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Effect of Socio-Demographic Characteristics on Level of Zinc in Serum of Adults in Najaf

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***Abstract*—Background: Zinc is an essential trace element in maintaining human health. Zinc deficiency has many adverse effects on the body's growth and validity and delays the individuals' daily performance of duties. The study aimed: to find the association between serum zinc levels and different socio-demographic factors.Material and Methods: A cross-sectional study was conducted to achieve the study's aim from November 2021to May 2022. The size of sample comprises 140 participants. All study members were adults ages ranging from (18-65) years taken randomly from Al-Najaf Governorate. The data was collected by estimating serum zinc and using a simple questionnaire, then analyzed using a statistical program. Results: The association between serum zinc with educational level and monthly income wasa significant p-value (0.048 and 0.027, respectively). Other socio-demographic characteristics were not significant. Conclusion: The study concluded that educational level and monthly income could affect serum zinc level more than Other socio-demographic characteristics.**

***Keywords*—Normal zinc, Zinc deficiency, socio-demographic characteristics, and cross-sectional study**

I. INTRODUCTION

zinc is one of the essential nutrients, has unlimited public health significance (Chasapis *et al*., 2020), and is second only to iron(Amin *et al*., 2020). Zn is fundamental in its extensive participation in proteins, lipids, deoxyribonucleic acid (DNA) metabolism, gene transcription, and numerous other biological processes (Mcclung, 2019). Three major biological roles of Zn in the body: are structural, catalytic, and regulatory components (King *et al*., 2015). Zn participates in the structure of more than 2000 transcription factors and is a cofactor for more than 300 enzymes (Mcclung, 2019). All living things require Zn to grow and develop.Moreover,it prevents free radicals from forming because it is an antioxidant mineral (Pae *et al*., 2012). The daily requirement of Zn is 9.4-10 mg for men and 6.5-7.1 mg for women, according to WHO (Gao *et al*., 2018).

Zn deficiency remains a significant public health problem among the top ten factors contributing to the disease burden in developing countries (Nasiri-Babadi *et al*., 2021). Occurs in the body when Zn absorption cannot meet the body's physiological needs(Warthon-Medina *et al*., 2015), and insufficient Intake, requirements increase, and mal absorption increases Losses (Gupta *et al*., 2020). The global prevalence of Zn deficiency affects approximately 17% of the world's population(White, 2012). In developing countries, more than 25% of the population suffers from Zn deficiency due to inadequate Zn intake, while in industrialized countries, the number is as high as 15% (Wessels & Rink, 2020). It is more commonly observed in developing regions attributable to malnutrition. However, it is associated with aging and many chronic diseases in developed regions (Maxfield & Crane, 2020).

Effects of Zn deficiency are based on the intra- and extracellular function of the Zn ions and their interactions with proteins (Grüngreiff et al., 2020), including impairment of numerous metabolic processes, decreased resistance to infection due to impaired immune function, abnormalities of the skin and its appendages, as well as disorders of wound healing and hemostasis (Grüngreiff *et al*., 2020). Also, excessive Zn loss may lead to digestive disorders, Urinary tract disorders, chronic inflammatory bowel diseases, Cohn's disease, and ulcerative colitis (Kersting *et al*., 2013). Also, Zn deficiency can cause hair loss, diarrhea, Glossitis, nail atrophy, infertility, anemia, and changing taste (Mahawar *et al*., 2017). In addition, it has a vital role in the formation and development of obesity, as it is linked to the change and decline of metabolism and the formation of fatty tissue (Zaky *et al*., 2013.; Rios-Lugo *et al*., 2020).

II. METHODOLOGY

A cross-sectional study was conducted to achieve the study's aims end o The sample size comprises 140 participants. All study members were adults ages ranging from (18-65) years taken randomly from Al-Sadr medical city in Al-Najaf city. The data was collected by estimating serum zinc and usingag a sa simple questionnaire, then causingusing a statistical program. Excluded the age groups less than 18 years or more than 65 years, Pregnant and

lactating females, any individual suffering from diseases (hypertension, diabetes, kidney disorders and liver disease, chronic diarrhea, and cancer), take any nutritional supplements (vitamins or minerals) or medications that affect zinc levels, and smokers.Current study data were obtained using a simple questionnaire containing different socio-demographic characters through direct participant interviews and blood sample collection to estimate Serum Zinc.

A. Questionnaire form

1. Part one: socio-demographic characteristics.

The number of questions in this part (8 items) includes age, gender, Residence, educational level, marital status, Occupational, monthly income, and exercise.

2. Part two: Biochemical measurement.

Blood samples collected from participants involved drawing 5 ml of venous blood after fasting for 12 hours using disposable syringes. Then, blood was placed in a typical tube and waited until it coagulated at (25 C)room temperature. Then serum was parted by centrifugation at (3000) rpm for (10m). After that separation, the serum and located in Eppendorf tubes. After that, the sample is reserved at -20°C for future analysis.

B. Estimation of Serum Zinc

1. Principle

The chromogen in the reagent reacts with zinc to produce a colored compound whose color intensity matches with zinc concentration in the sample (Makino, 1991).The name of the reagents and amounts show in Table.1. Also,

Table.II shows the working principle of spectrophotometer cells.

Table.1Reagent applied to estimate zinc level concentration in the serum

Reagent A	"Borate buffer 0.37Molar mass(Mm), PH 8.2؛ Saliciladoxime 12.5Mm؛ Dimethylglyoxime1.25Mm; surfactants and preservatives".
Reagent B	"Nitro-PAPS; 0.4Mm, preservatives".
Standard	"Zn ion 200 µg/dl (30.6 Micromole per liter (µmol/l); stabilizers and preservatives".

Table.II Work steps and their cells in the spectrophotometer

Reagent	Blank	Standard	Sample
Work Reagent Distilled water Standard sample	1 µl 50µl — —	1 µl — 50µl —	1 µl — — 50µl
"Mixed and measured the absorbance against blank at 578 nm.Colour is stable for 30 minutes."			

III. CALCULATION

The formula below is used to calculate serum Zn levels in the blood.

$$\text{Zn } \mu g/dl = \frac{\text{A(sample)}}{\text{A(standard)}} \times 200$$

Globally, there is no acceptable cut-off rate for Zn concentration in serum. “The International Zn Nutrition Advisory Group” determined that 70 micrograms per deciliter (µg/dL) was the cut-off rate for serum Zn concentration (Hotz *et al*., 2003). In our study, we used this recommendation issued by it, where a concentration of less than 70 µg/dl was approved for a low level of Zn in the serum, and a greater value equal to 70 µg/dl is considered a normal level of Zn in the serum.

IV. MATERIALS

A. Chemicals Apparatus and Equipment

Table.3 Chemical devices and equipment that used in this search, and suppliers

NO.	Apparatus	Suppliers
1	spectrophotometer	APLE PD-303 UV Japanese
2	Centrifuge	HettichaEBA 20 German
3	Waterbath	Memmert – German
4	Refrigerator	L G South Korea
5	Disposable syringes	Egypt
6	Plain tubes	Jordan
7	Eppendorf tube	EP-200 Wuhan, China
8	Zn Kit	Bussero(Milano) ITALY

B. Statistical Analysis

The data in this research were analyzed using the "Statistical Package for the Social Sciences" (SPSS) version 20. The percentages, frequencies, standard deviation, and mean were obtained using descriptive statistics. T-test, Chi-square, Pearson correlation coefficient, and odds ratio were used in the analysis.

Note.A P-value ≤0.05 is considered significant.

V. RESULTS AND DISCUSSION

The sample of this study included (140) adults, whose age range was (18-to 65)years, with a mean ±SD of Serum zinc level (of 69.19 ±14.910).The distribution of search participants about socio-demographic features appeared in table 5.

According to the study participants' age group,they were between (18-65) years. The age group (18-25) years they represented the highest percentage (34.3%) among other age groups. This result aligns with another study conducted in China among Adults (Wang et al., 2018) and anotherstudy in Iraq from a national survey (Pengpid and Peltzer, 2021).

The majority of the total participants in the study were females (61.4%). This result is consistent with a study conducted in Erbil / Iraq (Shabu, 2019), which found that (75.5%) of the participants are females.

The results also showed that most participants were urban residents (63.6%). This result is consistent with a study conducted in the northern province of Turkey (Ustu *et al*., 2012), finding (56.6%) urban. The researcher attributed this to the fact that the advisory unit for nutrition and obesity care in the hospital is located in the center of the city.

At the educational level, the results showed that the highest percentage (42.9%) of the participants were university graduates. On the other hand, the lowest percentage (5.7%) of the participants was Illiterate. This result is similar to a study conducted in QalatSaleh City/ Iraq *(Arrar et al.*, 2021). Also, a study conducted in Al-Diwaniya City (Al-Gharify&Faraj, 2021) found that the participant was Illiterate (4.2%).

This study indicated that most participants were married (70.7%). This result parallels a study conducted in Indonesia (Thamrin *et al*., 2021).

The results of our study indicated that the highest percentage of participants were housewives (39.3%). In the opposite direction, the lowest percentage of participants was from the student category (4.3%). This result aligns with the other results conducted in Iraq (Shabu, 2019). The researcher attributed this to the fact that there are more female visitors to the hospital than men

Regarding the monthly income, the highest percentage of respondents (49.3%) have between (500,000-1,000,000 Iraqi dinars (IQD)) per month. This aligns with the study's results in Iraq (Abdullah *et al*., 2021).

On the level of physical activity, the results of our study show that (87.1%) of individuals do not exercise regularly, representing (72.9%). Guidelines and recommendations issued by the WHO for adults (18-64 years) on the amount of physical activity to maintain good health. It generally recommends at least 30 minutes of moderate physical activity daily (World Health Organization, 2020).

There are other studies conducted in Iraq, Ramadi City (Al-Ani *et al*., 2020), and Erbil (Shabu, 2019), it was found that the percentage of those who practice non-regular exercises reached (94.1%, and 94.3%, respectively), and these results support our results.

The aim required in this study is to find out the association between zinc level with socio-demographic characteristics. Participants were divided based on the cut-off point for the zinc level, first for people with a normal level greater than or equal to 70(µg/dL) and the second for people with zinc deficiency less than 70(µg/dL).

Table.4 Distribution of the search participants about the socio-demographic features

Socio-demographic		N.(%)
Age (years)	18-25	48(34.3)
	26-35	31(22.1)
	36-45	36(25.7)
	46-55	13(9.3)
	>55	12(8.6)
Gender	Male	54(38.6)
	Female	86(61.4)
Residences	Rural	51(36.4)
	Urban	89(63.6)
Educational level	Illiterate	8(5.7)
	Primary school	33(23.6)
	Secondary	39(27.9)
	College	60(42.9)
Marital status	Single	41(29.3)
	Married	99(70.7)
Occupational	Employee	39(27.9)
	Student	6(4.3)
	Earner	24(17.1)
	Housewife	55(39.3)
	Retired	16(11.4)
Monthly income	< 500000IQD	44(31.4)
	500000-1000000IQD	69(49.3)
	>1000000IQD	27(19.3)
Exercise (≥30 minutes daily)	No	102(72.9)
	Yes	38(27.1)
Total		140

The current study showed that the association in terms of age group with the level of Zn in the blood (µg/dL) was not significant at (p-value ≤ 0.05), as appears in Table 6. This result is consistent with the results of the research conducted by (Gau *et al*., 2021) in America, where the results of this research showed that there is no significance at (P- value ≤ 0.05) in addition to another study that supported our results conducted In Greece, on children and their parents from 18-60 years of age, and concluded that there was no significant e between age and Zn level in parents (adults), on the contrary, the age group less than 18 years (children) was significantly related with the level of Zn (Voskaki *et al*., 2010).

On the other hand, our results do not agree with the results of (Kim *et al*., 2016) study conducted in South Korea, where an association was found between age and Zn level in the plasma of adult males.

This difference between studies is due to sampling inclusion criteria and sample size. The association between age group and Zn level can be explained based on the

availability of Zn-containing food (red animal meat, seafood, and nuts) and the individual's nutritional habits (the amount and method of food preparation) (Lowe *et al*., 2009), in addition to the individual's exposure to infectious and chronic diseases, depression, poverty, the period of pregnant women, children in adulthood, dental problems (Gibson, 2012), smoking and drinking alcohol, as it leads to the consumption or need of a large amount of Zn.

In our current study, those who suffer from infectious and chronic diseases, are smokers, and take medications were excluded, and this explains the absence of a significant relationship between the age group and Zn.

Table 5 Association between age groups and serum zn

Age groups	**Serum Zn (µg/dl)**		P-**value**
	Low Serum Zn	**Normal Serum Zn**	
	No.(%)	**No.(%)**	
18-25	26(54.2)	22(45.8)	0.349
26-35	16(51.6)	15(48.4)	
36-45	20(55.6)	16(44.4)	
46-55	6(46.2)	7(53.8)	
>55	10(83.3)	2(16.7)	
Total	78(55.7)	62(44.3)	

Table 7 shows no significant at (p-value ≤ 0.05) association between gender and Serum Zn(µg/dl). However, the percentage of men who suffer from a low level of Zn (46.3%) is lower than that of women who suffer from a low level of Zn(61.6%). These results are in agreement with other studies conducted in Iran, the first in Tehran (Mohammadi *et al*., 2015), the second in Shushtar(Jahangirimehr *et al*., 2021), and the third in Yazd city (Anbari-Nogyni *et al*., 2020) which showed that there were no significant impact of gender on the level of Zn in the blood, p-value(0.953, 0.591, and 0.811 respectively).

The explanation for the difference between males and females in the level of Zn in the blood is due to the physiological state of the female body, such as changes that occur as a result of menstruation (Arafat et al., 2018; Yani et al., 2016). Also, exclusive breastfeeding and pregnancy lead to the need for an additional amount of food (Haider M Abdulhussein *et al*., 2021; Muhsen & Ahmed, 2021). In addition, females tend to eat plant-based foods (Sandstead, 1995).

The lack of a significant difference in our current study can be attributed to the fact that pregnant and lactating women were omitted.

Table 8 shows that there was no sign at (p-value ≤ 0. 05) association between place of residence and blood Zn level (µg/dL). This result is consistent with the research conducted by (Azemati et al., 2020) in Iran, where their results indicated no significant effect of place of residence on serum Zn level at (P-value = 0.006). On the other hand, and in contrast to our results, another study in China found that the place of residence affects the level of Zn in the blood, as the Zn deficiency in the rural population was (70.7%), while it was (15.3%) in the urban population (Ma *et al.*, 2008).

In general, meals should contain a variety of foods in a balanced diet (Haydar Mohsin Abdulhussein & Ahmed, 2021; Lim, 2018). The researcher attributes the no association between the place of living and the level of Zn due to no food diversity between the city center and the rural. In Iraq and recent years, there was no difference between the nutrition in rural and urban areas. In the last decade, the economic and social situation improved, and ease of movement between rural and city led to the improvement and availability of food in remote (rural) areas and positively impacted the pattern of food and consumption in general (Sabeeh *et al*., 2022).

Table.9 shows that there is a significant correlation at (p-value ≤ 0.048) between the educational level and the level of zinc in the blood (µg/dL). This result is consistent with the research conducted by (Wang et al., 2018) in China, where their results indicated a significant effect of place of residence on the level of Zn in the blood at (P value = 0.001). Perhaps this is attributed to the researcher. The higher the educational level, the higher the zinc level, due to the knowledge of healthy food containing zinc, leaving harmful foods that lead to a lack of zinc absorption.

Table 10 shows no significant association between Marital status and serum Zn (µg/dl) level,where the P-value was (= 0.753). This result agrees with the research conducted in Brussels, Belgium, by (Pepersack et al., 2001), where the results of their study indicated that there was no significant impact of marital status on the level of Zn in the blood serum at a significant level (P-value ≤ 0.05).

The researcher explains this because of the lack of influence of marriage on the type and eating habits of individuals, and a study conducted in Iraq supported that there was no significant difference between the food pattern between single and married (Ahmed & Hameed, 2021).

Table 11 shows a significant (p-value ≤ 0.027) association between Monthly income and Serum Zn level (µg/dl), Where the percentage of individuals who low monthly income (46.2%) suffered from zinc deficiency. This result was similar to other study results (Wang et al., 2018), indicating a significant association at (p-value = 0.001).

The natural source of zinc is by eating foods containing high levels of zinc, and therefore, high-income individuals have the purchasing power (to shop for meat, fish, and nuts) containing high sources of zinc more than low-income (poor). The researcher attributes this to reason.

Table 12 shows no significant at (p-value ≤ 0.05) association between exercise and Serum Zn level (µg/dl), Where the percentage of individuals who exercise daily Zn content is higher (52.6%) than those who do not exercise, which is not a big difference. This result is similar tothe study conducted in Iran by (Zare et al., 2019), which indicated no significant correlation between exercise and Zn level at (p-value = 0.550).The explanation of the relationship between Zn and exercise is unclear, as individuals who exercise about 90% tend to eat food containing proteins (meat and fish) more than others. Thus their Zn level is higher (Micheletti *et al*., 2001), but studies have found that

Zn is excreted through sweat or urine in people who exercise Sports than others, and thus leads us to the conclusion that exercise does not affect Zn levels (Deruisseau *et al*., 2002; Minini *et al*., 2013; Rodriguez Tuya *et al*., 1996).

Table 6 Association between gender and serum zn

Gender	Serum Zn (µg/dl)		P-value
	Low Serum Zn	Normal Serum Zn	
	No.(%)	No.(%)	
Male	25(46.3)	29(53.7)	0.075
Female	53(61.6)	33(38.4)	
Total	78(55.7)	62(44.3)	

Table 7 Association between residences and serum zn

Residences	Serum Zn(µg/dl)		P-value
	Low	Normal	
	No.(%)	No.(%)	
Rural	32(62.7)	19(37.3)	0.205
Urban	46(51.7)	43(48.3)	
Total	78(55.7)	62(44.3)	

Table 8 Association between educational level and serum zn

Educational level	Serum Zn(µg/dl)		P-value
	Low	Normal	
	No.(%)	No.(%)	
Illiterate	7(9.0%)	1(1.6%)	0.048
Primary school	27(34.6%)	6(6.9%)	
Secondary	23(29.5%)	16(25.8%)	
College	21(26.9%)	39(62.9%)	
Total	78	62	

Table 9 Association between marital status and serum zn

Marital status	Serum Zn (µg/dl)		P-value
	Low	Normal	
	No.(%)	No.(%)	
Single	22(53.7)	19(46.3)	0.753
Married	56(56.6)	43(43.3)	
Total	78(55.7)	62(44.3)	

Table 10 Association between monthly income and serum zn

Monthly income	Serum Zn (µg/dl)		p-value
	Low	Normal	
	No.(%)	No.(%)	
< 500000IQD	36(46.2)	8(12.9)	0.027
500000-1000000IQD	29(37.1)	40(65.0)	
>1000000IQD	13(16.7)	14(22.6)	
total	78	62	

Table 11 Association between exercise and serum zn

Exercise/ 30minutes and more daily	Serum Zn(µg/dl)		P-value
	Low	Normal	
	No.(%)	No.(%)	
Yes	18 (47.4)	20(52.6)	0.327
No	60 (58.8)	42(41.2)	
Total	78(100.0)	62(100.0)	140

VI. CONCLUSION

Educational level and monthly income can affect serum zinc levels more than Other socio-demographic characteristics.

Other socio-demographic characteristics do not affect the level of zinc in the blood

RECOMMENDATION

Encourage healthcare workers to measure serum zinc levels in all patients .and raise awareness about the importance and benefits of zinc and food containing zinc. More extensive research studies should be conducted on large sample sizes.

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