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A Study of the Effects of Obesity on a Number of Vitamins, β-Carotene, and Ferritin in Men in Mosul

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Abstract
Recent studies have indicated the potential effects of obesity on various metabolic pathways and biochemical variables, and it is considered one of the most significant risk factors in heart disease, diabetes, and the occurrence of several forms of cancer. Therefore, the current study is interested in estimating the levels of β-carotene, vitamin D, vitamin B12, and ferritin in blood serum. The study included 30 samples from men who were divided into two groups. The first group included 10 samples from normal, otherwise healthy men with a body mass index in the range 18-22 kg/m^2 as a control group, while the second group included 20 men suffering from obesity, with a body mass index in the range 26-31 kg/m^2, and was considered for a group of patients whose ages ranged from 20 – 40 years old. The results showed significant differences in levels of β-carotene, vitamin D, vitamin B12, and ferritin when comparing the group of obese men with the control group. This indicates a significant impact of obesity on the biochemical variables measured in this study, demonstrating that obesity is significant risk factors in the development of diabetes and heart disease.
Keywords: *Obesity, β-carotene, vitamin D, ferritin.*

INTRODUCTION

(WHO) defines obesity as being overweight with an excessive accumulation of fat, which is known to pose certain health risks (Mounien et al., 2019). Obesity is closely linked to Vascular diseases and heart disease, type 2 diabetes, and various forms of cancer, all of which can reduce life expectancy, and increase the total burden of certain diseases worldwide such as inflammation, insulin resistance, fatty liver, and high blood pressure (Yao, et al., 2021). Obesity is associated with an increase in the amount of adipocytes, which is the main cause of increased oxidative stress, in addition to increased inflammation in the cell (Hamulka, et al., 2023) . Recent studies have proven the role of oxidative stress and what it can do to cause obesity in several ways, the most important of which is the deposition of harmful fatty tissue in the body,which leads to increased use of antioxidants, including carotenoids (Thomas-Valdés et al., 2017; Bohn, 2019). Carotenoids are compounds that contribute to the green, red and orange colours of most and vegetables and fruits, They are chemical substances.. Scientists have shown that carotenoids have many biological functions and are active species in our food (Eggersdorfer, & Wyss, 2018). Among the most abundant types of carotenoids in plasma are β-carotene, α-carotene, β-cryptoxanthin, and provitamin A carotenoids. There are other types of carotenoid, such as lutein and zeaxanthin, which plays a major role in vision (Rowles, et al., 2017), while lycopene is a form of carotenoid that plays an important role in the prevention of cancer (Landrum, & Bone, 2001). Moreover, studies have shown that fat-soluble carotenoids are present in fat droplets within fat rings, which themselves play a role in absorbing and transporting fats, for which there is a possible link between carotenoids and weight gain (Beydoun, et al., 2019). Vitamin D is considered essential to bone tissue, as well as the internal balance of minerals such as Phosphorus, calcium and their receptors are found throughout the body, which indicates that it has multiple functions, as VD and vitamins are major products of the main building processes. Vitamin D is often considered more of a hormone than a vitamin. The active form of vitamin D is 1,25-dihydroxyvitamin D (1,25 OH_2 D), which in itself plays no role in stimulating calcium absorption and reabsorption from bone. It plays a role in reducing parathyroid hormone (PTH), and also has another function outside the skeleton, namely reducing the production of type I collagen, enhancing muscle The function is to stimulate the immune system, the process of differentiation of cells from each other, and insulin. (Vranić, 2019). There is an apparent correlation between weight gain and obesity with vitamin D deficiency, for which there are several suggested direct and indirect lines. The most common cause is its deficiency in food (Holick, et al., 2008), with its deficiency largely linked to physiological reasons. In addition, the vitamin D hormone is vital to various non-calcium activities (Bouillon, et al., 2008), including the regulation of the biology of adipocyte cells (Kong, & Li, 2006). .In addition, the role of the vitamin D receptor (VDR) is linked to regulating global energy metabolism through the regulation of adipose tissue fat depot location and expansion (Wong, et al., 2009).

Vitamin B12 an essential vitamin because it is obtained entirely from plants by certain bacteria residing in the human large intestine Aureli, et al., 2023). However, the absorption site in the small intestine is quite distal from the site of synthesis, which belongs to the D subfamily of ATP-linked cassette transferases. (Green, et al., 2017). (Boachie, et al., 2020). Ferritin is used as a marker for iron deficiency in health care facilities worldwide (Khan, et al., 2016). Due to it being an acute phase reactant, the serum ferritin level is likely to be elevated in people suffering from obesity and who are overweight due to a subclinical inflammatory state (O'Brien et al., 2016; Huang, et al., 2015). Accordingly, the use of ferritin as a marker for ID or IDA in overweight people is controversial (Kim et al., 2015), In recent years, there has been a growing number of studies that have considered the relationship between the level of ferritin in the serum and various forms of obesity (Wang et al., 2016; Wu et al., 2010). It has been concluded that body mass index and waist-to-hip ratio are the strongest predictors of the level of ferritin in the serum (Oshaug et al., 1995). Analytical studies from the National Health and Nutrition Survey have shown that serum ferritin levels are linked to abdominal obesity and other indicators of body fat distribution (Gillum, 2001; Jehn et al., 2004).

MATERIALS AND METHODS

30 blood serum samples were collected and divided into two groups: the group of healthy people (10 individuals) and the group of people suffering from obesity (20 individuals) based on average body mass index (BMI). For each individual, 5 ml of blood was taken, placed in a sterile tube, and separated using a centrifuge at 3000 xg. Measured of β- carotene by HPLC, vitamin D by Immunofluorescence kit for the rapid and quantitative determination of Vitamin D dedicated to the Microprofit Fluorecare instrument. The package contains 20 tests. , vitamin B12 by FLUROCARE REAEDER (POC Multiparameter Analyzer) , and ferritin by immunoassay sandwichmethod with a final fluorecent detection (ELFA).

Estimation of -carotene

Sample preparation:

Beta-carotene was measured according to the method () where 200 microliters of blood serum were taken and placed in a centrifuge. Then 1 ml of distilled water was taken and mixed with 70 microliters of ethanol, which contains ascoric acid at a concentration of (0.01%) as this solution helps precipitate the protein in addition to helping protect the carotenoid groups.. After that, (2) ml of hexane solution is added in order to extract and isolate the carotenoids, and then centrifugation is carried out at a speed of 2500 rpm for 20 minutes, after which the reverse layer containing the carotenoids is isolated.after which the hexane layer was collected and evaporated to dryness under nitrogen. The sample is then dried using nitrogen gas and then the dried sample is dissolved in 100 microliters of a methylene chloride/methanol mixture, then filtered and then 100 microliters are injected for measurement into a HPLC device.
An HPLC (model SYKAM, Germany) was used to analyze and detect -carotene. The mobile phase had an isocratic flow of a 30/70 (v/v) mixture of water and acetonitrile, with a flow rate of 1.0 mL/min, a C18–ODS (25 cm × 4.6 mm) column and a UV-Vis detector (at a wavelength of 476 nm) (Tzeng, M. S et al., 2004).

RESULTS:

Table (1) :Biochemical Parameter

Parameters	Control BMI (18.5-22.9) n = 10	Obese BMI ≥ 28 n = 20	*P value
β-carotene	80.00 ± 2.54	38.83 ± 1.26	0.000
Vitamin D	47.18 ± 16.1	27.2 ± 5.13	0.001
Vitamin B12	461.75 ± 86.87	197.6 ± 2.88	0.001

Ferritin	63.18 ± 8.37	81.38 ± 14.93	0.636

Mean ± S.D *P ≥ 0.005

DISCUSSION

This study showed a significant decrease in the percentage of carotenoids in obese people because these species tend to accumulate in adipose tissue, where these tissues act as a trap for lipophilic molecules (Ost et al., 2014) (Trasino et al., 2015). These observations are consistent with growing evidence for such lipid-mediated disorders as insulin resistance (Beydoun et al., 2019), fatty liver disease (Greenwald, 2003), and coronary artery disease associated with low levels of vitamin A (Liu et al., 2016). The reason for the low percentage of carotenoids in people suffering from obesity may be due to the greater fat mass, as associated with oxidative stress, which in turn reduces the concentration of carotenoids (Andersen, et al., 2006), or otherwise due to the accumulation of carotenoids in the abdominal fat of obese people (Chung, et al., 2009; Moran et al., 2018). Otherwise, a decrease in carotenoids in the blood serum of people suffering from obesity may be due to retinoid, species that mediate the metabolism of vitamin A, especially retinol and retinoic acid, which have anti-obesity effects (Reboul, 2013; Rodriguez-Concepcion, et al., 2018).

Retinoids contribute to preventing the formation and production of fatty compounds, as well as helping to prevent their storage and accumulation. They also play a fundamental role in the process of inflammation and the response to it. Retinoids work to reduce obesity through their role in inhibiting fat cells, by binding (retinoic acid) receptors with the copied part of the same acid (CCAAT). This works to enhance the binding protein of the alpha type (CEBP), which is considered very important for the formation of fat cells. (Schwarz et al., 1997) . Retinoids also work to reduce the process of fat accumulation and collection inside cells, especially white tissue (WAT), which is specialized in storing excess energy in the form of neutral triglycerides, and brown tissue (BAT), which generates heat through fat metabolism. (Saely et al., 2012). White fat can be converted back to brown, which is represented by shiny or beige fat cells that appear in the WAT stores in the bodies of mammals under thermal activity, which leads to the decomposition of fats (Blaner, 2019; Palou et al., 2013). White fat can be converted into the disassembled structure, which is known as (UCP1) plays an important role in the process by uncoupling the respiration process that takes place in the mitochondria, and thus this process reduces the accumulation and collection of white fat. (Montanari et al., 2017).

Vitamin D

The results of our study indicated that there is a significant difference between people suffering from obesity and people of normal weight; this may be due to the fact that in people suffering from obesity, vitamin D is distributed across a larger volume, lowering its concentration in the serum and leaving 25(OH)D significantly distributed within the serum, muscles, fats. which leads to increased obesity (Walsh, Bowles, Evans, 2017). There is another mechanism that explains this decrease in vitamin D, however, which is its storage in adipose tissue (AT) as it is a fat-soluble vitamin that accumulates and is retained in AT, leading to a decrease in vitamin D in people with large amounts of AT (Gangloff, et al., 2016). A decrease in 25(OH)D may be due to poor hepatic 25(OH)D hydroxylation, which tends to be the case in patients with (non-alcoholic fatty liver) diseaseIt is considered one of the well-known cases in the subject of obesity, as a number of studies have found that the concentration of (25(OH)D) in the blood serum when it decreases is closely linked to the severity of liver cirrhosis and the occurrence of necrosis, as well as the enhancement of inflammation, and this is confirmed by histology. (Mikolasevi´c et al., 2016; Milic et al., 2015); otherwise, a decrease in vitamin D may be due to the different genomic and non-genomic verses that vitamin D performs, which have a role in obesity (Sun & Zemel, 2008).

Vitamin B12:

The reason for the decrease in vitamin B12 is its importance in completing the main metabolic pathways. This was confirmed through laboratory studies conducted on primary human fat cells and liver cell lines, which lead to a decrease in the level of cobalamin, a decrease in the synthesis of methionine, a decrease in the synthesis of the derivative S-adenosylmethionine (SAM) and an increase in production of (Hcy) and (S-adenosyl-homocysteine). The resulting decrease in the ratio (SAM/ SHcy) occurs through a decrease in the methyl concentration and an increase in the promoter regions of genes involved in the formation, production, and metabolism of cholesterol.(Adaikalakoteswari et al., 2015). Vitamin B12 deficiency is also closely linked to increased triglycerides in and within living cells, through increased production and absorption of fatty acids, in addition to a significant decrease in the level of beta oxidation. (Boachie et al., 2021). Inside cells, methylmalonic acid accumulates due to decreased vitamin B12 and inhibits the SP1 pathway, which is an enzyme that determines the rate of fatty acid oxidation (Rush et al., 2014; Yajnik, 2010).

Ferritin

Previous studies have shown an increase in the level of ferritin in the blood serum as a result of the chronic inflammatory reaction resulting from obesity, and not only from an increase in iron stores (Zafon et al., 2010). Ferritin is an acute-phase reactant and may increase due to infection or inflammation. High levels of ferritin have been positively associated with the risk of metabolic syndrome and obesity (Gillum, 2001). Ferritin is an indicator of inflammation and not of iron levels in overweight and obese people because it is an acute phase reactant, with the secondary effect that subclinical ferritin elevation in overweight and obese people may cause complete iron deficiency (Khan et al., 2016).

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