The Effect of Vitamin C Alone or in Combination with Vitamin E on Fasting Blood Glucose, Glycosylated Hemoglobin and Lipid Profile in Type 2 Diabetic Patients (Gaza Strip)

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ABSTRACT

This study was conducted to evaluate the effect of vitamin C alone or in combination with vitamin E on fasting blood sugar, glycosylated hemoglobin and lipid profile in type 2 diabetic patients in Gaza Strip. Fifty eight type 2 diabetic patients treated with metformin were selected from Palestine Medical Relief Society and some UNRWA health centers in Gaza Strip. They were divided into three groups. The first group (n=20) continued on metformin only. Oral vitamin C was added to the second group (n=19), whereas the combination of vitamin C and E was added orally to the third group (n=19). Fasting blood glucose (FBG), glycosylated hemoglobin (HbAlc) and lipid profile including (total cholesterol (TC), triglyceride (TG), LDL, HDL) were measured before and after three months of intervention.

There is a significant reduction (P < 0.05) in FBS, HbAlc and lipid profile in the second and third group compared to the first group. The reductions in FBS, HbA1c and TG were more significant (p value > 0.05) in the third group than the second group, while the reduction in TC was similar in both groups, and the reduction in LDL was more significant in the second group than the third group. Vitamin C alone or in combination with vitamin E caused a small and insignificant increase (P > 0.05) in HDL cholesterol.

In conclusion, the study revealed that the use of vitamin C alone or in combination with vitamin E provides good glycemic control, reduces lipid profile and improves HDL-cholesterol level

Keywords: Vitamin C, Vitamin E, Fasting Blood Sugar (FBS), Glycosylated hemoglobin (HbAlc), Lipid profile.

1. INTRODUCTION

Diabetes mellitus (DM) is a chronic progressive metabolic disorder characterized by dysfunction in the metabolism of fat, carbohydrates, protein and insulin[1,2] with inappropriate hyperglycemia due either to an absolute deficiency of insulin secretion or reduction of its biological effectiveness or both[3,4]. It is also associated with long-term damage, dysfunction, and failure of different organs as the eyes, kidneys, nerves, heart and blood vessels [4].

Diabetes is the most common endocrine disorder, its prevalence is expected to rise in the next decade. In 2000, the World Health Organization (WHO) recorded a total of 171 million people for all age groups worldwide (2.8% of the global population) with diabetes, and the numbers are expected to rise to 366 million (4.4% of the global population) by 2030 [2,5,6,7]. In Palestine in the year 2000, the estimated prevalence rate of diabetes was 9.0% in

adults aged 30 years and older [8,9].

Routine data gathered by the UN Relief and Works Agency in 2010, showed that the prevalence rate was 11.5% in the West Bank and 11.3% in the Gaza Strip among the registered Palestinian refugees aged 40 years and older [10].

Diabetes mellitus can be diagnosed either by the fasting blood sugar test which must be $\geq$ 126 mg/dl (7.0 mmol/L) or the oral glucose tolerance test which must be $\geq$ 200 mg/dl (11.1 mmol/L). Also by the presence of symptoms of hyperglycemia and random blood glucose $\geq$200mg/dl (11.1mmol/L). More recently, an international expert committee has recommended that DM can also be diagnosed by demonstrating increased hemoglobin Alc (HbAlc) of $\geq$ 48 mmol/mol (equivalent to $\geq$ 6.5%) which has also been endorsed by the WHO [4,11].

Table 1. Characteristics of the study population in all groups by demographic variables, educational level and BMI

Variable		Control (G1) (n=20)	Vitamin C only (G2) (n=19)	Vitamin C+E (G3) (n=19)
Age (yrs)		40-60	36-60	31-60
Sex	Male	11 (55%)	9 (47.3 %)	11 (57.9%)
	Female	9/(45%)	10 (52.7%)	8 (42.1%)
Gaza Strip Governorate	Gaza	13 (65%)	14 (73.7%)	9 (47.4%)
	Middle Governorate	4 (20%)	2 (10.5%)	7 (36.8%)
	Khanyounis	3 (15%)	3 (15.8%)	3 (15.8%)
Educational level	University	3 (15%)	8 (42 %)	7 (36.8%)
	Diploma	3 (15%)	4 (21%)	-
	Tertiary	4 (20%)	4 (21%)	5 (26.3%)
	Secondary	8 (40%)	3 (16%)	4 (21%)
	Primary	2 (10%)	-	3 (15.9%)
BMI (kg/m^2)		**27-32**	**27-31**	**27-31**

Different classes of antidiabetic drugs can be used for treatment of diabetes mellitus type 2, including Biguanides, Sulfonylurea and Meglitinides, α-Glucosidase inhibitors, Gliptins and Thiazolidinediones, while insulin (different forms) is used for treatment of diabetes mellitus type 1 and sometimes in type 2, that are not controlled by oral antidiabetic drugs[12]. During diabetes, persistent hyperglycemia causes increased production of free radicals especially reactive oxygen species (ROS) from glucose auto-oxidation and protein glycosylation[5,13]. The increase in the level of ROS in diabetes could be due to their increased production and/ or decreased destruction by nonenzymic and enzymic catalase (CAT), reduced glutathione (GSH) and superoxide dismutase (SOD) antioxidants [3], these ROS can lead to damage of cellular organelles and enzymes, increased lipid peroxidation, and development of insulin resistance, which consequently promotes the development of complications of diabetes mellitus, especially increased incidence of atherosclerosis[13].

The antioxidants can play a good role as adjunctive therapy in diabetes mellitus type 2, to achieve good glycemic control and minimize the cardiovascular complications. Our study intended to investigate the role

of antioxidants including vitamin C alone or vitamin C in combination with vitamin E on glycemic control and lipid profile among type 2 diabetic patients in Gaza Strip by measuring fasting blood sugar, glycosylated hemoglobin and lipid profile at the start of the study and after three months of antioxidants intake.

Table 2. Effect of vitamin C alone or in combination with vitamin E supplements on
fasting blood sugar (FBS) in type 2 diabetic patients

Group	Time	No.	FBS (mg/dl) (mean± S.D)	P- Value$^{¥}$	P- Value§	P- Value^{ɸ}
Control (G1)	Before treatment	20	144.00 ± 20.70	0.86	0.96^a	0.18^a
	After treatment	20	144.75 ± 28.35			
Vitamin C only (G2)	Before treatment	19	143.63 ± 20.26	0.00	0.02^b	0.177^b
	After treatment	19	133.42 ± 23.06			
Vitamin C+E (G3)	Before treatment	19	159.15 ± 30.05	0.00	0.03^c	0.013^c
	After treatment	19	122.94 ± 23.78			

P-value for FBS were calculated by paired – samples T test before and after three months of vitamins intake.

§) P-values were calculated by independent-samples t-test before treatment.

a) P-value for FBS at G1 and G2. b) P-value for FBS at G2 and G3. c) P-value for FBS at G1 and G3.

ɸ) P-values were calculated by independent-samples t-test after treatment.

a) P-value for FBS at G1 and G2. b) P-value for FBS at G2 and G3. c) P-value for FBS at G1 and G3.

Table 3. Effect of vitamin C alone or in combination with vitamin E supplements on
glycosylated hemoglobin (HbAlc) in type 2 diabetic patients

Group	Time	No.	HbAlC (mean± S.D)	P- Value$^{¥}$	P- Value§	P- Value^{ɸ}
Control (G1)	Before treatment	20	7.43 ± 0.79	0.61	0.21^a	0.00^a
	After treatment	20	7.37 ± 0.59			
Vitamin C only (G2)	Before treatment	19	7.15 ± 0.58	0.00	0.37^b	0.21^b
	After treatment	19	6.32 ± 4.46			
Vitamin C+E (G3)	Before treatment	19	7.32 ± 0.55	0.00	0.61^c	0.00^c
	After treatment	19	6.12 ± 0.50			

¥) P-values for HbAlC were calculated by paired – samples T test before and after three months of vitamins intake.

§) P-values were calculated by independent-samples t-test before treatment.

a) P-value for HbAlC at G1 and G2. b) P-value for HbAlC at G2 and G3. c) P-value for HbAlC at G1 and G3.

ɸ) P-values were calculated by independent-samples t-test after treatment.

a) P-value for HbAlC at G1 and G2. b) P-value for HbAlC at G2 and G3. c) P-value for HbAlC at G1 and G3.

2. MATERIAL AND METHODS

2.1. Study Design

This Study is non-randomized prospective controlled trial designed to evaluate the effects of using vitamin C alone (1000 mg per day) and in combination with vitamin E (800 mg per day) as adjunctive therapy for three

months on fasting blood sugar, glycosylated hemoglobin (HbAlC) and lipid profile in type 2 diabetic patients.

2.2. Patients
2.2.1. Study population and sample size

The patients participated in the study were type 2 diabetic patients, treated only with the oral hypoglycemic drug metformin, between the age of 30-60 years, from both genders. The sample size was sixty patients divided into 3 groups (each group contained 20 patients) according to the treatment protocol. They were selected from the diabetic clinic of Palestine Medical Relief Society-Gaza and some UNRWA health centers in Gaza Strip.

Table 4. Effect of vitamin C alone or in combination with vitamin E supplements on total cholesterol (TC) in type 2 diabetic patients

Group	Time	No.	TC (mg/dl) (mean± S.D)	P- Value$^\yen$	P- Value§	P- Value$^\phi$
Control (G1)	Before treatment	20	234.20 ± 29.48	0.42	0.31[a]	0.02[a]
	After treatment	20	241.55 ± 41.31			
Vitamin C only (G2)	Before treatment	19	244.84 ± 34.46	0.00	0.26[b]	0.356[b]
	After treatment	19	210.15 ± 38.06			
Vitamin C+E (G3)	Before treatment	19	233.84 ± 22.84	0.00	0.97[c]	0.001[c]
	After treatment	19	200.10 ± 27.26			

P-value for (TC) were calculated by paired – samples T test before and after three months of vitamins intake.

§) P-values were calculated by independent-samples t-test before treatment.

a) P-value for TC at G1 and G2. b) P-value for TC at G2 and G3. c) P-value for TC at G1 and G3.

ɸ) P-values were calculated by independent-samples t-test after treatment.

a) P-value for TC at G1 and G2. b) P-value for TC at G2 and G3. c) P-value for TC at G1 and G3.

2.2.2. Selection Criteria

1. Newly diagnosed patients of type 2 DM, aged between thirty to sixty years, who have fasting blood sugar level in the range of 126 to 200 mg/dl, HbAlc equal to or more than 6.5 mg/dl, triglycerides (TG) level more than 150 mg/dl and total cholesterol level more than 200 mg/dl, but both are not more than 400 mg/dl.

2. Patients who are only treated by metformin, not by any other oral hypoglycemic drugs or insulin therapy.

2.2.3. Exclusion Criteria

1. Patients aged more than 60 years or less than 30 years.

2. Patients with fasting blood sugar level less than 126 or more than 200 mg/dl.

3. Patients with serum levels of triglycerides and total cholesterol > 400 mg/dl.

4. Patients with medical illnesses including other endocrine, metabolic disorders, type 1 DM, isolated postprandial hyperglycemia.

5. Patients who were pregnant at the time of study

6. Patients with complications of diabetes including nephropathy, retinopathy cardiovascular diseases, history of renal stones and hypoglycemia.

7. Patients who have received vitamin C or vitamin E or any other antioxidant over the last three months.

2.3. Treatment protocol

The sample of the study consisted of 60 patients, they were divided into three groups; each group received their usual oral hypoglycemic drug metformin and divided as follows:

a. Twenty patients (group 1) did not receive vitamin C

or vitamin E supplements.

b. Twenty patients (group 2) received vitamin C (1000 mg per day) divided in two doses (500 mg each dose) for three months.

c. Twenty patients (group 3) received vitamin C (1000 mg per day) and vitamin E (800 mg per day), both were divided into two doses for three months.

Table 5. Effect of vitamin C alone or in combination with vitamin E supplements on total triglyceride (TG) in type 2 diabetic patients

Group	Time	No.	TG (mg/dl) (mean± S.D)	P- Value¥	P- Value§	P- Valueφ
Control (G1)	Before treatment	20	209.95 ± 51.75	0.12	0.141[a]	0.167[a]
	After treatment	20	222.95 ± 52.21			
Vitamin C only (G2)	Before treatment	19	242.31 ± 78.50	0.00	0.956[b]	0.503[b]
	After treatment	19	196.05 ± 66.34			
Vitamin C+E (G3)	Before treatment	19	241.00 ± 68.70	0.00	0.118[c]	0.013[c]
	After treatment	19	183.94 ± 40.67			

P-value for (TG) were calculated by paired – samples T test before and after three months of vitamins intake.

§) P-values were calculated by independent-samples t-test before treatment.

a) P-value for TG at G1 and G2. b) P-value for TG at G2 and G3. c) P-value for TG at G1 and G3.

φ) P-values were calculated by independent-samples t-test after treatment.

a) P-value for TG at G1 and G2. b) P-value for TG at G2 and G3. c) P-value for TG at G1 and G3.

Table 6. Effect of vitamin C alone or in combination with vitamin E on LDL-Cholesterol in type 2 diabetic patients

Group	Time	No.	LDL (mg/dl) (mean± S.D)	P- Value¥	P- Value§	P- Valueφ
Control (G1)	Before treatment	20	156.80 ±31.32	0.79	0.947[a]	0.009[a]
	After treatment	20	158.85 ± 39.27			
Vitamin C only (G2)	Before treatment	19	157.47 ± 31.69	0.00	0.335[b]	0.857[b]
	After treatment	19	121.00± 45.93			
Vitamin C+E (G3)	Before treatment	19	147.84 ± 29.02	0.00	0.361[c]	0.003[c]
	After treatment	19	123.26 ± 29.16			

P-value for LDL were calculated by paired – samples T test before and after three months of vitamins intake.

§) P-values were calculated by independent-samples t-test before treatment.

a) P-value for LDL at G1 and G2. b) P-value for LDL at G2 and G3. c) P-value for LDL at G1 and G3.

φ) P-values were calculated by independent-samples t-test after treatment.

a) P-value for LDL at G1 and G2. b) P-value for LDL at G2 and G3. c) P-value for LDL at G1 and G3.

**Table 7. Effect of vitamin C alone or in combination with vitamin E Supplements on
HDL- Cholesterol in type 2 diabetic patients**

Group	Time	No.	HDL (mg/dl) (mean± S.D)	P- Value[¥]	P- Value[§]	P- Value[ф]
Control (G1)	Before treatment	20	37.15 ±7.45	0.39	0.122[a]	0.019[a]
	After treatment	20	38.35 ± 8.12			
Vitamin C only (G2)	Before treatment	19	41.42 ± 9.35	0.08	0.181[b]	0.470[b]
	After treatment	19	44.36 ± 7.09			
Vitamin C+E (G3)	Before treatment	19	37.89 ± 2.28	0.05	0.738[c]	0.036[c]
	After treatment	19	39.94 ± 5.27			

P-value for HDL were calculated by paired – samples T test before and after three months of vitamins intake.

§) P-values were calculated by independent-samples t-test before treatment.

a) P-value for HDL at G1 and G2. b) P-value for HDL at G2 and G3. c) P-value for HDL at G1 and G3.

ф) P-values were calculated by independent-samples t-test after treatment.

a) P-value for HDL at G1 and G2. b) P-value for HDL at G2 and G3. c) P-value for HDL at G1 and G3.

2.4. Methods

The data was collected from:

2.4.1. Health Records

The medical record file of the patients were reviewed regarding personal information such as (age, gender, marital status, education level, place of residence, height, weight, etc..), medical history of any other diseases, the medication taken for these diseases and hypoglycemic drugs.

2.4.2. Biochemical Measurements

The biochemical measurements were done for each patient at the start of the study and after three months of vitamin C and vitamin E supplementation. One day before the required analysis, participants were phoned to visit the diabetic clinic and asked to be fast for at least 12 hrs. Blood samples were drawn from the peripheral circulation of the patients, and the samples were labeled by their names and date and sent immediately to the laboratory to perform the required tests, which included: Fasting blood sugar, glycosylated hemoglobin and lipid profile.

Fasting blood sugar (FBS), HbA1c and lipid profile tests were done after fasting a least 12 hrs, with free water excess by using photometric spectroscopic assay that depends on different enzymatic reactions for each parameter, releasing colored compound with concentration proportional to the concentration of the parameter found in the sample.

2.4.3. Statistical analysis

The collected data was defined, coded and analyzed using the statistical package of social science (SPSS) software package version 20. Statistical tests as frequency and distribution were done to express our data as number, percentages and Pie charts. Moreover, paired T-test was performed to compare fasting blood sugar, glycosylated hemoglobin and lipid profile before and after three months of treatment. Significance of the association was tested at an alpha value of ($P \geq 0.05$).

3. Results

3.1. Characteristics of the Study population

The total number of the study population who fulfilled the selection criteria was sixty patients, two patients were withdrawn due to incompliance. In the control group, 11

(55%) were males and 9 (45%) were females, their age ranged from 40 to 60 years. In the second group, nine were males (47.3%) and 10 (52.7%) were females, and their age ranged from 36 to 60 years. In the third group 11 (57.9%) were males and 8 (42.1%) were females, and their age range was from 31 to 60 years.

3.2. Effect of vitamin C alone or in combination with vitamin E supplements on fasting blood sugar (FBS)

The results presented as mean ± S.D, show a statistically insignificant change (P > 0.05) in FBS in the control group which was 144.00±20.70 mg/dl at the baseline and increased slightly to 144.75±25.83 mg/dl at the end of the study (3 months). In group 2 a statistically significant reduction (P<0.05) in FBS was seen, it decreased from 143.63±20.26 mg/dl at the baseline of the study to 133.42±23.05 mg/ dl following three months of vitamin C intake. While in group 3 patients, FBS was 159.15±15 mg/dl at the baseline of the study, decreased significantly (P=0.0) to 122.94±23.78 mg/dl. The reduction in FBS was equal to 22.75%. This reduction was more significant compared to that seen in group 2, calculated to be 7.0%.

3.3. Effect of vitamin C alone or in combination with vitamin E supplements on glycosylated hemoglobin (HbAlc)

Data about glycosylated hemoglobin level (HbAlc) among the study population demonstrated that changes in HbAlc in the control group, were slight and insignificant (P value = 0.61) , while in group 2 patients, HbAlc was 7.15 mg/dl at the baseline of the study and decreased significantly to 6.32 mg/dl (p value < 0.05), the reduction in HbAlc equaled 11.5%. In group 3 patients, HbAlc was 7.32 mg/dl at the baseline and decreased to 6.12 mg/dl at the end of study with a reduction equal to 16.3%. Data analysis showed a significant differences in HbAlc with p value < 0.05 in both G2 and G3, but the difference was more significant in group 3 than in group 2, who used vitamin C alone.

3.4. Effect of vitamin C alone or in combination with vitamin E supplements on total cholesterol

Data demonstrate the total cholesterol (TC) level among the study population. To clarify, in control group TC was 234.20±29.48 mg/dl at the baseline and increased insignificantly to 241.55 ± 41.31 mg/dl over three months. But in group 2 patients who used vitamin C alone, TC was 244.84 ±34.46 mg/dl at the baseline, and decreased to 210.15 ±38.06 mg/dl at the end of the study, this means that TC decreased significantly over the three months of treatment (P value < 0.05).

The decrease in TC in response to vitamin C use alone equaled to 14.1%. While TC in group 3 who used vitamin C in combination with vitamin E was 233.84 ± 22.84 mg/dl at the baseline, decreased significantly (P value < 0.05) to 200.10 ± 27.26 mg/dl at the end of study with a reduction equal to 14.4%. The reduction in TC seen in group 2 and group 3 following vitamins intake was closely similar.

3.5. Effect of vitamin C alone or in combination with vitamin E supplements on total triglyceride (TG)

Data about total triglyceride (TG) level among the study population. In control group, TG was statistically unchanged; however, in group 2 patients who used vitamin C alone, TG was 242.31 ±78.50 mg/dl at the baseline, decreased significantly to 196.05 ± 66.34 mg/dl at the end of study with P value equal to 0.001.

Furthermore a statistically significant reduction in TG with P value < 0.05 in group 3 Patients (used vitamin C in combination with vitamin E) was found, as TG was 241.00 ± 68.70 mg/dl at the baseline, decreased to 183.94 ± 40.66 mg/dl at the end of study. The reduction in this group was more significant than that seen in G2 patients, the reductions equaled to 19.2% and 23.6% in G2 and G3, respectively.

3.6. Effect of vitamin C alone or in combination with vitamin E supplements on LDL- Cholesterol

Data analysis shows that LDL – Cholesterol levels among the study population. In the control group, a slight increase in LDL-Cholesterol was found over the three

months of study, it was 156.80 ±31.32 mg/dl at the baseline, increased to 158.85 ±39.27 mg/dl at the end of the study. In group 2 patients, a reduction in LDL - Cholesterol equal to 36.47 mg/dl was seen over the three months study period, which is a highly significant reduction of P value ﹤0.05. However LDL was 147.84 ± 29.02 mg/dl at the baseline, and decreased to 123.26 ± 29.16 mg/dl in G3 Patients who used vitamin C in combination with vitamin E, this means a significant difference at P value 0.05 in LDL was found, but the difference in group 2 patients was more significant than that in group 3 patients. Where the reduction in LDL Cholesterol was equal to 23.1% and 16.6% in G2 and G3, respectively.

3.7. Effect of vitamin C alone or in combination with vitamin E Supplements on HDL-Cholesterol

The data show that the HDL Cholesterol levels throughout the study population increased slightly but statistically insignificant at the P value ﹤ 0.05 in all groups after three months of three experimental protocols, suggesting no effect for vitamin C alone or in combination with vitamin E on HDL Cholesterol level among the study population through the three months study period.

4. Discussion

4.1. Effect of vitamin C alone or in combination with vitamin E intake on fasting blood sugar

Results of the study showed a statistically insignificant reduction (P ﹥ 0.05) in FBS in the control group at the end of the study (3 months). But in group 2 and group 3 a statistically significant reduction (P ﹤ 0.05) in FBS was seen. The reduction was 22.75% in group 3, while in group 2 was equal to 7.0%, suggesting that the combination of vitamin C and vitamin E would give better effect on FBS level in type 2 diabetic patients than the use of vitamin C alone. These results were similar to those found by other researchers Afkhami and Shojaoddiny, 2007; Dakhale G.et., (2011); Refighi Z., (2011) and Vaksh S. (2003) [6,15,16,17]. For example, the study of vaksh S. (2013) which was conducted in India

for (4 weeks) on thirty type 2 diabetic patients, aged between (43-77 years), treated with their usual oral hypoglycemic drugs along with vitamin C 1000 mg, found a significant decrease in FBS at P value ﹤ 0.01.

On the other hand, other studies conducted by Bishop N. et al., (1985) and Ble-Castillo et al., (2005)[18,19] showed no effect of vitamin C and vitamin E on FBS. The study of Ble-Castillo et al., which evaluated the effects of alpha-tocopherol on the metabolic control and oxidative stress in thirty- four female type 2 diabetics between 40-70 years, divided into control group and alpha-tocopherol treated group (800 IU/day), and followed for 6 weeks. Researchers found that alpha-tocopherol administration had no beneficial effect on glycemic control.

4.2. Effect of vitamin C or in combination with vitamin E intake on glycosylated hemoglobin (HbAlc)

In the current study, we found that vitamin C intake significantly reduced HbAlc after three months of vitamin C intake (1000 mg in divided doses), the reduction in HbAlc equaled 11.5%. While vitamin C in combination with vitamin E caused larger reduction in HbAlc level than vitamin C alone, as HbAlc was reduced by 16.3% at the end of study. The results showed that vitamin C intake alone or in combination with vitamin E, improved HbAlc in type 2 diabetic patients, which is hopeful for people with the this chronic disease, in which poor glycemic control increases the risk of future cardiovascular diseases.

Various studies including Afkhami and Shojaoddiny, (2007); Rafighi Z., (2011), Dakhale G.,et al., (2011) and Vaksh S., (2013)[6,15,16,17] agreed with our results. For instance, the results obtained by Dakhale G.,et al. (2011) agreed with our results. The study was carried out in India on 70 type 2 DM patients treated with metformin (for 12 weeks), aged between (30-60 years). The patients were divided randomly into placebo group and vitamin C group, in which vitamin C was administrated in a dose of 1000 mg in two divided doses, The HbAlc decreased significantly at P value ﹤ 0.01.

A different study carried out by Bishop N. and his

colleagues (1985) [18],they followed up 50 type 2 diabetic patients for four months treated by 500 mg vitamin C or placebo. They found insignificant difference between the effect of vitamin C or placebo on HbAlc, showing the inability of the low dose of vitamin C to improve HbAlc.

4.3. Effect of vitamin C alone or in combination with vitamin E intake on total cholesterol (TC)

Results of the present study demonstrated positive effect of vitamin C alone or in combination with vitamin E on TC, which mean that TC decreased significantly over the three months of treatment (P value < 0.05).

These results were similar to those found by other researchers such as Eriksson and Kohvakka, (1995); Dakahle G., (2011), Rafighi Z., (2011), Soliman G., (2012) and Vaksh S., (2013) [6,14,16,17,20]. For example, the study of Eriksson and Kohvakka (1995), which was carried out on 56 type 2 diabetic outpatient of malmi municipal hospital in Finland, in which the patients were supplemented with a high dose of ascorbic acid supplement (2.0 g per day), they showed an improvement in cholesterol levels of patients after six months of vitamin C supplementation.

On the other hand, Mazloom Z. et al. (2011)[21] carried out a randomized study in Iran for six weeks in order to evaluate the effect of vitamin C supplementation (1000 mg per day) on fasting and postprandial oxidative stress and lipid profile on 30 type 2 diabetic patients aged between 30-65 years, The result of the study showed a significant decrease in fasting (P= 0.006) and postprandial MDA (P< 0.001) in vitamin C treated group compared to placebo group, but insignificant reduction in lipid profile including TC was found.

4.4. Effect of vitamin C alone or in combination with vitamin E intake on total triglyceride (TG)

Date about total triglyceride (TG) level among the study population showed a significant decrease in the level of triglyceride in patients who used vitamin C alone or in combination with vitamin E. This reduction in TG in both groups who either took vitamin C alone or vitamin C in combination with vitamin E was indicative

and means that, these antioxidants can be considered an important adjuvant therapy in type 2 diabetic patients.

Different studies previously concluded that either vitamin C alone or in combination with vitamin E gave positive effect on serum level of triglyceride such as Owu DU. et al., (2006); Afkhami and Shojaoddiny, (2007) and Rafighi Z., (2011) [6,17,22]. For example, a study conducted by owu DU. et al. (2006) to evaluate the effect of oral vitamin C administration on basal metabolic rate and lipid profile in alloxan – induced diabetic rats (n=6). Vitamin C was administered at 200 mg/kg body weight for eight weeks. The results showed that vitamin C administration significantly reduced triglyceride. But studies of Bishop N.et al. (1985) and Boshtam M.et al., 2005 [18,23] showed that vitamin C and or vitamin E had no effect on TG. For example Boshtam M. et al. (2005) conducted a clinical study on 100 type 2 diabetic patients in Iran to determine the effect of vitamin E (200 IU/ day) on TG for a period of 27 weeks. Findings of this study showed no effect of vitamin E supplementation on TG improvement. This could be explained by the low dose of vitamin E used (200 IU/day).

4.5. Effect of vitamin C alone or in combination with vitamin E intake on LDL cholesterol

In the current study, we used vitamin C (1000 mg per day in two divided doses) or vitamin C (1000 mg per day in two divided doses) in combination with vitamin E (800 mg per day in two divided doses) to evaluate their effect on LDL among type 2 diabetic patients. We found that a reduction in LDL – cholesterol was a highly significant at P value <0.05 in both group.

Recently, it has been suggested that either vitamin C alone or vitamin C in combination with vitamin E as antioxidant can play an important role in improving lipid profile including LDL among type 2 diabetic patients. For example, Rafighi Z., (2011)[6] carried out their study on 170 type 2 diabetic patients in Iran for three months. Patients were divided into four groups; vitamin C group was given (266.7 mg three times a day), vitamin E group was given (300 IU three times a day), vitamin C+E group was given (300 IU+ 266.7 mg each three times a day) and

the placebo group. The results showed a significant decrease in LDL level in all supplemented groups compared to placebo

On the other hand, studies such as that carried out by Mazloom Z., (2011)[15,21] and afkhami and Shojaoddiny, (2007) evaluated the effect of vitamin C alone or vitamin C in combination with vitamin E on LDL and found no effect. For example, Afkhami and Shojaoddiny, (2007) conducted a study for six weeks at Yazed Diabetes Research Center in Iran on 84 patients with type 2 diabetes who were divided into two groups, the first group (n=41) treated by vitamin C (500 mg) and the second group (n=43) treated by vitamin C (1000 mg). They found that vitamin C in a dose of 500 mg did not produce any significant decrease in LDL level, but the dose of 1000 mg decreased LDL level significantly, which means that a dose higher than 500 mg per day is needed to produce positive effect on LDL level.

4.6. Effect of vitamin C alone or in combination with vitamin E intake on HDL-Cholesterol

The results of our study showed that the HDL Cholesterol levels throughout the study period increased slightly but statically insignificant at P value ˂0.05 in all groups after three months of vitamin supplementation, suggesting no effect for vitamin C alone or in combination with vitamin E on HDL cholesterol among the study population.

This result agreed with the result of the study carried out by Dakhale G.et.al (2011),[17] in which the study showed no significant change in the serum levels of HDL in both groups.

5. CONCLUSIONS

At the end of the study and following data analysis, we concluded that both vitamin C (500 mg twice a day) alone and vitamin C in combination with vitamin E (400 mg twice a day) had a clear positive effect on FBS, HbAlc, TC and LDL among type 2 diabetic patients. They both reduced these parameters significantly after three months of treatment. The reduction in FBS, HbAlc and TG caused by vitamin C (500 mg twice a day) in combination with vitamin E (400 mg twice a day) was more than the reduction caused by vitamin C alone (500 mg twice a day), while the reduction in TC caused by both was closely similar. In the other hand the reduction in the serum level of LDL was more significant in vitamin C (500 mg twice a day) treated group than in the group treated by vitamin C (500 mg twice a day) in combination with vitamin E (400 mg twice a day).

Ethical Approval

The study was approved by Helsinki Committee of ministry of health-Palestine at 3/2012.

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تأثير فيتامين C بمفرده أو مع فيتامين E على مستوى السكر في حالة الصيام، مخزون السكر في الجسم ودهون الدم علي مرضى السكري من النوع الثاني في قطاع غزة

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ملخص

تهدف هذه الدراسة إلى تقييم تأثير Vitamin C بمفرده أو مع Vitamin E كعلاج مساعد للتقليل من مستوى السكر، مخزون السكر ومستوى الدهون في الدم بين مرضى السكري من الدرجة الثانية في قطاع غزة، وذلك من خلال اختيار ستين مريض سكري من النوع الثاني الذين يتناولون علاج metformin فقط من عيادة السكري في مؤسسة الإغاثة الطبية وبعض عيادات وكالة الغوث (UNRWA) في قطاع غزة، تم تقسيم المرضى إلى ثلاث مجموعات، المجموعة الأولى (ن = 20) استمرت على علاج السكري (metformin) ولم يضف للعلاج أي فيتامين، المجموعة الثانية (ن = 19) تم علاجها (500 مجم مرتين يومياً) بالإضافة لعلاج metformin، بينما المجموعة الثالثة (ن = 19) تم علاجها بـ Vitamin C (500 مجم مرتين يومياً) مع vitamin E (400 مجم مرتين يومياً) بالإضافة للعلاج (metformin) لقد تم متابعة المرضى وإجراء فحوصات مخبرية لهم في بداية الدراسة وبعد ثلاثة شهور لكل من مستوى السكر في الدم في حالة الصيام ومخزون السكر ودهون الدم وهي تشمل: (الكولسترول الكلي، الدهون الثلاثية، الكولسترول السيء والكولسترول الحسن).

تحليل نتائج الدراسة أظهر انخفاضاً ذا دلالة إحصائية في مستوى السكر في الدم في حالة الصيام، مخزون السكر ومستوى الدهون في مرضى المجموعة الثانية والثالثة مقارنة بمرضى المجموعة الأولى وذلك بعد ثلاثة شهور من الدراسة، الانخفاض في مستوى السكر في الدم في حالة الصيام ومخزون السكر والدهون الثلاثية كان أكثر وضوحاً في المجموعة الثالثة مقارنة بالمجموعة الثانية والانخفاض في مستوى الكولسترول كان تقريباً متساوياً في كلتا المجموعتين, بينما الانخفاض في مستوى الكولسترول السيء كان أكثر وضوحاً في المجموعة الثانية، ولقد تسبب كلاً من vitamin C بمفرده أو كلاً من Vitamin C مع Vitamin E زيادة بسيطة دون دلالة إحصائية في مستوى الكولسترول الحسن في كلتا المجموعتين الثانية والثالثة.

كشفت الدراسة أن تناول مضادات الأكسدة مثل vitamin C سواء بمفرده أو مع vitamin E من قبل مرضى السكري من النوع الثاني الذين يتناولون فقط علاج metformin يؤدي إلى انخفاض ذو دلالة إحصائية في مستوى السكر في الدم في حالة الصيام ومخزون السكر، وكذلك إلى انخفاض واضح في مستوى دهون الدم.

الكلمات الدالة: الجزيئات الحرة النشطة، فيتامين C، فيتامين E، مستوى السكر في الدم في حالة الصيام، مخزون السكر، مستوي الدهون في الجسم.