MERIT RESEARCH JOURNALS
www.meritresearchjournals.org

Merit Research Journal of Medicine and Medical Sciences (ISSN: 2354-323X) Vol. 4(9) pp. 432-439, September, 2016
Available online http://www.meritresearchjournals.org/mms/index.htm

Original Research Article

Evaluation of Iron, Copper, Manganese, Nickel and Zinc Levels in Serum of Patients Underwent to Different Surgical and Non Surgical Strategies to Reduce Weight

Ahssan Ali Lefta and *Rasha Hasan Jasim

Department of Chemistry-Faculty of Education for Girls-University of Kufa-Iraq

***Corresponding Author's E-mail: dr.rashahussainee@yahoo.com**

Abstract

Every day, life requires levels of high physical activity and food, the tendency genetic prefer to store excess calories in order to help the body to stay alive, so an overweight means increase in the body weight compared with the level of weight acceptable to the normal. Its belief that obesity is a result for losing of ability to correct habits of eating. Obesity is not a single disease, there are 300 different genes that were linked to obesity, in addition to several environmental factors could be associate to obesity happening, while most considerations commonly indicted to the fact that obesity process is a result of an interaction of environmental factors with the genetic predisposition lead to fat accumulation and increased in the adipose tissues. Trace elements are important materials for biochemical reactions in the human body. They are intervening in the synthesis of hormones, reproduce the cells, the immune system, and food digestion. Elements are inorganic compounds, do not synthesis in the body and are contain a minimum amount, so they are necessary for consumption food as well as more important in human life. 47patients (33.28 ±7.424 years with age range 34 years) and 24 healthy individuals (25.96 ± 3.983 years with age range 13 years) were enrolled in the present study. Patients with BMI more than 30 Kg/m^2 (45.179 ± 9.09 Kg/m^2, and 38.7 Kg/m^2 as BMI range); haven't diabetes mellitus, they aren't subjected to obesity surgical operation before. Control group might at approximate age range with the patients group, with similar food style. Average BMI of no smoking, no alcohol drinking healthy group was 18.5 Kg/m^2 (22.829 ± 0.752 Kg/m^2). A significant ($p < 0.05$) decrease of the Fe, Cu, Mn, and Ni levels in the patients' group comparison to those of healthy individuals. Results of Zn came unfamiliar to other element so as previous obesity studies, no significant variation ($p > 0.05$) was recorded when Zn levels of healthy and patients groups were compared together. Levels of Fe at obese patients were correlated significantly to Cu, Mn and Ni, while in the control group similar correlations were indicated at Fe to Cu and Mn levels only, on the other hand, level of Ni at healthy group failed to illustrate same patients results when it correlated to Fe. Strong positive correlation was observed for decreasing of Ni and Mn levels at patients group, in contrast to the relationship at the levels of these elements at control group which stay uncorrelated. Moderate significant correlation was noted at Ni and Zn levels were compared together at obese patients group, while no such correlation was observed at control individuals group. Other correlations were not statistical significance either at the neither healthy individuals nor obese patients. At obese group, statistical analysis showed that gender had no effect in the levels of the studies elements, except Mn and Ni. Although levels of Mn and Ni at the obese women were less than those in the control women, but these levels were higher than that recorded at obese males. In the control group, results of the advised trace elements didn't show significant differences between female and male subgroups. Evaluated trace elements in the current study at male patients were less than those noted at obese females. Zn levels don't correlated to obese individuals unless they had been have health complications correlated to obesity. Ni may be consider as a new trace element could use in the assessment of obesity and follow up its complications.

Keywords: Bypass, obese, sleeve and balloon, surgical operation, trace elements

INTRODUCTION

Obesity is a disorder in the regulation of body weight, diagnosed by gathering the increase of the body fat. Every day, life requires levels of high of physical activity and food, the tendency genetic prefer to store excess calories in order to help body for staying at the level of alive[1], so an overweight is mean increase the body weight compared with the level of weight acceptable to the normal[2]. BMI is the most common way for weight measurement and expression, it is the ratio of the body weight (Kg) to the square height (m^2)[3]. The range of 18.5-24.9 (Kg/m^2) of BMI is the healthy value, while individuals with BMI 25 – 29.9 (Kg/m^2) are considered overweight, but persons with 30(Kg/m^2) BMI or more are considered obese; at last the most of 40 called extremely obese[1].

Its belief that obesity is a result for losing of ability to correct habits of eating[4]. Obesity is not a single disease, there are 300 different genes were linked to obesity, in addition to several environmental factors could be associate to obesityhappening[5], while most considerations common indicted to the fact that obesity process is a result of an interaction of environmental factors with the genetic predisposition lead to fat accumulation and increased in the adipose tissues[6].

Trace elements are important materials for biochemical reactions in the human body. They are intervening in the synthesis of hormones, reproduce the cells, the immune system, and food digestion. Elements are inorganic compounds, do not synthesis in the body and are contain a minimum amount, so they are necessary for consumption food as well as more important in human life[7].

Iron is an essential element in the organism. In human, iron stores in the liver, spleen, duodenum, skeletal muscle, marrow and other. Total stored iron in the human is around between 600 to 1000 mg in male and 200 to 300 mg in female[10]. Reference range of iron in human serum about 50-170 µg/dl[11]; although the amount of iron in the body is small, but it is an essential constituent of hemoglobin, cytochrome other component of respiratory enzyme systems makes it an element of great fundamental importance. Iron has chief function lie in the transport of oxygen to the tissues and in cellular oxidation mechanisms[12]. Moreover, iron may found as inorganic or organic compounds such as hemoglobin and myoglobin or in combination with different proteins[13, 14]. Hemoglobin considers main source of iron in the human, when it contains about 65 -70% of total body's iron, it is located in heme. Excess iron stores in the liver, spleen and other organs after converting to ferritin, and there hemosiderin is another form of iron storage[15, 16]. Iron has an affinity to oxygen, nitrogen and sulfur that donor electrons and associated with iron[17], so the main function of iron is transfer of oxygen molecules[18]. The common oxidize forms of iron are ferrous (Fe^{+2}) and ferric (Fe^{+3}), the last occurs as a short-lived intermediate in central cell redox reactions. Iron, ingested in the Fe^{+3}, must be converted to the Fe^{+2} to be absorbed, this conversion happen in the stomach, where the gastric HCl provides the acidity to reduce Fe^{+3}.Conversion mechanism represent the body's strategy for regulation of the body iron's level. Iron absorption occurs in the upper duodenum also throughout the small intestine. The absorption of inorganic iron salts compares with that of the iron of foodstuffs, always ferrous iron is better absorbed than ferric. Age, the amount of iron in the body, and the form of ingested iron, considered the major influence factors in the absorption of iron [12]. Iron that is not absorbed is excreted through the feces [11]. Iron found with various forms in the dietary food, and the major dietary sources are liver, heart, kidney, egg yolk, shellfish and dried legumes. Intermediate sources are meat form muscles, poultry, fish, green vegetables and nuts [12].

Copper is an essential element in micronutrients required by life, it is transition metal and participate in total of biological processes including mitochondrial respiration, embryonic development, regulation of hemoglobin levels in addition to the hepatocyte function and neuronal function. Conversation of copper between its oxidization states (Cu II ⇆ Cu I) attribute its role as an important catalytic in numerous metabolic processes in the biological systems[19]. Copper plays an essential role in neumours enzyme system actions; where is acting as a mediator of electrons transporting through the usual oxidation processes, these enzymes are known as copper enzymes, which include: cytochrome c oxidase, tyrosinase, ferroxidase, lysyl oxidase, amine oxidase, catechol oxidase, superoxide dismutase and other[20,21]. Two copper containing enzymes ceruloplasmin (ferroxidase I) and (ferroxidase II) which have effectiveness on the oxidation of iron from Fe^{+2} to Fe^{+3}states[22]. Ceruloplasmin is a copper carrier protein in the blood, where is transferred to the liver immediately after the absorbed by the digestive system[23]. The main copper sources are fungus, potato, beans, peas, nuts especially peanuts and pecans be rich of capper, as well as wheat and fruits such as lemon and raisins. Other important sources nutrition copper include organ meat like liver and shellfish[24]. Daily consumption of Cu is 2-5 mg, it is absorbed in the upper part of the small intestine and duodenum, although there evidence for absorbed in the stomach[23]. Copper could be found in almost every organism cells. The highest concentrations of copper is discovering in the brain, liver, central nervous system and heart, in the organs of highest life kingdoms[23]. In the circulation, copper ions are linked to the protein ceruloplasmin almost 95% and the remained to albumin and amino acids. A small amounts of copper is pose in the urine. The main part of copper intake in the organism is excreted to bile juice, the amount of copper required by

the adult per day is about 0.9 mg[22,25]. Normal copper value in plasma or serum of adults is ranged between 70-140 µg/dL[8], this ratio is necessary in the human nutrition, especially for iron metabolism and formation of red blood cell, while an anemia considers a clinical sign for iron and copper deficiency[25].

Zinc is one of the most important trace element for human health; it's widely distribution in body tissues as well as fluids. Generally; the importance of zinc is reflect to it's essential role in the metabolic enzyme systems[26].Zinc is necessary for the action of many enzymes include carbonic anhydrase, alkaline phosphatase, pancreatic carboxypeptidase and variety of dehydrogenases. It has a participate role in the synthesis of carbohydrates, proteins and nucleic acids, as well as the metabolism of micronutrients, also zinc may have essential role in the polynucleotide transcription and then the process of gene expression. Normal values of serum zinc is 80-120 µg/dl [8]. The main sources of zinc are found in meat (pork, beef), poultry, fish, shellfish and less a mounts in the eggs, dairy, nuts, seeds and legume either fruits and vegetables be less content zinc. Zinc in food of animal original be more than that of the plant original because of a fiber which inhibit without zinc absorption by the intestines[27], it is excreted in pancreatic juice in bile and a cross the mucosa of the large intestine. This endogenous fraction form only a small part of the total zinc excreted in feces, since most is derived from unabsorbed intake. Up to about 0.5 mg of the ion is excreted daily in the urine[12]. Zinc is located in the body within the range 1.5 g in female and 2.5 g in male. Sixty percentage of total zinc in the body is existed in skeletal muscle, bone cells are contained. High zinc concentration are found in the choroid of eye and in the prostate fluids, hair and others[26].It would seem to be concerned with the healing of wound. The deficiency of zinc has been related to a form of dwarfism associated with hypogonadism[12].

Manganese is present in biological system link to protein in either Mn^{+2} or Mn^{+3} valence state. It is associated mainly with the formation of connective and bone tissues[8]. The highest manganese concentration are presented in liver, pancreas, kidneys, thyroid, pituitary and bone. Total manganese in the adult body is ranged between 12 and 20 mg/70 Kg, and the daily requirement of it is 2.5-7 mg/day [28,29],normal value for serum manganese is 0.5-1.3 µg/L. High manganese levels were demonstrated in the mitochondria, normally it is acting as cofactor to activate many enzymes, in addition to that manganese activates many enzymes that associated with fatty acid metabolism, protein synthesis and is involved in neurological function[28,30]. Moreover, manganese is required for the normal thyroid function, when participates in the formation of thyroxin[31]. Levels of tissue manganese are directly linked in to availability in the food. Manganese sources are distributing in grain food, nuts, leafy vegetables, soy products and tea[32]. Dietary manganese is absorbed from the small intestine through a mechanism similar to the followed mechanism in the iron absorption. Manganese absorption increase at low dietary intakes, in contrast to high intakes. About 2-15% of total manganese in serum is transported to the liver after binding to albumin, and then exported to other tissue linked to transferrin and possibly to α_2-macroglobulin.Alcohol increases the hepatic manganese level and apparently doubles its absorption[31]. Excretion of manganese is carried out by bile into feces, and small amount by urine [8].

There are many evidences suggested the essential role of Nickel as a trace element in mammals[33]. Nickel is found, with high concentration, in lung, liver, kidney and nasal septum, more concentration of nickel levels were found in heart, fat, brain, peripheral nervous tissue, thyroid gland and adrenal gland[34,35]. Nickel particles may remain in the lungs as nickel oxide form, excretion of nickel is done by urine in the nickel sulfate form which ranged between 0.9 to 4.1 µg/L, these values are not affected by age or sex but affected by the exposure time to the nickel steam. Nickel is played an essential role in the physiological processes, when it is participated as a cofactor in the iron absorption by the intestines, an interaction between iron and nickel levels is shown in the critical conditions only[36,37]. Nickel is known to be linked to certain protein and amino acids in the serum, and the placenta tissue, these ligands have an active role in the transfer and distribution of nickel in the body[34]. Main carrier protein of nickel in serum is albumin, but nickel is associated to α_2-macroglobulin and Histidine[38]. Normal value of serum nickel is ranged between 0.14 to 0.65 µg/L. There are variety diseases may affect in metabolism of nickel like myocardial infarction, acute stroke, burns and hepatic cirrhosis[39]. Daily food (rich nickel) supply body with about 0.5 mg/Kg of the net weight, while the exposure through the skin presents other source of nickel which it absorbed and cause nickel hypersensitivity. Other causes to explain the elevation of nickel levels included dialysis, drugs and organs implant and prostheses, but these levels are reflex to the efficiency of absorption in the digestive and respiratory systems[39]. Over dosage of dietary nickel is not absorbed and get rid of it often through the feces, sweat and milk[39,40].

SUBJECTS AND METHODS

During the period from the beginning of July 2015 to the end of February 2016, 47patients (33.28 ±7.424 years with age range 34 years) and 24 healthy individuals (25.96 ± 3.983 years with age range 13 years) were enrolled in the present study. Patients with BMI more than 30 Kg/m^2 (45.179 ± 9.09 Kg/m^2, and 38.7 Kg/m^2 as BMI range); haven't diabetes mellitus, they aren't subjected to obesity surgical operation before. In order to treat an excess of their body weight or health problems,

Table 1. Age and bmi details in the patients and controls groups

Groups (n)	Age (year)			BMI (Kg/m^2)		
	Mean ± S.D.	Min. – Max.	Range	Mean ± S.D.	Min. – Max.	Range
Patients 47	33.28 ±7.424	14 – 48	34	45.179 ± 9.09	30 – 68.7	38.7
Healthy 24	25.96 ± 3.983	22 – 35	13	22.829 ± 0.752	21.5 – 24.4	2.9

the present study patients were underwent to the neumours treatment kinds (surgically or non surgical operations). The patients' group were classified into three subgroups according to the type of treatment; firstly 3 patients were treated with bypass surgery, the second subgroup included 22 patients were underwent to sleeve surgery, while the last subgroup included 22 patients were treated by balloon strategic opinion. Selection of healthy individuals as a control group based on several criteria included: an absence of major medical or surgical illness in the previous 5 years, no hospital admissions, no current medication, and a subjective perception of good health as determined by health questionnaire. More than, control group might at approximate age range with the patients group, with similar food style. Average BMI of no smoking, no alcohol drinking healthy group was 18.5 Kg/m^2 (22.829 ± 0.752 Kg/m^2). Total information of study groups data was shown in the Table 1.

The patients group consisted of 32 (68%) female and15 (32%) male, while controls group consisted 8 (33%) female and 16 (67%) male.

Bypass surgical operation patients group was included 3 female only, while sleeve surgical operation patients group was included 15 females and 7 males, finally the group of patients who treated with balloon strategic consisted of 14 females and 8 males.

At the morning with fasting period more than eight hours; 5 ml of venous blood samples were collected from 71 from the study groups' individuals, 47 obese patients (BMI 45.179 ± 9.09 Kg/m^2, and age 33.28 ± 7.424 years) as a problem group, while healthy individuals (BMI 22.829 ± 0.752 Kg/m^2, and age 25.96 ± 3.983 years) as a control group. Sera of patient samples were collected from many private hospitals in AL-Najaf Al-Ashraf Government; involved: Al-Ghdeer Hospital, Al-Ameer Hospital and Al-Najaf Private Hospital. The selection of the study cases was based on the clinical diagnosis and the opinion of specialist doctors who identified the best type of treatment for the study cases.

The levels of serum iron, copper, manganese, nickel and zinc were determined by flame atomic absorption spectrophotometry (AA-6300).

The statistical analysis was done using the Statistical Package for the Social Science (SPSS) software for windows, Version 19.0. The results were expressed as mean ± standard deviation (Mean ± S.D.), maximum, minimum and range. The two study groups data were analyzed with Student's independent *t* test. One way analysis of variance (ANOVA) was used to compare parameters in different studied subgroups. Pearson's correlation was applied to determined the relations among the laboratory parameters of the present study, significance was determined regression. *p-values* less than 5% ($p < 0.05$) were considered statistically significant.

RESULTS AND DISCUSSION

Many trace elements involved as cofactors in many biochemical reactions. They play essential roles in many physiological processes, particularly; immunity and metabolism[41-44]. For a long time, trace elements have been identified as latent candidates for civilizing many health dysfunctions[45-49]and metabolic disorders like prediabetes, metabolic syndrome, and weight gain and obesity[50-52]. Comprehension alterations of cellular biomolecules leading to aggravate these metabolic disorders, identifying the cellular targets and sites of action of trace elements has reactivated interest in their therapeutic potential[41,53].

Fe, Cu, Mn, and Zn are considered customary trace elements evaluated as indicators for cellular changes that carried out during obesity process[50,54]. At hand study was designed to investigate levels of several trace elements in serum of obese individuals comparison to controls, in order to follow up effect of the excess in the body weight and several conjugate parameters in these element levels and actions.

In the present study, levels of five trace elements were evaluated in the sera samples of the obese patients in addition to control individuals groups. Table 2 shows a significant ($p < 0.05$) decrease of the Iron (Fe), Copper (Cu), Manganese (Mn), and Nickel (Ni) levels in the patients group comparison to those of healthy individuals. Results of Zinc (Zn) came unfamiliar to other elements. No significant variation ($p > 0.05$) was recorded when Zn levels of healthy and patients groups were compared together.

Results of the present work agreed with the previous obesity studies that focused on the deficiency of Fe concentration at obese persons (children so as adults) response to the elevation of Hepcidin (the key regulator of Fe metabolism) concentrations, whereas several

Table 2. Comparison of the levels of several trace elements in the sera samples of patients and controls individuals

Subjects (n)	Fe Mean ± S.D. Min.-Max. Range	Cu Mean ± S.D. Min.-Max. Range	Mn Mean ± S.D. Min.-Max. Range	Ni Mean ± S.D. Min.-Max. Range	Zn Mean ± S.D. Min.-Max. Range
Obese 47	7.936±3.279 1.300-14.720 13.420	8.810±4.731 2.580-27.240 24.660	764.581±239.006 63.960-1130.080 1066.120	600.479±158.234 106.200-829.700 723.500	2.310±1.000 0.660-4.460 3.800
Control 24	15.879±1.983 12.560-19.480 6.920	12.069±1.121 10.160-14.820 4.660	1170.063±166.274 746.280-1449.920 703.640	757.788±56.853 630.560-849.600 219.040	1.958±0.377 1.270-2.610 1.340
p	0.000	0.002	0.000	0.000	0.119

Table 3. Comparison the levels of several trace elements in the sera samples of patients and controls individuals

Trace Element (ppm)	Subjects (n)				*p*
	Patients 47		Controls 24		
	Females 31 Mean ± S.D. Min.-Max. Range	Males 16 Mean ± S.D. Min.-Max. Range	Females 8 Mean ± S.D. Min.-Max. Range	Males 16 Mean ± S.D. Min.-Max. Range	
Fe	7.910±3.391 1.300-14.500 13.200	7.991±3.159 2.820-14.720 11.900	17.423±1.370 15.580-19.480 3.900	15.108±1.802 12.560-18.40 5.840	*0.930* *For 1vs2* *0.066* *For 3vs4* *0.000* *For 1vs3* *0.000* *For 2vs4*
Cu	8.157±2.936 2.580-12.280 9.700	10.163±7.129 3.380-27.240 23.860	12.643±0.990 10.440-13.860 3.420	11.783±1.098 10.160-14.820 4.660	*0.113* *For 1vs2* *0.606* *For 3vs4* *0.005* *For 1vs3* *0.253* *For 2vs4*
Mn	813.854±180.051 426.440-1108.760 682.320	662.516±313.201 63.960-1130.080 1066.120	1258.018±109.319 1066.120-1449.920 383.800	1126.086±175.004 746.280-1407.280 661.000	*0.029* *For 1vs2* *0.148* *For 3vs4* *0.000* *For 1vs3* *0.000* *For 2vs4*
Ni	633.788±118.514 331.880-829.700 497.82	531.480±207.456 106.200-756.680 650.480	722.665±65.750 630.560-849.600 219.040	775.350±44.180 683.660-829.700 146.040	*0.016* *For 1vs2* *0.341* *For 3vs4* *0.084* *For 1vs3* *0.000* *For 2vs4*

Table 3. Continue

Zn					*0.158*
	2.437±1.007	2.024±0.967	2.012±0.241	1.933±0.432	*For 1vs2*
	0.660-4.460	0.840-3.660	1.670-2.370	1.270-2.610	*0.836*
	3.800	2.820	0.700	1.340	*For 3vs4*
					0.234
					For 1vs3
					0.779
					For 2vs4

1: Female Patients, 2:Male Patients, 3: Healthy Females, and 4:Healthy Males. The Mean Difference is Significant at 0.05 Level

studies have found significantly higher concentrations of hepcidin in overweight individuals in comparison to those of normal weight[55,56]. This elevation in the hepcidin levels may be caused by obesity related inflammation since proinflammatory cytokines enhance hepcidin expression[57]. Weight loss in obese children leads to a decrease of serum hepcidin levels along with improvement of Fe absorption[58].

On the other side, findings of the current wok came converse to other studies that applied on the populations of obese and recorded an increase of Cu levels at obese persons comparison to skimpy individuals[54]. Present results could be explain according to the fact that elevation of Cu concentration in serum coincided with elevation of endo-antioxidant molecules, especially SOD. Highly activation of endo-antioxidants is happening at acrimonious inflammatory conditions, while obesity was classified as moderate to chronic inflammation.

Outcomes of Mn at patients suffered obesity absolutely agreed with general findings of previous studies that indicated to the negatively relationship of Mn levels to BMI or Waistline of obese persons[53,54].

Actually, past studies about relationship of Ni to the overweight or obesity are relatively underprivileged, so that; the present results may be flatten to more aggrandize studies in order to follow up Ni effect on the intermediate molecules that change during weight gain process.

The results of present work were disharmony with previous obesity studies, when they have been recorded a decrease of Zn element as an correlated parameter to the obesity complications[53,54]. This disagreement may be elucidate according to the present study patients were approximately devoid of obesity complications and they were bowed to medically reduce weight strategies in order to avoid complication of obesity, so that levels of Zn were approximate to their coequals at controls group.

In order to investigate effect of obesity in the levels of trace elements for both genders, ANOVA test was applied for comparing the subgroups together. At obese group, statistical analysis showed that gender had no effect in the levels of the studies elements, except Mn and Ni, as revealed in Table 3. Although levels of Mn and Ni at the obese women were less than those in the control women, but these levels were higher than that recorded at obese males.

In the control group, results of the advised trace elements didn't show significant differences between female and male subgroups.

In the purpose of following up the alterations in the levels of the studied trace elements (Fe, Cu, Mn, Ni, and Zn) during obesity process, comparison between patients and healthy individuals at the same gender was carried out. In the women subgroups, strong statistical decrease ($p < 0.05$) were observed in the levels of Fe, Cu, Mn, and Ni at patients compared to healthy women. On the other hand, Fe, Mn, and Ni only were illustrated significant variations when obese and control males compared together.

Hümeyra Y and his team[54] have been published study reported a significant decrease of Mn levels at obese women at comparison to healthy women, this finding exactly agreed with the present study findings.

According to the results in the Tables 2 and 3, levels of Zn in the two study groups in addition to their subgroups were so convergent together, so that; the statistical analysis failed to reveal significant differences between the major two groups (patients and controls), more than, no variances were observed at the comparison carried out between subgroups (female to male at the same group) with the same manner, at the comparison carried out between the two subgroups (with the same gender), they didn't illustrate statistical variations.

As shown in the Table 4, levels of Fe at obese patients were correlated significantly to Cu, Mn and Ni, while in the control group similar correlations were indicated at Fe to Cu and Mn levels only, on the other hand, level of Ni at healthy group failed to illustrate same patients results when it correlated to Fe (Table 5).

Strong positive correlation was observed for decreasing of Ni and Mn levels at patients group, in contrast to the relationship at the levels of these elements at control group which stay uncorrelated. Moderate significant correlation was noted at Ni and Zn levels were compared together at obese patients group, while no

Table 4. Correlation of trace elements levels in the sera samples of patients individuals

Trace Element (ppm)	Fe	Cu	Mn	Ni	Zn
Fe	1	0.783 0.000	0.521 0.005	0.402 0.008	0.206 0.207
Cu	0.783 0.000	1	-0.215 0.167	-0.159 0.308	-0.023 0.888
Mn	0.521 0.005	-0.215 0.167	1	0.801 0.000	0.263 0.105
Ni	0.402 0.008	-0.159 0.308	0.801 0.000	1	0.554 0.027
Zn	0.206 0.207	-0.023 0.888	0.263 0.105	0.554 0.027	1

r
p

Table 5. Correlation of the levels of trace elements in the sera samples of controls individuals

Trace Element (ppm)	Fe	Cu	Mn	Ni	Zn
Fe	1	0.647 0.001	0.531 0.008	-0.253 0.234	0.065 0.773
Cu	0.647 0.001	1	0.169 0.430	-0.294 0.164	0.006 0.980
Mn	0.531 0.008	0.169 0.430	1	0.125 0.562	-0.270 0.225
Ni	-0.253 0.234	-0.294 0.164	0.125 0.562	1	-0.099 0.662
Zn	0.065 0.773	0.006 0.980	-0.270 0.225	-0.099 0.662	1

r
p

such correlation was observed at control individuals group. Other correlations were not statistical significance either at the healthy individuals or obese patients, as observed in Tables 4 and 5.

Previous studies illustrated positive correlations of Fe to Mn and Zn, respectively, at obese peoples in contract to the negative relationship of Fe to Cu levels at same population[258,262]. Results of current study agreed with some of these studies findings and showed controverter to other findings.

CONCLUSION

Generally, evaluated trace elements in the current study at male patients were less than those noted at obese females. Zn levels don't correlate to obese individuals unless they had been having health complications correlated to obesity. Ni may be consider as a new trace element could use in the assessment of obesity and follow up its complications**.**

REFERENCE

(1) Jeffrey L, Laura M, Rebecca L, & Jack R. [2014]: *Thy State of Obesity*. Trust for Americans healthy.
(2) Clinical guidelines on the identification, *evaluation, and treatment of overweight and obesity in adults*: The evidence report. Bethesda, Md.: National Heart, Lung and Blood Institute, [1998]; NIH 98-4083.
(3) Parker-Pope T. [2008]: *Watch Your Girth*. The New York Times May.
(4) Sims E A, Danforth E J, Horton E S, Bray G A, Glennon J A, & Salans L B. [1973]: *Endocrine and metabolic effects of experimental obesity in man*. Recent ProgHorm Res; Vol. 29, p:457–496.
(5) Chagnon Y C, Rankinen T, Snyder E E, Weisnagel S J, Perusse L, & Bouchard C. [2003]: *The human obesity gene map: the 2002 update*. Obes Res; Vol. 11, p:313–367.
(6) Richard L, Atkinson R. : *The management of eating disorders and obesity*. second edition .
(7) David C, Ernestina F, Gerardo C, & Liliana D. [2011]: *Pediatric trace elements. Clinical update*. Actapediatrica de mexico. Vol. 32, No. 5, p:287-291.
(8) Carl A, Edward R, David E, & Barbara G. [2008]: *Fundamentals Of Clinical Chemistry*. 6th Edition
(9) Nielsen F H. [2008]: *Ultratrace elements possible importance for human: Au update*. Hyper trace elements and disease. Vol. 101, p:355-376.
(10) Saito H. [2014]: *Metabolism of iron stores*. Nagoya J. Mad. Sci.; Vol. 76, p:235-254.
(11) Arneson W, & Brickell J. [2007]: *Clinical chemistry :Alaboratorypersrective*. F.A. Davis, company. Printed in U.S.A.
(12) Latner L A. [1975]: *Clinical biochemistry*. Seventh edition, Newcastle University. London.
(13) Jackson A. [2010]: *Iron and Healthy*. Scientific Advisory Committee on Nutrition; printed in UK by TOS.
(14) Anderson B F, Baker H M, Norris G E, Rice D W, & Baker E N. [1989]: *Structure of human lactoferrin: crystallographic analysis and refinement at 2.8 Aº resolution*. J Mol Biol. Vol. 209, p: 711-34.
(15) Arkhipor A, Braun R, & Yin Y. [2008]: *Case study: Myoglobin*.

(16) Theil E C. [1987]: *Ferritin: structure, gene regulation in animals, plants, and micro-organisms*. Ann. Rev. Biochem. Vol. 56, p: 289-315.
(17) Arova S, & Kapoo R K. [2012]: *Iron metabolism in human: An overview*. New Delhi, India. www.intechopen.com.
(18) Koolman J, & Roonm K H. [2005]: *Color Atlas of Biochemistry*. 2ed edition, New Yourk.
(19) Krupanidhi S, Sreekumar A, &Sanjeevi C B. [2008]: *Copper and biological health*. Indian J. Med Res. Vol. 28, p:448-461.
(20) Uauy R, Olivares M, & Gonzalez M. [1998]: *Essentiality of copper in humans*. J ClinNutr. Vol. 67, No. 5, p:952-959.
(21) Turnlund J R. [2006]: *Copper. In: Modern Nutrition in Health and Disease*. 10th ed. Philadelphia: Lippincott Williams & Wilkins, p: 286-299.
(22) Angelova M, Asenova S, Nedkova V, &Koleva R. [2011]: *Copper in the human organism*. Trakia Journal of Sciences. Vol. 9, No. 1, p:88-98.
(23) Rosalind S G. [2005]: *Principles of Nutritional Assessment*. second edition, Oxford University, New York. p: 697-711.
(24) Stern B, Solioz M, Krewski D, Aggett P, & Baker S. [2007]: *Copper and Human health :Biochemistry, Genetics and strategies for modeling dose-response relationships*. Journal of Toxicology and Environmental Health, Part B. Vol. 10, p:157-222.
(25) Johnson M A, Fischer J G, & Kays S E. [1992]: *Is copper an antioxidant nutrient?*.Crit Rev Food SciNutr. Vol. 32, No. 1, p:1-31.
(26) FAO/WHO [2002]: *Zinc. In: Human Vitamin and Mineral Requirements*. Report of a Joint FAO/WHO Expert Consultation. FAO, Rome; p: 257-270.
(27) Izinc G. [2004]: *Assessment of the Risk of Zinc Deficiency in Populations and Options for its Control. International Zinc Nutrition Consultative Group Technical Document 1*. Food Nutr Bull. Vol. 25, No. 1, p: 94-203.
(28) David L W. [1990]: *The Nutritional Relationships of Manganese*. Sournal of orthomolecular Medicine. Vol. 5, No. 4, p:219-222.
(29) Hegsted B M. [1976]: *Food fortification*. In: Nutrition in the Community. McLaren, D.S., ED. John Wiley, N.Y.
(30) Wilson E D, Fisher K H, & Garcia P A. [1979]: *Principles of Nutrition*. John Wiley, N.Y.
(31) WHO. [1996]: *Trace Elements in human nutrition and health*. Geneva, printed in Belgium.
(32) Underwood E J. [1977]: *Trace Elements in Human and Animal Nutrition*. 4th Ed. Academic Press, N.Y.
(33) Goyer R. [1991]: *Toxic effects of metals*. In: Amdur MO, Doull JD, Klaassen CD, editors. Casarett and Doull's toxicology, 4th ed. New York: Pergamon Press; p: 623-80.
(34) Das K, Das S, & Dhundasi S. [2008]: *Nickel, its adverse health effects and oxidative stress*. Indian J Med Res. Vol. 128, p:412-425.
(35) Rezuke W N. [1987]: *Reference values for nickel concentrations in human tissues and bile*. American journal of industrial medicine. Vol. 11, p:419-426 .
(36) Nielsen F H. [1980]: *Effect of form of iron on the interaction between nickel and iron in rats: Growth and blood parameters*. J Nutr. Vol. 110, p: 965-73.
(37) Coogan T P, Latta D M, Snow E T, & Costa M. [1989]: *Toxicity and carcinogenicity of nickel compounds, In: McClellan RO, editor*. Critical reviews in toxicology. Boca Raton, FL: CRC Press. Vol. 19, p: 341-84.
(38) Sunderman F W. [1993]: *Biological monitoring of nickel in humans*. Scandinavian journal of work, environment & health. Vol. 19, p:34–38.
(39) WHO, Regional Office for Europe, [2000]: *Air quality guidelines*. Second edition, Copenhagen, Denmark.
(40) Sunderman F W, Hopfer S M, Sweeney K R, Marcus A H, Most B M, & Creason J. [1989]: *Nickel absorption and kinetics in human volunteers*. ProcSocExpBiol Med. Vol. 191, p: 5-11.
(41) Wiernsperger N, &Rapin J R. [2010]: Trace elements in glucometabolic disorders: an update. Wiernsperger and RapinDiabetology& Metabolic Syndrome. Vol. 2, No. 70, p: 2-9.
(42) David L, & Watts FA. [1990]: *Trace Elements and Neuropsychological Problems as Reflected in Tissue Mineral Analysis (TMA) Patterns*. Journal of Orthomolecular Medicine. Vol. 5, No. 3, p: 159-167.
(43) Goldhaber S B. [2003]: *Trace element risk assessment: essentiality vs toxicity*. RegulToxicolPharmacol. Vol. 38, p:232-242.
(44) Johansson L. [2011]:*Trace Element Levels in Scalp Hair from Adolescents in Río Negro, Argentina: Link to Environmental and Dietary Factors*. Linnaeus University, School of Natural Sciences, Degree project work
(45) Etebary S, Nikseresht S, Sadeghipour H R, & Zarrindast M R.[2010]: *Postpartum Depression and Role of Serum Trace Elements*. Iran J Psychiatry. Vol. 5, No. 2, p:40-46.
(46) Martin-Lagos F, Navarro-Alarn M , Terr-Martos C, Lbpez-G H , & Serrana M C. [1997]: *Serum copper and zinc concentrations in serum from patients with cancer and cardiovascular disease*. The Science of the Total Environment. Vol. 204, p: 27-35.
(47) Nawaz R, Zahir E, Siddiqui S, Usmani A, & Shad K F.[2014]: *The Role of Trace Metals and Environmental Factors in the Onset and Progression of Schizophrenia in Pakistani Population*. World Journal of Neuroscience. Vol. 4, p:450-460.
(48) Lakshmi M D, & Geetha A. [2011]: *Level of Trace Elements (Copper, Zinc, Magnesium and Selenium) and Toxic Elements (Lead and Mercury) in the Hair and Nail of Children with Autism*.Biol Trace Elem Res. p:1-11.
(49) Zima T, Tesar V, Mestek O, &Nemecek k.[1999]: *Trace Elements in End-Stage Renal disease*. Blood Purif. Vol. 17, p:187-198.
(50) Blazewicz A, Klatka M, Astel A, Partyka M, &Kocjan R.[2013]: *Differences in Trace Metal Concentrations (Co, Cu, Fe, Mn, Zn, Cd, and Ni) in Whole Blood, Plasma, and Urine of Obese and Nonobese Children*. Biol Trace Elem Res. Vol. 155, p:190–200.
(51) Hussain F, Arif M M, Sheikh MA, Nawaz H, & Jamil A. [2009]:*Trace Elements status in type 2 diabetes*. Bangladesh Journal of Medical Scince. Vol. 8, No. 3, p:1-5.
(52) Marjani A, Akbari F A, & Eshghinia S.[2015]: *Association Between Trace Elements and Metabolic Syndrome Among Type 2diabetes Mellitus Patients in Gorgan*. Asian J Pharm Clin Res. Vol. 8, Issue 3, p: 358-362.
(53) Bougle D, Bouhallab S, Bureau F, & Zunquin G. [2009]:*Effects of trace elements and calcium on diabetes and obesity, and their complications: Protective effect of dairy products — A mini-review*. Dairy Science & Technology. Vol. 89 , No. 3, p: 213-218.
(54) Humeyra F Y, Toker A, &Arıbas A.[2013]: *Serum trace elements in obese women with or without diabetes.* Indian J Med Res. Vol. 137, p:339-345.
(55) Aeberli I, Hurrell R F, & Zimmermann M B.[2009]: *Overweight children have higher circulating hepcidin concentrations and lower iron status but have dietary iron intakes and bioavailability comparable with normal weight children*. International Journal of Obesity. Vol. 33, No. 10, p:1111–1117.
(56) Giudice E M, Santoro N, & Amato A. [2009] : *Hepcidin in obese children as a potential mediator of the association between obesity and iron deficiency*. The Journal of Clinical Endocrinology and Metabolism. Vol. 94, No. 12, p: 5102–5107.
(57) Feldman A, Aigner E, Weghuber D, & Paulmichl K.[2015]: *The Potential Role of Iron and Copper in Pediatric Obesity and Nonalcoholic Fatty Liver Disease*. Bio Med Research International. Vol. 2015, p: 7.
(58) Amato A, Santoro N, & Calabr`o P [2010]: *Effect of body mass index reduction on serum hepcidin levels and iron status in obese children*. International Journal of Obesity. Vol. 34, No. 12, p: 1772–1774.