Metabolically Healthy Obese Subjects

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ABSTRACT

Introduction: Obesity is a well-known risk factor for type 2 diabetes and cardiovascular diseases. However, the prevalence of these disorders varies greatly due to highly heterogeneous metabolic clinical situations. A subtype of obesity, termed "metabolically healthy obesity" (MHO), includes obese individuals with a significantly lower risk of cardiometabolic complications. This phenotype can be assessed by various definitions, which still lack consensus.

Objective: Our study aimed to identify metabolically healthy obese (MHO) subjects among obese adults consulting at the department of Clinical Physiology and Functional Explorations, Metabolic and Nutrition Unit (CHU Annaba, Algeria), and to determine their percentage of body fat mass.

Materials and Methods: The present study is a retrospective cross-sectional study. Inclusion Criteria were adults Aged 18–65 years, BMI ≥ 30 kg/m², and metabolic syndrome parameters.

The criteria used to define the phenotype MHO were Lavie and al.'s recent harmonization proposal: BMI ≥ 30 kg/m² and none of the components of metabolic syndrome. 61 patients were selected according to the inclusion criteria.

Conclusion: This study showed that a non-negligible frequency of obese patients consulting at our department were metabolically healthy according to strict definition criteria. Special attention should be given to these patients to help them maintain their metabolic health and prevent conversion to an unhealthy metabolic profile.

Keywords: obesity, metabolic syndrome, insulin resistance, metabolically healthy obese.

INTRODUCTION

Obesity has reached epidemic proportions in recent decades in developed countries and more recently in developing countries (1).

Obesity is a significant risk factor for type 2 diabetes, cardiovascular diseases, several types of cancer, and is thus associated with increased mortality. Moreover, obese individuals are more likely to suffer from osteoarthritis, chronic pain, asthma, gallbladder diseases, and poor quality of life (2).

However, it is increasingly recognized that obesity is not a homogeneous condition, and a subset of obese individuals may not exhibit disturbed metabolic profiles or increased risk of cardiometabolic diseases.

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This obesity sub-phenotype is referred to as Metabolically Healthy Obesity (MHO) in the literature. Conversely, obesity with metabolic risk factors is called Metabolically Unhealthy Obesity (MUO) (3).

No universally accepted definition of MHO exists to date, impacting the accurate estimation of this phenotype's prevalence and complicating comparisons between studies.

The current global obesity epidemic is one of the greatest public health challenges of this century. Current approaches to treating obesity have limited success, making obesity treatment a real challenge. The concept of MHO could offer new opportunities by allowing stratification of obese individuals according to their metabolic phenotype rather than BMI alone. This stratification could prioritize patients who would benefit most from weight loss treatments and reduce the socioeconomic costs associated with obesity treatments (5). The MHO phenotype may also play a significant role in clinical practice, particularly regarding treatment goals and the development of new obesity therapies. However, the lack of a unified definition of metabolic health hinders its clinical relevance, and recent data on the evolution of this phenotype question its utility as a stratification strategy (6).

Objective: To identify the frequency of the MHO phenotype according to Lavie and al.'s criteria among obese patients consulting at the Clinical Physiology and Functional Explorations, Metabolic and Nutrition Unit (CHU Annaba, Algeria), and to determine the clinical and biological characteristics of the MHO subjects found in this study.

MATERIALS AND METHODS

Materials

Target Population Definition:

Our study analyzed the records of all adult obese patients meeting selection criteria and consulting at the department of Clinical Physiology and Functional Explorations, Metabolic and Nutrition Unit (CHU Annaba, Ibn Rochd Hospital) between January 2019 and September 2020. Among 189 patients recruited during the study period, only 61 met the inclusion criteria.

Selection Criteria:

Inclusion: Obese patients, BMI $\geq$ 30 kg/m², aged 18–65, with records containing weight, height, and all components of metabolic syndrome.

Exclusion:

1. Age <18 or >65
2. Pregnant women
3. BMI <30 kg/m²
4. Incomplete records (missing metabolic parameters: blood pressure, triglycerides, HDL cholesterol, fasting glucose)

II.2. Methods

Study Type, Location, and Period:

Retrospective cross-sectional study at CHU Annaba, at department of Clinical Physiology and Functional Explorations, Metabolic and Nutrition Unit, analyzing records of obese patients from January 2019 to September 2020.

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Design and procedure :

Data Collection:

Data were collected from records using a data sheet with five sections:

1. Identification, demographic, and socioeconomic data
2. Toxic habits (smoking, alcohol), personal comorbidities (hypertension, type 2 diabetes, dyslipidemia, cardiovascular diseases)
3. Physical activity and sedentary behavior assessment
4. Clinical and anthropometric data: weight, height, BMI, blood pressure
5. Biological assessments: fasting glucose, lipid profile (triglycerides, HDL-C, LDL-C, total cholesterol)

Anthropometric Measurements:

1. Weight measured by bioimpedance scale
2. Height measured barefoot with wall stadiometer
3. BMI calculated as weight (kg) divided by height squared (m^2)

Physical Activity Assessment:

WHO (World Health Organization) defines physical activity as any bodily movement produced by skeletal muscles requiring energy expenditure (7). Sedentary behavior is defined as a waking behavior with energy expenditure close to resting (≤1.5 METs) in a sitting or lying position (8,9). Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ), classifying individuals as active, moderately active, or inactive (10).

Biological Assessments:

Collected before obesity treatment initiation, after a 12 hour fast.

Blood Pressure:

Measured at the first consultation, seated after 10 minutes rest, with a manual sphygmomanometer.

Definitions:

Obesity: BMI ≥ 30 kg/m^2 (WHO) (11).

1. Grade I: 30–34.9
2. Grade II: 35–39.9
3. Grade III: ≥40

MHO Phenotype (Lavie and al.) (12,13,14):

BMI ≥ 30 kg/m^2 and none of the following metabolic syndrome criteria:

- Serum triglycerides ≥1.7 mmol/L (150 mg/dL) or on lipid-lowering treatment
- HDL-c <1.0 mmol/L (<40 mg/dL in men), <1.3 mmol/L (<50 mg/dL in women)

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- Systolic blood pressure SBP ≥130 mmHg and/or diastolic blood pressure DBP ≥85 mmHg or on antihypertensive treatment
- Fasting glucose ≥5.6 mmol/L (100 mg/dL) or on hypoglycemic treatment

II.3. Statistical Analysis:

Data analyzed using SPSS (version 20). Results expressed as means and standard deviations for quantitative variables, counts (n), and percentages (%) for qualitative variables.

RESULTS AND DISCUSSION

III.1. MHO Subjects

III.1.1. Frequency of MHO (Lavie and al. criteria):

Total number of MHO subjects: 8, representing 13.11% of the studied population. MHO prevalence: 13.2% in women, 14.28% in men.

III.1.2. MHO Characteristics:

III.1.2.3.Distribution of MHO patients by sex :

The obese patients with the MHO phenotype were predominantly female.

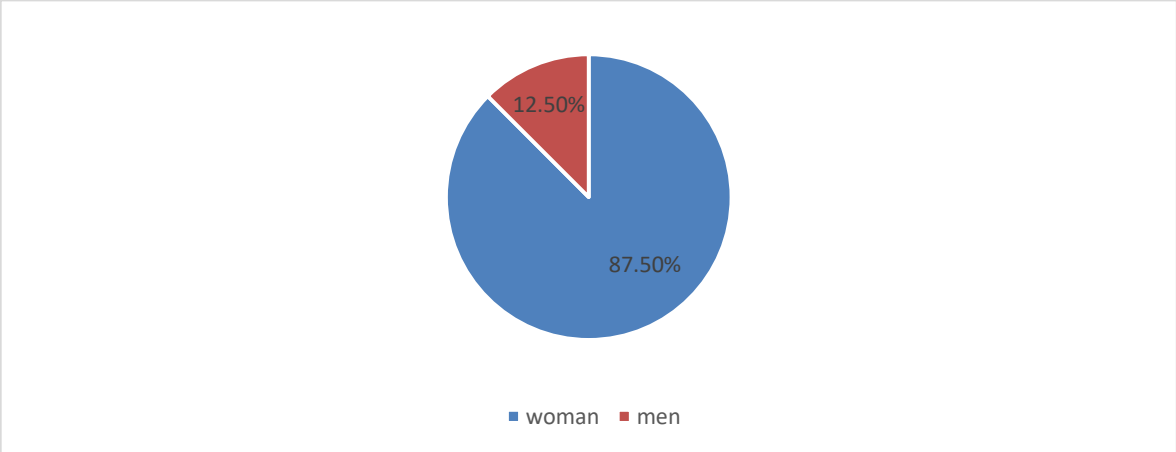

Figure 1: Distribution of MHO patients by sex

III.1.2.2.Distribution of MHO patients by Age:

Average age was 30.75 years (±10.15). 50% aged 18–24. No MHO patients aged 56–65.

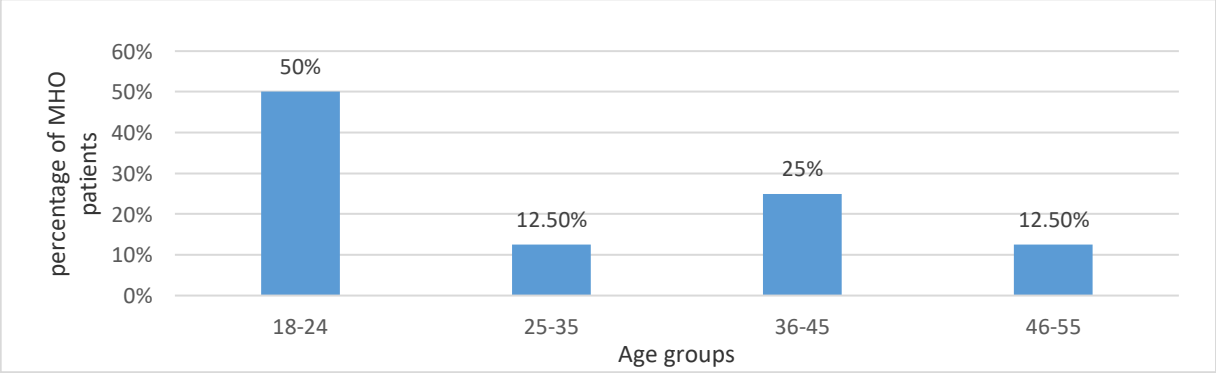

Figure 2 : Distribution of MHO patients by Age

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III.1.2.3.Distribution of MHO patients by Marital Status:

Half of the patients was single.

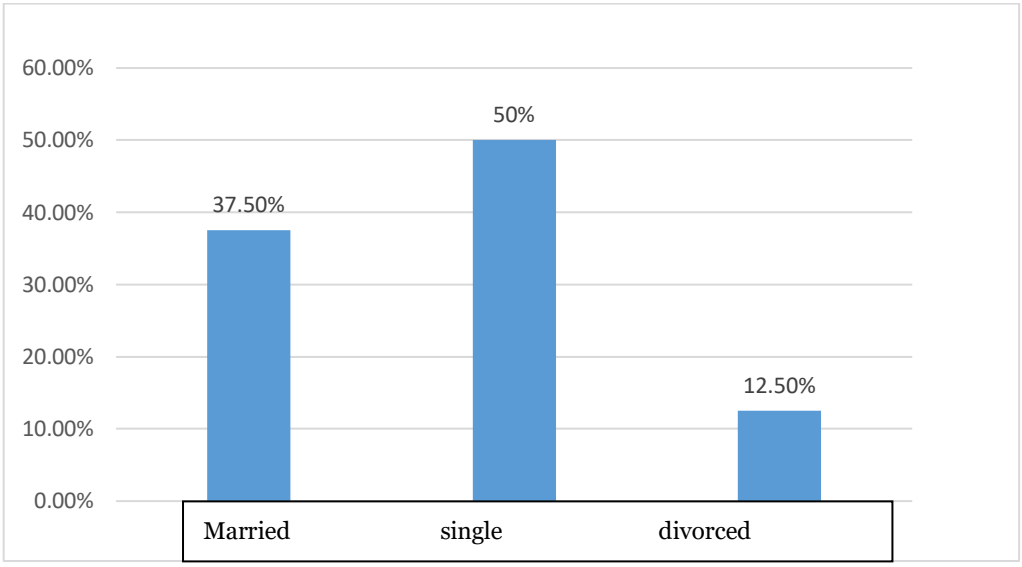

Figure 3: Distribution of MHO patients by Marital Status

III.1.2.4. Distribution of MHO patients by BMI:

62.5% had grade III obesity. Average BMI was 39.96 kg/m² (±6.90).

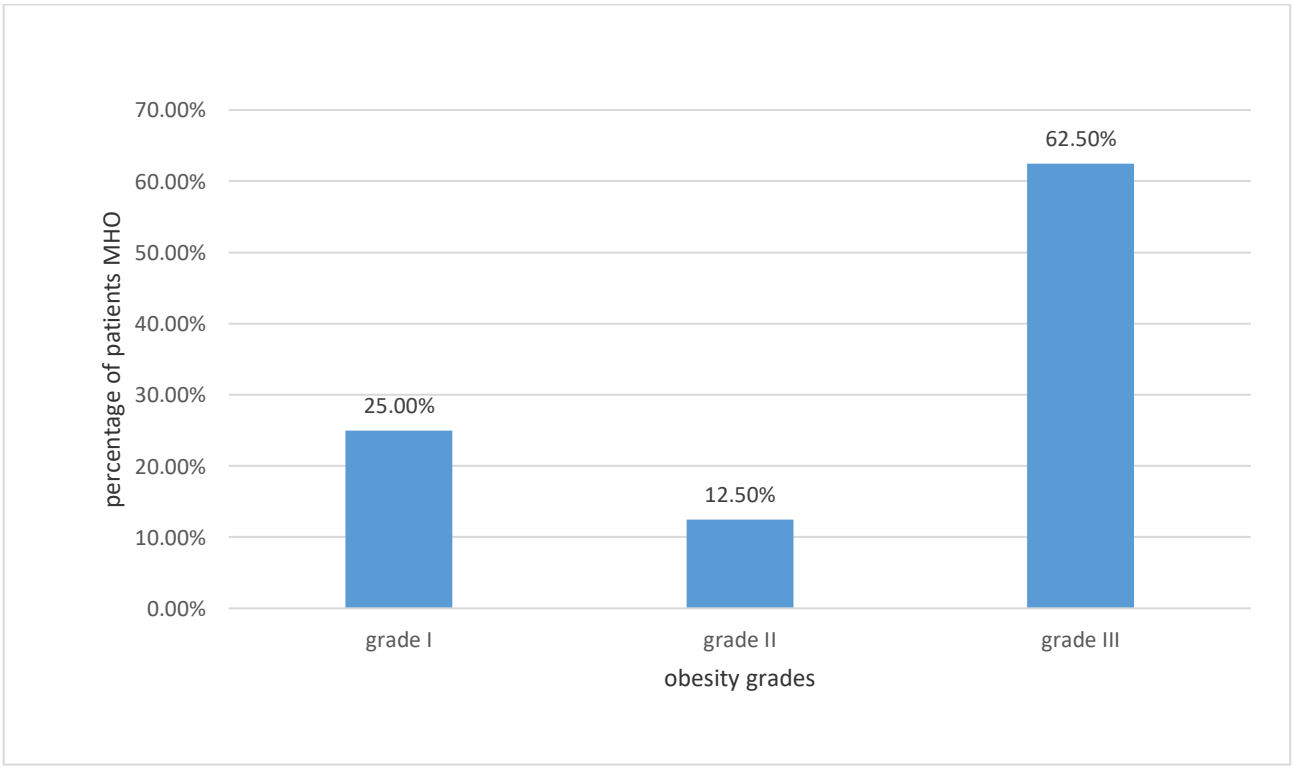

Figure 4 : Distribution of MHO patients by BMI

III.1.2.5.Distribution of MHO patients by Physical Activity/Sedentarity:

87.5% inactive per IPAQ.

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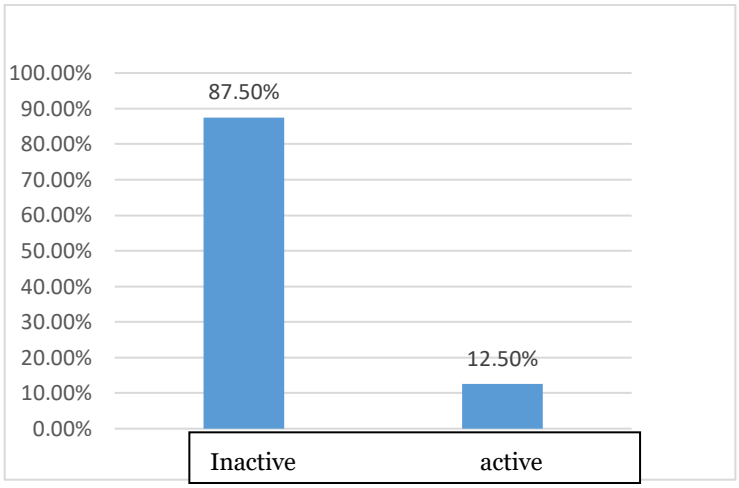

Figure 5: Distribution of MHO patients by Physical Activity/Sedentarity

III.1.2.6.Distribution of MHO patients by blood pressure and Biological Assessments:

Table 1: Blood pressure data and the biological profile of MHO patients

Parameter	mean	Standard deviation	minimum	maximum
Fasting blood glucose(g/L)	0,89	0,7	0,8	0,97
HDL-C (g/L)	0,517	0,557	0,44	0,71
Triglycérides (g/L)	0,93	0,148	0,71	1,07
Cholesterol total (g/L)	1,50	0 ,33	1,02	2,08
LDL-C (g/L)	0,892	0,21	0,70	1,37
SBP (mmHg)	117,5	4,62	110	120
DBP (mmHg)	71,25	3,53	70	80

DISCUSSION:

In this study, we used the Lavie et al. criteria to define the “metabolically healthy obese” (MHO) phenotype: BMI ≥ 30 kg/m² and 0 criteria for metabolic syndrome according to the 2009 consensus.

Our results showed that 13.11% of obese patients were metabolically healthy (Figure 01). Our findings are close to those reported in the literature by studies that used the absence of metabolic syndrome criteria as the definition for MHO.

In the prevalence estimate by Gordan and al. (15), the prevalence of MHO with 0 metabolic syndrome criteria was 13%.

Van Vliet-Ostaptchouk et al., within the BioSHaRE-EU project (16), defined MHO as having 0 metabolic syndrome criteria. Their results showed that nearly 12.1% of obese individuals were MHO.

Cătoi et al. (17) used the Lavie et al. criteria to define the MHO phenotype and found a MHO

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percentage of 22.22% among obese subjects, but the studied population consisted solely of patients with morbid obesity.

A study on the MHO phenotype was found in Algeria, that of Guedjati and al. conducted at Batna University Hospital (18). Their population was composed only of women, and they used two definitions of metabolic health: the modified Wildman definition (with at least 2 criteria to consider an obese individual as MHO) and the 2009 consensus criteria for metabolic syndrome (less than three criteria to define MHO). Their results cannot be compared with those of our study because the definitions used are not the same.

The mean age of metabolically healthy obese individuals in our study was 30.75 years (±10.15 years), the most represented age group was 18-24 years, and no MHO patients were found in the 56-65 year age group (Figure 02). These data are consistent with those in the literature, where MHO is more commonly found among young people (5, 15, 34, 35).

The mean BMI among MHO patients was 39.96 kg/m² (±6.90) and 62% of MHO patients had grade III obesity (Figure 04). This is consistent with some data reporting that MHO and MUO do not differ in terms of BMI but rather in body fat distribution (15). However, it does not agree with other studies that have reported that MHO is more frequent among obese individuals with BMI ≤35 kg/m² (21).

Regarding biological parameters, the minimum HDL-c value was 0.44 and the maximum fasting blood glucose was 0.97 in MHO patients (Table 01). These two values are close to the upper and lower limits of normal (according to the 2009 consensus definition of metabolic syndrome) and could be factors for transition from MHO to MUO in the long term, as reported by some studies (22, 23).

Only 25% of MHO patients were considered active according to the physical activity assessment used (Figure 05).

A metabolic and cardiorespiratory exercise test is better suited for the objective measurement of physical activity and cardiorespiratory fitness, which has been identified as an important physiological trait for metabolic health independent of BMI (24). However, we do not have this test available in our department.

This study has some limitations that should be acknowledged. First, it is based on retrospective data, which may introduce a selection bias. Second, the absence of cardiorespiratory tests prevents a full assessment of the participants' functional capacity. Finally, certain inflammatory markers were not included in the protocol. Despite these constraints, our work provides a relevant initial insight that can be further developed through prospective studies with a more comprehensive protocol.

Perspectives

One of the major current challenges in research on the MHO phenotype is the lack of a clear and universal definition. Indeed, the prevalence of this profile can vary significantly, ranging from 7% to 30% depending on the criteria used and the studies conducted. To advance the field, it is important to harmonize methods in order to enable comparisons across studies and establish more reliable diagnostic criteria for MHO.

Although cross-sectional studies describe the metabolic profile at a single point in time, most highlight that this phenotype is often transient. Many individuals classified as MHO tend to develop metabolically unhealthy obesity (MUO) over time. Therefore, longitudinal studies are essential to better understand the factors driving this transition, particularly the influence of age, sex, physical activity level, and dietary habits.

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CONCLUSION

Metabolically healthy obesity is a concept based on clinical observations that a subgroup of obese individuals do not exhibit overt cardiometabolic abnormalities. No universally accepted definition exists, though harmonized definitions have been proposed. MHO prevalence varies by definition and study characteristics.

Our retrospective cross-sectional study at CHU Annaba found that 13.11% of obese patients were metabolically healthy by strict criteria, with half being young adults (18–24 years). However, MHO individuals remain at higher risk for type 2 diabetes, cardiovascular diseases, and mortality compared to healthy lean individuals. Additionally, half of MHO individuals may transition to MUO over time. Therefore, obesity treatment should also be recommended for these patients to prevent complications and preserve metabolic health.

The lack of standard MHO definitions and treatment guidelines limits its integration into clinical practice. Nonetheless, it is important to suggest a healthy lifestyle, such as adopting the Mediterranean diet proven effective in preventing cardiovascular diseases in obese individuals and regular physical activity. A moderate weight loss of 10% may suffice to maintain metabolic health in this phenotype. Bariatric surgery has also been shown effective in MHO subjects and may be considered per current recommendations. The MHO phenotype could also serve as a treatment target for MUO patients to facilitate adherence to prescribed regimens.

Conflict of Interest: The authors declare no conflicts of interest related to this article.

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