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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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OBESITY AND THYROID FUNCTION IN OBESE WOMEN: A PILOT STUDY

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Abstract.

Background: Obesity is an expanding pathology in the world and in Tunisia. We conducted this study to assess the thyroid function in a population of obese women and to investigate the relationship of thyroid status parameters with clinical and metabolic parameters.

Methods: This was a cross-sectional retrospective study about 50 obese women. We collected body mass index (BMI), waist circumference (WC), serum free thyroxin (FT4) and thyroid stimulating hormone (TSH) levels, fasting glycemia (FG), baseline insulinemia, lipid profile, liver function, and body composition, assessed by bioelectrical impedancemetry. We assessed insulin resistance and pancreatic activity by calculating the Homeostasic Model Assessment for Insulin Resistance (HOMA-IR) and the Homeostasic Model Assessment to quantify Beta-cell function (HOMA-B) respectively.

Results: The mean BMI and WC were 41,2±9,3 kg/m² and 120±17,7 cm, respectively. The mean body fat percentage (BF) was 43,4±7,1%. The mean FT4 and TSH levels were 16,6±4,7 pmol/L and 2,4±1 IU/L, respectively. Two patients had subclinical hypothyroidism. Glycoregulation abnormalities were noted in 54%. The mean insulinemia, HOMA-IR and HOMA-B were 23,4±14,8 mIU/L, 6,5±5,1 and 230,4±162,1 respectively. Most patients had insulin resistance (96%). TSH was not correlated with cardiometabolic risk parameters nor with BF. FT4 was correlated with age (r=-0,3, p=0,017), FG (r=-0,29, p=0,019), insulinemia (r=-0,42, p=10-3), cholesterol (r=0,24, p=0,04) and high-density lipoprotein (r=0,24, p=0,002). It was not correlated with BF (r=-0,14, p=0,32).

Conclusion: In our population of obese women, FT4 seems to be more correlated than TSH with cardiometabolic risk parameters.

Key words. Obesity, thyroid, impedancemetry.

Introduction.

It is well established that body weight could vary in cases of dysthyroidism; Hypothyroidism is traditionally considered to be the cause of weight gain via, among other things, salt and water retention and reduced lipolysis [1].

The interaction between thyroid function and weight is currently a growing subject of study. According to certain authors, excess weight is associated with an increase in thyroid stimulating hormone (TSH), considered rather as a consequence of obesity [2-4].

However, several studies have been conducted to establish the link between TSH levels and weight. Most of them suggest that these levels tend to follow increasing weight [2,3].

However, the mechanism of this variation remains unclear. Some authors imply a counter-regulatory mechanism to counter the excessive inflation of adipose tissue. This mechanism involves the hypothalamic-pituitary unit and hormones, mainly leptin [1-4].

Thus, we proposed to carry out this study:

1. To evaluate thyroid function in a population of obese women.
2. To study the association between thyroid hormones assessment and clinico-metabolic parameters and body composition in the same population.

Materials and Methods.

Type of the study:

This is a cross-sectional descriptive study.

Population:

We included 50 obese patients aged between 18 and 65 years, who have not received any dietary prescription, and who consented to participate in our study.

We did not include pregnant women, patients who have been treated or currently being treated with a medication that could interfere with thyroid function (Cordarone, lithium carbonate, etc.), and patients with a history of: dysthyroidism, insulin-requiring diabetes, radiotherapy of the cervical region, autoimmune diseases, kidney disease and chronic liver disease.

Study protocol:

We evaluated sociodemographic characteristics and personal pathological history. We measured weight and body composition (evaluated by bioelectric impedancemetry using a professional TANITA-type impedancemeter), height (m) (measured using a measuring rod graduated in centimeters, in a patient in standing position and at the end of inspiration, off her shoes, with relaxed shoulders, dangling arms, straight legs and together heels) and waist circumference (WC) (cm) (measured at the end of expiration using a tape measure placed halfway between the anterior superior iliac spine and the costal margin, parallel to the ground). We dosed FT4, TSH, fasting blood glucose (FBG), glycated hemoglobin (HbA1C), baseline insulinemia, triglycerides (TG), total cholesterol (CT) and high-density lipoprotein cholesterol (HDL- c), and liver biological parameters (Aspartate aminotransferases (AST, Alanine aminotransferases (ALT) and gamma-glutamyltranspeptidase (GGT)). The biological parameters were taken from a blood sample after a 12-hour fast and analyzed at the laboratory of the

same institution.

We calculated the body mass index (BMI (Kg/m²)) by the formula: BMI=Weight/Height², and we estimated LDL-c by the Friedewald formula, if TG were less than 4.6 mmol/L: (LDL-c (g/L)=[CT(mmol/L)-HDL-c(mmol/L)-(TG(mmol/L)/2.2)]×0.387), and the triglyceride glucose index (TryG) by the formula: Index TryG=GAJ (mmol/L)×Tg (mmol/L).

We estimated insulin resistance by "The Homeostatic Model of Insulin Resistance Index" (HOMA-IR) (HOMA-IR=Insulinemia (mIU/mL) × FBG (mmol/L)/22.5), and cell function pancreatic beta by the homeostatic model (HOMA-B): HOMA-B=20×[insulinemia (mIU/L)/(GAJ (mmol/L)-3.5)].

Definition:

Obesity was defined and classified according to the World Health Organization [5]. Insulin resistance was defined by a HOMA-IR index > 2.4 [6]. Abdominal obesity was defined by a waist circumference (WC) ≥80 cm according to the 2009 International Diabetes Federation (IDF) standards, in the Mediterranean population [7]. Metabolic syndrome (MS) was defined by the presence of at least three criteria among those detailed by the International Diabetes Federation (IDF) in 2009 [7]. Dysthyroidism was defined according to the American Thyroid Association (ATA). Diabetes, prediabetes and dyslipidemia were defined according to the recommendations of the American Diabetes Association [8,9].

Statistical analysis:

We analyzed the data using SPSS version 21.0 software. The data were log transformed to correct for non-Gaussian distribution, obtained by the Shapiro-Wilk test. We calculated simple frequencies for the quantitative variables. We calculated means, medians and standard deviations for the qualitative variables. The association between two variables was studied using the Spearman correlation test. The comparison of two means from independent series was made using the Student t test. The significance level was set at 0.05.

Ethics:

Ethical Principles for Medical Research Involving Human Participants of the Declaration of Helsinki were applied. All participants in our study gave informed consent. The study was carried out with strict respect for medical confidentiality and anonymity.

Results.

Ten percent of our population were active smokers. Class 3 obesity was the most common (48%), followed by class 1 (36%) and class 2 (16%). Diabetes was the main comorbidity associated with obesity 20% (n=10). It was type 2 in all patients, treated with metformin. Its average duration was 2.2±1.2 years. 63% had prediabetes, 52% had MS, and 96% insulin resistance.

The clinical and biological characteristics were detailed in Table 1. The comorbidities and body composition characteristics of the population were detailed respectively in Tables 2 and 3. The results of the study of the correlation between thyroid parameters and clinical and metabolic characteristics of the population were detailed in Table 4.

Table 1. *Clinical and biological characteristics of the population.*

Variables:	Mean value ±Standard deviation	Median	Extremes
Age (years)	39,7±12,6 [20;63]	39	[20;63]
Weight (Kg)	103,9±23,2	100,2	[70,3;153,3]
High (cm)	159±5,8	158	[149;171]
BMI (Kg/m²)	41,2±9,3	38,7	[30,3;60,1]
WC (cm)	120±17,7	122	[88;160]
FBG (mmol/L)	6±1,6	5,4	[4,2; 11,3]
Hba1c (%)	5,8±0,7	5,7	[4,9; 7,9]
Baseline insulinemia (pmol/L)	23,4±14,8	20,9	[6,4; 84,3]
HOMA-IR	6,5±5,1	4,8	[1,3; 24]
HOMA-B	230,4±162,1	185,6	[35,4; 803,1]
FT4 (pmol/L)	16,6±4,7	16	[7,12; 26]
TSH (uUI/mL)	2,4±1	2,67	[0,27; 4,35]
Cholesterol (mmol/L)	4,8±0,7	4,7	[3,2; 6,9]
TG (mmol/L)	1,3±0,3	1,2	[0,7; 2,4]
HDL-c (mmol/L)	1,1±0,2	1,1	[0,5; 1,6]
LDL-c (g/L)	1,1±0,3	1,1	[0,5; 2]
ASAT	24,7±10,3	23	[11; 67]
ALAT	22,3±10,4	19	[9;51]
GGT	24,6±9,5	22	[11; 54]
PAL	23,9±6,6	24	[20; 37]
Creatininemia (mmol/L)	53,7±10,8	51,1	[38,6; 97]

Table 2. *Comorbidities associated with obesity and their prevalence.*

Comorbidities	Prevalence (%)
T2DM	20
Hypertension	4
Gonarthrose	6
Polycystic ovary syndrome	4
Obstructive sleep apnea syndrome	2
Fatty liver	2
Gastroduodenal ulcer	2
Asthma	2

Table 3. *Body composition characteristics of the population.*

Body composition	Mean value ± Standard deviation:	Median:	Extremes:
Fat mass:			
In % of weight:	43,4±7,1	44,1	[31,1; 58,1]
In Kg:	47,3±16	45,3	[22,4; 88,7]
Lean mass (Kg):	56,1±7,7	45,6	[44,1; 72]
Muscular mass (Kg):	53,3±7,5	51,9	[41,9; 69,3]
Bone mass (Kg):	2,9±0,4	2,9	[2,2; 3,8]

Discussion.

In our study we showed a low prevalence of dysthyroidism, represented only by subclinical hypothyroidism, diagnosed in two patients. Metabolically, we showed a high prevalence of class III obesity (48%), visceral obesity (100%), glycoregulation disorders (54%), insulin resistance (96%). and MS (52%).

Table 4. *Study of the correlation between the parameters of the thyroid assessment and the clinical and metabolic characteristics of the population.*

Clinical and biological parameters	FT4		TSH	
	r	p	r	p
Age	**-0,3**	**0,017**	0,18	0,2
BMI	-0,17	0,21	0,21	0,13
WC	-0,07	0,63	0,2	0,14
FBG	**-0,29**	**0,019**	0,007	0,96
HbA1C	-0,15	0,28	-0,006	0,96
Cholesterol	**0,24**	**0,04**	0,09	0,52
TG	-0,16	0,25	0,15	0,28
HDL	**0,24**	**0,002**	-0,18	0,19
LDL	0,05	0,7	0,11	0,43
Index TryG	-0,23	0,09	0,13	0,34
Basal insulinemia	**-0,42**	**0,001**	0,15	0,28
HOMA-IR	-0,2	0,09	0,13	0,33
HOMA-B	-0,07	0,63	0,07	0,61
ASAT	-0,2	0,16	0,08	0,54
ALAT	-0,28	0,05	0,16	0,25
GGT	-0,19	0,17	0,01	0,9
Alkaline phosphatase	0,14	0,21	0,24	0,84
FM (%)	-0,14	0,32	-0,09	0,53
LM (Kg)	-0,17	0,22	**0,34**	**0,013**
MM (Kg)	-0,18	0,18	**0,33**	**0,019**

HyperLDLemia was the most common lipid abnormality (92%), followed by hypercholesterolemia (32%), hypoHDLemia (12%) and hypertriglyceridemia (10%). Body composition was characterized by a percentage of fat mass (FM) exceeding 44% in half of the population.

We did not show a significant association between FT4 and TSH with BMI nor with WC nor with FM. TSH was positively correlated with lean mass (LM) (p=0.013) and muscular mass (MM) (p=0.019).

The correlates of FT4 were age (r=-0.3, p=0.017), baseline insulinemia (r=0.42, p=0.001), FBG (r=-0.019; p= 0.019), HDL (r=0.24; p=0.002) and CT (r=0.24; p=0.04). Those of TSH were LM (r=0.34; p=0.013) and MM (r=0.33; p=0.019).

Evaluation of thyroid function in the population:

In the Kitahara CM study, BMI and WC were significantly positively associated with FT3 and TSH but not with FT4 [10]. And in the study conducted by Santos Palacios S with more than 20,000 subjects, it was shown that the average TSH was significantly higher in cases of obesity (BMI < 30 kg/m2: 2.16[0.72; 4.39]; BMI ≥ 30 kg/m2: 2.28 [0.71–4.47]; p< 0.01) [11].

Thus, our results were discordant with the literature. However, they should be interpreted with caution, given the small size of the sample studied and that the population studied included only women.

Despite our results, the association between thyroid function and obesity no longer needs to be demonstrated. Indeed, physiopathologically, FT3, the active form of thyroid hormones, comes from thyroid follicle secretion, but essentially from the peripheral deiodination of FT4 via iodothyronine deiodase type 1. The expression of this enzyme is stimulated in the white adipose tissue of obese subjects. However, expression of the thyroid hormone receptor, TR alpha 1, and the TSH receptor is reduced. In case of weight loss these receptor changes vary in the opposite direction. In light of these findings, the interactions between adipose inflation and thyroid function are clearer and are independent of obesity-related metabolic alterations [12].

In our population, the only dysthyroidism diagnosed was subclinical hypothyroidism. Its prevalence was 4% (n=2). However, this result should be interpreted with caution. This prevalence could be underestimated, given the small size of the sample studied, but it could also be overestimated; Indeed, the practice of a thyroid assessment is not systematic. Its realization follows clinical suspicion of dysthyroidism.

Knudsen N et al showed in a population of more than 4000 subjects that elevation of TSH, even minimal, is associated with obesity. This abnormality could disappear in the case of weight reduction [2]. Similarly, in another study conducted by Michalaki et al. among 144 obese patients, 76.4% (n=110) of whom were women, subclinical hypothyroidism was common in 7.7%. In light of these results, the authors of the study considered that obese people tend to have higher levels of TSH and linked this to an adaptation of their central thyrostat to a higher level [13].

The close interactions currently proposed between the thyrotropic axis and adipose tissue encourage us to look for possible clinical consequences of these interactions.

For this reason, we analysed the association between the parameters of the thyroid assessment and the clinical-metabolic phenotype of the patients.

In our study, the prevalence of MS was 52%. It is probably underestimated given that we have not evaluated the population blood pressure. In patients with MS, mean FT4 was lower and mean TSH was higher (FT4=17±3.5 pmol/L, TSH=2.6 IU/L) compared to patients without SM (19±4.2 pmol/L, TSH=2.1±1 (IU/L)) without reaching the significance threshold.

Likewise, we showed that FT4 was negatively correlated with age (p=0.017), FBG (p=0.019) and baseline insulinemia (p=10-3), and positively correlated with Cholesterol (p=0.04) and HDL (p=0.002), and that TSH was not significantly correlated with any metabolic parameter. Thus, FT4 appears to be more correlated than TSH with cardiometabolic risk parameters than TSH.

A similar result was shown in Marzullo P's study conducted on 952 obese euthyroid patients: FT4 was negatively associated with TG, baseline insulinemia and HOMA-IR, and positively associated with HDL-c. On the other hand, TSH was not associated with any cardiometabolic risk parameter [14].

Data from the study conducted by Annemieke Roos et al. on 2703 adults with euthyroidism showed that FT4 was significantly inversely correlated with TC, LDL and TG, and significantly positively correlated with LDL. FT4 and TSH were associated with HOMA-IR (p<0.001 and p=0.024, respectively). These results led the authors to conclude that obese euthyroid subjects whose thyroid function is at the lower limit of normal present an increased cardiovascular risk [15].

Thus, most of our results are consistent with what has been reported in the literature, in terms of association between thyroid function and metabolic phenotype.

However, some studies have shown different results. This is the case of the study carried out by G De Pergola with 201 women, overweight or obese, where FT3 was positively associated with BMI and TT, FT4 was negatively associated with age and baseline insulinemia, and TSH were positively correlated with age and WC. The authors suggested, in the light of these results, the hypothesis of an upward adaptation of the thyrostat by adipose tissue, which rather constitutes a simple adaptive thermogenic phenomenon, and which is not associated with metabolic parameters [16].

Thus, no metabolic correlate of FT4 or TSH can be formally retained, given the divergence of results and the limitations of the studies. Most were carried out on unrepresentative, small or inhomogeneous samples including overweight patients or elderly subjects, which could bias the results.

Thus, we can suggest that FT4 reflects cardiometabolic risk better than TSH in obese subjects. TSH, being correlated with LM according to our study, its metabolic implication in obesity appears more complex; Indeed, we assume that its action does not only concern the LM but also the FM where it may act via the FT4.

Metformin is an oral antidiabetic drug widely prescribed in patients with type 2 diabetes mellitus (T2DM). It has recently been suggested that it may reduce TSH levels in euthyroid subjects. The mechanisms of this variation remain unknown, but could involve neutralization of central T3 effects, inhibition of hypothalamic AMPK and dopaminergic effects. A direct effect of metformin inhibiting pituitary TSH secretion is also plausible [17-19].

In our study, we found that the mean levels of FT4 and TSH were lower (FT4=17.2±2.1 pmol/L, TSH=2.1±1 IU/L) in obese patients with T2DM treated with metformin compared to those obese non-diabetics (FT4=18.1±4.2 pmol/L, TSH=2.4±1 IU/L) without reaching the significance threshold.

In other studies, the results have been different. This is the case of the study carried out by Paolo Martzullo on more than 900 obese patients [14]. The mean FT4 level was significantly higher in patients taking metformin. The authors of this study linked this result to the heterogeneity of the subgroups studied; Indeed, patients treated with metformin had an older average age and were more obese and more insulin resistant than patients in the homologous group, with a higher prevalence of visceral obesity. And they considered that metformin would be a potential confounding factor that could reduce TSH levels [11,20].

Thus, results about the interaction between thyroid function and metformin remain discordant. In our study we were not able to separately study the association of metformin and that of diabetes with the variation in TSH given that all diabetic patients were treated with metformin.

Among the strong points of our study, we quote the homogeneity of our population where we only included obese-adult-women, the analysis of biological parameters within the same laboratory using the same biochemical method for each parameter, and the analysis of body composition by the same bioelectrical impedancemetry device and by the same observer, which allowed us to limit information bias. However, we criticize our study for the absence of a control group of non-obese patients, the small sample size, and the absence of measurement of FT3, leptin and antithyroid antibodies. However, their dosage is expensive and is not common practice.

Conclusion.

In light of our results and those of the literature, the relationship between obesity and thyroid function remains complex and controversial. The challenge for any healthcare professional is the correct interpretation of a thyroid assessment, taking into account the weight status of the patient, given that thyroid function could be the target of metabolic adaptations especially in the case of obesity.

FT4 in obese women appears to be more correlated than TSH with cardiometabolic risk parameters. These two parameters were not correlated with LM.

Larger-scale studies are essential to better characterize this association and identify the underlying mechanisms. Once a causal link is established, the definition of new euthyroid thresholds for obese subjects is indicated in order to avoid unjustified treatment for these patients.

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