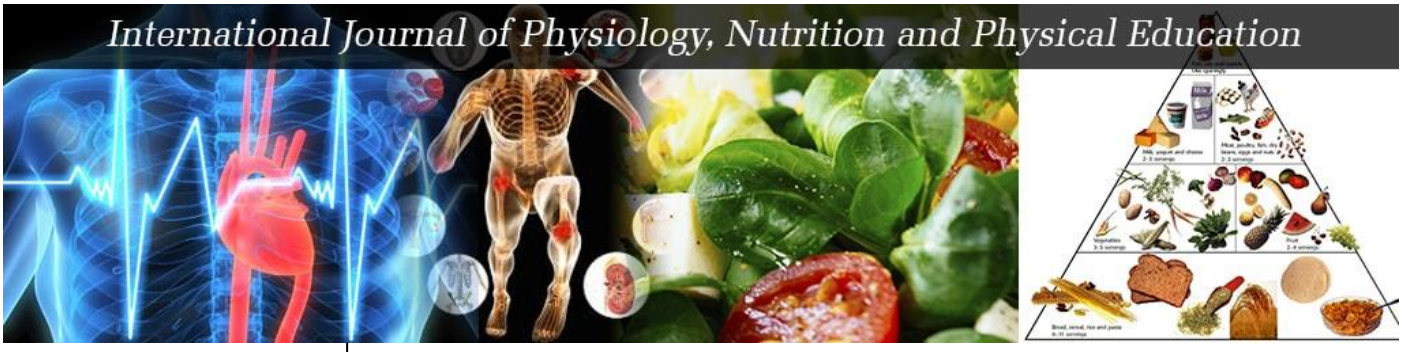

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Effect of physical activity and diet in the control of metabolic abnormalities: A case report in Tamil Nadu, India

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Abstract
Globally, in the present scenario, there is a notable change in the eating habits and physical activities of the people and has risen the chances of the risk of metabolic abnormalities. These conditions, end up with a number of non communicable diseases, that decreases the quality of life of people and increases the economic burden of the individual, the family and the society. Initiation of life style modifications, at an early stage may help to over the risk of metabolic abnormalities. Modifications of dietary habits and physical activity have proved to be successful in correcting the metabolic abnormalities.

Keywords: dietary habits, physical activity, metabolic abnormalities, diabetes mellitus, lipid profile

1. Introduction
Globally, there is increasing evidence for the existence of metabolic disorders among the population, irrespective of the age. Manual activities have been replaced by means of modern machineries, equipments and automobiles and as a result, there is marked decrease in the physical activity of the people and this has been confirmed through several research works. Furthermore, urge for the taste of food and to cope up with the present faster world, the eating habits of the people have been changed to a larger extent and all these have ended up with several ailments among the population. The unhealthy habits, can be turned right through following healthy life style practises. Hence, life style modifications particularly in terms of food habits and physical activity is required to sustain a healthier life. In recent days, new management and preventives approaches have been evolved and several research work have been concentrating in rendering better management approach, in preventing and managing the metabolic disorders of the people [1]. A case presentation of metabolic disorders and the successful management approach is presented below.

2. Case presentation
An adult male, thin built, has been referred for dietary modifications and presented with complaints of uncontrolled diabetes and high lipid profile.

2.1. Assessment of Health Record
On examination of the earlier health reports of the subject, it was observed that his body weight was 76 kg and measured about 1.711 metres in height. Biochemical investigations showed that his haemoglobin level was 15 g/dl, fasting blood sugar as 202 mgs% and HbA1c of 8.8%. Further, the lipid profile of the subject showed that his total cholesterol level as 236 mg/dl, triglycerides as 643 mg/dl, High density lipoproteins as 37 mgs/dl, low density lipoproteins as 134 mgs/dl, very low density lipoproteins as 62.4 mgs/dl with Cholesterol and High density lipoproteins ratio of 6.3. The biochemical values of the subject is presented in the Table No.1.

Table 1: Bio-chemical investigations of the subject

Parameters	Value	Reference Value
Haemoglobin g/dl	15	11.7–16.6
Blood Sugar fasting mg/dl	202	80–116
Blood Sugar Post Prandial mg/dl	328	140 - 160
Urine Sugar	Nil	-
HbA1C	8.8	Below 6
Lipid Profile		
Total Cholesterol mg/dl	236	124–263
Triglycerides mg/dl	643	58–277
High Density Lipoproteins mg/dl	37	26–65
Low density lipoproteins mg/dl	134	64–180
Very low density lipoproteins mg/dl	62.4	
Cholesterol HDL ratio	6.3	
Liver function and kidney function test of the subject		
Urea mg/dl	16	15 - 40
Creatinine mg/dl	1.2	0.7–1.3
Uric acid mg/dl	7.8	3.5–8.3
Total protein g/dl	7.6	6.7–8.5
Serum Albumin g/dl	4.6	3.9–5.0
Serum Globulin g/dl	3.0	2.4–4.0
A/G ratio	1.53	

Further, the Liver function and kidney function tests were found to be within the normal limits.

2.1. Current and past dietary intake assessment

The dietary pattern and the dietary intake was assessed through food frequency questionnaire and 24 hour dietary recall method for 3 days, respectively. According to the dietary guidelines of Indians, a sedentary man has to consume at least 100g of fruits and 500g of vegetables a day (200g of other vegetables, 200g of Roots and Tubers and 100g of green leafy vegetables) and all five food groups has to be present in the daily menu plan [2]. The dietary assessment of the individual revealed that the intake of the subject satisfies Five food groups and reported to have consuming all five food groups regularly in the daily menu. Further, the consumption of fruits and vegetables were also found to be good and met with the recommendations of the Dietary guidelines for Indians. The subject reported that approximately he used to consume at least 300 grams of vegetables (Green leafy vegetables and other vegetables) and 300 grams of fruits for minimum of 5 days in a week. The nutrient intake of major nutrients was calculated using 24 hour dietary recall method for 3 days and the nutrient intake of major nutrients is tabulated below in Table No. 2.

Table 2: Nutrient intake of the subject before the intervention

	Before intervention	
Nutrients	**Quantity**	**Composition**
Energy KCAL	3171	
Carbohydrates g	493	62.3%
Proteins g	59	7.4%
Fats g	107	30.3%

The total calorie intake of the subject was found to be 3171 Kcal, but, whereas, according to the dietary guidelines of Indians belonging to sedentary activity, the total energy requirement is only 2320 Kcal. It is understood that the subjects consumes approximately an additional of 850 kcal that his requirement. And hence, resulted in positive energy balance. Further, the composition of the major nutrients in the diet has not been maintained in the right proportion.

2.2. Current and past physical activity assessment

In general, the physical activity of today's generation has been reduced because of modernization. Manual work of the people were replaced by various machineries, equipments and thus, the physical activity of the people is getting decreased day by day due to modern innovations. The physical activity pattern of the subject revealed that he belonged to sedentary life style practices and doesn't involved in regular exercising habit. But, his usual day to day activities involved at least 45 minutes to 1 hour of walking on all working days (five days in a week) and during the week ends, the time spend on physical activity is less compared to that of the week days.

2.3. Current complaints

It was elucidated from the subject that he often experiences the feeling of hunger in the day time and have the urge to take foods, even though, he takes the food to his satisfaction. Apart from this, the subject has complained of urinating at least 2 -3 times during the night time.

On perusal of the health records and the from the assessment of the subject, it is diagnosed that the subject is having metabolic abnormalities as the blood glucose levels and lipid profile is abnormal, and further, the subject has positive energy balance with Body Mass Index of 26 and falls in the category of overweight or pre-obese.

3.1. Interventional frame work and goal setting

Based on the above diagnosis, an interventional frame work was designed. The key areas that has included in the interventional programme are here under.

- To balance the energy intake according to the individual's requirement.
- To reduce his body weight by 6 kilogram, to reach the ideal body weight of 70.
- To alter the composition of major nutrients, to control the metabolic abnormality
- To increase his energy expenditure, through physical activity.

Recent researches reveals that change in the composition of macro nutrients helps in controlling metabolic disorders. Diets such as Atkins diet, Zone diet, LEARN diet are some of the notable diets for controlling the body weight [3-6]. It is also observed through earlier research studies, that a low carbohydrate diet is helpful in controlling the metabolic abnormalities. Hence, the composition of the major nutrients was modified as per the requirement of the individual and the same was applied for this interventional therapy.

The energy requirement of the subject was estimated by applying Harris Benedict's equation BMR = (10 × weight in kg) + (6.25 × height in cm) - (5 × age in years) + 5. The activity of the individual is also considered for the calculation and arrived at 2150 kcals per day [7-8].

Need and the benefits of the interventional therapy was explained to the subject and enough flexibility was allowed in the interventional programme according to practicability. The subject was advised to follow a low carbohydrate, high protein and high fat diet [9-10] and based on the above principle, the menu was planned in such a way by modifying the proportion of major nutrients in the diet and the subjects has asked to avoid starchy carbohydrates (cereals, sugars and starchy roots and tubers). A list of food exchanges were also provided along with the diet, so as to avoid monotony of the diet and further, with the help of food exchange list, the individual can choose any of the listed foods according to their choice and preferences. The total calorie has been

distributed between major nutrients as, 25% from carbohydrates, 35% from proteins and 40% from fats. In order to avoid forgo from the intervention programme and to avoid certain feast like circumstances, the subjects were asked to follow the above dietary habits for at least 5 days in a week.

In addition to the above dietary regime, the subject were asked to involve in Physical activity as it is one of the key determinant in the energy expenditure. The benefits of physical activity is well understood through research work and several positive outcomes related to the control of metabolic abnormalities were widely reported [11]. As per the WHO, Global recommendations of Physical activity [12], the basic requirement of physical activity for adults is as follows:

150 minutes of moderate intensity aerobic physical activity in a week (or)

75 minutes of Vigorous intensity aerobic physical activity throughout the week

Aerobic exercised should be carried out in bouts of at least 10 minutes duration of physical activity in 2 or 3 times in a day.

To get additional health benefits, it is recommended by WHO, to spent 300 minutes in doing moderate intensity aerobic physical activity or 150 minutes of vigorous intensity aerobic physical activity and also to include muscle strengthening activity for at least 2 days or more in a week [13].

Hence, the subject was asked to do physical activity for about 60 minutes (which includes 30 minutes of aerobic exercise like walking, jogging, gardening; 15 minutes of work related activity like carrying loads, climbing staircases; and 15 minutes of muscle strengthening exercises) of physical activity for at least 5 days in a week.

The subject was closely monitored with the help of the family members and to continue the same regime for about 150 days and to report once in 2 months to clarify their doubts and to find out whether, the subject is in track of the intervention programme. Further, the subject was asked to maintain a health record for dietary intake and time spent to do physical activity. The subject has also been recommended to take biochemical tests for selected bio chemical parameters after 120 days of the intervention programme.

4. Follow-up and outcome of the study

During the follow up visits the patients log book has been scrutinised and it was noted that the patients has followed up the said dietary regime for at least 5 days in a week and the energy intake was assessed by randomly selecting 10 days of food intake, recorded in the log book. It was observed that the energy intake ranged between 1950 - 2180 kcal on the selected days. The average intake of the subject during the interventional day was estimated approximately as 2100 Kcal, a day and the composition of the major nutrients was as per the said dietary regime. The subject has excluded sugar and starchy carbohydrates during the interventional period. But, in few occasions the subject couldn't avoid certain situations and has slightly relaxed the dietary regime. Further, the subjects underwent physical exercise regularly and opted to walk for at least 50 minutes and done stretching exercise for 10 minutes daily.

The composition of major nutrients before and during the interventional period is depicted in the Table no. 4. Before the intervention period, the total energy was obtained from 25.1% of carbohydrates, 7.4% of proteins and 30.3% of fats. But during the intervention period, the total energy was obtained from 25.1% of carbohydrates, 34.2% of proteins and 40.6% of fats. The comparison of nutrient composition before and during the interventional period shows a significant variation (Fig. 1) and the subject has adhered to the dietary regime as prescribed.

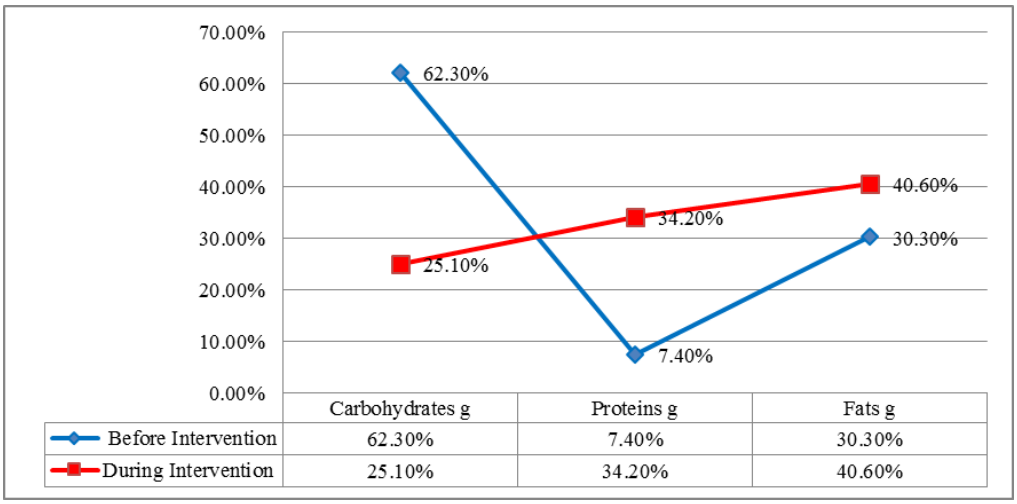
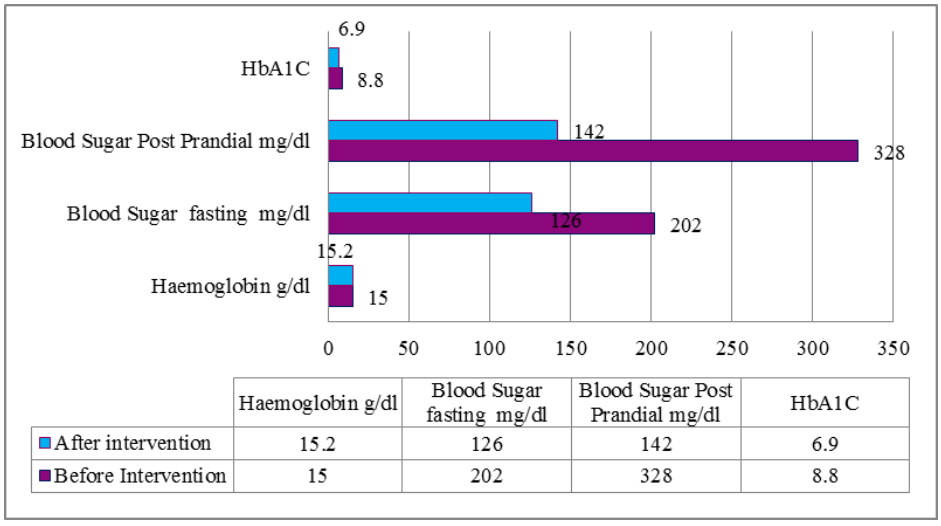


Fig 1: Comparison of composition of major nutrients before and during intervention

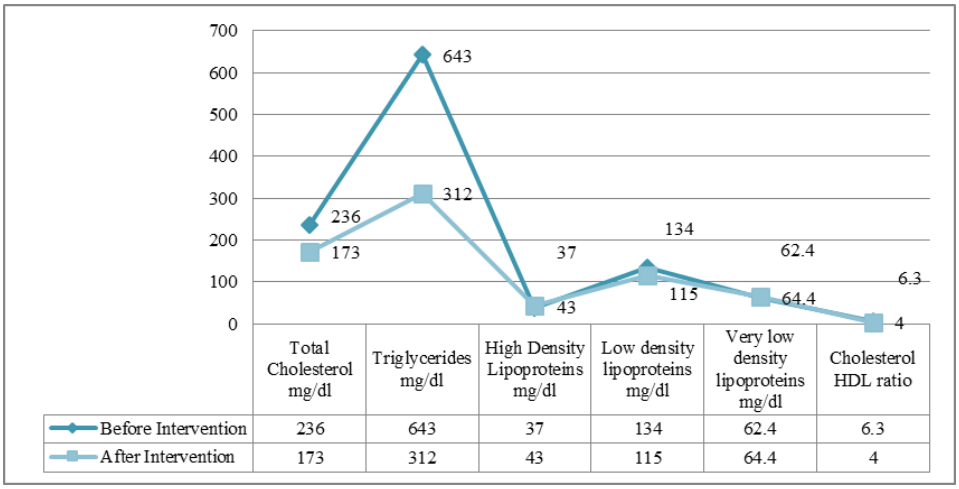
The biochemical parameters of the subjects was estimated after the intervention period and it reflected a positive sign in the management therapy. The comparison of the values of biochemical parameters, before and after the intervention, it is revealed that the fasting blood glucose level was found to be decreased from 202 to 126mgs/dl and the HbA1C was reduced from 8.8 to 6.9 % after the intervention period (Fig.2).



	Haemoglobin g/dl	Blood Sugar fasting mg/dl	Blood Sugar Post Prandial mg/dl	HbA1C
After intervention	15.2	126	142	6.9
Before Intervention	15	202	328	8.8

Fig 2: Comparison of Diabetic profile of the subject before and after the intervention

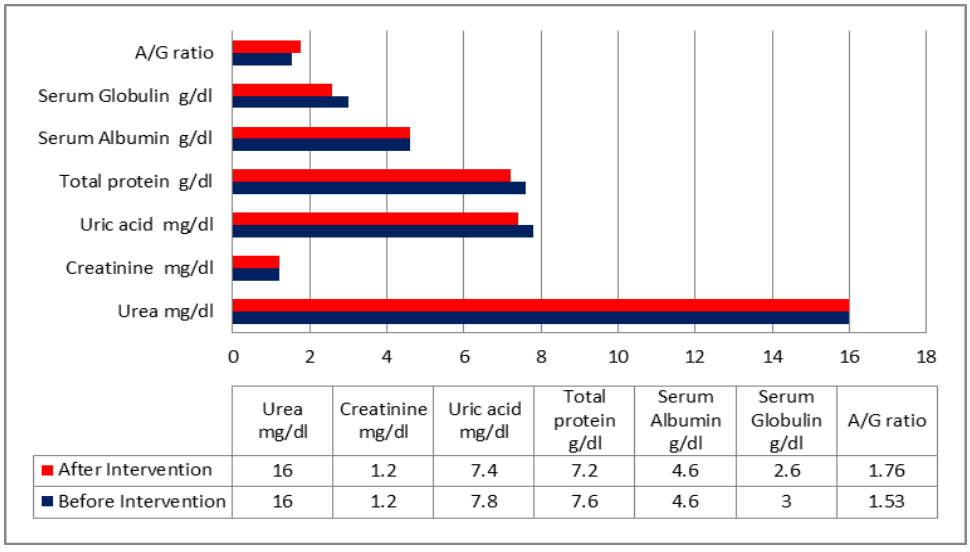
Likewise, the lipid profile of the subject has also reflected a positive sign towards the management therapy as there is significant reduction in the values. It is observed through the reports that the total cholesterol has come done from 230 to 173 mgs/dl, triglycerides from 643 to 312 mgs/dl, HDL has been improved from 37 to 43 mgs/dl, LDL from 134 to 115 and the Cholesterol and HDL ratio has reduced from 6.3 to 4.0 (Fig. 3)



	Total Cholesterol mg/dl	Triglycerides mg/dl	High Density Lipoproteins mg/dl	Low density lipoproteins mg/dl	Very low density lipoproteins mg/dl	Cholesterol HDL ratio
Before Intervention	236	643	37	134	62.4	6.3
After Intervention	173	312	43	115	64.4	4

Fig 3: Comparison of lipid profile of the subject before and after the intervention

The obtained liver function tests and the kidney function test were found to be in the same levels, before the start of the interventional therapy and after the intervention period, except for few components (Fig.4).



	Urea mg/dl	Creatinine mg/dl	Uric acid mg/dl	Total protein g/dl	Serum Albumin g/dl	Serum Globulin g/dl	A/G ratio
After Intervention	16	1.2	7.4	7.2	4.6	2.6	1.76
Before Intervention	16	1.2	7.8	7.6	4.6	3	1.53

Fig 4: Comparison of liver function and kidney function tests before and after intervention

The level of uric acid was 7.4 mg/dl before the intervention and has decreased by 0.4 mg/dl after the intervention period. Likewise, the levels of total protein has decreased by 0.4 mg/dl after the intervention period and serum globulin has also decreased by 0.4 mg/dl. This reveals that the functions of the liver and the kidney has not been affected because of the alteration done in the composition of the major nutrients.

The findings of the study infers that, increasing the physical activity and consumption of a modified diet with low carbohydrate (low or avoiding the consumption of starchy and sugar foods) have a positive effect in controlling certain metabolic disorders like obesity, type II diabetes, and abnormal lipid profile.

5. Conclusion

Hence, it is revealed through this case study that a low carbohydrate, high protein and high fat diet excluding starch and sugar carbohydrate along with 45 minutes to 1 hour minutes of physical activity for at least 5 days in a week, will be effective in controlling certain metabolic disorders.

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