Antioxidants and oxidative damage markers response to visceral fat loss in obese female subjects.

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Research note

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Abstract

Objective Visceral obesity and related diabetes is reaching epidemic proportions in the United Arab Emirates (UAE). Inflammation and oxidative damage are possible mechanisms linking visceral obesity to diabetes and other related complications. We have recently reported that levels of oxidative stress and inflammatory markers increase with increasing waist circumference (WC) in obese female subjects. The aim of this study was to measure antioxidants and oxidative damage markers response to visceral fat loss. Results Overall 293 females who received structured dietary education for obesity management were included in the study. Over a follow-up period of 427±223 days, obese subjects had a mean (±SD) of 13±5 education sessions. At the end of the follow up period we found decreased visceral fat, inflammatory and oxidative damage markers and increased antioxidant enzymes and vitamins, however, no significant differences were found between obese subjects who lost visceral fat compared to those who gained visceral fat. Both increased fruits and vegetables and decreased calorie intake had significant independent positive effects on WC decrease [odd ratio (95% CI): 1.04 (1.01, 1.08); p=0.045 and 1.0 (1.0, 1.01); p=0.048 respectively].

Introduction

The prevalence of obesity and related diabetes and other cardiovascular disease (CVD) risk factors is increasing rapidly and reaching epidemic proportion in the Gulf countries including the United Arab Emirates (UAE) [1-3]. The UAE has one of the highest prevalence of abdominal (visceral) obesity related diabetes mellitus in the World [3]. Possible mechanisms that relate visceral obesity to increased risk of diabetes and other related complications include inflammation, and oxidative damage [4,5]. We have recently reported that levels of oxidative stress and inflammatory markers are higher in obese women than non-obese women and increase with increasing WC in the UAE [6,7]. The aims of this study were to investigate antioxidants both enzymes and vitamins and oxidative damage markers response to visceral fat loss in overweight and obese female subjects.

Methods

All overweight and obese subjects visiting ambulatory community health centres for obesity management in Al Ain city were invited to take part in the study. Following informed written consent, eligible subjects had a anthropometric measurements and fasting 10 ml of blood taken for measurements of antioxidant enzymes and vitamins, markers of oxidative damage and inflammation and other related clinical, nutritional and biochemical variables at baseline. Participants were then assigned to receive structured dietary education by an experienced dietician. Inclusion criteria included subjects aged 18 years and over with body mass index (BMI) >25. Individuals participating in other intervention trials, on dietary supplements or taking anti-obesity medications and those unable to give an informed written consent were excluded. The Local research ethical committee has approved the study.

Dietary education: All subjects received structured dietary education to increase their fruits and vegetables consumption and reduce high energy food intake by 2 experienced dieticians.

Measurements: All participants had baseline assessment and anthropometric data including body weight, height and BMI were measured using Tanita body composition analyser.

A validated short semi-quantitative food frequency questionnaire designed for self-administration following a brief verbal discussion was used to assess subject's fruit and vegetables intake. Calorie intake was measured using a locally validated 24-hour recall diary at baseline and at the follow up visit. A validated questionnaire was used to assess occupation and leisure-related physical activity.

Blood samples: Methods for measurement of antioxidant vitamins (E, A and beta-carotene) and enzymes [superoxide dismutase (SOD), Catalase, glutathione peroxidase (GPx), and glutathione (GSH)], inflammatory markers (Hs-CRP, TNF and IL6), endothelial dysfunction (intracellular adhesion molecule (i-CAM), vascular cell adhesion molecule-1 (v-CAM) ; lipid peroxidation marker Thiobarbituric Acid Reactive Substances (TBARS) and Protein Oxidation marker protein carbonyl were published before [7].

2.4 Statistics and analysis:

Paired-samples T test, one-way and repeated-measures analysis-of-variance were used to test within and between-subject changes. Multiple logistic regression analysis was used to examine the independent influence of dietary intervention including fruits and vegetables consumption and on change in WC at follow up.

Results

Details of the 293 overweight and obese females with a mean (±SD) age 35±11 included in the analysis were published before. Inflammatory and oxidative damage markers significantly increased with a significant decrease seen in the antioxidant β-carotene with increasing WC quartiles ($p<0.05$) [Figure 1]. Although table 1 show significant decrease in all inflammatory markers (Hs-CRP, TNF, α IL6) and the oxidative damage marker TBARs and a significant increase in some antioxidant enzymes and vitamins, no significant differences were seen however in antioxidants, oxidative damage, inflammatory and endothelial dysfunction markers in obese subjects with decreased WC compared to those with increased WC at the end of the follow up period. After adjusting for lifestyle and other important prognostic indicators in the multiple logistic regression analysis, both increased fruits and vegetables and decreased calorie intake had significant independent positive effects on WC decrease [odd ratio (95% CI): 1.04 (1.01, 1.08); p=0.045 and 1.0 (1.0, 1.01); p=0.048 respectively] (Table 2). In addition increased fruits and vegetables consumption did have an independent positive effect on WC decrease even after adjusting for interaction between calorie and fruits and vegetables intake [odd ratio : 1.043 (1.00, 1.088); p=0.048).

Discussion

In this study we found a positive association between inflammatory and oxidative damage markers and visceral fat in overweight and obese subjects. Our results also suggest an inverse association between some antioxidants and visceral fat and that increased fruits and vegetables consumption may also have a weak but positive association with visceral fat loss independent of its calorie reducing effect.

In a small trial before, we have also demonstrated that supplementation with antioxidant vitamins improved antioxidant status and reduced tissue inflammation in obese diabetic patients [8]. A recent meta-analysis has shown that increasing daily intake of green leafy vegetables may reduce the risk of type 2 diabetes [9]. Taken together these studies results suggest a beneficial role of higher fruits and vegetables intake in subjects with visceral obesity mediated by decreased inflammatory response and mitigation of oxidative damage. Our study results show no significant differences in antioxidants, oxidative damage, inflammatory and endothelial dysfunction markers between obese subjects who lost visceral fat and those gained visceral fat at follow up. However, recent evidence revealed beneficial effects of high fruits and vegetables Mediterranean diets on CVD risk in overweight and obese subjects independent of weight change [10]. Furthermore recent recommendations suggest the focus should mainly be on increasing fruit and vegetables rather than counting calories to combat obesity epidemics [11].

Our study results also suggest a weak but positive association between increased fruits and vegetables intake and decrease in visceral fat. Although replication of this finding is needed higher consumption of red/purple fruit and vegetables such as tomato, red onion, date, red cabbage, watermelon, cherries, red grapes, berries, strawberry and red plum has been associated with lower abdominal fat gain [12]. Another study reported a beneficial effect of higher intake of both fruit and vegetable and cereal fiber on abdominal obesity prevention [13]. Effects of fruits and vegetables on visceral obesity could be mediated by decreased inflammatory response, mitigation of oxidative damage associated with inflammatory cytokines that favor lipolysis and lipid oxidation instead of fat storage [14-16]. This is clearly an area for further research.

The average visceral fat and weight loss achieved by our study population in response to dietary education is around 3%. Although traditionally recommended weight loss target is around 5%, recent evidence suggests that small falls in weight can improve health provided they are long term [17, 18].

In conclusion we have demonstrated in this study that increased visceral fat is associated with increased oxidative stress. Our results also support a beneficial role of higher fruits and vegetables intake in subjects with visceral obesity however further replication of this finding is needed. These findings if proven, with availability of healthy food choices could have enormous public health implications for reduction of visceral obesity and its consequences in our community and worldwide. The benefits of antioxidant-rich diets in obese subjects may therefore need to be explored in larger intervention studies.

Limitations

The main limitations of our study are the lack of a control group and the open design. Nevertheless we have adjusted for important prognostic differences such as age, marital status, physical activity and the number of education sessions in the analysis. Body composition measurements for example, were performed digitally and printed on a sheet with little room for observer error. Biochemical analyses were also carried by a laboratory technician not involved in the recruitment, dietary education or data collection. Another potential limitation was the reduced number of follow up blood samples.

List Of Abbreviations

WC=waist circumference; CVD=cardiovascular disease; UAE=United Arab Emirates; BMI=body mass index; HC=hip circumference; Hs CRP= high sensitivity C reactive protein; IL6=Interleukin 6; LDL= Low density lipoprotein; HDL= High density lipoprotein

Declarations

Acknowledgement

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Availability of data and material:

Data is available upon request to the corresponding author

Consent to publish:

Not applicable

Ethics and consent statement:

Al Ain Medical District Human research ethics committee approved the study by (09/70). Written consent was obtained from all patients recruited to this study.

Competing interest:

The authors declare that they have no financial or non-financial competing interest or conflict of interest

Authors' contribution:

SG wrote the first draft, JA, AE & JY contributed to the analysis and presentation of data. All authors

contributed to the design and running of study, writing of the manuscript and the discussion. All authors read and approved the final manuscript.

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Tables

Table 1

Antioxidants, oxidative damage, inflammatory and endothelial dysfunction markers of study population [Mean (SD)]

Variable	Baseline (n=107)	Follow up (n=107)	Mean difference (95% C.I)	P value
Hs CRP (mg/l)	7.8 (7)	6.6 (7)	1.6 (-0.32, 2.8)	0.118
IL6 (pg/ml)	2.68 (1.7)	2.15 (1.8)	0.52 (.10, 0.94)	0.015
TNFα (pg/ml)	1.39 (0.47)	0.82 (3.7)	0.5 (0.57, 3.85)	0.000
Vitamin E (mg/l)	6.6 (4)	7.4 (3)	-0.8 (-0.83, 4.3)	0.115
Vitamin A (mg/l)	0.44 (0.23)	0.50 (0.14)	-0.06 (-0.15, 0.03)	0.203
β-carotene (µg /ml)	0.224 (0.24)	0.287 (0.25)	-0.06 (-0.13, 0.007)	0.077
Superoxide dismutase (U/ml)	3.99 (2.4)	4.73 (3.5)	-0.75 (-1.47, -0.026)	0.043
Catalase (nmol/min/ml)	26 (13)	46 (19)	-20 (-24, -16)	0.000
Glutathione peroxidase (ng/ml)	45 (14)	57 (18)	-13 (-27, 0.4)	0.057
Glutathione (GSH) (nM/ml)	6.55 (4.3)	6.40 (4.1)	0.14 (-0.818, 1.104)	0.768
Protein carbonyl (nmol/mg)	0.0813 (0.05)	0.072(0.07)	0.01 (-0.005, 0.025	0.204
TBARS (nmol/ml)	35 (11)	30 (10)	4.8 (2.5, 7)	0.000
i-CAM (ng/ml)	214 (48)	218 (62)	-4 (-16, 8)	0.530
v-CAM (ng/ml)	576 (148)	592 (160)	-16 (-47, 15)	0.313

Table 2

Multiple logistic regression analysis of the influence of some clinical prognostic variables on change in waist circumference (loss vs. gain) of study population at follow-up

iable	Regression coefficient	Standard error	Odd ratio for unit change (95% C.I)	P value
(years)	-.018	.022	.98 (.94 to 1.03)	.413
ital status (married, narried, divorced)	.295	.268	1.3 (0.79 to 2.27)	.271
el of education mary, secondary, graduate)	-.259	.182	.77 (.54 to 1.10)	.154
nber of visits to clinic	.088	.053	1.09 (.99 to 1.21)	.095
ts & vegetables consumption vings)	.040	.020	1.04 (1.01 to 1.08)	.045*
sical activity : active, moderately active, active)	-.042	.225	.96 (.62 to 1.49)	.853
orie intake (kcal/day)	.001	.000	1.0 (1.00 to 1.001	.048*

* P < 0.05

+Results adjusted for baseline calorie and fruits & vegetables intakes and physical activity

Figures

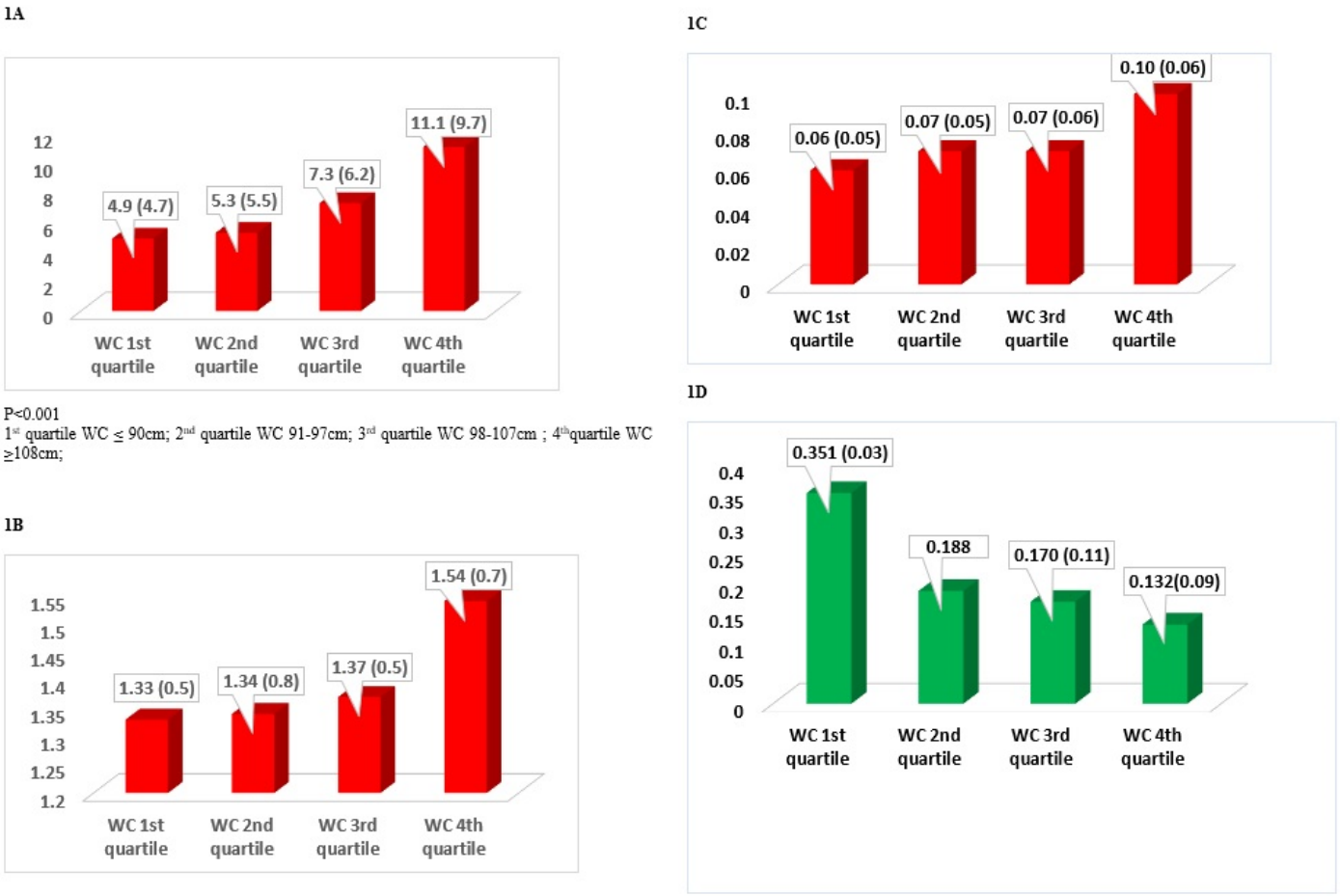

Figure 1

Baseline hs-CRP (mg/l) [A], TNFα (pg/ml) [B], Protein carbonyl (nmol/mg) [C] and β-carotene (µg/ml) [D], [mean (SD)] according to quartiles of waist circumference (WC) of female subjects.