of 10 days naturopathic treatment in 100 participants, both male and female of 38.48 ± 10.86 years of age. The primary outcome variable is the weight of the individual and the secondary outcome measures included body composition and lipid profile. No adverse effects were observed throughout the duration of the study. A reduction of 3.77% weight, 4.02% of BMI, 10.51% of total cholesterol, 29.33% of serum triglycerides, 7.97% of LDL, and 30.31% of VLDL were observed following the 10 days Yoga and Naturopathy based lifestyle intervention. Also, a reduction of 2.75% of fat mass, 4.72% of free fat mass, 4.68% of muscle mass, 4.28% of bone mass, 4.54% of estimated BMR, and 13.64% of estimated reduction in degree of obesity in participants when corrected for their BMI were observed. Our findings suggest that Yoga and Naturopathy based life style intervention improves the measures of obesity and may potentially alleviate associated complications.

19 Introduction:

20 World Health Organization defines overweight as the BMI greater than or equal to 25
21 Kg/m² and obesity as BMI greater than or equal to 30 Kg/m² ⁽¹⁾. Obesity is considered as a growing
22 global epidemic with an estimate of 1.5 billion adults aged 20 years and older to be overweight
23 and over 200 million men and 300 million women, constituting approximately 10% of adults were
24 obese. Also, as per estimates in 2010, about 43 million children under five years of age were
25 overweight ⁽²⁾. Statistics suggest a steep increase in obesity incidence in low and middle income
26 countries since 1980 ⁽³⁾.

27 Obesity in India is becoming a serious threat with changing food habits and lifestyle
28 increasing the morbidity and complications ⁽⁴⁾. As per the statistics of the National Family Health
29 Survey – 3 [NFHS-3] ⁽⁵⁾ study, amongst the 15-49 year age group 14.8% women and 12.1% men
30 were overweight or obese and 33% of women and 28.1% men were having BMI below normal
31 levels NFHS-3 ⁽⁶⁾. The prevalence of obesity is higher amongst women than men and is more
32 prevalent in the states of Punjab (30%), Kerala (28%) and Delhi (26%), the states which are
33 relatively richer states in India ⁽⁷⁾. These prevalence ratios are expected to increase in NFHS-4
34 survey. In older adults, obesity exacerbates the age related decline in physical function, which
35 causes frailty, impairs quality of life and results in increases in hospitalization ^(8-9 10). Given the
36 increasing prevalence of obesity and overweight, the most common phenotype may be obese,
37 disabled, older adult ⁽¹¹⁾.

38 With an understanding that heredity plays an important role in influencing body weight,
39 the recent upsurge in the increase of obesity incidence can also be attributed to the shift in diet
40 towards energy rich dense food rich in fat and sugars but low in vitamins and other micronutrients,

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3 41 thereby drastically increasing the calorie intake³. There are epidemiological datasets indicating the
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6 42 increased risk of obesity incidence with chronic intake of fatty diet and frequent consumption of
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8 43 fast food ^(12 13 14 15).

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11 44 Associated with high calorie intake, sedentary lifestyle is a major contributor to obesity¹⁶.
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14 45 Prolonged working hours with shorter sleep duration and night shift working tends to cause
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16 46 disinhibition eating behavior trait significantly increasing the risk of overeating and gaining
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18 47 weight⁽¹⁷⁾. Studies have shown that, people consume more food while watching television than
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21 48 when compared to eating normally ⁽¹⁸⁻¹⁹⁾. The same behavior has been shown to have a direct
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23 49 association with the increasing incidence of obesity and other metabolic disorders ⁽²⁰⁻²¹⁾. National
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26 50 Health and Nutrition Examination Survey shows a close relationship between low levels of
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28 51 physical activity and weight gain in both men and women ⁽²²⁻²³⁾.

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31 52 Although obesity has reached a state that is drawing the attention of the policy makers
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34 53 related to health care delivery systems across the world, there exists a very little evidence from
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36 54 trials regarding the efficacy of weight loss interventions⁽²⁴⁾ (Witham & Avenell, 2010). However
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38 55 there are confounding studies suggesting weight loss in the elderly people might not be beneficial
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41 56 unless there are complications associated with weight. But scientific studies suggest that weight
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43 57 loss in the elderly also helps in minimizing morbidity from arthritis, diabetes and associated cardio
44
45 58 vascular risk factors and improve well-being⁽²⁵⁾ (Elia, 2001). Also, weight loss has been shown to
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48 59 produce beneficial effects on muscle strength, endurance and well-being⁽²⁵⁾ (Elia, 2001).

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51 60 Nature cure alternatively termed as Naturopathy is stated in Oxford dictionary that, 'It is a
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54 61 system of alternative medicine based on the theory that diseases can be successfully treated or
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56 62 prevented without use of drugs, by techniques such as diet, exercise and massage'⁽²⁶⁾ (Oxford
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4 63 Dictionary, 2014). Henry Lindlahr, a naturopath defines Nature Cure as “a system of building the
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6 64 entire being in harmony with the constructive principle in Nature on the physical, mental, moral
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8 65 and spiritual planes of being”. He defines chronic disease as a condition of the organism “in which
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10 66 lowered vitality, due to accumulation of waste matter and poisons, with the consequent destruction
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12 67 of vital parts and organs, has progressed to such an extent that Nature’s healing forces are no
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14 68 longer able to react against the disease conditions by acute corrective efforts (acute reactions like
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16 69 fever, common cold etc.,)”⁽²⁷⁾ (Henry Lindlahr, 1922). The above principles of nature cure are in
17
18 70 tune with the principles of Altruism which are now slowly being understood by the modern
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20 71 science. A recent discovery about the altruistic nature of the stem cells (hESCs) safeguarding a
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22 72 group of cells maintain their ‘stemness’ just by regulating themselves into three paths: they
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24 73 differentiate, they die or they repair the damage in the cell so that they continue their living⁽²⁸⁾
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26 74 (Das et al., 2012). This phenomenon of altruism is expected to enhance by nature cure. Classical
27
28 75 naturopaths have stated that, “Body has got its own recuperative power, through which it can heal
29
30 76 itself when left alone”, which is being understood by the western scientists as demonstrated through
31
32 77 the efficacy of intermittent fasting⁽²⁹⁾ (Varady & Hellerstein, 2007) and calorie restriction⁽³⁰⁾
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34 78 ³¹⁾(Heilbronn & Ravussin, 2003; Hursting, Lavigne, Berrigan, Perkins & Barrett, 2003). However,
35
36 79 most of the beneficial effects obtained through the virtue of Yoga and Naturopathy treatments
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38 80 remain un-elucidated.

81 **Methodology:**

82 **Set Up and Participants:**

83 In this 2 year study, we are presenting the data collected from our Nature cure Hospital set
84 up in South India, in patients diagnosed with obesity from a 10 days yoga and naturopathy based

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3 85 lifestyle intervention. The study was approved by the Institutional Ethics Committee. We recruited
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5 86 100 obese adults of age 38.48 ± 10.86 years, both males and females after getting a written
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8 87 informed consent. The participants were considered eligible for the study if their BMI was more
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10 88 than 30 Kg/m^2 and if their weight was stable for the previous year without fluctuations of more
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12 89 than 2 kg as observed through their past medical records. All patients who were having their BMI
13
14 90 more than or equal 45 Kg/m^2 , unable to perform any physical activity and yoga; or diagnosed with
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16 91 systemic complications like epilepsy, hypertension and other psychological conditions as well as
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18 92 persons who were receiving drugs that affect bone health and metabolism or who were current
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20 93 smokers, were excluded.
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25 94 **Study Outcomes:**

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29 95 The primary outcome was the change from the baseline in the weight. Secondary outcomes
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31 96 included the body composition analysis and lipid profiling of the recruits.
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35 97 **Assessments:**

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38 98 Body weight and BMI were calculated as per the standard procedures. Fat mass, lean mass,
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40 99 visceral fat of the whole body were measured using the Tanita body composition analyzer. Five
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42 100 ml of blood was collected in vacutainers, containing EDTA in the morning following an overnight
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44 101 fast on day 1 and day 11 for estimation of total cholesterol, triglycerides, LDL, VLDL and HDL.
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48 102 **Intervention:**

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52 103 The participants recruited in the study were prescribed a balanced diet that provided an
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54 104 energy deficient of 500 to 800 Kcal per day from their daily energy requirement⁽³²⁾. Apart from
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56 105 the dietary intervention, they were given Yoga sessions comprising of physical postures (*asanas*)
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3 106 and voluntary breath regulation practices (*pranayama*) for a period of 60 minutes and 20 minutes
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5 107 respectively daily for 10 days (**table 1**) and also, naturopathic interventions comprising of steam
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7 108 bath and sauna bath to promote peripheral circulation ^(7 33) & metabolism; massage therapy was
8
9 109 administered to promote relaxation and metabolism. It was advised to all the participants to expose
10
11 110 themselves in the sun for 20 minutes in the morning hours (7:00 AM) to meet their Vitamin D
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13 111 requirements⁽³⁴⁾. Mud Bath, involving application of sun dried, finely powdered clay from the river
14
15 112 beds were applied over the body, which are known to promote free electron transfer from the earth
16
17 113 to the human body thereby neutralizing the free radicals and alleviate inflammation⁽³⁵⁾. Cold water
18
19 114 treatments were employed to activate the thermal centers of the body to stimulate heat production
20
21 115 and increasing the catabolic activity ⁽³⁶⁾.

27 28 116 **Statistical Analysis:**

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31 117 The statistical analysis was performed using SPSS 16. Baseline characteristics were
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33 118 compared with the use of analysis of variance. Longitudinal changes were elucidated with the use
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35 119 of repeated measures analysis of variance, with adjustment for baseline values.

36 37 38 39 120 **Results:**

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43 121 A total of 100 subjects were recruited and monitored. As the subjects were offered with
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45 122 intervention in an in-patient setup, the attendance at all the sessions was complete (100%). There
46
47 123 was no adverse effect observed throughout the duration of the study. A reduction of 3.77% weight
48
49 124 ($p<0.001$), 4.02% of BMI ($p<0.001$), 10.51% of total cholesterol ($p<0.001$), 29.33% of serum
50
51 125 triglycerides ($p<0.001$), 7.97% of LDL ($p<0.001$), and 30.31% of VLDL ($p<0.001$) were observed
52
53 126 following the 10 days nature cure lifestyle intervention. Also, a reduction of 2.75% of fat mass
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55 127 ($p<0.001$), 4.72% of free fat mass ($p<0.001$), 4.68% of muscle mass ($p<0.001$), 4.28% of bone
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3 128 mass ($p < 0.001$), 4.54% of estimated BMR ($p < 0.001$), and 13.64% of estimated reduction in degree
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6 129 of obesity in participants when corrected for their BMI were observed. Interestingly there was a
7
8 130 1.55% increase in the fat indicated by the body composition. However, there were no changes in
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11 131 the HDL levels ($p < 0.001$) following the intervention.

132 **Conclusions:**

133 Obesity and overweight in adults might pose in the near future as a public health problem
134 that challenges the nations' health care professionals and delivery systems. In this 10 days nature
135 cure based lifestyle intervention has shown possible role in reduction of complications through
136 reduction of total cholesterol and circulating free fatty acids. It is also evident from the findings
137 that yoga and naturopathy based lifestyle intervention can ameliorate the cardio-vascular
138 complications as measured through reduction in body weight, BMI and body composition proving
139 it to be beneficial.

140 Evidence based data in the treatment of obesity and overweight is very limited⁽²⁴⁾. Studies
141 so far have focused on the assessment of cardio-vascular functions and insulin resistance. Studies
142 have been conducted to estimate the efficacy of exercise and diet in the management of obesity⁽³⁷⁾.
143 However, yoga and naturopathy based lifestyle interventions though extensively practiced across
144 India and recommended by the Government of India, have not been studied scientifically for its
145 efficacy. Our data are suggestive that, weight loss therapy in adults shall emphasis on promoting
146 physical activity and simultaneously alleviate the associated complications of obesity and
147 overweight.

148 The improvements that were seen in the objective measures suggest the possible ability of
149 the obese adults to maintain their health status. The noted reductions in the LDL, VLDL,

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3 150 triglycerides and total cholesterol levels are suggestive of reductions of complications associated
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6 151 with obesity. However, the complications of obesity and the functional status measured in terms
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8 152 of the maximal exercising capacity are beyond the scope of the present study.
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11 153 A potential adverse effect of our interventions was the reductions in muscle mass and bone mass,
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13 154 which was also observed in other studies having exercise and diet as interventions. In order to
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15 155 combat the loss of bone mass as observed in the earlier studies, we had included sun bath in our
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17 156 intervention. However, the efficacy of sun bath in our study remains un-elucidated. The strengths
18
19 157 of our study includes a controlled design, comprehensive diet and yoga programs with subjects
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21 158 having higher adherence rates and use of objective tools to measure physical functions and present
22
23 159 metabolic status. A limitation of our study is that the subject recruitment was not-randomized and
24
25 160 lack of follow up to understand if the obtained weight loss can be maintained for over a period of
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27 161 time. This study has shown grossly from the reductions in the LDL, VLDL and total cholesterol
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29 162 levels that it should be having a downstream effect in the alleviation of associated complications
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31 163 and progression of the disease. Also, we speculate that the observed effects might be mediated
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33 164 through leptin ^(38 39) currently believed to control body composition largely through hypothalamic
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35 165 receptors that regulate food intake and thermogenesis, which might have contributed to lowering
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37 166 triglyceride formation from free fatty acid and increasing free fatty acid oxidation⁽⁴⁰⁾ .
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45 167 However, further studies are warranted to evaluate the efficacy of the intervention in
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47 168 improving physical performance in obese individuals. In conclusion, our findings suggest that
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49 169 nature cure as a life style intervention improves the obesity state of the individual and may
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51 170 potentially alleviate associated complications of obesity.
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3 172 **List of Abbreviations**
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5
6 173 BMI – Body Mass Index
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9 174 BMR – Basal metabolic Rate
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12 175 EDTA – Ethylene-di-amine tetra acetic acid
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15 176 HDL – High Density Lipoprotein
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18 177 LDL – Low Density Lipoprotein
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21 178 NFHS – National Family Health Survey
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24 179 SPSS – Statistical Package for Social Studies
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27 180 VLDL – Very Low Density Lipoprotein
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30 181 WHO – World Health Organization
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32 182 **References:**
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35
36 ¹ World Health Organization, *Obesity: Preventing and Managing the Global Epidemic*. Geneva,
37 Switzerland. 2000

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41 ² World Health Organization. *Obesity and Overweight*. 2014 [Cited Sep 01]
42
43 <http://www.who.int/mediacentre/factsheets/fs311/en/>.
44

45
46 ³ Finucane MM, Stevens, GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, & Ezzati, M. National, regional,
47 and global trends in body-mass index since 1980: systematic analysis of health examination surveys and
48 epidemiological studies with 960 country-years and 9· 1 million participants. *The Lancet*. 2011; 377(9765):
49 557-567.
50
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56 ⁴ DIaMoND J. Medicine: diabetes in India. *Nature*. 2011; 469(7331): 478-479.
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⁵ NFHS-3: Key indicators for India from NFHS-3. Retrieved from <http://www.rchiips.org/nfhs/factsheet.shtml>, accessed on May 25, 2014.

⁶ Kalra S, and Unnikrishnan AG. Obesity in India: The weight of the nation. *JMNN*. 2012; 1(1): 37.

⁷ Kihara T, Biro S, Imamura M, Yoshifuku S, Takasaki K, Ikeda Y, et al. Repeated sauna treatment improves vascular endothelial and cardiac function in patients with chronic heart failure. *J Am Clin Car*. 2002; 39(5): 754-759.

⁸ Blaum CS, Xue QL, Michelon E, Semba RD, Fried LP. The association between obesity and the frailty syndrome in older women: the Women's Health and Aging Studies. *J Am Geriatr Soc*, 53(6), 927-934.

⁹ Elkins JS, Whitmer RA, Sidney S, Sorel M, Yaffe K, Johnston SC. Midlife Obesity and Long-Term Risk of Nursing Home Admission. *Obesity*. 2006; 14(8): 1472-1478.

¹⁰ Villareal DT, Banks M, Siener C, Sinacore DR, Klein S. Physical frailty and body composition in obese elderly men and women. *Obesity Res*. 2004; 12(6): 913-920.

¹¹ Alley DE, Ferrucci L, Barbagallo M, Studenski SA, Harris TB. A research agenda: the changing relationship between body weight and health in aging. *J Gerontol A Biol Sci Med Sci*. 2008; 63(11): 1257-1259.

¹² Wing RR. Changing diet and exercise behaviors in individuals at risk for weight gain. *Obesity Res*. 1995; 3(S2), 277s-282s.

¹³ Kestens Y, Daniel M. Social inequalities in food exposure around schools in an urban area. *Am J Prev Med*. 2010; 39(1), 33-40.

¹⁴ Gross LS, Li L, Ford ES, Liu S. Increased consumption of refined carbohydrates and the epidemic of type 2 diabetes in the United States: an ecologic assessment. *Am. J. Clin. Nutr*. 2004; 79(5), 774-779.

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- ¹⁵ Malik VS, Popkin BM, Bray GA, Després JP, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation*. 2010; *121*(11), 1356-1364.
- ¹⁶ Tremblay MS, Colley RC, Saunders TJ, Healy GN, Owen N. Physiological and health implications of a sedentary lifestyle. *Appl Physiol Nutr Metab*. 2010; *35*(6), 725-740.
- ¹⁷ Chaput JP, Després JP, Bouchard, C, Tremblay A. The association between short sleep duration and weight gain is dependent on disinhibited eating behavior in adults. *Sleep*. 2011; *34*(10), 1291.
- ¹⁸ Braude L, Stevenson RJ. Watching television while eating increases energy intake: Examining the mechanisms in female participants. *Appetite*. 2014;
- ¹⁹ Lazarou C, Soteriades ES. Children's physical activity, TV watching and obesity in Cyprus: the CYKIDS study. *Eur J Public Health*. 2010; *20*(1), 70-77.
- ²⁰ Thorp AA, Healy GN, Owen N, Salmon J, Ball K, Shaw JE, Dunstan DW. Deleterious Associations of Sitting Time and Television Viewing Time with Cardiometabolic Risk Biomarkers Australian Diabetes, Obesity and Lifestyle (AusDiab) study 2004–2005. *Diabetes care*. 2010; *33*(2), 327-334.
- ²¹ Gupta, R., & Gupta, V. P. (2008). Obesity is major determinant of coronary risk factors in India: Jaipur Heart Watch studies. *Indian Heart J*, *60*, 26-33.
- ²² Smith DE, Lewis CE, Caveny JL, Perkins LL, Burke GL, Bild DE. Longitudinal changes in adiposity associated with pregnancy: The CARDIA study. *JAMA*. 1994; *271*(22), 1747-1751
- ²³ Yaemsiri S, Slining MM, Agarwal SK. Perceived weight status, overweight diagnosis, and weight control among US adults: the NHANES 2003–2008 Study. *Int J Obes*. 2011; *35*(8), 1063-1070.
- ²⁴ Witham MD, Avenell A. Interventions to achieve long-term weight loss in obese older people: A systematic review and meta-analysis. *Age Ageing*. 2010; *39*(2), 176-184.
- ²⁵ Elia M. Obesity in the elderly. *Obesity Res*. 2001; *9*(S11), 244S-248S.

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- ²⁶ Oxford Dictionary. Retrieved from <http://www.oxforddictionaries.com/definition/english/naturopathy>
- ²⁷ Lindlahr H. *Nature Cure: Philosophy & Practice based on the Unity of Disease & Cure*. Chicago: The Nature Cure Publishing Company. 1922.
- ²⁸ Das B, Bayat-Mokhtari R, Tsui M, Lotfi S, Tsuchida R, Felsher DW, Yeger H. HIF-2 α Suppresses p53 to Enhance the Stemness and Regenerative Potential of Human Embryonic Stem Cells. *Stem Cells*. 2012; 30(8), 1685-1695.
- ²⁹ Varady KA, Hellerstein MK. Alternate-day fasting and chronic disease prevention: a review of human and animal trials. *Am. J. Clin. Nutr.* 2007; 86(1), 7-13.
- ³⁰ Heilbronn LK, Ravussin E. Calorie restriction and aging: review of the literature and implications for studies in humans. *Am. J. Clin. Nutr.* 2003; 78(3), 361-369.
- ³¹ Hursting SD, Lavigne JA, Berrigan D, Perkins SN, Barrett JC. Calorie Restriction, Aging, and Cancer Prevention: Mechanisms of Action and Applicability to Humans*. *Annu Rev Med.* 2003; 54(1), 131-152.
- ³² Villareal DT, Apovian CM, Kushner RF, Klein S. Obesity in older adults: technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society. *Obesity Res.* 2005; 13(11), 1849-1863.
- ³³ Tei C, Horikiri Y, Park JC, Jeong JW, Chang KS, Toyama Y, Tanaka N. Acute hemodynamic improvement by thermal vasodilation in congestive heart failure. *Circulation.* 1995; 91(10), 2582-2590.
- ³⁴ Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. *Am. J. Clin. Nutr.* 2004; 80(6), 1678S-1688S.
- ³⁵ Ober AC. Grounding the human body to earth reduces chronic inflammation and related chronic pain. *ESD Journal.* 2003; *July*.

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³⁶ Nadler SF, Weingand K, Kruse RJ. The physiologic basis and clinical applications of cryotherapy and thermotherapy for the pain practitioner. *Pain Physician*. 2004; 7(3), 395-400.

³⁷ Villareal DT, Chode S, Parimi N, Sinacore DR, Hilton T, Armamento-Villareal R, Qualls C, Shah K. Weight loss, exercise, or both and physical function in obese older adults. *N. Engl. J. Med.* 2011; 364(13), 1218-1229.

³⁸ Telles S, Naveen VK, Balkrishna A, Kumar S. Short term health impact of a yoga and diet change program on obesity. *Med Sci Monit.* 2009; 16(1), CR35-CR40.

³⁹ Mammès O, Betoulle D, Aubert R, Giraud V, Tuzet S, Petiet A, Fumeron F. Novel polymorphisms in the 5' region of the LEP gene: association with leptin levels and response to low-calorie diet in human obesity. *Diabetes.* 1998; 47(3), 487-489.

⁴⁰ Shimabukuro M, Koyama K, Chen G, Wang MY, Trieu F, Lee Y, Unger RH. Direct antidiabetic effect of leptin through triglyceride depletion of tissues. *Proc Natl Acad Sci.* 1997; 94(9), 4637-4641.

Table 1

	Pre	Post	Significance	% difference
	Mean ± SD	Mean ± SD		
Height (cm)	1.62±0.08			
Weight	79.48±13.41	76.54±12.88 [#]	p<0.001	↓ 3.77%
Fat	34.67±7.14	35.21±7.49	p=0.019	↑ 1.55%
Fat mass	27.97±8.80	27.21±8.63 [#]	p<0.001	↓ 2.75%
Free Fat Mass	51.70±9.37	49.32±8.69 [#]	p<0.001	↓ 4.72%
Muscle mass	49.19±9.03	46.94±8.22 [#]	p<0.001	↓ 4.68%
Total Cholesterol	191.62±38.14	172.49±32.94 [#]	p<0.001	↓ 10.51%
Serum Triglyceride	171.86±70.61	127.90±52.76 [#]	p<0.001	↓ 29.33%
HDL	39.60±5.93	39.60±7.49	p=1.00	↔ 0.00%
LDL	114.99±37.58	106.18±32.40 [#]	p<0.001	↓ 7.97%
VLDL	35.60±15.49	26.23±10.81 [#]	p<0.001	↓ 30.31%
Bone Mass	2.604±0.45	2.50±0.41 [#]	p<0.001	↓ 4.28%
BMR	1573.91±268.77	1503.99±243.25 [#]	p<0.001	↓ 4.54%
BMI	30.25±4.60	29.06±4.38 [#]	p<0.001	↓ 4.02%
Degree of Obesity	37.39±20.64	32.62±20.01 [#]	p<0.001	↓ 13.64%

Table 1: Table indicating the Mean ± SD values of the variables measured at Day 1 and Day 11.

* p< 0.01; ** p<0.05; # p<0.001