The Difference in Antioxidant Vitamins Consumption between Obese and Non-Obese Lebanese Individuals

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Abstract

Background: Obesity is a serious health issue due to its association with severe comorbidities and mortality. The prevalence of obesity is increasing worldwide, reaching alarming levels in low-income or high-income countries. The Eastern Mediterranean region is no exception, with high obesity rates in countries sometimes exceeding those reported by developed ones. In Lebanon, as in most countries of the eastern Mediterranean, national studies on obesity are rare.

Obesity has been associated with a markedly increased oxidative stress: it is characterized by higher levels of reactive oxygen or nitrogen species. Antioxidant vitamins (vitamin A, C and E), among other components, play a big role in the protection against oxidative stress. Literature shows that obese have lower rates of antioxidant defenses (vitamins) than non-obese.

Objective: In this study, dietary antioxidant vitamin intakes were measured and compared for obese and non-obese Lebanese.

Design: A thirty-four items Semi-Quantitative Food Frequency Questionnaire (SQFFQ) was used on 500 Lebanese (153 males and 347 females) aged 18-62 years old, it covers the major sources of dietary antioxidant vitamins in Lebanon and it was validated against 24-hour recalls in 49 individuals (32 non-obese and 17 obese). The subjects were recruited from the database of dietary clinics. Anthropometric parameters (weight and height) were measured according to standardized protocols. Total energy intake was adjusted for 250 participants (166 non-obese and 84 obese).

Results: The means of daily consumption of vitamin A, C and E were lower for obese individuals compared to non-obese counterparts. The values were respectively for

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Non-obese Mean ± SD</th>
<th>Obese Mean ± SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>18.9 ± 70.2 µg</td>
<td>15.5 ± 455.9 µg</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>31.7 ± 30.4 mg</td>
<td>60.1 ± 41.7 mg</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>12.5 ± 5.7 mg</td>
<td>15.6 ± 7.3 mg</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

The differences between the daily consumption of antioxidant vitamins for non-obese vs obese individuals were highly significant (Student’s t-Test, p = 0 <0.01). Furthermore, this results were highly significant after caloric adjustment for 250 participants (Anova one way, for vitamin A, C and E respectively, p = 0.014, p = 0 and p = 0 <0.05).

Conclusion: The consumption of a healthy and balanced diet composed of dietary sources of vitamins with antioxidant properties such as fruits and vegetables should be strongly recommended to obese people. Future analysis should take into consideration the confounding factors such as socioeconomic factors, to clarify this association between antioxidants vitamins and obesity status.

Keywords: Obesity; Antioxidant; Vitamins; Semi-quantitative Food Frequency Questionnaire; Nutrition Assessment

Introduction and Background

Evidence is mounting that obesity has been associated with a markedly increased oxidative stress that is characterized by an imbalance between tissue oxidants (free radicals, reactive oxygen and/or nitrogen species) and antioxidants and might be a major mechanism underlying obesity-related co-morbidities [1]. Antioxidant vitamins (vitamin A, C and E), among other components, play a big physiological role in the protection against oxidative stress [2]. Literature shows that obese have lower rates of antioxidant defenses (vitamins) than non-obese [3-8].

According to WHO estimates, the prevalence of obesity tend to increase in the coming years (WHO, 2016) [9]; Obesity is now reaching worldwide unprecedented prevalence in low-income and high-income countries and the Eastern Mediterranean region is no exception (Figure 1) (The Lancet, 2016) [10]. In Lebanon, national studies on obesity are rare, so the aim of this study was to compare the dietary antioxidant vitamin intakes in obese and non-obese Lebanese participants, thereby creating a new registry for the Lebanese obese population.

Materials and Methods

Subjects

This study was conducted on 500 Lebanese (153 males and 347 females) mean age 33.5±/12 years old, recruited from the database of dietary clinics. Participants were examined between May 2016 and September 2016. Recruitment was done by a nutritionist/dietitian who summarized the purpose of this study. The exclusion criteria were pregnancy, less than 18 or above 62 years old and participation in a weight loss program including dietary changes and restrictions. This study was approved by the Ethics Committee of the Department of Human Nutrition and Dietetics of the Faculty of Agronomic and Food Sciences, Holy Spirit University of Kaslik, Lebanon. All participants consented to completing the questionnaires.

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SQFFQ
A thirty-four items Semi-Quantitative Food Frequency Questionnaire (SQFFQ) was administered face-to-face; it covers the major sources of dietary antioxidant vitamins in Lebanon. The validity and reproducibility of the questionnaire were studied in previous article (Figure 2).

Data were collected in May-September 2016. This SQFFQ was administered by a trained nutritionist/dietitian at dietary clinics on 500 Lebanese participants aged 18-61 Years. The SQFFQ was administered twice, 3 to 5 weeks apart (SQFFQ time 1- SQFFQ time 2), to assess reproducibility (subsample: 42 participants, 30 non-obese and 12 obese). To assess validity, the questionnaire was compared to six 24-HRs performed on a subsample of 50 participants (33 non-obese and 17 obese who have already completed the SQFFQ).

Measuring obesity
Although BMI is the most frequently used method to assess the level of obesity, BMI does not differentiate between body lean mass and body fat mass [11]. Obesity was defined according to Gallagher, et al. 2000 [12], where BMI (in kg/m²) established by the National Institutes of Health and the World Health Organization is linked to the percentage of body fat (Table 1). Anthropometric parameters (weight and height) were measured by a nutritionist/dietitian according to standardized protocols during the interview in the dietary clinics. The weight and body fat percentage were measured by bioelectrical impedance scale (Bode coder body composition analyzer) and the height by a stadiometer. The weight was recorded to the nearest 0.1 kg. The subjects were weighed with light clothing and bare feet or with stockings or socks. Size was measured without footwear and recorded to within 0.5 cm. All measurements were taken twice and the average of the two values was adopted and rounded.

Adjustment for Energy Intake
Total daily energy intakes were collected from 24-hour recalls from 250 participants (166 non-obese and 84 obese) among the 500 participants after completing the SQFFQ.

<table>
<thead>
<tr>
<th>Age and BMI</th>
<th>Women (white)</th>
<th>Men (white)</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-39 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI &lt;18.5</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>BMI ≥25</td>
<td>33</td>
<td>21</td>
</tr>
<tr>
<td>BMI ≥30</td>
<td>39</td>
<td>26</td>
</tr>
<tr>
<td>40-59 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI &lt;18.5</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>BMI ≥25</td>
<td>35</td>
<td>23</td>
</tr>
<tr>
<td>BMI ≥30</td>
<td>41</td>
<td>29</td>
</tr>
<tr>
<td>60-79 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI &lt;18.5</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>BMI ≥25</td>
<td>38</td>
<td>25</td>
</tr>
<tr>
<td>BMI ≥30</td>
<td>43</td>
<td>31</td>
</tr>
</tbody>
</table>

Table 1: Predicted body fat by sex and ethnicity based on 4-compartment estimates of percentage body fat (Gallagher et al. 2000).
Statistical Methods

Data from the SQFFQ were transformed into daily intake of each food (g/d) and beverage (ml/d). The daily intake was calculated by multiplying the specified portion unit by the frequency of intake, using the following values for reported frequencies: 1-3 times/d = 2 (1+2+3/3); 1-3 times/w =9.5 ((1/7+2/7+3/7)/3); 1-3 times/ month =0.06 ((1/30+2/30+3/30)/3); occasionally and never eaten =0.

The validity the SQFFQ was assessed, in a sub-sample of fifty participants (17 obese and 33 non-obese), by comparing the intakes of thirty-four food items from the SQFFQ with the average intakes from the six 24-HR. For each individual in the validation study, the daily intakes of foods consumed during each of the six 24-HR were computed and used to calculate the mean daily intakes of foods from the six 24-HR. The mixed dishes from the 24-HR were divided into their components and allocated to the appropriate food items of the questionnaire as would routinely be done in the analysis of mixed dishes [13]. Pearson correlation coefficients and Bland-Altman plots were used to measure the strength of the relationship between food intakes estimated by SQFFQ and the 24-HRs.

The means of the 3 antioxidant vitamins were compared for obese and non-obese and the daily caloric intake was adjusted also for obese and non-obese participants.

Estimates were analyzed using the statistical software package SPSS® (Statistical Package for Social Sciences, version 24.0, SPSS Inc., Chicago, III, USA). Results with a p <0.05 value will be considered statistically significant.

Results

Demographic Characteristics

The demographic characteristics of the participants in the SQFFQ evaluation study are given in Table 2. The mean age of the 170 obese participants in this study was 33.46 years, 34 % were females and 33.63 % were males.

Difference in Antioxidant Vitamins Intake between Obese and Non-Obese

The means of daily consumption of vitamin A, C and E were lower for obese individuals compared to non-obese. The values were respectively for Vitamin A: 18.9 +/- 70.2 vs 155.1 +/- 455.9 micrograms of Retinol Activity Equivalents (graph 1), for vitamin C: 31.7 +/- 30.4 vs 60.1 +/- 41.7 milligrams (graph 2) and for vitamin E: 12.5 +/- 5.7 vs 15.6 +/- 7.3 milligrams (graph 3). The difference between the daily consumption of antioxidant vitamins for non-obese vs obese individuals were highly significant (Student’s t-Test, p = 0 <0.01 for vitamin A, C and E).

The non-obese group (BMI ≤30) is defined by a body fat percentage below 39 (white women aged from 20-39 years old) and below 26 (white men aged from 20-39 years old), below 41 (white women aged from 40-59 years old) and below 29 (white men aged from 40-59 years old and

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>SE or %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese (n=170)</td>
<td>33.46</td>
<td>0.751</td>
</tr>
<tr>
<td>Non-Obese (n=330)</td>
<td>33.61</td>
<td>0.579</td>
</tr>
<tr>
<td>Male (n=143)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese (n=170)</td>
<td>52</td>
<td>36.36</td>
</tr>
<tr>
<td>Non-Obese (n=330)</td>
<td>91</td>
<td>63.63</td>
</tr>
<tr>
<td>Female (n=347)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese (n=170)</td>
<td>118</td>
<td>34</td>
</tr>
<tr>
<td>Non-Obese (n=330)</td>
<td>229</td>
<td>66</td>
</tr>
</tbody>
</table>

Table 2: Characteristics of the participants (n=500) in the development study of the SQFFQ in Lebanon.
daily energy intake adjustment

In this study, total daily energy intakes were collected from 24-hour recalls from 250 participants (166 non-obese and 84 obese) among the 500 participants after completing the SQFFQ. Afterwards the daily calories were adjusted for vitamin A, C and E in the obese and non-obese participants. And then the difference between the daily consumption of antioxidant vitamins for non-obese vs obese individuals was tested via the One-way ANOVA. The results were highly significant too after caloric adjustment with p-values for vitamin A, C and E respectively, p = 0.014, p = 0 and p = 0 <0.05.

Discussion

In this study, dietary antioxidant vitamin intakes were measured and compared for obese and non-obese Lebanese using a SQFFQ developed and validated to evaluate the antioxidant vitamins consumption in the Lebanese population. The study provided for the first-time data on the difference of consumption of vitamins with antioxidant properties in the obese and non-obese population. Not only the difference in the means of the 3 vitamins was to obvious (Graph 1, 2 and 3), but this difference between the daily consumption of antioxidant vitamins for non-obese vs obese individuals were highly significant according to Student’s t-Test, p = 0 <0.01. And this result was compatible with different studies abroad that tested the difference in food intake and also the blood and urine biomarkers [3-7,14-19].

As for the calorie adjustment, intakes of most specific nutrients are correlated with total energy intake, especially when comparing intakes of micronutrients such as vitamins in obese and non-obese people. Therefore, it might result of confounding by total energy intake. For this reason, in this study, total daily energy intakes were collected from 24-hour recalls from 250 participants (166 non-obese and 84 obese) among the 500 participants after completing the SQFFQ. Afterwards the daily calories were adjusted for vitamin A, C and E in the obese and non-obese participants. The difference between the daily consumption of antioxidant vitamins for non-obese vs obese individuals was highly significant too after caloric adjustment.

Micronutrient deficiencies (including antioxidants) continue to be public health problem in several regions of the world, not only in poor communities, but also in populations in developed countries. Obesity disrupts antioxidant defenses in tissues. These insufficient defenses may be due to a low dietary intake of antioxidants since the obese have a lower consumption of foods rich in antioxidants (fruits, vegetables, whole grains, legumes, wine, olive oil, seeds and nuts) which is documented by various studies in a meta-analysis by Vincent, et al. 2007 [1]. This low consumption occurs even when fresh products are available and cheap, so it is common in all countries. Obesity has been associated with a markedly increased oxidative stress that itself is an important etiologic factor of the pathologic process of obesity co-morbidities such as cardiovascular disease [20,21]. Fortunately, several defense processes exist against the reactive oxygen species, the first line of defense is their uptake by non-enzymatic systems such as vitamins A, C and E among others (Lavoie, 2012). Normal tissue concentrations of antioxidants suppress oxidative processes and protect tissues. Therefore, the need of intervention strategies to reduce the oxidative stress associated with obesity. According to the literature, it can be lowered through changes in diet such as introducing more antioxidant vitamins in food [22-26] to control blood sugar, decrease fat mass and consequently decrease blood lipid concentrations, which leads, to the reduction of oxidation of LDL and inflammatory cytokines and, to lower concentrations of leptin. Similarly, the consumption of more antioxidants vitamins help to increase the defenses of tissue antioxidants and decrease the production of endothelial oxidants.

Conclusion

Maintaining a healthy lifestyle with a balanced diet rich in antioxidants such as fruits and vegetables, is associated with reduced oxidative stress. Unfortunately, this protection is less effective in obese with decreased consumption of dietary antioxidants.

To be noted that future analysis should take into consideration the confounding factors such as socioeconomic factors and adjustment for age, to clarify this association between low consumption of antioxidants vitamins and obesity status.

References


