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RESEARCH ARTICLE

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Estimation of Lipid Profile and Zinc in smoking and Non-Smoking Urban and Rural people of Al Hila city.

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ABSTRACT

The aim of the study was to determine lipid profile (Total cholesterol , Triglycerides, HDL,LDL,vLDL and Zinc levels in smokers and nonsmokers in General Hilla hospital from Urban and Rural people the stusy populations were (16) Smokers as patients group and (16) nonsmokers as control group ,the results showed a high significant levels (P≤0.05) of triglycerides, low significance (P≤0.05) in LDL in smokers when compared with non smokers and no sginficance (P≥0.05) in total cholesterol, HDL and Zn levels ,In the differences between urban and reural ,there are a high significance differences (P≤0.05) in total cholesterol levels, HDL and LDL and low significance (P≤0.05) in vLDL in urban compared with rural people and high significance level. P≤0.05) in Zn levels in male smokers.

Keywords: Lipid profile, Zinc, Smoking, Hila City

INTRODUCTION

Fifty-five percent of all fatalities are because of conditions that cannot be spread from person to person, ailments include cancer, diabetes, cardiovascular disease, and stroke (1). Following cardiovascular disease, it is expected that cancer (12%), diabetes (5%), and chronic lung disease (2%), will remain the next leading causes of death. Associated with alterationslipid and lipoprotein metabolism has been linked to cardiovascular disease, diabetes, and even certain malignancies (2). Zinc is well recognized for its capacity to reduce oxidative stress, in addition to its activities as an enzymes catalyst and supplier to fat, sugar, and protein metabolism (3).

Additionally, it is an essential signaling component in development. Reduced production of persistent inflammatory response by helping to reduce the production of inflammatory cytokines. Physiologic syndrome, atherosclerotic, and type 2 diabetes mellitus can't form without it because of the role it plays in insulin generation, storage, and release. Zinc levels in people have been the subject of little and conflicting research. The risk of developing multiple sclerosis and poor lipid profiles have both been related to zinc levels that are too high, according to certain studies. Patients with multiple sclerosis have been shown to have excessive amounts of zinc in their urine and erythrocytes. (5). It's possible that zinc levels may be used as a illnesses marker due to its shown associations with ros generation, inflammation, and lipid and glucose levels. Due to our current knowledge, it is necessary to examine zinc's role in Noncommunicable diseases like diabetes, Over half of all deaths occur because of heart disease, lung disease, cancer, or diabetes (1). The top cause of death is expected to be cardiovascular disease (27%), followed by malignancy (11%), adiposity (4%), and bronchial asthma (2%)Disruptions in lipid and lipoprotein transport have been linked to CVD, diabetes, and even certain malignancies (2).

Zinc's anti-oxidant properties are well-known, and it is also recognized that it plays an important part in enzyme catalysis and in the processing of carbs, proteins, and fats. Additionally, it is an essential signaling component in development. **(4)**. Decreased levels of inflammatory cytokines help control the

chronic inflammatory response. Because of its function in insulin production, storage, and release, it is crucial to the increase in metabolic syndrome (MS) and atherosclerosis (6). With adult-onset diabetes. Research on zinc levels in humans is scant and has shown contradictory findings. A high zinc level has been linked to a worse lipid profile and an increased risk of multiple sclerosis in certain research. Multiple sclerosis patients have been shown to have elevated zinc levels in their erythrocytes and high levels of zinc in their urine, according to another research. **(7)** It has also been shown that zinc has significant links to oxidative Glucose and cholesterol levels as well as stress and inflammation levels, suggesting indicating that zinc availability may be a marker of metabolic disorders. Given where we are currently, it's clear that a comprehensive review of zinc's function in metabolic disease is warranted **(8)**. Animal tests have shown that zinc depletion causes adverse impacts on vascular health, including changes in aorta cell shape, fatty acid metabolism, and glucose metabolism(**9**) Increased sensitivity to oxidative stress is shown in vascular endothelial cells when zinc levels are low. Acute zinc deficiency also induces pro-atherogenic modifications in key transcription factors and adhesion molecules in LDL receptor knock-out mice. **(10).**

A significant inverse association between dietary Zinc consumption and the prevalence of diabetes and cardiovascular disease was seen in human studies, as were a number of their related risk factors, including hypertension and hypertriglyceridemia. Therefore, zinc may have a preventative role in atherogenesis **(11**). Zinc therapy has been associated with reduced levels of all three lipids in human studies. (12) while increasing HDL cholesterol. However, contradictory studies have now debunked these initial conclusions. One well-designed study, even when conducted in accordance with the most severe research design guidelines, seldom provides definitive conclusions.(**13**).

Therefore, it might be harmful to patients' health to modify healthcare procedures based on the results of a single high-profile scientific experiment. Systematic reviews and meta-analyses often have more power and lower bias than the individual studies they include, and the most accurate overall evaluation of an intervention may be obtained via the meticulous pooling of treatment effects. Foster et al. (2008) conducted a meta-analysis of randomized controlled trials to better understand the impact of zinc supplementation on individuals' blood lipids. However, in the stable individuals as a whole, zinc supplementation had no impact on plasma lipoproteins, the HDL and cholesterol levels was shown to decline. However, serum lipids in humans have been the subject of numerous recent research investigating the effects of zinc supplementation. However, the outcomes were not consistent **(15,16,18) .**

METHODS AND MATERIALS

Practical part

TABLE 1: Equipment: Basic medical analysis laboratory equipment:

Equipment	Tools
Water bath	Tubes
Spectrophotometer	Tips
Refrigerator	Micropipette
Incubator	Rack
Water Distillation Apparatus	Torniquet
Centrifuge	Disposable Syringes

Triglycerides

The first tenet is that one's approach should depend on one's response on Tinder.

Tissue lipase for triglycerides Water + glycerol + unsaturated fatty acids

GK = Glycerol + Adenosine Triphosphate The Reaction of Glycerol-3-Phosphate with Adenosine Diphosphate

3 Phosphate of Glycerol + 2 Oxygen = Dihydroxyacetone Phosphate + Water

Hydrogen peroxide plus 4-chlorophenol plus PAP pod quinoneimine (pink) with water

The concentration of triglyceride in a sample may be determined by measuring the absorbance of the colored complex (quinoneimine) at 500 nm.

Manual Procedure

The reagent and specimen were let to stand at room temperature

TABLE 2:

Pipette into well identified test tubes	Blank	Standard	Assay
Reagent	1 ml	1 ml	1 ml
Demineralised water	10 µl		
Standard		10 µl	
Specimen			10 µl

After combining the ingredients, we let it 10 minutes to rest at room temperature. Sample absorbance was measured at 500 nm and compared to that of a reagent blank. 3.2.4 calculation: results were calculated in accordance with (fossati,and prencipe,1982). :

Result $= \frac{abs(assay)}{abs(standard)}$ ×standard concentration

cholesterol

3.3.1 This reaction scheme best describes the basic enzymatic technique described by allain et al. is as following :

Cholesterol easters _____CE _ Cholesterol + free fatty acids

Cholesterol + O_2 ___co_ _ Cholesterol 4 one +H_2O_2

$2H_2O_2$ + Phenol + PAP __POD_ _ Quinoneimine (pink) + $4H_2O$

Specimen Collection and Handling

Within 2 hours after collection, fasting plasma samples were centrifuged to isolate their relevant cell populations from the EDTA tubes they were stored in (3500 – 4000 RPM for 15 mins).

Method:

One thousand microliters of the reagent were combined with ten microliters and left to stand for 10 minutes at room temperature.

The blank absorption spectrum was collected at 500 nm (480-520).

Procedure

Let the samples and reagent remain at room temperature for a time to prepare them.

Calculation

Manual Procedure:

Result $= \frac{abs(assay)}{abs(standard)}$ ×standard concentration

HDL-Cholesterol (PTA)

Principle

Before HDL-Cholesterol detection using a total cholesterol reagent, the reagent was prepared for use on specimens. HDL cholesterol was isolated from the centrifuged supernatant and quantified using total cholesterol reagent (cholesterol CHOP-PAP).

Reagents (ready to use after preparation)

TABLE 3:

Vial R1 Precipitant	
Phosphate acid (PTA)	13.9 mmol/L
Magnesium chloride	570 mmol/L
Vial R2 Standard	
Cholesterol	100 mg/dL (2.58 mmol/L)

Specimen collection and Handling

Specimens were collected on EDTA centrifuged and plasma ermoved from blood cells within 3 hours

HDL-Cholesterol in specimen

Material Used :

1-The essentials for a medical research laboratory.

2-.HDL-LDL CK-MB Callbrator

3-HDL, LDL, CK-MB, and Control Sera (human origin)

. 4-Total cholesterol-measuring reagent

Procedure

Specimen, Calibrator and Control Preparation:

TABLE 4:

Pipette in centrifuge tube	Macro-Method-method	Micro-method
Specimen	1 mL	5.0 mL
Precipitant	100 µL	50 µL
The tubes were mixed vigorously .let to stand for 10 minutes at room temperature and centrifuged for minues at 3500 -4000 PRM (1500g).		

Assay: Reagent and supernatants were let to stand at ambient temperature, after which a calibrator standard or pre-treated seric calibrator is used to ensure accuracy. (With the Total Cholesterol CHOD PAP or equivalent).

TABLE 5:

Pipette in well identified Test tubes	Blank	Standard	Assay
Reagent	1ml	1ml	1ml
Demineralized water	25 µL		
Standard 100 mg / dl		25 µL	
Supeermatant			25 µL
The materials were mixed .test tubes was let set aside for 5 minutes at 37° C, or 10 minutes at room temperature. The agent reagent blank absorbance was measured at 500 nm (480-520), where the color is stable for just one hour.			

3.4.7 calculations: Method n°1 for calculating the results was as follows: using the included gold standard of 100 mg/dl:

Result = $\frac{abs\,(\,assay\,)}{abs\,(\,calibrator\,)}$ X calibrator concentration

RESULTS AND DISCUSSIONS

Triglycerides (TG)

The tables below show the relation between smoking and TG.

1-Smokers ,2-non smokers

	n	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	16	308.75	116.173	29.043	246.85	370.65	206	631
2	16	176.8	75.079	18.770	136.81	216.82	81	367
Total	32	242.78	117.261	20.729	200.50	285.06	81	631

	Sum of squares	df	Mean square	F	sig
Between groups	1392260.031	1	139260.31	14.557	<.001
Within groups	286993.438	30	9566.448		
Total	426253.469	31			

Differences in TG levels between smokers and nonsmokers are statistically significant, which may be attributable to the health risks associated with smoking. matching the findings of (koda et. al. 2016)

4.2 total cholesterol

The tables below show the relation between smoking and Total cholesterol.

1- Smokers
2- Nonsmokers

	n	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	16	194.31	65.074	16.269	159.64	228.99	111	372
2	16	161.25	39.780	9.945	140.05	182.45	81	228
Total	32	177.78	55.649	9.837	157.72	197.84	81	372

	Sum of squares	df	Mean square	F	sig
Between groups	8745.031	1	8745.031	3.007	.093
Within groups	87256.438	30	2908.548		
Total	96001.469	31			

These results are consistent with those of other studies showing a significant difference between smokers and nonsmokers in total cholesterol (3)

high- Density lipoprotein (HDL)

The tables below show HDL levels of smokers and nonsmokers.

1- Smokers
2- Nonsmokers

	n	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	16	31.25	6.105	1.526	28.00	34.50	18	43
2	16	32.31	4.012	1.003	30.17	34.45	25	42
Total	32	31.78	5.110	.903	29.94	33.62	18	43

	Sum of squares	df	Mean square	F	sig
Between groups	9.031	1	9.031	.338	.565
Within groups	800.438	30	26.681		
Total	809.469	31			

There is no signification between smokers and nonsmokers in realtion to HDL, due to smoking and its complictions for smokers Both [11] and [17] observed similar results when testing HDL.

low- Density lipoprotein (LDL)

The tables below show the relation between smoking and LDL levels .

1- Smokers
2- Nonsmokers

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	16	80.63	37.677	9.419	60.55	100.70	10	156
2	16	114.00	20.357	5.089	103.15	124.85	101	162
Total	32	97.31	34.276	6.059	84.95	109.67	10	162

	Sum of squares	df	Mean square	F	sig
Between groups	8911.125	1	8911.125	9.718	.004
Within groups	27509.750	30	916.992		
Total	36420.875	31			

There is a signification between smokers and nonsmokers of (LDL) might be due to smoking and its complictions . These results are consistent with those of (jain and ducatman,2018), although they contrast with those of (3)

very low- Density lipoprotein (vLDL)

The tables below show the relation between smoking and vLDL .

1- Smokers
2- Nonsmokers

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	16	52.50	9.661	2.415	47.35	57.65	33	70
2	16	27.19	6.452	1.613	23.75	30.63	19	46
Total	32	39.84	15.187	2.685	34.37	45.32	19	70

	Sum of squares	df	Mean square	F	sig
Between groups	5125.781	1	5125.781	75.959	1
Within groups	2024.438	30	67.481		
Total	7150.219	31			

There is a large signification between smokers and nonsmokers in (vLDL) results, which might be due to smoking and its complications. The results of this investigation were found to be consistent with those of (4)

4.6 zinc (zn)

The tables below show the relation between smoking and zinc .

1- Smokers
2- Nonsmokers

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	16	130.44	81.196	20.299	87.17	173.70	48	316
2	16	72.25	49.871	12.468	45.68	98.82	26	190
Total	32	101.34	72.576	12.830	75.18	127.51	26	316

	Sum of squares	df	Mean square	F	sig
Between groups	27086.281	1	27086.281	5.966	.021
Within groups	136198.938	30	4539.965		
Total	163285.219	31			

There is a signification between smokers and nonsmokers in relation to the levels of zn. Which might be due to smoking and its complications . This research confirms the results of a previous study by (9)

Triglycerides (TG)

The tables below show the relation between smoking and TG in different smoking residents.

1- Smokers in the city
2- Smokers in the countryside

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	263.88	26.368	9.322	241.83	285.92	206	293
2	8	248.78	9.558	3.379	240.76	256.74	240	262
Total	16	256.31	20.690	5.173	245.29	267.34	206	293

	Sum of squares	df	Mean square	F	sig
Between groups	915.063	1	915.063	2.327	.149
Within groups	5506.375	14	393.313		
Total	6421.438	15			

The tables below show the difference in TG levels between male and female smokers.

1- Smoker male 2- smoker female

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	280.00	47.343	23.671	204.67	355.33	239	321
2	8	301.75	33.984	16.992	247.67	355.83	280	352
Total	16	290.88	39.884	14.101	257.53	324.22	239	352

	Sum of squares	df	Mean square	F	sig
Between groups	946.125	1	946.125	.557	.484
Within groups	10188.750	6	1698.125		

There is no signification between smokers residents or between male and female smokers about TG smoking and its complications may be the cause of these results.

total cholesterol: The tables below show the relation between smoking and different types of residents regarding total cholesterol.

1- Urban Smokers. 2- Rural smokers

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	187.38	12.363	4.371	177.04	197.71	157	193
2	8	155.13	12.392	4.381	144.77	165.48	138	169
Total	16	171.25	20.502	5.126	160.33	182,17	138	193

	Sum of squares	df	Mean square	F	sig
Between groups	4160.250	1	4160.50	27.156	<.00
Within groups	2144.750	14	153.196		
Total	6305.000	15			

The tables below show the relation between male and female smokers regarding total cholesterol.

1- Male smokers 2- female smokers

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	157.00	21.441	7.581	139.07	174.93	133	200
2	8	201.63	21.193	7.493	183.91	219.34	151	222
Total	16	179.31	30.906	7.726	162.84	195.78	133	222

	Sum of squares	df	Mean square	F	sig
Between groups	7965.563	1	7965.563	17.529	<.001
Within groups	6361.875	14	454.420		
Total	14327.438	15			

There are large significations between urban and rural smokers residents and also between male and female smokers regarding total cholesterol levels , which might be due to smoking and its complications . The results are consistent with those seen in (11,15). respectively

high-density lipoprotein (HDL)

The tables below show the relation between smokers and different types of residents regarding HDL.

1- Urban Smokers. 2- Rural smoker

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	34.38	7.444	2.632	28.15	40.60	21	39
2	8	23.25	4.027	1.424	19.88	26.62	17	29
Total	16	28.81	8.150	2.038	24.47	33.16	17	39

	Sum of squares	df	Mean square	F	sig
Between groups	495.063	1	495.063	13.824	.002
Within groups	501.375	14	35.812		
Total	996.438	15			

The tables below show the relation between male and female smokers about HDL.

1- Smokers male 2- smokers female

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	29.13	8.493	3.003	22.02	36.23	20	43
2	8	33.13	6.664	2.356	27.55	38.70	18	38
Total	16	31.13	7.658	1.915	27.04	35.21	18	43

	Sum of squares	df	Mean square	F	sig
Between groups	64.000	1	64.000	1.098	.312
Within groups	815.750	14	58.268		
Total	879.750	15			

There is signification between smokers residents about HDL that smoking and its complications may be the cause of this results. But there is not signification between male and female smokers.

Low-density lipoprotein (LDL)

The tables below show the relation between different types of residents regarding LDL levels.

1- Urban Smokers:8. 2- Rural smoker:8.

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	113.88	23.375	8.264	94.33	133.42	87	152
2	8	76.13	18.558	6.561	60.61	91.64	47	89
Total	16	95.00	28.209	7.052	79.97	110.03	47	152

	Sum of squares	df	Mean square	F	sig
Between groups	5700.250	1	5700.250	12.798	.003
Within groups	6235.750	14	445.411		
Total	11936.000	15			

The tables below show the relation between male and female smokers about LDL

1- male Smokers. 2- female smoker.

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	74.00	21.889	7.739	55.70	92.30	36	95
2	8	123.50	14.813	5.237	111.12	135.88	115	152
Total	16	98.75	31.295	7.824	82.07	115.43	36	152

	Sum of squares	df	Mean square	F	sig
Between groups	9801.000	1	9801.000	28.060	<.001
Within groups	4890.000	14	349.286		
Total	14691.000	15			

There is a signification between urban and rural smoking residents regarding LDL levels , which might be due to smoking and its complications. These results agree to those in (11) there is a large signification between male and female smokers regarding LDL levels which in turn agree with those of (6).

The very Low-density lipoprotein (vLDL)

The tables below show the relation between smoking and vLDL of urban and rural smokers.

1- Urban Smokers. 2- Rural smoker.

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	53.63	8.280	2.927	46.70	60.55	41	70
2	8	40.63	10.756	3.803	31.63	49.62	22	52
Total	16	47.13	11.448	2.862	41.02	53.23	22	70

	Sum of squares	df	Mean square	F	sig
Between groups	676.000	1	676.000	7.338	.017
Within groups	1289.750	14	92.125		
Total	1965.750	15			

The tables below show the relation between smoking and vLDL of female and male smokers

2- male Smoker. 2- female smoker.

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	49.00	8.401	2.970	41.98	56.02	38	67
2	8	47.88	10.494	3.710	39.10	56.65	33	58
Total	16	48.44	9.201	2.300	43.53	53.34	33	67

	Sum of squares	df	Mean square	F	sig
Between groups	5.063	1	5.063	.056	.816
Within groups	1264.875	14	90.348		
Total	1269.938	15			

There is signification in vLDL levels of urban and rural smoking residents , which might be due to smoking and its comparison between the vLDL in female and male smokers . The no difference between male and female smoked is insignificant.

Zinc (Zn)

The tables below show the relation between zinc and smoking in urban and rural residents.

2- Urban Smokers. 2- Rural smoker.

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	108.00	4.276	1.512	104.43	111.57	104	112
2	8	121.00	20.326	7.186	104.01	137.99	103	154
Total	16	114.50	15.697	3.924	106.14	122.86	103	154

	Sum of squares	df	Mean square	F	sig
Between groups	676.000	1	676.000	3.134	.098
Within groups	3020.000	14	215.714		
Total	3696.000	15			

The tables below show the relation between zinc levels in male and female smokers.

1. male Smoker. 2- female smoker.

	N	Mean	Std deviation	Std . error	Lower bound	Upper bound	minimum	maximum
1	8	149.63	30.905	10.927	123.79	175.46	129	211
2	8	78.25	13.594	4.806	66.89	89.61	56	99
Total	16	113.94	43.479	10.870	90.77	137.11	56	211

	Sum of squares	df	Mean square	F	sig
Between groups	20377.563	1	20377.563	35.753	<.001
Within groups	7979.375	14	569.955		
Total	28356.938	15			

There is a large signification between male and female smokers regarding zinc levels , which might be due to smoking and its complications . As far as we are aware, no prior discoveries are comparable to this one, hence it is impossible to judge its significance. Whether or not a person in a community smokes is of little significance.

REFERENCES

1. Al-Makki, A., DiPette, D., Whelton, P. K., Murad, M. H., Mustafa, R. A., Acharya, S., ... & Khan, T. (2022). Hypertension pharmacological treatment in adults: a World Health Organization guideline executive summary. Hypertension, 79(1), 293-301.
2. Watson R. R and Demeester F. (2016) Handbook of Lipids in Human Function: Fatty Acids". Elsevier Inc. Kidlington, Oxford OX5 1GB, UK.
3. Jain RB. (2017) Lipid distribution differentials among smokers and nonsmokers and within various types of smokers." Ann Clin Lab Res, 5(2): 168 DOI: 10.21767/2386-5180-1000168
4. Rashan M. A. A., Dawood M. T., Abdul Razzaq A. H., and Hassali M. A.(2016)" The Impact of Cigarette Smoking on Lipid Profile among Iraqi Smokers". International Journal of Collaborative
5. Ferrier D. R. (2017) Lippincott Illustrated Reviews: Biochemistry". Wolters Kluwer and Lippincott Williams & Wilkins, a Wolters Kluwer business. China.

6. Bolego C., Poli A., Paoletti R. (2002)" Smoking and gender". Cardiovascular Research. 53 (3): 568- 576.
7. Ranasinghe P, Wathurapatha WS, Ishara MH, Jayawardana R., Galappatthy P., Katulanda P. andConstantine GR (2015) Effects of Zinc supplementation on serum lipids: a systematic review and meta- analysis'. Nutrition & Metabolism. 12:26.
8. Shaw J (1979) Trace elements in the fetus and young infant. Am J Dis Child 133: 1260-1268 Shrimpton R, Marinho HA, Rocha YS, Alencar FH (1983) Zinc supplementation in urban Amazonian mothers: concentrations of Zn and retinol in maternal serum and milk. Proc NutrSoc 42: 122A
9. Al-Timimi D. J., Haji M. R., and Mohammad B. Y. (2010)" Zinc Status Among Smokers and Non-Smokers: Relation to Antioxidant Stress". Duhok Medical Joumal. 4(1).
10. Zhang R., (2016) "The ANGPTL3-4-8 model, a molecular mechanism for triglyceride trafficking", Open Biol. 6 1-11.
11. Alkanaani, M. I., Rajab, E. R., Abdulwahed, A. M. H., Dabos, T., Alshammiri, B., Abdullah, S. N., & Al-Samarraie, M. Q. (2020). Visfatin hormone level and lipid profile in some hyperlipidemia patients in samarra city. Biochem. Cell. Arch, 20(1), 1191-1193.
12. Wu J.W., Yang H., Wang S.P., Soni K.G., Brunel-Guitton C., Mitchell G.A., (2015)" Inborn errors of cytoplasmic triglyceride metabolism", J. Inherit. Metab. Dis. 38 85-98.
13. Vasudevan DM, Sreekumari S, and Vaidyannthan K. (2022)" Textbook of BIOCHEMISTRY for Medical Students (Seventh Edition)". Jaypee Brothers Medical Publishers (P) LTD. New Delhi- India..
14. Brown K. H., Wuehler S. E., and Peerson J. M. (2001) The importance of zinc in human nutrition and estimation of the global prevalence of zinc deficiency". Food and Nutrition Bulletin. The United NationsUniversity. 22(2).
15. de Groot R, van den Hurk K, Schoonmade LJ, de Kort WLAM, Brug J, Lakerveld J. (2019)"Urban-rural differences in the association between blood lipids and characteristics of the built environment: a systematic review and meta-analysis". BMJ Global Health. 4 (1).
16. Fossati, P. and Prencipe, L. (1982) Serum Triglycerides Determined Calorimetrically with an Enzymethat Produces Hydrogen Peroxide. Clinical Chemistry, 28, 2077-2080.
17. Taiwo E. O. and Thanni L. OA. (2012) Comparing Lipid Levels of Smokers and Nonsmokers in Sagamu, South-West, Nigeria. Hosp Pract Res. 6(1):18-22.
18. Abdulwahed, A. M. H., Alkanaani, M. I., Alsamarrai, A. H., Hamad, M. A. M., Dakheel, A., & Al-Samarraie, M. Q. (2020). Determination of some visfatin hormone level and lipid profilein some breast cancer patients in Samarra city. Annals of Tropical Medicine and Health, 23, 265-267.