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ORIGINAL ARTICLE

Correlation between urinary incontinence and peripheric polyneuropathy without diabetes in women with obesity grades II and III

Correlação entre incontinência urinária e polineuropatia periférica sem diabetes em mulheres com obesidade graus II e III

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Abstract

Introduction: Obesity and its strong link with urinary incontinence (UI) have been widely documented in the literature. *Objective:* The objective of the study was to evaluate the prevalence of UI and polyneuropathy (PNP) in women with obesity classes II and III and explore possible associations. *Methods:* 211 women underwent the International Consultation on Incontinence Questionnaire - Short Form (ICIQ-SF), the Neuropathy Symptom Score (NSS), and the abbreviated International Physical Activity Questionnaire (IPAQ), in addition to anthropometric measurements, laboratory tests, and gynecological evaluation. Comparisons of UI scores and PNP symptoms were made using the Mann-Whitney, Spearman, and Pearson's Chi-Square ($\chi 2$) tests. *Results:* The prevalence of women with UI and obesity classes II and III was 69.6% (n=147), and the presence of PNP symptoms was 58.8% (n=128). In the univariate analysis, UI showed no association with PNP (p= 0.374), physical inactivity (p= 0.895), smoking (p= 0.630), menopause (p= 0.134), or parity (p= 0.073). PNP was also not associated with a sedentary lifestyle (p= 0.058), smoking (p= 0.438), menopause (p= 0.225), or parity (p= 0.441). There was no significant difference in UI (p= 0.372) and PNP (p= 0.179) scores between classes II and III of obesity. Age showed a significant correlation with ICIQ (p= 0.007) and NSS (p= 0.008). UI correlated positively with the number of normal births (p < 0.032). *Conclusion:* UI and PNP in women with obesity classes

II and III without DM were not associated with each other and other variables but were related to increasing age and normal birth.
Keywords: Age Groups; Menopause; Obesity; Polyneuropathies; Urinary Incontinence.

Resumo

Introdução: A obesidade e a sua forte ligação com a incontinência urinária (IU) têm sido amplamente documentadas na literatura. *Objetivo:* Avaliou-se a prevalência de IU e polineuropatia (PNP) em mulheres com obesidade graus II e III e identificar possíveis associações. *Métodos:* 211 foram submetidas ao Questionário Internacional de Consulta sobre Incontinência - Versão Curta (ICIQ-SF), ao Escore de Sintomas de Neuropatia (NSS) e ao Questionário Internacional de Atividade Física – abreviado (IPAQ), além de medidas antropométricas, exames laboratoriais e avaliação ginecológica. As comparações entre os escores de IU e os sintomas de PNP foram realizadas utilizando os testes de M*ann-Whitney, Spearman e Qui-Quadrado de Pearson* ($\chi 2$). *Resultados:* A prevalência de mulheres com IU e obesidade classes II e III foi de 69,6% (n=147), e a presença de sintomas de PNP foi de 58,8% (n=128). Na análise univariada, a IU não apresentou associação com PNP (p=0,374), inatividade física (p= 0,895), tabagismo (p=0,630), menopausa (p=0,134) ou paridade (p=0,073). PNP também não foi associada a sedentarismo (p= 0,058), tabagismo (p= 0,438), menopausa (p=0,225) ou paridade (p=0,441). Não houve diferença significativa nos escores de IU (p=0,372) e PNP (p=0,179) entre as classes II e III de obesidade. A idade apresentou correlação significativa com ICIQ (p=0,007) e NSS (p=0,008). A IU correlacionou-se positivamente com o número de partos normais (p<0,032). *Conclusão*: IU e PNP em mulheres com obesidade graus II e III sem DM não foram associadas entre si e outras variáveis, mas foram relacionadas ao aumento da idade e ao parto normal.
Palavras-chave: Faixa de Idade; Menopausa; Obesidade; Polineuropatias; Incontinência Urinária.

Introduction

UI is defined by the International Continence Society (ICS) as the complaint of any involuntary loss of urine or unintentional urination. The condition occurs in both sexes but is much more common in women [1]. UI is classified as exertional (UIE), urgency (UIU), mixed (UIM), overflow, or functional [2].

UI has a significant impact on women's social, physical and psychological lives, and has a diagnostic prevalence rate ranging from 25% to 75% of the general population [3]. In women with mild to moderate stress, urgency, mixed or overflow incontinence, treatment with pelvic physiotherapy through pelvic floor exercises is associated with a reduction in symptoms and can be an effective first-line treatment [4].

Some of the factors associated with the cause of UI in women are obesity, parity, menopause and old age, smoking, and a sedentary lifestyle [5].

Obesity contributes to incontinence because of increased intra-abdominal pressure due to central adiposity, which raises bladder pressure and urethral mobility, leading to stress incontinence. This kind of UI is already well established but can also exacerbate detrusor instability, causing UIU [6].

An association between obesity and PNP has been reported in some studies, regardless of the presence of diabetes mellitus (DM). The factors associated with PNP occurrence in obesity are similar to those described in DM [7-10]. However, severe deficiencies in a wide range of micronutrients have also been found in patients with severe obesity, which may contribute to the development of PNP [11].

Autonomic neuropathy, such as that in DM, can lead to a neurogenic bladder. Symptoms associated with neurogenic bladder are similar to those of UI, but there is typically no urge to urinate. Instead, urine loss occurs due to bladder overflow and structural disturbances in its tissues [12].

Studies have recommended considering obesity as a possible cause of PNP in patients without DM. It is crucial to evaluate treatment strategies for this metabolic change, as obesity is associated with a series of complications, including neurological disorders such as PNP [9,13].

Peripheral neuropathy (PNP) was previously considered by some authors as a complication of bariatric surgery (BS) [14]. However, more recent publications have suggested a change in this perspective. These more recent studies point to the observation of a regression of PNP in patients undergoing BS. This finding indicates that, in some cases, BS not only results in weight loss and improvement in obesity-related conditions but may also have positive effects in reducing neurological complications such as PNP [10].

Studies have shown the presence of PNP in patients with obesity. Research suggests that there may be an association between the prevalence of UI and the prevalence of PNP. The prevalence of urinary incontinence was evaluated in women with obesity grades II and III without diabetes mellitus, and it was verified whether there is an association with factors such as peripheral neuropathy, physical inactivity, post-menopause, parity, smoking, and age.

Methods

After approval by the Research Ethics Committee (CAAE 56373621.4.0000.5335), a cross-sectional study was carried out, from October 2021 to December 2023, in women with obesity grades II and III, at the Obesity Treatment Center (OTC) of the *Irmandade Santa Casa de Misericórdia de Porto Alegre* (ISCMPA).

Women over 18 years of age with a history of grade II and III obesity, according to the World Health Organization, were included. Women excluded were those under the age of 18, illiterate, pregnant and postpartum women, lactating, with lower urinary tract infections at the time of evaluation, with interstitial cystitis, urogenital cancer, patients undergoing chemotherapy or neurological diseases except peripheral neuropathy, degenerative diseases, history of pelvic floor surgery, women who have received treatment for pelvic floor muscle dysfunction with pelvic physiotherapy in the last three months, with hypothyroidism defined by TSH levels greater than six μm/L, with a history of alcohol abuse according to the CAGE-40 questionnaire [15], patients with DM according to the ADA [16], renal failure or acute liver disease, HIV positive, undergoing treatment for tuberculosis, patients with inadequate vitamin replacement B12 (levels less than 210 pg/ml) and BMI < 19 kg/m².

Of the hospital's outpatients, 80% are women, so there was interest in looking for the association between UI and symptoms of the presence of PNP

in obesity. The prevalence and factors related to UI and PNP were studied exclusively in women.

The sample size was calculated based on the study by SUBAK (2015) using the WinPEPI (Programs for Epidemiologists for Windows) program [6], which found the prevalence of UI in pre-BS women at 49.3% and was configured to detect a 5% difference in the prevalence of UI, considering a 95% confidence interval and a significance level of 5%, and obtained a sample size of 385 subjects and another 10% for losses.

When evaluating PNP symptoms, it is necessary to exclude other secondary causes, such as alcoholism, decompensated hypothyroidism, dysproteinemia, anemia, use of potentially nephrotoxic drugs, and signs of spinal cord compression, among others. The assessment was conducted by analyzing the patient's medical history and laboratory tests and using the NSS to evaluate the symptoms that may indicate the presence of peripheral neuropathy [17]. UI was assessed using the ICIQ-SF [18], and physical activity was performed using the IPAQ - short version [19].

Data were collected on female assessment, types of birth, smoking, anthropometric data, laboratory data, medical history, and medications in use.

Statistical analysis was performed using IBM® SPSS® statistical software (version 26.0). The findings were presented using absolute (n) and relative frequencies (%) and minimum and maximum values, arithmetic mean, and standard deviation according to the nature of the variables. Pearson's Chi-Square test (χ^2) was used to test associations between qualitative variables. Spearman's correlation (Rho) was used to test the relationships between quantitative variables. Comparisons of UI and PNP scores were performed using the Mann-Whitney test. The Shapiro-Wilk test was used to test the adherence of variable distributions to the normal curve, and a significance level of $p \leq 0.05$ was adopted.

Results

The sample for this study included 211 women recruited from the OTC, with ages ranging from 18 to 65 years (mean= 35.8 ± 9.3 years). Of the 231 women initially recruited, 20 (6.2%) were excluded due to specific factors, according to the study's exclusion criteria. The majority of participants were white, totaling 72.8% (n= 152). The anthropometric profile of these women, classified as obesity grades II and III, is shown in Table 1.

Table 1 – *Anthropometric profile*

	n	Minimum	Maximum	Mean	SD
Weight (Kg)	211	83.0	193.0	112.7	18.5
Height (cm)	211	147.0	176.0	161.5	6.6
BMI (kg/m^2)	211	35.1	74.5	43.1	5.9
Waist circumference (cm)	211	91.0	166.0	118.9	12.1
Hip circumference (cm)	211	115.0	180.0	136.4	11.4
Wrist circumference (cm)	211	16.0	36.0	22.4	2.5
Arm circumference (cm)	211	26.0	63.0	39.8	4.8

The prevalence of obesity in grades II and III was 32.2% (n= 68) and 67.8% (n= 143), respectively. There was no significant difference between UI and PNP scores between obesity levels UI (p= 0.372), with PNP (p= 0.179) with obesity grades II and III. Furthermore, there was no association between UI and PNP symptoms (p= 0.374). Tables 2 and 3 below present these data along with the distribution of UI classification levels based on physical activity levels (IPAQ), PNP symptoms, menopause, parity, and smoking status of the participants (n= 211).

Table 2 – *Distribution of UI classification levels depending on physical activity levels (IPAQ), peripheral polyneuropathy, menopause, parity, and smoking (n= 211)*

			UI					
			Continent	**UI Mild**	**UI Moderate**	**UI Severe**	**UI Very severe**	**Total**
IPAQ (*p*= 0.895)	Very Active	n(%)	0(0.0)	0(0.0)	1(1.8)	0(0.0)	0(0.0)	1(0.5)
	Active	n(%)	34(53.1)	12(75.0)	34(60.7)	43(60.6)	3(75.0)	126(59.7)
	Insufficient Active	n(%)	3(4.7)	0(0.0)	2(3.6)	3(4.2)	0(0.0)	8(3.8)
	Sedentary	n(%)	27(42.2)	4(25.0)	19(33.9)	25(35.2)	1(25.0)	76(36.0)
Peripheral PNP (*p*= 0.374)	Yes	n(%)	38(59.4)	6(37.5)	32(57.1)	46(64.8)	2(50.0)	124(58.8)
	No	n(%)	26(40.6)	10(62.5)	24(42.9)	25(35.2)	2(50.0)	87(41.2)
Menopause (*p*= 0.134)	No	n(%)	61(95.3)	16(100.0)	52(92.9)	61(85.9)	3(75.0)	193(91.5)
	Yes	n(%)	3(4.7)	0(0.0)	4(7.1)	10(14.1)	1(25.0)	18(8.5)
Births (*p*= 0.073)	Nulliparous (0)	n(%)	24(37.5)	6(37.5)	14(25.0)	22(31.0)	1(25.0)	67(31.8)
	Primiparous (1)	n(%)	21(32.8)	8(50.0)	16(28.6)	14(19.7)	2(50.0)	61(28.9)
	Multiparous (2+)	n(%)	19(29.7)	2(12.5)	26(46.4)	35(49.3)	1(25.0)	83(39.3)
Smoking (*p*= 0.630)	Never Smoked	n(%)	58(90.6)	12(75.0)	47(83.9)	63(88.7)	4(100.0)	184(87.2)
	Former Smoker	n(%)	5(7.8)	4(25.0)	8(14.3)	6(8.5)	0(0.0)	23(10.9)
	Smoker	n(%)	1(1.6)	0(0.0)	1(1.8)	2(2.8)	0(0.0)	4(1.9)
Total		n(%)	64(100,0)	16(100,0)	56(100,0)	71(100,0)	4(100,0)	211(100,0)

Table 3 – *Distribution of peripheral polyneuropathy classification levels depending on physical activity levels (IPAQ), menopause, parity, and smoking (n= 211)*

			Peripheral Polyneuropathy		
			Negative	Positive	Total
IPAQ (p= 0.058)	Very Active	n(%)	1(1.1)	0(0)	1(0,5)
	Active	n(%)	43_a(49.4)	83_a(66.9)	126(59.7)
	Insufficient Active	n(%)	4(4.6)	4(3.2)	8(3.8)
	Sedentary	n(%)	$39(44.8_a)$	$37(29.8_a)$	76(36.0)
Menopause (p= 0.225)	No	n(%)	82(94.3)	111(89.5)	193(91.5)
	Yes	n(%)	5(5.7)	13(10.5)	18(8.5)
Parity (p= 0.441)	Nulliparous	n(%)	31(35.6)	36(29.0)	67(31.8)
	Primiparous	n(%)	26(29.9)	35(28.2)	61(28.9)
	Multiparous	n(%)	30(34.5)	53(42.7)	83(39.3)
Smoking (p= 0.438)	Never Smoked	n(%)	74(85.1)	110(88.7)	184(87.2)
	Former Smoker	n(%)	12(13.8)	11(8.9)	23(10.9)
	Smoker	n(%)	1(1.1)	3(2.4)	4(1.9)
Total		n(%)	87(100)	124(100)	211(100)

UI did not demonstrate a significant association with sedentary lifestyle (p= 0.895), smoking (p= 0.630), menopause (p= 0.134), and parity (p= 0.073), as indicated in Tables 2 and 3 above. Likewise, PNP did not show a significant association with a sedentary lifestyle (p= 0.058), smoking (p= 0.438), menopause (p= 0.225), and parity (p= 0.441). However, although the association between PNP symptoms and IPAQ did not reach statistical significance, significant differences were observed in the proportion of active women with positive PNP and sedentary women with negative PNP symptoms, suggesting a marginal association. Finally, the correlation test revealed a correlation between UI and PNP with age, as shown in Table 4.

Table 4 – *Spearman correlations between age, NSS (peripheral PNP), and ICIQ (urinary incontinence) (n= 211)*

		ICIQ TOTAL		Age		NSS	
		rho	*p*	rho	*p*	rho	*p*
Spearman's rho	Age	**0.185	0.007			**0.183	0.008
	NSS	0.003	0.970	**0.183	0.008		
	TOTAL ICIQ			**0.185	0.007	0.003	0.970

Age showed a positive and significant correlation with the ICIQ (p= 0.007) and NSS (p= 0.008) scores. As women advance in age, the scores that measure the occurrence of UI and symptoms of PNP peripheral areas are also increasing. Figure 1 and 2 below illustrate these relationships found more clearly.

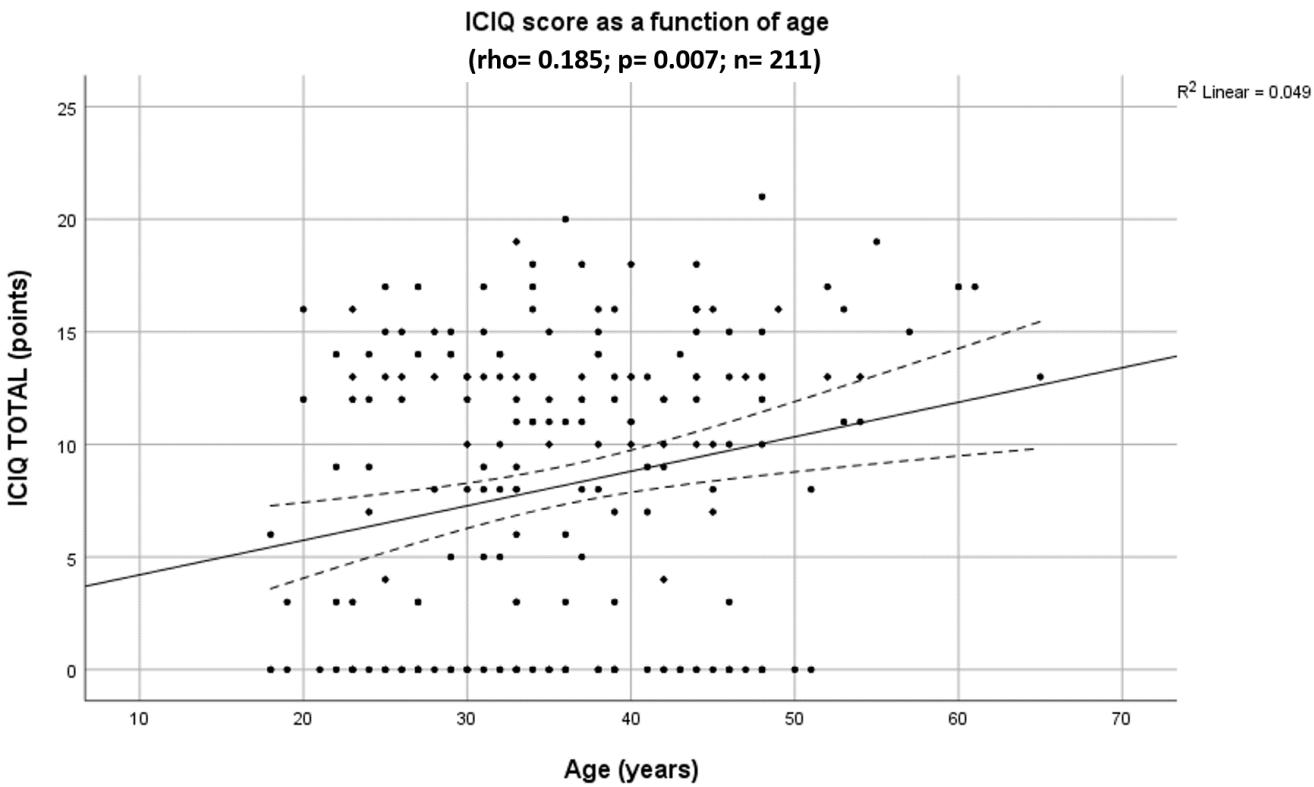

Figure 1- *ICIQ score as a function of age*

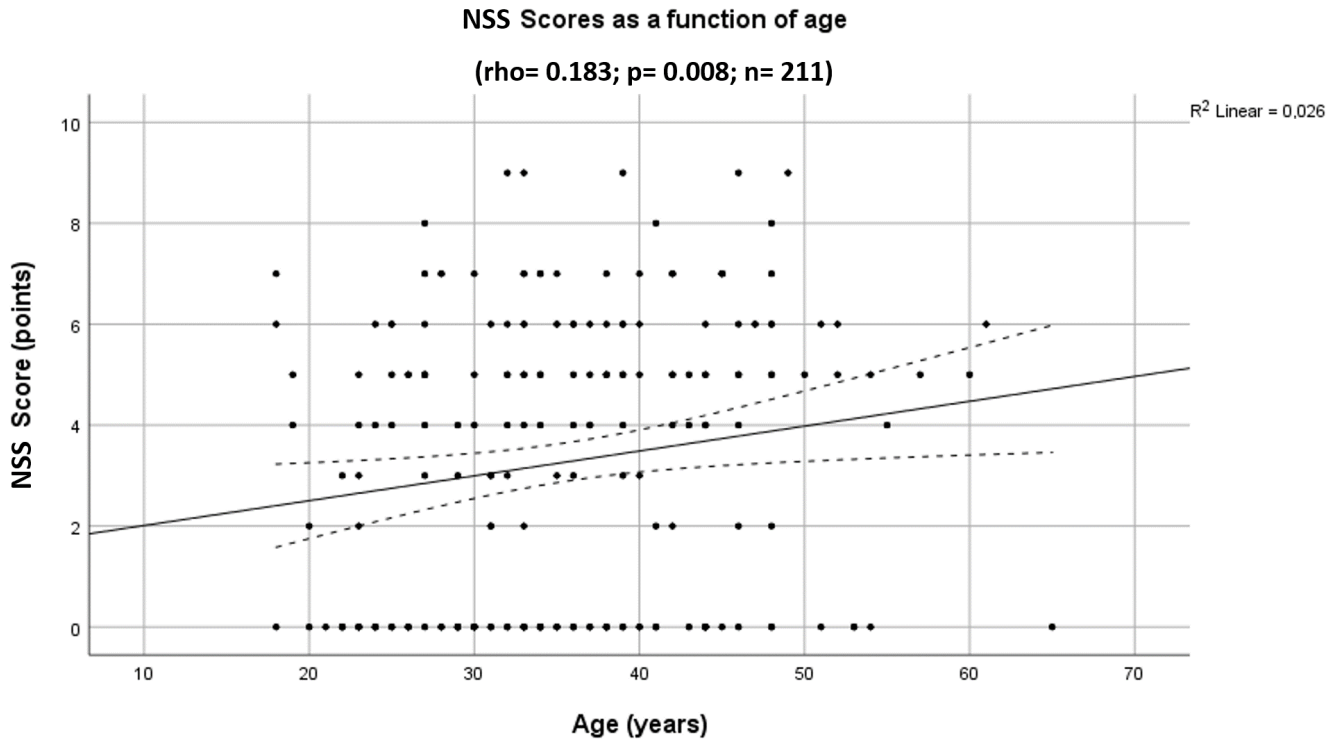

Figure 2 - *NSS as a function of age*

The prevalence of UI among women with obesity grades II and III was 69.6% (n= 147), of which 30.3% (n= 64) were continent. The classification of symptoms by ICIQ revealed that 7.6% (n= 16) had mild symptoms, 26.5% (n= 56) moderate, 33.6% (n= 71) severe, and 1.9% (n= 4) very severe. When asked about situations in which urine loss occurred, 37.4% (n= 79) reported loss when coughing or sneezing, 24.2% (n= 51) before reaching the bathroom, 13.7% (n= 29) during physical activities, 12.8% (n= 27) after urinating and while getting dressed, 10.9% (n= 23) during sleep, 6.2% (n= 13) continuously and 3 .8% (n= 8) for no apparent reason. It is important to note that the sum of the percentages (%) exceeds 100% due to the multiple responses allowed in ICIQ.

The prevalence of positive PNP symptoms in women with obesity grades II and III was 58.8% (n= 124), while negative PNP was 41.2% (n= 87). These values were dichotomized. However, the classification according to the level of symptoms revealed that 14.7% (n= 31) had mild symptoms, 30.8% (n= 65) moderate, and 13.3% (n= 28) serious.

Regarding the obstetric profile of the women in this group, it was observed that 31.8% (n= 67) of them did not have any pregnancy, while 28.9% (n= 61) had 1 pregnancy, 34.2% (n= 72) had 2 to 3 pregnancies, and 5.2% (n= 11) had 4 or more pregnancies. Regarding the number of vaginal births, 76.8% (n= 162) of women did not have any vaginal birth. Of those who did, 14.2% (n= 30) had 1 birth, 9.0% (n= 19) had 2 to 3 births, and no woman had 4 births or more.

Regarding births by cesarean section, 50.7% (n= 107) did not have any birth. Of those who did, 30.8% (n= 65) had 1 birth, 18.0% (n= 38) had 2 to 3 cesarean sections, and only 0.5% (n= 1) had 4 cesarean sections or more. Regarding complications in vaginal births, 71.4% (n= 35) of women who had vaginal births had an episiotomy, 8.2% (n= 4) had

lacerations, and no complications involving the use of forceps were recorded. No complications were observed in cesarean sections (n= 104). There were no significant differences in ICIQ scores concerning the presence of episiotomy (p= 0.447) or laceration (p= 0.837).

This study revealed a positive correlation between UI and the number of vaginal births among the 49 women who had this type of birth (p<0.032), indicating that the greater the number of vaginal births, higher the UI score. However, no significant association was observed between the presence of PNP symptoms and vaginal birth (p < 0.093) or cesarean section (p < 0.752), nor between UI and cesarean section (p < 0.959).

The level of physical activity, measured by the IPAQ, was distributed as follows: 36.0% (n= 76) of the participants were classified as sedentary, 3.8% (n= 8) as insufficiently active, 59.7% (n= 126) as active and 0.5% (n= 1) as very active. Variations in circumferences and BMI did not show a significant correlation with UI and PNP symptoms. All correlations between these variables were practically null.

Discussion

A significant association was found between advanced age and normal birth in women with obesity grades II and III, as demonstrated by univariate analysis. For a more detailed understanding of the variables associated with PNP symptoms, bivariate analyses were carried out, investigating factors such as menopause, parity, degrees of obesity, smoking, and physical inactivity. However, no significant difference was identified in any of these factors.

In a study conducted by Sampselle [20], although the prevalence of UI was high, reaching 57%, the symptoms reported by women were less severe, with 15% classified as moderate and 10% as severe. The difference in the categorization of symptoms between the two studies can be explained by the fact that UI symptoms tend to be more pronounced in women with a higher rate of obesity compared to those with lower weight [20].

In a study conducted by Peyrat et al. [21], women reported greater urinary loss during exertion, with a prevalence of 12.4%, and due to urgency, with 1.6%, corroborating the results found in our study. The higher prevalence found in our study can be attributed to the inclusion of women with a Body Mass Index (BMI) greater than 35 kg/m², while Peyrat's study evaluated women with a BMI greater than 25 kg/m² [21], indicating a possible relationship between obesity and UI.

Studies by Bijani et al. [22] and Morowatisharifabad et al. [23] revealed that approximately one-third of women over 60 years of age had UI, with a prevalence of 62.2% [22,23]. On the other hand, the study carried out by Gallas et al. [24] included women with a mean age of 36.8 ± 8.32 years (range 23 to 60 years), of whom 58% were overweight or obese (overweight BMI between 25.0 and 29.9 kg/ m², and obesity when the BMI is equal to or greater than 30 kg/m²), and the prevalence of UI was 45%. Within this group, 40.3% had UIU, 24.6% had stress UI and 19.9% had mixed UI. These results differ from the percentages found in this study, both concerning the prevalence and type of UI symptoms [24].

Obesity has been identified as a condition that worsens UI due to excessive weight accumulation in the pelvic floor region [20,25]. Consistent scientific evidence supports the association between obesity

and increased incidence of UI. Studies conducted by Ninomiya et al. (2017) and Hagan et al. in the USA found a significant relationship between weight gain and increased occurrence of UI [26]. However, a study carried out by Peyrat et al. [21] in France did not identify a significant increase in UI associated with obesity [21]. The present study, in line with the findings of Peyrat et al. [21] also did not find a significant association between UI and obesity in grades II and III, despite a high prevalence, highlighting the importance of considering multiple factors when analyzing UI.

The study by Dias et al. [7] and Machado et al. [27], who included women with a profile similar to those in the present study, with severe obesity and candidates for bariatric surgery (BS), demonstrated a prevalence of PNP symptoms of 11.6% and 20.4%, respectively, and these prevalences were associated with age [7,27]. It is observed that PNP is commonly present in individuals with obesity, even in the absence of DM, and its prevalence tends to be higher before BS. However, the prevalence of PNP symptoms in this study was significantly higher, reaching 58.8%, compared to these previous studies, and age was also identified as an associated factor.

The study by Nienov et al. [8] found a prevalence of 24(11)11% (n= 24) of PNP in non-diabetic individuals with obesity grades II and III, as well as metabolic syndrome (MS). It is important to note that this study included both men and women [8]. In patients with obesity and without DM in the present study, the independent association of PNP with age aligns with the results of Callaghan et al. [9] in a cross-sectional epidemiological survey with 4,002 Chinese participants. In this study, the authors investigated the association of MS components with PNP and found that altered Michigan Neuropathy Screening Instrument (MNSI) examination was associated with age and body weight. It was identified that obesity and DM (but not pre-diabetes) were the main metabolic drivers of PNP [9]. However, it is relevant to highlight that in this study there was only an association between PNP and age, and the questionnaire used is not valid for PNP diagnosis, only to indicate the symptoms.

In summary, the results of this study suggest that the symptoms and increased prevalence of PNP and UI in women with grade II and III obesity can be attributed to obesity and aging. This association is evident, since oxidative stress increases with age, obesity, and menopause [28], and there is an increase in oxidative stress associated with PNP [29].

This study has some significant limitations, such as the low number of participants in the sample, which did not meet the sample size calculation, and the short data collection period. Furthermore, only the NSS was used, without considering the Neuropathy Impairment Score (NIS), which limits a more precise investigation of PNP, providing only indications of the symptoms. Despite the existing limitations, this study is relevant because it addresses a topic that is little discussed in the literature, investigating the factors associated with PNP symptoms and their relationship with UI in patients with severe obesity.

Conclusion

In women with obesity grades II and III without DM, there is a high prevalence of UI and symptoms of PNP, but there was no association between the prevalence of these two variables among themselves. UI was also not associated with a sedentary lifestyle, smoking, menopause, or parity, but there was a positive correlation between age and normal birth.

Conflicts of interest

There are no conflicts of interest.

Sources of funding

Authors' own funding.

Authors' contributions

Conception and design of the research: Freitas MELNC, Schmid H; Data collection: Freitas MELNC; Data analysis and interpretation: Freitas MELNC, Schmid H; Statistical analysis: Freitas MELNC, Schmid H; Manuscript writing: Freitas MELNC; Critical revision of the manuscript for important intellectual content: Schmid H, Paiva LL.

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