Association between Body Mass Index and Complete Blood Count Parameters

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Abstract: Obesity is an abnormal or extraordinary cumulative fat in the body which can lead to health problems. Its prevalence increased worldwide. This study aims to identify the effect of obesity on CBC parameters in obese subjects. Two hundred obese patients of either gender, the mean age was (33.71±2) years, 148 were females (74.4%) and 52 were males (25.6%), each subject submitted to medical history, physical examination, and CBC test. The results of the study revealed that there was a correlation between BMI and CBC parameters, (P value <0.05). This study concluded that there is positive correlation between CBC and BMI (positively correlated, p-value <0.05).

Keywords: Body Mass Index, Complete Blood Count.

INTRODUCTION

Obesity and being overweight were chief health problems all around the world; with a high prevalence in many regions worldwide [1]. It is thought that; more than two hundred million males and three hundred million females are obese nowadays [2]. According to world health organization data, a high percentage of people that are over 18 years old are overweight and obese. Various studies have revealed a correlation between obesity and heart diseases (like acute coronary syndrome, left ventricular enlargement, arrhythmias, and cardiac standstill). Obesity also causes high blood pressure, hyperglycemia, and an abnormal lipid profile which can cause major cardiac issues [3, 4].

Body Mass Index is an imperative parameter for obesity identification [5]. Additional measurements (like waist measurement and the valuation of waist ratios and visceral fat contents) are used clinically to detect obesity type. Obesity is also associated with atherosclerotic changes in the coronary arteries. Many studies revealed that atheroma starts primarily in young people and accumulates with aging progression which clues to coronary occlusion. In fact, atherosclerotic changes in overweight and obese people values are more when compared to normal person [6]. Studies showed obesity in early decades of life usually leads to high-risk cardiac problems [7, 8].

Regarding to pathophysiology of the disease there are two causes that lead to abnormal CBC count, which are chronic inflammation and diminished fibrinolysis.

Obesity can cause chronic inflammatory process [9-11]. The cause of chronic inflammation is the release of inflammatory cytokines which are secreted by adipocytes tissues, causing the macrophages activation and adhesion to fatty tissue [9]. The abundance of macrophages found more in abdominal viscera. Adhesion of macrophages is caused by an increase of Monocyte Chemotactic Protein 1 (MCP 1) in the adipose tissues. Low oxygen in the adipose tissue also leads to macrophages activation [12].

Activation of macrophages also react with fatty tissues to increase the secretion of other inflammatory cytokines like tumor necrosis factor α (TNF α), interleukin 6 (IL 6), which cause hepatic inflammation, more abundant in the blood vessels, and cause the acceleration of systemic inflammatory condition [13].

The complications of obesity also include thrombosis of the vascular tissues. It also causes stimulation of platelets accumulation and adherence which leads to blood coagulation, and decreasing anticoagulants amount in the systemic circulation, which cause increasing amount of thrombin, and stimulate platelet aggregation [14].

Obesity also leads to impairment of fibrinolysis which is an important process that results in breakdown of the fibrin clot by the action of tissue plasmin [15]. Fibrinolysis is regulated by the action of tissue plasminogen activator inhibitor that is secreted by the endothelium of the blood vessels, liver, and adipocytes [16]. It acts as a strong inhibitor of tissue plasminogen

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activators that convert plasminogen to plasmin. Patients with central obesity have high levels of PAI1 [17, 18].

Objectives

This study aims to identify the effect of obesity on CBC parameters in a sample of obese subjects.

SUBJECTS AND METHODS

This is a cross-sectional study that included (200) obese patients of either gender with a mean age of (33.71±2) years old patients presented with obesity, 148 were females (74.4%) and 52 were males (25.6%), all of them underwent anthropometric measurement to obtain Physical examination, Height, Weight, BMI, and CBC. This study was attained at single obesity center that is located at Baghdad city; during the period from October 2024 till February 2025.

The weight was measured to all subjects in light clothes and was measured per Kilograms (Kg) by using a special weight scale, subjects were asked to stand in upright vertical position. The height was written down in centimeters (cm).

Body Mass Index (BMI) is the weight of a person in kilograms divided by the square height of that person in meters.

BMI was measured in accordance with the formula:

BMI = weight (Kg)/Height (M^2).

Classification of BMI according to WHO 2016 in adults as following [19]:

1. Underweight < 18.50 Kg/m^2
2. Normal weight 18.50-24.99 Kg/m^2
3. Overweight 25.00-29.99 Kg/m^2
4. Class I Obesity BMI 30.00-34.99 Kg/m^2”
5. Class II Obesity BMI 35.00-39.99 Kg/m^2
6. Class III Obesity BMI ≥40.00 Kg/m^2

Exclusion Criteria

1. Arrhythmias patient
2. Ischemic heart disease patients
3. Diabetes mellitus
4. Hypertensive patient
5. Patient with thyroid gland disorder
6. Pulmonary embolism
7. Chronic obstructive pulmonary disease

Ethical Issues

Official approvals were obtained from the related facilities, and the researchers institution. After a comprehensive explanation of the objectives for the participated patients who were assured that the data was taken would remain confidential and would not be used for any purpose rather than the research work.

Statistical Analysis

Analysis of data done by using SPSS 25 (Statistical Packages for Social Sciences version 25). It includes measurement of data frequency, percentage, mean, and standard deviation. One-way ANOVA test was used to compare numerical data. Chi-square test was used for the categorical data. The level of P value, which is less than 0.05, was considered statistically significant.

RESULTS

A cross-sectional study included 200 obese patients having complete blood count test. Of the study cases, 148 were females (74.4%) and 52 were males (25.6%).

The age distribution of patients sample is shown in Table **1**.

The mean age value was (33.712) years.

The minimum age value recorded was 15 years and the maximum value was 60 years.

Age was not significantly associated with the CBC findings, (p-value >0.05); but the female patients had significantly higher CBC parameters than males (p-values <0.05).

Table 1: Distribution of the Sample According to Age Groups

Age Range (Years)	No.	Percent (%)
15-30	86	43.2
31-45	82	41.2
46-60	32	15.6

Patients were classified according to their BMI into the following groups:

Table 2: Hematological Parameters in Different Study Groups

Study Groups	WBC ($\times10^{3}/mm^{3}$)	RBC ($\times10^{6}/mm^{3}$)	Platelet ($\times10^{3}/mm^{3}$)
Group 1	6.78±1.02	5.00±0.2	277.6±60.1
Group 2	7.70±1.34	5.1±0.4	288.9±66.01
Group 3	7.99±1.60*	5.12±0.34**	310.9±78.3***

*WBC was significantly higher in group 3 patients than other two groups, (p-value <0.05).
** RBC was significantly higher in group 3 patients than other two groups, (p-value <0.05).
***Platelet was significantly higher in group 3 patients than the other two groups, (p-value <0.05).

Group 1: BMI between 30.0-34.9 kg/m^2 (45 cases, 22.6%).

Group 2: BMI between 35.0-40.0 kg/m^2 (66 cases, 33.2%).

Group 3: BMI over 40.0 kg/m^2 (89 cases, 44.2%).

The mean value for BMI was 40.39 kg/m^2

The minimum BMI value recorded was 30.20 kg/m^2 and maximum value was 57.10 kg/m^2.

Hematological findings of the study groups are shown in Table **2**.

Hematological findings of the study groups in terms of hemoglobin and hematocrit levels as shown in Table **3**.

Table 3: Comparison among Study Groups with Concern to Hemoglobin and Hematocrit Levels

Study Groups	Hemoglobin (g/dl)	Hematocrit (%)
Group 1	13.11±56	42.44±3.33
Group 2	13.68±66	42.65±3.48
Group 3	14.23±47*	43.58±3.99**

* Hemoglobin& ** Hematocrit levels were significantly higher in group 3 patients than other two groups, (p-value <0.05).

DISCUSSION

In this study, obese female patients were more than males (74.4% versus 25.6%). Patients mean age in the study was (33.71±2) years.

The predominance of obesity in females may be attributed to childbirth because of hormonal and metabolic changes [20, 21], vulnerability to certain disease about half of the cancers in females and a quarter in males increase in obese patients [22], and household roles. CBC parameters were significantly higher in obese female participants.

As seen in the result there is a positive association between BMI and CBC count in obese patients. The increase is significant (P value is <0.05).

The result agrees with the study of Lee Y.-J. *et al*., 2005 [23] which shows increase in WBC. This is caused by the high number of immunoglobins caused a chronic inflammatory process caused by increase production of inflammatory cytokines by adipose and fatty tissues [24].

Obesity is the accumulation of high fat in the body that causes major health problems. Adipose tissue participates in the regulation of physiological body processes, that include inflammatory processes and immune reactions [25].

Fatty and adipose tissues produce a wide range of inflammatory cells, including the adipokines leptin, adiponectin, resistin, cytokines and chemokines [26].

In addition, there is an increase in size and numbers of adipocytes that cause reduction in the blood supply in obese patients which further cause hypoxia [27]. Hypoxia leads to necrosis and infiltration of macrophages adipose tissues, which cause an increase in inflammatory mediators production. Inflammatory mediators include TNF α, IL 6, and adiponectin. IL 6 stimulates liver cells to produce and secrete CRP that also leads to inflammation [28, 29].

CONCLUSIONS

According to the present study, there is a positive correlation between CBC and BMI (The increase is significant; p-value is <0.05).

CONFLICT OF INTEREST

No conflict of interest was declared.

LIMITATIONS

1. Low number of cases.
2. Uncooperative patients.

AUTHORS' CONTRIBUTION

Rayan Zaidan Khalaf: study concepts, design.

Ghaidaa Rifaat Hamid: data collection, analysis, writing manuscript, draft submission.

All authors read and approved the final version of the manuscript.

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REFERENCES

[1] Hassan QA, Abdulqader SK, Bakr GM, an, A'wad SN, Abdullah RH, *et al*. Linking NAFLD and Nephrolithiasis: A CT-Based Investigation. Journal of Contemporary Medical Sciences 2024; 10(4). https://doi.org/10.22317/jcms.v10i4.1603

[2] Okati-Aliabad H, Ansari-Moghaddam A, Kargar S, Jabbari N. Prevalence of Obesity and Overweight among Adults in the Middle East Countries from 2000 to 2020: A Systematic Review and Meta-Analysis. J Obes 2022; 2022: 8074837. https://doi.org/10.1155/2022/8074837

[3] Poirier P, Giles TD, Bray GA, Hong Y, Stern JS, Pi-Sunyer FX, *et al*. Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss: an update of the 1997 American Heart Association Scientific Statement on Obesity and Heart Disease from the Obesity Committee of the Council on Nutrition, Physical Activity, and Metabolism. Circulation 2006; 113(6): 898-918. https://doi.org/10.1161/CIRCULATIONAHA.106.171016

[4] AL-Jawad FH, Hashim H, Al-Attar Z, Al-Ani AH. Changing the lipid profile and renal functions by Allium sativum, Nigella sativa and Hibiscus sabdariffa in essential hypertensive patients. World J Pharm Phamaceutical Sci 2018; 4: 125-34.

[5] Zeller M, Steg PG, Ravisy J, Lorgis L, Laurent Y, Sicard P, *et al*. Relation between body mass index, waist circumference, and death after acute myocardial infarction. Circulation 2008; 118(5): 482-90. https://doi.org/10.1161/CIRCULATIONAHA.107.753483

[6] McGill Jr HC, McMahan CA, Herderick EE, Zieske AW, Malcom GT, Tracy RE, *et al*. Obesity accelerates the progression of coronary atherosclerosis in young men. Circulation 2002; 105(23): 2712-8. https://doi.org/10.1161/01.CIR.0000018121.67607.CE

[7] Manson JE, Colditz GA, Stampfer MJ, Willett WC, Rosner B, Monson RR, *et al*. A prospective study of obesity and risk of coronary heart disease in women. New England Journal of Medicine 1990; 322(13): 882-9. https://doi.org/10.1056/NEJM199003293221303

[8] Wilson PWF, D'Agostino RB, Sullivan L, Parise H, Kannel WB. Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. Archives of Internal Medicine 2002; 162(16): 1867-72. https://doi.org/10.1001/archinte.162.16.1867

[9] Tchernof A, Després J-P. Pathophysiology of human visceral obesity: an update. Physiological Reviews 2013. https://doi.org/10.1152/physrev.00033.2011

[10] Vandanmagsar B, Youm Y-H, Ravussin A, Galgani JE, Stadler K, Mynatt RL, *et al*. The NLRP3 inflammasome instigates obesity-induced inflammation and insulin resistance. Nature Medicine 2011; 17(2): 179-88. https://doi.org/10.1038/nm.2279

[11] Zaid Al-Attar SJ, Imad Hashim. Prevalence of Anemia Types Among Overweight and Obese Patients Attending The Obesity Research and Therapy Unit at AL-Kindy College of Medicine. International Medical Journal 2020; 25(1): 435-48.

[12] Balistreri CR, Caruso C, Candore G. The role of adipose tissue and adipokines in obesity-related inflammatory diseases. Mediators of Inflammation 2010; 2010(1): 802078. https://doi.org/10.1155/2010/802078

[13] Van Gaal LF, Mertens IL, De Block CE. Mechanisms linking obesity with cardiovascular disease. Nature 2006; 444(7121): 875-80. https://doi.org/10.1038/nature05487

[14] Levi M, van der Poll T, Schultz M, editors. Infection and inflammation as risk factors for thrombosis and atherosclerosis: Thieme Medical Publishers 2012. https://doi.org/10.1055/s-0032-1305782

[15] Levi M, van der Poll T, ten Cate H, editors. Tissue factor in infection and severe inflammation2006: Copyright© 2006 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New….

[16] Shimomura I. Enhanced expression of PAI-l in visceral fat: possible contributor to vascular disease in obesity. Nature Medicine 1996; 2: 1-5. https://doi.org/10.1038/nm0796-800

[17] Tichelaar YIGV, Kluin-Nelemans HJC, Meijer K. Infections and inflammatory diseases as risk factors for venous thrombosis. Thromb Haemost 2012; 107(05): 827-37. https://doi.org/10.1160/TH11-09-0611

[18] Rydberg E, Arlbrandt M, Gudmundsson P, Erhardt L, Willenheimer R. Left atrioventricular plane displacement predicts cardiac mortality in patients with chronic atrial fibrillation. International Journal of Cardiology 2003; 91(1): 1-7. https://doi.org/10.1016/S0167-5273(02)00578-8

[19] Hung S-P, Chen C-Y, Guo F-R, Chang C-I, Jan C-F. Combine body mass index and body fat percentage measures to improve the accuracy of obesity screening in young adults. Obesity Research & Clinical Practice 2017; 11(1): 11-8. https://doi.org/10.1016/j.orcp.2016.02.005

[20] Spyrou N, Avgerinos KI, Mantzoros CS, Dalamaga M. Classic and novel adipocytokines at the intersection of obesity and cancer: diagnostic and therapeutic strategies. Current Obesity Reports 2018; 7: 260-75. https://doi.org/10.1007/s13679-018-0318-7

[21] Al-Sattam Z, Hassan S, Majeed B, Al-Attar Z. Knowledge about anemia in pregnancy among females attending primary health care centers in Baghdad. Open Access Macedonian Journal of Medical Sciences 2022; 10(B): 785-92. https://doi.org/10.3889/oamjms.2022.8506

[22] Argyrakopoulou G, Dalamaga M, Spyrou N, Kokkinos A. Gender differences in obesity-related cancers. Current Obesity Reports 2021; 10: 100-15. https://doi.org/10.1007/s13679-021-00426-0

[23] Lee YJ, Shin YH, Kim JK, Shim JY, Kang DR, Lee HR. Metabolic syndrome and its association with white blood cell count in children and adolescents in Korea: the 2005 Korean National Health and Nutrition Examination Survey. Nutrition, Metabolism and Cardiovascular Diseases 2010; 20(3): 165-72. https://doi.org/10.1016/j.numecd.2009.03.017

[24] Hadaegh F, Azizi F. Effect of Weight Change on Incident of metabolic syndrome and its components according to Iranian Waist circumference and NHLBI: TLGS. Iranian Journal of Endocrinology and Metabolism 2010; 12(2): 116-30.

[25] Karastergiou K, Mohamed-Ali V. The autocrine and paracrine roles of adipokines. Molecular and Cellular Endocrinology 2010; 318(1-2): 69-78. https://doi.org/10.1016/j.mce.2009.11.011

[26] Lafontan M. Fat cells: afferent and efferent messages define new approaches to treat obesity. Annu Rev Pharmacol Toxicol 2005; 45(1): 119-46. https://doi.org/10.1146/annurev.pharmtox.45.120403.095843

[27] Cinti S, Mitchell G, Barbatelli G, Murano I, Ceresi E, Faloia E, *et al*. Adipocyte death defines macrophage localization and function in adipose tissue of obese mice and humans. Journal of Lipid Research 2005; 46(11): 2347-55. https://doi.org/10.1194/jlr.M500294-JLR200

[28] Zhang S, Liu Q, Wang J, Harnish DC. Suppression of interleukin-6-induced C-reactive protein expression by FXR agonists. Biochemical and Biophysical Research Communications 2009; 379(2): 476-9. https://doi.org/10.1016/j.bbrc.2008.12.117

[29] Al-Jawad FH, Al-Attar Z, Abbood MS. The Protective Effect of Nitroglycerin, N-Acetyl Cysteine and Metoprolol in CCL4 Induced Animal Model of Acute Liver Injury. Open Access Maced J Med Sci 2019; 7(11): 1739-43. https://doi.org/10.3889/oamjms.2019.469

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