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Original Study

Clinical suspicion of sarcopenic obesity and probable sarcopenic obesity in Colombian women with a history of surgical menopause: a cross-sectional study

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Abstract

Objectives: To identify the frequency of clinical suspicion of sarcopenic obesity (CSSO) and probable sarcopenic obesity (PSO) and to estimate the association between them and surgical menopause.

Methods: A cross-sectional study carried out in women residing in Colombia, ages 60 to 75 years. Body mass index, the SARC-F scale, SARC-CalF < 31, and SARC-CalF <33 versions adding the calf circumference measurement in the last two were used to identify CSSO. Muscle strength measurement was added to the above measures to establish PSO. Surgical menopause was defined in women who underwent bilateral oophorectomy simultaneously with hysterectomy before natural menopause. Adjusted and unadjusted logistic regression were performed between CSSO or PSO with surgical menopause, bilateral oophorectomy after natural menopause, and abdominal hysterectomy with ovarian preservation. All participants provided informed consent. $P < 0.05$ was statistically significant.

Results: Seven hundred women 67.0 ± 4.8 years old were included; 23.7% were obese, 68.1% had reduced muscle strength, and 4.2% had surgical menopause. CSSO was found in 3.0% with SARC-F and with SARC-CalF < 31; whereas 2.0% were found with SARC-CalF <33. PSO was found in 2.4%, 1.5%, and 2.2% with SARC-F, SARC-CalF <31, and SARC-CalF <33, respectively. Surgical menopause was associated with PSO but was not associated with CSSO. Bilateral oophorectomy after menopause and hysterectomy with ovarian preservation were not associated with CSSO or PSO.

Conclusions: In a group of older adult women, the frequency of CSSO was up to 3.0% and PSO up to 2.4%. Surgical menopause was statistically significantly associated with PSO. On the contrary, CSSO was not associated.

Key Words: Climacteric – Hysterectomy – Menopause – Obesity – Ovariectomy – Sarcopenia.

Sarcopenic obesity is a multifactorial, progressive, and silent condition in which decreased skeletal muscle mass and function coexist with excessive body fat accumulation. In other words, it is a combination of sarcopenia and obesity.[1-3] Overall morbidity and mortality rates of this condition are higher than in sarcopenia and obesity individually.[2-5]

One of the factors involved in establishing sarcopenic obesity is the decline of physical activity with advancing age, which promotes the loss of muscle fibers and the accumulation of adipose tissue.[6] Visser et al[7] pointed out that adiposity favors a catabolic effect on muscle mass due to the production of inflammatory cytokines derived from the fat tissue itself. Sarcopenic obesity occurs more frequently in individuals with the following characteristics: age over 60 years old, sedentary lifestyle, high fat diet, high alcohol consumption, and smoking.[2]

Suggested diagnostic criteria for sarcopenic obesity are the same as those established for obesity and sarcopenia.[6,8] For obesity, the World Health Organization recommends the following measures: body mass index (BMI) $>30\,kg/m^2$ or waist circumference measurement >102 cm for men or >88 cm for women.[9,10] As for sarcopenia, it has been defined and classified by different consensuses: The European Working Group on Sarcopenia in Older People (EWGSOP),[11,12] The International Working Group on Sarcopenia,[13] The Foundation for the National Institutes of Health,[14] and The Asian Working Group for Sarcopenia.[15]

The Strength, Assistance with walking, Rise from a chair, Climb stairs and Falls (SARC-F) scale is recommended as a

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screening method for sarcopenia due to its easy and fast application, as well as its reasonable specificity, although it has low sensitivity.[16] The measurement of calf circumference was proposed to improve sensitivity. Two cut-off points have been indicated in women: 31 and 33 cm, denominated SARC-CalF-31 and SARC-CalF-33, respectively.[17] To establish probable sarcopenia, Ciudin et al[3] have suggested adding muscle strength measurement.

Ovarian hormones regulate muscle mass; therefore, their reduction is related to sarcopenia.[18,19] The cessation of ovarian estrogens and androgens is usually gradual (natural menopause) or sudden, mainly due to surgical menopause. Whether or not accompanied by bilateral oophorectomy, abdominal hysterectomy is the most commonly performed gynecologic surgery, especially in the 40 to 44 age group, with an estimated annual rate in the United States of 510 surgical procedures per 100,000 population.[20,21] Each year, approximately 300,000 women undergo bilateral oophorectomy at the time of hysterectomy, and in one out of four women under 51 years of age, the removed ovaries are histologically normal.[20,22]

Few studies explore the relationship between gynecological conditions and surgeries with sarcopenic obesity, and even several authors have pointed out that the information on this musculoskeletal condition is limited.[2,3,6] Studies on the association between gynecological surgery and sarcopenic obesity in the Latin American population were not identified, nor is there any information on the behavior of surgical menopause concerning sarcopenic obesity in adult Colombian women. The objective of this study was to identify the frequency of clinical suspicion of sarcopenic obesity (CSSO) and probable sarcopenic obesity (PSO) as well as to estimate the association between each of them with a history of surgical menopause, bilateral oophorectomy performed after natural menopause, and abdominal hysterectomy with ovarian preservation.

METHODS

Design

Analytical cross-sectional study, part of the research project Sarcopenia en Mujeres Colombianas (SARCOL).

Participants

Women between 60 and 74 years old who lived in two Colombian geographic departments, Bolívar and Santander, were included. In 2019, they were invited by the researchers or by previously trained surveyors to fill out a printed form in their units of residence. Women who did not wish to participate, those with cognitive disabilities, reading and writing deficiencies, physical morbidities that limited the taking of anthropometric measurements, inability to walk, and with clinically visible edema of the lower limbs, were excluded. Also, those with a history of severe heart failure, kidney failure, oncological pathologies, unilateral oophorectomy with removal or conservation of the uterus and with vaginal, subtotal, or obstetric hysterectomy were excluded.

Tools

A form made up of three parts was applied. The first part included questions about age, ethnicity, education, work activity, children, and personal history of oophorectomy and hysterectomy, specifying the menopausal status of the participants at the time of surgery.

The second part included the following anthropometric measurements carried out by one of the researchers. Bodyweight (kg) was determined with a digital scale, with the woman standing barefoot and without accessories. Height (m) was identified using a wall-mounted height rod, with the woman standing barefoot and her body aligned against the surface of the height rod. Calf circumference (cm) was established with a measuring tape taking two measurements of the thickest area of each leg and then recording the average value. Measurements above the cut-off point were scored with zero, and those below the cut-off point with a ten. Muscle strength (kg), according to the grip strength of the dominant hand, was calculated with a digital dynamometer (Trailite TLLSC100) with the participant being seated, without arm support, shoulder in adduction, elbow flexed 90°, and forearm and wrist in a neutral position. Three consecutive measurements were made, with 1-minute rest intervals, and the average value was recorded.

The third part included the SARC-F scale questions, which explore opinions about muscle strength, the need for assistance in walking, difficulty in rising from a chair, difficulty in climbing stairs, and the number of falls in the last year. For the first four questions, scores were assigned as follows: no difficulty (zero), some difficulty (one), many difficulties, or unable to do (two). For the fifth question: none (zero), one to three falls (one), and four or more (two). Since its development by Malmstrom and Morly, the SARC-F scale has been validated in different populations and languages.[16,17,23-26] Yang et al[24] found sensitivity and specificity of 20.0% and 95.6% for SARC-F and 48.9% and 90.6% for SARC-CalF, respectively, compared with the EWGSOP criteria. Similar data were reported in the Brazilian population.[25] For the present study, the Spanish translation, and validation of Sánchez-Rodríguez were used.[26] Cronbach alpha of 0.67 was found for the SARC-F scale in the study population.

The forms were applied daily and consecutively until they were all used up. At the end of each day, the forms were reviewed and, the correctly filled ones were numbered, filed, and transcribed into a Microsoft Excel database. Incorrectly filled-out forms were numbered and filed in the discarded folder.

Definitions

CSSO was established in three ways: (a) SARC-F ≥ 4 + BMI $\geq 30\,kg/m^2$, (b) SARC-CalF-31 ≥ 11 + BMI $\geq 30\,kg/m^2$, and (c) SARC-CalF-33 ≥ 11 + BMI $\geq 30\,kg/m^2$. In turn, PSO was also identified with three measurements: (a) SARC-F ≥ 4 + muscle strength $<20\,kg$ + BMI $\geq 30\,kg/m^2$, (b) SARC-CalF-31 ≥ 11 + muscle strength $<20\,kg$ + BMI $\geq 30\,kg/m^2$, and (c) SARC-CalF-33 ≥ 11 + muscle strength $<20\,kg$ + BMI $\geq 30\,kg/m^2$. These definitions are based on the EWGSOP2 algorithm for case-finding and diagnosis of sarcopenia.[3,11] Obese women were identified with BMI $\geq$30 kg/m^2. A history of surgical menopause was defined in women who underwent bilateral oophorectomy simultaneously with hysterectomy while still having menstrual cycles.

Sample size

The sample size was calculated in the OpenEpi program (http://www.openepi.com/Menu/OE_Menu.htm) with the Fleiss with continuity correction formula for the difference of proportions. No studies were found that established the prevalence of women with CSSO, with and without a history of surgical menopause, for which a pilot test was carried out with the first 100 forms filled out. Using the SARC-CalF-31$\geq$11 + BMI $\geq$30 kg/m^2 criterion, the prevalence of women with CSSO and a history of surgical menopause was 20%, and the prevalence of women with CSSO and without a history of surgical menopause was 5%. With a confidence level of 99% and a power of 90%, a sample size calculation of 312 participants was obtained. A total of 760 forms were available for daily application.

Statistical analysis

The statistical analysis was performed with STATA/IC 16.0. In the case of continuous variables, data are expressed as means and standard deviation, and categorical variables as absolute and relative values. Unadjusted logistic regression was performed to estimate the OR and 95%CI of the association between CSSO (dependent variable) with the history of abdominal hysterectomy with or without bilateral oophorectomy (independent variables). Women with bilateral oophorectomy were classified according to whether it was performed before menopause or in natural postmenopause (independent variables). Another unadjusted logistic regression was performed using the same independent variables but considering PSO as the dependent variable. In addition, adjusted logistic regression models were performed with the same dependent and independent variables, to the latter were added: age, years since menopause, ethnicity, and abdominal obesity. The goodness of fit was estimated with the Hosmer-Lemeshow test. A value of $P < 0.05$ indicated statistical significance.

Ethical considerations

Women were informed about the research objectives and that no personal data that allowed them to be identified was collected. All participants provided informed consent. No incentives were offered in exchange for participation; the Declaration of Helsinki on human research, Belmont Report ethical principles, and the Colombian Ministry of Health 8430 Resolution of 1993 were considered. The present study is classified as minimal risk research. The SARCOL project has approval from the institutional and research ethics committee of the University of Cartagena, Colombia.

RESULTS

To apply the 760 forms, a total of 874 women were invited since 114 (13.0%) had exclusion criteria. Sixty (7.8%) forms were incorrectly filled out and were discarded. The present study was carried out with the information obtained from 700 women.

The mean age of all participants was 66.9 $\pm$ 4.6 years, 42.8% were mixed-race, and 57.2% were Afro-descendants; 23.7% were obese; 68.1% had reduced muscle strength, and 83.4% had decreased gait speed. In 19.4%, calf circumference was $\leq$31 cm, and 37.2% had calf circumference $\leq$33 cm. None of the studied women reported laparoscopic hysterectomy, and 229 (32.7%) reported a history of abdominal hysterectomy by laparotomy. Among them, 155 (67.7%) underwent surgery before menopause and 74 (32.3%) after menopause. Ovaries were preserved in 184 (80.3%) and removed in 45 (19.6%). Of the latter, 30 (66.6%) had their ovaries removed while still menstruating, resulting in surgical menopause. The mean age at surgical menopause was 46.9 $\pm$ 4.0 years and at natural menopause 48.2 $\pm$ 4.1 (Table 1).

CSSO was identified in 21 (3.0%) women, using both SARC-F and SARC-CalF-33, and in 14 (2.0%) using SARC-CalF-31. In turn, PSO was found in 17 (2.4%), 11 (1.5%), and 16 (2.2%) women using SARC-F, SARC-CalF-31, and SARC-CalF-33, respectively.

In the bivariate analysis, a history of abdominal hysterectomy without bilateral oophorectomy, performed before menopause or postmenopause, was not associated with CSSO nor PSO ($P > 0.05$). There was no association between CSSO nor PSO with a history of bilateral oophorectomy performed simultaneously with hysterectomy in postmenopausal women ($P > 0.05$). In the nonadjusted analysis, surgical menopause was associated with CSSO and PSO, using all three measuring

TABLE 1. *Characteristics of studied population (n = 700)*

Age, y, X $\pm$ SD	66.9 $\pm$ 4.6
Age of menopause onset, y, X $\pm$ SD	48.1 $\pm$ 4.1
Years since menopause onset, X $\pm$ SD	18.9 $\pm$ 6.3
Weight, kilograms, X $\pm$ SD	67.6 $\pm$ 12.8
Body mass index, kg/m^2,X $\pm$ SD	26.5 $\pm$ 4.8
Abdominal circumference, cm, X $\pm$ SD	90.2 $\pm$ 14.5
Calf circumference, cm, X $\pm$ SD	34.1 $\pm$ 4.0
Muscle strength, kg, X $\pm$ SD	16.6 $\pm$ 6.1
Age range 60-64 y, *n* (%)	258 (36.8)
Age range 65-79 y, *n* (%)	203 (29.1)
Age range 70-74 y, *n* (%)	239 (34.1)
Hispanic, *n* (%)	300 (42.8)
Afro-descendants, *n* (%)	400 (57.2)
Normal nutritional status, (BMI: 18.5-24.9) *n* (%)	253 (36.1)
Underweight, (body mass index: < 18.5) *n* (%)	24 (3.4)
Overweight, (body mass index: 25.0-29.9) *n* (%)	257 (36.7)
Obesity, (body mass index: $\geq$30) *n* (%)	166 (23.7)
Abdominal obesity (abdominal circumference >88 cm), *n* (%)	368 (52.5)
Calf circumference $\leq$31 cm, *n* (%)	136 (19.4)
Calf circumference $\leq$33 cm, *n* (%)	261 (37.2)
Low muscle strength (<20 kg), *n* (%)	477 (68.1)
Hysterectomy without bilateral oophorectomy, *n* (%)	184 (26.2)
Hysterectomy without bilateral oophorectomy before menopause, *n* (%)	125 (17.8)
Hysterectomy without bilateral oophorectomy in pos-menopause, *n* (%)	59 (8.4)
Bilateral oophorectomy at the time of hysterectomy	45 (6.4)
Surgical menopause, *n* (%)	30 (4.2)
Bilateral oophorectomy at the time of hysterectomy in posmenopause, *n* (%)	15 (2.1)

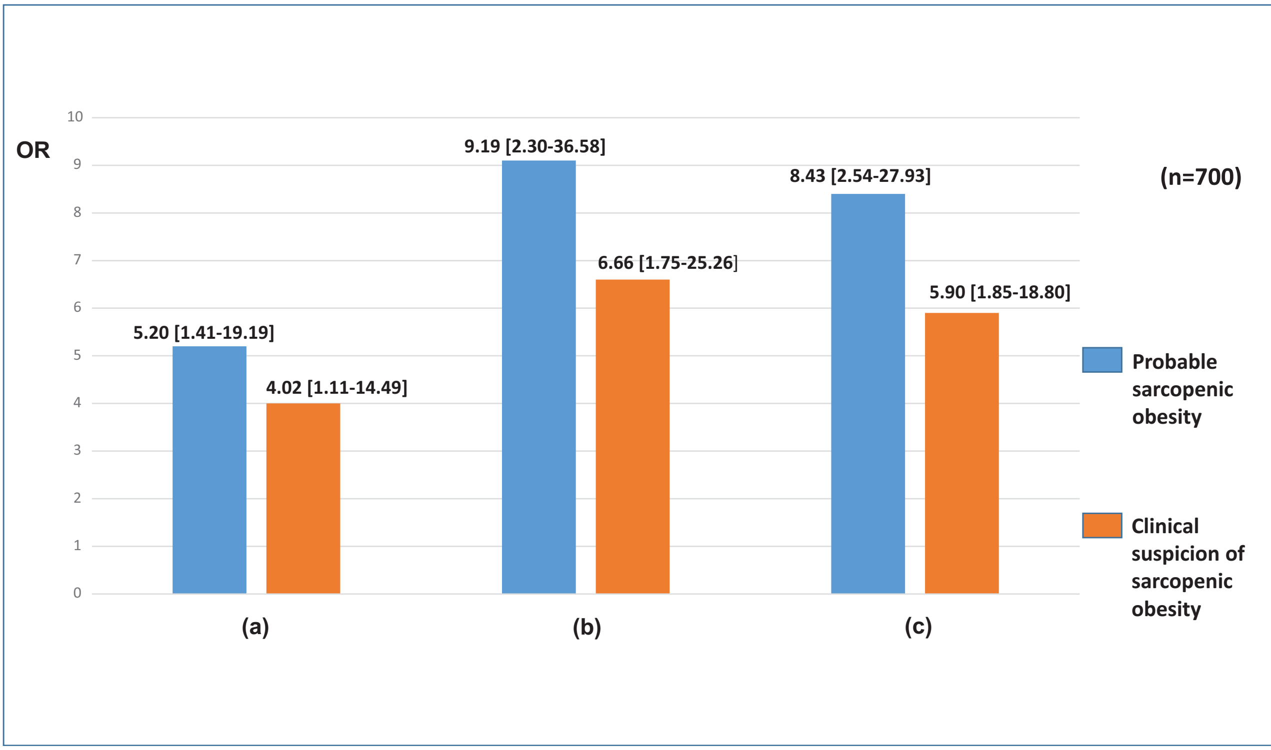

FIG. 1. Association between clinical suspicion of sarcopenic obesity and probable sarcopenic obesity with surgical menopause. Unadjusted logistic regression. **(a)** Probable sarcopenic obesity: SARC-F $\geq$4 + muscle strength <20 kg + BMI $\geq$30 kg/m^2. Clinical suspicion of sarcopenic obesity: SARC-F $\geq$4 + BMI $\geq$30 kg/m^2. **(b)** Probable sarcopenic obesity: SARC-CalF-31 $\geq$11 + muscle strength <20 kg + BMI $\geq$30 kg/m^2. Clinical suspicion of sarcopenic obesity: SARC-CalF-31 $\geq$11 + BMI $\geq$30 kg/m^2.**(c)** Probable sarcopenic obesity: SARC-CalF-33 $\geq$11 + muscle strength <20 kg + BMI $\geq$ 30 kg/m^2. Clinical suspicion of sarcopenic obesity: SARC-CalF-33 $\geq$11 + BMI $\geq$30 kg/m^2. Independent variable: Surgical Menopause. Data are presented as OR (95% CI) $P \leq 0.05$.

versions ($P < 0.05$) (Figure 1). However, the association between CSSO and surgical menopause in the adjusted models lost statistical significance. On the other hand, PSO established with SARC-CalF-31 and SARC-CalF-33 was associated four and five times, respectively, with surgical menopause ($P < 0.05$) Table 2.

DISCUSSION

CSSO was found between 2.0% and 3.0% and PSO between 1.5% and 2.4%, depending on the SARC-F version used. Stenholm et al[27] reported a frequency of sarcopenic obesity between 4% and 12% in studies that used muscle mass measurement to identify sarcopenia and between 4% and 9% when using muscle strength. While Cauley[2] reported a frequency ofsarcopenic obesity between 2.7% and 5.8% in a selection of cohort studies, Levine and Crimmins[28] reported 10.4% in a population that included 56% women and 81% of White ethnicity. The different diagnostic criteria and the different measurement tools used, among other considerations, explained the differences in the frequencies.

The association found in this study between a history of hysterectomy with CSSO and PSO differed according to the surgical management of the ovaries and menopausal status at the time of surgery. No association was observed when the ovaries were preserved, and only the uterus was removed. If ovarian and uterine removal were performed before menopause, an association with sarcopenic obesity was found, unlike if they were performed after menopause. In the only similar study that could be identified, Karia et al[29] reported that North American women who underwent bilateral oophorectomy at an early age, before 45 years of age, showed an elevated risk of sarcopenic obesity OR: 2.32 (95% CI, 1.30-

TABLE 2. *Association between clinical suspicion of sarcopenic obesity and probable sarcopenic obesity with surgical menopause. Adjusted logistic regression*[a,b]

	Clinical suspicion of sarcopenic obesity			Probable sarcopenic obesity		
	SARC-F + BMI	SARC-CalF-31 + BMI	SARC-CalF-33 + BMI	SARC-F + BMI + muscle strength	SARC-CalF-31 + BMI + muscle strength	SARC-CalF-33 + BMI + muscle strength
	OR [95% CI]					
Surgical menopause	1.82 [0.44-7.47]	3.15 [0.79-12.50]	3.35 [0.98-11.36]	2.24 [0.53-9.39]	4.41 [1.03- 18.77]	5.16 [1.40-18.94]

[a]Independent variables: age, years since menopause, ethnicity, and abdominal obesity
[b]Hosmer-Lemeshow: >0.05.

4.13). Similar to their results, in our study, history of surgical menopause was associated with an increase in CSSO and an increase in PSO, compared with women who had an intact uterus and ovaries. These findings can be explained by the hormonal deficiencies that are suddenly established after removing the ovaries. It is accepted that hormonal status changes, particularly the decline in estrogen, negatively affect women's health.[30]

Estrogen reduction contributes to decreased bone mass density, redistribution of subcutaneous fat to the visceral area, decreased lean mass, increased cardiovascular risk, and decreased quality of life.[31,32] In a cross-sectional study, Roland et al[33] reported that muscle mass decreased 0.6% annually after menopause. It has also been noted that postmenopausal women have twice the amount of noncontractile muscle tissue and more intramuscular fat compared with premenopausal women.[31] In addition, older women have lower muscle performance than younger women.[34] Lannuzzi-Sucich et al[35] observed that muscle mass correlates with estrone and estradiol, whereas van Geel et al[36] reported a positive relationship between lean body mass and estrogens. Estradiol promotes muscle repair, satellite muscle cell proliferationandcontributes to preserving skeletal strength by binding to estrogen receptors present in the cell membrane, cytoplasm, and nuclear membrane of muscle fibers.[37] It is well known that estradiol can inhibit the release of proinflammatory cytokines, especially tumor necrosis factor-alpha and interleukin-6, which promote fat mass accumulation and compromise muscle function by degrading various muscle proteins.[7]

Messier et al[31] noted that, alongside the estrogenic reduction observed during postmenopause, other significant reductions occur regarding cortisol, dehydroepiandrosterone sulphate (DHEA), insulin like growth factor-1, parathyroid hormone, Vitamin D, calcium, and growth hormone. These changes generate an increase in intramuscular fat, a decrease in muscle fibers and motor units, a reduction in muscle strength, more significant physical disability, and fragility. After oophorectomy, androgen levels rapidly drop as well. Twenty percent of people over 60 years of age and 50% of those over 80 years of age have low testosterone levels, which correlates with reduced muscle mass and redistribution of visceral fat.[32] In postmenopausal women, the decrease in bioavailable testosterone occurs parallel to reducing muscle mass and strength.[38] However, further studies are needed to explain the relationship between ovarian hormones and muscle mass and provide specific recommendations regarding estrogen and androgen supplementation in women with sarcopenic obesity, which are currently lacking.[31]

It is essential to identify sarcopenic obesity due to its association with several comorbidities: increased insulin resistance, diabetes, cardiovascular disease, metabolic syndrome, dyslipidemia, arterial hypertension, stress, suicidal ideation, knee osteoarthritis, reduced coordination, or aerobic capacity, osteoporosis, and fractures, among others.[2,3,6,28,39,40] In a meta-analysis of cohort studies, Tian and Xu[41] showed that sarcopenic obesity increased all-cause mortality.

The findings of the present study regarding surgical menopause contribute to other observations. It has been suggested that early menopause is a risk factor for cardiovascular disease; in this regard, Pfeifer et al[42] found RR: 1.56 (95% CI, 1.08-2.26) and note that the younger the age at menopause, the higher the mortality rate in women with rheumatoid arthritis. In the long term, bilateral oophorectomy performed before the onset of natural menopause has been associated with increased risk of depressive and anxiety symptoms, Parkinson disease, cognitive impairment or dementia, as well as other morbidities. It is perhaps causally related to accelerated aging.[43-45]

The present study has the usual limitations of cross-sectional designs; the results imply statistical and not causal associations. Although the number of women included is based on population data, it should be considered a convenience sample, and extrapolations should be avoided. In the assessment, no questions were asked about the age at which gynecologic surgery was performed, the frequency of physical activity, nutritional characteristics, and lifestyle, all of which are elements involved in sarcopenia. Serum levels of ovarian hormones, DHEA, pituitary gonadotropins, and cytokines, which would allow a better dimension of the observed associations, were not measured. Vascular and immunogenic factors that are important in the context of menopause and sarcopenic obesity due to their role in free radicals, oxidative stress, changes in the mitochondrial function of muscle cells, and apoptosis affecting muscle function were not explored.[31,40] Imaging tests, such as osteodensitometry, magnetic resonance imaging, computed tomography, or ultrasound, were not available to establish the diagnosis of sarcopenic obesity due to the community focus of the SARCOL project. These imaging tests are not available in primary care in our country. Although attempted to be reduced, selection and information biases may still be present.

This study has the strength of being one of the first to be carried out in a group of women recruited in their communities, combining a screening tool and anthropometric measurements to determine the association between CSSO or PSO with the history of gynecological surgeries. In addition, it is one of the first to visualize and alert about the possible relationship between surgical menopause and sarcopenic obesity in older women. Studies with other designs are needed to define further the relationship between surgical menopause, oophorectomy, and hysterectomy with sarcopenic obesity, using diagnostic criteria.[3,11,12]

In the World Report on Aging, the World Health Organization[46] noted the importance of promoting healthy aging, enhancing the functional capacity of the elderly, and favoring healthy states in old age due to the increase in the older population. Consistent with the above, it is suggested that primary and specialized care policies for adult women routinely include screening tools for sarcopenia, such as the SARC-F, SARC-CalF-31, SARC-CalF-33, and measurement of muscle strength. In addition, it is essential to articulate musculoskeletal health assessment with obesity screening. Health professionals should be interested in the early identification of women with a history of oophorectomy before natural menopause and those with sarcopenic obesity to promote good health, well-being, and quality of life. Finally, gynecologists should carefully consider the actual indication for bilateral oophorectomy, especially when women have not yet moved into the postmenopausal state.

CONCLUSIONS

In a group of older Colombian women, who were clinically evaluated in their places of residence, the frequency of CSSO was up to 3.0% and PSO up to 2.4%. A history of surgical menopause was significantly associated with PSO using the SARC-F scale + calf circumference + BMI and muscle strength, but it was not statistically associated with CSSO.

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