Original Article

Impacts of Oat Supplementation on Serum Total Cholesterol and Serum Triglyceride in Patients with Type 2 Diabetes Mellitus

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Abstract

Background: *Type 2 diabetes mellitus (T2DM) is a common metabolic disorder worldwide characterized by insulin resistance and hyperglycemia associated with unhealthy diet, sedentary lifestyle and obesity. People having T2DM and dyslipidemia face increased risk of cardiovascular disease. Healthy life style with proper diet play crucial role in managing T2DM. Oat is associated in lowering serum lipid which causes reduction of cardiovascular diseases (CVDs) by controlling diabetes.* ***Objectives:*** *The aim of this study was to observe the effects of oat supplementation on serum total cholesterol (TC) and serum triglyceride (TG) in patients with T2DM.* ***Materials and Methods:*** *A prospective interventional study was done in Dhaka Medical College from July 2021 to June 2022. Total eighty diagnosed T2DM patients of both genders age ranging 35-60 years were selected on the basis of inclusion and exclusion criteria. Among them 40 T2DM without oat supplementation were considered as control group. Another 40 age and gender matched T2DM with oat supplementation (60gm/day) for 12 weeks were considered as study group. Serum TC and serum TG were estimated at the beginning of the study and after 12 weeks of study period in control and study groups.* ***Results:*** *Serum TC and TG levels were significantly decreased in study group after 12 weeks of oats supplementation in comparison to that of their baseline value and also in comparison to the control group.* ***Conclusion:*** *Regular supplementation of oats lowers serum TC and TG in patients with T2DM.*

Keywords: Diabetes mellitus; Oat; Total cholesterol; Triglyceride.

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Introduction

Diabetes Mellitus is characterized by hyperglycemia with typical symptoms of thirst, polyuria, polydipsia and weight loss.[1] About 537 million adults worldwide are diabetic and 6.7 million adults estimated to die due to diabetes mellitus (DM) or its complications.[2] The risk factor of type 2 diabetes mellitus (T2DM) includes increasing age, obesity, physical inactivity, family history (1st degree relatives) or strong genetic predisposition, women with previous gestational diabetes mellitus (GDM), dyslipidemia, hypertension, polycystic ovarian syndrome and ethnicity.[3]

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Diagnostic (modified) criteria for DM are (one or more of the following criteria are met); fasting plasma glucose: ≥7.0mmol/L (126 mg/dL), two-hour plasma glucose after 75g oral glucose load [oral glucose tolerance test (OGTT)] ≥11.1 mmol/L (200 mg/dL), HbA1c: ≥48 mmol/mol (equivalent to 6.5%), random plasma glucose in the presence of symptoms of hyperglycemia: ≥ 11.1 mmol/L (200 mg/dL).[2,4]

Diabetes mellitus is one of the commonest global non-communicable diseases which is epidemic in developing countries. The prevalence of diabetes in Bangladesh is 8.4% in adult population. Modification of life style along with healthy diet, physical activity and drug constitutes management of DM.[5]

Avena sativa (common oat) is a species of cereal grain rich in soluble dietary fiber in which β-glucan is the principal component.[6] Oat supplementation is associated with lowering total cholesterol (TC) by 0.09mmol/L which corresponds to reduction of 2%.[7] The risk of cardiovascular diseases can also be lowered by oat consumption.[8]

Li et al. (2016) observed a significant reduction in serum (TC) and triglyceride (TG) in oat

intervention group after one-year intervention.[9] McGeoch et al. (2013) found that total cholesterol was decreased following the oat diet compared with the standard diet.10 Kabir et al. (2002) found no significant effect on TG. Fasting serum cholesterol was lower in the study group compared with the control group.[11]

The findings of the above studies revealed that the impact of oat supplementation on total cholesterol and triglyceride in T2DM patients are contradictory and not conclusive. Therefore, the aim of this study was to evaluate the effects of oat supplementation on total cholesterol and triglyceride in patients with T2DM.

Materials and Methods

Ethical Approval of the Study Protocol: The research work was carried out after obtaining ethical clearance from concerned departments, Research Review Committee and Ethical Review Committee of Dhaka Medical College, Dhaka.

Study Design and Setting: This prospective interventional study was carried out in the Department of Physiology, Dhaka Medical College, Dhaka from July 2021 to June 2022. A total of 80 diagnosed T2DM patients of both genders with age 35-60 years were selected from outpatient department of Endocrinology, Dhaka Medical College Hospital, Dhaka. Among them 40 T2DM patients without oat supplementation were considered as control group. Another age and gender matched 40 patients of T2DM with oat supplementation (60gm/day) for 12 weeks were considered as study group. Study subjects were allocated in the study group and control group randomly.

Inclusion Criteria: Inclusion criteria were diagnosed patients of T2DM according to World Health Organization (WHO) and International Diabetes Federation (IDF) 2021 of both genders with age ranging 35-60 years. All the diabetic patients were on same oral hypoglycemic drug (Metformin).

Exclusion Criteria: Exclusion criteria were pregnancy and lactation, patients who were on insulin therapy, steroid and OCP, patients with endocrine disorder other than DM, patients with recent or past history of myocardial infarction, heart failure, severe hypertension (BP >180/110 mm Hg), renal and liver disorders, patients with concurrent acute illness including infectious diseases and malignancy, smoking and alcohol intake and known allergic to oat.

Study Procedure: All the patients of T2DM of the study group were supplemented orally 60 grams of oats per day (60gm/day) for 12 weeks.[10] Oats were purchased from local market. The brand of oat was Quaker oats. 1kg oats container pot of Quaker oats and a measuring cup was given to the study group for every 17 days interval and they were encouraged to consume the supplied oat daily. 60 grams oats were measured by supplied measuring cup. A person can consume 1kg of oat for 17 days. Each subject of the study group was supplied a total of 5 kg oats (5 container of 1kg Quaker oats) during 12 weeks of study period. A regular telephonic contact and periodic visit was taken to supply oats and to ensure compliance with intervention. Empty containers of oat and the amount of oats in the container were checked to understand that the subjects were consuming the oats regularly.

Laboratory Procedure: With all aseptic precaution, 6 ml of venous blood was collected from ante-cubital vein by 10cc disposable plastic syringe from each subject after an overnight fasting (at least 12 hours). The blood was transferred in a de-ionized glass test tube and was kept in slanted position till formation of clot. Then blood sample was centrifuged at a rate of 3000 rpm for 10 minutes for separation of serum. After that, supernatant serum was collected in labeled ependrof tube and preserved in a refrigerator below -20°C until analytical measurement of serum TC, TG, serum creatinine and serum ALT were done. Serum creatinine and serum ALT were

done to exclude renal and liver disease respectively. Analytical measurement was done into the Department of Laboratory Medicine, Dhaka Medical College Hospital, Dhaka. Measurement of serum TC and TG were done in all the subjects of both control and study groups, at the beginning of the study (baseline) and after 12 weeks of oat supplementation in the study group and without any oat supplementation for 12 weeks in the control group. Fasting serum TC was estimated by enzymatic endpoint method (Cholesterol oxidase/peroxidase method) and reading was taken by Dimension® Automated Biochemistry Analyzer. Fasting serum TG was estimated by enzymatic endpoint method by Dimension® Automated Biochemistry Analyzer method.

Statistical Analysis: Statistical analysis was performed by using a computer based statistical program SPSS (Statistical package for social science) version 23. Results were expressed as mean and standard deviation (mean ± SD). p value <0.05 was considered as level of significance. Paired student's 't' test was performed to compare quantitative data between baseline and after 12 weeks within same group and unpaired student's 't' test was performed to compare quantitative data between control and study groups. Chi square test was performed to compare qualitative data between control and study groups.

Results

In this study, total 80 patients were included. Among them 77 patients completed this study. 3 patients from the study group were excluded due to their personal reason. General characteristics of the study population was shown by age (years), gender (percentage), systolic blood pressure (mmHg) and diastolic blood pressure (mmHg) [Table-I].

Serum total cholesterol showed no significant difference in the control group after 12 weeks in comparison to their baseline value and also in comparison to the study group. Total cholesterol decreased significantly in the study group after 12 weeks of oat supplementation in comparison to their baseline value and also in comparison to the control group [Table-II]

Serum triglyceride showed no significant difference in the control group after 12 weeks in comparison to their baseline value and also in comparison to the study group. Triglyceride decreased significantly in the study group after 12 weeks of oat supplementation in comparison to their baseline value and also in comparison to the control group [Table-III].

Table-I: General Characteristics of the subjects in control and study groups (n=77)

Parameters		**Control group (*n*=40)**	**Study group (*n*=37)**	***p*-value**
Age (years)		46.7±7.7 (35-59)	46.4±7.6 (31-59)	>0.05
Gender	Male	18(53%)	16(47%)	>0.05
	Female	22(51%)	21(49%)	>0.05
Systolic BP (mmHg)		124.5±6.4 (110-130)	122.8±8.4 (110-140)	>0.05
Diastolic BP (mmHg)		79.8±7.3 (70-90)	79.9±5.3 (70-90)	>0.05

Results were expressed as mean ± SD. Unpaired Student's 't' test was performed to compare age, systolic BP and diastolic BP between control and study groups. Chi Square test was performed to compare gender between control and study groups. P value < 0.05 was accepted as level of statistical significance. n = number of study population.

Table II: Serum total cholesterol in study and control groups (*n*=77)			
Parameters	**Serum Total Cholesterol (TC) in mg/dl**		
	Control Group (*n*=40)	**Study Group (*n*=37)**	***p* value**
At baseline	220.2±14.0 (203-257)	220.9±13.5 (204-250)	0.481
After 12 weeks	220.1±12.0 (170-235)	201.1±14.8 (200-250)	0.000
***p* value**	0.931	0.000	
Results were expressed as mean ± SD. Paired t test was performed for comparison between baseline and after 12 weeks within group. Unpaired t test was performed to compare between control and study groups. p value <0.05 was accepted as level of statistical significance. n = number of subjects.			

Table III: Serum triglyceride in study and control groups (*n*=77)			
Parameters	**Serum Triglyceride (TG) in mg/dl**		
	Control Group (*n*=40)	**Study Group (*n*=37)**	***p* value**
At baseline	207.5±65.4 (87-358)	192.9±44.1 (60-368)	0.792
After 12 weeks	208.8±62.3 (85-300)	172.3±41.6 (60-359)	0.000
***p* value**	0.385	0.000	
Results were expressed as mean ± SD. Paired t test was performed for comparison between baseline and after 12 weeks within group. Unpaired t test was performed to compare between control and study groups. p value <0.05 was accepted as level of statistical significance. n = number of subjects.			

Discussion

The objective of the present study was to observe the impacts of oat supplementation on serum TC and serum TG in patients with T2DM. In this present study, serum TC and serum TG decreased significantly in the study group after 12 weeks of oat supplementation in comparison to their baseline value and also in comparison to the control group. These findings are compatible with some studies.[12] It may be due to decreased reabsorption and increased excretion in feces of micelles containing bile acid which is entrapped by β-glucan in intestine because of its high viscosity. Increased excretion of bile acid decreases fat absorption and thus lowers plasma lipid. Fermentation capacity of oat also produced short chain fatty acid (SCFA) which inhibit hepatic cholesterol synthesis.[1,13,14]

Pino et al. (2020) found that TC and TG was decreased significantly in oat group possibly due to SCFA which modulate lipolysis in adipocytes but in control group TC and TG was not increased significantly.[15]

On the contrary, Tessari and Lante (2017) found no significant differences in TC and TG level between the control and the study groups possibly because of the already near-normal lipid values of the subjects.[16]

Liatis et al. (2009) observed significant reduction in total cholesterol in the oat beta glucan group compared with their baseline value. No significant changes were observed in TC and TG in the control group. This lipid lowering mechanism may be due to increased binding of oats with bile acids in the small intestine leading to disrupting their reabsorption (enterohepatic circulation) and subsequently forcing the liver to use more cholesterol to synthesize new bile acids to compensate for the loss of bile acids in feces. Oats also forms a thick (gel-like), undisturbed (stagnant) water layer near intestinal mucosa which act as physical barrier against the absorption of bile acids.[17]

Reyna et al. (2003) observed that following supplementation with oat, TC and TG were reduced non-significantly in the study group in comparison to the control group. The possible mechanisms may be decreased absorption of lipid and reduced lipolysis.[18]

Strengths of this study was that the study subjects were age and gender matched and they were allocated randomly in the study group as well as in the control group and the period of observation was long (12 weeks) for better interpretation of the impact of oat supplementation. However, the number of the study population was small and serum adiponectin level was not measured to confirm the mechanism of action of oat on adipose tissue to decrease serum TG level.

Conflict of Interest: The authors of this manuscript declare no conflict of interest.

Conclusion

Findings of the present study prove that oat supplementation for 12 weeks reduces total cholesterol and triglyceride. As a result, supplementation of oat may be recommended in Diabetes Mellitus patients for proper control and better management of the disease and to minimize the complications of the disease.

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