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The Influence of Oral Multivitamins Supplementation on Selected Oxidative Stress Parameters and Lipid Profiles among Sudanese Patients with Type-2 Diabetes

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Abstract

AIM: The objective of the current study was to assess the influence of oral multivitamins supplementation on some oxidative stress parameters (serum Vitamin A, C, E, Zinc, Malondialdehyde (MDA)) and lipid profile among Sudanese patients with type- 2 diabetes mellitus (T2DM).

MATERIAL AND METHOD: Three hundred Sudanese patients with T2DM and Hundred healthy subjects (control group) were enrolled in this cross-sectional study. Blood was collected after overnight fasting for 10-12 hrs. Fasting plasma glucose (FBG), lipid profiles, Glycosylated haemoglobin (HbA1c%), Serum zinc, Malondialdehyde (MDA), Vitamins A, E, and C levels were measured using standardised laboratory techniques. Data was collected with the help of a structured questionnaire and direct interview.

RESULTS: Biochemical parameters of the study population were shown a highly significant difference (P value < 0.05), between the means of serum vitamin A, C, E, Zinc, MDA, HbA1c, triglycerides, HDL, FBG, total cholesterol and LDL. Significant differences in serum vitamin A, C, E, Zinc, MDA, triglycerides, HDL and FBG between people with diabetes who used multivitamins and diabetics who did not use it (P-value < 0.05).

CONCLUSION: The study observed a significant increase in serum levels of vitamin A, C & E and other biomarkers parameters in patients with T2DM who take oral multivitamins supplements; such improvement may lead to minimising the diabetic complications. Further studies are needed to explore the possible therapeutic role of multivitamins supplements for T2DM patients.

Introduction

According to international diabetes Federation (IDF), there were over 2.247.000 cases of diabetes in Sudan in 2017 with the prevalence of 10.9% (confidence interval: 5.6-17.7%), which expected to reach 14.2% by 2045 [1]. High prevalence of type- 2 diabetes mellitus (T2DM) and prediabetes was observed among Sudanese [2], [3]. T2DM is a progressive condition in which the body becomes resistant to the normal effects of insulin and gradually loses the capacity to produce enough insulin in the pancreas. Diabetes has been known as an oxidative stress disorder caused by an imbalance between free radical formation and the ability of the body's natural antioxidants [4]. Oxidative stress is hypothesised to play an important part in the development of late diabetes complications. In the absence of an appropriate compensatory response by the endogenous antioxidants, such as vitamins C and E, catalase, glutathione, and superoxide dismutase, oxidative stress dominates resulting in the activation of stress-sensitive intracellular signalling pathways [5]. Most patients with diabetes have lipid metabolism disorders, most common forms are decreased high density lipoprotein (HDL) and increased triglyceride, cholesterol and LDL in patients' serum.

High doses of vitamins C and E have been shown to decrease blood glucose, plasma cholesterol and triglyceride in T2DM patients [6]. Vitamins and minerals play an important role in glucose metabolism, so understanding the impact of vitamin and mineral deficiencies and the potential utility of

supplementation is relevant to the prevention and management of T2DM. The majority of diabetic individuals should receive daily vitamins and minerals within the ranges of recommended values from consumption of natural food sources and/or fortified foods [7]. Several epidemiological studies have investigated the association between dietary intake and plasma levels of some micronutrients and plasma lipid concentrations in a variety of populations. Serum levels of Vitamin C, magnesium and zinc have been reported to be correlated inversely with serum levels of cholesterol [8], [9].

The purpose of the present study was to assess the influence of oral multivitamins supplementation on some oxidative stress parameters and lipid profiles among Sudanese patients with T2DM.

Material and Method

This cross-sectional hospital-based study enrolled three hundred patients with known T2DM admitted to Bahri diabetes centre, Sudan. Hundred healthy subjects (non-diabetic) were enrolled as a control group. Patients were received either 500 mg or 1000 mg randomly daily of oral multivitamins which contains the recommended daily allowance of vitamins and minerals supplement for not less than 6 weeks. About 7.0 ml of venous blood were obtained from the candidates after overnight fasting (10-12) hrs. The collected blood was drawn in three containers (heparin, EDTA and fluoride oxalate). The whole blood was used immediately after collection for testing HbA1c%. The blood in all containers was gently mixed and then centrifuged to obtain plasma. FBG, lipid profiles, zinc, MDA, Vitamins A, E, and C antioxidant were measured by using standardised laboratory techniques. Data such as age, weight and height were collected with the help of a structured questionnaire and direct interview. Body mass index (BMI) was calculated by = Weight (kg)/Height (m^2). Ethical clearance of research was obtained from the Ethical Committee of Bahri diabetic center-Bahri and the Ethical Committee of Faculty of Medical Laboratory Sciences, University of Science and Technology, Omdurman, Sudan. Verbal and written consent was obtained from each participant before enrollment.

Data were analysed using statistical package for social science (SPSS) software [version 21, Chicago, IL, USA). The variables analysed were age, weight, BMI, and biochemical parameters about T2 diabetes status and intake of a multivitamin. Chi-squared test for association and an independent T-test for continuous variables were used to test for significance at *P* value < 0.05.

Results

In the current study, 300 patients with T2DM and 100 healthy subjects were included. The mean ages of the study and the control groups were 50.1 ± 14.0 and 51.2 ± 11.1 years respectively (Table 1).

Table 1: Characteristics of the study groups

Variables	Control group (non-diabetics) (n = 100)	Study group (T2DM) (n = 300)	*P* value
Age (years)	50.1 ± 14.0	51.2 ± 11.1	0.06
Weight (kg)	74.5 ± 12.2	79.7 ± 22.8	0.032*
BMI (w/h^2)	25.2 ± 3.2	29.5 ± 8.1	0.0004*

*Significant differences (P value < 0.05).

The means of serum vitamin A, C, E, Zinc, MDA, HbA1c, triglycerides, HDL, FBG, total cholesterol and LDL have shown a highly significant difference (*P* value < 0.05) between the study group and healthy subjects (Table 2).

Table 2: Comparison of the means of some blood parameters (Vitamins (A, E& C), MDA, zinc, HbA1C, FBG and lipid profile) between T2DM and non-diabetics

Variables	Control group (non-diabetics) (n = 100)	Study Group (T2DM) (n = 300)	*P* value
Vitamin A (µg/dL)	81.2 ± 21.8	50.3 ± 20.0	0.001*
Vitamin E (µ/mL)	15.6 ± 4.8	5.2 ± 1.8	0.001*
Vitamin C (µg/mL)	10.0 ± 2.2	3.9 ± 1.3	0.0003*
MDA (µM)	2.4 ± 1.1	6.7 ± 6.2	0.001*
Zinc (µmol/L)	100.5 ± 12.9	77.2 ± 9.8	0.001*
HbA_1c%	4.9 ± 0.3	7.5 ± 1.4	0.001*
FBG (mg/dL)	101.5 ± 11.9	160.4 ± 65.5	0.0002*
Triglycerides (mg/dL)	107.1 ± 20.1	124.6 ± 79.1	0.033*
Total Cholesterol (mg/dl)	117.3 ± 20.9	164.8 ± 45.6	0.0006*
LDL (mg/dL)	86.6 ± 20.6	109.0 ± 34.7	0.0003*
HDL (mg/dL)	51.9 ± 6.2	41.8 ± 11.9	0.0008*

* Significant differences in all blood parameters between control and test group (*P* value < 0.05).

Concerning intake of multivitamin (n = 194, 64.7%) of patients with T2DM on multivitamin, while (n = 106, 35.6%) of them were not. Significant differences in serum vitamin A, and E, Zinc, MDA, triglycerides, HDL and FBG between people with diabetes who used oral multivitamins and diabetics who did not use it (*P*-value < 0.05). No significant differences in total cholesterol and LDL between T2DM patients who used multivitamins and for those who did not use it (*P* value > 0.05) (Table 3).

Table 3: Comparison of blood parameters (Vitamins (A, E& C), MDA, zinc, HbA1C, FBG and lipid profile) among test group according to Intake of multivitamins

Variables	Intake (n = 194)	No Intake (n=106)	*P* value
Vitamin A (µg/dL)	61.2 ± 14.6	30.3 ± 11.0	0.001*
Vitamin E (µ/mL)	6.1 ± 1.3	3.4 ± 1.4 (1.0 - 9.0)	0.002*
Vitamin C (µg/mL)	4.3 ± 1.2	3.2 ± 1.3	0.08**
MDA (µM)	4.7 ± 4.3	10.4 ± 7.3	0.01*
Zinc (µmol/L)	80.3 ± 8.6	71.7 ± 9.3	0.003*
HbA_1c%	6.9 ± 0.7	8.7 ± 1.6	0.03*
Triglycerides (mg/dL)	116.5 ± 64.2	139.2 ± 99.6	0.02*
Total Cholesterol (mg/dl)	162.6 ± 39.4	168.9 ± 55.2	0.259**
LDL (mg/dL)	108.3 ± 32.0	110.5 ± 39.3	0.598**
HDL (mg/dL)	43.9 ± 11.2	37.8 ± 12.2	0.0002*
FBG (mg/dL)	133.0 ± 43.8	210.6 ± 69.1	0.001*

* Significant differences in Serum Vitamin A, and E, Zinc, MDA, Triglycerides, HDL, HbA_1c and FBG between diabetics who used multivitamins and diabetics who did not used it (P-value < 0.05); ** No significant differences in vitamin C, total cholesterol and LDL between diabetics who used multivitamins and diabetics who did not used it (P value > 0.05).

There was a significant negative correlation between the duration of diabetes and vitamin A, C &E in addition to MDA and zinc levels (Figure 1).

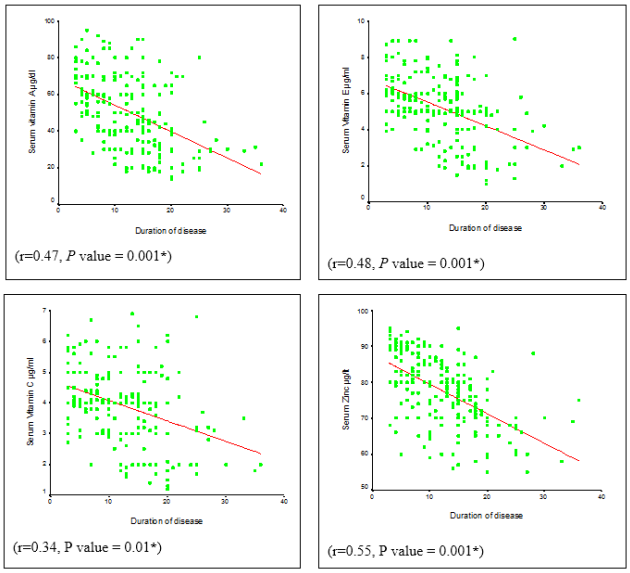

Figure 1: Scatter plot shows the relationship between the duration of the disease and the numbers of biomarker parameters among T2DM patients (N = 300)

Discussion

High prevalence of Type 2 diabetes mellitus (T2DM) and prediabetes was observed among Sudanese [2], [3]. The objective of this study was to assess the influence of oral multivitamins supplementation on some oxidative stress parameters (serum Vitamin A, C, E, Zinc, MDA) and lipid profile among Sudanese patients with T2DM. The results showed a significant increase in the means of the plasma levels of fasting glucose, cholesterol, LDL, triglycerides, MDA and HbA1c of the test group when compared with healthy control group subjects. While, the means of the plasma levels of antioxidant vitamins (A, E, C), HDL and zinc showed a significant reduction when compared with that of the control group. This finding which indicates the excessive glycosylation of haemoglobin and poor control of diabetes is by the results reported by some studies among patients with T2DM [10], [11], [12].

Increased serum cholesterol, LDL, triglycerides and reduce in HDL indicate the presence of dyslipidemia. Some factors may contribute to the changes in lipid metabolism in patients with T2DM, including insulin resistance and/or relative insulin deficiency, and hyperglycaemia [13]. The marked significant reduction in vitamins A, E, C and zinc, has been reported by various studies indicating metabolic abnormalities, which is related to increased cardiometabolic risks. Such reduction may be attributed to the increase in the need to control the excessive oxidative stress produced by abnormalities in glucose metabolism [14], [15]. In both types of diabetes, there is a massive oxidative and nitrosative stresses which have been associated with intensive changes on both antioxidant enzyme systems and total antioxidant capacity causing peroxidative damage to lipids, proteins, nucleic acids and carbohydrates which can be used as DM biomarkers [16].

In the present study, we subdivided the study group according to the multivitamin intake. The results showed a significant difference in serum vitamin A, and E, Zinc, MDA, triglycerides, HDL and FBG between T2DM patients who intake oral multivitamins and T2DM patients who did not (*P* value < 0.05), Our finding is inconsistent with a number of studies, Gazis *et a*l., observed that supplementation in diabetic patients considerably reduced HbA1c levels [17]. Prajapat *et al.* concluded that supplementation and normal diet might improve plasma glucose and lipid profile in patients with T2DM [18]. Sayed *et al.* observed that dietary regimen together with supplementation with zinc might be useful to suppress plasma glucose and to regulate insulin secretion of diabetics [19]. Another study conducted among Nigerians patients with T2DM concluded that vitamins supplementation was significantly increased GSH levels and lowered MDA levels [20]. Polidori *et a*l. found those very old age patients with T2DM have lower plasma concentrations of vitamin A &E [21]. The benefits of using multivitamins not only limited to the glucose and lipid metabolisms; Barringer *et al.*, noticed the reduction the incidence of infections in patients with T2DM who use multivitamins supplementation and minerals for One-year [22].

In conclusion, a significant difference of Serum vitamin A, E, C, Zinc and MDA between T2DM patients and healthy subjects was found in this study. Furthermore, a significant difference of some endogenous antioxidant levels was observed in patients with T2DM who administered oral multivitamins; such improvement may minimise the diabetic complications. Further studies are needed to explore the possible therapeutic role of multivitamins supplements for T2DM patients.

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