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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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ASSOCIATION PROPERTIES OF COMPLETE BLOOD COUNT FOR LEVELS OF THYROID STIMULATING HORMONE

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Abstract.

Background: Thyroid disorders, hypothyroidism or hyperthyroidism, are frequently encountered in medical practice. Estimating the significance of MPV as an indicator of thrombotic propensity in hypothyroidism would be helpful and looking for association of complete blood count with thyroid-stimulating hormone is quite useful in discovering and monitoring thyroid disorders. **Objectives:** To find any correlations between complete blood count parameters and thyroid-stimulating hormone levels and exploring complete blood count (CBC) as a marker of cardiovascular risk and inflammation. Looking for cutoff values in CBC indices to help indicate thyroid-stimulating hormone levels in suspected patients. **Methods:** In a retrospective study, 92 patients were randomly chosen from patients suspected of hypothyroidism, and complete blood count and thyroid stimulating hormone tests were performed, followed by statistical analysis. **Results:** Positive significant correlation existed between mean platelet volume (MPV) and thyroid stimulating hormone (TSH). Significant difference in Mean TSH in patients with MPV equal to 10 fL and more and patients with MPV more less than 10 fL. Significant difference in Mean TSH in patients with platelets distribution width (PDW) equal to 12 and less and patients with PDW more than 12. Positive significant correlation between MPV and PDW was found. A significant difference in means of MPV between subjects of less than 0.4 mU/L TSH and subjects of TSH more than 4 mU/L, and between subjects of TSH between 0.4- 4.0 mU/L and subjects of TSH level more than 4.0 mU/L. **Conclusions:** MPV and PDW have a correlation with TSH levels represented by a cutoff values of 12 and 10 fL for PDW and MPV respectively are associated hypothyroidism state. Other CBC parameters have no significant association value for TSH level.

Key words. Thyroid diseases, complete blood count, thyroid stimulating hormone, mean platelet volume, platelets distribution width.

Introduction.

Thyroid disorders hypothyroidism or hyperthyroidism are frequently encountered in medical practice, these disorders have wide diversity ranging from sub-clinical to overt-clinical presentation, and using a relatively cheap, often-done investigation. Exploring the association properties of CBC (complete blood count) for TSH (thyroid stimulating hormone) is quite useful in discovering and monitoring thyroid disorders and even early discovery of subclinical thyroid disorders, especially in limited resources countries. CBC parameters have determinant value for serum ferritin [1], and monitoring value for some inflammatory conditions [2], like medullary thyroid carcinoma [3], these studies will encourage us to see the same for TSH. Thyroxine (T4), 3,5,3'-triiodo-L-thyronine (T3), are thyroid hormones (THs) controlled by the hypothalamus-pituitary - thyroid axis, the hypothalamus produces a thyrotropin-releasing hormone which stimulates TSH release from the pituitary gland, TSH stimulates the thyroid gland to produce thyroid hormones [4]. Changing in levels of thyroid gland hormones in the circulation that is to say, hypothyroidism or hyperthyroidism will affect the levels of pituitary TSH either up or down [5]. TSH affects the growth and differentiation of every cell in the body [6], including blood cells, RBC (red blood cells), WBC (white blood cells), and platelets.

Atherosclerosis is associated with hypothyroidism, atherosclerosis is a disease of arterial circulation involving mainly tunica intima causing progressive narrowing of the arterial lumen which will interfere with blood flow to the tissues and organs causing tissue damage in which the heart, brain, and kidneys are the most important targets due to its serious consequences on body health. Many factors in atherosclerosis pathogenesis include inflammation, triglyceride elevation, thrombosis, and oxidative stress [7-9].

Platelet activation is important in thrombosis and atherosclerosis; platelets promote foam cell recruitment and activation and endothelial cell proliferation, triggering atherosclerotic plaque formation, a healthy endothelium is the barrier that prevents platelets from adhering to the highly thrombogenic subendothelial connective tissue [10] any endothelial injury will lead to exposure of subendothelial connective tissue which contains collagen and VWF (von Willebrand factor) the will lead to adhesion of platelets and initiation of a thrombus [11]. knowing the association between TSH and CBC parameters, specifically platelet indices, will help a lot in anticipating thrombosis and atherosclerosis and, hence, initiating early management activity. Hypothyroidism and consequently elevated TSH is a risk factor for cardiac diseases, Patients with subclinical hypothyroidism have higher MPV (mean platelet volume) and PDW (platelets distribution width). Increased MPV means larger platelets [10]. PDW and MPV, which are part of CBC parameters, are promising inflammatory markers and are expected to be affected by thyroid disorders [12]. However, platelets indices changes not specific for thyroid disorder it is associated with other medical conditions like type II diabetes mellitus [13], obesity [14], rheumatoid arthritis [15], as well as thyroid disorder [16].

Platelet activation plays a crucial role in coronary heart diseases, which play a major role in morbidity and mortality [11]. The present study sought to find any associations between

CBC parameters and TSH level and exploring CBC as a marker of cardiovascular risk and inflammation via exploring cutoff values in CBC indices to help indicate TSH levels in suspected patients.

Materials and Methods.

In a retrospective study, 92 subjects were randomly selected from patients suspected of hypothyroidism, from general residents who underwent screening, comprising 44 males and 48 females. CBC (EDTA sample) and TSH (serum sample) tests were performed on freshly collected samples.

CBC parameters include Haemoglobin, packed cell volume, mean cell volume, red cell distribution width, and other red cell parameters. White cell count, total and differential counts (absolute counts), platelet count, mean platelet volume, platelet distribution width, and other platelet indices were also included.

Depending on the normal range of TSH, we got three groups below, within (control group), and above the normal range; these groups were analyzed statistically.

CBC reports were done using MS4 computerized system using EDTA samples processed immediately after intravenous sampling from patients.MPV normal range 6-13 fL, PDW normal range 6-10 according to MS4 computerized system.

Serum samples for TSH were obtained and processed using thmindray CL-1000i and results were recorded.

Correlation analysis was done between CBC parameters and TSH level. Another approach was done by dividing our studied persons into two groups using a cutoff value of 10 fL for MPV, and also we have another two groups using a cutoff value of 12 for PDW in both approaches we studied the TSH level, these cutoff values were established according to ROC analysis for MPV and PDW and according to the upper normal limit for both MPV and PDW, these cutoff values supported by similar study [12] .

Statistical analysis was performed using the SPSS program for Windows 16, IBM Co, Chicago, IL, USA. Pearson correlations between TSH levels with various CBC indices were conducted. t-test and Mann-Whitney test were performed for the mean±SD for parameters. Person correlation analyses and independent sample T-tests were done for MPV data at cutoff value of 10 fL. One-way ANOVA used to compare MPV between subjects of less than 0.4 mU/L TSH and those of TSH between 0.4-4.0 mU/L. ROC analysis was used to confirm the correlation indicating specificity and sensitivity for highly associated parameters (MPV and PDW). A P value of 0.05 or less was considered significant.

Results.

The correlation analysis between TSH concentration and different CBC indices in 92 participants demonstrated predominantly non-significant correlation across several hematological parameters tested. Regarding RBCs indices, TSH revealed weak negative correlations with Hb ($r = -0.006$, $p = 0.957$), hematocrit ($r = -0.033$, $p = 0.754$), MCV ($r = 0.013$, $p = 0.901$), MCH ($r = 0.048$, $p = 0.649$), MCHC ($r = -0.050$, $p = 0.639$), RDW ($r = 0.057$, $p = 0.588$), and RBC ($r = -0.041$, $p = 0.700$), with all p-values well above the significance threshold of 0.05. Correspondingly, WBC indices demonstrated no significant correlations, including total WBCs ($r = -0.017$, $p = 0.873$), neutrophil count ($r = 0.022$, $p = 0.833$), lymphocyte count ($r = 0.020$, $p = 0.852$), monocyte count ($r = -0.013$, $p = 0.899$), eosinophil count ($r = -0.058$, $p = 0.584$), and basophil count ($r = -0.020$, $p = 0.852$). Regarding platelet indices, platelet count revealed a weak negative correlation ($r = -0.100$, $p = 0.344$), PDW revealed a weak positive correlation ($r = 0.114$, $p = 0.278$), and plateletcrit revealed a weak negative correlation ($r = -0.059$, $p = 0.575$), all of which were statistically non-significant. However, MPV demonstrated a weak but significant positive correlation with TSH levels ($r = 0.242$, $p = 0.020$), suggesting that higher TSH levels are linked with slightly larger platelet volumes (Table 1).

The ROC analysis data using PWD to indicate high TSH (Figure 1) indicates that PDW demonstrated a slight a supportive, not definitive, role in screened participants with elevated TSH levels. The AUC = 0.630 PDW with high potential of accuracy indicated by cut-off: 12.8, Sensitivity: 60.0% and Specificity: 78.0% which is potentially acceptable.

The ROC analysis data using MPV to indicate high TSH (Figure 2) indicates that MPV demonstrated an adjuvant, with high sensitivity at moderate specificity, role in screened participants with elevated TSH levels. The AUC = 0.807 MPV with high potential of accuracy indicated by cut-off: 9.2, Sensitivity: 100% and Specificity: 57.3% which is potentially acceptable.

The group 1 (lower MPV) revealed higher HB levels (13.9±1.8 g/dL) compared to group 2 (12.3±2.5 g/dL), alongside higher hematocrit values (42.1±5.1% versus 38.1±7.1%). Moreover, group 1 showed lower eosinophil counts (0.07±0.1) compared to group 2 (0.18±0.3). Results also revealed group 1 having a mean MPV of 9.0±0.5 fL versus group 2 10.4±0.5 fL. Additionally, PDW was significantly lower in group 1 (11.7±2.3) compared to group 2 (13.7±2.2). Most notably, TSH levels demonstrated marked difference between groups i.e. group 1 having significantly lower TSH levels (2.65±2.8 mIU/L) compared to group 2 (16.5±32.7 mIU/L), reflecting the correlation observed in the previous analysis. Other parameters including RBCs indices, WBC counts, and platelet counts demonstrated slight but non-significant differences, suggesting that MPV cutoff at 10 fL primarily related to HB status, eosinophil levels, platelet morphological parameters, alongside TSH levels (Table 2).

The scatter plot demonstrates that as TSH concentrations increased, MPV values correspondingly increased, confirming that elevated TSH levels are correlated with larger platelet sizes (Figure 3).

Participants with lower MPV values (less than 10 fL) have shown significantly different mean TSH levels compared to those with higher MPV values (10 fL or more), confirming that platelet size serves as a distinictive factor for thyroid function status (Figure 4).

Participants with PDW values of 12 or less demonstrated significantly different mean TSH levels versus those with PDW values less than 12, confirming that platelet size differences is correlated with thyroid function status (Figure 5).

As MPV increases, confirming larger mean platelet size, PDW also increases, reflecting greater differences in platelet size distribution within the sample (Figure 6).

Table 1. *Correlations between TSH levels with various CBC indices.*

	HB	**HCT**	**MCV**	**MCH**	**MCHC**	**RDW**	**RBC**
Pearson Correlation	-0.006	-0.033	0.013	0.048	-0.050	0.057	-0.041
Sig. (2-tailed)	0.957	0.754	0.901	0.649	0.639	0.588	0.700
N	92	92	92	92	92	92	92
	WBC	NT	LYM	MON	EOS	Bas	
Pearson Correlation	-0.017	0.022	0.020	-0.013	-0.058	-0.020	
Sig. (2-tailed)	0.873	0.833	0.852	0.899	0.584	0.852	
N	92	92	92	92	92	92	
	THROMBO	MPV	PDW	PCT			
Pearson Correlation	-0.100	0.242*	0.114	-0.059			
Sig. (2-tailed)	0.344	**0.020**	0.278	0.575			
N	92	92	92	92			

Table 2. *Comparison of MPV data at cutoff value of 10 fL.*

Parameters	**MPV cutoff 10 and more**	**N**	**Mean±SD**
HB	1.00 *#	82	13.9±1.8
	2.00	10	12.3±2.5
HCT	1.00 *#	82	42.1±5.1
	2.00	10	38.1±7.1
MCV	1.00	82	83.2±5.4
	2.00	10	81.8±11.3
MCH	1.00	82	27.4±2.2
	2.00	10	26.4±4
MCHC	1.00	82	83.1±111.3
	2.00	10	145.8±146
RDW	1.00	82	9.4±4.3
	2.00	10	7±6
RBC	1.00	82	5.1±0.65
	2.00	10	4.7±0.9
WBC	1.00	82	8.6±10.3
	2.00	10	8.7±4.5
NT	1.00	82	4.4±1.7
	2.00	10	5.5±3.6
LYM	1.00	82	2.4±0.65
	2.00	10	2.5±0.85
MON	1.00	82	0.43±0.2
	2.00	10	0.5±0.4
EOS	1.00 *#	82	0.07±0.1
	2.00	10	0.18±0.3
Bas	1.00	82	0.04±0.1
	2.00	10	0.03±0.02
THROMBO	1.00	82	254.4±65.2
	2.00	10	225.7±55.9
MPV	1.00 *#	82	9±0.5
	2.00	10	10.4±0.5
PDW	1.00 *#	82	11.7±2.3
	2.00	10	13.7±2.2
PCT	1.00	82	0.6±0.8
	2.00	10	0.97±1
TSH	1.00 *#	82	2.65±2.8
	2.00	10	16.5±32.7

Data expressed as Mean±SD, data at cutoff value of MPV of 10 fL and more (group 2) compared to less than 10 fL (group 1) for each parameter, the parameters with * indicates t-test and # indicates Mann-Whitney test for at P values less than 0.05.

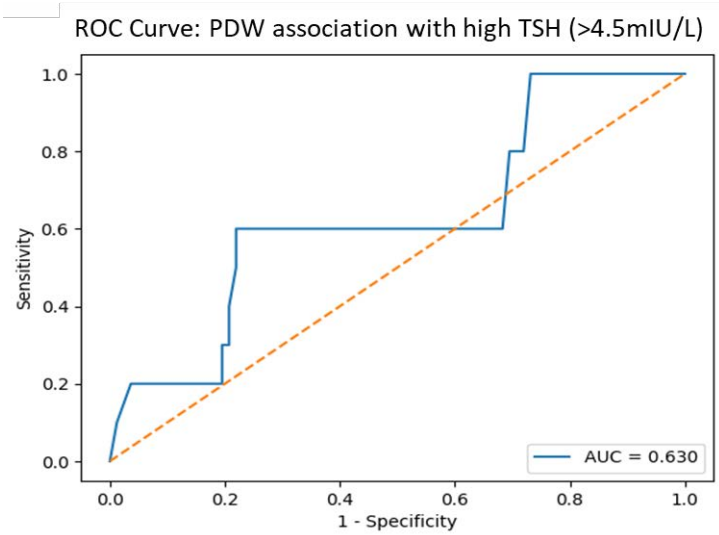

Figure 1. *ROC analysis using PDW to demonstrate the possibility of association with high TSH based on data from TSH-screened participants (n=92).*

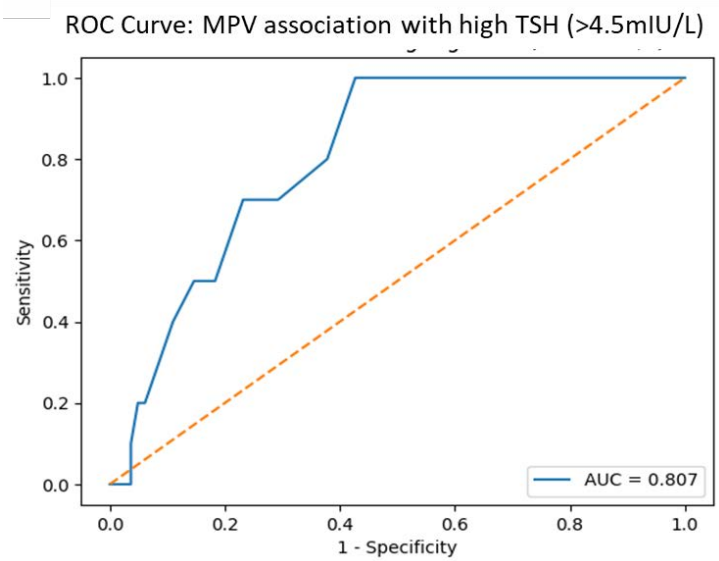

Figure 2. *ROC analysis using MPV to demonstrate the possibility of association with high TSH based on data from TSH-screened participants (n=92).*

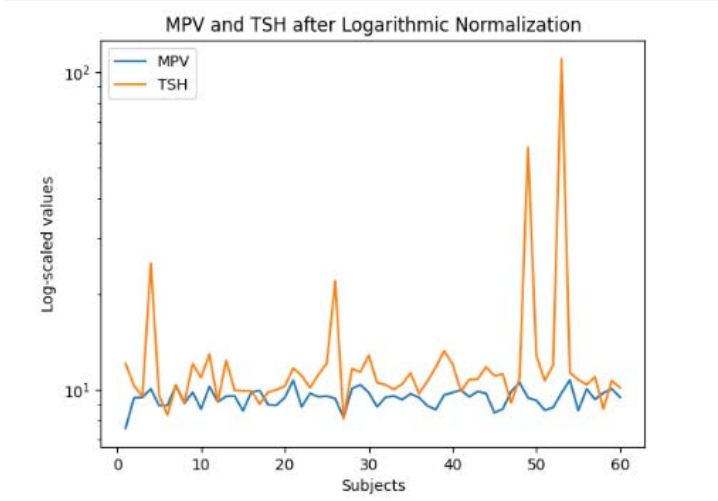

Figure 3. *Chalder Fatigue Scale results.*

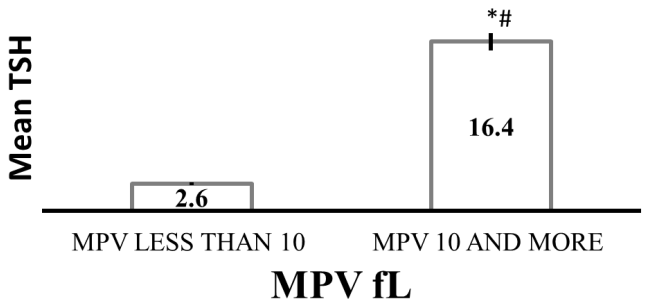

Figure 4. *The serum levels of TSH (mU/L) in patients with MPV less than 10 versus patients with MPV 10 and more. The histogram bar indicates the mean TSH levels and standard deviation. P value <0.05 considered significant using [*]t-test and [#]Mann-Whitney test.*

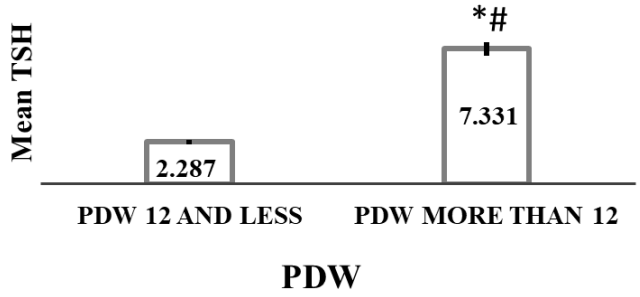

Figure 5. *The serum levels of TSH (mU/L) in patients with PDW 12 and less versus patients with PDW more than 12. The histogram bar indicates the mean TSH levels and standard deviation. P value <0.05 considered significant using [*]t-test and [#]Mann-Whitney test.*

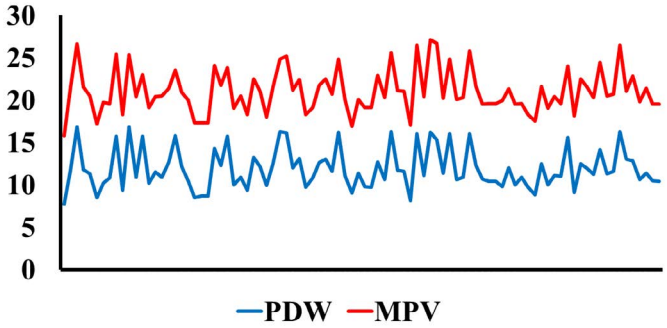

Figure 6. *Positive correlation between MPV and PDW (P value < 0.05).*

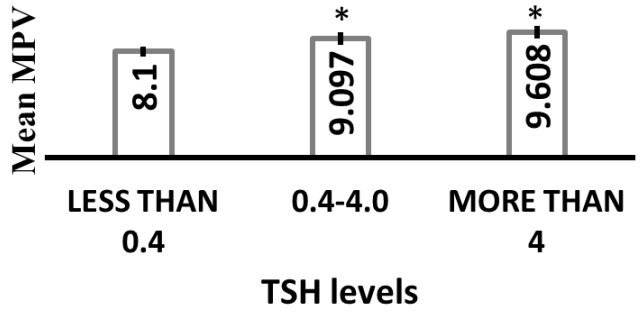

Figure 7. *Comparison of MPV between subjects of less than 0.4 mU/L TSH and those of TSH between 0.4-4.0 mU/L. * indicates significant difference MPV between subjects of less than 0.4 mU/L TSH and those of TSH levels more than 4.0 mU/L at p value less than 0.05 using P value <0.05 considered significant using * one-way ANOVA followed by post hoc Tukey test.*

Participants with TSH levels less than 0.4 mU/L demonstrated significantly different MPV values when compared to those with normal TSH levels, suggesting that hyperthyroid subjects could be distinguished by platelet morphology. Moreover, significant difference in MPV existed between participants with TSH levels less than 0.4 mU/L (hyperthyroid subjects) and those with elevated TSH levels greater than 4.0 mU/L (hypothyroid subjects), confirming that both hyperthyroidism and hypothyroidism correlated with different MPV trends (Figure 7).

Discussion.

The present research demonstrated a positive correlation between MPV and TSH levels, reflecting that as one of these parameters increases, the other proportionally rose as well. Patients with higher MPV demonstrated significantly different TSH levels versus those with lower MPV. Similarly, patients having narrower PDW patterns were having significantly different TSH level than those with wider PDW. Moreover, strong positive correlation existed between MPV and PDW.

There is a bilateral relationship between the neuroendocrine and immune systems affecting various inflammatory cells like lymphocytes, monocytes, natural killer cells, and other activities like chemotaxis and phagocytosis. TSH affects inflammation and eradication of pathogens [4]. Both hypothyroidism and hyperthyroidism affect the immune and inflammatory systems although many immune cells failed to correlate with thyroid hormone levels [17], this support our study results as there is no significant correlation of TSH with the followings, haemoglobin, RBC (red blood cells) count, total WBC count, neutrophils, lymphocytes, monocytes, eosinophils, basophils and platelets counts. Recent research points to the role of hemogram indices like MPV, PDW, and red cell distribution width in mild to higher inflammation [12].

Patients with MPV of 10 fL and more (more inflammation) have lower mean Haemoglobin level than subjects with MPV of less than10 fL, this quite expected and supported by other study, anaemia of chronic inflammation is a good example of the relation between inflammation and Hb level [18].The degree of anaemia correlates with the degree of hypothyroidism [19], in other words there is a positive correlation between the hypothyroidism state, inflammation and anaemia .Eosinophils count have higher mean in subjects with MPV of 10 fL and more than subjects with MPV of less than10 fL supporting our opinion of having more inflammation in the former group as eosinophils is an inflammatory parameter.

Platelets indices mainly MPV and PDW are inflammatory markers (which are cheap and available with computerized CBC reports) for many diseases like rheumatoid arthritis, coronary artery diseases, and ankylosing spondylitis [20]. Increased MPV and PDW reflect increased platelet activity, which may be associated with decreased platelet count [21]. MPV also gives a clue about platelet rate of production, platelet size, and activity, as larger platelets are more active [21]. Platelets have an important role in hemostasis [6]. Patients with subclinical hypothyroidism have higher levels of PDW and MPV, and they are at a higher risk for ischemic heart disease [23]. Ischemic heart disease is widespread worldwide, even in developed countries, and platelet activation plays a crucial role in pathogenesis [10]. The previous facts point to the risk of thrombosis and cerebral and cardiac atherosclerosis in thyroid disorders.

Our study noted a positive and statistically significant correlation between TSH and MPV, meaning that hypothyroidism is a risk factor for platelet activation and consequently increases the risk of thrombosis and atherosclerosis. This is supported by other studies [7,22,23].

Hypothyroidism is an inflammatory condition [24]. In a pro-inflammatory status, interleukin 6 is increased, which affects megakaryocytes, leading to increased nucleus ploidy and cytoplasm of megakaryocytes, leading to the production of larger platelets with higher MPV [25], these enlarged platelets is not exactly same size in our opinion in other wards that will lead to increase PDW.

The results also demonstrated that the higher the TSH level, the higher the MPV level, the less thyroid function. Additionally, higher the TSH level associated with the higher the PDW level, the less thyroid function. So we can assume that in clinically suspected patients for hypothyroidism with no other inflammatory conditions, both MPV values of 10 fL and more and PDW values of more than 12 both strongly suggest a hypothyroidism state, this supported by another study conducted by [12] in which MPV more than 9.4 fL has 80%, 72% sensitivity and specificity respectively for expecting hypothyroidism, RDW have an association value for hypothyroidism in this referred study, but we cannot confirm it by our study may be due the difference in sample size. We cannot find other studies to support our cutoff value for PDW in exploring hypothyroidism. Both MPV and PDW are inflammatory indicators, so a significant positive correlation between them is expected. The facts stated in supports that the higher the TSH level, the higher the MPV level, the higher TSH level and the less thyroid function, and the more the inflammatory burden affecting the human body.

Conclusion.

MPV and PDW have helpful and adjuvant values for TSH levels. Cutoff values of 12 and 10 fL for PDW and MPV, respectively, are associated with hypothyroid state in clinically suspected patients. No other CBC parameters or cell counts have association value for TSH levels.

REFERENCES

1. Ibrahim A, Mustafa B, Jameel F. Prediction of iron deficiency in children using easy laboratory tools. Georgian Medical News. 2023;343:53-6.

2. Ibrahim AM. Significance of Particular Platelets Indices: Review Article. International Journal of Pharmacy and Pharmaceutical Studies. 2023;7:1-5.

3. Li C, Zhang H, Li S, et al. Prognostic impact of inflammatory markers PLR, LMR, PDW, MPV in medullary thyroid carcinoma. Frontiers in Endocrinology. 2022;13:861869.

4. Jara EL, Muñoz-Durango N, Llanos C, et al. Modulating the function of the immune system by thyroid hormones and thyrotropin. Immunology letters. 2017;184:76-83.

5. Erge E, Kiziltunc C, Balci SB, et al. A novel inflammatory marker for the diagnosis of Hashimoto's thyroiditis: Platelet-count-to-lymphocyte-count ratio. Diseases. 2023;11:15.

6. Ijaz SH, Jamal SM, Qayyum R, et al. Relationship between thyroid hormone levels and mean platelet count and volume: quantitative assessment. Cureus. 2018;10.
7. Alomair BM, Al-Kuraishy HM, Al-Gareeb AI, et al. Increased thyroid stimulating hormone (TSH) as a possible risk factor for atherosclerosis in subclinical hypothyroidism. Thyroid Research. 2024;17:13.
8. Mancini A, Di Segni C, Raimondo S, et al. Thyroid hormones, oxidative stress, and inflammation. Mediators of inflammation. 2016;2016:6757154.
9. Kvetny J, Heldgaard PE, Bladbjerg EM, et al. Subclinical hypothyroidism is associated with a low-grade inflammation, increased triglyceride levels and predicts cardiovascular disease in males below 50 years. Clinical Endocrinology. 2004;61:232-8.
10. Erikci AA, Karagoz B, Ozturk A, et al. The effect of subclinical hypothyroidism on platelet parameters. Hematology. 2009;14:115-7.
11. Shah A, Rauf Y. Inflammation and atherosclerosis. JK Practitioner. 2007;14:71-74.
12. Bilgin S, Tel BM, Kahveci G, et al. Hypothyroidism is strongly correlated with mean platelet volume and red cell distribution width. National Journal of Health Sciences. 2021;6:7-10.
13. Cakir L, Aktas G, Enginyurt OZ, et al. Mean platelet volume increases in type 2 diabetes mellitus independent of HbA1c level. Acta Medica Mediterranea. 2014;30:425-8.
14. Aktas G, Kocak MZ, Duman TT, et al. Mean platelet volume (MPV) as an inflammatory marker in type 2 diabetes mellitus and obesity. Bali Medical Journal. 2018;7:650-653.
15. Atwa ET, Omar HM, Amin A, et al. Red cell distribution width and mean platelet volume in rheumatoid arthritis patients: Its association with disease activity. Reumatologia clinica. 2022;18:399-405.
16. Şit M, Kargı E, Aktaş G, et al. Mean platelet volume should be a useful indicator in diagnosis of Hashimoto's thyroiditis. Acta Medica Mediterranea. 2014;30:1263-1266.
17. De Vito P, Balducci V, Leone S, et al. Nongenomic effects of thyroid hormones on the immune system cells: new targets, old players. Steroids. 2012;77:988-95.
18. Hassan M, Abdayem C, El Daouk S, et al. Correlation of Hemoglobin Level with New Inflammatory Markers in the Emergency Department: A Retrospective Study Exploring Neutrophil-to-Lymphocyte, Monocyte-to-Lymphocyte, Platelet-to-Lymphocyte, and Mean Platelet Volume-to-Platelet Count Ratios. Cureus. 2024;16.
19. Eram F, Quamri MA, Zaidi A. A Comprehensive Review of Anaemia Associated with Hypothyroidism. New Emirates Medical Journal. 2024;5:e02506882282237.
20. Işık M, Şahin H, Hüseyin E. New platelet indices as inflammatory parameters for patients with rheumatoid arthritis. European journal of rheumatology. 2014;1:144.
21. Kutluturk F, Gul SS, Sahin S, et al. Comparison of mean platelet volume, platelet count, neutrophil/lymphocyte ratio and platelet/lymphocyte ratio in the euthyroid, overt hypothyroid and subclinical hyperthyroid phases of papillary thyroid carcinoma. Endocrine, Metabolic & Immune Disorders-Drug Targets (Formerly Current Drug Targets-Immune, Endocrine & Metabolic Disorders). 2019;19:859-65.
22. Lippi G, Danese E, Montagnana M, et al. Mean platelet volume is significantly associated with serum levels of thyroid-stimulating hormone in a cohort of older euthyroid subjects. Endocrine Research. 2015;40:227-30.
23. Ichiki T. Thyroid hormone and atherosclerosis. Vascular pharmacology. 2010;52:151-6.
24. Baldissarelli J, Manica A, Pillat MM, et al. Increased cytokines production and oxidative stress are related with purinergic signaling and cell survival in post-thyroidectomy hypothyroidism. Molecular and cellular endocrinology. 2020;499:110594.
25. Korniluk A, Koper-Lenkiewicz OM, Kamińska J, et al. Mean platelet volume (MPV): new perspectives for an old marker in the course and prognosis of inflammatory conditions. Mediators of inflammation. 2019;2019:9213074.