ESTIMATION OF TOTAL ANTIOXIDANT CAPACITY AND COENZYME Q10 IN IRAQI OBESE ADULTS: CONTROL-CASE STUDY

Ghassan Adnan Mhalhal1,2, Siamak Salami1, Mustafa Taha Mohammed3

1Department of Clinical Biochemistry, Shahid Beheshti University of Medical Sciences, Iran.
2Department of Chemistry, College of Science, Mustansiriyah University, Baghdad, Iraq.

ABSTRACT

Obesity is a disease of modern era, grow fast and linked with the progression of cardiovascular and metabolic diseases. Oxidative stress, the disturbance of oxidants and antioxidants homeostasis, has studied extensively in these cardiometabolic disorders. The current study investigated the oxidative stress by using antioxidant side of the equation to predict oxidative stress status in obese individuals. A total of 100 subjects had enrolled in the study which divided as 60 obese adult and 40 healthy lean control on comparable ages. Serum levels of TAC and CoQ10 were estimated in both groups. The level of TAC and CoQ10 was significantly lower (P<0.01) in obese subjects compared to healthy control, additionally, significant negative association has obtained between CoQ10 and BMI as well as TAC and BMI. Also, positive association was found between TAC and CoQ10. Obese adults have shown to have significant reduction in antioxidant defense components systemically, and this reduction is linked with the increase of BMI, thus morbidly obesity is a serious affector on redox balance and lead to major consequences. Also, the association between TAC and CoQ10 indicates that CoQ10 is an important part in the circulation antioxidant system.

Keywords: Obesity, Oxidative stress, Antioxidants, TAC, CoQ10.

I. INTRODUCTION

The grown rates of obesity has drag the attention as it can cause serious health casualty. Obesity is a condition where the fats are accumulated and aggregate in various locations of human’s body [1]. The world health organization (WHO), has set a definition for obesity by using body mass index (BMI), which announced that peoples who have BMI≥30 kg.m⁻² are classified to be obese [2]. Additional indexes are used now with obesity that gave more precise indications of fat distribution such as waist to hip ratio (WHpR) and waist to height ratio (WHtR) [3]. Obesity is associated with many disorders of cardiovascular and metabolic systems, such disorders are major health risks and could lead to mortality. Hypertension, insulin resistance, diabetes mellitus, heart failure, liver dysfunction, progressive of cancer and many others are linked with obesity [4].

Oxidative stress is a condition occurs under the disturbance of redox system between oxidants and antioxidants, in which oxidants escape the defense of antioxidants system and practice their harmful effects freely [5]. Oxidants comprises free radicals and reactive oxygen species (ROS), and the latter are very reactive species centered with oxygen and include wide materials such as superoxide anion, hydrogen peroxide, hydroxyl radical, peroxy nitrite, lipid peroxides and other substances [6]. Antioxidants on the other hand, act to prevent the harmful effects of these reactive species by different mechanisms, and include an army of endogenous and dietary solders, such as the enzyme superoxide dismutase, catalase, and glutathione peroxidase, the small molecules glutathione, uric acid, and coenzyme Q10, the dietary substances vitamin C and E, carotenoids, and polyphenols [7].

CoQ10 is a lipid soluble antioxidant present in all cell membranes and is implicated in the mitochondrial electron transport chain which helps to stabilize complex III as well as transports electrons from complex I and II to complex III and can enhance oxidative phosphorylation [8]. CoQ10 is considered as a vitamin-like factor, because in body it can be produced endogenously during the 17 steps so that benzoquinone ring is made of amino acids tyrosine or phenylalanine and side chains isoprenoids of acetyl COA in the mevalonate pathway and at least seven water-soluble vitamins (vitamins B6, B12, C, riboflavin, niacin, pantothenic acid, and folic acid) and several minor minerals are needed in this pathway. Under normal circumstances there is no need to get external source but it is possible that CoQ10 levels under certain conditions, including cardiovascular disease, degenerative muscle...
disorders, oxidative stress, and aging are decreased below the requirement level [9]. CoQ10 is a naturally found in dietary sources and a dietary supplement. It is present in a wide variety of foods from animal and vegetable sources, with large amounts present in chicken legs, heart, liver, and herrings; and in vegetables such as spinach and cauliflower; and whole grains but in a lower concentration in comparison with meat and fish [10].

II. MATERIALS AND METHODS

Subjects
The study involved one hundred adult individual. Forty healthy subject were enrolled as control for the study, as well as sixty subject were enrolled from AL-Kindy Obesity Research and Therapy Unit. The ages of the samples were between (20-48) years old. The laboratory side of the study was performed at the laboratory of biochemistry research in the department of chemistry science, Mustansiriyah University.

Sample collection
Blood samples were collected from the subjects after a period of 12 hour fasting. A plastic disposable 5mL syringe was used for venipunctures and blood drawn slowly. Then the blood was translocated into gel tube and left for 10 min at room temperature to clot. Blood samples then centrifuged at 1500g for 10 min and the obtained serum stored in three Eppendorf tubes at -20 ºC until analysis. Anthropometric measurements was obtained also from the participants including height, weight, and waist circumference.

Methods
Serum TAC concentration was determined by using Erel method [6]. CoQ10 was determined by using ELISA kit from Sunlong (China). BioTech ELISA microplate washer ELX50 and microplate reader ELX800 devises were used. And the results were statistically analyzed for descriptive data, independent t-test of mean comparisons and Person’s correlation coefficient by using SPSS-26.

Results
Results are expressed in the form of mean±SD, and range (minimum and maximum values). The comparative results are in Table 1. The age was comparable (P>0.05) between obese (32.47±6.31 year) and control (32.28±6.41 year).

Obese subjects have significant (P<0.01) higher values of BMI (37.25±4.64 kg.m⁻²) compared to control (22.69±1.72 kg.m⁻²). The significant higher values (P<0.01) has observed for waist circumference, WHpR and WHtR as well, Table 1.

Table 1: Outcomes of control and obese.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control, N=40</th>
<th>Obese, N=60</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>32.28±6.41 (20-49)</td>
<td>32.47±6.31 (20-48)</td>
<td>0.833</td>
</tr>
<tr>
<td>BMI (kg.m⁻²)</td>
<td>22.69±1.72 (19.14-24.89)</td>
<td>37.25±4.64 (30.07-47.27)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>80.85±5.19 (67-90)</td>
<td>114.08±12.42 (89-135)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>WHpR</td>
<td>0.78±0.041 (0.69-0.86)</td>
<td>1.08±0.19 (0.6-1.52)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>WHtR</td>
<td>0.49±0.045 (0.38-0.58)</td>
<td>0.77±0.11 (0.57-1.11)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>TAC (µmol Vit C. Eq. /L)</td>
<td>1.41±0.19 (0.97-1.67)</td>
<td>1.24±0.27 (0.84-1.59)</td>
<td>0.001*</td>
</tr>
<tr>
<td>CoQ10 (ng/mL)</td>
<td>2.51±0.86 (1.06-6.14)</td>
<td>1.78±0.94 (0.82-6.93)</td>
<td>&lt;0.0001*</td>
</tr>
</tbody>
</table>
The serum level of TAC was reduced significantly (P=0.001) in obese subjects (1.24±0.27 µmol Vit C. Eq. /L) compared to healthy control (1.41±0.19 µmol Vit C. Eq. /L). CoQ10 level was reduced significantly (P<0.001) as well in obese subjects (1.78±0.94 ng/mL) compared to healthy control (2.51±0.86 ng/mL).

Pearson’s correlation coefficient analysis has indicated a moderate significant positive correlation between TAC and CoQ10 in obese subjects (r= 0.326, P= 0.011). Also, obese adults have shown significant negative association of TAC (r= -0.535, P<0.001) and Coenzyme Q10 (r= -0.284, P=0.028) with BMI. Additionally, significant correlation has observed among BMI, WHpR and WHtR, see Table 2.

Table 2: Pearson’s correlation among parameters.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>BMI</th>
<th>Waist C.</th>
<th>WHpR</th>
<th>WHtR</th>
<th>TAC</th>
<th>CoQ10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>P</td>
<td>r</td>
<td>P</td>
<td>r</td>
<td>P</td>
</tr>
<tr>
<td>Age</td>
<td>0.204</td>
<td>0.118</td>
<td>0.85</td>
<td>-0.143</td>
<td>0.274</td>
<td>0.102</td>
</tr>
<tr>
<td>BMI</td>
<td>-</td>
<td>-</td>
<td>0.20</td>
<td>0.476</td>
<td>&lt;0.00</td>
<td>0.370</td>
</tr>
<tr>
<td>Waist C.</td>
<td>0.166</td>
<td>0.205</td>
<td>-</td>
<td>0.315</td>
<td>0.014</td>
<td>0.433</td>
</tr>
<tr>
<td>WHpR</td>
<td>0.476</td>
<td>&lt;0.00</td>
<td>0.315</td>
<td>0.01</td>
<td>-</td>
<td>0.325</td>
</tr>
<tr>
<td>WHtR</td>
<td>0.370</td>
<td>0.004</td>
<td>0.433</td>
<td>-</td>
<td>0.325</td>
<td>0.011</td>
</tr>
<tr>
<td>TAC</td>
<td>-0.535</td>
<td>&lt;0.00</td>
<td>0.006</td>
<td>0.96</td>
<td>-0.189</td>
<td>0.147</td>
</tr>
<tr>
<td>CoQ10</td>
<td>-</td>
<td>0.284</td>
<td>0.88</td>
<td>-0.086</td>
<td>0.515</td>
<td>-</td>
</tr>
</tbody>
</table>

* Significant at P≤0.05
* Significant at P≤0.01
III. DISCUSSION

TAC and CoQ10 levels have reduced in serum of obese subjects of the current study. This reduction of circulation total antioxidants generally and CoQ10 specifically results in progressive of oxidative stress attacks on the vital components of the cell. The findings of TAC are in agreement with Epingeac et al. (2019) [11], Amirkhizii et al. (2010) [12], Lim et al. (2012) [13], Leo et al. (2016) [14], who have reported a systemic decrease of total antioxidant capacity in obese subjects of their study.

Oxidative stress has been reported in obese people [15]. Overproduction of ROS evolve the incidence of oxidative stress [16]. The excess supply of energy substrates in obesity is believed to lead to increased ROS formation [17]. The high calories intake raise the load on mitochondria, which in turn results in mitochondrial dysfunction. The results of this dysfunction revealed by impairment in fatty acid oxidation, secretion of adipokines, dysregulation of glucose homeostasis, and ultimate increasing in the production of ROS [18]. In addition to mitochondrial dysfunction, inflammation also has an influence on the production of ROS [19]. The hypertrophied adipocytes triggers the accumulation of macrophages in adipose tissue [20]. M1 Macrophages involved in the increasing of ROS generation [21]. The increase of ROS production in adipocytes leads to a decrease in the expression of antioxidant enzymes [16]. Taay et al. (2020) [22], have reported significant increase of serum ROS is accompanied with reduction in the concentration of the antioxidant enzyme glutathione peroxidase in Iraqi obese females. Furthermore, Albuali (2014), reported significant decrease in the activities of antioxidant enzymes (SOD, GPx and glutathione reductase) as well as reduced glutathione in the blood of obese children [23].

CoQ10 results are agreed with Mancini et al. (2008) [24], and Mehmnetoglu et al. (2011) [25]. CoQ10 is a molecule that functionalized in both mitochondrial metabolism and ROS detoxification. Depletion of CoQ10 content was found in subcutaneous adipose tissue of obese subjects and mice. Overexpression of COQ2 in 3T3-F442A pre-adipocytes decreased the CoQ redox state and promoted ROS synthesis by the mitochondria [26]. CoQ10 acts as a fat-soluble antioxidant to potently protect lipid membranes and lipoproteins from oxidative damage and to prevent DNA damage [27]. It has been reported that CoQ10 supplementation increases fat oxidation and energy expenditure in inguinal white adipose tissue. Decreased mRNA expression of the lipogenic enzymes fatty acid synthase and acetyl-CoA carboxylase 1, and the glycerogenic enzyme phosphoenolpyruvate carboxykinase are responsible for the lipid lowering effect of CoQ10 [28]. Many studies have suggested CoQ10 administration in the prevention of obesity related risks such as hypertension and diabetes mellitus [29-32].

The significant correlation between CoQ10 and TAC in obese people at the current study, suggests that CoQ10 makes up an important portion of the total antioxidant in circulation. On the other hand the negative correlation of these antioxidants with BMI indicates that body fats have major influence on the antioxidant system.

IV. CONCLUSION

Obese people turn on to develop oxidative stress not only by the elevation of ROS but through antioxidants reduction as well. CoQ10 appeared as an important antioxidant of the system and obesity improve the reduction of this major antioxidant, which may lead to more aggressive risks. Thus, CoQ10 supplementation seems to be good choice to avoid the complex consequences and risks of obesity.

REFERENCES


