Prevalence and risk factors of dynapenia in women during the climacteric period

Dinapenia em mulheres climatéricas: prevalência e fatores de risco

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Abstract

Introduction: The climacteric is a critical stage in women's lives, characterized by hormonal decline and body changes such as reduced muscle strength, which increase the risk of falls, fractures, and mortality, thereby compromising quality of life. **Objective:** To investigate the prevalence of dynapenia and its associated factors in climacteric women. **Methods:** This cross-sectional, analytical, epidemiological study used probabilistic sampling and included climacteric women enrolled in the Family Health Strategy units of Montes Claros, Minas Gerais state, Brazil, between August and October 2024. Data collection included sociodemographic information, gynecological-obstetric history, anthropometric measures, and physical fitness assessments. Dynapenia, the outcome variable, was evaluated using handgrip strength measurement. Associations between dynapenia and explanatory variables were tested through bivariate analyses followed by Poisson's regression with robust variance in a hierarchical model. **Results:** Among the 533 women evaluated, 43.9% had dynapenia. The condition was positively associated with having a partner, body fat percentage above the median, and below-median performance on the modified push-up test. By contrast, body mass index was identified as a protective factor against dynapenia. **Conclusion:** Dynapenia was highly prevalent and associated with sociodemographic, clinical, and behavioral factors. Identifying determinants of dynapenia during the climacteric is essential for developing effective preventive and intervention strategies to promote women's health and quality of life.

Keywords: Muscle strength. Menopause. Climacteric.

Resumo

Introdução: *O climatério é um período significativo na vida da mulher, marcado pela redução hormonal e por alterações corporais como o declínio da força muscular, que eleva o risco de quedas, fraturas e mortalidade, impactando a qualidade de vida.* ***Objetivo:*** *Estimar a prevalência e os fatores associados à dinapenia em mulheres climatéricas.* ***Métodos****: Trata-se de uma pesquisa epidemiológica, transversal e analítica, com amostragem probabilística, realizada com mulheres climatéricas atendidas nas Estratégias de Saúde da Família de Montes Claros, Minas Gerais, entre agosto e outubro de 2024. As variáveis referiram-se a fatores sociodemográficos, características gineco-obstétricas, medidas antropométricas e avaliação da aptidão física. A variável desfecho, dinapenia, foi avaliada por meio da mensuração da força de preensão manual. A associação entre as variáveis estudadas e a presença de dinapenia foi verificada por análise bivariada seguida de regressão de Poisson, com variância robusta, em modelo hierarquizado.* ***Resultados:*** *Das 533 mulheres avaliadas, 43,9% apresentaram dinapenia. A condição manteve-se associada a fatores como ter companheiro, percentual de massa gorda acima da mediana e desempenho inferior à mediana no teste de flexão de braço. Por outro lado, o índice de massa corporal mostrou-se um fator de proteção contra a dinapenia.* ***Conclusão:*** *Verificou-se elevada prevalência de dinapenia e sua associação com fatores sociodemográficos, clínicos e comportamentais. A compreensão dos fatores determinantes da dinapenia durante o climatério é fundamental para o desenvolvimento de estratégias eficazes de prevenção e intervenção, com vistas a promover a saúde e a qualidade de vida.*

Palavras-chave: *Força muscular. Menopausa. Climatério.*

Introduction

The climacteric is a key physiological stage in women's lives and typically occurs between 45 and 55 years of age, marking the transition from reproductive to non-reproductive years. It is divided into three phases: perimenopause, menopause, and postmenopause.[1] During this transition, ovarian function progressively declines, leading to reduced hormone levels and permanent loss of fertility,[2] affecting more than 500 million women worldwide every year.[3]

Beyond reproductive changes, the climacteric is associated with important alterations in body composition, including increased central adiposity, reduced muscle mass, and decreased bone mineral density.[4] These changes, largely driven by declining estrogen levels, directly compromise muscle strength and may lead to the development of dynapenia.[5]

Defined as the age-related loss of muscle strength, dynapenia is increasingly recognized as a significant public health issue.[6] Reduced muscle strength has been linked to severe clinical outcomes, including osteoporosis, osteosarcopenia, falls, fractures, mobility loss, functional dependence, and higher mortality risk.[7,8] Collectively, these consequences substantially affect the quality of life of women during the climacteric.

Multiple factors contribute to dynapenia in this population, such as abdominal obesity, metabolic syndrome, dyslipidemia, impaired glucose metabolism,[4] vitamin D deficiency,[9] age at menopause, and reduced bone mineral density.[10] Given that the climacteric involves heightened physiological and psychosocial vulnerability, identifying the determinants of dynapenia is crucial to inform preventive and care strategies.

As the main gateway to the health system, Primary Health Care (PHC) provides a strategic setting for early detection, risk assessment, and interdisciplinary interventions aimed at health promotion and active aging. Aligning research with public health policies for women strengthens integrated strategies for preventing chronic conditions and enhances the quality of care within Brazil's National Health System (SUS, Portuguese acronym for *Sistema Único de Saúde*).

Accordingly, this study aimed to estimate the prevalence of dynapenia and identify its associated factors in climacteric women receiving care in PHC. Specifically, its describes their sociodemographic, gynecological, anthropometric, physical fitness, and clinical profiles. We hypothesize that dynapenia is highly prevalent among climacteric women, associated with sociodemographic, clinical, and anthropometric factors, and remains underdetected due to insufficient systematic screening in PHC.

Methods

This study analyzed baseline data from the project titled "Assessment of the health conditions of climacteric women: a longitudinal study", conducted between July and October 2024. It adopted a cross-sectional, analytical, epidemiological design and included climacteric women receiving care from 166 Family Health Strategy

(FHS) teams in Montes Claros, Minas Gerais state, Brazil. Eligible participants were women aged 40-65 years enrolled in the FHS. Women were excluded if they failed to attend data collection after three attempts, were pregnant or postpartum, bedridden, or had neurological or neurogenerative diseases.

Participants were recruited by FHS teams in collaboration with Community Health Agents, using a pre-existing list of women registered in the Primary Health Care Information System. The study was authorized by the Municipal Health Department and Primary Health Care Coordination of Montes Claros. Recruitment occurred from July 1 to August 10, 2024, and data collection took place in person at selected health units from August 12 to October 25, 2024. Both urban and rural FHS units participated, with assessments scheduled in advance.

A probabilistic sampling strategy was applied. Based on the 2024 registry of women in the FHS (n = 54,964) and an expected dynapenia prevalence of 17.7% (from national estimates), a sample size of 223 women was calculated, assuming a 95% confidence level and 5% margin of error. To enhance precision, allow stratified analyses, and account for potential losses, 533 participants were ultimately included, thereby improving methodological rigor and the statistical power of inferential analyses.

A pilot study was conducted in one FHS unit with women in the target age range after interviewer training and before data collection, to test the questionnaire, physical assessment procedures, and interviewer performance. Since no adjustments to the instruments were necessary, field data collection proceeded as planned. Data included sociodemographic characteristics, gynecological-obstetric history, anthropometric measures, and physical fitness assessment.

To minimize assessment bias, the evaluators responsible for handgrip strength (HGS) measurement and physical tests were blinded to the participants' clinical and sociodemographic characteristics. Blinding was ensured by separating the interview and physical assessment stages, which were conducted by different professionals at different times.

The outcome variable, dynapenia, was assessed by HGS measured with an Instrutherm DM90 digital hydraulic dynamometer, following recommendations of the American Society of Hand Therapists. Volunteers were seated, with the shoulder adducted and in neutral rotation, the elbow flexed at 90º, and the forearm and wrist in neutral positions. After demonstration by the evaluator, participants were asked to perform maximal contractions sustained for five seconds, with one-minute intervals between measurements. The dominant hand was tested, and the arithmetic mean of the three trials was used for analysis, following the most reliable method for HGS assessment.[11] Dynapenia was diagnosed using the cutoff proposed by the European Working Group on Sarcopenia in Older People 2 (EWGSOP 2): HGS < 16 kg/f.[12]

Explanatory variables included sociodemographic characteristics: skin color (classified by Brazilian Institute of Geography and Statistics criteria: black, brown, white, yellow, or indigenous, later characterized as white/non-white); marital status (with or without a partner); education (more than high school/high school or less); and income (>minimum wage/up to one minimum wage).

Gynecological variables included reproductive age (≥ 33 years/< 33 years) and climacteric phase (pre-/post-menopause). Data were collected through self-reported questionnaires. Women with irregular menstrual cycles aged 46-51 years were classified as premenopausal and those with no menstrual cycle for at least 12 months and aged ≥ 52 years as postmenopausal.[13]

Anthropometric assessments included body mass index (BMI), calculated based on weight (kg), determined using a digital scale (Líder®, model P-150 C), and height, (m) measured with a stadiometer. BMI classification followed the latest guidelines from the Brazilian Association for the Study of Obesity and Metabolic Syndrome[14]: underweight (< 18.5), normal (18.6-24.9), overweight (25-29.9), grade I obesity (30-34.9), grade II obesity (35-39.9), and grade III obesity (≥ 40). For analysis, BMI was dichotomized as normal versus altered, according to Marques et al.[15]

Abdominal obesity was determined by waist circumference (WC) measured at the iliac crest at the end of normal expiration. Participants with WC ≥ 88 cm were classified as obese.[16] WC was further dichotomized as normal or altered. Bioimpedance analysis was used to evaluate visceral fat (VF) (< 7.00/≥ 7.00), basal metabolic rate (BMR) (≥1 .402/< 1.402 kcal), and body fat percentage (BFP) (< 26.30/≥ 26.30), all dichotomized at the median.

Abdominal strength was measured using the one-minute sit-up test proposed by Medeiros et al.[17] Participants lay supine with feet secured and hands behind

the head, and were instructed to touch their knees with their elbows during trunk flexion. The total number of correct repetitions in one minute was recorded and dichotomized at the median (16 repetitions).

Upper limb strength was assessed through a modified push-up test: participants performed maximal cycles of elbow flexion and extension in a prone position, with hands on the floor at shoulder width.[17] The number of valid repetitions was recorded, requiring full elbow extension and flexion to at least five centimeters from the floor; knees could support the body during the movement. No time limit was imposed, and pauses were not permitted. Results were dichotomized at the median of 12 repetitions.

Clinical variables were obtained via self-report: "Has any physician ever diagnosed you with diabetes?" and "Has any physician ever diagnosed you with hypertension"? (yes/no).[18,19] Musculoskeletal symptoms and osteoporosis were classified as absent or present based on Sá and Santos.[20]

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS), version 21. Descriptive statistics summarized the distribution of explanatory variables. Bivariate analyses identified associations with dyapenia, and variables with $p \leq 0.20$ were entered into the multivariate analysis. Adjusted analyses used Poisson regression with robust variance within a hierarchical framework: sociodemographic variables formed the distal (1st-level) block; gynecological, anthropometric, and clinical variables the second-level block; and physical fitness variables (abdominal and upper limb strength) the proximal (third-level) block (Figure 1). Prevalence ratios (PR) with 95% confidence intervals (CI) were reported; statistical significance was set at 5% ($p < 0.05$).

The study was approved by the Research Ethics Committee of Centro Universitário FIPMOC (protocol no. 6.154.120/2023) and the Municipal Health Department of Montes Claros. All participants provided written informed consent after receiving information about the study objectives, evaluation procedures, and voluntary nature of participation.

Results

A total of 533 climacteric women enrolled in FHS units were evaluated, of whom 43.9% (n = 234) presented dynapenia.

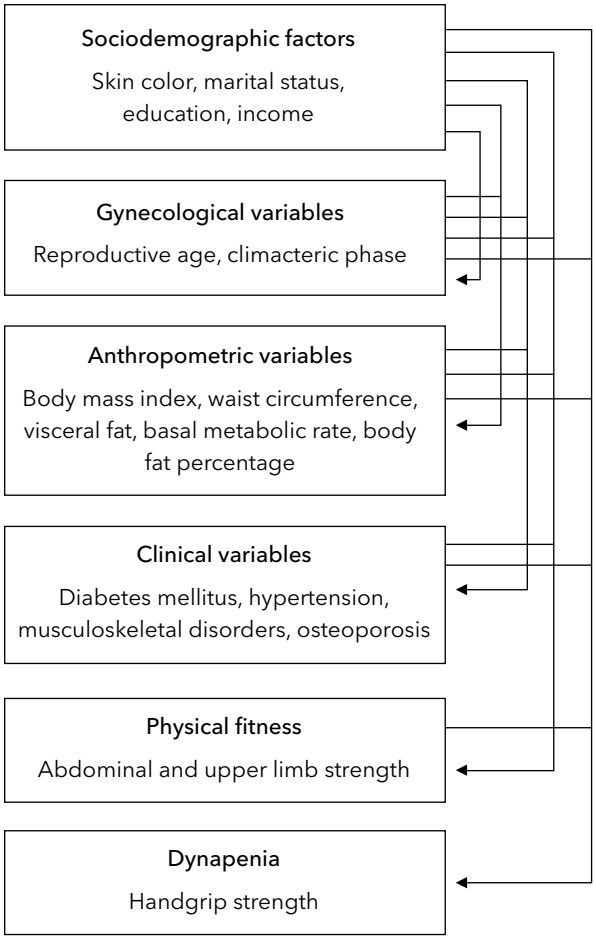

Figure 1 - Hierarchical model of factors associated with dynapenia in climacteric women.

Most participants self-identified as non-white, lived with a partner, had completed at least high school, and reported an income above the minimum wage. In relation to gynecological variables, the majority had a reproductive age of ≥33 years and were classified as postmenopausal. With respect to anthropometric characteristics, most women presented altered BMI and WC, VF < 7, BMR < 1402, and BFP < 26.3. For physical fitness variables, the majority performed below the median in both the one-minute sit-up and modified push-up tests. In terms of clinical variables, most participants reported not having diabetes or osteoporosis; however, hypertension and musculoskeletal disorders were prevalent. Table 1 presents the results of the bivariate analysis of associations between sociodemographic, gynecological, anthropometric, and physical fitness factors with dynapenia, while Table 2 presents the association between clinical variables and dynapenia.

Table 1 - Explanatory factors associated with dynapenia in climacteric women (Montes Claros, Brazil, 2024)

Variables	n (%)	Crude PR (95%CI)	p-value
Sociodemographic variables			
Skin color			
White	90 (16.9)	Reference	
Non-white	443 (83.1)	0.87 (0.63 - 1.12)	0.434
Marital Status			
With partner	274 (51.4)	Reference	
Without partner	259 (48.6)	1.30 (1.01 - 1.68)	**0.046**
Education			
> High School	390 (73.2)	Reference	
≤ High School	143 (26.8)	1.22 (0.91 - 1.67)	**0.196**
Income			
> 1 minimum wage	178 (33.4)	Reference	
≤ 1 minimum wage	355 (66.6)	0.87 (0.65 - 1.14)	0.322
Gynecological variables			
Reproductive age			
≥ 33 years	258 (48.4)	Reference	
< 33 years	275 (51.6)	1.09 (0.85 - 1.42)	0.491
Climacteric phase			
Pre-menopause	230 (43.2)	Reference	
Post-menopause	303 (56.8)	1.00 (0.77 - 1.30)	0.997
Anthropometric variables			
Body mass index			
Normal	193 (36.2)	Reference	
Altered	340 (63.8)	0.76 (0.59 - 0.99)	**0.038**
Waist circumference			
Normal	73 (13.7)	Reference	
Altered	460 (86.3)	0.84 (0.60-1.22)	0.347
Visceral fat			
< 7.00	277 (52.0)	Reference	
≥7.00	256 (48.0)	1.10 (0.84 - 1.42)	0.479
Basal metabolic rate			
≥ 1,402kcal	264 (49.5)	Reference	
< 1,402 kcal	269 (50.5)	1.25 (0.96 - 1.62)	**0.092**
Body fat percentage			
< 26.30	268 (50.3)	Reference	
≥ 26.30	265 (49.7)	0.82 (0.63 - 1.06)	**0.139**
Physical fitness			
One-minute sit-up test			
Above median	14 (2.6)	Reference	
Below median	519 (97.4)	0.60 (0.34 - 1.22)	**0.119**
Modified push-up test			
Above median	260 (48.8)	Reference	
Below median	273 (51.2)	1.34 (1.04 - 1.75)	**0.025**

Note: PR = crude prevalence ratio at 0.25; 95% CI = 95% confidence interval. Bold values mean significant results where p-value < 0.05.

Table 2 - Clinical variables associated with dynapenia in climacteric women (Montes Claros, Brazil, 2024)

Variables	n (%)	Crude PR (95%CI)	p-value
Diabetes mellitus			
Absent	463 (86.9)	Reference	
Present	70 (13.1)	0.72 (0.46 - 1.08)	**0.136**
Hypertension			
Absent	248 (46.5)	Reference	
Present	285 (53.5)	1.01 (0.79 - 1.31)	0.908
Musculoskeletal disorders			
Absent	240 (45.0)	Reference	
Present	293 (55.0)	1.02 (0.79 - 1.33)	0.858
Osteoporosis			
Absent	396 (74.3)	Reference	
Present	137 (25.7)	1.21 (0.91 - 1.59)	**0.186**

Note: PR = crude prevalence ratio at 0.25; 95% CI = 95% confidence interval. Bold values mean significant results where p-value < 0.05.

Table 3 - Adjusted prevalence ratios of factors associated with dynapenia in climacteric women (Montes Claros, Brazil, 2024)

Variables	Adjusted PR (95% CI)	p-value
Marital status		
With partner	Reference	
Without partner	1.10 (1.00 - 1.23)	0.026
Body mass index		
Normal	Reference	
Altered	0.66 (0.50 - 0.88)	0.000
Body fat percentage		
<26.30	Reference	
≥26.30	1.33 (1.02 - 1.73)	0.005
Physical fitness		
Modified push-up test		
Above median	Reference	
Below median	1.12 (1.00 - 1.26)	0.014

Note: PR = crude prevalence ratio at 0.25; 95% CI = 95% confidence interval.

Table 3 presents the statistical significance of all independent variables (sociodemographic, anthropometric, and physical fitness) tested for their association with impaired HGS. In multivariate analysis, absence of a partner (PR = 1.10), higher BFP (PR = 1.33), and lower performance in the modified push-up test (PR = 1.12) were independently associated with increased prevalence of dynapenia. Conversely, overweight and obesity were protective factors against reduced HGS (PR = 0.66), indicating greater strength in women with higher BMI values.

Discussion

This study identified the prevalence of dynapenia and its associated factors in a substantial sample of climacteric women receiving care in PHC services in a major city in northern Minas Gerais. Although cutoff points for dynapenia vary across studies, several national findings align with the present results.[21-23] Previous Brazilian studies[21-23] reported high dynapenia prevalence among women. Alexandre et al.[21] found a prevalence of 34.4% in older women living in São Paulo in a cross-sectional study of 1,168 participants, while Leite et al.[22] reported 56.5% prevalence among older women attending a primary care unit in the Federal District. Additionally, Borges et al.[23] analyzed data from the Brazilian Longitudinal Study of Aging (ELSI-Brazil) and recorded a prevalence of 27.5% among women aged 65 years or older. Internationally, a cross-sectional study at Ramaiah Medical College and Hospital in India evaluated 106 postmenopausal women aged 56-65 years and found that 60.4% exhibited poor HGS, while 39.6% had normal values. [24]

García-Alfaro et al.[25] studied 249 postmenopausal women aged 50-84 years at Dexeus University Women's Hospital in Spain and reported dynapenia prevalence of 31.3%, which falls within the intermediate range of previous studies (7.7 - 52.4%) influenced by age, geographic location, and ethnicity. A subsequent study by García-Alfaro et al.[26] of 402 postmenopausal women aged 47-83 years found a prevalence of 25.6%, with higher rates in women over 65 years (42.1%) compared to those 65 years or younger (16.8%).

During menopause, women experience both muscle loss and a significant decline in muscle strength, which compromise functional capacity. Its close association with overall health and well-being in postmenopausal women makes HGS particularly relevant in this context.[27] Reduced HGS can compromise performance of daily activities, increase the risk of falls and immobilization, and lead to loss of independence, which negatively affect quality of life.[28]

Multivariate analysis revealed a greater prevalence of dynapenia in women without a partner. These findings are consistent with Zhou et al.,[29] who also identified an association between dynapenia and sociodemographic factors, suggesting that lack of social support, such as the absence of a partner, may exacerbate muscle strength decline in this population. Similarly, Borges et al.[23] observed higher dynapenia prevalence among individuals without a partner, highlighting the influence of marital status and living conditions on muscle health.

In the present study, altered BMI was identified as a protective factor against dynapenia. This finding aligns with Mahishale and Kulkarni,[30] who reported a positive correlation between higher BMI and the presence of dyapenia in a cross-sectional study of 65 postmenopausal women. One possible explanation for this apparent contradiction lies in the limitation of BMI, which considers only height and weight, without accounting for body composition factors such as BFP and lean mass.[31]

Dynapenia was positively associated with higher BFP. These results corroborate Arteaga-Pazmiño et al.,[32] who observed a similar association in 105 middle-aged and older women. Both body fat and lean mass are estimated using formulas that relate these values to the square of the individual's height, providing clinically relevant measures for nutritional assessment and diagnosis of conditions such as dynapenic obesity.[33]

The modified push-up test engages the pectoral, deltoid, and triceps muscles, which are responsible for upper limb strength.[34] In women with dynapenia, loss of muscle mass and strength may compromise performance in this exercise. Santos et al.[35] demonstrated that postmenopausal women with dynapenia exhibited reduced arm circumference and muscle area compared to non-dynapenic women, resulting in decreased muscle mass and strength. In the present study, the modified push-up test was used to assess physical fitness, reflecting upper limb strength and endurance. Results indicated that women performing fewer push-ups than the median were more likely to exhibit dynapenia. Although primary research on this association is limited, Bogucka et al.[36] found that women with dynapenia tend to be more sedentary and less active, while physically active women have a 55% lower risk of developing dynapenia compared to their inactive counterparts.[37]

The present has several limitations that should be acknowledged. The study population consisted exclusively of women enrolled in PHC services, predominantly from lower socioeconomic backgrounds, which limits the generalizability of the findings to the broader population. In addition, the cross-sectional design precludes inferences regarding causal relationships between dynapenia and the evaluated variables. Another limitation is the use of self-reported variables such as clinical conditions, which may introduce inaccuracies, although field team training and a pilot study were conducted to mitigate this bias.

Nonetheless, this study is highly relevant, providing valuable information on dynapenia among women in PHC in a large city in northern Minas Gerais. The findings have practical applicability, potentially guiding preventive strategies and physical therapy interventions aimed at maintaining muscle strength and functionality in climacteric women. Furthermore, future longitudinal studies are recommended to better understand the causal relationship between dynapenia and its associated factors.

Conclusion

This study demonstrates a high prevalence of dynapenia among climacteric women attending primary health care units, highlighting significant associations with sociodemographic factors. Women without a partner and those with higher body fat percentage exhibited a greater likelihood of developing dynapenia, indicating

that sociodemographic characteristics and comorbidities may contribute to muscle strength loss. Conversely, overweight and obesity were protective factors for handgrip strength. Moreover, the association between lower muscle strength and poorer performance in the push-up test underscores the importance of interventions focused on muscle strengthening, particularly resistance exercises. Preventive strategies, including strength training programs and social support, may be essential in primary care to promote health and prevent functional decline in these women. Implementing these practices could enhance the well-being of climacteric women, reduce dynapenia-related risks, and support healthy, active aging.

Authors' contributions

All the authors conducted the literature search and screening, produced the tables, contributed to manuscript revision, and approved the final version.

Data availability statement

Research data is not available.

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