5. DISCUSSION
In the present study, patients suffering from chronic NCDs such as diabetes, anemia, hypertension, obesity and cancer were treated with diets specially designed for each type of patients. The nutrient content and required calories were based on certain principle and thus varied for the patient of one type of disease to other type. It was observed that patients treated with drug along with the diet improved certain physical and biochemical parameters compared to those patients that were treated only with drugs. The changes in blood sugar level of diabetic patients, BMI of obese patients, blood pressure of hypertensive patients and Hb level of anemic patients were well pronounced in response to diet treatment. Though there were changes observed in parameters in response to drug, the magnitude was comparatively less or insignificant in many cases.

Diet and nutrition are important factors in the promotion and maintenance of good health throughout the entire life course of human beings. Diet taken in the form of a variety of right food but in quantities that are too large would yield a large amount of calories and thus have an adverse affect on human body. On the other hand, food with right calories from only one group will lack essential nutrients and would cause serious health problems. Thus maintaining a balance between the two is highly essential for a better health. Each type of cell that constitutes an organ/organ system has a special function. The specialized functions of different cells require nutrients to perform particular roles. Different physiological processes require substances of dietary origin called nutrients. Various nutrients are vitamins, macroelements such as carbon, oxygen, hydrogen, calcium, and magnesium; trace elements such as iron, magnesium, selenium, iodine; as well as copper, zinc, manganese, 8 essential amino acids; and 2 essential fatty acids, without which life would be impossible, (Bourre, 2006).

Lack of suitable diet leads to the cause of various diseases. The role of diet as determining factor of chronic NCDs is well established and occupies a prominent position in prevention activities of the diseases (WHO, 2002). Evidences support the view that alteration in diet has strong effects both on health throughout the life. These effects may be positive or negative as well. Further, adjustments in dietary intake may not only influence present health status, but may determine whether or not an individual will develop such diseases as cancer, CVD and diabetes much later in life.
In many developing countries, food policies remain focused only on under nutrition and are not addressing the prevention of chronic disease.

The world food economy is not static process. It changes with time and leads to gradual shifting of dietary patterns, for example, increased consumption of energy-dense diets high in fat and low in unrefined carbohydrates. These patterns are combined with a decline in energy expenditure that is associated with a sedentary lifestyle, motorized transport, labour-saving devices in the home and thus the phasing out of physically demanding manual tasks in the workplace, and leisure time that is preponderantly devoted to physically undemanding pastimes.

In response to these changes in dietary and lifestyle patterns, chronic NCDs that include obesity, DM, CVD, hypertension and stroke, and some types of cancer are becoming increasingly significant causes of disability and premature death in both developing and newly developed countries (WHO, 2003).

5.1. Effect of diet on diabetic patients

There is much controversy regarding the nature and kind of diabetic diet. Patients suffering from diabetes are usually recommended with diets rich in fibres, low in fat and sugar. In our study, one group of diabetic patients was treated with only drug and the other group was treated with drug along with diet. The diet that that was prescribed consisted of low carbohydrate, low fat, rich in minerals with frequent feeding. The parameters measured were BMI, blood sugar level and blood pressure etc. under the influence of only drug and combination of drug and diet at the same time.

Excess of the body weight is due to accumulation of body fat that leads to an adverse condition on human health (WHO, 2000). This condition is known as obesity and is defined by BMI. Body weight with normal BMI (18.5–24.9) is a desirable for reducing risk factors for various cardiovascular diseases and maintaining a good health. Excessive body weight is associated with various diseases, including T2D and various other diseases and has been found to reduce the life expectancy (Haslam and James, 2005). Reduction of excess weight and attaining a normal BMI could only be
possible by regular physical exercise and intake of a suitable diet. In the present study, the BMI of the diabetic patients that were under combined treatment of drug and diet together declined significantly as compared to patients that were only drug treated. This indicates the decline in body weight of the patients from the above normal level to the range of normal level. As about 88% of the diabetic patients under treatment belonged to non-exercise group and the BMI of comparatively less number of patients responded to drug, it could be assumed that the recommended diet might play a role in reduction of body weight of diabetic patients. Obesity contributes to the development of T2D. Management of weight control efforts are an important component of the clinical management of diabetes. Epidemiological studies have shown that weight change could predict diabetics and lost of weight is known to produce short term improvement in glycemic control in people with T2D. Though lost of weight is associated with diabetes, there is little information that mentions the relationship between weight change and development of diabetics. Many previous studies have shown that BMI and weight gain predict incidence of diabetes (Chan et al., 1994; Hanson et al., 1995; Heilbronn et al., 1999; Newman et al., 1999). Thus to prevent the occurrence of diabetes and reduce the severity of the disease, control of body weight as was observed in our study through a regular and suitable dietary habit along with medication can be recommended.

Type 2 DM results either from insulin resistance in which the cells do not respond properly to the signaling of insulin or due to the deficiency of insulin. In both the cases the blood sugar level rises as it is not metabolized properly. This leads to the development of long term serious complications such as CVDs, renal failure and retinal damage etc. Thus maintaining a normal blood sugar level is one of the very significant clinical aspects of diabetics and can be achieved with diet, exercise and appropriate medication. The medication in T2D mainly includes intake of insulin. Diet along with other factors plays a prominent role in control of blood sugar level of diabetic patients of all age groups. The result of our study reveals that those patients who regularly consumed the recommended diet (low carbohydrate and low fat) along with medication have shown a significant decline in their blood glucose level both fast and post-pondial compared to patients that were following medication but not with a standard food habit. In patients under only medication, less decline in blood glucose level might have happened due to an unhealthy dietary habit. Diets rich in
carbohydrates raise the plasma glucose level, insulin, triglycerides and non esterified fatty acids leading to insulin resistance (Wolever and Mehling, 2003). Also, foods with higher GI and GL are known to cause rapid post-pondial increase in blood glucose and insulin (Jenkins et al., 1981) and have been shown to increase the risk of T2D and CVD in western (Salmeron et al., 1997; Liu et al., 2004) as well as in Asian populations, specifically in China (Villegas et al., 2007) and India (Mohan et al., 2009). This further substantiates that diets should be specially designed for diabetic patients that are low in carbohydrates, low in fats and rich in dietary fibers and its consumption along with medication as undertaken in this study may be considered as an inevitable step for the management of diabetes and thus reducing the health complications.

5.2. Effect of diet on obesity

Obesity caused due to excess body fat has been related to a number of cardiovascular and metabolic disorders such as hypertension, T2D, hyperinsulinemia, dyslipidemia, atherosclerosis, and even certain types of cancers. (Gutierrez Guisado et al., 2008; Ingelsson et al., 2009). In addition to the genetic inheritance, sedentary lifestyle and high caloric intake are the main causes of excessive weight gain (Kemper et al., 2004; Radulian et al., 2009). Changes in dietary habits are essential for weight lost. In our study we designed and recommended low calorie diet to persons with high BMI that consisted of high proteins, moderate carbohydrates, low fat, and rich in vitamin and minerals (Table 3.4). The effect of the diet on body weight was found to be significant. It was observed that the BMI of obese patients declined from above normal value to normal value after 60 d irrespective of male or female, vegetarian or non vegetarian food habit. Though low-carbohydrate diets have often been recommended as effective tools for weight loss over short-term periods, but their long-term effects have not been fully established (Grieb et al., 2008). In contrast, in our nutritional treatment the effect of diet was more pronounced after long term treatment compared to the short term (30 d). Many clinical intervention programs have studied different nutritional treatments in order to improve both weight loss and weight maintenance or associated metabolic related disturbances. These treatments include macronutrient composition (Backes et al., 2008; Brehm and D'Alessio, 2008) incorporation of bioactive ingredients such as fiber (Rodriguez et al., 2005), manipulation of the GI (Abete et al., 2008) and manipulating the composition of minerals such as calcium (Zemel et al., 2005) and selenium (Zulet et al., 2009) etc. It
has been observed that low-GI could cause rapid weight loss, control and management of blood glucose and insulin level, reduction in triglycerides and blood pressure (Agus et al., 2000; Pereira et al., 2004). Further it has also been evidenced that diets moderately rich in proteins and modestly restricted in carbohydrates and fat have beneficial effects on body weight homeostasis. Thus a diet designed that contains moderately high protein, low-GI carbohydrates and fat have beneficial effects that contribute to eight loss and weight control and could be used as an alternative to conventional diets (Muzio et al., 2007).

5.3. Effect of diet on hypertension

Hypertension is the condition that elevates the arterial blood pressure. Under this condition the heart has to work harder than normal to circulate blood through the blood vessels. Thus, it poses a major risk factor for stroke, myocardial infarction (heart attacks), heart failure and chronic kidney disease. Diet plays a vital role in control of hypertension. In this study, persons with hypertension were treated with the designed diet to control the BMI and blood pressure. Excess body weight was not found in all the hypertensive patients. The diet consisted of normal calories with moderate proteins, and carbohydrates, low fat, vitamins and minerals rich and low sodium. Though the body weight of the patients was not significantly affected but was controlled. However, the blood pressure of almost each individual decreased from a higher value towards normal even after 30 d of treatment. This indicated the importance of the dietary manipulation in control of the hypertension. Many studies have been conducted to study the effect of different food types on hypertension. Reddy and Katan, (2004) have reviewed the effect of diet and nutrition on hypertension and other cardiovascular diseases. Composite diets (such as DASH diets, Mediterranean diet, ‘prudent’ diet) are known to reduce the risk of hypertension and coronary heart diseases. Dietary sodium is associated with elevation of blood pressure, while dietary potassium lowers the risk of hypertension and stroke (Reddy and Katan, 2004). Fruits and vegetables when taken regularly and frequently have been demonstrated to be protective against hypertension (Ness and Powles, 1997). A reduction in blood pressure in patients that were recommended the diet with low sodium and containing fruits and vegetables has also been observed in this study. Thus these studies including the present one reveal that recommendation of diet or
dietary intervention is required at various levels to decrease the rate of hypertension and associated risk factors including cardiovascular diseases.

5.4. Effect of diet on anemia

Anemia is the most common disorder of the blood. This study was conducted to find out the effect of diet on Hb level of anemic patients irrespective of the cause of the diseases i.e. due to lack of iron or chronic immune activation. Dietary iron deficiency is usually the major contributing factor for anemia. Though there may be many causes of anemia, nutritional deficiencies (e.g. low intakes of folic acid and vitamins A, B\textsubscript{12}, and C) and infectious diseases (e.g. malaria and hookworm) also contribute to the prevalence of anemia. To avoid the deficiency of nutritional factors anemic patients were treated with the designed diet that consisted of high protein, low carbohydrate and very rich in minerals and vitamins. The menu along with other standard foods consisted of spinach and other leafy vegetables. These patients were also given drugs that was mostly iron rich. Another group of patients were treated only with drugs and were taking their diet as usual. The results of this study revealed that the body weight of a significant number of patients that were taking both drug and designed diet improved compared to those anemic patients that were treated with only drug along with their normal diet (Fig. 4.5). This shows the positive effect of a diet on anemic patients. The other important parameter that was studied was Haemoglobin content of anemic patients. The Hb level of both male and females increased in both the groups. However the level of Hb increased very significantly in 80% individuals after 60 d of diet treatment (Fig. 4.7 and 4.8). It has been observed that iron deficiency anemia restricts physical growth and development of humans. Iron deficiency anaemia is known to delay the psychomotor development and impair the cognitive development in children in several countries including India (Seshadri and Gopaldas, 1989). It is also known to impair the cognitive development at all stages of life. Studies have shown that anemic workers are less efficient compared to non-anemic workers. Diet plays a major role in prevalence of anemia in pregnant women (Sharma et al., 2003). In our study we have observed that changes in dietary habit has significantly improved the Haemoglobin level of pregnant women subjects. Thus the findings of these studies pertaining to the effect of iron deficiency anemia on various health aspects and the effect of diet on elevation of Hb level as has been observed in the present study warrants a screening programme for identifying the anemic person belonging to
various socio-economic groups due to iron deficiency. Further, the identified anemic persons may be recommended the designed diet to bring the level of Haemoglobin to non-anemic level.

5.5. Effect of diet on carcinoma patients

Many things are known to increase the risk of cancer. These include use of tobacco, certain infections, radiation exposure, lack of physical activity, environmental pollutants and dietary factors. About 80-90% of cancers are caused by environmental factors and half of these are caused due to diet. Several dietary recommendations have been proposed to reduce the risk of cancer and improve the health status of cancer patients. In this study, cancer patients were recommended with diets of normal calorie that consisted of moderate carbohydrate, high protein, rich in vitamins and minerals. The diets were also rich in vegetable and fruit juice. A noticeable difference was observed in BMI, Hb level, and blood pressure of the patients that took the recommended diet as per the routine (Fig. 4.15-4.18 and table 4.4). The BMI of the patients increased from below normal to normal value in many cases. This indicated us an increase in body weight of these patients. Other parameters like Hb concentration also significantly increased in the patients. The blood pressure of many of the carcinoma patients shifted to normal range when treated with recommended diets for long term. The role of diet towards cancer varies greatly according to the type of cancers (Anand et al., 2008; Willett, 2000). In our study, the recommended diet never consisted of meat and other non vegetarian food items. The heavy consumption of red meat is the main cause of several cancers including gastrointestinal tract and colorectal (Chao et al., 2005; Hogg, 2007), prostate (Rodriguez et al., 2006), bladder (Garcia-Closas et al., 2007), breast (Tappel, 2007), gastric (Hanlon, 2006) and oral cancers (Toporcov et al, 2004). On the other hand, it has been observed that a low intake of fresh fruits and high cooking temperatures in Indian dishes may account for low levels of vitamin C, resulting into higher risks of stomach, mouth, pharyngeal, esophageal, lung, pancreas, and cervical cancers (Chandalia et al., 2003). Studied have revealed that vegetarians have a lower risk of esophageal (Roa, 1997), oral (Roa et al., 1994) and breast cancers (Jain et al, 1999). Beans, chickpeas, lentils and pulses are the principal components of vegetarian diet and are a rich source of proteins. Consumption of these foods is significantly associated with reductions in cancer (Jain et al., 1999; Mills et al., 1989). The Indian diet containing adequate
quantities of vegetables, fruits, and fiber rich grains provides protection against the increased risk of colon and breast cancers (World Cancer Research Fund, 1997). These studies along with the present study pertaining to the effect of diet on cancer patient highlights the importance of dietary habits both in prevention and control of the diseases and improving the health status of the patients.

In conclusion, diets designed for obese, diabetic, hypertension, anemic and carcinoma patients could be prescribed for these patients in controlling the body weight, blood glucose level, blood pressure, Hb level etc. These diets when taken along with the prescribed drug have a better effect as compared to the patients that are only drug treated. Therefore, the role of diet in prevention as well as control of various diseases is noteworthy and can not be undermined. Thus, the type of diets and its menu designed by experts based on the severity of the disease, age, sex and other conditions would have immense effect both in prevention and control of various chronic diseases and he mechanism of action of the diet on various parameters warrants further investigation.