

Original Article



Prevalence of vasomotor symptoms and the associated risk factors: the “Mi Menopausia” app study

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ABSTRACT

Objective: To assess the prevalence of vasomotor symptoms (VMS) and their associated sociodemographic, life-style, and medical risk factors, as well as their impact on health-related quality of life (HRQOL) in peri- and postmenopausal Spanish women using the Mi Menopausia app.

Study design: Cross-sectional convenience sample of 13,956 women registered with the Mi Menopausia app (June 2021–November 2025). A total of 11,378 women were included in the final analysis after exclusions for incorrect or incomplete data, or cancer history.

Main outcome measures: Moderate to severe VMS (MS-VMS), defined as ≥ 7 hot flashes/day with sweating or intensity $\geq 3/5$.

Results: Of the total of 11,378 women in the final sample, 48.4% were peri- and 51.6% postmenopausal. The prevalence of VMS was 77.4% and MS-VMS 63.9%. MS-VMS were independently associated with obesity (odds ratio [OR] 1.27; 95% confidence interval [CI] 1.12–1.45), smoking (OR 1.26; 95%CI 1.12–1.42), alcohol intake (OR 1.20; 95%CI 1.06–1.34), and a history of bilateral oophorectomy (OR 1.38; 95%CI 1.03–1.84). University education (OR 0.71; 95%CI 0.65–0.77), being employed (OR 0.85; 95%CI 0.76–0.96) and having sexual intercourse (OR 0.87; 95%CI 0.78–0.97) were independently associated with lower odds of MS-VMS. The menopausal symptoms linked to MS-VMS were irritability (OR 1.65; 95%CI 1.12–2.41), insomnia (OR 2.23; 95%CI 1.52–3.27), feeling older (OR 1.93; 95%CI 1.32–2.83) and vaginal dryness (OR 10.66; 95%CI 2.71–41.87). Bone fractures (OR 1.16; 95%CI 1.02–1.33), depression/anxiety (OR 1.37; 95%CI 1.24–1.50), cardiopathy (OR 1.51; 95%CI 1.12–2.02) and pneumopathy (OR 2.30; 95%CI 1.28–4.13) were more common in women with MS-VMS. Women with MS-VMS had lower HRQOL as measured by the Cervantes SF scale. Only 17% of women with VMS were treated; 9.2% used hormone therapy.

Conclusion: VMS, especially MS-VMS, were associated with reduced HRQOL and with multiple risk factors, supporting the clinical need for targeted interventions in menopausal women.

Abbreviations: ANOVA, Analysis of variance; Cervantes SF, Cervantes short form scale; CI, Confidence interval; COVID, Coronavirus disease; GSM, Genitourinary syndrome of menopause; HRQOL, Health-related quality of life; MHT, Menopausal hormone therapy; OR, Odds ratio; OTC, over the counter; SD, Standard deviations; SWAN, Study of Women's Health Across the Nation; VMS, Vasomotor symptoms.

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1. Introduction

Menopause represents a key transition in women's lives, extending beyond one-third of their lifespan and influencing physical, emotional, and social dimensions. The hormonal changes trigger diverse symptoms that impair health-related quality of life (HRQOL); that is why, there is a need for evidence-based strategies to support women during this significant phase of their lives [1].

Vasomotor symptoms (VMS), including hot flashes and night sweats, affect up to 80% of women during menopause transition [2]. These symptoms often begin in perimenopause, peak at menopause onset, and persist for an average of 4.5 years after the final menstrual period (with a median duration of 7.4 years overall), although up to one-third of women continue for over 10 years [3].

Several factors, such as cultural environment, educational background, and socioeconomic status, are likely to influence the variability in the severity, duration, and perception of menopausal symptoms [4]. Likewise, several factors, particularly obesity and smoking, have been associated with VMS [5]; however, the associated factors remain poorly characterized, and the evidence regarding the identified risk factors is inconsistent. In addition, there is a lack of contemporary cohort studies that incorporate key variables, such as cardiometabolic and other comorbidities, hormonal and non-hormonal treatments, and mental health status.

VMS etiology involves hypothalamic dysregulation of KNDy neurons and narrowed thermoregulation usually correlated with estrogen levels [6], and its presence and persistence are associated with poorer HRQOL across diverse countries [1]. In Spain, a cross-sectional study showed that menopausal symptom-related HRQOL is influenced by factors such as mental health, sexuality, and lifestyle [7]. On the other hand, HRQOL scales such as the Cervantes-short form (SF) have been used to determine women's needs for natural, pharmacological, or hormonal treatments, thereby making prescriptions more objective [8].

To date, no large-scale studies have examined the relationship between vasomotor symptoms (VMS) and sociodemographic, lifestyle, or medical factors in peri- and postmenopausal women in the Spanish population. Therefore, this study aims to analyze data from the Mi Menopausia app to investigate sociodemographic and medical factors associated with VMS, as well as their impact on HRQOL.

2. Material and methods

A total of 13,956 women were registered in the app “Mi Menopausia” from June 2021 to November 2025. This app was created by the Spanish Menopause Society with the aim of assessing HRQOL associated with menopause symptoms. The study was approved on January 13th, 2021, by the Ethics Committee of the Hospital Clínico San Carlos in Madrid, with approval number 20.391-E.

The app “Mi Menopausia,” whose features and design have been previously published [7], is specifically designed for peri- and postmenopausal women to assess HRQOL during menopause using the validated Cervantes Short Form (SF) scale. The app ensures user anonymity by not collecting personal identification data; instead, it assigns each user a unique random number. After downloading and registering with a username and password inaccessible to researchers, users complete a comprehensive questionnaire including demographic data, lifestyle factors, menopause symptoms, treatments, and medical history, followed by the Cervantes SF scale to evaluate the impact of menopausal symptoms on HRQOL. The Cervantes SF scale is a validated scale designed to measure HRQOL in peri- and postmenopausal Spanish women [9]. This scale includes 16 items rated on a 0-to-5 Likert scale, covering menopause and health, psychological, sexual, and partner relationship domains. This result is supported by the population-based norms published to the Spanish population, which facilitate the interpretation of these scores in clinical practice, research, and health management. The scale measures the impact of menopausal symptoms on

HRQOL, overall and in each domain (menopause and health, psychology, sexuality and partner relationships), where 0 indicates the best possible HRQOL (no impact of menopausal symptoms), and 100 indicates the worst HRQOL (greatest impact of menopausal symptoms), with population-based Spanish norms facilitating clinical interpretation and research application [10,11].

Informed consent was obtained online before questionnaire completion. Once submitted, the questionnaire is locked to prevent editing and can only be retaken after three months. The app targets women with climacteric symptoms, those attending medical centers for related issues, or those interested in their menopausal quality of life. Quality control measures during data entry were used to reduce possible errors and bias. Menopausal status was defined by clinical criteria including time since last menstruation, and medical and surgical history [7].

We included women in peri-postmenopause status who properly completed the app questionnaire and signed the informed consent. Postmenopausal women were defined as those whose last menstruation occurred more than 12 months ago or have undergone bilateral oophorectomy. In cases of prior hysterectomy without bilateral oophorectomy, we classified women as postmenopausal if presenting menopausal symptoms and a medical history clearly indicative of postmenopausal status (e.g., age over 55, or a diagnosis confirmed by a healthcare professional). Perimenopausal women were considered those whose last menstruation occurred less than 12 months ago, experienced menstrual irregularities with amenorrhea lasting 60 or more days, and exhibited menopausal symptoms.

We excluded those records containing incorrect, incomplete, inconsistent, or duplicate data. The women who were diagnosed with or treated for any type of cancer and/or received antiestrogen drugs were also excluded to reduce bias.

VMS, including hot flashes and night sweats, were assessed using a dedicated section of the self-administered questionnaire. The presence of VMS was defined as any reported frequency or intensity of hot flashes or night sweats during the preceding four weeks. Mild VMS were defined as fewer than seven hot flashes per day, without associated sweating, and an intensity score below 3 on a 0–5 Likert-type scale. Moderate-to-severe VMS were defined as seven or more hot flashes per day, with associated night sweats and/or an intensity score of 3 or higher on the 0–5 scale. Moderate-to-severe VMS were defined using app-specific thresholds validated in the Cervantes-SF vasomotor subdomain, aligning with clinical bother thresholds in SWAN and Spanish guidelines [3,8,9].

2.1. Statistical analysis

Discrete variables are expressed in frequencies and percentages, and quantitative variables were presented as means and standard deviations (SD). The Cervantes-SF score was calculated as described previously [7]. Chi² test was used to assess the association between VMS and qualitative variables. Kolmogorov-Smirnov test was used to assess the normal distribution of the quantitative variables. Student *t*-tests and ANOVA were used to analyze the relationship between VMS and the other measured variables. Mann-Whitney and Kruskal Wallis tests were used for quantitative non-parametric variables. Post-hoc Bonferroni test was used to analyze the association between each of the VMS categories.

Effect sizes were calculated for qualitative variables using eta squared (η^2), interpreted according to Cohen's criteria: small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 \geq 0.14$). For quantitative variables, Cramér's V was used: small (<0.10), moderate (0.10–0.30), and large (>0.30).

A backward stepwise multiple logistic regression analysis was carried out to identify the independent variables related to moderate-to-severe VMS. We include in the model the variables that had prior epidemiological evidence of VMS association, clinical relevance, and that were univariately associated ($p < 0.05$) with moderate-to-severe

VMS in the univariate analysis. Predictors were added to the model when their significance level was below 0.05 and removed when it exceeded 0.10. Odds Ratio (OR) (β exp) with the 95% confidence interval (CI) was calculated. All statistical tests were two-tailed, and the significance level was set at $p < 0.05$. IBM SPSS statistics version 29 software for windows was used.

3. Results

In this app-based convenience sample, a total of 13,956 women were analyzed and 11,378 were included in the final analysis. The flow chart with the including and excluded women is shown in Fig. 1. A total of 2596 women were excluded due to incorrect, incomplete, confusing, repetitive data or previous cancer.

A total of 33.8% of women used the app based on social media information, and 16.4% followed their healthcare provider recommendation. The primary purpose for using the app was to monitor quality of life among 62.2% of users. Table 1 presents the baseline characteristics of the series and the relationship of VMS with sociodemographic factors. This population was representative of middle-aged Spanish women [7] and the prevalence of VMS by autonomic community are shown in Fig. 1S (Supplemental data).

Of the participants, 48.4% were perimenopausal women, while the remaining 51.6% were postmenopausal. The average age of menopause in postmenopausal women was 49.6 years (SD: 5.5), with 1.7% experiencing early menopause. Obesity was present in 12.6% of the women, the majority were Caucasian (86.4%), 62.2% had a university education, 82.7% had a stable partner, 82.3% were employed, 59.8% exercise regularly and 91.5% reported being sexually active. Additionally, 16.1% were smokers, and 36.6% were moderate to frequent alcohol consumers.

The most prevalent menopausal symptom in the study series, overall and in peri- and postmenopausal women, was VMS, followed by brain fog. Vaginal dryness in perimenopausal and joint pain and insomnia was the third most reported symptoms among the women (Fig. 2).

Presence of VMS, especially moderate-to-severe, were associated with obesity, menopausal status, lower year of the last menstruation, education level, employment status, sexual activity, smoke habits, alcohol consumption and having undergone bilateral oophorectomy (Table 1). However, the effect sizes for these associations were small. In the multivariable analysis, independent risk factors for moderate-to-severe VMS were obesity (OR 1.27, 95% CI 1.12–1.45), postmenopausal status (OR 1.19, 95% CI 1.09–1.30), current smoking (OR 1.26, 95% CI 1.12–1.42), frequent alcohol intake (OR 1.20, 95% CI 1.06–1.34), and history of bilateral oophorectomy (OR 1.38, 95% CI

1.03–1.84). Protective independent factors were older age (per year increase, OR 0.99, 95% CI 0.98–0.99), university education (OR 0.71, 95% CI 0.65–0.77), being employed (OR 0.85, 95% CI 0.76–0.96), and having sexual intercourse (OR 0.87, 95% CI 0.78–0.97) (Table 2). While univariate associations showed small effect sizes, multivariable analysis confirmed clinical independence of some variables (e.g. obesity OR 1.27, smoking OR 1.26, university education OR 0.71) to the odds of moderate-to-severe VMS. A potential multicollinearity among lifestyle (smoking, alcohol, obesity) and socioeconomic variables (education, employment) was assessed using variance inflation factors (VIF). All VIF values ranged from 1.12 to 2.14, remaining below the 2.5 threshold indicative of concerning multicollinearity. Sensitivity analyses excluding socioeconomic variables yielded similar lifestyle effect estimates (e.g. obesity OR 1.29 vs previous 1.27), confirming result robustness.

Menopause-related quality of life measure by Cervantes-SF scale showed that women with moderate-to-severe VMS showed significantly worse scores across all Cervantes-SF domains except Sexuality and Partner domains (Table 3). As expected, the Menopause/Health domain, which contains three subdomains: vasomotor (which measure the effects of VMS), health and aging, exhibited the largest effect size ($\eta^2 = 0.362$, effect clinically relevant), followed by global Cervantes SF score ($\eta^2 = 0.087$) and Psychology domain ($\eta^2 = 0.044$), while Sexuality and Partner domains showed trivial effects ($\eta^2 < 0.001$).

Table 4 reveals associations between menopausal symptoms and VMS severity in this series. Moderate-to-severe VMS linked to higher rates of most menopausal symptoms (all $p < 0.001$), including insomnia (67.3%), skin dryness (66.4%), joint pain (64.6%), low libido (61.9%), sadness (52.6%), vaginal dryness (57.3%), irritability (50.8%), feeling older (55.2%), brain fog (74.1%), interference with daily activities (30.4%), dyspareunia (31.8%), anorgasmia (15.8%), and tremor (8.2%). Effect sizes were moderate in almost all symptoms, having insomnia the highest effect size (Cramer's $V = 0.231$), following by interference with daily activities and skin dryness. Multivariable analysis found as independent symptoms associated with moderate-to-severe VMS to vaginal dryness (OR 10.66, 95% CI 2.71–41.87), insomnia (OR 2.23, 95% CI 1.52–3.27), feeling older (OR 1.93, 95% CI 1.32–2.83; $p = 0.001$), and irritability (OR 1.65, 95% CI 1.12–2.41). These patterns underscore pronounced symptom clustering with VMS intensity, especially sleep, urogenital, mood, and cognitive domains.

Regarding treatments for VMS relief in this cohort (Table 5), VMS severity showed a significant association with over the counter (OTC) compound use ($p = 0.001$; Cramér's $V = 0.094$, small-moderate effect size), reaching 6.6% prevalence in moderate-to-severe VMS. Prescription drugs exhibited a borderline association ($p = 0.052$; Cramér's $V = 0.023$, small effect), with 1.3% use among women with moderate-to-severe VMS. Menopausal hormone therapy (MHT) use was 9.1% overall and remained consistent across strata ($p = 0.417$; Cramér's $V = 0.013$, very small effect).

Table 6 shows how common diseases in menopausal women and the link to the severity of VMS. Depression or anxiety was the most prevalent, affecting 22.6% overall and rising to 24.7% in women with moderate-to-severe VMS ($p = 0.001$, Cramér's $V = 0.064$, small effect). Heart disease (2.4%), lung conditions (0.9%), diabetes (1.8%), and prior bone fractures (10.8%) also linked to worse VMS, though at lower rates (all $p < 0.060$) and small effect size (Cramér's $V < 0.035$). In the multivariable model confirmed these associations with moderate-severe VMS: depression/anxiety (OR 1.37, 95% CI 1.24–1.50), cardiopathy (OR 1.51, 95% CI 1.12–2.02), pneumopathy (OR 2.30, 95% CI 1.28–4.13), and bone fractures (OR 1.16, 95% CI 1.02–1.33). Diabetes edged toward significance (OR 1.37, 95% CI 0.99–1.92). Women with worse VMS tend to have higher rates of mood disorders, heart-lung issues, and fractures.

4. Discussion

This analysis of 11,378 peri- and postmenopausal Spanish women,

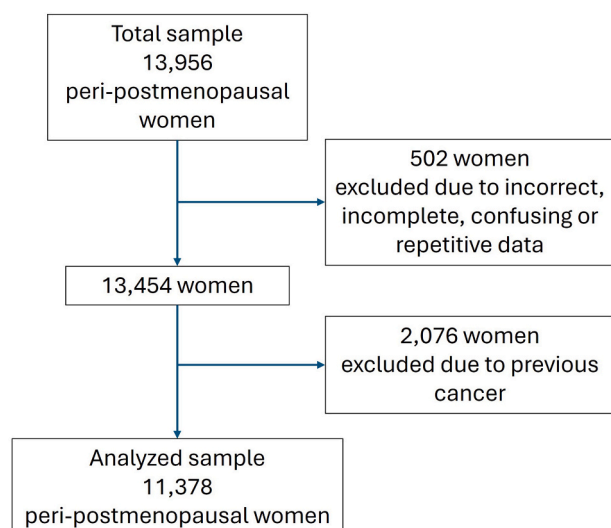


Fig. 1. flow chart of series selection.

Table 1

Baseline characteristics and sociodemographic factors, and their association with vasomotor symptoms. Data are presented as frequency (%) or mean $\pm$ standard deviation.

	Total N = 11,378	No VMS N = 2569	Mild VMS N = 1540	Moderate-to-severe VMS N = 7269	p value	Effect size ^b
Prevalence	100%	22.6%	13.5%	63.9%	–	–
Age (years)	51.3 $\pm$ 5.5	51.4 $\pm$ 6.2	51.5 $\pm$ 5.3	51.3 $\pm$ 5.3	0.284	0.001
BMI (kg/m ²)	24.5 $\pm$ 4.8	24.6 $\pm$ 4.7	24.5 $\pm$ 4.8	25.1 $\pm$ 4.8	<0.001	0.007
Obesity (BMI > 30 kg/m ²)					<0.001	0.047
• $\leq$ 30 kg/m ²	11,276 (86.5)	2278 (23.1)	1371 (13.9)	6195 (62.9)		
• >30 kg/m ²	1432 (12.6)	279 (19.5)	156 (10.9)	997 (69.6)		
• Missing	102 (0.9)					
Menopause status					<0.001	0.040
• Perimenopause	5874 (51.6)	1419 (24.2)	793 (13.5)	3662 (62.3)		
• Postmenopause	5504 (48.4)	1150 (20.9)	747 (13.6)	3607 (65.5)		
Age at last menstruation (years) ^a	49.6 $\pm$ 5.5	49.8 $\pm$ 5.6	50.0 $\pm$ 5.5	49.5 $\pm$ 5.4	0.024	0.004
Early menopause					0.080	0.021
• Yes	188 (1.7)	45 (23.9)	15 (8.0)	128 (68.1)		
• No	11,190 (98.3)	2524 (22.6)	1525 (13.6)	7141 (63.8)		
Ethnicity					0.585	0.017
• White	9829 (86.4)	2246 (22.9)	1324 (13.5)	6259 (63.7)		
• Asian	37 (0.3)	12 (32.4)	7 (18.9)	18 (48.6)		
• African	21 (0.2)	3 (14.3)	2 (9.5)	16 (76.2)		
• Latin American	1246 (11.0)	266 (21.3)	173 (13.9)	807 (64.8)		
• Afro-American	8 (0.1)	2 (25)	1 (12.5)	5 (62.5)		
• Missing	237 (2.1)					
Education level					<0.001	0.074
• No formal education	55 (0.5)	13 (23.6)	9 (16.4)	33 (60.0)		
• Primary	1043 (9.2)	158 (15.1)	115 (11.0)	770 (73.8)		
• High school	3048 (26.8)	568 (18.6)	390 (12.8)	2090 (68.6)		
• University	7072 (62.2)	1798 (25.4)	1006 (14.2)	4268 (60.4)		
• Missing	160 (1.4)					
Partner					0.075	0.020
• No	1374 (12.1)	336 (24.5)	165 (12.0)	873 (63.5)		
• Occasional	312 (2.7)	60 (19.2)	37 (11.9)	215 (68.9)		
• Stable	9406 (82.7)	2114 (22.5)	1298 (13.8)	5994 (63.7)		
• Missing	286 (2.5)					
Employment status					<0.001	0.039
• Housewife	826 (7.3)	154 (18.6)	116 (14.0)	556 (67.3)		
• Employed	9367 (82.3)	2165 (23.1)	1292 (13.8)	5910 (63.1)		
• Unemployed	556 (4.9)	98 (17.6)	58 (10.4)	400 (71.9)		
• Retired	293 (2.6)	67 (22.9)	23 (7.8)	203 (69.3)		
• Missing	336 (3.0)					
Sexual activity					<0.001	0.043
• No	962 (8.5)	192 (20.0)	94 (9.8)	676 (70.3)		
• Regular intercourse	6395 (56.2)	1526 (23.9)	905 (14.2)	3964 (62.0)		
• Sporadic intercourse	2663 (23.4)	547 (20.5)	372 (14.0)	1744 (65.5)		
• Only masturbation	961 (8.4)	224 (23.3)	113 (11.8)	624 (64.9)		
• Only caresses	96 (0.8)	24 (25.0)	1492 (13.5)	7072 (63.8)		
• Missing	301 (2.6)					
Exercise (N = 1546)					0.060	0.054
• No	198 (12.8)	37 (18.7)	18 (9.1)	143 (72.2)		
• Occasional	423 (27.4)	73 (17.3)	44 (10.4)	306 (72.3)		
• Regular	925 (59.8)	202 (21.8)	120 (13.0)	603 (65.2)		
Smoking					<0.001	0.050
• No	7966 (70.0)	1855 (23.3)	1164 (14.6)	4947 (62.1)		
• Occasional	450 (4.0)	108 (24.0)	53 (11.8)	289 (64.2)		
• Daily	1375 (12.1)	244 (17.7)	144 (10.5)	987 (71.8)		
• Ex-smoker	1501 (13.2)	345 (23.0)	170 (11.3)	986 (65.7)		
• Missing	86 (0.8)					
Alcohol consumption					0.004	0.048
• No	2655 (23.3)	651 (24.5)	385 (14.5)	1619 (61.0)		
• Occasional (<1 unit/week)	4254 (37.4)	955 (22.4)	555 (13.0)	2744 (64.5)		
• Moderate (1–2 units/week)	2545 (22.4)	312 (20.4)	200 (13.1)	1016 (66.5)		
• Frequent (>3 units/week)	1621 (14.2)	325 (20.0)	208 (12.8)	1088 (67.1)		
• Missing	303 (2.7)					
Bilateral oophorectomy					0.002	0.033
• Yes	267 (2.3)	37 (13.9)	36 (13.5)	194 (72.7)		
• No	11,000 (96.7)	2508 (22.8)	1487 (13.5)	7005 (63.7)		
• Missing	111 (0.1)					

VMS (vasomotor symptoms); BMI (body mass index).

^a Only postmenopausal women.

^b In qualitative variables, Eta square (η^2) (small 0,01; moderate 0,06; high 0,14 (Cohen)). In quantitative variables, Cramer V (small <0.10, moderate 0.10–0.30 and high >0.30).

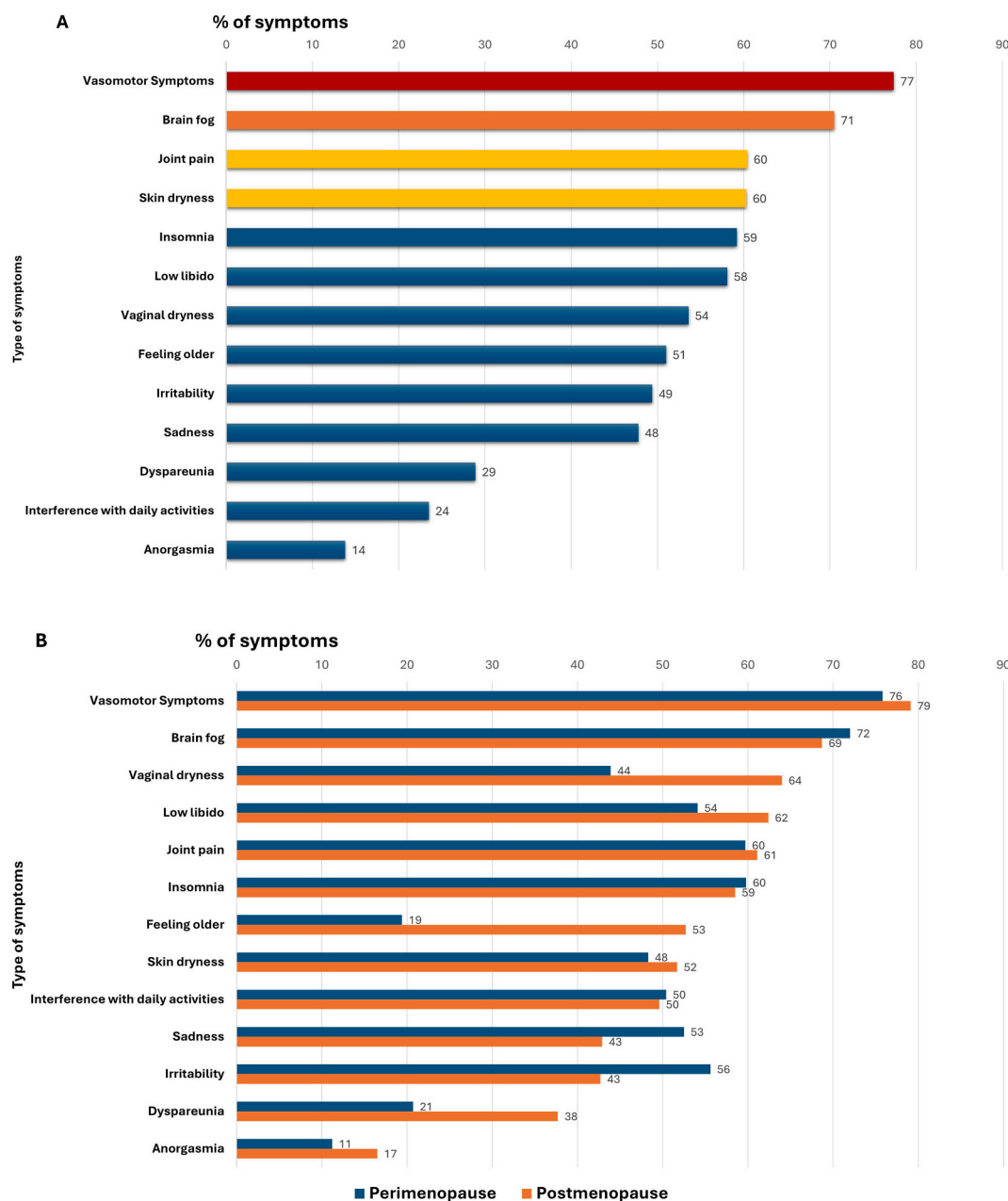


Fig. 2. Percentage of menopausal symptoms reported by the Spanish women in the app “Mi Menopause”. A: in the global series. B in peri and postmenopausal women.

Table 2

Multivariate analysis of independent factors associated with moderate-to-severe vasomotor symptoms.

R ² : 0.023	B coefficient	Standard error	Wald	p value	OR	95% CI
Age (linear increment per year)	−0.02	0.004	10.55	0.001	0.99	0.98–0.99
Obesity (BMI > 30 kg/m ²) vs normal/overweight	0.24	0.07	13.84	<0.001	1.27	1.12–1.45
Postmenopause vs perimenopause	0.17	0.05	14.01	<0.001	1.19	1.09–1.30
University studies vs no university studies	−0.35	0.05	59.61	<0.001	0.71	0.65–0.77
Employed vs not employed	−0.16	0.06	6.74	0.009	0.85	0.76–0.96
Sexual intercourse vs no sexual intercourse	−0.14	0.06	6.03	0.014	0.87	0.78–0.97
Current smoking vs no current smoking	0.23	0.06	15.58	<0.001	1.26	1.12–1.42
Alcohol intake > 3 U/week vs no/infrequent alcohol intake	0.18	0.06	8.92	0.003	1.20	1.06–1.34
Bilateral oophorectomy vs no bilateral oophorectomy	0.32	0.15	4.71	0.030	1.38	1.03–1.84

BMI (body mass index).

Only variables independently associated with vasomotor symptoms in multivariate analysis ($p < 0.05$) are shown.

from the “Mi Menopausia” app, identified a moderate-to-severe VMS prevalence of 63.9%. VMS were associated with multiple

Table 3

Association between vasomotor symptoms and menopause-related quality of life assessed by the Cervantes Short-Form (SF) scale.

Cervantes sort form score (mean $\pm$ standard deviation)					
Domains					
VMS	Global	Menopause/ Health	Psychology	Sexuality	Partner ^b
All series	40.1 $\pm$ 16.5	40.2 $\pm$ 20.0	42.8 $\pm$ 27.8	49.0 $\pm$ 24.5	25.2 $\pm$ 23.5
No	32.0 $\pm$ 14.8	20.0 $\pm$ 12.1	32.8 $\pm$ 25.8	48.5 $\pm$ 25.1	24.7 $\pm$ 23.8
Mild	35.9 $\pm$ 15.0	30.7 $\pm$ 12.8	35.9 $\pm$ 25.7	49.3 $\pm$ 25.0	25.9 $\pm$ 24.0
Moderate-severe	43.9 $\pm$ 16.1	49.1 $\pm$ 17.4	47.8 $\pm$ 27.6	49.1 $\pm$ 24.0	25.2 $\pm$ 23.5
<i>p</i> value	<0.001	<0.001	<0.001	0.506	0.379
Effect size ^a	0.087	0.362	0.044	0.001	0.001

VMS (vasomotor symptoms).

^a Eta square (η^2): small 0,01; moderate 0,06; high 0,14 (Cohen).

^b *N* = 9496 women with partner.

sociodemographic and lifestyle factors, reduced HRQOL, and clustered with other menopausal symptoms and comorbidities. Notably, more than 80% of symptomatic women experiencing VMS were undertreated.

The prevalence of moderate-to-severe VMS was higher than

previously reported. While overall VMS prevalence ranges from 50 to 80%, moderate-to-severe VMS prevalence is typically reported between 38% and 60% in high-income countries, although lower rates have been observed in Asian populations, such as Japan (16%) [12–14]. This variability may relate to differences in definitions, populations, and study designs. In our study, the higher prevalence likely reflects both the severity definition and the symptomatic nature of app users, as 62% accessed the app due to menopausal symptoms. In a Spanish random survey of 1254 peri- and postmenopausal women, hot flashes prevalence was 67% in perimenopausal and 41% in postmenopausal women [2]. Our moderate-to-severe VMS definition (≥ 7 hot flashes/day or intensity $\geq 3/5$) reflects clinically significant impact, explaining higher prevalence vs. reported rates using looser weekly thresholds.

Obesity, smoking, and alcohol intake were associated with a 20–30% increased risk of moderate-to-severe VMS, consistent with previous pooled analyses [5]. In our study, postmenopausal women experienced more moderate-to-severe VMS than perimenopausal women, likely due to the abrupt estrogen decline in this stage compared with the fluctuations in perimenopause. Although VMS intensity decreased slightly with age in our data, the cross-sectional design limits conclusions on symptom trajectory compared with longitudinal studies such as SWAN (Study of Women's Health Across the Nation) study [15].

University education, employment and sexual intercourse were independently associated with lower odds of moderate-to-severe VMS. These findings align with previous studies [15,16]. Socioeconomic

Table 4

Relationship between menopausal symptoms and vasomotor symptoms (VMS). Data presented as frequency (%).

	Total N = 11,378	No VMS N = 2569	Mild VMS N = 1540	Moderate-to-severe VMS N = 7269	<i>p</i> value	Effect size ^a
Tremor	699 (6.1)	54 (2.1)	51 (3.3)	594 (8.2)	<0.001	0.113
Vaginal dryness	6100 (53.6)	1109 (43.2)	823 (53.4)	4168 (57.3)	<0.001	0.116
Skin dryness	6863 (60.3)	1198 (46.6)	836 (54.3)	4829 (66.4)	<0.001	0.172
Dispareunia	3289 (28.9)	551 (21.4)	427 (27.7)	2311 (31.8)	<0.001	0.094
Low libido	6612 (58.1)	1294 (50.4)	815 (52.9)	4503 (61.9)	<0.001	0.104
Anorgasmia	1565 (13.8)	247 (9.6)	167 (10.8)	1151 (15.8)	<0.001	0.081
Insomnia	6732 (59.2)	1033 (40.2)	810 (52.6)	4889 (67.3)	<0.001	0.231
Irritability	5617 (49.4)	1037 (40.4)	671 (43.6)	3909 (50.8)	<0.001	0.119
Sadness	5443 (47.8)	984 (38.3)	632 (41.0)	3827 (52.6)	<0.001	0.129
Feeling older	5801 (51.0)	1089 (42.4)	697 (45.3)	1015 (55.2)	<0.001	0.114
Joint pain	6870 (60.4)	1305 (50.8)	868 (56.4)	4697 (64.6)	<0.001	0.120
Interference with daily activities	2671 (23.5)	273 (10.6)	189 (12.0)	2209 (30.4)	<0.001	0.217
Brain fog (<i>n</i> = 1729)	1219 (70.5)	211 (60.3)	138 (65.4)	870 (74.0)	<0.001	0.130

Multivariate analysis ^b						
R ² : 0.149	B coefficient	Standard error	Wald	P value	OR	95%CI
Vaginal dryness vs no vaginal dryness	2.37	0.70	11.49	<0.001	10.66	2.71–41.87
Anorgasmia vs no anorgasmia	0.41	0.24	2.87	0.09	1.50	0.94–2.41
Insomnia vs no insomnia	0.80	0.20	16.93	<0.001	2.23	1.52–3.27
Irritability vs no irritability	0.50	0.20	6.46	0.011	1.65	1.12–2.41
Feeling older vs no feeling older	0.66	0.19	11.51	<0.001	1.93	1.32–2.83

OR: odds ratio. CI: confidence interval.

^a Cramer's V score: small <0.10, moderate 0.10–0.30 and high >0.30.

^b Only variables independently associated with vasomotor symptoms in multivariate analysis (*p* < 0.05) are shown.

Table 5

treatments used for vasomotor symptoms in the series. Data are given in frequency (%).

	Total N = 11,378	No VMS N = 2569	Mild VMS N = 1540	Moderate-to-severe VMS N = 7269	<i>p</i> value	Effect size ^b
No treatment	9621 (84.6)	2286 (88.9)	1307 (84.9)	6028 (82.9)	<0.001	0.069
MHT (any type)	1040 (9.1)	220 (8.6)	150 (9.7)	670 (9.2)	0.417	0.013
OTC compounds	591 (5.2)	38 (1.5)	74 (4.8)	479 (6.6)	<0.001	0.094
Drugs ^a	126 (1.1)	25 (1.0)	9 (0.6)	92 (1.3)	0.052	0.023

MHT: menopausal hormone therapy. OTC: over the counter.

^a Paroxetine and Fezolinetant.

^b Cramer's V score: small <0.10, moderate 0.10–0.30 and high >0.30.

Table 6

Diseases featured in the series and their link to vasomotor symptoms. Data are given in frequency (%).

	Total N = 11,378	No VMS N = 2569	Mild VMS N = 1540	Moderate-to-severe VMS N = 7269	p value	Effect size ^b
Depression/anxiety	2575 (22.6)	490 (19.0)	293 (11.4)	1792 (24.7)	<0.001	0.064
Cardiopathy	240 (2.1)	44 (1.7)	19 (1.2)	177 (2.4)	0.003	0.032
Ictus	52 (0.5)	10 (0.4)	7 (0.5)	35 (0.5)	0.837	0.006
Pneumopathy	78 (0.7)	5 (0.2)	9 (0.6)	64 (0.9)	0.001	0.034
Diabetes mellitus	181 (1.6)	35 (1.4)	16 (1.0)	130 (1.8)	0.058	0.022
Autoimmune diseases ^a	1018 (8.9)	222 (8.6)	123 (8.0)	673 (9.3)	0.234	0.016
Hepatopathy	205 (1.8)	36 (1.4)	23 (1.5)	146 (2.0)	0.086	0.021
Endometriosis	79 (0.7)	18 (0.7)	11 (0.7)	50 (0.7)	0.993	0.001
Arthritis	63 (0.6)	10 (0.4)	12 (0.8)	41(0.6)	0.259	0.015
Arthrosis	163 (1.4)	28 (1.1)	25 (1.6)	110 (1.5)	0.238	0.016
Thyroid diseases	19 (0.2)	5 (0.2)	2 (0.1)	12 (0.2)	0.884	0.005
Migraine	90 (0.8)	17 (0.7)	10 (0.7)	63 (0.9)	0.495	0.011
Any bone fracture	1157 (10.3)	253 (22.7)	128 (8.4)	776 (10.8)	0.016	0.027

Multivariate analysis ^c						
R ² : 0.011	B coefficient	Standard error	Wald	P value	OR	95% CI
Depression/anxiety vs no depression/anxiety	0.31	0.05	41.06	<0.001	1.37	1.24–1.50
Cardiopathy vs no cardiopathy	0.41	0.15	7.33	0.007	1.51	1.12–2.02
Pneumopathy vs no pneumopathy	0.83	0.30	7.77	0.005	2.30	1.28–4.13
Diabetes Mellitus vs no diabetes mellitus	0.32	0.17	3.52	0.061	1.37	0.99–1.92
Any bone fracture vs no	0.15	0.07	5.16	0.023	1.16	1.02–1.33

^a excluding thyroid diseases.^b Cramer's V score: small <0.10, moderate 0.10–0.30 and high >0.30.^c Only variables independently associated with vasomotor symptoms in multivariate analysis (p < 0.05) are shown.

factors (university education, employment) and lifestyle factors (obesity, smoking) remained independently associated with moderate-to-severe VMS after mutual adjustment. These associations persisted despite low-to-moderate correlations between variable sets, indicating distinct rather than fully mediated pathways. In our series, employment was associated with lower VMS; however, women with severe symptoms are more likely to report adverse work outcomes [17]. Employment may contribute to better HRQOL and resilience, enabling improved adaptation to menopausal symptoms [7,18,19].

Regular sexual intercourse was associated with a lower VMS severity and improved HRQOL, which is in line with other studies with similar populations [7,20]. An active sexual life correlates positively with higher resilience and greater life satisfaction, reflecting better psychological well-being. Partner support helps preserve life satisfaction and emotional well-being, key markers of a less symptomatic menopausal transition [21]. Sexual activity during menopause reflects a complex interplay of genitourinary symptoms, psychological well-being, partner dynamics, and sociocultural factors beyond VMS alone [22,23].

VMS severity is strongly correlated with a clinically significant HRQOL decline, particularly in the “Menopause and Health” domain, which exhibits the strongest association and largest effect size due to its focus on vasomotor distress. This supports the use of this domain to guide VMS treatment selection, as recommended by some guidelines [8].

Moderate-to-severe VMS were associated with insomnia, irritability, and vaginal dryness, consistent with previous findings [24,25]. Feeling older is a subjective perception influenced by the overall burden of menopausal symptoms, but it has not been specifically or consistently associated with VMS in the literature [26]. These symptoms likely share underlying mechanisms, including estrogen deficiency and sleep disruption, highlighting the multidimensional burden of VMS [27].

Only 17% of women with moderate-to-severe VMS received treatment, with 9.2% using MHT, consistent with its low use in clinical practice despite being recommended as first-line therapy by most menopause societies after individual risk-benefit assessment [28]. This undertreatment requires cautious interpretation given the limited data obtained in the app on treatment indications, duration, timing relative

to symptom onset, and concurrent contraindications. This undertreatment may reflect cultural barriers, risk perceptions, and fragmented care [8,28] underscoring the need for improved education and integration of menopause care into primary care [2]. Nonhormonal treatments, are mainly used in women who cannot or do not wish to use MHT [8]. The use of over the counter (OTC) treatments for VMS likely reflects preference for perceived “natural” therapies despite limited evidence of efficacy [29].

Moderate-to-severe VMS were associated with depression, cardiopathy, pneumopathy, and fractures. Recent studies support a bidirectional relationship between VMS and depressive symptoms, with sleep disturbance acting as a key mediator [26]. The SWAN study and other longitudinal cohorts have shown that VMS severity and bother are more strongly associated with mood disturbance than frequency alone [24]. Cardiovascular associations are supported by previous studies, potentially mediated by autonomic dysfunction and adverse metabolic profiles [30]. There are no well-established studies specifically linked with chronic pneumopathies to the VMS. The available evidence focuses more on the association between menopause and worse lung function or increased risk of asthma/obstructive disease [31]. Diabetes mellitus showed borderline significance in relation to VMS. Some studies have reported an increased risk of diabetes [32] and greater insulin resistance in women with VMS [33]. Bone fractures were modestly associated with VMS. Some studies have found VMS linked to lower bone mineral density [34] and higher hip fracture risk [35].

4.1. Strengths and limitations

This study benefits from a large real-world sample and represents the first evaluation of factors associated with VMS in a representative middle-aged Spanish population.

Primary limitations include challenges in defining and grading VMS severity, as data were self-reported, and potential selection bias, since most users accessed the app due to symptoms, likely inflating prevalence estimates. This app-based cohort represents symptomatic, digitally engaged women and may not fully capture asymptomatic individuals, limiting generalizability. Additionally, some women may have been

receiving treatment at the time of reporting, although this likely had minimal impact, as only 17% of those with moderate-to-severe VMS were treated. Other limitations inherent to self-administered questionnaires include possible inaccuracies, missing responses, lack of medical guidance during data collection, and limited information on treatment timing or duration.

5. Conclusions

In summary, this cross-sectional study reveals a high prevalence of VMS associated with modifiable risk factors (obesity, smoking, alcohol) and medical conditions (especially depression), while higher education, employment, and sexual activity are factors associated with a reduction in its prevalence. The presence of VMS was associated with reduced HRQOL and is clustered with other menopausal symptoms, such as insomnia and vaginal dryness. This study represents the first large-scale Spanish study simultaneously examining real-world VMS patterns, their impact on HRQOL using the Cervantes-SF validated scale, the clustering of VMS with other menopausal symptoms, and Spanish-specific treatment gaps in a digitally engaged symptomatic cohort. These data support clinical recommendations for routine VMS screening, lifestyle interventions, and personalized hormonal or non-hormonal treatments. However, prospective longitudinal studies are needed to establish causality given self-report limitations.

Contributors

Pluvio J. Coronado contributed to conception and design of the study, data collection, coordination, statistical analysis, preparation of the manuscript and drafting and editing of the paper.

Nicolás Mendoza, Silvia P. González, Sonia Sánchez-Méndez, Jesús Presa, Ana R. Jurado, Esther de la Viuda, and Francisco Quereda contributed to conception and design of the study, preparation of the manuscript and drafting and editing of the paper.

María Fasero contributed to conception and design of the study, statistical analysis, preparation of the manuscript and drafting and editing of the paper.

All authors saw and approved the final version and no other person made a substantial contribution to the paper.

Ethical approval

This study was approved on January 13th, 2021, by the Ethics Committee of the Hospital Clínico San Carlos in Madrid, with approval number 20.391-E.

Provenance and peer review

This article was not commissioned and was externally peer reviewed.

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Data sharing and collaboration

There are no linked research data sets for this paper. Research data are available from the “Asociación Española para el Estudio de la Menopausia (AEEM)” (aeem@aeem.es).

Declaration of competing interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.maturitas.2026.108958>.

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