

Sarcopenic Obesity as a Complication of Overweight and Obesity – a Summary of Knowledge

Jan Jurgiel^{1,A,B,C,D,E}

ORCID: 0000-0003-1011-002X

Patryk Karabin^{2,A,B,C,D}

ORCID: 0009-0008-0606-5063

Adrianna Graniak^{1,A,B,C,D}

ORCID: 0000-0001-5484-8320

Konrad Józwik^{3,A,B,C,D}

ORCID: 0000-0001-6326-5098

Piotr Opyd^{1,A,B,C,D}

ORCID: 0000-0002-2409-2785

Michał Lis^{1,4,A,D,E,F}

ORCID: 0000-0001-7675-398X

¹ Department of Internal Diseases with the Endocrinology and Diabetology Subunit, Nephrology and Dialysis Center, Czerniakowski Hospital, Warsaw;

² Jędrzej Śniadecki Specialist Hospital, Nowy Sącz;

³ Multi-Specialist Regional Hospital, Gorzów Wielkopolski; ⁴ Lazarski University, Warsaw

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ABSTRACT

Sarcopenic Obesity as a Complication of Overweight and Obesity – a Summary of Knowledge

Jurgiel J.¹, Karabin P.², Graniak A.¹, Józwik K.³, Opyd P.¹, Lis M.¹

¹ Department of Internal Diseases with the Endocrinology and Diabetology Subunit, Nephrology and Dialysis Center, Czerniakowski Hospital, Warsaw; ² Jędrzej Śniadecki Specialist Hospital, Nowy Sącz; ³ Multi-Specialist Regional Hospital, Gorzów Wielkopolski; ⁴ Lazarski University, Warsaw

The contemporary trend towards elevated consumption of processed food and a sedentary lifestyle has induced noticeable alterations in body composition observed in the population. These unprecedented changes have given rise to the emergence of novel pathological conditions, including sarcopenic obesity. This condition is characterized by an excessive accumulation of body fat in conjunction with skeletal muscle depletion and functional impairments. Diagnosis hinges upon a comprehensive evaluation of medical history and the performance of functional and imaging studies. The therapeutic strategy relies on the appropriate dietary regimen and increased physical activity. Current scientific research in the domain of sarcopenic obesity is advancing significantly, with potential pharmacotherapy involving novel weight-loss medications and other strategies addressing this health issue.

Keywords: sarcopenic obesity, obesity, sarcopenia, overweight

STRESZCZENIE

Otyłość sarkopeniczna jako powikłanie nadwagi i choroby otyłościowej – podsumowanie wiedzy

Jurgiel J.¹, Karabin P.², Graniak A.¹, Józwik K.³, Opyd P.¹, Lis M.¹

¹ Oddział Chorób Wewnętrznych z Pododdziałem Endokrynologiczno-Diabetologicznym, Pododdziałem Nefrologicznym i Stacją Dializ, Szpital Czerniakowski Sp. z o.o., Warszawa; ² Szpital Specjalistyczny im. Jędrzeja Śniadeckiego, Nowy Sącz; ³ Wielospecjalistyczny Szpital Wojewódzki, Gorzów Wielkopolski; ⁴ Uczelnia Łazarskiego, Warszawa

Współczesny trend związany ze wzmożonym spożyciem wysoko przetworzonej żywności oraz prowadzeniem siedzącego trybu życia spowodował zauważalne zmiany w składzie ciała obserwowane w populacji. Te bezprecedensowe zmiany skutkują pojawieniem się nowych jednostek chorobowych, takich jak otyłość sarkopeniczna. Stan ten charakteryzuje się nadmiernym gromadzeniem tkanki tłuszczowej w połączeniu z utratą masy mięśniowej oraz ograniczeniami funkcjonalnymi. Postępowanie diagnostyczne opiera się na dokładnym wywiadzie lekarskim oraz przeprowadzeniu badań czynnościowych i obrazowych pozwalających na rozpoznanie tej patologii oraz wdrożenie odpowiedniego postępowania terapeutycznego opartego na zbilansowanej diecie i zwiększeniu aktywności fizycznej. Problematyka otyłości sarkopenicznej jest tematem wielu badań naukowych dotyczących możliwości farmakoterapii przy użyciu nowych leków redukujących masę ciała oraz innych strategii terapeutycznych.

Słowa kluczowe: otyłość sarkopeniczna, choroba otyłościowa, sarcopenia, nadwaga

Introduction

The ageing of the population, in conjunction with the escalating obesity epidemic, has contributed to a notable increase in the prevalence of sarcopenic obesity (SO). This pathological state is characterized by excessive fat deposition accompanied by skeletal muscle atrophy and functional impairment [1]. While estimates indicate that nearly ten per cent of the global adult population is affected by this condition, epi-

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demiological data display considerable heterogeneity based on the adopted diagnostic criteria [2, 3]. Recognizing the significance of sarcopenic obesity as a distinct disease entity, the European Society for Clinical Nutrition and Metabolism (ESPEN) and the European Association for the Study of Obesity (EASO) issued a consensus statement in 2022, offering a comprehensive definition and diagnostic framework [4]. Given its widespread occurrence and detrimental effects on patients' quality of life, healthcare professionals from diverse specialities should display an interest in understanding sarcopenic obesity.

Methods: Literature Search and Study Selection

A narrative literature review was performed by searching MEDLINE via PubMed. To be included in the article, all studies had to be peer-reviewed and written in English. In vitro studies and animal model research were excluded from our analysis. The search was performed using the following keywords: *obesity AND muscle loss, obesity AND sarcopenia, overweight AND muscle loss, overweight AND sarcopenia*. Additionally, publications and articles for which the full text could not be accessed were also excluded.

After the initial screening, the articles were critically assessed for eligibility by authors (J.J., P.K.). Our search included all literature related to the topic of aetiology, clinical criteria in diagnosis, and management of sarcopenic obesity in the articles from the year 2000.

Pathomechanism

Sarcopenic obesity commonly occurs with ageing, characterized by an increased relative ratio of fat to muscle [5]. This change is linked to reduced physical activity in this population, contributing significantly to a caloric surplus and subsequent fat deposition [6]. Prolonged inactivity and limited exercise negatively affect muscle protein turnover, leading to muscle atrophy [7]. General weakness, decreased muscular strength and endurance in this group of patients contribute to a sedentary lifestyle, perpetuating a vicious circle. Inappropriate dietary patterns among these individuals, coupled with an excessive caloric intake and inadequate protein supply, further intensify muscle breakdown, exacerbating the catabolic process. Additionally, inadequate vitamin D3 levels have been associated with the development of this entity [8]. These alterations coincide with metabolic disruptions associated with adipose tissue accumulation. Metabolically active adipose tissue produces tissue hormones that exacerbate oxidative stress, inflammation, and insulin resistance [9, 10], thereby promoting muscle protein

breakdown [11, 12]. These changes involve cellular-level processes, including mitochondrial dysfunction in muscle tissue cells, resulting in resistance to anabolic hormones and increased protein catabolism [13]. Ectopic fat deposition in muscle tissue, stemming from excessive adipose tissue expansion, is a common consequence of obesity. This state can induce metabolic lipotoxicity characterized by heightened oxidative and inflammatory processes, along with the accumulation of detrimental diacylglycerols and ceramides in myocytes [14, 15].

Diagnosis

The recommendations from ESPEN and EASO concerning the diagnosis of sarcopenic obesity primarily emphasize screening, accurate diagnosis, and the evaluation of disease severity [4]. Screening for sarcopenic obesity entails assessing the simultaneous presence of an elevated body mass index (BMI) using WHO standards (or another validated method of measuring excessive body weight), as well as identifying indicators of sarcopenia using validated questionnaires like SARC-F and considering the presence of risk factors and clinical symptoms (table 1).

Table 1. Clinical symptoms of suspicion factors for the screening of sarcopenic obesity

1. Age >70 years
2. Chronic disease diagnosis included but not limited to: <ol style="list-style-type: none"> a. Chronic heart failure b. Chronic kidney disease c. Chronic bowel failure or dysfunction d. Chronic liver disease (particularly NASH and liver cirrhosis) e. Chronic respiratory disease f. Chronic neurologic and neurodegenerative diseases g. Chronic cognitive impairment h. Depression i. Organ transplantation j. Endocrine disease k. Osteoarthritis l. Cancer
3. Recent acute disease/nutritional events <ol style="list-style-type: none"> a. Recent hospitalization b. Recent major surgery or trauma c. Recent sustained immobilization or reduced mobility d. Recent history of reduced food intake e. Recent weight loss f. The recent rapid increase in weight g. Long-standing restrictive diets and bariatric surgery
4. History of <ol style="list-style-type: none"> a. Repeated falls b. Weakness, exhaustion c. Fatigability d. Perceived progressive movement limitations

Adapted from: Donini et al.: Definition and Diagnostic Criteria for Sarcopenic Obesity: ESPEN and EASO Consensus Statement, Obes Facts 2022;15: 321–335.

To confirm or refute a positive screening outcome, a more precise evaluation of muscle strength and body composition analysis is required. Muscle strength can be assessed using a handgrip strength test employing a dynamometer, where the patient performs three squeezes, and the average value is calculated from the three measurements. A diagnosis of muscle weakness is made if the average result falls below 26 kg for men and 16 kg for women [16]. Alternatively, the chair-stand test (5-time sit-to-stand test, 30-s chair-stand test) can be used regarding appropriate reference values for sex, ethnicity, and age [17]. For body composition analysis, DXA (dual-energy X-ray absorptiometry) or BIA (bioelectrical impedance) testing should be conducted [18, 19].

Once the diagnosis of sarcopenic obesity is confirmed, patients should be categorized into one of two stages:

Stage 1: Sarcopenic obesity without complications

Stage 2: Sarcopenic obesity with the presence of at least one complication related to excessive body weight and/or muscle weakness and atrophy, such as cardiovascular disease, mobility disability, or osteoporosis [4].

Clinical implications and management

The loss of muscle tissue with coexisting obesity leads to significant health consequences, including an increased risk of developing frailty syndrome, which adversely affects the quality of life, particularly in older individuals [20]. Frailty syndrome is characterized by a state of vulnerability and diminished physiological reserve, leading to an elevated susceptibility to adverse health outcomes. In individuals with sarcopenic obesity, the presence of frailty syndrome compounds the negative impact on their overall well-being. Furthermore, obesity-related muscle atrophy in patients with chronic diseases is associated with higher mortality rates and a poorer prognosis [21,22]. The metabolic consequences of sarcopenic obesity encompass an elevated risk of metabolic syndrome, increased tissue resistance to insulin, and the presence of dyslipidemias or hypertension. Individuals with sarcopenic obesity also commonly experience reduced physical performance and imbalance, resulting in a higher frequency of falls. This, coupled with the heightened risk of osteoporosis observed in these patients, increases the susceptibility to fractures and immobilization [23].

Prevention of the development of sarcopenic obesity necessitates the implementation of a comprehensive approach encompassing both physical activity and dietary management. Existing research findings indicate that solely implementing dietary

changes without incorporating regular exercise may exacerbate the progression of sarcopenia [24]. To maximize the desired outcomes, resistance exercises, which have been proven to be effective in increasing muscle mass and strength, should be prioritized. In addition, incorporating aerobic exercises, such as walking, into the exercise regimen can expedite fat loss and further enhance the overall impact of the intervention.

In the randomized controlled clinical trials FranSO and FORMOsA-SOS, Kemmler et al. observed a positive impact of the combination of whole-body electromyostimulation with a protein-rich diet on muscle mass accrual and fat reduction among elderly individuals afflicted with sarcopenic obesity [25, 26]. While the outcomes demonstrate a less pronounced effect compared to resistance and aerobic exercise regimens, it can be useful within the population unable to perform physical activities. However, the study encountered a notable limitation as the intervention failed to exert a statistically significant impact on obesity within the same demographic. This outcome prompts critical consideration, especially given the increasing prevalence of sarcopenic obesity in aging populations. Moreover, the challenges encountered in recruiting the intended sample size of 75 individuals, despite a rigorous screening process, introduce a potential source of bias. Espinoza et al. described the other possible intervention with the use of intranasal oxytocin, which in their study led to an increase in lean body mass and a reduction in the low-density lipoprotein fraction among elderly individuals afflicted by sarcopenic obesity [27]. Additionally, it's noteworthy that oxytocin administration, despite increasing lean mass, did not translate into improved physical function, possibly due to the chosen assessment's limitations and the short treatment duration. These nuanced findings underscore the need for further research to optimize oxytocin interventions and broaden our understanding of their comprehensive effects. However, both of those interventions – described by Kemmler and Espinoza – seem to be less potent than the implementation of resistance and aerobic training.

The implementation of a well-designed dietary plan is of paramount importance in the effective management of sarcopenic obesity. Special consideration should be given to ensuring an appropriate consumption of complete protein, usually advised within the range of 1.2–1.6 grams per kilogram of body weight [28]. Additionally, in cases of vitamin D3 deficiency, it is advisable to consider supplementation at a dosage of 2000–4000 IU per day [29]. Seeking guidance from a certified nutritionist for personalized nutritional consultation is highly recommended to customize dietary recommendations based on the individual's unique re-

quirements and preferences. It is essential to remain mindful of protein restriction in patients diagnosed with chronic kidney disease and an estimated glomerular filtration rate lower than 30 ml/min/1.73 m². Similarly, elderly patients should avoid excessively restrictive diets due to the higher susceptibility to hypoglycemia and the subsequent risk of dangerous falls and fractures [30]. On the other hand, pharmaceutical agents commonly employed for weight reduction purposes, including orlistat, phentermine, naltrexone/bupropion, or liraglutide, are yet to demonstrate their efficacy in effectively treating sarcopenic obesity. Consequently, it is not advised to recommend their administration in sarcopenic obesity until sufficient evidence supporting their usefulness emerges. Nevertheless, bariatric surgery may be considered a potential treatment modality, warranting careful evaluation and consultation with healthcare professionals [23, 31].

Further research is needed in two crucial populations. Firstly, within the pediatric population, there is a pressing need for a comprehensive investigation. In 2022, Zembura and Matusik conducted a systematic literature review examining the prevalence and complications of sarcopenic obesity in children and adolescents [32]. Unfortunately, the inconclusive nature of the results and conclusions can be attributed to the disparate methodologies and definitions of sarcopenic obesity applied across the various studies. The reported prevalence of sarcopenic obesity among this group exhibited significant variation, ranging from 7% to well over 80%, primarily because of differences in the diagnostic criteria used. Therefore, it is imperative to establish a consensus on diagnostic criteria for sarcopenic obesity within the pediatric population.

Similarly, there is a dearth of data concerning individuals with malignancies. The issue of comorbidity involving sarcopenic obesity in cancer patients has garnered growing attention. In a meta-analysis conducted in 2022, Gao et al. demonstrated that sarcopenic obesity significantly reduces recurrence-free periods, elevates the occurrence of postoperative complications, and extends hospitalization durations among cancer patients [33]. Furthermore, the authors highlighted the prevalence of sarcopenic obesity within this patient group, emphasizing the necessity for systematic screening and diagnosis of sarcopenic obesity in cancer patients. However, there are limitations within the analysis which are related to relatively small samples, different diagnostic criteria across the studies, and limited data related to non-digestive cancers. Notwithstanding, appropriate screening and management would facilitate the implementation of appropriate therapeutic interventions, subsequently improving patient prognosis.

Conclusions and Future Directions

1. The comprehensive understanding of the pathomechanism in sarcopenic obesity remains an ongoing pursuit, necessitating intensified research efforts to unravel the molecular and physiological basis. Such endeavours promise to afford valuable insights into prospective therapeutic targets.
2. There is a necessity for intensive screening for sarcopenic obesity in different cohorts of patients to characterize the prevalence of this entity.
3. It is crucial to formulate nutritional protocols specific to sarcopenic obesity, entailing the definition of exact macro and micronutrient constituents in dietary plans. Additionally, guidelines should be formulated for recommended physical activity, distinguishing between aerobic and resistance training, and specifying the intensity and frequency of such activities.
4. A group of special interest should be immobile patients for whom it is not possible to implement exercise training and rehabilitation.
5. The use of novel pharmaceutical interventions in sarcopenic obesity remains understudied. Further randomized controlled trials should be conducted to investigate the efficacy of these drugs in addressing the multifaceted challenges associated with sarcopenic obesity.

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Address for correspondence:

Jan Jurgiel
Stępińska 19/25
00-739 Warszawa
tel: +48 22 31 86 328
e-mail: jan.jurgiel@szpitalczerniakowski.waw.pl
