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Original article

Prevalence and Clinical Characteristics of Metabolic Syndrome in Patients with Hypertension Attending a Primary Care Unit in Benghazi

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ABSTRACT

Metabolic syndrome (MetS) is a cluster of cardiovascular risk factors that increase the likelihood of having cardiovascular disease and all-cause mortality. Despite the pivotal role of hypertension in MetS, statistics on the prevalence of MetS in Libyan patients with hypertension are scarce. This study aimed to ascertain the prevalence and clinical attributes of MetS in adult patients with hypertension at a primary care unit in Benghazi, Libya. A cross-sectional study, conducted from January to June 2020, and included 200 participants. Based on Modified National Cholesterol Education Program Adult Treatment Panel III guidelines, the participants were categorized into MetS and non-MetS groups. The data was collected and analyzed using SPSS Statistics software, version 27. The study population comprised 134 females and 66 males with a mean age of 51.32 ± 8.9 years. A significant proportion (73%) met the diagnostic criteria for MetS, with an average age of 52.13 ± 8.6 years, older than non-MetS patients. Females predominated in the MetS group (74.7% vs. 25.3%, p-value < 0.001), displaying a higher metabolic score than males (3.4 ± 0.9 vs. 2.8 ± 1.3, p-value = 0.003). Regarding MetS criteria, 29.5% met three, 27.5% met four, and 16% met all five criteria. MetS patients exhibited significantly higher frequencies and mean values of MetS components compared to non-MetS patients (p-value < 0.001). Notably, high waist circumference was the most prevalent criterion (84%), whereas type II diabetes mellitus had the lowest prevalence (32%). In conclusion, the study underscores the significance of early detection of MetS in patients with hypertension, ultimately contributing to more efficient healthcare delivery for this population in Libya.

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INTRODUCTION

Cardiovascular disease is a major health epidemic that is responsible for a significant number of premature deaths globally [1]. The Middle East and North Africa, where this study was conducted, are an especially affected region, due to the high prevalence of cardiovascular risk factors [2].

Metabolic syndrome (MetS) is a group of interrelated cardiovascular risk factors, namely central obesity, diabetes mellitus (DM), reduced high-density lipoprotein cholesterol (HDL-C), hypertension (HTN), and atherogenic hypertriglyceridemia. It is also known by several other names, such as syndrome X, obesity dyslipidemia syndrome or

insulin resistance syndrome [3]. Metabolic syndrome has recently gained increased attention because its interconnected risk factors directly contribute to the development of atherosclerotic cardiovascular disease [4]. It is a public health epidemic in the current era [5, 6] as it is associated with a 2-fold increase in cardiovascular events and a 1.5-fold increase in all-cause mortality [7]. The metabolic syndrome score, calculated by giving one point for each ATP III criteria met by the patient, is associated with increased risk of acute coronary syndrome events [8].

Insulin resistance is a major health challenge encountered by healthcare providers. Normally, insulin acts to reduce high glucose levels to maintain optimal cellular functions [9]. However, in cases of metabolic derangement, cells and tissues that are normally sensitive to insulin develop resistance in such a way that they no longer respond to insulin levels in the blood [9, 10]. This invariably leads to compensatory hyperinsulinemia to facilitate glucose uptake by target tissues, attempting to normalize blood glucose levels [11]. In the majority of cases, insulin resistance has no overt clinical manifestations, particularly at the early stages when beta-cells are still able to compensate by vigorously producing more insulin [12].

Correlation studies have found that excessive fat accumulation in the upper body, including abdominal subcutaneous deposition and visceral deposition, are associated with the development of hypertension, dyslipidemia and insulin resistance [13]. Apple-shaped bodies characterized by central or abdominal visceral obesity and therefore have a greater risk of developing insulin resistance than pear-shaped bodies, in which the excess fat is primarily distributed in the lower part of the body [14, 15].

Multiple sets of criteria for diagnosing metabolic syndrome have been proposed over the past decade. In 2001, the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) presented a straightforward diagnostic framework that establishes diagnosis when any three of the following five criteria are met:

1. High waist circumference (WC) ≥ 102 cm in males and ≥ 88 cm in females.
2. High triglycerides (TG) level ≥ 150 mg /dl or drug treatment for high TG.
3. Low HDL-C level < 40 mg/dL for males and < 50 mg/dL for females, or drug treatment for low HDL-C.
4. High fasting plasma glucose (FPG) level > 110 mg/dL or drug treatment for high glucose.
5. High systolic blood pressure (SBP) ≥ 130 mmHg, diastolic blood pressure (DBP) ≥ 85 or drug treatment for hypertension.

Apart from reducing the threshold for high FPG from 110 to 100 mg/dl, the current American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) statement maintains the original ATP III criteria. This revised criterion corresponds to the update of the American Diabetes Association regarding impaired fasting glucose [4].

Both hypertension and metabolic syndrome are significant independent risk factors for cardiovascular disease and their coexistence doubles the overall risk due to mutual synergism. Despite being two closely related conditions, none of the existing antihypertensive medications are approved for treating hypertension in the presence of metabolic syndrome [16]. Many studies have examined the angiotensin receptor blocker telmisartan and have found that it has helpful properties in preventing and improving metabolic syndrome. Although determining the optimal dose for such indication requires large and prolonged clinical trials, this medication might be suggested as a suitable alternative due to its positive impact on hypertension, obesity, diabetes mellitus, and dyslipidemia [17].

Numerous diverse studies have investigated the prevalence of metabolic syndrome worldwide, however only a limited number have focused on metabolic syndrome in patients with hypertension [18]. For example, Sorkhou et al [19] assessed the prevalence of MetS utilizing NCEP-ATP III criteria among a cohort of 250 patients with hypertension who followed Mishref Family Practice Health Center in Kuwait. The prevalence was 34%, with 56.4% of the participants being females and 43.5% males. Furthermore, 41.9% of those who met the MetS criteria were aged above 55 years [19].

On the other hand, in a hospital-based study in China, Hsu et al [8] addressed the prevalence and characteristics of metabolic syndrome in Chinese patients with hypertension. Among the 426 participants, prevalence was 47.9%, with a higher trend towards females who also exhibited a significantly higher metabolic syndrome score [8].

In a study conducted in Jordan, Yasein et al [20] evaluated the prevalence of MetS among 345 hypertensive patients at family clinics in the University of Jordan Hospital. The study found that 65% of the patients had MetS, with a higher proportion of females meeting the ATP III criteria for diagnosis [20].

Similarly, in their study on the prevalence of MetS and the adequacy of NCEP-ATP III diagnostic criteria in Nigerian patients with hypertension, Ogbu and Ugwuja [21] conducted research at the University of Nigeria Teaching Hospital. They randomly selected 436 patients and found a MetS prevalence of 45.6% that is a higher in females than in males (54% vs 36.4%). The study also highlighted diagnostic limitations in the ATP III criteria, particularly with respect to WC and HDL-C, and it proposed adjustments to enhance the accuracy of diagnosis among this specific population [21].

In another study conducted by Govindula et al [22] at Mahatma Gandhi Memorial Hospital in India, the aim was to explore the relationship between hypertension and metabolic syndrome as risk factors for cardiovascular disease. A cohort of 120 patients with hypertension were included and a significant majority (82.5%) met the NCEP-ATP III criteria for diagnosis [22].
Recently, Bamekhlah et al [18] conducted a study at Al-Rayan Specialized Hospital in Yemen to evaluate the prevalence of metabolic syndrome among 345 patients with hypertension. The study reported a prevalence of 60% with a predominance among females compared to males. Diabetes mellitus was the most common MetS criterion, while low HDL-C was the least frequent. The study also revealed that more than 50% of the study population fulfilled four criteria while around one third fulfilled all five criteria [18].
In Libya, prior studies have been conducted to investigate the prevalence of metabolic syndrome in general populations in Al-Qardah Al-Shati [23] and in diabetic populations in Benghazi [24]. However, based on the author's understanding, no prior study has explored the prevalence among Libyan hypertensive patients. Therefore, this study aimed to investigate the prevalence and clinical characteristics of metabolic syndrome in a population of adult patients attending the hypertension clinic at Al-Kish Polyclinic in Benghazi. Such a study will inspire physicians to confidently diagnose and appropriately treat those high-risk patients to prevent serious and deadly complications.

METHODS

Study design

A cross-sectional study included adult hypertensive outpatients who were examined sequentially over a period of six months from January 2020 to June 2020 at Al-Kish Polyclinic in Benghazi, Libya.

Study population

The study population included 200 adult patients who either had pre-existing hypertension or were newly diagnosed during their initial visit to the hypertension clinic. Participation in the study was limited to patients who provided informed consent.

Exclusion criteria

We excluded patients with advanced chronic kidney disease, Class III/IV congestive cardiac failure according to New York Heart Association, decompensated liver cirrhosis, secondary causes of obesity or hypertension, and pregnant women.

Collection of data

The collection of demographic data was done through a clinician patient interview and detailed medical history was taken including participant age, gender, history of chronic diseases and any prescribed medications.

Clinical and anthropometric evaluations

Blood pressure readings were obtained using an aneroid sphygmomanometer with an adequate size cuff. A special cuff was used to measure blood pressure in markedly obese participants. The participant was allowed to rest on a chair for 5-10 minutes with no smoking or consumption of coffee or alcohol in the 30 minutes before measurement. The first and fifth Korotkoff sounds were used to identify systolic and diastolic blood pressure measurements, respectively. The average of two readings separated by five-minute interval was recorded.
Following this, waist circumference, a vital anthropometric parameter, was measured at the end of exhalation utilizing a 1 cm wide non-stretchable tape with a minimum scale division of 0.1 cm. The participants were instructed to stand upright with minimal clothing during the procedure. The tape was positioned horizontally, midway through an imaginary line between the inferior margin of the last rib and the superior border of the iliac crest, without exerting pressure on the skin or soft tissues. Two measurements were taken, and the mean value was documented

Biochemical evaluation

The participants were instructed to fast overnight (10-12 hours) before sample collection for the biochemical evaluation, which included analyzing their fasting lipid profile and plasma glucose levels.

Definitions

Adhering to the revised NCEP-ATP III guidelines, hypertension was diagnosed if SBP ≥ 130 and/or DBP ≥ 85 mmHg, or if patients were already taking antihypertensive medication. Subsequently, patients were assessed to determine if they met the criteria for metabolic syndrome according to the NCEP-ATP III guidelines.

Data Analysis

Data was analyzed and processed using the SPSS Statistics software, version 27. Basic descriptive statistics, such as mean and standard deviation, were employed to introduce the numerical variables of the participants. Student's t-test was used to examine the differences in the mean while Pearson's chi-square test was employed to compare the prevalence of metabolic between genders. Statistical significance was denoted by p-values below 0.05. Figures were created using Microsoft Excel 2010.

Ethics

Informed consent was obtained from the study participants as a demonstration of their willingness to engage in the research. The purpose of the study and the evaluation process were also explained in depth and easily understood terms for the few patients who were illiterate. This approach exhibited the authors' commitment to ethical research guidelines and ensured that participants had a clear understanding of the study in which they were involved. To safeguard confidentiality and privacy, personal details of participants, including identities and addresses, were omitted from the study documentation.

RESULTS

The study was conducted during the period from January 1st, 2020, to June 28th, 2020, and enrolled 200 adult hypertensive patients, of whom 134 (67%) were females and 66 (33%) were males, with a mean age of 51.32 ± 8.9 years. The study found that 146 (73%) of the participants fulfilled the diagnostic criteria of Modified NCEP-ATP III for metabolic syndrome (Figure 1) with a predominance among females (74.7% vs 25.3%, p-value < 0.001).

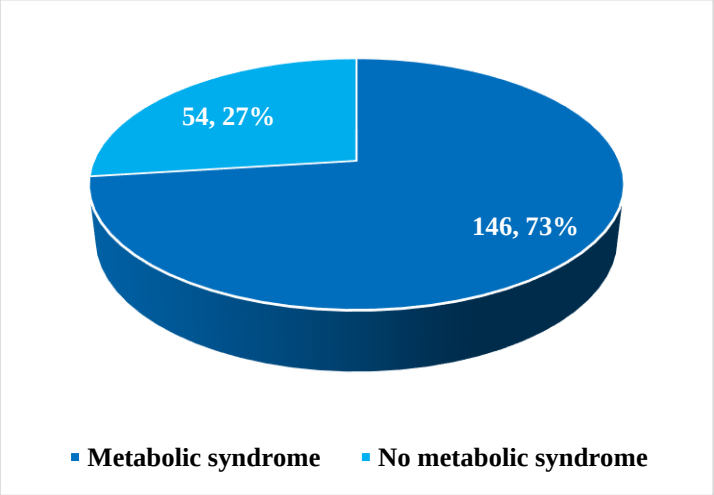

Figure 1. Prevalence of metabolic syndrome among the study participants

The study further revealed that female hypertensive patients exhibited an elevated metabolic syndrome score in comparison to their male counterparts, showcasing a statistically significant difference (3.4 ± 0.9 vs to 2.8 ± 1.3, with a p-value = 0.003).

Among the study participants, patients with metabolic syndrome had a mean age of 52.13 ± 8.6 years, which was significantly older than non-metabolic syndrome patients (49.11 ± 9.3 years, p-value = 0.03). When participants were stratified by age group, the prevalence of metabolic syndrome was 56.3% among patients < 40 years and 74.5% among those ≥ 40 years (p-value = 0.14). See Table 1 for additional examination of the data.

Table 1. Prevalence of metabolic syndrome according to age group

Age groups	Metabolic syndrome	No metabolic syndrome	Total
Age < 40 years	9 (56.3%)	7 (43.7%)	16 (100%)
Age ≥ 40 years	137 (74.5%)	47 (25.5%)	184 (100%)
Total	146 (73%)	54 (27%)	200 (100%)

After pre-existing hypertension, which was the inclusion criterion for the study participants, the most common of the modified NCEP-ATPIII criteria was high waist circumference (168, 84%), whereas the lowest one was type II DM (64, 32%). The prevalence of other criteria was as follows: low HDL-C (106, 53%), high TG (89, 44.5%), and impaired FPG (77, 38.5%). The frequency of individual MetS abnormalities was significantly higher in patients with metabolic syndrome than in those without metabolic syndrome (p-value < 0.001). For comprehensive analysis, refer to the data presented in table 2.

Table 2. Frequency of metabolic syndrome components among the study participants

Variables	Total	Metabolic syndrome	No metabolic syndrome	p-value
High WC	168 (84%)	140 (95.9%)	28 (51.9%)	< 0.001
Low HDL-C	106 (53%)	101 (69.2%)	5 (9.3%)	< 0.001
High TG	89 (44.5%)	84 (57.5%)	5 (9.3%)	< 0.001
Impaired FPG	77 (38.5%)	73 (50%)	4 (7.4%)	< 0.001
Type II DM	64 (32%)	61 (41.8%)	3 (5.6%)	< 0.001

With exception of SBP and DBP readings, the mean values of clinical, anthropometric, and biochemical variables were significantly higher in metabolic syndrome patients than in non-metabolic syndrome participants, as shown in Table 3. The text continues here (Figure 2 and Table 2).

Table 3. Clinical and biochemical characteristics of the study participants

Characteristics	Metabolic syndrome	No metabolic syndrome	p-value
Age	52.13 ± 8.6	49.5 ± 9.3	0.03
WC	108.5 ± 10.8	101.6 ± 12.3	< 0.001
HDL-C	44.16 ± 12.2	55.5 ± 17.4	< 0.001
TG	170.7 ± 84.8	112.3 ± 39.5	< 0.001
FPG	115.1 ± 29.1	97.0 ± 11.1	< 0.001
SBP	141.5 ± 17.2	140.3 ± 17.9	0.6
DBP	88.3 ± 11.9	87.6 ± 11.4	0.7

By analyzing the metabolic syndrome score, it was noted that (59, 29.5%) of the study participants met three criteria, whereas (55, 27.5%) met four criteria and (32, 16%) fulfilled all five criteria for metabolic syndrome, as shown in **Error! Reference source not found.** . It was also noted that (43, 21.5%) of the study participants were at a high risk of developing metabolic syndrome since they already have met two of the five criteria.

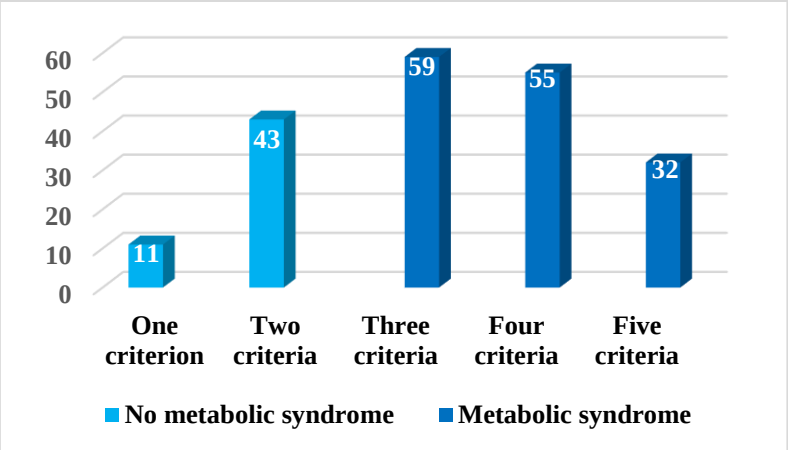

Figure 2. Distribution of study participants according to metabolic syndrome score

DISCUSSION

The prevalence of metabolic syndrome observed in this study was comparable to a prevalence of 71.6% from a hospital-based study in Brazil [25] but higher than many similar studies conducted in the Middle East region, such as 34% in Kuwait, [19] 51.6% in Iran, [26] 60% in Yemen [18] and 65% in Jordan [20]. Similarly, it exceeded the prevalence documented by many African studies. For example, Ogbu and Ugwuja [21] found a prevalence of 45.6% among adult hypertensive patients attending Outpatient clinics of the University of Nigeria Teaching Hospital. Additionally, Tadewos et al [27] reported a prevalence of 48.2% from Hawassa University Comprehensive Specialized Hospital in Ethiopia, while N'guetta et al [28] revealed a prevalence of 48.4% at Abidjan Heart Institute in Côte d'Ivoire.

On the other hand, figures from Asian studies were variable, with Govindula et al [22] from India found a higher prevalence of 82.5% while Hsu et al [8] from China found a lower prevalence of 47.9%. These worldwide figures signify the high prevalence of metabolic syndrome, which could be attributed to the conjunction of hypertension with the components of metabolic syndrome, namely, obesity, glucose intolerance, and dyslipidemia [29]. Understanding the variations in metabolic syndrome prevalence across different regions not only highlights the significance of genetic and lifestyle factors in shaping disease profiles but also aids in developing region-specific interventions.

The observed pattern of metabolic syndrome predominance among females (74.7%) synchronized with similar findings from other studies worldwide, including 73.8% from Jordan [20], 72% from Iran [26], 69% from Côte d'Ivoire [28], 67.5% from Yemen [18], 56.4% from Kuwait [19], 54% from Nigeria [21], and 52.3% from China [8]. In contrast, Govindula et al [22] reported a prevalence of metabolic syndrome predominantly among Indian males.

Regarding metabolic syndrome score, this study found that females had a higher score compared to males. This result was consistent with a study by Hsu et al [8], which revealed lower mean scores for both genders (2.8 ± 1.2 for females and 2.4 ± 1.2 for males). This disparity in metabolic syndrome severity between genders highlights the importance of personalized therapeutic strategies that consider the gender-specific differences in metabolic risk profiles.

The age distribution analysis also yielded an interesting outcome. The authors noted that patients with metabolic syndrome were older and had a higher average age compared to those without the syndrome. This finding emphasizes the association between advanced age and the development of metabolic syndrome and insulin resistance [22]. While this observation was consistent with literature from several studies [8, 18-20], a report by Bulhoes and Araújo [25] from Brazil presented a different perspective, indicating that patients with no metabolic syndrome had a slightly higher mean age in comparison to those with the syndrome (61.17 ± 12.44 vs. 60.52 ± 9.64).

The observed sequence of metabolic syndrome components in this study mirrors the findings documented by Bulhoes and Araújo [25] from Brazil and Thakur et al [30] form India. The prevalence of high waist circumference as the most common component resonates with results from Jordan [20] and Côte d'Ivoire [28]. Conversely, type II DM as the least frequent component, was also noted by Yasein et al [20] from Jordan. Noteworthy is the report by Bamekhlah et al [18] from Yemen, which highlighted type II DM as the most prevalent criterion among the metabolic syndrome components.

Through subgroup analysis, the authors determined that approximately 22% of the metabolic syndrome patients fulfilled all five criteria. This percentage was lower than the 34.8% reported by Bamekhlah et al [18] but higher than the 10.8% reported by Salagre et al [31]. Such patients may be at an increased risk for atherosclerotic cardiovascular disease, including ischemic heart disease and cerebrovascular disease.

CONCLUSION

The study revealed a highly significant prevalence of metabolic syndrome among study participants (73%), with more than 40% having four or five criteria according to the NCEP-ATP III definition. There were notable gender and age disparities in metabolic syndrome prevalence, with females exhibiting a higher prevalence, and more than 74% of diagnosed patients were 40 years of age or older. High waist circumference was the most prevalent criterion of metabolic syndrome, whereas type II diabetes mellitus was the least frequent.

Based on the study results, the authors recommend integrating routine screenings for metabolic syndrome components into clinical practice. They also advocate for conducting longitudinal studies to monitor metabolic syndrome over time to evaluate the impact of therapeutic interventions on mitigating its risks.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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معدل انتشار وخصائص متلازمة الأيض لدى مرضى ارتفاع ضغط الدم الذين يترددون على وحدة للرعاية الأولية في بنغازي

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قسم الباطنة، كلية الطب البشري، جامعة بنغازي، بنغازي، ليبيا

المستخلص

متلازمة الأيض هي مجموعة من عوامل الخطر القلبية الوعائية والتي تزيد من احتمالية الإصابة بأمراض القلب والأوعية الدموية ومعدل الوفيات العامة. على الرغم من الدور الحيوي لارتفاع ضغط الدم في متلازمة الأيض، إلا إن الإحصائيات حول انتشار متلازمة الأيض بين المرضى الليبيين المصابين بارتفاع ضغط الدم تعد نادرة. لذا، هدفت هذه الدراسة إلى تحديد انتشار وسمات متلازمة الأيض لدى مرضى ارتفاع ضغط الدم البالغين في وحدة للرعاية الأولية في بنغازي، ليبيا. نوع الدراسة مقطعية وتمت في الفترة من يناير إلى يونيو 2020، تضمنت 200 مشارك. باستخدام الإرشادات المعدلة لبرنامج التثقيف الوطني للكوليسترول – لوحة علاج البالغين – الجزء الثالث، تم تصنيف المشاركين إلى مجموعتين: مجموعة تعاني من متلازمة الأيض ومجموعة أخرى لا تعاني منها. تم تجميع البيانات وتحليلها باستخدام برنامج إحصائيات SPSS، الإصدار 27. تألفت عينة الدراسة من 134 فرد من الإناث و66 من الذكور بمتوسط أعمار 51.32 ± 8.9 سنة. استوفت نسبة كبيرة من المشاركين (73%) المعايير التشخيصية للمتلازمة الأيضية، بمتوسط أعمار 52.13 ± 8.6 سنة، وهو متوسط أكبر من المرضى الذين لا يعانون من متلازمة الأيض. سادت الإناث في مجموعة المرضى المصابين بمتلازمة الأيض (74.7% مقابل 25.3%، القيمة الاحتمالية أقل من 0.001)، وأيضا أظهرت الإناث درجة أيضية أعلى من الذكور (3.4 ± 0.9 مقابل 2.8 ± 1.3، القيمة الاحتمالية = 0.003). فيما يتعلق بمعايير متلازمة الأيض، فقد استوفى 29.5% ثلاثة معايير، واستوفى 27.5% أربعة معايير، فيما استوفى 16% المعايير الخمسة جميعها. كما أن المرضى المصابين بمتلازمة الأيض أظهروا تكرارات وقيمًا متوسطية أعلى وذات دلالة إحصائية لمكونات متلازمة الأيض مقارنة بالمرضى الذين لا يعانون منها (القيمة الاحتمالية أقل من 0.001). الجدير بالذكر أن قياسات محيط الخصر المرتفعة كانت المعيار الأكثر انتشارًا (84%)، في حين أن معدل انتشار مرض السكري من النوع الثاني هو الأقل (32%). في الختام، تؤكد الدراسة على أهمية الكشف المبكر عن متلازمة الأيض في المرضى المصابين بارتفاع ضغط الدم، مما يسهم في توصيل الرعاية الصحية بكفاءة أكبر لهذه الفئة في ليبيا.

الكلمات المفتاحية. ارتفاع ضغط الدم، مقاومة الأنسولين، متلازمة التمثيل الغذائي، معايير برنامج التثقيف الوطني للكوليسترول – لوحة علاج البالغين – الجزء الثالث.