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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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HEPCIDIN AND FERRITIN MODULATED IN OBESE MALE

Mohammed N. Mahmmod[1], Entedhar R. Sarhat[2]*.

[1]*University of Northern Technology, Kirkuk, Iraq.*

[2]*College of Medicine University of Tikrit, Tikrit, Iraq.*

Abstract.

Obesity has reached truly epidemic proportions worldwide and has become one of the most prevalent health problems that our world currently faces. The goal of the study is to identify the relationship between body mass index (BMI), insulin, hepcidin, and ferritin in obese males. Ninety males were recruited into the study; forty participants were assigned to the obese group were have BMI>30 kg/m^2, twenty to overweight group were have BMI between 25-30 kg/m^2, and another thirty to the control group were have slow BMI<25 kg/m^2. The serum hepcidin, serum fasting insulin, serum ferritin and fasting glucose were evaluated in each of the studied groups. The Obese group showed a significant increase of the serum hepcidin concentration compared with the control group (4.65 ± 1.92 vs. 3.43 ±1.52, p = 0.015). No prominent differences were detected in the three groups in ferritin and glucose concentration. Investigation of iron regulated cytokine hepcidin can be participated in future as iron deficiency marker in obese subject in conjugation with serum iron and serum ferritin.

Key words. Obesity, hepcidin, insulin resistance, iron deficiency.

Introduction.

Body mass index (BMI) is used to classify the overweight and obese groups. Body mass index (BMI) of 30 kg/m^2 or higher is considered obese, whereas a BMI of 25 kg/m^2 or higher is considered overweight [1]. Nearly 30% of the population is now categorized as overweight or obese due to the pandemic levels of adiposity that have been observed throughout the world [2].

Global health issues including obesity and iron insufficiency affect billions of people worldwide. Iron deficiency, or hypoferremia, is the most prevalent micronutrient deficiency globally, despite the fact that fat and obesity are the main risk factors for many chronic disorders, including cardiovascular diseases, diabetes, and several malignancies. Untreated iron deficiency can lead to iron deficiency anaemia, a serious health issue that manifests as exhaustion, decreased life productivity, growing evidence indicates the reality of a link between obesity and iron deficiency. This is especially true in children. Children, teenagers, and adults were all affected by this connection [3]. According to Ibrahim et al (2023), 13.5, 13.6, 23.5, and 21.7 of male adolescents with light, normal, overweight, and obesity, respectively, had iron deficiency (serum iron 60 g/ dl) [4]. According to Kerkadi et al. (2021) [5], adult men with normal weight, overweight, grade 1 obesity, and grade 2 obesity, respectively, had mean blood iron levels of 72.6, 64.2, 59.1, and 54.7 g/dl [5]. Hepcidin status and low-grade chronic inflammation are thought to be key factors in the connection between obesity and hypoferremia [6]. Although it is acknowledged that obesity poses a concern to iron deficiency, The relationship's mechanics remain unclear [4]. Wenzel et al. [7] were the first to identify a link between obesity and iron deficiency. In 1962. Seltzer and Mayer's research findings concurred with those of Wenzel [8]. Similar to tumor necrosis factor (TNF-), interleukin-6 (IL- 6), and C- reactive protein (CRP), obesity is a chronic low-grade inflammatory condition that induces the release of inflammatory cytokines [9]. Hepcidin expression is directly increased by these cytokines [10]. Hepcidin is a 25-amino-acid peptide that is mostly generated by the liver and eliminated in the urine. It is the primary regulator of systemic iron homeostasis, which limits intestinal iron absorption and macrophage iron release [11]. Ferroportin, an iron transporter, is also regulated by hepcidin in target cells [12]. According to a previous study, individuals with chronic illnesses had increased hepcidin attention, which resulted in decreased iron absorption and increased iron insulation in the reticuloendothelial system, both of which contributed to anemia [13]. Studies from Western nations found elevated blood hepcidin levels in children with obesity, and some of them linked these levels to iron autobiographies [14].

Therefore, the aim of this study was to assess and compare insulin effects among obese, overweight, and normal weight males on Hepcidin level and ferritin level. We hypothesized that obesity would promote elevation in hepcidin level compared to overweight and control. Furthermore, this study is expected to add to the scientific literature that suggests the use of hepcidin as biological marker in diagnosis of iron deficiency in obese males.

Patients and Methods.

Subjects: A cross-sectional study was conducted from the beginning of November 2022 until the end of May 2023 among 60 overweight and obese healthy male (mean age 39 ± 16.1 years) For the comparison, a total of 30 apparently healthy control subjects (mean age 38.1±15.4 years) without a personal history of any metabolic abnormalities were recruited to the study. The controls were taken from the same geographic areas as the patients. All individuals were randomly recruited from Kirkuk Governorates. Specifically, we recruited Participant into three categories according to BMI obese BMI> 30 kg/m^2 (n=40), overweight BMI 25-30 kg/m^2 (n=20) and control BMI<25 kg/m^2 (n=30).

In this study, all participants were performed anthropometric and biophysical tests. The anthropometric and biophysical tests were carried out at the in laboratory and outside the laboratory building, respectively. Height and weight were measured for participants by trained nurses. Weight and height were measured in kilogram (kg) and centimeter (cm) respectively. Body weight was measured by a balance scale to the nearest half-kilogram with the individuals in light clothing and without shoes. The body mass index (BMI) was taken from the ratio of the body mass (kilograms) formula divided by body height (meters) squared. Waist circumference was measured in centimeters (cm) at the end of normal expiration halfway between the lowest rib and the iliac crest with the investigator standing at the side to ensure that the measuring tape is horizontal across the back and

the front of the participant. After anthropometric measurements, after that for all participants' 5-mL samples of venous blood were collected from the forearm vein.

The blood samples were centrifuged at 4000 g for 10 min. Serum plasma was analyzed using ELISA analyzer, Genotik USA with sandwich Elisa method for the determination of hepcidin and insulin. For analyses, And Gisse diagnostic kits for turbidimetric determination of serum ferritin level.

Compliance with ethical standards: Before the initiation of the study, all participants received an explanation of the procedure and the risks that would later be faced in their participation, and they provided informed consent to participate in this study. The study was approved by the ethics committee of the Director of health Kirkuk, and all procedures were in accordance with the Declaration of Helsinki.

Statistical Analysis: Computerized statistical analysis was performed using SPSS statistic program v29 and Prism Graphpad v9. Comparison was carried out using one way ANOVA T-Test probability (P value). The P value < 0.05 was considered statistically significant and P value > 0.05 considered non-significant statistically. Correlation coefficient used to find the correlation between studied markers by using Pearson correlation.

Results.

The anthropometric and biophysical characteristics of participant from all of the groups are shown in Table 1. Significant differences were found among three groups regarding anthropometric and biophysical variables.

Chemical tests: As shown in table 2, Figure 1, and Figure 2. ANOVA showed significant increased level of hepcidin in obese group when compared to control group (4.65 ng/ml±1.92 vs. 3.43 ng/ml ±1.52 p<0.05), indicating hepcidin level increase in obesity. However, ANOVA revealed no significant for ferritin level and glucose level in obese group (p = 0.133, p=0.94, respectively) and (p=0.57, p=0.93) in overweight group. Significant differences were detected in insulin level in obese and overweight group when compared to control group (16.77±7.68, 14.98±4.78 vs. 11.7 ±2.79 and p= 0.003, p= <0.001, respectively).

Pearson correlation: As shown in table 3 and figure 2, correlation coefficient (r) reveals. No significant association between insulin and hepcidin in obese groups (r =0.2, p = 0.238). However, a significant negative correlation between insulin and ferritin found in obese group (r= -0.61, p <0.001). Specifically, ferritin level decrease in increase of insulin level (Figure 3).

Discussion.

Male obesity has become a global health issue, Research on the pathophysiological mechanisms behind obesity and their impact on iron metabolism disorders and the emergence of iron deficiency anemia was sparked by the discovery of the endocrine activity of adipose tissue and adipokines [15]. The main findings of this study are: (1) There were no prominent differences were detected in all three groups to ferritin level (2) compared to control group, obesity significantly increased insulin concentration; (3) there were significant increase level of hepcidin in obese males when compared to normal weight

Table 1. *Biophysical and anthropometric variables among all groups.*

Variable	Control n=30 Mean ±SD	Overweight n=20 Mean ±SD	P-value	Obese n=40 Mean ±SD	P-value
Age (years)	38.1±15.4	37.5± 14.55	0.8909	39 ± 16.1	0.8143
Weight (Kg)	66.53±24.50	72.28±6.66	0.3121	80.90±11.49	0.0017*
Height (cm)	165.9± 8.53	168±7.84	0.3831	163.18±9.19	0.4857
Body Mass Index (kg/m2)	23.37±1.53	27.22±0.61	< 0.001*	32.29±4.1	< 0.001*
Waist Circumference (cm)	83.99±7.77	90.32±7.24	0.0056*	99.12±10.45	< 0.001*
SD is the standard deviation. *One-way ANOVA. Statistically significant differences between Obese, overweight and control ($p < 0.05$).					

Table 2. *Biochemical variables among all groups.*

Variable	Control (n=30)	Overweight (n=20)	P-value	Obese (n=40)	P-value
Fasting glucose (m\dl)	102.1±8.15	101.9±9.22	0.9360	102.3±13.4	0.9426
Fasting insulin (µu\ml)	11.7 ±2.79	14.98± 4.78	0.0036*	16.77±7.68	<0.001*
Serum ferritin (ng\ml)	88.6±29.8	93.35±28.2	0.5754	77.9±28.3	0.1331
Serum hepcidin (ng\ml)	3.43±1.52	3.66 ± 1.79	0.8944	4.65±1.92	0.0156*
SD is the standard deviation. *One-way ANOVA. Statistically significant differences between Obese, overweight and control (p < 0.05).					

Table 3. *Pearson Correlation Results between Insulin and Hepcidin, Ferritin, Transferrin, and Iron in obese group.*

Combination	R	95.00% CI	n	P
Insulin – hepcidin	0.2	[-.11_ .4]	40	0.2
Insulin- Ferritin	-0.61	[-.78_ -.38]	40	<0.001*
Insulin – Transferrin	0.51	[.24-.71]	40	.0.0006*
Insulin - iron	-0.36	[-.6_ -.05]	40	0.02
R=correlation coefficient, CI= confidence intervals, n= number. * Significant at p<0.05				

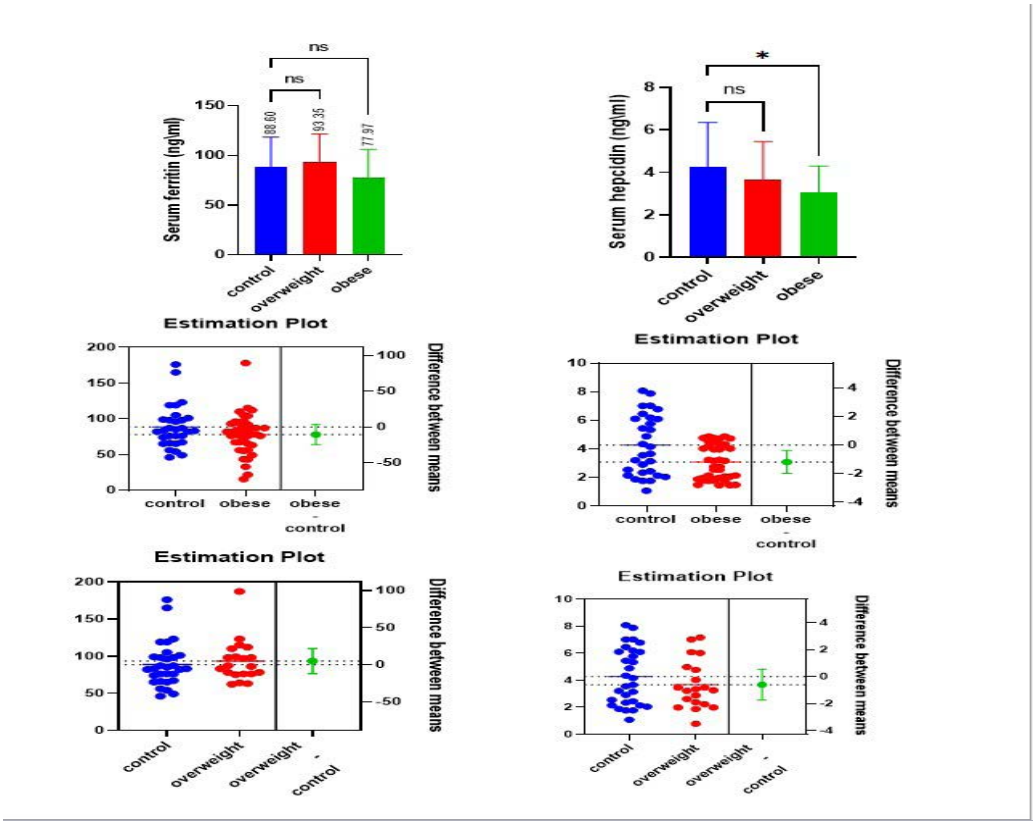

Figure 1. *Bar plot of mean values with 95% CI error bars accompanied by Estimation plot with 95% Confidence intervals of mean differences between the groups for ferritin (left) and hepcidin (Right). * Significant at (p<0.05) , NS (non-significant).*

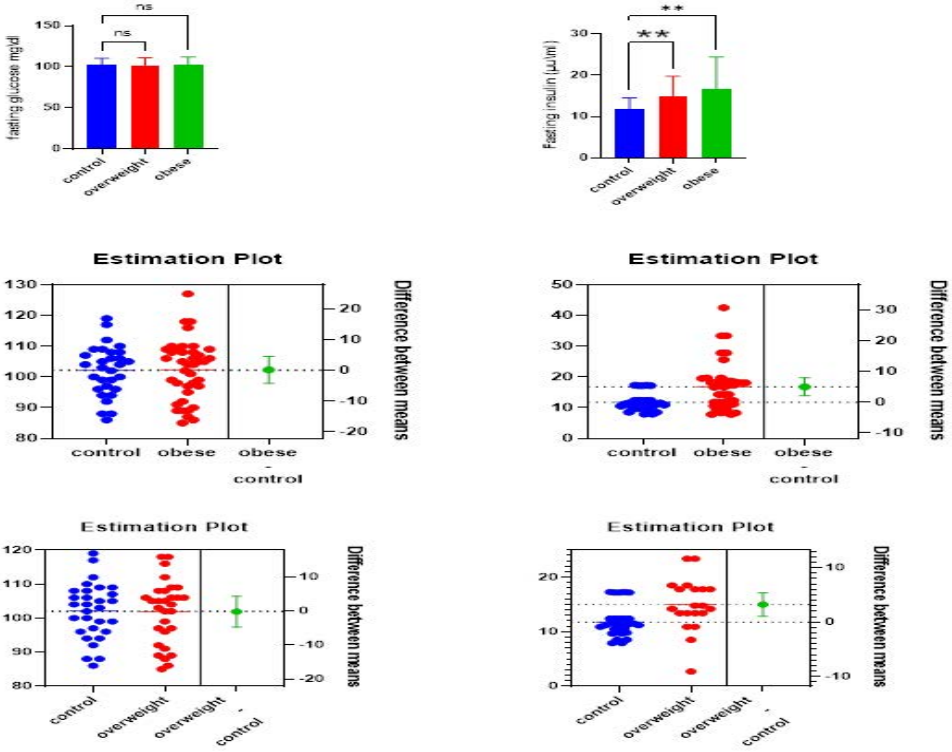

Figure 2. *Bar plot of mean values with 95% CI error bars accompanied by Estimation plot with 95% Confidence intervals of mean differences between the groups for Glucose (left) and Insulin (Right). ** Highly Significant at (p<0.001), NS (non-significant).*

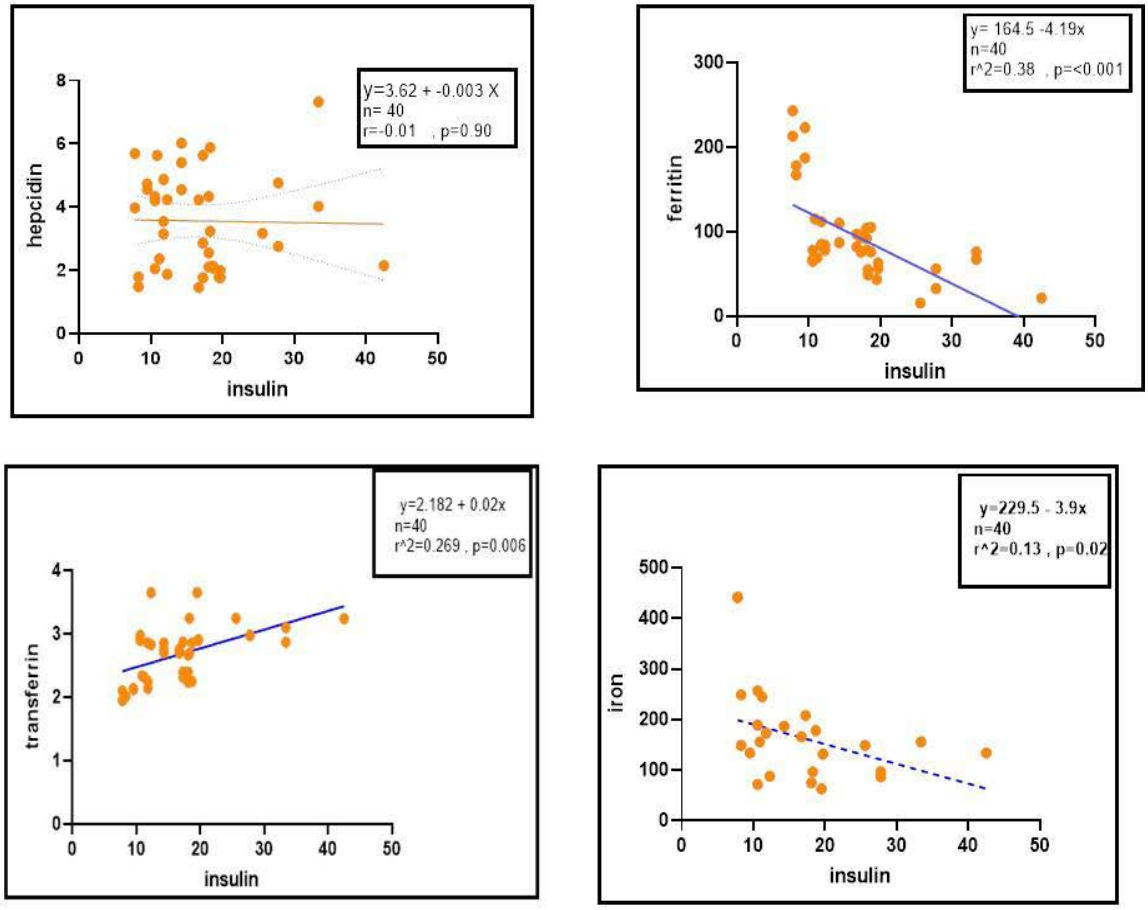

Figure 3. *Scatter plot depicting the correlation between Insulin and each of Hepcidin, Ferritin, transferrin, and Iron. Regression line was added to ease the interpretation (obese group).*

males. (4) Strong negative association found between ferritin and insulin in obese.

Hepcidin levels were higher in obese people than in those of normal weight, according to other investigations [16-18]. The results of this study suggest that there is growing evidence for the association between obesity and iron insufficiency. This connection is believed to be caused by elevated hepcidin levels that are mediated by chronic inflammation. When researchers began to evaluate inflammatory markers and serum hepcidin in addition to various iron status markers, a deeper knowledge of the connection between obesity and iron deficiency was gained [19].

We realize that there are still some limitations in this study. Firstly, we did not pay attention to the other obesity linked hormones like (leptin and adeponectin), which may have been the factors that could differentiate the results [20,21]. Secondly, the lack of several inflammatory marker, such as c-reactive protein (CRP), interleukin-6 (IL-6). These markers are needed to explain the unanswered phenomena in this study [22,23], moreover, children should be studied carefully in the same manner [24], the effect of the type of diet [25] need to be followed to exclude the effects of lifestyle changes on the level of hepcidin. In addition to these aforementioned variation in the response could be also associated with the variation in the status of localized milieu of oxygen supply, immunomodulatory cytokine, cellular structure, and behaviours [26-28].

Conclusion.

We demonstrated that obese males are more efficient in developing iron deficiency compared with normal weight males. There were no prominent differences detected in all three groups to ferritin and glucose level. Obesity has a crucial effect on insulin concentration. Ferritin cannot be used as golden marker for iron deficiency in obesity.

Conflict of interest.

The authors state no conflict of interest with respect to the research, authorship, and/or publication of this article.

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