bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

HEALTH CONDITIONS ASSOCIATED WITH OVERWEIGHT IN CLIMACTERIC WOMEN

Maria Suzana Marques[1,2,¶], Ronilson Ferreira Freitas[1,¶], Daniela Araújo Veloso Popoff [1,2,¶], Fernanda Piana Santos Lima de Oliveira[2,¶], Maria Helena Rodrigues Moreira[3,¶], Andreia Maria Araújo Drummond [4,&], Dorothéa Schmidt França [2,&], Luís Antônio Nogueira dos Santos [1,2,&], Marcelo Eustáquio de Siqueira e Rocha[1,&], João Pedro Brant Rocha[4,&], Maria Clara Brant Rocha[5,&], Maria Fernanda Santos Figueiredo Brito[1,¶], Antônio Prates Caldeira[1,2,¶], Fabiana Aparecida Maria Borborema[2,&], Viviane Maria Santos[2,&], Josiane Santos Brant Rocha[1,2,¶]

[1]State University of Montes Claros, Montes Claros, Minas Gerais, Brazil.
[2]Fipmoc University Center (UNIFIPMoc), Montes Claros, Minas Gerais, Brazil.
[3]University of Trás-dos-Montes and Alto Douro, Department of Sports Science, Exercise and Health. Research Center in Sports Science, Health and Human Development (CIDESD). Center for the Research and Technology of Agro-Environmental and Biological Sciences (CITAB), Portugal.
[4]Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil.
[5]Faculty of Medical Sciences of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil.

[*]Corresponding author.

E-mail: fernandapiana@gmail.com (FPSLO).

[¶]These authors contributed equally to this work.

[&]These authors also contributed equally to this work.

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Abstract

This study aims to investigate the association between health conditions and overweight in climacteric women assisted by primary care professionals. It is a cross-sectional study conducted with 874 women from 40 to 65 years of age, selected by probabilistic sampling between August 2014 and August 2015. In addition to the outcome variable, other variables such as overweight/obesity, sociodemographic, reproductive, clinical, eating and behavioural factors were evaluated. Descriptive analyses of the variables investigated through their frequency distributions were performed. Then, bivariate analyses were performed through Poisson regression. For the multiple analyses, the hierarchical Poisson regression was used to identify factors associated with overweight/obesity in the climacteric period. The prevalence of overweight/obesity was 74%. Attending public school (PR: 1.30 - 95% CI 1.14 - 1.50), low schooling (PR: 1.11 - 95% CI 1.01 - 1.23), gout (PR: 1.18 - 95% CI 1.16-1.44), kidney disease (PR: 1.18 - 95% CI 1.05 - 1.32), metabolic syndrome - MS (PR: 1.19 - 95% CI 1.05 - 1.34) and fat intake (PR: 1.12 - 95% CI 1.02 - 1.23) were considered risk factors for overweight. Having the first birth after 18 years (PR: 0.89 - 95% CI 0.82 to 0.97) was shown to be a protective factor for overweight and obesity. The presence of overweight and obesity is associated with socio-demographic, reproductive, clinical and eating habits.

Introduction

Brazil has been presenting a rapid process of demographic and epidemiological transition, leading to the frequent occurrence of chronic-degenerative diseases[1]. The increase in the prevalence of overweight, represented by overweight and obesity, among the elderly female population raises great concern in developed and developing countries.

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Since overweight and obesity are risk factors for adverse health events[2] such as disturbances in lipid and glycidic metabolism, psychological stress and sleep alterations, with increasing risk of cardiovascular diseases[3], musculoskeletal disease, acute myocardial infarction[4], cancer[5] and worse quality of life in comparison to those who were satisfied with their body weight [6].

Overweight and obesity have become a public health problem in the world. The projection for 2025 is that about 2.3 billion adults are overweight, and more than 700 million are obese. According to a study conducted in 2016, the rate of overweight among Brazilian women is 50.5%, increasing this frequency with age and up to 64 years[7].

Epidemiological data are still scarce associating excess weight with behavioural and clinical variables in climacteric women[8], using probabilistic samples[9]. Considering that climacteric is an important period of the women life cycle, and that this period is related to the potential peak of fat mass and obesity in this group, the current study aimed to investigate the association between health conditions and excess of weight ratio in climacteric women, assisted by primary care professionals, since this phase may assume a pathological character or be associated with other chronic diseases.

Materials and methods

A cross-sectional and analytical study was carried out in the city of Montes Claros, Minas Gerais, Brazil, from August 2014 to August 2015, whose target population consisted of 30,801 climacteric women enrolled in 73 health care units, excluding pregnant, postpartum or bedridden women. This study was carried in the Family Health Strategy (FHS) that represents the mechanism of primary health care (PHC) on the public health system in Brazil [10].

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Sampling was of the probabilistic type, and the selection of the sample occurred in two stages. Each health care unit team was taken as a conglomerate, being drawn 20 units, covering the urban and rural area for data collection. Following this, a proportional number of women were randomly selected according to the climacteric stratification criteria of the Brazilian Society of Climacteric (SOBRAC), in 2013[11]. Women between 40 and 65 years of age, enrolled in the selected teams and physically able to respond to the questionnaires and submitted to anthropometric measurements and laboratory tests (12-hour fasting) were considered eligible to participate in the study. The researchers made the previous training of all collectors and interviewers and maintained supervision during the data collection stage. After this selection, the women were invited to present themselves for the research in a previously established date. The final sample consisted of 874 climacteric women who were invited to sign the Informed and Post-Informed Consent.

The nutritional status of women was evaluated by body mass index (BMI), which was considered as a study outcome. Despite the inclusion of some patients over 60 years, women were categorised into eutrophic (BMI <25 kg / m²) and overweight (IMC ≥ 25 kg/m²), following a categorisation model used in other studies with similar population groups [12, 13, 14]. Initially, women were weighed wearing light clothing and without footwear, in orthostatic position, with their feet together and arms relaxed throughout the body, by a mechanical anthropometric medical scale (Balmak 11) with a capacity of 150 kg and divided into 100 g. The stature was measured by anthropometer (SECA 206®), fixed in a flat wall and without skirting. In this measurement, the women were instructed to keep their feet together, in an upright position, with their head positioned in the Frankfurt plane. For the calculation of BMI, the body weight in kilograms was divided by the squared height, expressed in meters (BMI = P/A²).

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

The women answered questions related to the independent variables, which were allocated in three blocks: (1) sociodemographic, (2) reproductive (3) clinical, eating and behavioural habits.

The block of sociodemographic variables included age (40-45, 46-51, 52-65 years); type of school (public or private); level of schooling (elementary school I, elementary school II, high school / higher education); marital status (married, separated, divorced, widowed); labor occupation (yes or no); monthly income (≥ 01 minimum wage, <01 minimum wage), being the minimum wage equivalent to US$217,42 at the time of data collection; number of people residing in the same house (up to 2, more than 2) and; skin color (white, not white).

The reproductive variables comprised the age of menarche (≤ 11 years, 12-14 years and ≥ 15 years), first birth weight (<4000g; ≥ 4000g), climacteric symptoms assessed by the Kupperman Index[15] (absent/mild; moderate/severe) and age of first delivery (≤ 18 years old> 18 years).

The clinical, eating and behavioral variables included: liver disease (absent, present), gout (absent; present), renal disease (absent; present), Metabolic Syndrome (MS) (absent; present); Urinary incontinence (absent, present), cardiovascular disease risk (low risk, intermediate risk, high risk), drinking (yes, no), fat intake (yes, no), smoking (yes or no), symptoms of depression, quality of sleep and physical activity.

Metabolic Syndrome (MS) was evaluated using the NCEP-ATPIII criteria of the Brazilian Society of Diagnosis and Treatment of MS[6], urinary incontinence was assessed by the International Consultation on Incontinence Questionnaire-Short Form ICIQ-SF[17], the risk for cardiovascular diseases was assessed by Framingham Global Risk Score[18], the symptoms of depression were evaluated by the Beck Depression Inventory[19], sleep quality was assessed by the Pittsburgh Sleep Quality Index[20] and physical activity practice

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

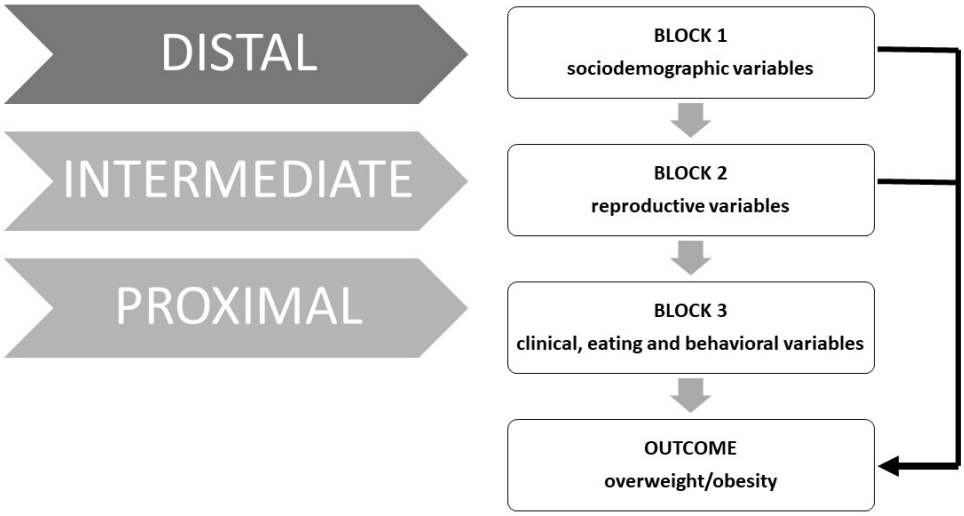
was assessed through the International Physical Activity Questionaire (IPAQ short version) [21].

The women were submitted to peripheral venous blood collection to analyse the laboratory parameters. Serum triglyceride levels were determined by the colourimetric enzymatic method. The level of HDL (High-Density Lipoprotein) cholesterol was obtained by selective precipitation of LDL (Low-Density Lipoprotein) cholesterol and VLDL (Very Low-Density Lipoprotein) cholesterol with dextran sulphate in the presence of magnesium ions, followed by dosing by enzymatic system cholesterol oxidase/peroxidase with calorimetry and reading, as performed in the total cholesterol dosage, using Labtest® reagents, in Cobas Mira®[22] apparatus. The lipid profile was analysed according to parameters proposed by the Brazilian Society of Cardiology[23] and fasting glycemia according to the standards of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus[24].

The data was tabulated in the statistical software Statistical Package for Social Science (SPSS, version 21, Chicago, Illinois). Initially, descriptive analyses of all variables through their frequency distributions were carried out, and then, bivariate analyses of the outcome-variable with each independent variable were performed using the Chi-Square Test. Gross Prevalence Ratios (PR) were estimated with their respective 95% confidence intervals. Variables with a descriptive level (p-value) of less than 0.25 were selected for multiple analysis using the hierarchical Poisson regression model, adapted to the model proposed by other authors[9]. The model was composed of blocks of variables at distal (sociodemographic variables), intermediate (reproductive) and proximal (clinical, eating and behavioural) variables. Prevalence ratios (PR) adjusted with their respective 95% confidence intervals were estimated, remaining in the model only those that presented descriptive level $p<0.05$. At each hierarchical level, the stepwise

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

153 forward procedure was adopted: starting the model with the statistically significant
154 variable selected in the bivariate analysis, and then adding other variables (Fig. 1).
155
156 **Figure 1:** Model with the statistically significant variable selected in the bivariate
157 analysis, and then adding other variables.



158
159
160 As this study involved humans, it was submitted, appreciated and approved for
161 execution by an Ethics and Research Committee (No. 817,166), with the ethical precepts
162 of the Brazilian Resolution CNS 466/2012 being fully observed.
163

164 Results

165 The sample consisted of 874 women between 40 and 65 years of age, of whom
166 74.1% were overweight. When categorised by climacteric phases, it was observed that
167 postmenopausal women had a higher prevalence of overweight/obesity (54.3%).
168 The results of the bivariate analysis revealed the following variables associated with
169 the overweight/obesity outcome: age between 52 and 65 years ($p = 0.184$), private school

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

(p = 0.000), low schooling (p = 0.093) (p = 0.0006), liver disease (p = 0.000), gout (p = 0.000), disease (p = 0.106), weight of the 1st child at birth equal to or greater than 4000 g (p = .039), high risk for cardiovascular diseases (p = 0.000), alcohol consumption (p = 0.039) and fat intake (p = 0.065). However, women between 46 and 51 years of age (p = 0.184), who had a late menarche age (p = 0.039) and had children over 18 years old (p = 0.004) had a protective effect against overweight and obesity. It should be emphasized that there was a high prevalence of overweight and obesity in all the independent variables presented (Table 1).

Table 1: Sample characteristics and gross prevalence ratio (PR) for overweight/obese according to sociodemographic factors, reproductive, clinical, behavioural and eating habits of menopausal women.

Variables		n	%*	Overweight / obesity (%)*	Gross PR ($CI_{95\%}$)	*p*-Value
Sociodemographic						
Age	40 to 45	236	27.9	73.2	1.00	0.184
	46 to 51	241	26.8	70.0	0.95 (0.85 – 1.07)	
	52 to 65	397	45.4	77.0	1.04 (0.95 – 1.15)	
Type of school attended	Public	822	97.3	73.2	1.00	0.000
	Private	24	2.7	93.6	1.26 (1.11 – 1.43)	
Schooling	High school/ Graduate	281	31.8	70.9	1.00	0.093
	Fundamental II	231	26.6	73.0	1.03 (0.92 – 1.15)	
	Fundamental I	358	41.6	77.5	1.11 (1.01 – 1.21)	
Labor occupation	Yes	347	40.4	71.7	1.00	0.106
	No	520	59.6	76.0	1.07 (0.99 – 1.16)	
Reproductives						
Age at menarche	12 to 14 (Normal)	513	60.6	75.9	1,00	0.039
	≤ 11 (Early)	101	11.8	79.8	1.06 (0.95 – 1.18)	
	≥ 15 (Late)	260	27.6	67.6	0.90 (0.82 – 1.00)	
Weight of 1st child at birth	< 4000 g	600	84.8	73.0	1,00	0.050
	≥ 4000 g	106	15.2	80.8	1.11 (1.00 – 1.24)	
Climacteric Symptoms	Absent / Light	541	62.3	72.6	1,00	0.203
	Moderate / Intense	332	37.7	76.4	1.05 (0.97 – 1.14)	
First delivery age	≤18 anos	218	27.3	81.2	1,00	0.004
	> 18 anos	605	72.7	72.1	0.89 (0.82 – 0.96)	
Clinical; eating /behavioural habits						
Liver disease	Absent	792	91,6	73.0	1.00	0.000
	Present	74	8.4	86.3	1.21 (1.10 – 1.33)	

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Gout	Absent	822	95.4	73.0	1.00	0.000
	Present	38	4.6	91.9	1.27 (1.15 – 1.40)	
Kidney disease	Absent	700	85.4	72.1	1.00	0.000
	Present	119	14.6	88.2	1.20 (1.10 – 1.31)	
Metabolic syndrome	Present	317	35.2	59.6	1.00	0.000
	Absent	557	64.8	81.9	1.39 (1.25 – 1.53)	
Urinary incontinence	Absent	676	77.5	71.9	1.00	0.026
	Present	195	22.5	81.2	1.10 (1.01 – 1.20)	
Cardiovascular disease	Low risk	388	43.7	66.6	1,00	
	Intermediate Risk	423	48.4	78.7	1.15 (1.06 – 1.26)	0.000
	High risk	66	7.9	87.0	1.31 (1.16 – 1.46)	
Alcoholism	No	646	78.8	73.0	1,00	0.239
	Yes	163	21.2	79.8	1.06 (0.96 – 1.16)	
Fat intake	No	655	80.2	73.0	1.00	0.065
	Yes	163	19.8	79.8	1.09 (1.00 – 1.19)	

* values corrected by the drawing effect (deff); RP: Gross prevalence ratio; 95% CI: Confidence interval.

The socio-demographic (marital status, monthly income, number of individuals residing in the same house and color of skin), clinical and behavioral (smoking, physical activity, depression symptoms, sleep quality) factors did not present significant associations ($p < 0.250$) with overweight/obesity, and are not included in the hierarchical model.

The health conditions that were associated with overweight/obesity in the hierarchical model at the distal level were private school (PR = 1.30, p = 0.000) and low level of education (PR = 1.11, p = 0.033). After adjusting for sociodemographic factors, an association at intermediate level between the first childbirth above 18 years (PR = 0.90, p = 0.010) was observed, and this variable had a protective effect against the occurrence of overweight/obesity (Table 2). At the proximal level, after adjusting for the potential confounding factors analyzed, the presence of gout (RP = 1.18, p = 0.004), MS (RP = 1.29, p = 0.000), kidney disease (P = 1.19, p = 0.006) and fat intake (PR = 1.12, p = 0.014) were found to be positively associated with overweight/obesity (Table 2).

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Table 2: Prevalence ratio adjusted for overweight/obesity according to sociodemographic, reproductive, clinical, eating and behavioural factors of climacteric women.

Variables		PR ($CI_{95\%}$) adjusted	*p* Value
Sociodemographic (distal level)			
Type of scholl attended	Public	1.00	
	Private	1.30 (1.14 -1.50)	0.000
Schooling	High School/Graduate	1.00	
	Fundamental II	1.05 (0.94 – 1.17)	0.420
	Fundamental I	1.11 (1.01 -1.23)	0.033
Reproductives (Intermediate level)			
First delivery age	≤18 anos	1.00	
	> 18 anos	0.90 (0.82 -0.97)	0.010
Clinical; eating/behavioural and habits (proximal level)			
Gout	Absent	1.00	
	Present	1.18 (1.05 -1.32)	0.004
Metabolic Syndrome	Absent	1.00	
	Present	1.29 (1.16 -1.44)	0.000
Kidney disease	Absent	1.00	
	Present	1.18 (1.08 -1.29)	0.000
Cardiovasculares disease	Low risk	1.00	
	Intermediate risk	1.05 (0.95–1.15)	0.332
	High risk	1.19 (1.05–1.34)	0.006
Fat intake	No	1.00	
	Yes	1.12 (1.02 -1.23)	0.014

PR: Gross and adjusted prevalence ratio; 95% CI: confidence interval

Discussion

The prevalence of overweight and obesity in the population of the present study was higher than 2/3 of the sample, with a BMI mean of 28.67 ± 6.35 kg/m^2, with a predominance of overweight in postmenopausal women. These findings are in accordance with a study conducted in São Paulo/Brazil, where the BMI mean in postmenopausal women was 29.0 ± 5.6 kg/m^2 [25].

Weight gain in climacteric is due to the ageing process and estrogenic depletion, with the centralised distribution of fat mass related to ovarian failure [26], which leads to a change in the hormonal environment previously dominated by estrogen to an environment where there is a predominance of testosterone, favouring androgenicity [27]. Also,

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

inadequate lifestyle habits, such as sedentary lifestyle, consumption of fats and sugars, can lead to physiological and metabolic alterations[28]. The limited perception of body weight and the importance of the control[29], and the use of medications such as antidepressants, analgesics, and anxiolytics [30] also compete for the appearance of this condition.

Obesity is associated with insulin resistance and chronic inflammation predisposing to various diseases, including breast cancer, whose pathogenesis has been linked to increased estrogen levels[31].

In addition, excessive body weight also contributes to the occurrence of systemic arterial hypertension (SAH), depression and worsening of climacteric symptoms[32]. Together with other comorbidities, they impair the quality of life of women and impact their functionality[33].

According to the findings of the study, having attended private school seems to be associated with overweight in the climacteric. This may be due to the more accessible food with high caloric rates in childhood and adolescence, leading to weight excess, which could be perpetuating in adult life. However, the literature cannot explain these findings consistently, presenting evidence of a higher prevalence of weight excess among students of private schools in other age groups [34;35.]

Still, some studies evidence the association between low schooling and high BMI[36], in consonance with the present findings, suggesting that a higher level of education may favour healthier living habits, such as the intake of vegetables and fruits[37] and the regular practice of physical activity[38].

Regarding the gynaecological aspects, having a delivery occurred after the age of 18 was shown to be a protective factor for overweight/obesity. Other studies have also shown an association between overweight/obesity, early parturition and parity[39,40].

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Findings suggest that younger maternal age at first delivery is independently associated with a higher risk of central obesity and MS in climacteric[41]. One explanation would be the possibility of a higher number of pregnancies among women with early parturition and lifestyle changes, although the pathophysiology of this association is still unclear and deserves additional studies[42]. Multiparity is associated with an increase in the prevalence of MS since it favours abdominal obesity[43] and insulin resistance in climacteric women[44].

The diagnosis of gout and overweight/obesity in climacteric are also associated. This finding becomes relevant since hyperuricemia correlated with insulin resistance, hypertension, obstructive sleep apnea, chronic renal disease (CKD), MS and elevated cardiovascular risk[45,46]. According to this context, hyperuricemia may be related to an increase in the prevalence of coronary artery disease (CAD) and to the incidence of major cardiovascular events in climacteric women, being an independent risk factor[47]. Chromosomal abnormalities are associated with elevated serum levels of uric acid and gout in postmenopausal women, demonstrating a possible role of sex hormones in the regulation of the urate transporter in gout[48].

An association between kidney disease and overweight was found in the present study. These data are consistent with the Brazilian Society of Nephrology's Dialysis Survey in 2014, which showed that 37% of dialysis patients were overweight or obese as a risk factor for CKD[49]. In addition, obesity is associated with MS, that is also a risk factor for the development of CKD[50].

Overweight is related to compensatory hyperfiltration, which occurs to meet the metabolic demands increased by body weight, with possible damage to the kidneys and increased risk of long-term glomerulopathy, besides being also a risk factor for nephrolithiasis and kidney cancer. The obese patient also has a higher relative risk for

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

264 developing albuminuria and a decrease in the glomerular filtration rate, even without
265 CKD[51].

266 In climacteric, with increased risk for obesity, MS becomes more prevalent,
267 increasing the incidence of cardiovascular disease and the risk of acute myocardial
268 infarction (AMI)[52], a vulnerability attributed to the decrease of estrogen and insulin
269 resistance[53]. The association between overweight/obesity and MS was observed in the
270 present study with the consequent risk elevation for cardiovascular diseases. Another
271 study corroborated these findings and demonstrated that the prevalence of MS was also
272 higher in postmenopausal women[54]. Obesity presents as a possible primary factor for the
273 occurrence of MS and the risk of cardiovascular diseases, since an overweight patient
274 may also have visceral adiposity, which is one of the diagnostic criteria of MS.

275 Among the overweight/obese women in this study, the diet characterised by fat
276 intake was associated with overweight. A document published by the Health Surveillance
277 Agency points out that excessive consumption of saturated fat, as well as sugars, is related
278 to the development of chronic noncommunicable diseases, including obesity[55.] The
279 balance in fat consumption is a viable strategy for a possible reduction of cardiovascular
280 risk in this population[56], since inadequate diet is the leading cause of cardiovascular
281 mortality[23].

282 The present study presents as limiting factors the use of BMI as the sole diagnostic
283 criterion for overweight/obesity, in detriment to the use of other gold standard techniques,
284 such as dual X-ray densitometry (DEXA). The variables liver diseases, kidney disease
285 and gout, were addressed by self-report, and it was not possible to establish with precision
286 the different etiologies of these diseases, but being able to establish their association in a
287 generic way, provoking the need for further studies using more accurate diagnostic tools,
288 such as imaging or laboratory tests. Moreover, it is a cross-sectional study and, therefore,

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

unable to establish causality among the studied variables. Despite the presented limitations, the obtained results bring relevant information on the subject, besides listing variables to be studied in future researches. It should be emphasised that the sample used in the study was representative of the population and was obtained in a probabilistic way, strengthening the results and associations obtained.

In addition, from a socioeconomic point of view, the population studied resides in a region that represents the Brazilian reality with confidence, located in a transition zone between considered rich Brazil (represented by the South and Southeast states) and Brazil with characteristics of poverty (represented by the Northern and Northeastern states). Therefore, the present study brings relevant associations on the health of climacteric women in an emblematic and representative area of the Brazilian population.

Conclusion

The presence of overweight/obesity was associated with climacteric women who had attended private schools, with low schooling, gout, metabolic syndrome, kidney disease, with high cardiovascular risk and who ingest fats in the diet. In turn, having first delivery after 18 years of age was presented as a protective factor for women not to become overweight/obese. It is suggested to monitor the modifiable factors since they were associated with overweight in climacteric women assisted by primary health care services.

References

1. Cunha ACNP, Cunha NNP, Barbosa MT. Geriatric teaching in Brazilian medical schools in 2013 and considerations regarding adjustment to demographic and

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

epidemiological transition. Rev Ass Med Bras. 2016; 62(2): 179-183. DOI: 10.1590/1806-9282.62.02.179.

2. NCD Risk Factors Collaboration (NCD-RisC). Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19·2 million participants. The Lancet. 2016; 387(10026):1377–96. DOI: 10.1016/S0140-6736(16)30054-X.

3.Nogueira IAL, da Cruz EJSN, Fontenele AMM, Figueiredo Neto JA. Alterations in postmenopausal plasmatic lipidome. PLoS ONE. 2018; 13 (9): e0203027. DOI: 10.1371/journal.pone.0203027.

4. Silveira EA, Vieira LL, Jardim TV, Souza JD. Obesity and its Association with Food Consumption, Diabetes Mellitus, and Acute Myocardial Infarction in the Elderly Arq. Bras. Cardiol. 2016; 107(6): 509-517. DOI: 10.5935/abc.20160182.

5. Moley KH, Colditz GA. Effects of obesity on hormonally driven cancer in women. Sci Transl Med. 2016; 8(323): 323ps3. DOI: 10.1126/scitranslmed.aad8842.

6. Medeiros de Morais MS, Andrade do Nascimento R, Vieira MCA, Moreira MA, Camara SMAD, Campos Cavalcanti Maciel A *et al*. Does body image perception relate to quality of life in middle-aged women? PLoS ONE. 2017; 12(9): e0184031. DOI: 10.1371/journal.pone.0184031.

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

337 7. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de
338 Vigilância de Doenças e Agravos não Transmissíveis e Promoção da Saúde. Vigitel Brasil
339 2016: vigilância de fatores de risco e proteção para doenças crônicas por inquérito
340 telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de
341 risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito
342 Federal em 2016 / Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento
343 de Vigilância de Doenças e Agravos não Transmissíveis e Promoção da Saúde. – Brasília:
344 Ministério da Saúde, 2017. 160p.: il. ISBN 978-85-334-2479-1. Available at:
345 http://portalarquivos2.saude.gov.br/images/pdf/2018/marco/02/vigitel-brasil-2016.pdf.
346
347 8. Lui Filho JF, Baccaro LF, Fernandes T, Conde DM, Costa-Paiva L, Pinto Neto AM.
348 Factors associated with menopausal symptoms in women from a metropolitan region in
349 Southeastern Brazil: a population-based household survey. Rev Bras Ginecol Obstet.
350 2015; 37(4):152-8. DOI: 10.1590/SO100-720320150005282.
351
352 9. Gonçalves JTT, Silveira MF, Campos MCC, Costa LHR. Overweight and obesity and
353 factors associated with menopause. Ciência & Saúde Coletiva. 2015; 21(4): 1145-56.
354 DOI: 10.1590/1413-81232015214.16552015.
355
356 10.Andrade MV, Coelho AQ, Xavier Neto M, Carvalho LR, Atun R, Castro MC.
357 Transition to universal primary health care coverage in Brazil: Analysis of uptake and
358 expansion patterns of Brazil's Family Health Strategy (1998-2012). PLoS ONE. 2018;
359 13(8): e0201723. DOI: 10.1371/ journal.pone.0201723.
360

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

11. The North American Menopause Society (NAMS). Menopause Guidebook. Available at: www.menopause.org . Traduzido pela SOBRAC – Associação Brasileira de Climatério. Guia da Menopausa. Ajudando a mulher climatérica a tomar decisões informadas sobre a sua saúde. 7 ed. São Paulo: 2013. ISBN 978-0-9701251-4-9. Available at: http://sobrac.org.br/media/files/publicacoes/00001261_a12361_leigos_rev2mcowfinal.pdf

12 Mason C, Xiao L, Imayama I, Duggan C, Wang CY, Korde L, *et al*. Vitamin D3 supplementation during weight loss: a double-blind randomized controlled trial. Am J Clin Nutr. 2014. DOI: 10.3945/ajcn.113.073734.

13. Yan LL, Daviglus ML, Liu K, Pirzada A, Garside DB, Schiffer L, Dyer AR, Greenland P. BMI and health-related quality of life in adults 65 years and older. Obes Res. 2004; 12(1): 69-76. DOI: 10.1038/oby.2004.10.

14. Fanelli F, Mezzullo M, Belluomo I, Di Lallo VD, Baccini M, Ibarra Gasparini D *et al*. Plasma 2-arachidonoylglycerol is a biomarker of age and menopause related insulin resistance and dyslipidemia in lean but not in obese men and women. Mol Metab. 2017; 6(5): 406–415. DOI: 10.1016/j.molmet.2017.03.005.

15. Kupperman HS, Blatt MHG. Menopausal indice. J Clin Endocrinol. 1953; 13(1): 688-694.

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

16. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). Jama 2001 May 16; 285(19): 2486-97. DOI:10.1001/jama.285.19.2486.

17. Tamanini JTN, Dambros M, D'Ancona CAL, Palma PCR, Netto Jr NR. Validation of the "International Consultation on Incontinence Questionnaire - Short Form" (ICIQ-SF) for Portuguese. Rev Saúde Pública. 2004;38(3)438-44. DOI: 10.1590/S0034-89102004000300015.

18. D'Agostino RB, Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM, *et al*. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. Circulation. 2008;117(6):743-53. DOI: 10.1161/CIRCULATIONAHA.107.699579.

19. Gorenstein C, Andrade L. Inventário de depressão de Beck: propriedades psicométricas da versão em português. Rev Psiq Clin.1998; 25:245-250.

20. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213.

21. Benedetti TRB, Mazo GZ, Barros MV. Aplicação do Questionário Internacional de Atividade Física para avaliação do nível de atividades físicas de mulheres idosas: validade concorrente e reprodutibilidade teste/reteste. Rev Bras Ciên e Mov. 2004; 12(1):25-33.

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

410 22 - Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of
411 low-density lipoprotein cholesterol in plasma, without use of the preparative
412 ultracentrifuge. Clin Chem. 1972;18(6):499-502.
413
414 23. Faludi AA, Izar MCO, Saraiva JFK, Chacra APM, Bianco HT, Afiune Neto A et al.
415 Atualização da Diretriz Brasileira de Dislipidemias e Prevenção da Aterosclerose – 2017.
416 Arq Bras Cardiol 2017; 109(2Supl.1):1-76. DOI: 10.5935/abc.20170121. Available at:
417 http://publicacoes.cardiol.br/2014/diretrizes/2017/02_DIRETRIZ_DE_DISLIPIDEMIA
418 S.pdf
419
420 24. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Report
421 of the expert committee on the diagnosis and classification of diabetes mellitus. Diabetes
422 Care. 2003;26(1):S5-20. DOI: 10.2337/diacare.26.2007.S5.
423
424 25. Steiner ML, Azevedo LH, Bonacordi CL, Barros AZ, Strufaldi R, Fernandes CE.
425 Avaliação de consumo alimentar, medidas antropométricas e tempo de menopausa de
426 mulheres na pós-menopausa. Rev Bras Ginecol Obstet, 2015; 37(1):16-23. DOI:
427 10.1590/SO100-720320140005138.
428
429 26. Karvonen-Gutierrez C, Kim C. Association of Mid-Life Changes in Body Size, Body
430 Composition and Obesity Status with the Menopausal Transition. Healthcare
431 (Basel), 2016; 13;4(3). DOI: 10.3390/healthcare4030042.
432

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

433 27. Janssen I, Powell LH, Jasielec MS, Kazlauskaite R. Covariation of change in
434 bioavailable testosterone and adiposity in midlife women. Obesity (Silver Spring), 2015;
435 23(2): 488-494. DOI: 10.1002/oby.20974.
436
437 28. Barbalho SM, Bechara MD, Quesada K, Gabaldo MR, Goulart RA, Tofano RJ *et al*.
438 Metabolic syndrome, atherosclerosis and inflammation: an inseparable triad? J Vasc Bras.
439 2015; 14(4):319-327. DOI: 10.1590/1677-5449.04315.
440
441 29. Muennig P, Jia H, Lee R, Lubetkin E. I Think Therefore I Am: Perceived Ideal Weight
442 as a Determinant of Health. Am J Public Health 2008; 98(3): 501-506. DOI:
443 10.2105/AJPH.2007.114769.
444
445 30. Castelo-Branco C. Clinical aspects and relationships between weight gain, obesity
446 and menopause. Maturitas. 2009; 63 (Suppl 1): S19. DOI: 10.1016/S0378-
447 5122(09)70075-1.
448
449 31. Gershuni V, Li YR, Williams AD, So A, Steel L, Carrigan E, *et al*. Breast
450 cancer subtype distribution is different in normal weight, overweight, and obese women.
451 Breast Cancer Res Treat. 2017;163(2):375-381. DOI: 10.1007/s10549-017-4192-x.
452
453 32. Blümel JE, Chedraui P, Aedo S, Fica J, Mezones-Holguín E, Barón G, *et al*. Obesity
454 and its relation to depressive symptoms and sedentary lifestyle in middle-aged women.
455 Maturitas. 2015; 80(1):100-5. DOI: 10.1016/j.maturitas.2014.10.007.
456

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

457 33. Sorpreso ICE, Soares Júnior JM, Fonseca AM, Baracat EC. Female aging. Rev Assoc
458 Med Bras 2015; 61(6):553-556. DOI: 10.1590/1806-9282.61.06.553.
459
460 34. Rosaneli CF, Auler F, Manfrinato CB, Rosaneli CF, Sganzerla C, Bonatto MG et al.
461 Evaluation of the prevalence and nutritional and social determinants of overweight in a
462 population of schoolchildren: a cross-sectional analysis of 5,037 children. Rev. Assoc.
463 Med. Bras. 2012;58(4): 472-476. DOI: 10.1590/S0104-42302012000400019.
464
465 35. Simmonds M, Burch J, Llewellyn A, Griffiths C, Yang H, Owen C. The use of
466 measures of obesity in childhood for predicting obesity and the development of obesity-
467 related diseases in adulthood: a systematic review and meta-analysis. Health Technol
468 Assess. 2015 Jun;19(43):1-336. DOI: DOI: 10.3310/hta19430.
469
470 36. Alves RFS, Faerstein E. Educational inequality in the occurrence of abdominal
471 obesity: Pró-Saúde Study. *Rev Saude Publica*. 2015;49: 65. DOI: 10.1590/S0034-
472 8910.2015049005786.
473
474 37. Lins APM, Sichieri R, Coutinho WF, Ramos EG, Peixoto MVM, Fonseca VM.
475 Healthy eating, schooling and being overweight among low-income women. Ciência &
476 Saúde Coletiva. 2013;18(2):357–66. DOI: 10.1590/S1413-81232013000200007.
477
478 38. Freire RS, Lélis FLO, Fonseca Filho JA, Nepomuceno MO, Silveira MF. Regular
479 physical activity: a population-based study in North Minas Gerais, Brazil. Rev Bras Med
480 Esporte. 2014; 20(5):345-349. DOI: 10.1590/1517-86922014200502062.
481

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

482 39. Kac G, Velásquez-Meléndez G, Valente JG. Menarche, early pregnancy, and obesity
483 in selected Brazilian women from a health care center in Belo Horizonte, Minas Gerais,
484 Brazil. Cad Saúde Pública. 2003; 19(Suppl. 1):111-8. DOI: 10.1590/S0102-
485 311X2003000700012.
486
487 40. Bobrow KL, Quigley MA, Green J, Reeves GK, Beral V; Million Women Study
488 Collaborators. Persistent effects of women's parity and breastfeeding patterns on their
489 body mass index: results from the Million Women Study. Int J Obes (Lond). 2013;
490 37(5):712-7. DOI: 10.1038/ijo.2012.76.
491
492 41. Sim JH, Chung D, Lim JS, Lee MY, Chung CH, Shin JY, *et al*. Maternal Age at First
493 Delivery Is Associated with the Risk of Metabolic Syndrome in Postmenopausal Women:
494 From 2008–2010 Korean National Health and Nutrition Examination Survey. PLoS ONE.
495 2015; 10(5): e0127860. DOI:10.1371/journal.pone.0127860.
496
497 42. We JS, Han K, Kwon HS, Kil K. Effect of Maternal Age at Childbirth on Obesity in
498 Postmenopausal Women: A Nationwide Population-Based Study in Korea. Medicine
499 (Baltimore). 2016; 95(19):e3584. DOI: 10.1097/MD.0000000000003584.
500
501 43. Vladutiu CJ, Siega-Riz AM, Sotres-Alvarez D, Stuebe AM, Ni A, Tabb KM, *et al*.
502 Parity and Components of the Metabolic Syndrome Among US Hispanic/Latina Women:
503 Results From the Hispanic Community Health Study/Study of Latinos. Circ Cardiovasc
504 Qual Outcomes. 2016; 9 (2 Suppl 1): S62-9. DOI:
505 10.1161/CIRCOUTCOMES.115.002464.
506

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

507 44. Kim JH, Lee SJ. Parity and increased risk of insulin resistance in postmenopausal
508 women: the 2010 Korean National Health and Nutrition Examination Survey.
509 Menopause. 2017;13. DOI: 10.1097/GME.0000000000000846.
510
511 45. Jung JH, Song GG, Ji JD, Lee YH, Kim JH, Seo YH, *et al*. Metabolic syndrome:
512 prevalence and risk factors in Korean gout patients. Korean J Intern Med. 2018. DOI:
513 DOI: 10.3904/kjim.2016.062.
514
515 46. Lopes HF, Corrêa-Giannella ML, Consolim-Colombo FM, Egan BM. Visceral
516 adiposity syndrome. Diabetol Metab Syndr. 2016; 8:40. DOI: 10.1186/s13098-016-0156-
517 2.
518
519 47. Zhang JW, He LJ, Cao SJ, Yang Q, Yang SW, Zhou YJ. Association of serum uric
520 acid and coronary artery disease in premenopausal women. PLoS One. 2014;
521 9(9):e106130. DOI: 10.1371/journal.pone.0106130.
522
523 48. Zhang L, Spencer KL, Voruganti VS, Jorgensen NW, Fornage M, Best LG *et al*.
524 Association of functional polymorphism rs2231142 (Q141K) in the ABCG2 gene with
525 serum uric acid and gout in 4 US populations: the PAGE Study. Am J Epidemiol. 2013;
526 177(9):923-32. DOI: 10.1093/aje/kws330.
527
528 49. Sesso RC, Lopes AA, Thomé FS, Lugon JR, Martins CT. Brazilian Chronic Dialysis
529 Census 2014. J Bras Nefrol. 2016; 38(1): 54-61. DOI: 10.5935/0101-2800.20160009.
530

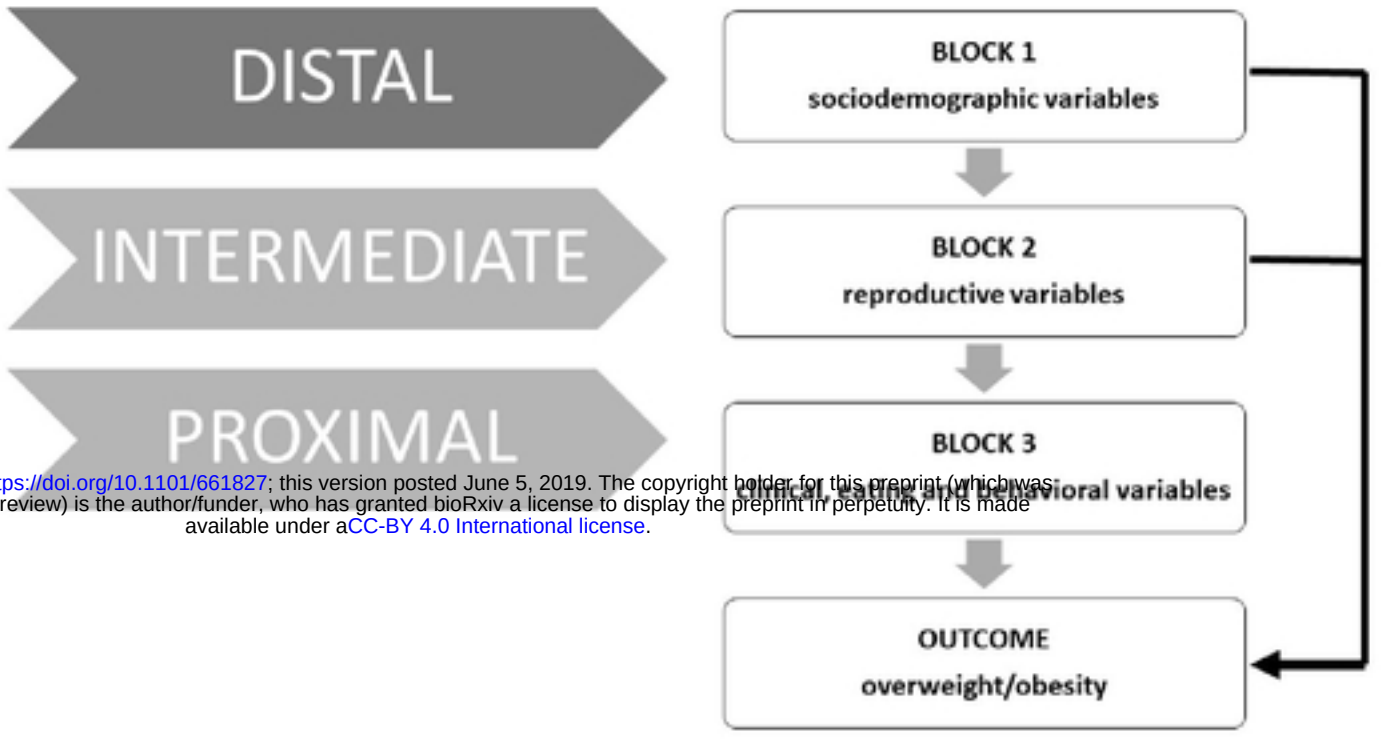
bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

531 50. Stefanska A, Bergmann K, Sypniewska G. Metabolic Syndrome and Menopause:
532 Pathophysiology, Clinical and Diagnostic Significance. Adv Clin Chem. 2015;72:1-75.
533 DOI: 10.1016/bs.acc.2015.07.001.
534
535 51. Garofalo C, Borrelli S, Minutolo R, Chiodini P, De Nicola L, Conte G. A systematic
536 review and meta-analysis suggests obesity predicts onset of chronic kidney disease in the
537 general population. Kidney Int. 2017; 91(5):1224-1235. DOI:
538 10.1016/j.kint.2016.12.013.
539
540 52. Sharma S, Aggarwal N, Joshi B. Suri V, Badada S. Prevalence of metabolic syndrome
541 in pre- and post-menopausal women: A prospective study from apex institute of North
542 India. J Midlife Health. 2016 Oct-Dec; 7(4): 169–174. DOI: 10.4103/0976-7800.195695.
543
544 53. Meirelles RMR. Menopause and metabolic syndrome. Arq Bras Endocrinol Metab.
545 2014;58(2):91-6. DOI: 10.1590/0004-2730000002909.
546
547 54. Figueiredo Neto JA, Figuerêdo ED, Barbosa JB, Barbosa FF, Costa GRCC, Nina VJS
548 *et al*. Metabolic Syndrome and Menopause: Cross-Sectional Study in Gynecology Clinic.
549 Arq Bras Cardiol 2010; 95(3): 339-45. DOI: 10.1590/S0066-782X2010005000094.
550
551 55. Agência Nacional de Saúde Suplementar (Brasil). Diretoria de Normas e Habilitação
552 dos Produtos. Gerência-Geral de Regulação Assistencial. Gerência de Monitoramento
553 Assistencial. Coordenadoria de Informações Assistenciais. Manual de diretrizes para o
554 enfretamento da obesidade na saúde suplementar brasileira [recurso eletrônico]/Agência
555 Nacional de Saúde Suplementar. Diretoria de Normas e Habilitação dos Produtos.

bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

556 Gerência-Geral de Regulação Assistencial. Gerência de Monitoramento Assistencial.
557 Coordenadoria de Informações Assistenciais. – Rio de Janeiro: ANS, 2017. 6.5 MB;
558 ePUB. ISBN 978-85-63059-36-9. Available at:
559 http://www.ans.gov.br/images/Manual_de_Diretrizes_para_o_Enfrentamento_da_Obesi
560 dade_na_Sa%C3%BAde_Suplementar_Brasileira.pdf
561
562 56. Silver HJ, Kang H, Keil CD, Muldowney JA, Kocalis H, Fazio S, *et al*. Consuming a
563 balanced high fat diet for 16 weeks improves body composition, inflammation and
564 vascular function parameters in obese premenopausal women. Metabolic. 2014;
565 63(4):562-73. DOI: 10.1016/j.metabol.2014.01.004.
566

Figure 1: Model with the statistically significant variable selected in the bivariate analysis, and then adding other variables.



bioRxiv preprint doi: https://doi.org/10.1101/661827; this version posted June 5, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Figure