Obesity and its relation to depressive symptoms and sedentary lifestyle in middle-aged women

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ABSTRACT

Background: The prevalence of obesity increases during female mid-life and although many factors have been identified, data from Latin America is lacking.

Objective: To assess factors related to obesity among middle-aged women and determine the association with depressive symptoms, sedentary lifestyle and other factors.

Methods: A total of 6079 women aged 40–59 years of 11 Latin American countries were asked to fill out the Goldberg Anxiety and Depression Scale, the Menopause Rating Scale, the Athens Insomnia Scale, the Pittsburgh Sleep Quality Index and a general questionnaire containing personal socio-demographic data, anthropometric measures and lifestyle information. Obesity was defined as a body mass index (BMI) ≥ 30 kg/m^2.

Results: Obesity was observed in 18.5% and sedentary lifestyle in 63.9%. A 55.5% presented vasomotor symptoms, 12.2% had severe menopausal symptoms and 13.2% used hormone therapy for the menopause. Prevalence of depressive symptoms was 46.5% and anxiety 59.7%. Our logistic regression model found that significant factors associated to obesity included: arterial hypertension (OR: 1.87), depressive symptoms (OR: 1.57), sedentary lifestyle (OR: 1.50) diabetes mellitus (OR: 1.34), higher number of individuals living at home (OR: 1.31), sleep problems (OR:1.22), anxiety (OR: 1.21), having a stable partner (OR: 1.20), parity (OR: 1.16) and vasomotor symptoms (OR:1.14). A lower risk for obesity was found among women using hormonal contraceptives (OR: 0.69).

Conclusion: Obesity in middle-aged women is the consequence of the interaction of multiple factors. It was associated to hypertension, depressive symptoms, sedentary lifestyle, climacteric symptoms and other factors.

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1. Introduction

Obesity constitutes a worldwide serious public health problem due to its high prevalence, high mortality, and associated disability. The World Health Organization (WHO) has reported that in the world overweight and obesity affect 1.4 billion adults. This organization has also estimated that 2.8 million adults die each year because of overweight [1]. Therefore, analyzing factors related to obesity is highly relevant.

Traditionally reports indicate that women are at a higher risk of obesity [2]. Nevertheless, this epidemiological profile may be shifting. Indeed, using a representative sample of the US population consisting of 5926 adults of both sexes, the 2009–2010 National Health and Nutrition Examination Survey (NHANES) found that

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the prevalence of obesity is 35.5% among adult males and 35.8% in adult women [3]. Although the prevalence of obesity is similar between the both sexes, women undergoing ovarian hormone decline experience symptoms and metabolic changes that can significantly affect the risk of developing obesity. Vasomotor symptoms (an important feature of the climacteric) are more prevalent in women with a higher body mass index (BMI) [4]. Furthermore, the menopause increases by 18% the risk of abdominal obesity and the metabolic syndrome [5].

From a different perspective, studies indicate that sedentary lifestyle is an important factor related to obesity. A systematic review of the literature including 20 studies seeking the association between obesity and level of physical activity, showed an inverse relationship between physical activity and body weight and/or a direct relation between sedentary lifestyle and overweight/obesity [6].

The prevalence of menopausal complaints such as vasomotor symptoms, depressed mood and insomnia increases after age 40 [7]. Regarding depressive mood, a review of 107 studies reported that depression is a significant factor favoring sedentary lifestyle [8]. There appears to be a relationship between mood and the frequency of physical exercise; hence depression is associated with less physical activity and maniac behavior with more activity [9].

As in clinical practice many middle-aged women report cessation of their physical activities due to lack of motivation, we were interested in evaluating factors associated to obesity in this group of women and exploring the hypothesis that depressive symptoms (an important menopausal symptom) and sedentary lifestyle would also be related factors. To date, studies relating menopausal symptoms with sedentary lifestyle and obesity are scarce.

2. Methods

2.1. Study design and participants

The present study represents a data re-analysis of a cross-sectional study of the Collaborative Group for Research of the Climacteric in Latin America (REDLINC) which was originally designed to assess menopausal symptoms and sleep problems and related risk factors. For this, middle-aged Hispanic women (40–59 years) who accompanied patients attended for at 20 health-care centers from cities with more than 500,000 inhabitants in 11 Latin American countries (the REDLINC V study) were surveyed. Information about participating countries, cities (centers) and researchers are detailed in Appendix 1. More details regarding the used methodology is explained elsewhere [10]. Health status was defined in accordance to the National Center for Health Statistics as that enabling the performance of daily routine activities [11]. Black or indigenous women and those with mental deficits or physical ailments that could interfere with the understanding of the questionnaire or the interview process were excluded. The research protocol of this study was reviewed and approved by the Bioethics Committee of the PROSAM Foundation, Santiago, Chile. According to the principles of the Helsinki Declaration [12] participants fulfilling inclusion criteria were informed about the research, its purpose, the questionnaires and their content and requested to provide signed consent. Statistical software (EPI-INFO 6.04, Centers for Disease Control and Prevention, Atlanta, USA; 2001) was used to calculate a minimal sample size of 194 per center considering that each covered an estimated population of 50,000 women [13]. A minimum of 250 participants was requested from each center.

2.2. Investigated parameters and used instruments

2.2.1. General questionnaire
In order to record all data, an itemized questionnaire was previously constructed and validated in 50 women at each Latin

American REDLINC affiliated and participating center before implementation. Variables in the questionnaire included: age (years), educational level (expressed as total years of schooling), marital status and/or existence of a stable partner, parity, number of individuals living at home, menopausal status, surgical menopause, smoking habit, alcohol consumption, number of weekly aerobic physical activities (30 min periods of physical activity as i.e. walking, jogging, bicycle riding), history of chronic illnesses and the use of hormonal contraceptives, hormone therapy (HT) or alternative therapies for menopause. For each participant weight (kg), height (mt), and waist circumference (cm) was recorded. BMI was calculated by the formula weight/squared height.

Sedentary lifestyle was self-defined by women as the performance in the past month of less than three weekly 30 min periods of aerobic physical activity [14,15]. Menopausal status was defined according to STRAW criteria [16]: premenopausal (women having regular menses), perimenopausal (women having irregularities in their menses by more than 7 days of their menstrual cycle), postmenopausal (no more menses in the last 12 months). The latter was further categorized as early (from 1 to 4 years) or late postmenopausal (≥5 years). Menopausal symptoms were evaluated with the Menopause Rate Scale (MRS) [17]. These symptoms were considered severe in women achieving a total MRS score greater than 16 [18]. Smokers were defined as those who consumed ≥5 cigarettes per day [19]. A problem drinker was defined as that achieving three or more points in the Brief Scale of Abnormal Drinking (BSAD) [20]. Low educational level was defined as 12 years or fewer of education [21]. Other definitions included: obesity (BMI ≥30 kg/m^2); arterial hypertension as a blood pressure of ≥140/90 mmHg or the use of anti-hypertensives; diabetes mellitus: those having this diagnosis or who were treated with anti-diabetic medication. Women considered to have a sleep disorder were those achieving a total score equal or higher than 6 in the Athens Insomnia Scale [22] or more than 4 in the Pittsburgh Sleep Quality Index [23]. Details of the aforementioned scales (i.e content and scoring system) have previously been described [10].

2.2.2. The Goldberg Anxiety and Depression Scale [24]
This test not only screens for the diagnosis of depression or anxiety, but also discriminates between both and gauges their respective intensities. It has two subscales with 9 questions each: the anxiety sub-scale (questions 1–9) and depression sub-scale (questions 10–18). The answers are either affirmative or negative and with more than 4 affirmative answers in the anxiety sub-scale and more than 3 in the depression sub-scale it has been possible to detect 73% and 82% of the cases of anxiety and depression, respectively among Latin American population [25].

2.3. Statistical analysis

Data analysis was performed with the Stata (Stata/IC 13.1 for Windows, StataCorp Lp, 2013). Continuous variables are presented as mean values ± standard deviations (SD); whereas qualitative variables are presented as absolute and relative frequencies. 95% confidence intervals (CI) are displayed for means and percentages. The Shapiro–Wilk test was used to assess the normality of data distribution. According to this, group comparisons for non-parametric continuous data were performed with the Mann–Whitney test. Percentages between groups were evaluated with the Pearson chi-square test.

Logistic regression analysis (LR) was performed to determine factors related to obesity [26]. In this analysis, obesity was considered as the dependent variable. Independent variables considered for analysis were: Sedentary lifestyle, depressive symptoms, anxiety, arterial hypertension, current smoking status, problematic drinking, diabetes mellitus, age, postmenopausal status, surgical

menopause, presence of vasomotor symptoms, drug use (hormonal contraceptives or HT for the menopause), having a stable partner, number of individuals living at home and education ≤12 years. Prior to LR, variables with more than two answer categories (age, number of individuals living at home, parity, vasomotor symptoms, depressive symptoms and anxiety) not fulfilling linearity assumption (graphic methods and linearity tendency test) linear transformation was performed in accordance to the obesity logit [27,28]. For the construction of the LR model, a stepwise forward entry of variables was performed considering for the final model a *p* value of <0.05 [27,29] and a higher ROC area (*p* value <0.05) [30]. The interaction effect of independent variables was evaluated constructing interaction variables. Once the final model was determined the Wald test was used [26,28] to assess the weight of predictive variables. The Pregibon link test was also used in the final model to evaluate the correct selection of predictive variables and the adequacy of the linearity of the logit [30]. In Independent variables of final model, the correlation coefficients were determined and collinearity analysis was performed, thus obtaining the condition index and variance inflation factor (VIF) [31,32].

The Hosmer–Lemeshow test was also applied to the final regression model to assess goodness of fit. Leverage estimation, Pearson delta chi-square ($\Delta \chi^2$), Delta deviation (ΔD) and Delta–Beta Pregibon statistics were also used to weigh the influence of certain individual cases over the fitness and parameters of the final model [33,34]. If influencing observations existed during fitness of the model and/or during the estimation of parameters, LR was performed without these observations and results compared with the proposed model.

3. Results

A total of 6598 women were invited to participate of which 6079 (92.1%) were included in the study. Mean age and educational level of the entire sample was 49.8 ± 5.4 and 10.8 ± 4.9 years, respectively. Mean parity was 2.5 ± 1.5. The mean number of individuals living at home was 4.1 (95% CI 4.0–4.1). A 68.9% (95% CI 67.7–70.0) had a stable partner, 57.6% (95% CI 56.4–58.9) were postmenopausal and 15.8% (95% CI 14.9–16.7) had surgical menopause.

A 55.5% (95% CI 54.2–56.7) presented vasomotor symptoms, 12.2% (95% CI 11.4–13.0) had severe menopausal symptoms (Total MRS score >16), 13.2% (95% CI 12.4–14.1) used HT for the menopause and 11.5% (95% CI 10.7–12.4) hormonal contraceptives. According to the Goldberg Scale 46.5% (95% CI 45.2–47.8) displayed depressive symptoms and 59.7% anxiety (95% CI 58.4–60.9). Regarding lifestyles and habits, sedentary lifestyle was observed in 63.9% (95% CI 62.7–65.1), obesity in 18.5% (95% CI 17.6–19.5), 11.3% were current smokers (95% CI 10.5–12.1) and 0.1% were problem drinkers (BSAD). Nearly a quarter of surveyed women had hypertension (22.9%) and 8.6% diabetes.

Characteristics of studied women in accordance to the presence or not of obesity are depicted in Table 1. Compared with non-obese women, obese were more sedentary and had more depressive symptoms, anxiety, parity and number of people living at home. In addition, they had more sleep problems and vasomotor symptoms (*p* < 0.0001). The presence of severe menopausal symptoms (total MRS scores >16) was higher among obese women (18.9 vs. 10.6%, *p* < 0.0001). Equally, obese women had a stable partner, hypertension, were postmenopausal and had surgical menopause in a higher rate than non obese ones (*p* < 0.01). They used fewer hormonal contraceptives.

Vasomotor symptoms logit showed linearity with obesity; therefore, is introduced into the model as it is. Contrary to this, anxiety, depressed mood, age, number of individuals living at home and parity displayed a lack of linearity; therefore they were dichotomized in order to be entered into the LR model: anxiety (Goldberg Anxiety Scale >9), depressed mood (Goldberg Depression Scale > 0), age (age > 48 years), number of individuals living at home (>5) and parity (>2).

Final LR model for the factors related to obesity is depicted in Table 2. Significant factors were arterial hypertension (OR: 1.87), depressive symptoms (OR: 1.57), sedentary lifestyle (OR: 1.50), diabetes mellitus (OR: 1.34), higher number of individuals living at home (OR: 1.31), sleep disturbance (OR:1.22), anxiety (OR: 1.21), having a stable partner (OR: 1.20), parity (OR: 1.16) and vasomotor symptoms (OR:1.14). A lower risk for obesity was found among women having using hormonal contraceptives (OR: 0.69). The ROC area for the model was 0.66 (CI 95%: 0.64–0.67). Interaction

Table 1
Characteristics of women studied according to the presence of obesity.

Characteristics	Non obese women *n* = 4952 (81.5%)	Obese[a] women *n* = 1127 (18.5%)	*p* value[*] (two sided)
Age, mean ± SD	49.7 ± 5.4	50.3 ± 5.5	0.0008
Educational level (>12 years), *n* (%)	3212 (64.9)	758 (67.3)	0.127
With stable partner, *n* (%)	3372 (68.1)	814 (72.2)	0.007
Parity, mean ± SD	2.5 ± 1.5	2.8 ± 1.6	0.0001
Number of individuals living at home, mean ± SD	4.0 ± 1.8	4.2 ± 2.0	0.0073
Postmenopausal, *n* (%)	2,804 (56.6)	699 (62.0)	0.001
Surgical menopause, *n* (%)	748 (15.1)	211 (18.7)	0.003
HT use, *n* (%)	651 (13.1)	153 (13.6)	0.701
Hormonal contraceptive use, *n* (%)	613 (12.4)	88 (7.8)	0.0001
Vasomotor symptoms, *n* (%)	2682 (54.2)	689 (61.1)	0.0001
Depressive symptoms[b], Goldberg, *n* (%)	2214 (44.7)	612 (54.3)	0.0001
Anxiety, Goldberg[c], *n* (%)	2849 (57.5)	779 (69.1)	0.0001
Sleep disorders, *n* (%)	2697 (54.5)	743 (65.9)	0.0001
Severe menopausal symptoms[d] (total MRS score >16)	526 (10.6)	213 (18.9)	0.0001
Sedentary lifestyle, *n* (%)	3073 (62.7)	813 (72.1)	0.0001
Current smoker, *n* (%)	553 (11.2)	133 (11.8)	0.544
Problem drinker, *n* (%)	7 (0.1)	2 (0.2)	0.776
Arterial hypertension, *n* (%)	994 (20.5)	397 (35.2)	0.0001
Diabetes mellitus, *n* (%)	380 (7.7)	144 (12.8)	0.0001

Continuous data are presented as mean ± standard deviations and qualitative data as absolute and relative frequencies (*n*, %).

[a] Obesity = body mass index ≥ 30.
[b] Score > 3 in the Goldberg Depression Scale.
[c] Score > 4 in the Goldberg Anxiety Scale.
[d] Total MRS score > 16.
[*] *p* Values obtained with the Mann–Whitney test or the Pearson chi square test according to each case; *n*, number of observations; SD, standard deviation; HT, hormone therapy.

Table 2
Factors associated to obesity in studied women.

Variables	OR (95% CI)
Arterial hypertension	1.87 (1.61–2.16)
Depressed mood (Goldberg Scale)	1.57 (1.29–1.92)
Sedentary lifestyle	1.50 (1.30–1.73)
Diabetes mellitus	1.34 (1.08–1.66)
Number of individuals living at home (>5)	1.31 (1.11–1.56)
Sleep disturbance	1.22 (1.05–1.42)
Anxiety (Goldberg Scale)	1.21 (1.03–1.43)
Having a stable partner	1.20 (1.04–1.39)
Parity (>2)	1.14 (1.06–1.22)
Presence of vasomotor symptoms (MRS)	1.14 (1.06–1.22)
Use of hormonal contraceptives	0.69 (0.54–0.88)

Only values with $p < 0.05$ are included in the table. OR, odds ratios; CI, confidence intervals.

variables constructed from independent variables did not display likelihood and/or a significant ROC area ($p < 0.05$) in order to be included in the final regression model.

Our final model evidenced a correct specification of the model with compliance to the linearity assumption of the logit (Pregibon link test). The highest correlation coefficient between predictive variables of final model RL was observed for depressive symptoms and sleep problems (0.35). Likewise, variance inflation factor (<1.2) and the condition index (<8.4) ruled out co-linearity. Individual observations were not encountered that would influence the model. The Hosmer–Lemeshow test was used to assess the goodness of fit of our model grouped into 10 quantiles. Obtained p value was 0.21 which confirmed the quality of our model.

4. Discussion

Our results demonstrate firstly a high prevalence of obesity in this group of Latin American women. This rate is higher than the overall one reported in the world population [1], but lower than the 39.5% for obesity described among women aged 40 to 59 in the US for 2011–2012 [35]. On the other hand, in this group of women we found a high rate of them engaged in a sedentary lifestyle. This rate however is lower than the reported (using the same definition) by the Chilean National Health Survey for women of similar age (93.4%) [36]. Equally, a high prevalence of menopausal symptoms was observed among our obese women which is in agreement with the reports of others [37,38].

Our logistical regression model showed that hypertension, sedentary lifestyle and several menopausal symptoms (i.e. vasomotor, depressive, anxiety and sleep problems) were independently associated to a higher risk of obesity. In our model, arterial hypertension was the most significant of these factors. Studies have reported that dopamine (a neurotransmitter) plays an important role in hypertension through its influence on the central and/or autonomic nervous system [39]. A regulatory link between microvascular and perivascular adipose tissue inflammation and adipokine synthesis may explain the mechanism of obesity-associated hypertension [40].

Our study also showed that obesity was associated to menopause related psychological symptoms. This association has also been observed in a study that evaluated 177,047 North American adults. This US study found that depression, as well as anxiety, were related to a higher risk of obesity; independent of health status and psychosocial and lifestyle factors. In men, this association was seen only when BMI was higher than 40 kg/m^2; in women, on the other hand, this risk was higher when BMI was higher than 25 [41]. This relationship was also demonstrated in the Third National Health and Nutrition Examination Survey. Indeed, obesity was associated with depression in women (OR: 1.82, 95% CI, 1.01–3.3) but not in men (OR: 1.73, 95% CI, 0.56–5.37)

[42]. We also observed that sleep disturbances and vasomotor symptoms were significantly associated to obesity. Supporting our observation is the fact that hot flashes, sleep disorders and mood problems observed during the menopausal transition have been related to estrogen-related changes in neuronal transmission [43].

In agreement with other studies, our LR model showed that a sedentary lifestyle is related to a higher risk of being obese. A Spanish study showed that postmenopausal women (mean age 73.1 years) that remain seated more than four hours a day have a 2.7 higher risk of being obese [44]. Another study showed that adult women that watch TV for more than 4 h a day have 2.38 times the likelihood of being obese as compared to those who watch less than one hour a day [45]. Similarly, a Brazilian study showed that middle-aged women (mean 57.1 years) who walk less than 6000 steps a day, present a higher risk of overweight/obesity (OR: 2.1, 95% CI 1.05–2.94) and a higher waist circumference (OR: 1.7, 95% CI 1.23–3.62) than more active ones [46].

Neurochemical changes observed during the menopausal transition are not only associated to menopausal symptoms but also to decreased caloric expenditure [47,48]. Moreover, one must bear in mind that estrogen deficit produces an increase in brain peptides that increases appetite (neuropeptide Y, ghrelin and melanin concentrating hormone) [49]; therefore explaining why changes in weight are more common during the menopausal transition. A role for the central nervous system in the development of obesity is also supported by the fact that obese middle-aged women display a higher prevalence of vasomotor symptoms (also linked to neurotransmitters) [50]. Hence, we could hypothesize that menopausal hormonal changes cause alterations in the cerebral chemistry that are not only related to symptoms but also to weight increase.

Among the weaknesses of the present study, one can mention its cross-sectional design which does not allow the analysis of causal relationships. Second, although the definition we used for sedentary lifestyle has epidemiological value; it lacks the strictness of definitions contained in more specific instruments used to evaluate physical activity. Despite this, the high number of studied subjects and its multi-centric nature could be seen as potential strengths, but at the same time could be seen as a weakness due to the variability observed among centers.

In summary, it can be concluded that obesity in middle-aged women is the consequence of the interaction of multiple factors. It was associated to hypertension, depressive symptoms, sedentary lifestyle, climacteric symptoms and others factors.

Contributors

Obesity and its relation to depressive symptoms and sedentarism in middle-aged women.

Competing interest

The authors of the manuscript "Obesity and its relation to depressive symptoms and sedentarism in middle-aged women" declare no conflict of interests.

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No funding was secured for this study.

Ethics

The research protocol of this study was reviewed and approved by the Bioethics Committee of the PROSAM Foundation, Santiago,

Chile. According to the principles of the Helsinki Declaration participants fulfilling inclusion criteria were informed about the research, its purpose, the questionnaires and their content and requested to provide signed consent.

Acknowledgments

Appendix A. Appendix 1

A.1. List of participating countries, investigators and (city)

Argentina: María C. Zúñiga (Mendoza), Mabel Martino (Rosario), Silvina Witis (Buenos Aires); **Bolivia:** María T. Espinoza (Cochabamba), Desire Mostajo (Santa Cruz); **Chile:** Juan E. Blümel (Santiago de Chile), Juan Fica (Santiago de Chile), Daniel Flores (Santiago de Chile), María S. Vallejo (Santiago de Chile); **Colombia:** German Barón (Bogotá), Gustavo Gómez (Cali), Alvaro Monterrosa (Cartagena), William Onatra (Bogotá); **Dominican Republic:** Ascanio Bencosme (Santiago de los Caballeros); **Ecuador:** Peter Chedraui (Guayaquil), Andrés Calle (Quito), Hugo Sánchez (Machala); **México:** José A. Hernández-Bueno (México, DF), Luz M. Bravo (Guadalajara); **Panamá:** Konstantinos Tserotas (Panamá); **Paraguay:** Zully Benítez (Asunción); **Perú:** Eliana Ojeda (Cuzco), Fiorella Laribezcoa (Piura), Edward Mezones-Holguín (Piura); **Uruguay:** Selva Lima (Montevideo).

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