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INFLUENCE OF CIGARETTE SMOKING ON NUTRITIONAL AND BIOCHEMICAL PARAMETERS IN MEN

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ABSTRACT

Hundred and thirty two male healthy smokers and non-smokers aged 40-55 years were evaluated using anthropometric, dietary intake and biochemical measurements. The mean body mass index was 26.87 ± 1.6 for smokers and 29.96 ± 1.1 for non-smokers. Body fat percent was significantly lower in smokers than that in non-smokers.

Smokers declared significantly lower intakes of vitamins A, E and significantly higher intakes of saturated fat and energy derived from carbohydrates than non-smokers.

The plasma vitamin levels revealed deficiency in vitamin A, E, and C in smokers than that of non-smokers. The activities of scavenging enzyme superoxide dismutase (SOD) and glutathione peroxidase (GSH-PX) were significantly higher in smokers than non-smokers.

Smoker subjects received dietary supplementation with vitamins A, C, and E for two months. After supplementation, the levels of these vitamins were increased significantly in plasma. On the other hand, the activity of superoxide dismutase (SOD) showed a significant decrease and the activity of glutathione peroxidase (GSH-PX) was non-significantly decreased in smokers than in non-smokers.

The present study revealed many unhealthy patterns of nutrient intakes in smokers as compared to non-smokers and should be advised to obtain sufficient amounts of antioxidants in their diets. Also, supplementation with vitamin A, E and C lead to improve the activities of the free radical scavenging enzymes.

INTRODUCTION

Smoking causes an increase in free radicals, reactive nitrogen and oxygen species; and the cigarette smoking is associated with increases in the incidence and severity of several diseases including atherosclerosis, cancer and chronic obstructive lung diseases (Diana, 1993 and Traber *et al*., 2000). Free radicals may be the most critical factors triggering plasma antioxidant depletion, lipid peroxidation, and protein modification (Eiserich *et al*., 1995). Oxidative stress imposed by cigarette smoking has a low impact upon certain pathways involved in DNA damage and the antioxidative defense system (Nia *et al.*, 2001). However, smoking tends to cluster with other lifestyle risk factors (Thornton *et al*., 1994 and Raitakari *et al*., 1995).

A clustering of smoking and unhealthy dietary habits was documented in many studies (Whichelow *et al*., 1991; Thornton *et al*., 1994; Woodward *et al*., 1994 and Faruque *et al*., 1995). Cross-sectional data show that cigarette smokers consume diets different from those of people who do not smoke (Subar *et al.*, 1990; Whichelow *et al*., 1991 and Margatts & Jackson, 1993).

Researchers have proposed that antioxidants such as vit. E, ascorbate, and carotenoids have a protective effect by scavenging oxidants,

thus preventing lipid peroxidation (Halliwell *et al*., 1992 and Eiserich *et al*., 1995). Antioxidants appear to have differing declines in serum levels as a reduced dietary intakes and the effects of smoking (Wei *et al.*, 2001).

The objective of this work was to study the nutritional, anthropometric and biochemical measurements of smokers in comparison to non-smokers. Also, the effect of 2-month supplementation with antioxidant vitamins (A, E and C) on the biochemical parameters of smokers were examined.

MATERIALS AND METHODS

Material:

The study included hundred and thirty two male healthy volunteers with an age ranged of 40-55 years. All subjects were asked for smoking habits, and divided into two groups, smokers and non-smokers. All current smokers group smoked between 10 to 30 cigarettes per day for more than 15 years. Anthropometric variables were measured for all cases. Body height and weight were measured without shoes but with one layer of clothing. Body mass index (BMI) was calculated from weight and height measurements. Body fat percent (%BF) was calculated according to Blanchard *et al*. (1990).

Dietary intake data:

The average daily intake of an individual is based upon three separate 24-hour dietary recalls. The data from the dietary records were converted to nutrient intakes using World Food Dietary Assessment computer program (1996).

Biochemical measurements:

Blood samples were obtained from all subjects after overnight fasting for determination of: blood hemoglobin (VanKapmen and Zijlstra, 1965), blood glutathione peroxidase (GSH-PX) (Kraus and Ganther, 1980), erythrocyte superoxide dismutase (SOD) (Roth and Gilbert, 1984), plasma vitamin A (Neeld and Pearson, 1963), plasma vitamin E (Desai and Machlin, 1985) and plasma vitamin C (Jagota and Dani, 1982).

Only smoker subjects were supplemented with vitamins C (500 mg), E (70 mg) and A (30,000 IU) for 2-month. After 2-month of supplementation all the mentioned biochemical parameters were re-evaluated for studying the effect of vitamins supplementation on smokers status.

RESULTS AND DISCUSSION

Table (1) shows the anthropometric and body characteristic of smokers and non-smokers subjects. The mean body mass index (BMI) was slightly lower in smokers than in non-smokers, but this difference failed to attain statistical significance. According to the reference value of George, (1998), 40 % from smokers were under weight and only 11.1% from non-smokers had BMI less than 25. These results indicate that smokers may be exposure to weight loss more than non-smokers. Body fat percent reduced significantly in smokers than non-smokers, these results agreed with that of Ma *et al*. (2000), who found that current smokers had the lowest body mass

index when compared with non and former smokers. It has been proposed that changes in metabolism, especially in fat oxidation, and lifestyles may also account for weight fluctuations related to smoking and abstaining (Raitakari *et al*., 1995 and Jensen *et al*., 1995).

Table (1): Anthropometric and body characteristics of the studied group.

Variable	Smoker (n=60)	Non-smoker (n=72)	p
Age (yrs)	60.3±2.1	55.4±5.1	n.s
Weight (Kg)	71.93±3.4	68.61±1.8	n.s
Height (m)	1.65±0.03	1.52±0.03	<0.005
BMI (kg/m^2)	26.87±1.6	29.96±1.1	n.s
BMI < 25	40%	11.1%	
Body fat (%)	30.72±2.3	36.75±1.4	<0.05

Table (2) shows that energy, protein and fat intakes decreased non-significantly, while carbohydrate increased non-significantly in smokers than non-smokers. Smokers also declared significantly higher intakes of energy derived from carbohydrates, saturated fat and non-significantly lower consumption of polyunsaturated fat than non-smokers. Many studies showed that smoking cigarettes affects food choice and nutrient intake, thus Dallongeville *et al*. (1997) suggest that smoking has powerful effect on dietary habits. Thompson *et al*. (1992) reported that smoking cigarettes is associated with a different food pattern and altered nutrient intake, in particular more saturated fat, less polyunsaturated fat and low consumption of antioxidant vitamin.

Table (2): Energy and nutrient daily intake (mean ± SE) of Smokers and non-smokers.

Parameter	Smoker (n = 60)	Non-smoker (n =72)
Energy (Kcal)	1755.7±44.5	1800.6±35.3
Protein (g)	74.6 ±5.0	79.8±5.3
Fat (g)	38.8±2.7	46.5±3.7
Carbohydrate (g)	277.1±6.3	265.7±10.8
Protein (%energy)	16.87±0.9	17.72±1.1
Fat (%energy)	19.87±1.4	23.29±1.8
Carbohydrate (%energy)	63.56±1.1	58.39±1.9*
Saturated Fat (g)	22.95±1.3	18.45±1.9*
Mono-unsaturated fat (g)	11.99±1.2	14.01±1.2
Poly-unsatyrated fat (g)	6.74±1.6	6.87±1.4
Vitamin A (RE)^{c}	305.9±24.7	476.0±32.8****
Vitamin E (TE)^{d}	1.42±0.2	2.08±0.2**
Vitamin C (mg)	38.1±3.6	40.1±3.4

(RE)^{c}: Retinol equivalent; (TE)^{d}: Tocopherol equivalent; *P < 0.05; ** p < 0.025 ***p<0.001

Vitamins E and A intakes decreased significantly in smokers than in non-smokers ($p<0.025$ and 0.001 respectively), while vitamin C intake showed a non-significant decrease in smokers than in non-smokers. In agreement with Ma *et al*. (2000) and Phillips *et al*. (2000), they found that light and heavy smokers had a significantly lower mean dietary antioxidant vitamin intake than that of non-smokers. Also, Wei *et al*. (2001) concluded that antioxidants appear to have differing declines in serum levels as a result of reduced dietary intakes and the effects of smoking.

Table (3) shows the biochemical parameters of smokers and non-smokers subjects. The hemoglobin levels of smokers and non-smokers were within the reference range of normal, which conform to them being chosen as generally healthy. On the other hand, the plasma vitamins A, E and C were significantly lower in smokers than non-smokers ($p<0.001$, <0.001 and <0.05 respectively). This finding is in agreement with that of (Simon, 1992; Eiserich *et al*., 1995 and Wei *et al*., 2001), who suggest that smokers have lower plasma levels of antioxidant vitamins. Also, in vitro exposure of plasma to cigarette smoke results in depletion of antioxidants, ascorbic acid being consumed first (Cross *et al*., 1993). Lykkesfeldt *et al*., (2000) suggested that the lower concentrations of plasma vitamin E and carotenoids in smokers than in non-smokers may primarily have been caused by differences in dietary habits. Our finding suggesting that the low concentrations of plasma antioxidants in smokers may possibly reflects the low intake of foods rich in antioxidant vitamins and the fact that antioxidants are likely to be used more rapidly in the oxidation process, or both.

Table (3): Biochemical parameters of nutritional status in the studied group.

Parameter	Smoker (n=60)	Non-smoker (n=72)	p
Hemoglobin (g/dl)	13.54±1.3	13.06±1.6	n.s
Blood GSH-PX (u/l)	36.04±3.3	26.67±1.9	<0.025
Erythrocyte SOD (u/g Hb)	2689±110.3	2200±114.6	<0.001
Plasma Vit. A (ug/dl)	27.64±0.47	33.57±0.84	<0.001
Plasma Vit. C (mg/dl)	0.57±0.01	0.83±0.13	<0.05
Plasma Vit. E (mg/dl)	0.66±0.02	0.79±0.04	<0.005

Blood glutathione peroxidase and erythrocyte superoxide dismutase activity were significantly higher in smokers than non-smokers ($p<0.025$ and < 0.001 respectively). These finding agreed with previous studies of Banerjee *et al*., (1998) who found that vitamin C and glutathione levels were decreased significantly while lipid-peroxide levels were increased significantly in a group of adult male smokers. Hilbert and Mohsenin (1996) found that catalase and glutathione peroxidase activities were high in smokers compared with non-smokers. Also, Hulea *et al*. (1995) found that superoxide dismutase and glutathione peroxidase activities were high in smokers compared with non-smokers.

Table (4) shows the biochemical parameters of smokers before and after 2-month of supplementation with vitamin mixture. There was a non-significant reduction in hemoglobin and the activity of glutathione peroxidase in smokers after supplementation with vitamins. Erythrocyte superoxide dismutase activity reduced significantly ($p<0.05$) in smokers after supplementation. Plasma levels of vitamin A, E and C increased significantly after supplementation ($p<0.001$, <0.005 and <0.001 respectively). This reduction may partly explain by the potential prooxidant effects of vitamin supplementation. Brown *et al*. (1997) suggested that a supplement of 70-140 mg vitamin E/day is sufficient to prevent free radical-mediated peroxidation of erythrocytes in vitro in both smokers and non-smokers, and that high-dose vitamin E supplements should be accompanied by sufficient ascorbate intakes. Lykkesfeldt *et al*., (2000) suggested that plasma ascorbic acid was depleted by smoking and repleted by moderate supplementation. The present findings support a protective role for antioxidant vitamins against cigarette smoke-induced oxidative damage and associated degenerative diseases.

Table (4): Biochemical parameters of nutritional status in the studied group before and after supplementation.

Parameter	Smoker (n=60)	Smoker (n=60)	p
	Before	After suppl.	
Hemoglobin (g/dl)	13.54±1.3	13.88±1.17	n.s
Blood GSH-PX (u/l)	36.04±3.3	31.12±2.4	n.s
Erythrocyte SOD (u/g Hb)	2689±110.3	2400±90.4	<0.05
Plasma Vit. A (ug/dl)	27.64±0.47	38.54±0.27	<0.001
Plasma Vit. C (mg/dl)	0.57±0.01	0.911±0.04	<0.001
Plasma Vit. E (mg/dl)	0.66±0.02	0.88±0.07	<0.005

In conclusion: This finding suggest that smokers have many unhealthy habits as compared with non-smokers and should be advised to obtain sufficient antioxidants in their diets and increased the intake of polyunsaturated fatty acids especially ω-3 fatty acids. The present research also suggest that supplementation with vitamin mixture (E, A and C) for 2-month may prevent free radical production and elevate plasma levels of these vitamins, also lead to improve the activities of the free radical scavenging enzymes in smokers.

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تأثير تدخين السجائر على بعض الدلالات الغذائية والبيوكيميائية في الرجال

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أجريت الدراسة على عدد ١٣٢ رجلا مدخنا وغير مدخنا تتراوح أعمارهم ما بين ٤٠ و ٥٥ سنه. وقد استخدمت الدراسة بعض المقاييس الأنثروبومترية – الغذائية - والبيوكيميائية لتقييم حالة المدخنين ومقارنتهم بغير المدخنين.

أوضحت النتائج أن مقياس كتلة الجسم للمدخنين كان ٨٧, ٢٦ ± ١,٦ ولغير المدخنين كان ٢٩,٩٦ ± ١ و١. وقد كانت النسبة المئوية لدهن الجسم أقل معنوياً في المدخنين وذلك بالمقارنة بغير المدخنين.

أظهرت مجموعة المدخنين نقصا معنويا في المتناول اليومي من فيتامينات (ا ، هـ) وكذلك في الطاقة المستمدة من الكربوهيدرات وأيضا الدهون المشبعة بالمقارنة بغير المدخنين.

وجد أن مستوى بلازما الدم من الفيتامينات كان قليلا في مجموعة المدخنين بالمقارنة بالمجموعة الغير مدخنه. وان النشاط الأنزيمي لكل من السوبراكسيددسميوتيز والجلوتاثيون بيراكسيديز كان ارتفاعهما معنويا في المدخنين بالمقارنة بغير المدخنين.

تم تدعيم مجموعة المدخنين بجرعة يوميه من فيتامينات (ا ، هـ ، ج) لمدة شهرين. أما بعد التدعيم بالفيتامينات (ا ، هـ ، ج) فقد ارتفع تركيز كل منهما في بلازما الدم بصوره معنوية. أما نشاط انزيم السوبراكسيددسميوتيز انخفض معنويا في حين ان نشاط إنزيم الجلوتاثيون بيراكسيديز كان انخفاضه غير معنوي في المدخنين بالمقارنة بغير المدخنين.

من النتائج السابقة يجب أن ينصح المدخن بتحسين عاداته الغذائية وخصوصا أن يحتوى طعامه على كميه كافيه من مضادات الأكسدة. كذلك التدعيم بفيتامينات (ا ، هـ ، ج) تؤدى إلي تحسن في نشاط الأنزيمات المتصيدة للشقوق الحرة.