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Article

Effect of Body Mass Index on Testosterone and Electrolytes in Male Hormone Imbalance Patients

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Abstract: The study of this work was to evaluate the relationship betweenBody Mass Index(BMI) and sex steroid hormonestotal testosterone . When compared to normal and overweight people, the obese group's total testosterone concentrations were lower, and the body mass index and testosterone had a negative connection. Obesity and low testosterone levels can have detrimental effects on mood, emotions of well-being, exercise capacity, sleep apnea, and fertility. Numerous of these characteristics can be enhanced by losing weight, and it's possible that the resulting increase in testosterone will have positive impacts in addition to those brought about by the weight loss. Electrolytes disturbances are one of the many phenomena resulting from obesity.

Keywords: Body Mass Index, Testosterone, Potassium, Sodium, Chloride.

Introduction

When excess body fat accumulates to a level that is detrimental to one's health, it is referred to as obesity. Individuals are categorized as obese if their body mass index (BMI) is calculated by dividing the weight by the height squared, is greater than 30 kg/m²,the ranges (25–30 kg/m²) is characterized as overweight [1].

Over 300 million individuals globally are clinically obese, and over 1 billion adults are overweight. Obesity has the reached epidemic proportions, and it is a major contributor to chronic illness and impairment [2]. It's the most obvious—yet most disregarded—public health issue that poses a threat to both industrialized and developing nations [3,4] . With major social and psychological ramifications that impact people of all ages and socioeconomic backgrounds, obesity is a complicated illness [5]. By the age of 40, the obesity has been demonstrated to shorten life expectancy by the seven years [6].

Men who are obese often have low levels of testosterone hormone because they do not have overt hypothalamic-pituitary-testicular (HPT) axis dysfunction. The primary cause of decline in total testosterone levels in moderate obesity is a decrease in the sex hormone-binding globulin , which is linked to insulin resistance. Reduced free testosterone levels are also linked to more severe obesity because of HPT axis' repression. Merely having low testosterone levels can cause a self-perpetuating cycle of metabolic problems and a rise in fat. A functional, non-permanent condition that may be curable with substantial weight loss is obesity-related hypotestosteronemia [7].

Men who are obese often have low testosterone levels because they do not exhibit overt hypothalamic-pituitary-testicular (HPT) axis dysfunction. The main cause of the general drop in testosterone levels in moderate obesity is a decrease in the sex hormone-binding globulin , which is linked to insulin resistance. Reduced testosterone levels are also linked to more severe obesity. Merely low testosterone levels have the potential to cause a self-fulfilling cycle of metabolic issues as well as an increase in obesity. A functional, non-permanent condition that may be curable with substantial weight loss is obesity-related hypotestosteronemia. Apart from creating noteworthy social and environmental obstacles, obesity is linked to several unfavorable health outcomes, such as heightened likelihood of cardiovascular ailments, sleep apnea, osteoarthritis, specific types of cancer, and decreased testosterone levels in males [7].

Obesity has also been reported to affect serum electrolytes. Electrolyte imbalances are main common in obese individuals than in the general population. Obesity leads to impairment of Na+/K+-ATPase pump, and electrolyte imbalance is one manifestation of this impairment [8, 9]. Electrolytes; sodium Na+, potassium K+ and chloride Cl-. have several vital functions in a body and are necessary for cell and organ to function at their best [10,11]. One of the most significant cations is sodium, which controls the body's overall water content [9, 12]. Additionally, it is crucial for electrical transmission in a variety of systems, including the neurological and muscular ones. However, Potassium is essential for the general health of cells and is in charge of controlling heart rate and muscle contraction [13,14]. Chloride is plays maintain a normal balance of the body fluids [10]. Bicarbonate, on the other hand, plays a role in maintaining blood pH (i.e., acid-base balance) [15]. Imbalances in these electrolytes can jeopardize the body's normal functions the cell. Disturbances, such as an increase or decrease in these electrolytes can lead to detrimental effects [16]. Sympathetic nervous system (SNS) over activity, An essential pathway that links fat to hypertension is found in the kidneys. Adipokines play a critical role in increasing blood pressure. Hyperinsulinemia brought on by insulin resistance increases the amount of plasma in circulation, enhances salt retention, and encourages sodium reabsorption [17]. Additionally, hyperinsulinemia stimulates the rennin angiotensin aldosterone system (RAAS) and the SNS , which accelerates atherosclerosis by causing Smooth muscle cells in the vascular system to hypertrophy. This, in turn, increases peripheral vascular resistance. Despite volume overload, obesity is linked to higher RAAS activity because obese hypertension people have stimulated tissue RAASs [18]. Serum electrolytes, including sodium, potassium, chloride, and bicarbonate, are essential for cells to produce energy, keep their walls stable, and operate normally. In addition to producing energy and contracting muscles, they also transfer bodily fluids and water and engage in a variety of other functions [10,11]. Low levels of serum electrolytes can lead to seizures, weakness, abnormal heart rhythms, paralysis, coma and death in extreme cases. Cardiovascular disease and metabolic acidosis can be developed as a result of the imbalance in serum electrolytes . Obesity causes a disturbance in water balance leading to increase in ratio of the extracellular fluid to the intracellular fluid. This subsequently leads to a decrease in serum electrolytes such as sodium, chloride, potassium and bicarbonate. Serum sodium values in patients with extreme obesity were within or below the lower reference range [9].There is paucity of information the population under study for the association between electrolyte levels and obesity, hence, this study aimed at filling this knowledge gaps.

Objectives : To investigate the relationship between low testosterone and electrolyte imbalance and the rise in the body mass index (BMI) (overweight and obesity).

Materials and Methods

1. Materials

Materials	Company
Human Testosterone II (TES2) ELFA Kit 30 Tests	Vidas (France)
Human electrolyte analyze Na+, K+, Cl– Kit	Jokoh (Japan)

2. Instruments

Instruments	Company
Adjustable micropipette 100-1000 UL	Ependorffe (Garmany)

Adjustable micropipette 10-100 UL	Ependorffe (Garmany)
100-1000UL tip	Ependorffe (Garmany)
10-100UL tip	Ependorffe (Garmany)
Centrifuge	Hittich (Japan)
Roche Diagnostics Cobas C 111 instrument	Roche diagnostics (Garmany)
EX-Ds without auto-samplerinstrument	Jokoh (Japan)
Vidas	bio Merieux (France)

3. Subjects

Fifty male participants provided serum samples. From June 2023 to October 2023, Baghdad City saw 25 male patients with low testosterone and 25 male control subjects.

The study populations were divided into two weight categories, ranging from 65 to 110 kg.

1. Group G1 :- Control It is includes 25 males have the hormone testosterone at normal levels.
2. Group G2 :- There are fifty males have a low or decrease levels of testosterone hormone.

4. Sample Collections

A vein puncture was used to remove five milliliters (MLS) of venous blood, which was then permitted to clot before being centrifuged for (15) minutes in 4042 g.

In this investigation, serum has isolated and stored at -20°C until time of analysis. The substances being examined were sodium (Na), potassium (K), chlorine (CL), and testosterone hormone.

5. Data Collections

Each subject provides their informed consent, and then a questionnaire is used to collect all the necessary data, which includes the following: name, age, weight, residence, marital status, and smoking.

Information :

1) medical history for any recent or past illnesses, as well as the kind of medicine.
2) Take a supplements.
3) Taking any men sexual stimulants.

6. Testosterone hormone Procedure

Three milliliters 3ml of blood were extracted and put into the gel tube .To separate the tube, it was put in the centrifuge. From the separated sample, 100µl of serum were extracted and added to the device's cuvette for measuring. It was inserted into the VIDAS apparatus. Next, we select the word "Start.".

7. Electrolyte (Na, K, Cl) Procedure

Three milliliters 3ml of blood were extracted and put into the gel tube. To separate the tube, it was put in the centrifuge. From the separated sample, 300µl of serum were extracted and added to the measurement device's cuvette. It was inserted into the Jokoh gadget. Next, we select the term INT. Once you press, a tiny needle emerges. After inserting the needle into the serum sample, we press the "MEAS" button. Then the results will appears directly.

Results

The current investigation involved measure the levels of potassium, sodium, chloride, and testosterone in fifty(50) patients with low testosterone levels and twenty-five(25) healthy control men weighing an average of 65 to 110 kg.

1. Testosteron level (ng/ml) compared to the control

	No.	Mean±SD	P-value
Control	25	5.47±1.52	P≤0.01
G1(65-80) Kg	10	5.212±1.420	
G2(81-95) Kg	7	5.826±1.355	
G3(96-110)Kg	8	5.490±2.580	
Total testosterone	50	1.804±0.841	
G1(65-80)Kg	8	2.450 ±0.293	
G2(81-95)Kg	18	2.166 ±0.582	
G3(96-110)Kg	24	1.286 ±0.819	

The testosterone level was found to have increased significantly (P≤0.01) when compared to the control group.

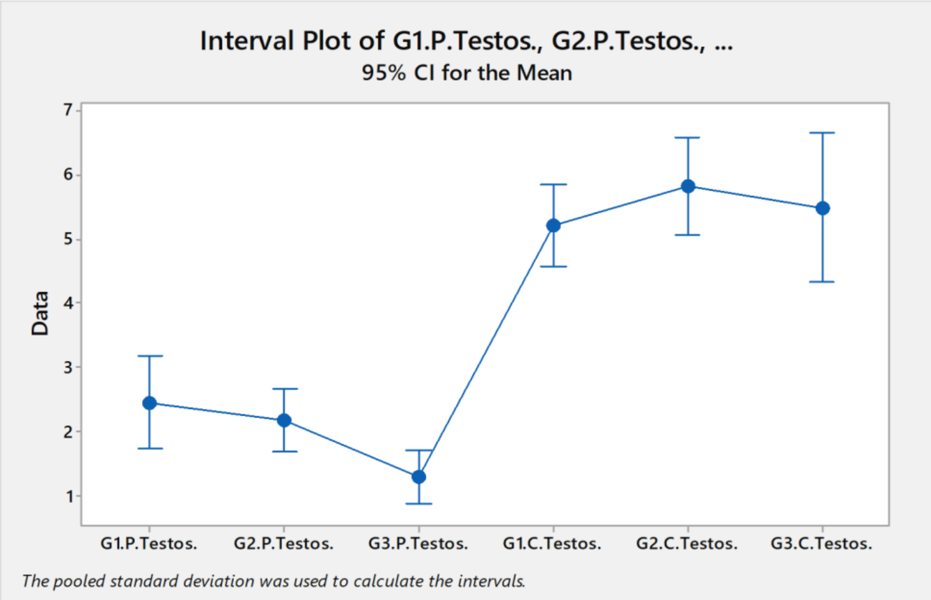


Figure (3.1):- Levels of (Testosterone) in patients group and controlgroup

2. Potassium level (ng/ml) compared to the with control

	No.	Mean±SD	P-value
Control	25	4.252±0.381	P≤0.05
G1(65-80)Kg	10	4.1550±0.2988	
G2(81-95)Kg	7	4.5010±0.3690	
G3(96-110)Kg	8	3.9930±0.4550	
PotassiumTotal	50	4.399±0.297	
G1(65-80)Kg	8	4.2813 ±0.1949	
G2(81-95)Kg	18	4.4075 ±0.2958	
G3(96-110)Kg	24	4.4653 ± 0.3278	

The potassium level differed significantly (P≤0.05) from the control group, according to the data.

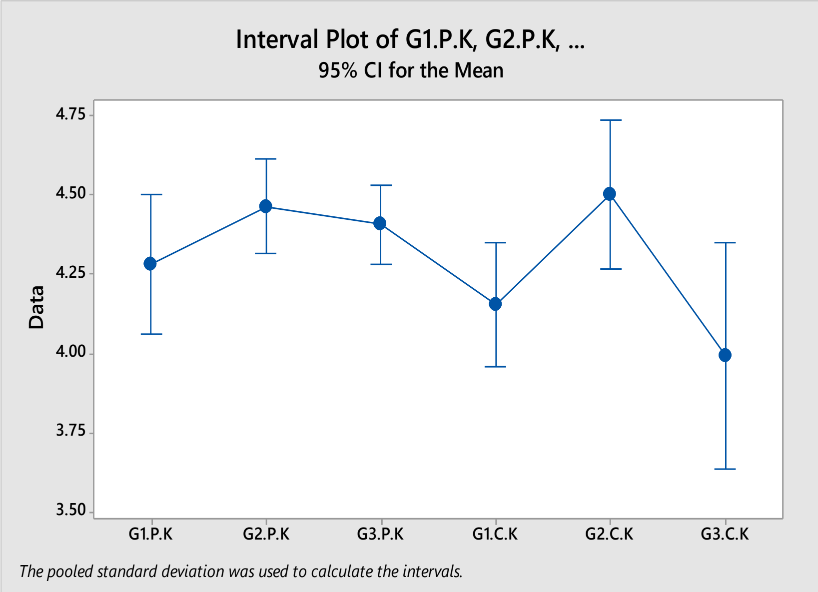


Figure (3.2):- Levels of (Potussium) in patients group and controlgroup

3. Soduim level (ng/ml) compared to the control

	No.	Mean±SD	P-value
Control	25	139.01±1.71	P≥0.05
G1(65-80)Kg	10	138.640±1.809	
G2(81-95)Kg	7	139.657±1.804	
G3(96-110)Kg	8	138.733±1.069	
Soduim Total	50	138.88± 3.00	
G1(65-80)Kg	8	138.938 ±1.952	
G2(81-95)Kg	18	139.013 ±3.074	
G3(96-110)Kg	24	138.546 ±3.327	

A significant difference (P≥0.05) was not seen between the control group and the sodium level , according to the data.

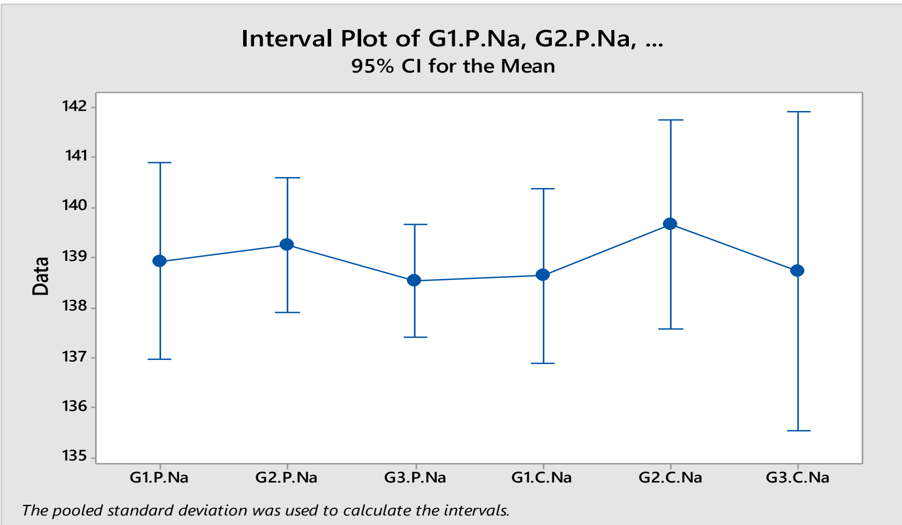
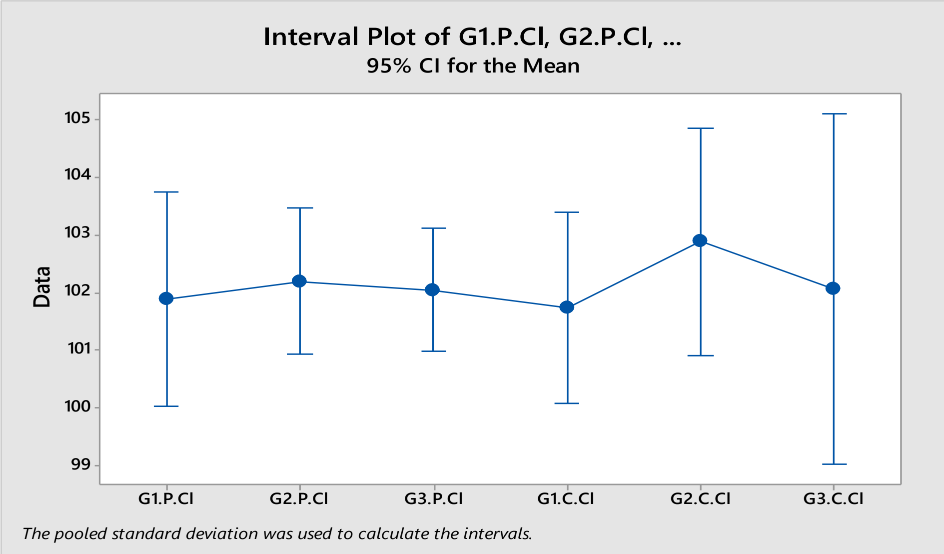


Figure (3.3):- Levels of (Sodium) in patients group and controlgroup

4. Chloride level (ng/ml) compared to the control

	No.	Mean±SD	P-value
Control	25	102.20± 2.22	P≥0.05
G1(65-80)Kg	10	101.750± 2.095	
G2(81-95)Kg	7	102.886±2.521	
G3(96-110)Kg	8	102.070±2.350	
ChlorideTotal	50	102.08± 2.66	
G1(65-80)Kg	8	101.888±2.283	
G2(81-95)Kg	18	102.200±2.569	
G3(96-110)Kg	24	102.050±2.980	

The study showed that the chloride level and the control did not differ significantly (P≥0.05).



Discussion

There is a correlation between low serum testosterone and obesity, as shown by several research; however, the majority of these studies examined this correlation in conjunction with other hypogonadism risk factors.Studies have demonstrated the pathogenetic processes relating fat and insulin resistance to hypogonadism. (19,20) .

Additional researchers discovered that obesity, the metabolic syndrome, and type 2 diabetes all lower testosterone levels. They came to the conclusion that low testosterone levels are separate risk factors for these illnesses .However, we did not include patients with metabolic syndrome or diabetes in this investigation. In order to assess its impact on serum testosterone levels independently of other known risk variables investigated by other researchers, the only risk factor examined was an increase in body mass index (21).

The result presented in table 2, showed the significant progressive increase ($P < 0.05$) in serum sodium levels of normal weight, overweight and obese individuals although the increase remained within the normal range. This could be attributed to the increased reabsorption and retention of sodium caused by obesity induced hyperinsulinemia (22).

Serum potassium levels showed a gradual decrease from normal weight to overweight and lastly to obese individuals ($P < 0.05$). This was attributed to the increased activity of aldosterone which has been reported to cause an increase in potassium secretion at the distal convoluted tubule (23).As well as the increase in the ratio of the extracellular fluid to the intracellular fluid and just like serum sodium level; this decrease was also maintained within the normal range. No significant difference was found between chloride and bicarbonate serum levels between the two groups ($P > 0.05$).

Conclusion

The BMI of middle-aged males is significantly inversely correlated with serum total testosterone. According to this study, being obese increases a person's susceptibility to electrolyte abnormalities. As a result, routine electrolyte testing in obese people is necessary to prevent issues with the kidneys and heart. This study observed that there were increased serum sodium levels and decreased serum potassium levels in obese peoples when compared to overweight and normal weight subjects. It also showed that the serum electrolytes levels of obese individuals

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