Diet and Lifestyle to Prevent, Control or Reverse Type 2 Diabetes

Smrithy Divakaran[1]* and Sasidharan PK[1,2]

[1]Department of General Medicine, PVS Hospital, Kerala, India

[2]Department of Medicine & Hematology, Government Medical College, Kozhikode

Abstract

Background: Several advances have taken place in diagnosis and medical management of diabetes, but we have been ignoring the most ideal primary management of diabetes with diet and lifestyle modification. Diet and lifestyle modification can halt the progress or even reverse the course of diabetes at least in some persons.

Objectives: The study was to assess the effect of weight reduction by diet and lifestyle modifications on blood sugar levels.

Methods: It was a prospective observational single cohort study in overweight diabetics who could achieve weight reduction with diet and lifestyle over a period of one and half years. Subjects were motivated by repeated counseling; using diet charts developed by us, and educated about diet and lifestyle modification. Fifty consecutive patients who complied with the lifestyle modification and achieved at least 3 Kg of consistent weight loss on follow up were taken for analysis.

Results: 44 subjects out of 50 were found to be overweight but 70% only agreed to have put on weight others were not even aware of being overweight. The mean body weight of the subjects at the time of inclusion was 69 Kg and after intervention came down to 63 Kg. The mean FBS before intervention was 174 mg/dL which came down to 119 mg/dL after intervention and this was statistically significant.

Conclusion: Diet and lifestyle modification by patient education is the corner stone in diabetes management, and it is possible to control diabetes or even reverse it if the intervention is done early.

Keywords: Diabetes reversal; Balanced diet; Diet and lifestyle; Weight reduction; Blood sugar control

OPEN ACCESS

Introduction

Type 2 diabetes was a rare disease once but is assuming pandemic proportions with its accompanying mortality and morbidity due to its vascular complications. Several lifestyle and dietary factors influence the prevalence of diabetes in any region and identification of these factors is necessary to modify the course of the disease. Environmental influences due to urbanization leading to overeating reduced physical activity and unmanaged stress are the prime culprits. India ranks second in diabetic population with a prevalence of 8.7% [1]. Among the states in India, Kerala is the diabetic capital of India with the highest prevalence of 20% [2,3]. Several advances have taken place in diagnosis and medical management, but none of these has effectively controlled type 2 diabetes and modified its accompanying or coexisting problems. Being a lifestyle disease, the management should have been modifying lifestyle and diet and drug therapy only as a last resort. Diet and lifestyle modification can halt or even reverse the course of the disease [4]. Unfortunately, majority with diabetes have no awareness on how to modify their diet and lifestyle or they do not give importance to it. In this study, we tried imparting knowledge regarding proper balanced diet with carbohydrate and calories restriction and lifestyle changes to overweight diabetics, with an intention to achieve weight reduction and assessed the effect it on well-being and blood sugar levels.

Objectives

To assess the influence of diet and lifestyle modification with weight reduction on fasting blood sugar levels in overweight/obese diabetic patients.

Materials and Methods

It was a prospective observational single cohort study conducted in the Department of General Medicine of PVS Hospital, Kozhikode, Kerala. Subjects who attended the General Medicine outpatient department during the period January 2017 to July 2018 and satisfied the inclusion criteria were taken for the study. Overweight or obese patients above 18 years of age with history of uncontrolled type 2 diabetes and those who gave history of weight gain from their previous normal weight before developing diabetes, were recruited. For the study purpose, the previous normal weight was taken as the lowest recorded weight after completion of skeletal maturity, at the age of 18 to 20 years, or when they were healthy and physically active. We recruited all consecutive overweight obese diabetics and gave instructions and tips on diet and lifestyle modifications and were kept under follow up for one year. Subjects were motivated by repeated counseling, using diet charts developed by us (Figure 1 & 2) and educated about lifestyle modification and periodic follow up was done to assess weight reduction and fasting blood sugar levels. The effect of weight reduction on fasting and post prandial blood sugars levels were assessed on follow ups, till adequate sample size was got and it is an ongoing work. Fifty consecutive patients who complied with the lifestyle modification and achieved at least 3 Kg of consistent weight loss were taken for analysis. Subjects with type 1 diabetes, lean diabetics- BMI<18.5, pregnant or lactating mothers, those with end stage disease, severe cognitive impairment, or psychiatric disease that interferes with memory and compliance, subjects on glucocorticoids or agents causing hyperglycaemia were excluded from the study. The Institutional Ethics Committee (IEC) of the PVS hospital, Kozhikode at its meeting on 31st July 2017, approved the project and gave sanction for the human studies, informed consent was obtained from all participants, and the study was conducted in line with the guidelines outlined in the Declaration of Helsinki.

Study Tools

Semi structured questionnaire was used to collect data on diet and lifestyle. Questionnaire included type of food intake, frequency of intake of items like vegetables, fruits, and protein rich food. Dietary history was collected by 24-h recall method and the frequency over a week. Adequate fruits intake should be 100 gm fruits/day in three servings and vegetable intake more than 300 gm vegetables/day in 3 servings [5]. Use of alcohol, smoking, and other addictions were enquired. Type, duration and frequency of physical activities and leisure activities were recorded, and the physical activity was assessed based on International physical activity questionnaire, IPAQ. Height and weight were measured at recruitment and weight monitored periodically. Information regarding duration of diabetes, medications, complications and regarding comorbidities like NASH, hypertension, ischemic heart disease were collected. All subjects were evaluated to rule out any organ failure. BMI was calculated and classified based on the Asian criteria for BMI [6]. The diet plan developed by us with a pictorial representation of the quantity/proportions and quality of foods were given for easy understanding (Figure 1 and 2). They were asked to reduce calorie rich foods to at least 50% or as less as possible and to increase the proportion of high fiber vegetables in order to restrict caloric intake. With the Figure 2 they were instructed to eat to fill only half the capacity of the stomach, and were instructed to restrict eating to a maximum of three times a day and to avoid all snacks, all fast foods, junk foods as sweets. We advised all of them to start their meal with large amount of high fiber vegetables, either
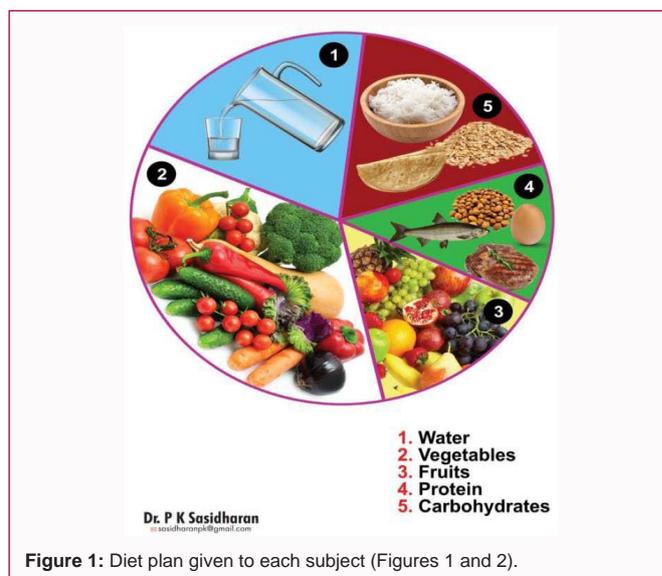

Figure 1: Diet plan given to each subject (Figures 1 and 2).

in the form of salads, soups or curries, along with a small fruit (30 gram to 50 gram) and one glass of water before eating calorie- rich foods (Figure 1). Taking fiber rich vegetables fruits and water initially helped in reducing the need for calorie-rich foods and ensured that they got all the essential nutrients and vitamins.

Hypoglycemic agents like insulin and sulfonylurea were stopped completely at the first visit itself and all the subjects were put on Metformin alone, in order to avoid the risk of hypoglycemia, which would interfere with the goal of achieving weight loss. Metformin was used at 500 mg to 1000 mg twice daily to a maximum of 2 gm/day. Subjects were motivated at each visit to change their dietary habits and to take the tablets regularly. Fasting Blood Sugars (FBS) were recorded in the first visit and weight and FBS were monitored at each subsequent visit. Since the primary objective was to achieve weight reduction, all subjects were given individualized practical tips to restrict calories in comparison to their previous level of intake, and it was a huge task which was time consuming. Physical activity at the time of developing diabetes was assessed. Subjects who were involved in physical activities were asked to continue it or increase it. Subjects engaged in sedentary or light physical activity were advised and regularly motivated to walk briskly, or do some aerobic exercise. They were given individualized practical tips on increasing physical activity too. Subjects were also motivated to refrain from alcohol and smoking. Subjects were advised weekly review for the first 3 weeks to 4 weeks. If the blood sugars and weight showed a falling trend, they were asked to review after a month with FBS. If the blood sugars and body weight remained high, they were motivated again for lifestyle modification and calorie cutting and reviewed weekly with FBS till their blood sugars and body weight showed a falling trend. Thereafter, monthly reviews were maintained for continued motivation. Fasting blood sugars was measured at each visit and the average of two fasting blood sugars at the initial visit and after one year were used for comparison. Those who failed to achieve weight reduction were not taken for analysis. HbA1C was not done as a measure of cost cutting; instead we depended only on repeated FBS and the subjects' feeling of well-being. Data was analyzed using SPSS 21.0 and graphs were depicted using Microsoft Excel. Continuous variables were summarised as Mean ± Standard Deviation or with median. The Paired continuous variable was tested using paired t test. Comparison of continuous variables between two groups was performed using

independent sample t test. Categorical data was summarized in terms of frequency with percentage. For all tests p value <0.05 was considered statistically significant.

Results and Discussion

All the participants who were compliant to lifestyle intervention and diet modification, were able to achieve weight loss, those who were noncompliant and did not achieve weight reduction were excluded from analysis. 58% of the subjects were males and 42% were females, the male predominance is in concordance with the higher prevalence of Diabetes in men compared to women in Kerala [7,8].

BMI of the Subjects

Altogether the percentage of overweight, pre-obese and obese subjects constituted 88%. Only 12% had apparently normal BMI, but even those subjects had history of weight gain from their original normal weight, this observation points towards the aetiology of diabetes-overeating and physical inactivity as the major two factors and the third being unmanaged stress [4,9]. Despite being overweight, only 35 patients (70%) gave history of weight gain in the recent past. This must be much more than 70%, since many are not in the habit of monitoring the weight or do not care about small weight gains. Similar studies have shown a prevalence of obesity varying between 71% to 84% in the diabetics [10,11,12]. The rising prevalence of obesity is a matter of great concern since it is a modifiable risk factor for diabetes and other lifestyle diseases.

Weight Loss after Dietary Modification

After meticulous dietary modifications and constant motivation, after a year there was significant weight loss in all selected subjects. Weight loss could be achieved either by calorie restriction and increased physical activity but we focused more on the dietary aspect in this study. The mean body weight of the subjects before intervention was 69 Kg and after the intervention 63 Kg. The difference between weights before and after lifestyle modification was found to be statistically significant with p value <0.001. Weight loss was seen to be higher in the pre-obese group, but no statistically significant association was seen between the two variables (p=0.108).

Change in FBS after Lifestyle Modification and Weight Reduction

One year after the lifestyle intervention, 40 subjects out of 50 had normalized their blood sugar levels. In some of the newly developed diabetics we could even stop Metformin. The mean FBS before intervention was 174 md/dl which came down to 119 mg/dl after intervention and this was statistically significant (p<0.001). The association between change in FBS and change in weight before and after intervention also was statistically significant (p=0.02). But 10 subjects had an increase in their FBS even though insulin and all the drugs except Metformin had been discontinued in them too. They were found to have increased FBS, because they were less compliant with dietary habits. Still all of them had more energy levels and physical well-being as compared to their previous status. The weight loss in this group was less than 4 Kg only. Our results give the impression that our primary concern should be calorie restriction, with intake of a balanced diet and weight reduction and not on blood sugar control alone. Our findings were correlating with similar lifestyle intervention studies done previously [13,14].
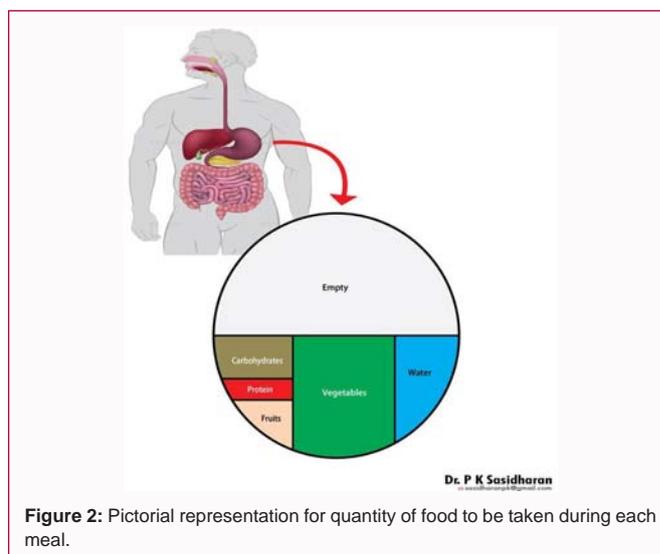

Figure 2: Pictorial representation for quantity of food to be taken during each meal.

Treatment Profile of the Subjects

At the time of enrolment, 60% of the subjects were on two or more drugs and insulin for control of blood sugars (not of diabetes), which was gradually tapered and good control of blood sugar could be achieved with diet and Metformin alone. We could stop all the medicines including insulin and continued only on Metformin thereby reducing the cost of therapy. Guidelines for type 2 diabetes recommend starting pharmacotherapy only after diet and lifestyle modifications fails to achieve good control of blood sugar levels and Metformin as the first line oral drug for overweight diabetics. But physicians often ignore the difficult job of diet and lifestyle modification, shifting their focus to achieving normal blood sugars and HbA1C, using multiple drugs including sulfonylurea. But weight reduction is absolutely essential to prevent organ damage in type 2 diabetes and it is impossible to achieve weight reduction on sulfonylurea and insulin. Sulfonylurea is a wrong medication in overweight or obese diabetics and even use of insulin is unnecessary in overweight diabetics unless there are some specific reasons [15]. But nowadays, it is seen that there is rapid escalation of drugs for intensive control of glycemic levels without assessing their weight, diet and lifestyle, which causes weight gain and further worsening of insulin resistance and organ damage. In our study, majority of the subjects recruited were on multiple drugs, with increased cost of treatment and even poor compliance, but none of them were previously advised by their doctors to restrict calorie intake and modifying lifestyle.

Dietary habits: Awareness regarding diabetes, risk factors, complications and awareness on balanced diet was seen only in 30% of the subjects. All had increased calorie intake and 70% had inadequate protein intake too. Only 16 % took adequate vegetables and only 6% of them included fruits in their diet. We found lots of misconceptions regarding diet among the subjects. None of the subjects believed that they were eating more than what they needed and never realized that they were overweight. It was a huge task to convince the patients that they were consuming excess calories and that they were overweight as they always tend to compare their weight with the people around them who are mostly overweight. After convincing the subjects that they are overweight, the next task was to motivate them to restrict caloric intake to achieve weight reduction and the personal sessions at each visit was needed to motivate and give them practical tips for

weight loss. The reasons for the extra caloric intake and the ways to reduce caloric intake was given to every patient after assessing the caloric requirement based on their physical activity and assessing their calorie intake by dietary questionnaire. High fiber vegetable intake was found to be very low with only 16% of the subjects taking apparently adequate amounts. This was primarily due to lack of awareness of importance of vegetables in diet, wrong concepts regarding what constitutes vegetables and undue awareness and fear of insecticides in vegetables. Most of them considered potatoes, tapioca and similar roots and tubers and unripe jack fruit as vegetables and consumed them along with rice or wheat leading to excess calorie intake. In fact, lack of inclusion of high fiber vegetables in the diet was primarily responsible for the higher consumption of calories. The subjects had to be given practical tips on what all vegetables they should include in each meal and the desirable proportions as given in Figure 1. We advised all of them to start their meal with large amount of vegetables, either in the form of salads, soups or curries, along with a small fruit and one glass of water before eating calorie- rich foods as per the diet plan. Taking fiber rich vegetables initially helped in reducing the need for calories and also ensured that they got all the essential nutrients and vitamins which were usually missing in the diet.

Majority were avoiding fruits altogether in their diet for fear of losing control of blood sugars. They were not aware of the fact that regular consumption of fresh whole fruits is beneficial to diabetics. Only 6% of the subjects consumed adequate fruits in their diet and thus they were getting deprived of the essential vitamins, antioxidants and minerals which are needed in the body to protect against complications of diabetes. If at all they consumed fruits occasionally, many were taking dry dates or boiled banana as fruits which was just giving them excess calories only without any benefit of the fruits. There are studies showing massive increases in per capita calorie consumption with reduced intake of vegetables and fruits in the subjects with diabetes [16,17]. But these observations also do not help manage diabetes in a given person, unless we study that individual for habits and environmental influences on calorie consumption, since the reasons vary from person to person and should be analyzed and plans should be individualized to achieve calorie restriction. The counseling should be given to other family members as well. We studied each subject along with their family members and they were given personalized diet plan to achieve calorie restriction. This approach was contrary to the popular practice where the focus of diabetic control is centered on use of hypoglycemic agents, blood glucose levels, and HbA1C levels and less importance is given to weight reduction.

Physical Activity among the Subjects

Only 14% were involved in high physical activity and 56% of the subjects in our study were involved in very low or no physical activity and had a sedentary lifestyle. Our focus was more on calorie restriction, but we gave tips on increasing their physical activity too. Studies had shown increasing physical activity by structured training was found to be more effective than unstructured physical activity [18]. In our population, considering the limited availability of training centers, economic/time constraints, decreased awareness regarding such exercise programs, advice on increasing unstructured exercise only was given as it was more feasible and could be easily followed by the subjects. We could have achieved more weight reduction if we had combined diet modification with structured physical activity as well, which is a limitation of our study. It is seen that even though many

of the clinical guidelines recommend exercise while managing type 2 diabetes, only 30% to 40% people with diabetes are seen to engage in regular exercise in spite of proper advice [19]. Physical activity was found to be comparatively higher in the lower socioeconomic status. This may be due to their occupation, making them getting involved in more often in manual work as part of their work. Most subjects belonging to middle class and upper class were found to be having lower level physical activity, due to their jobs which require less activity and access to modes of transport and amenities which decrease the need for exertion and physical activity.

Compliance with Lifestyle Modification Advices

We could achieve weight reduction in almost all our subjects, though for the study purpose we did not include those who did not achieve weight reduction. The good compliance seen in our study was only due to regular personal counseling sessions, encouraging frequent follow up visits, maintaining a good rapport, not only with the subjects but also their spouses and caretakers. Patient non-compliance is a substantial obstacle to the achievement of therapeutic benefit from lifestyle modification. Our study underscores the important issue of patient education, good physician-patient relationship and persistent motivation for calorie reduction, lifestyle changes and patient compliance. Similar strategies have been explained by Marshal et al. to improve compliance among patients during lifestyle modification [20]. Thus proper lifestyle modification is feasible and is a better option in type 2 diabetics, which should be implemented through the primary health care while managing them.

Literacy and Awareness Regarding Diabetes

Kerala being a state with high literacy rate, majority of the participants were well educated, but awareness regarding the disease and its risk factors was seen only in 30% [21]. This observation underscores the importance of health education in primary care and school health programs.

Socioeconomic Status and Calorie Intake

Seventy six percentage of the subjects belonged to the middle class which is similar to the previous studies [7,8]. BMI was predominantly higher in the middle class. The Scenario in the study subjects is a representation of the developing and developed societies where there is less physical activity with increased calorie intake under the influence of consumerist forces. This shows that we have to give more stress on the entire society, especially the middle class in changing their diet and lifestyle by sustainable and regular awareness programs through primary care.

Comorbidities in the Subjects

Comorbidities were seen in 34 subjects out of fifty. Eighteen (18) subjects were found to be hypertensive of whom 4 were detected during the evaluation, suggesting a high association between the two because of obvious reasons. SGPT elevation was seen in 16 subjects due to Non-Alcoholic Fatty Liver Disease (NASH). Six subjects had both hypertension and NASH. Nine subjects had history of ischemic heart disease and were on antiplatelets and statins.

Conclusion

Weight reduction, with diet and lifestyle modification leads to normalization of blood sugars and if started early it would even

reverse type 2 diabetes. Increased consumption of high fiber vegetables is the key to calorie restriction or lack of inclusion of adequate proportion of high fiber vegetables is primarily responsible for the higher consumption of calories. Diabetes, Hypertension and NASH coexist. Fruits intake is almost absent in the diabetics due to fear of loss of control. It is possible to reduce the cost of therapy and pill-burden in overweight diabetics with diet and lifestyle intervention. Increasing the physical activity along with calories restriction is the ideal management for diabetes.

Recommendations

Individualized attention and care are needed to change diet and lifestyle and it would be better done at primary care level. There is an urgent need to create awareness regarding diabetes and the need to achieve weight reduction by calorie restriction and physical activities. People need to be taught about properly balanced diet with inclusion of higher proportion of high fiber vegetables, adequate fruits and protein intake and the bad effects of increased calorie intake. We need to develop strategies to motivate diabetics and the whole society for lifestyle changes, rather than focusing on intense blood sugar control after the development of diabetes. There is an urgent need to create awareness on diabetes prevention and control of it with weight reduction. Educating children and adolescents for good eating habits or for changing it early in life can prevent several lifestyle diseases which are growing exponentially nowadays due to bad eating habits.

References

1. World Health day 2016: Diabetes. South East Asia Regional office. 2017 [cited 11 October 2017].

2. Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 DM: Indian scenario. Indian J Med Res. 2007;125(3)217-30.

3. Thankappan KR, Shah B, Mathur P, Sarma PS, Srinivas G, Mini GK, et al. Risk factor profile for chronic non communicable diseases: Results of a community-based study in Kerala, India. Indian J Med Res. 2010;131(4):53-63.

4. Sasidharan PK, Diabetes and our health care, how to prevent Diabetes? Chapter 5, Heal-thy India, Untold secrets of Health care.1st edition.: Jaypee Brothers, New Delhi;2017

5. Dietary guidelines for Indians, National institute of nutrition, Hyderabad. [Internet] Ninindia.org. 2018.

6. Appropriate body mass index for Asian populations & its implications for policy & intervention strategies. The Lancet. 2004;363(9403):157-63.

7. Vijayakumar G, Arun R, Kutty VR. High prevalence of Type 2 DM & other metabolic disorder in rural central Kerala. JAPI.2009;57(1):563-7.

8. Harikrishnan S, Sarma S, Krishnan MN, Venugopal K, Mohanan PP, Jeyaseelan L, et al. Prevalence of metabolic syndrome & its risk factor in Kerala, south India: Analysis of a community based cross sectional study. PLOS ONE. 2018.

9. Sasidharan PK. Nutrition and balanced diet, chapter 51, Doctor's Pocket Companion, Jaypee Brothers, New Delhi. 2nd Ed. 2019;1222-49.

10. Akholkar PJ. Prevalence of obesity in diabetic and non-diabetic population. Int J Res Med Sci. 2015;3(8):2114-7.

11. Dausi C, Casson F, Gill GV, Pinkney JH. Prevalence of obesity in type 2 diabetes in secondary care. Association with cardiovascular risk factors. Postgraduate Med J. 2006;82(966);280-4.

12. Patel M, Patel I, Yash M, Rathi SK. A hospital based observational study of type 2 diabetes subjects from Gujarat. India J Health Population. 2011;9(3):265-72.

13. Gregg WE, Thompson TJ, Williamson DF, Gerzoff RB. Trying to lose weight, losing weight & 9 year mortality in overweight U.S. adult with diabetes. Diabetes Care. 2004;27(3):657-62.

14. Deshmukh SM, Lifestyle modification on control of Diabetes mellitus. Int J Diab Dev. Countries. 2000;20(1):89-97.

15. American Diabetes Association. American Diabetes Association Clinical practice recommendations. Diabetes Care. 2007;30:S1-S1O3.

16. Schmidt MI, Duncan BB, Canani LH, Karohl C, Chambless L. Association of waist hip ratio with Diabetes mellitus. Strength and possible modifiers. Diabetes care. 1992;15(7):912-4.

17. Steven S, Hollingsworth KG, Avery L, Aribisala B, Caslake M, Taylor R, et al. Very low-calorie diet & 6 months of weight stability in Type 2 Diabetes. Pathophysiological changes in responders & non-responders. Diabetes Care. 2016;39(6):808-15.

18. Sanghani NB, Parchawani DN, Palandukar KM, Shah AM, Dhanani JV. Impact of lifestyle modification on glycemic control in patients with type 2 diabetes mellitus. Ind J Endo & metabolism. 2013;17(6):1030-9.

19. Plotnikoff RC, Johnson ST, Loucaides CA, Bauman AE, Karunamuni ND, Pickering MA, et al. Population based estimates of physical activity for adults with type 2 DM: A cautionary tale of confounding by weight status. J Obes. 2011;1(5):1-5.

20. Marshal H, Becker LA, Strategies for enhancing patient compliance. J Community Health. 1980;6(2):113-35.

21. Census 2011. Office of the Registrar General & Census Comissioner, Ministry of home affairs, GOI, New Delhi; 2001.