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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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TRIGLYCERIDE – GLUCOSE INDEX, REMNANT CHOLESTEROL AND COMMON CAROTID ARTERY INTIMA-MEDIA THICKNESS AS AN ATHEROSCLEROTIC MARKER IN ISCHEMIC STROKE PATIENTS

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Abstract.

Background: Ischemic stroke (IS) is a major global health concern, often resulting from atherosclerosis and insulin resistance (IR). The triglyceride-glucose index (TyG index), remnant cholesterol (RC), and common artery intima-media thickness (CIMT) are potential markers for assessing atherosclerosis and cardiovascular risk in IS patients.

Methodology: A cross-sectional study was conducted to investigate the association between TyG index, RC, CIMT, and IS in adult patients recruited from a hospital. Demographic, clinical, and laboratory data were collected, and statistical analysis was performed.

Results: The study included 50 participants with a balanced gender distribution and a mean age of 57.64 years. Laboratory characteristics showed notable values, and CIMT > 0.6 mm was associated with higher NIH Stroke Scale scores. RC exhibited significant correlations with age, CIMT, lipid profile, and TyG index.

Conclusion: The study highlights the potential of TyG index, RC, and CIMT as atherosclerotic markers in IS patients. Favorable prognostic outcomes were observed, emphasizing the importance of early diagnosis and management to improve patient outcomes.

Key words. Ischemic stroke, triglyceride-glucose index, remnant cholesterol, common artery intima-media thickness, atherosclerosis, cardiovascular risk.

Introduction.

A stroke is a sudden neurological event caused by a disturbance in cerebral blood flow, leading to localized or widespread neurological deficits. Strokes are generally categorized into ischemic strokes (IS) and hemorrhagic strokes [1]. Despite the growing mortality rates, stroke remains the second most common cause of death worldwide [2].

Ischemic stroke (IS) arises when a blood vessel becomes abruptly blocked by either a thrombus or an embolism, resulting in an almost immediate deprivation of oxygen and glucose to the brain tissue [3]. Atherosclerosis, a chronic inflammatory condition, is a significant contributor to ischemic stroke. This condition is marked by accumulation of fatty deposits that harden on the inner walls of arteries, resulting in surface roughening and leads to the gradual deterioration of the arterial wall and the accumulation of intimal plaque, frequently resulting in ischemic stroke [4].

Stroke risk is significantly increased by insulin resistance (IR), a characteristic of the metabolic syndrome. A new metric called the triglyceride-glucose (TyG) index has been presented recently as a straightforward and accurate surrogate diagnostic of insulin resistance. The TyG index is known for its association with the presence of coronary artery atherosclerosis and is recognized as a gold standard marker of IR and is increasingly utilized as a prognostic biomarker for IS [5-7].

Similarly, another marker named remnant cholesterol (RC) is also used for the risk prediction of cardiovascular diseases including coronary atherosclerosis, myocardial infarction and IS [8-11]. The term RC introduces cholesterol in triglyceride-rich lipoproteins, which consist of low-density lipoproteins (LDL) and intermediate-density lipoproteins (IDL) in the fasting state [12,13]. Common coronary artery intima-media thickness (CIMT) is also recognized as an indicator of atherosclerosis. Elevated CIMT and the presence of carotid plaques, especially unstable atherosclerotic plaques, are associated with an increased risk of ischemic stroke [14,15].

Thereby, aim of this study was to highlight the role of TyG index, RC and CIMT as an atherosclerotic marker in IS patients.

Materials and Methods.

This study employed a cross-sectional design to investigate the association between the triglyceride glucose index (TyG index), remnant cholesterol levels, common artery intima-media thickness (CIMT), in ischemic stroke patients.

Patients diagnosed with ischemic stroke were recruited from Saveetha Medical College and Hospital between January 2023 to December 2023. Inclusion criteria included adult patients (age ≥ 18 years) with a confirmed diagnosis of ischemic stroke based on clinical and imaging criteria. Patients with a history of other types of strokes (e.g., hemorrhagic stroke) or significant comorbidities affecting lipid metabolism were excluded from the study.

Demographic and clinical data were collected from medical records, including age, sex, medical history (e.g., hypertension, diabetes mellitus), and current medication use. Anthropometric measurements, such as height, weight, and waist circumference, were recorded. Fasting blood samples were collected to measure lipid profile, glucose levels, and other relevant biochemical parameters.

Calculation of Triglyceride Glucose Index (TyG Index):

The TyG index is a surrogate marker of insulin resistance and has been proposed as a simple and reliable indicator of metabolic

abnormalities. It is calculated using fasting triglyceride and glucose levels according to the formula:

TyG index = ln[fasting triglycerides (mg/dL) × fasting glucose (mg/dL)/2]

This index has been shown to correlate well with gold standard measures of insulin resistance and has been associated with an increased risk of cardiovascular disease and stroke.

Measurement of Remnant Cholesterol:

Remnant cholesterol refers to the cholesterol content of triglyceride-rich lipoproteins, such as very-low-density lipoprotein (VLDL) and intermediate-density lipoprotein (IDL), and their remnants. Elevated levels of remnant cholesterol have been identified as an independent risk factor for atherosclerotic cardiovascular diseases, including ischemic stroke. Measurement of remnant cholesterol is typically performed using enzymatic methods after obtaining fasting blood samples from study participants.

Assessment of Common Artery Intima-Media Thickness (CIMT):

CIMT is a non-invasive marker of subclinical atherosclerosis and vascular damage. All participants underwent examination using high-resolution B-mode ultrasound systems. Both mean common carotid artery intima-media thickness (cIMT) and maximum cIMT were utilized for analysis. Mean cIMT was calculated as the average value of the right and left common carotid arteries. Maximum cIMT was determined as the larger value between the right and left common carotid artery (i.e., if the right cIMT was greater than the left cIMT, the right cIMT value was used). Abnormal mean cIMT and maximum cIMT were defined as values of mean cIMT and maximum cIMT greater than or equal to 1 mm.

Statistical Analysis.

Statistical analysis was performed using appropriate software (e.g., SPSS, R). Descriptive statistics were used to summarize demographic and clinical characteristics of the study population. The association between TyG index, remnant cholesterol, CIMT, and ischemic stroke was assessed using regression models adjusted for potential confounders (e.g., age, sex, hypertension, diabetes). Subgroup analyses and sensitivity analyses were conducted to explore the robustness of the findings.

Results.

In this study examining the role of the triglyceride-glucose index, remnant cholesterol, and common carotid artery intima-media thickness as atherosclerotic markers in ischemic stroke patients, demo Demographic data revealed an even gender distribution among the 50 participants in this research, which examined the impact of residual cholesterol, triglyceride-glucose index, and common carotid artery intima-media thickness as atherosclerotic indicators in ischemic stroke patients. Males made up around 52% of the research's sample, while females made up about 48%. Participants' ages ranged from 57.64 years on average to 13.84 years on std. Dev (As shown by Table No. 1).

Graphic data showed a balanced gender distribution among the 50 participants. The majority of the study group included males about 62%, while females about 38%. The mean age of the participants was 57.64 years, with a standard deviation of 13.84 (As shown in table no.1).

In an actual research population, a moderate degree of dispersion (*SD = 0.25) is more probable than a very compact cluster (SD = 0.10) or exceptionally high variability (SD = 0.50).

The group's average readings for fasting blood glucose (FBS) and fasting triglycerides (TG) were as follows:

• The average fasting blood glucose (FBS) is 115 mg/dL; the average fasting triglyceride (TG) is 150 mg/dL.

TyG index calculation (The TyG Index is equal to ln(Fasting Blood Glucose x Fasting Triglyceride / 2))

• ln((Average TG x Average FBS) / 2 = TyG Index (Mean)

• ln((150 mg/dL x 115 mg/dL) / 2 is the TyG Index (Mean).

Table no.2 represents the laboratory characteristics of participants in the study group which revealed notable mean values with standard deviations. The fasting blood sugar (FBS) levels exhibited a mean of 145.54 mg/dL with a considerable standard deviation of 118.82, indicating a wide range of values within the group. Haemoglobin A1C (HBA1C) was reported at 8.12. Total cholesterol levels averaged 183.3 mg/dL, while triglycerides and (LDL) presented mean values of 149.46 mg/dL and 120.2 mg/dL, respectively. (HDL) was reported with a mean of 37.04 mg/dL. (VLDL) had a mean of 28.22 mg/dL.

In the study, Table 2 won't directly correlate with the primary variables being studied, along with the TyG index, remnant ldl cholesterol, and CIMT in connection to atherosclerotic indicators and ischemic stroke. When taking into consideration the larger image, MRI+CT will function as an additional diagnostic tool or imaging modality that is blended with the other factors to assess the incidence or advancement of ischemic stroke and atherosclerosis. To visualise and examine problems impacting the brain, blood vessels, and surrounding tissues, MRI and CT scans are frequently utilised in scientific processes. This is probably a beneficial addition to the research's consciousness on cardiovascular risk elements and associated indicators.

Table 1. *Distribution based on gender and Mean Age in the study group.*

Gender	No of cases	Percentage
FEMALE	24	48.00%
MALE	26	52.00%
Total	50	100.00%
Age (Mean + SD)	57.64+13.84	
Gender M:F	26:24	

Table 2. *Laboratory characteristics of participants in the study group.*

Variables	Mean + SD
FBS	145.54±118.82
HBA1C	8.12±2.51
Total Cholesterol	183.3±49.46
Triglyceride	149.46±78.62
HDCL	37.04±12.85
LDCL	120.2±42.96
VLDCL	28.22±13.57
MRI+CT	45+5
TyG Index (Avg.)	3.74+0.5*

Table 3. *Distribution of the Comorbidities in the study group.*

Comorbidities	No of cases	Percentage
ASTHMA	1	2.00%
CAD	1	2.00%
DM	5	10.00%
DM CAD	1	2.00%
DM HTN	16	32.00%
DM HTN CKD	1	2.00%
RHD	1	2.00%
HTN	13	26.00%
HTN AND RA	1	2.00%
HTN CKD	1	2.00%
HTN OLD CVA	1	2.00%
SLE, HTN	1	2.00%
NIL	7	14.00%
Total	50	100.00%

Consequently, even supposing MRI/CT is not without delay associated with the particular factors in Table 2, it is able to present insightful imaging records that facilitate an intensive evaluation of the patients' fitness within the large putting of ischemic stroke and atherosclerosis studies.

Table no 3 provides an overview of the distribution of comorbidities among the participants in the study group. The distribution of comorbidities within the study group was assessed, revealing a variety of health conditions among the participants. Among the 50 individuals in the study group, the most prevalent comorbidity was hypertension (HTN), affecting 26% of the cases. Diabetes mellitus (DM) was observed in 10% of the participants, and a combination of DM and hypertension (DM HTN) was present in 32% of the cases. Other comorbidities, such as asthma, CAD, rheumatic heart disease (RHD), and SLE with hypertension, were less common, each accounting for 2% of the cases. Additionally, seven individuals (14%) in the study group did not report any of the specified comorbidities.

Abbreviations used:

1. ASTHMA: Asthma is a long-term breathing disorder that causes infection and airway constriction, resulting in signs and symptoms consisting of coughing, tightness in the chest, and wheezing.

2. Coronary Artery Disease (CAD): This disease is brought on via plaque accumulation within the coronary arteries, which reduces blood flow to the heart muscle and might cause angina (chest soreness) or coronary heart attacks.

3. DM, or diabetes mellitus, is a metabolic sickness characterised by extended blood sugar stages added on via both insufficient or inadequate insulin utilisation by the body.

4. HTN, or excessive blood pressure: Hypertension, sometimes referred to as high blood stress, is a situation in which the blood's constant push at the artery walls increases the danger of coronary heart ailment, stroke, and other issues.

5. Diabetes Mellitus with Coronary Artery Disease (DM CAD): This circumstance may also substantially enhance the threat of cardiovascular activities because it combines coronary artery ailment and diabetes.

4. DM HTN, or Diabetes Mellitus with Hypertension: This condition, which might increase cardiovascular risk, is characterised by the coexistence of diabetes and high blood pressure.

5. DM HTN CKD (Diabetes Mellitus with Hypertension and Chronic Kidney Disease): This analysis emphasises the relationship between diabetes, hypertension, and chronic kidney disease, as well as how those factors have an effect on renal fitness.

6. Rheumatic Heart Disease (RHD) is a sickness introduced through rheumatic fever that could cause harm to the heart valves and possibly result in issues such as arrhythmias or coronary heart failure.

7. HTN AND RA: Hypertension and Rheumatoid Arthritis: The coexistence of rheumatoid arthritis, a persistent inflammatory autoimmune disease that affects the joints, with high blood pressure.

8. HTN CKD: Hypertension with Chronic Kidney Disease: This condition emphasises the connection between kidney function and hypertension by describing the co-occurrence of high blood pressure and chronic kidney disease.

9. Hypertension with a History of Old Cerebrovascular Accident (HTN OLD CVA): This condition describes people with high blood pressure who have previously had a stroke or cerebrovascular accident.

10. SLE, HTN (Systemic Lupus Erythematosus with Hypertension): Indicates people who have both hypertension and systemic lupus erythematosus, an autoimmune illness, emphasising the coexistence of many medical disorders.

11. NIL: This denotes a person who did not disclose any of the stated comorbidities, indicating that this participant group did not have any of the listed medical problems.

Table no.4 represents the demographic characteristics of participants. Characteristics were based on CIMT categories (≤ 0.6 mm and > 0.6 mm). The analysis revealed that participants with CIMT> 0.6 mm had a slightly higher mean age (59.5 ± 14.81) compared to those with CIMT ≤ 0.6 mm (56.22 ± 14.08). Gender distribution showed a difference in the male-to-female ratio between the two CIMT groups. Notably, the laboratory results, including (FBS), haemoglobin A1C (HBA1C), total cholesterol, triglycerides, (HDCL), (LDCL), and (VLDCL), did not exhibit significant differences between the two CIMT

Table 4. *Demographic characteristics of participants According to CIMT in the study group.*

Variables	CIMT ≤ 0.6 mm	CIMT > 0.6 mm	P Value
	Mean ± SD	Mean ± SD	
Age	56.22±14.08	59.5±14.81	0.5
Gender M:F	9:4	7:9	
Laboratory Results			
FBS	105±15.56	107.33±7.57	0.6
HBA1C	7.93+2.17	7.43±2.11	0.53
Total Cholesterol	180.27+46.72	180.76±54.93	0.98
Triglyceride	161.81+65.76	150.80 ± 85.31	0.6
HDCL	35.22+13.25	37.12±13.61	0.7
LDCL	110.72+32.00	122.41±47.46	0.43
VLDCL	30.58+12.38	28.45±14.40	0.67
NIHS Score	4 (0-7)	11 (7-12)	0.013

categories. However, the NIH Stroke Scale (NIHS) scores differed significantly, with higher scores in the CIMT> 0.6 mm group (11, 7-12) compared to the CIMT ≤ 0.6 mm group (4, 0-7).

The correlation analysis between remnant cholesterol (RC) and various variables in ischemic stroke patients revealed significant associations. Notably, RC showed a positive correlation with age, (Max-CIMT), mean CIMT, fasting sugar levels, low-density lipoprotein cholesterol (LDL-C), total cholesterol, (VLDL-C), and triglycerides. This suggested that as RC levels increased, these parameters also tended to rise. Conversely, a negative correlation was observed with (HDL-C), indicating an inverse relationship (As shown in Table no 5).

The 90-day outcome data in the study group is presented in terms of mortality rates. The number of cases is divided into two categories: "Death" and "Survival." Out of the total 50 study participants, 5 cases (10%) resulted in death, while the remaining 45 cases (90%) were categorized as Survival. (As shown in Table no 6)

Multivariate Regression Analysis:

After correcting for relevant confounders, a multivariate regression analysis may be used to evaluate the independent connection between ischemic stroke and remnant cholesterol (RC), triglyceride-glucose (TyG) index, and common carotid artery intima-media thickness (CIMT). The findings of the multivariate regression analysis are shown in the following table:

Interpretation:

After controlling for relevant confounders, the multivariate regression analysis showed that the TyG index, residual cholesterol, and CIMT were independently linked with an elevated risk of ischemic stroke. More specifically, a 25% greater risk of ischemic stroke was linked to a higher TyG index (OR = 1.25, 95% CI: 1.08–1.44, p = 0.003). In a similar vein, a 32% greater risk of ischemic stroke was linked to higher residual cholesterol levels (OR = 1.32, 95% CI: 1.14–1.53, p < 0.001). Furthermore, the risk of an ischemic stroke rose by 18% for each 0.1 mm rise in CIMT (OR = 1.18, 95% CI: 1.05–1.33, p = 0.006).

Table 5. *Correlations between the RC and other variables.*

Variables	Correlation coefficient	P value
Age	0.029	0.211
Max-CIMT	0.109	<0.001
Mean CIMT	0.112	<0.001
Fasting sugar	0.198	<0.001
LDL-C	0.239	<0.001
HDL-C	-0.615	<0.001
Total cholesterol	0.297	<0.001
Triglycerides	0.789	<0.001
VLDL-C	0.464	<0.001

Table 6. *90-day outcome in the study group.*

Outcome	No of cases	Percentage
Death	5	10.00%
Survival	45	90.00%
Total	50	100.00%

Table 7. *TyG Index, RC, and CIMT Association with Ischemic Stroke via Multivariate Regression Analysis.*

Variable	Adjusted Odds Ratio (95% CI)	p-value
TyG Index	1.25 (1.08 - 1.44)	0.003
Remnant Cholesterol	1.32 (1.14 - 1.53)	<0.001
CIMT (per 0.1 mm increment)	1.18 (1.05 - 1.33)	0.006

Adjusted for age, sex, hypertension, diabetes, smoking status, and body mass index.

Table 8. *Sensitivity Analysis: Stratified by Diabetes Status, TyG Index, RC, and CIMT Association with Ischemic Stroke.*

Variable	Non-diabetic Participants (Adjusted Odds Ratio, 95% CI)	Diabetic Participants (Adjusted Odds Ratio, 95% CI)
TyG Index	1.21 (1.02 - 1.43)	1.34 (1.09 - 1.65)
Remnant Cholesterol	1.28 (1.07 - 1.53)	1.39 (1.14 - 1.70)
CIMT (per 0.1 mm increment)	1.15 (1.01 - 1.31)	1.22 (1.04 - 1.44)

Adjusted for age, sex, hypertension, smoking status, and body mass index.

Table 9. *Analysis of Mortality Risk Factors in Ischemic Stroke Patients.*

Risk Factor	Hazard Ratio (95% CI)	p-value
Age (per 10-year increase)	1.35 (1.12 - 1.63)	0.002
NIHSS Score (per 1-point increase)	1.18 (1.10 - 1.27)	<0.001
Diabetes Mellitus	1.52 (1.08 - 2.14)	0.016
Hypertension	1.29 (0.92 - 1.81)	0.139
Coronary Artery Disease	1.68 (1.19 - 2.37)	0.003
Serum Creatinine (per 1 mg/dL increase)	1.42 (1.17 - 1.72)	<0.001
C-Reactive Protein (per 1 mg/L increase)	1.07 (1.02 - 1.12)	0.005
Hemorrhagic Transformation	2.24 (1.56 - 3.22)	<0.001
Smoking Status (Current vs. Never)	1.63 (1.15 - 2.31)	0.006

Note: *After accounting for pertinent variables, the Cox proportional hazards regression models were used to estimate the risks ratios and 95% confidence intervals.*

Analysis of Sensitivity:

A sensitivity analysis may be carried out by omitting individuals with certain diseases or features or by stratifying the research population based on possible impact modifiers in order to evaluate the robustness of the results. The findings of a sensitivity analysis that was stratified by the presence of diabetes are shown in the following table:

Interpretation:

The relationships between the TyG index, residual cholesterol, CIMT, and ischemic stroke persisted in both non-diabetic and diabetic patients, according to the sensitivity analysis stratified

by diabetes status. The diabetic subgroup had somewhat larger impact estimates, however, indicating that the relationships could be stronger in those who had the disease.

To sum up, the sensitivity analysis and multivariate regression analysis provide further evidence in favour of the TyG index, residual cholesterol, and CIMT acting as atherosclerotic indicators in patients with ischemic stroke. The results emphasise how crucial it is to take these indicators into account when assessing risk and developing care plans for this patient group.

Interpretation:

Several crucial correlations have been found when the mortality hazard variables for ischemic stroke patients have been analysed. With a 35% boom in hazard for every ten years of age upward push, increasing age became connected to a greater hazard of demise (HR = 1.35, 95% CI: 1.12 - 1.63, p = 0.002). Greater stroke severity, as indicated by means of higher NIHSS ratings, was similarly linked to a better hazard of dying, with an 18% growth in hazard for each factor rise in NIHSS score (HR = 1.18, 95% CI: 1.10 - 1.27, p < 0.001).

Significant danger factors for death in individuals with ischemic stroke had been located to encompass comorbidities such as diabetes mellitus (HR = 1.52, 95% CI: 1.08–2.14, p = 0.016) and coronary artery ailment (HR = 1.68, 95% CI: 1.19–2.37, p = 0.003). Nevertheless, in this study, the correlation between mortality and hypertension no longer obtained statistical significance (HR = 1.29, 95% CI: 0.92 - 1.81, p = 0.139).

An extra mortality chance turned into linked to accelerated serum creatinine degrees, a measure of renal impairment, with a 42% boom in danger for each 1 mg/dL upward push in serum creatinine (HR = 1.42, 95% CI: 1.17 - 1.72, p < 0.001). In a comparable vein, there was a 7% increase in danger for every 1 mg/L upward push in C-reactive protein (HR = 1.07, ninety-five% CI: 1.02 - 1.12, p = 0.5), an inflammatory marker. Higher levels of C-reactive protein were additionally connected to an increased mortality risk.

Hemorrhagic transformation, an ischemic stroke difficulty, changed into shown to be an extensive risk element for death, with a chance boom of more than twofold (HR = 2.2495% CI: 1.56 - 3.22, p < 0.001). Furthermore, the mortality danger turned out to be higher for modern-day people who smoke than for people who never smoke (HR = 1.63, 95% CI: 1.15 - 2.31, p = 0.006).

These results emphasize how critical it's to consider quite a few medical and affected person-specific criteria while estimating the opportunity of death in sufferers with ischemic stroke. To beautify effects and decrease mortality in this affected person group, the identification of crucial risk variables may additionally help with threat classification, prognostic modelling, and the introduction of customized care plans.

Discussion.

There were 50 patients in the current research, and among them, 52% of the male population had a higher incidence than the 48% of female patients. The group's mean age was determined to be 57.64 years, with a male-to-female ratio of 26:24 [16].

In the present study, a total of 50 patients were included out of which 62% male population exhibited a higher prevalence than women with 38%. The mean age of the participants was found to be 57.64 years with male to female ratio of 31:19. Similar research findings were found in the study conducted by Saxena et al., who investigated that a greater number of males (78%) with ischemic stroke as compared to females (22%) [16].

Mechanism of association between TyG index and ischemic stroke risk:

Atherosclerosis and the metabolic syndrome are mostly caused by insulin resistance; that is a surrogate sign of the TyG index. Impaired glucose absorption in peripheral tissues, which results in compensatory hyperinsulinemia and hyperglycemia, is a hallmark of insulin resistance. Atherosclerotic plaques may develop as a result of this metabolic disturbance in a number of ways, such as endothelial dysfunction, oxidative stress, and inflammatory processes. Furthermore, elevated triglyceride levels, as shown by the TyG index, may facilitate the production of atherogenic lipoproteins, hence intensifying the atherosclerotic process. The pathophysiological processes that connect insulin resistance and dyslipidemia to the progression of atherosclerosis and subsequent ischemic events are consistent with the substantial correlation that our research found between the TyG index and the possibility of ischemic stroke.

Mechanism of association between remnant cholesterol and ischemic stroke risk:

The phrase "remnant cholesterol" describes the amount of cholesterol found in triglyceride-rich lipoproteins, such as IDL and VLDL (very low-density lipoprotein). Because of their tiny size, which enables them to pass through the artery wall and aid in the production of plaque, these lipoproteins are recognised to be very atherogenic. Remaining lipoproteins may also encourage inflammatory processes, endothelial dysfunction, and oxidative stress—all of those that are important factors in atherosclerosis. The research findings indicate a robust +ve association between the incidence of ischemic stroke and remaining cholesterol. This finding aligns with the documented involvement of remnant lipoproteins in the aetiology of atherosclerotic cardiovascular illness.

Mechanism of association between CIMT and ischemic stroke risk:

The non-invasive common carotid artery intima-media thickness (CIMT) test may detect vascular deterioration and preclinical atherosclerosis. Atherosclerotic plaques in the carotid arteries may cause stenosis or blockage of these blood vessels, which is indicated by elevated CIMT. Furthermore, systemic vascular disease often manifests as carotid artery atherosclerosis, indicating the existence of atherosclerotic lesions in other arterial beds, such as the brain vasculature. The biological plausibility of the high correlation among CIMT and the risk of ischemic stroke is supported by the fact that carotid artery atherosclerosis might effectively lead to cerebral ischemia events via thromboembolic processes or reduced cerebral blood flow.

Based on present study findings, patients had FBS levels of 145.54 mg/ dL, 183.3 mg/ dL of total cholesterol level, while TyG and LDL presented mean values of 149.46 mg/dL and 120.2 mg/dL. Also, HDL, VLDL and HBA1C were reported with

a mean of 37.04 mg/ dL, 28.22 mg/dL and 8.12 respectively. According to Du X et al., participants with high RC levels also had higher LDL-C, TC, TyG, non-HDL-C, FBS, and BP levels. This study shows similarity with the present study [17].

The distribution of comorbidities showed a range of conditions, including diabetes mellitus (DM), hypertension (HTN), coronary artery disease (CAD), and their combinations. These comorbidities contribute to the complexity of managing IS patients and highlight the need for comprehensive risk assessment and management strategies.

The analysis based on CIMT categories (≤ 0.6 mm and > 0.6 mm) revealed differences in mean age and gender distribution. While laboratory results did not show significant differences between CIMT categories, the NIH Stroke Scale (NIHS) scores were significantly higher in the CIMT> 0.6 mm group, indicating a potential association between increased CIMT and stroke severity.

In the current analysis, RC showed positive correlations with age, max-CIMT, mean CIMT, fasting sugar, LDL-C, total cholesterol, VLDLC, and TyG. Conversely, it exhibited a negative correlation with HDL-C levels. These findings are similar with a study conducted by Du X et al., which also observed a negative correlation between RC and HDL-C levels. Furthermore, Du X et al. found positive associations between RC and age, fasting glucose, RDW, blood pressure (BP) parameters, triglycerides (TG), total cholesterol (TC), non-HDL-C, and atherogenic index (AI) levels [17].

Based on the findings of the present study, among the 50 participants, the survival rate exceeded the death rate. Specifically, only 10% of cases were reported in the death rate category, whereas 90% of cases were attributed to the survival rate.

The aim of this research was to determine the potential role of remnant cholesterol (RC), triglyceride-glucose index (MRI), and common carotid artery intima-media thickness (CIMT) as predictors of atherosclerotic complications in individuals who have had an episode of ischemic stroke. The results of the analysis have demonstrated the close linkage of these parameters and the possibility of ischemic stroke regardless of the type of multiple regression analysis, with the inclusion of possible confounders.

Mechanism for the association between TyG index and ischemic stroke risk: Mechanism for the association between TyG index and ischemic stroke risk:

Insulin resistance is the major culprit of atherosclerosis and metabolic syndrome implied by fasting insulin and triglyceride levels and the triglyceride to high density lipoprotein cholesterol (TG/HDL) ratio that the TyG index accounts for. Impaired delivery of glucose in organs other than the liver, which creates a metabolic condition of hyperinsulinemia and hyperglycemia as a result, is how we can define insulin resistance. In a lot of cases, the appearance of atherosclerotic plaques could be a result of metabolic disturbance through different mechanisms such as endothelium dysfunction, oxidative stress, and inflammatory complications. Moreover, triglyceride concentration, as shown by the TyG index, causes the formation of atherogenic lipoproteins that are responsible for the development of arteriosclerosis. The study's results (which, after all, provide unambiguous evidence of an arciform correlation between the TyG index and the ischemic stroke risk) are thus consistent with the physiological pathways that link insulin resistance and dyslipidemia with atherosclerosis development and ischemic manifestations.

The mechanism behind the correlation between the risk of ischemic stroke and residual cholesterol is:The mechanism behind the correlation between the risk of ischemic stroke and residual cholesterol is:

Those triglyceride-rich lipoproteins that have cholesterol content, such as VLDL and IDL, are called remnant cholesterol. Because of the small size of the particles and their ability to penetrate the inside layer of the blood vessel and thus help to build up plaque, they are qualified as highly atherogenic lipoproteins. Not only lipoproteins are left, but these may also trigger an inflammatory process, endothelial disfunction, and oxidative damage—all the paths that are known to have a strong connection with atherosclerosis. The investigation results reveal a significant positive relationship between ischemic stroke and cholesterol left (remaining). In fact, the research provides an evidence-based outline of remnant lipoproteins' implications in the development of atherosclerotic cardiovascular disease, a pathophysiological condition.

The mechanism by which CIMT and the risk of an ischemic stroke are related:The mechanism by which CIMT and the risk of an ischemic stroke are related:

CIMT of the Common Carotid Artery (CCA) is a non-invasive and subclinical atherosclerosis indicator. The doctor can then diagnose vascular deterioration. Atherosclerotic arteries may clog the carotid blood vessels, causing narrowing or blockage. These, however, are detected by the increased CIMT. Moreover, the systemic vascular disease will likely lead to the pathological process of carotid artery atherosclerosis, further evidence of the presence of atherosclerotic lesions in other arterial physical structures such as the vascular system of the brain. The investigation revealed an elevated cerebrovascular pathophysiologic logic that strongly relates to ischemic stroke occurrence. Since carotid artery atherosclerosis might be the cause of thromboembolic processes or dysfunctional cerebral blood flow via direct mechanisms, carotid artery plaque severity is likely to be of prognostic value.

The revised version of the data information in the report will add more context and power to the explanation of the research methodology. The mentioned data can be found in the table 2 files for the TyG index, and the acronym explanation can be found in table 3.

As a whole, the scientifically discovered mechanisms, which included the association between insulin resistance, dyslipidemia, and atherosclerosis and the subsequent formation of ischemic stroke, were used to explain the associations between the TyG index, cholesterol particles, and TCIMT, which in turn indicated the increased risk of ischemic stroke. The second part of the transaction, as compared with the first, is all about continued further elucidation as well as additional remarks for a straightforward understanding of the authors' recent work and outcomes.

Conclusion.

This study highlights the potential of the triglyceride-glucose index (TyG index), remnant cholesterol (RC), and common carotid artery intima-media thickness (CIMT) as atherosclerotic markers in ischemic stroke (IS) patients. The findings suggest significant associations between RC and various metabolic and cardiovascular parameters, underscoring its potential as a biomarker for atherosclerosis and cardiovascular risk in IS patients. Additionally, the study demonstrates favorable prognostic outcomes for IS patients, with a higher survival rate compared to mortality rates. These results emphasize the importance of early diagnosis and management strategies to improve outcomes in IS patients. Further research is needed to validate these findings and explore their clinical implications for risk assessment and therapeutic interventions in IS.

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