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Article

Investigating the Interconnections Between Dimensions of Menopause Symptoms, Body Image and Interoceptive Sensibility: A Network Analysis

Aoife Coyle ^{1,2,†}, Akansha M. Naraindas ^{3,†}, Ciara Mahon ⁴ and Sarah Cooney ^{1,*}

¹ School of Psychology, University College Dublin, Belfield, Dublin, Ireland

² Institute of Psychology, Psychiatry and Neuroscience, King's College London, UK

³ Department of Psychology, University of Exeter, Exeter, UK

⁴ School of Psychology, Dublin City University, Ireland

* Correspondence: s.cooney@ucd.ie

† These authors contributed equally to this work.

Abstract

Background: Midlife is a period of heightened vulnerability to menopausal symptoms and body image concerns. However, little is known about how the experience of menopausal symptoms relates to the awareness of and attention toward internal body signals. Taking a dimensional approach, this study employed network analysis to examine how menopausal symptom domains relate to dimensions of interoceptive sensibility and body image in middle-aged women and identified the most influential and bridging features within this interconnected system. **Methods:** Two hundred and thirteen cisgender women aged 40–60 years residing in Ireland completed online measures of body appreciation (BAS-2), state body satisfaction (BISS), interoceptive sensibility (MAIA-2), and menopausal symptoms (Menopause Rating Scale). **Results:** Attention Regulation, Trusting, Body Appreciation, and Body Listening showed the highest expected influence. Body Appreciation emerged as the strongest bridge node, connecting interoceptive sensibility, body image, and menopausal symptoms. Trusting was negatively associated with psychological symptoms, whereas Noticing was positively associated with somatic symptoms. Regression analyses showed that lower body appreciation predicted greater somatic, urogenital, and psychological symptom severity, and lower Trusting predicted higher psychological symptom severity. Older age was associated with higher somatic and urogenital symptoms, while younger age was associated with higher psychological symptoms. **Conclusions:** Findings suggest that body appreciation and interoceptive trust are central, bridging processes in women's experience of menopausal symptoms. Interventions that enhance body appreciation and interoceptive trust may help reduce psychological and physical symptom burden during the menopausal transition.

Keywords: menopause symptoms; interoception; body appreciation; body satisfaction; body image; network analysis; women's health

1. Introduction

Women's midlife represents a significant life stage marked by the menopause transition and the numerous symptoms associated with it. Hormonal shifts during this period can affect brain function, alter physiological processes, and interact with evolving social expectations regarding ageing, thereby increasing women's vulnerability to psychological distress and body dissatisfaction [1–5]. To date, the majority of the research on body image during menopause has been limited to negative body image constructs, namely body dissatisfaction (see [5] for review). Rather than representing only satisfaction or dissatisfaction with one's appearance, body image encompasses both negative and positive dimensions [6,7], such as body acceptance, body esteem, and functional appreciation [8].

Body appreciation refers to holding positive, respectful attitudes toward one's body, including acceptance, care, and protection of bodily needs. It also involves valuing the body for its functionality and uniqueness while resisting unrealistic appearance ideals and external pressure [9,10]. Importantly, it is closely connected to a person's self-reported awareness of and attention to signals from within the body: interoceptive sensibility [11–14]. Indeed, interoceptive sensibility may be a potent modulator of body image such that lower internal body sensitivity may lead individuals to prioritise external information related to body appearance, e.g., body shape or size. In contrast, greater internal body sensitivity might promote awareness of positive functions that the body performs, helping individuals to respond to their body's needs and foster positive body image [15–18]. This study examines, for the first time, the interrelations between dimensions of body image and interoceptive sensibility with the experience of menopausal symptoms in middle-aged Irish women.

Women's body image experiences during midlife are complex. As women age, they naturally diverge from the youthful, slender ideals often promoted in Western culture [19–22]. Which can heighten body dissatisfaction for women who perceive a widening of the gap between societal ideals and their changing bodies. During menopause, defined as the cessation of menstruation following 12 consecutive months of amenorrhea with no other apparent cause [23], women experience a range of physical changes, including shifts in weight distribution, increases in body fat, and alterations in body shape [20–22]. Lasting a median of 7.4 years [24], menopausal symptoms encompass somatic, neurological, psychological, and genitourinary changes [25]. Hormone replacement therapy (HRT) is widely regarded as the most effective treatment for alleviating vasomotor symptoms of menopause and can also reduce urogenital symptoms, with more variable effects on psychological symptoms [25]. Common menopausal symptoms, including hot flashes, night sweats, fatigue, low mood, low libido, mood and cognitive difficulties, emerge during perimenopause and are experienced on average into the first four years of postmenopause [24,26]. These transitions, marking the end of a woman's reproductive capacity, are characterised as a window of vulnerability for poor mental health, including increased risk for disordered eating [27] and body image disturbances [28]. Relatively little work has been done to examine which dimensions of body image and menopausal symptoms are impacted [29]. Given that half of the population will experience the menopausal transition, it is crucial to gain a deeper understanding of how the experience of menopausal symptoms relates to the experiences of the bodily self.

Women in midlife experience many of the same appearance concerns as in adolescence and early adulthood, including notable levels of body dissatisfaction, heightened self-objectification, and ongoing worries about weight, size and shape [13,16,30,31]. They also tend to report increased anxiety related to ageing appearance [32] and reduced attunement to internal bodily signals compared to younger cohorts [13]. By contrast, some research has shown that with increasing age, women's priorities shift from concerns about physical appearance to an emphasis on bodily functionality, a shift associated with an increase in body appreciation [22,33]. Additionally, many women report a sense of release from appearance-based pressures that are predominantly directed at younger women [34]. These mixed patterns of continuity and change underscore the need to examine how concurrent hormonal transitions may intensify or reshape women's bodily experiences during midlife.

Fluctuations in reproductive hormones, particularly estradiol (E2), progesterone (P4), and follicle-stimulating hormone (FSH), play a significant role in women's physical and psychological well-being [35]. Evidence indicates that hormonal transition periods heighten vulnerability to mood disturbances, including depression, which frequently co-occurs with eating pathology [27]. Research on premenstrual syndrome, pregnancy, and postpartum further shows that shifts in E2 and P4 are linked to depressive symptoms [27], and studies with younger populations suggest that menstrual-cycle-related hormonal variation can influence body image and disordered-eating symptoms [36–38]. Collectively, this work suggests that the hormonal instability characteristic of menopause may similarly shape women's experiences of their bodies [39,40]. Given that body dissatisfaction itself is associated with greater depressive symptoms and heightened risk for eating-disorder onset or recurrence [41,42], these hormonal shifts may compound psychological distress during midlife.

Although perimenopause often begins around age 40, the timing, duration, and progression through pre-, peri-, and postmenopausal stages differ widely across individuals [43,44]. Large-scale studies have highlighted that women follow diverse trajectories through menopause, with up to 20 distinct transition patterns identified [45]. This heterogeneity challenges the assumption that menopausal stages constitute uniform, non-overlapping categories and may partly explain why findings on body image outcomes across menopausal groups remain inconsistent. While some studies have reported no significant differences in negative body image between stages [46,47] others suggest that certain aspects of body image vary depending on menopausal status [28]. A growing body of research suggests that it is not menopausal stage itself but the presence, frequency, and severity of symptoms that exert greater influence on body image [5]. Symptoms such as vasomotor changes, sleep disturbance, urogenital issues, and psychological difficulties can arise at any point during the transition, often peaking in late perimenopause and persisting for years beyond the final menstrual period. Evidence indicates that a heavier symptom burden is associated with more negative body-related attitudes and evaluations, spanning diminished appearance satisfaction, increased preoccupation with weight and shape, and more negative emotional appraisals of the body [28,48–50]. Recent evidence indicates that menopausal quality of life, which encompasses both the presence of symptoms and the distress they cause across physical, psychosocial, and sexual domains, varies systematically according to eating disorder risk. Specifically, women at higher risk of eating disorders report poorer quality of life across these domains, alongside greater body dissatisfaction and lower body appreciation [29]. Importantly, both symptom frequency and intensity appear relevant: frequent vasomotor and psychological symptoms have been linked to poorer appearance evaluation [51] while greater severity across somatic, urogenital, and psychological domains predicts lower body satisfaction [49]. Collectively, these findings suggest that women's experiences of menopausal symptoms, rather than stage of transition alone, are key to understanding the links between menopause and body image.

The experience of the body is not limited to one's body image (i.e., the thoughts, beliefs, and attitudes we have toward our physical appearance and functionality [6]). Beneath our skin, a myriad of complex signals provide a moment-to-moment account of our internal physiological state [11]. Broadly, interoception refers to the capacity to sense and interpret the body's internal physiological states. This includes a wide array of signals, such as hunger, fullness, thirst, itch, muscular effort, bladder and gastrointestinal cues, as well as respiratory, cardiac, thermal, metabolic, pain-related, and other visceral sensations, which are all classified as interoceptive inputs [52]. Differences in how these signals are processed can heighten susceptibility to mental health conditions [53]. Women are particularly vulnerable [54] and are twice as likely as men to experience anxiety and depression [63,64]. This increased susceptibility has been associated with the substantial physiological and hormonal fluctuations that occur across the female lifespan. Major reproductive transitions, including puberty, pregnancy, and menopause, generate marked bodily changes that can render internal signals more variable and harder to interpret [55–57]. Consistent with this, women who tend to rely more on external cues when interpreting internal states such as hunger [58,59] report greater attention to bodily sensations, and report more frequent somatic symptoms [58,60,61]. One account proposes that women's elevated self-reported interoception compared to men's may partially stem from the significant bodily and hormonal transitions that occur throughout key reproductive transitions [54,61]. However, despite growing interest in interoception and mental health, little research has focused on its role in women's health, especially across key reproductive transitions such as menopause [54,55,62].

Within this domain, interoceptive sensibility (IS) has emerged as a key construct in body image research [12]. Importantly, this construct captures both anxiety-based hypervigilance and a mindful mode of attending to interoceptive cues. The former is associated with emotional vulnerability, hypochondriasis, and anxiety, whereas the latter promotes adaptive coping, resilience, and psychological health [63,64]. It is commonly assessed using tools such as the Multidimensional Assessment of Interoceptive Awareness (MAIA-2), which divides the construct into eight subscales

[65,66]. The Not-Distracting scale, which captures the tendency to divert attention away from unpleasant bodily sensations, has been described as reflecting a less mindful and potentially maladaptive attentional style. In contrast, higher scores on scales such as Trusting and Body Listening indicate a more adaptive and mindful engagement with interoceptive signals, characterised by greater confidence in the body and more effective self-regulation [65,67]. Together, these dimensions highlight the importance of considering qualitative differences in how attention is directed toward and used to interpret interoceptive cues.

Studies have consistently found an inverse relationship between IS and dimensions of negative body image, such as self-objectification [13,16], body dissatisfaction [14,18], in men and women [14,17], and different nationalities and ethnicities e.g.,[68]. Given the multidimensional nature of interoceptive sensibility, relying solely on total scores may obscure the nuanced ways its specific components interact to influence body image. For instance, analyses of MAIA-2 subscales have revealed different aspects of interoceptive sensibility, including how internal bodily signals are evaluated and managed, relate in distinct ways to components of body image. In particular, the degree to which people *notice* interoceptive cues negatively predicted body appreciation and positively predicted both overweight preoccupation and appearance orientation. In contrast, perceiving interoceptive signals as *safe* and *reliable* emerged as the strongest and most consistent predictor across all positive body-image outcomes, as well as overweight preoccupation [14].

Higher IS is significantly associated with a more positive body image [14,69–71]. Findings indicate that the tendency to notice and sustain attention towards interoceptive signals may reinforce the positive functions the body performs [15,69]. Daubenmier (2005) demonstrated that awareness of interoceptive signals and the way that such stimuli are valued and responded to was significantly associated with body satisfaction in adult women. Oswald et al. (2017) documented similar findings, where both IS and appraisals of interoceptive signals partially mediated the relationship between body appreciation and intuitive eating [71]. It is also possible that people who are better able to regulate attention towards their internal bodily signals are better able to appreciate the positive functions their body performs, which in turn might result in a more generalised appreciation of the body [8,72,73].

Recent work has conceptualised the body's external and internal experiences as components of a single, interacting network of influence. Network analysis provides a powerful framework for identifying which components exert the greatest influence within a system (i.e., centrality) and for visualising the relationships among these components [74]. Recent research by Naraindas et al (2025) has shown that women with high body dissatisfaction are characterised by lower levels of body listening, self-regulation, and body trusting. In contrast, emotional awareness emerged as the most central interoceptive feature among women with low body dissatisfaction, highlighting the role that emotional regulation may have in limiting the negative consequences of appearance concerns.

Beyond identifying central features, network analysis also enables the examination of bridge components, which connect distinct communities within a network. This allows us to better understand how different clusters of bodily experiences interact. Direct connections between nodes from different clusters reflect the co-occurrence of distinct symptom complexes [75]. For example, Zhang et al. (2024) demonstrated that maladaptive interoceptive sensibility acts as a bridge linking higher levels of negative body image and self-objectification. However, little research has investigated how positive body image facets, including body appreciation and body satisfaction, relate to interoceptive sensibility or bridge other altered bodily experiences during major physiological transitions such as menopause. This gap is especially salient given women's increased vulnerability in mid-life to mood and body image disturbances in the context of menopausal hormonal changes. The age range of 40–60 years was selected to capture women across the menopausal transition, from early perimenopause through postmenopause, a period during which menopausal symptoms commonly emerge and may persist for several years after the cessation of menstruation[24,44,76]. Accordingly, this exploratory study asks: How do menopausal symptom domains interrelate with features of body image and interoceptive sensibility? Based on previous

literature, we predict that body appreciation will show more positive bridges towards interoceptive sensibility nodes [14,16] and that body appreciation will show more negative relationships to menopause symptom severity nodes [29]. The network analysis will be used to identify the most influential interoceptive sensibility and body image features. These key nodes will then be examined as predictors of menopausal symptom severity. Given the known influence of age and HRT use on menopausal symptoms [25,44], their effects will also be examined.

2. Materials and Methods

Research Design

The present study was an online quantitative cross-sectional research design, measuring the relationship between dimensions of body image, interoceptive sensibility and menopausal symptoms in Irish women.

Participants

The study was conducted in Ireland and included a sample of 213 ($N=213$) cisgender women aged between 40 and 60 years ($M=50.39$, $SD=5.06$). Convenience sampling was used, and participants were recruited from the social media sites Facebook, Instagram, and WhatsApp. Participants were eligible to participate if they self-identified as a woman, were aged between 40-60 years, and resided in the Republic of Ireland. Participants were excluded from the study if they indicated that they did not reside in the Republic of Ireland or if they reported having an eating disorder. Participants were asked whether they are currently on HRT. Initially, 248 participants were recruited to participate in the study; however, after applying exclusion criteria, 35 were excluded. Therefore, the final analysis was based on a sample of 213 participants who provided complete data, which represents 86% of the original sample.

Measures

Body Image

Body Appreciation

To assess a facet of positive body image, participants were asked to complete the 10-item Body Appreciation Scale-2 BAS-2 [9]. The BAS-2 comprises

10 items that assess individuals' acceptance of, favourable opinions toward, and respect for their bodies. All items were rated on a 5-point scale, ranging from 1 (*never*) to 5 (*always*).

Higher scores on this scale reflect greater body appreciation. Studies have uniformly upheld the internal consistency, reliability and test-retest reliability of the BAS-2 scores. Cronbach's alpha and McDonald's omega estimates obtained in these studies have ranged from mid .80s to high.90s [9].

Body Satisfaction

To assess a dimension of appearance-related body image concerns, the Body Image States Scale (BISS) [77] is designed to measure affective, behavioural and cognitive body image states, i.e. body satisfaction. It is a sensitive measure that can detect momentary changes. It consists of six questions regarding how satisfied a person feels with their physical appearance 'right now at this present moment.'

Items of the BISS are scored on a 9-point response scale, and the mean score is used as an index of body satisfaction (range 1–9). Construct validity has been confirmed by an experiment on differential reactivity to appearance-related information as a function of the level of dysfunctional body-image investment (Cronbach's alpha >0.87 for all versions) [77].

Interoceptive Sensibility

Interoceptive Sensibility was assessed using the Multidimensional Assessment of

Interoceptive Awareness-2 [66] a 37-item multidimensional body self-

relations (MAIA-2) questionnaire used to analyse the participants' attention towards and awareness of their internal physiological state. The MAIA-2 provides a multidimensional profile of IS, with each of the eight subscales assessing a different dimension (see Table 1). Responses for all MAIA-2 items were given on a 6-point scale, ranging from *never* (0) to *always* (5). Scores for each subscale were computed as the mean of all associated items, and higher scores reflect greater IS. Items

were reverse-coded where necessary so that higher scores represented higher IS across all 37 questions. The 8-factor model of the MAIA-2 was confirmed with appropriate fit indices (RMSEA = 0.055 [95% CI 0.052–0.058]; SRMR = 0.064) and improved internal consistency reliability (Mehling et al., 2018).

Table 1. Subscales of the Multidimensional Assessment of Interoceptive Awareness-2 (MAIA-2; Mehling et al., 2018).

Subscale	Definition
Noticing	Awareness of both neutral and affectively charged body sensations.
Not-Distracting	Tendency not to ignore or distract oneself from sensations of discomfort or pain.
Not-Worrying	Tendency not to experience distress or worry when perceiving discomfort or pain.
Attention Regulation	Ability to sustain and control attention directed toward body sensations.
Emotional Awareness	Recognition of the link between body sensations and emotional states.
Self-Regulation	Using attention to body sensations to regulate distress or emotions.
Body Listening	Actively attending to the body for insight and guidance.
Trusting	Experiencing one’s body as safe, trustworthy, and reliable.

¹ Subscales adapted from Mehling et al. (2018).

Menopause Rating Scale

Menopausal symptoms were assessed using the Menopause Rating Scale (MRS) (see Table 2) [78]. The MRS is composed of 11 items with subscales evaluating three groups of menopausal symptoms (urogenital, somatic, and psychological). Each item can be graded by the participant from 0 (not present) to 4 (1: mild; 2: moderate; 3: severe; 4:very severe). For a particular individual, the total score for each subscale is the sum of each graded item contained in that subscale. Total MRS scores are the sum of the scores obtained for each subscale, with higher scores indicating greater symptom severity. Studies indicate acceptable reliability, with consistency coefficients ranging from 0.6 and 0.9 across countries, indicative of a very acceptable consistency of the MRS scale [79].

Table 2. Items and Subscales of the Menopause Rating Scale (MRS).

Subscale	Items
Somatic symptoms	1. Hot flushes, sweating (vasomotor symptoms)
	2. Heart discomfort (e.g., awareness of heartbeat, heart skipping, tightness)
	3. Sleep problems (difficulty falling or staying asleep, waking too early)
	4. Joint and muscular discomfort (pain in joints, stiffness, muscle pain)

	5. Depressive mood (feeling down, sad, lack of drive, mood swings)
	6. Irritability (feeling nervous, inner tension, aggressive)
Psychological symptoms	7. Anxiety (inner restlessness, panicky feelings) 8. Physical and mental exhaustion (decrease in performance, impaired memory, concentration difficulties, forgetfulness)
	9. Sexual problems (change in sexual desire, activity, satisfaction)
Urogenital symptoms	10. Bladder problems (difficulty in urination, increased frequency, incontinence)
	11. Vaginal dryness (dryness or burning in the vagina, difficulty with sexual intercourse)

¹ The Menopause Rating Scale (MRS) includes 11 items rated on a 5-point Likert scale (0 = none to 4 = very severe), with higher scores reflecting greater symptom burden.

Procedure

Participants were recruited between February 13th and March 8th, 2024, and the survey was hosted on Pavlovia (<https://pavlovia.org>). All participants received introductory information about the project and provided digital informed consent. Participants were then directed to a battery of questionnaires assessing demographic information, body appreciation, body satisfaction, interoceptive sensibility and menopausal symptoms.

Data analysis

All data and statistical analyses were performed using R statistical software (version 4.2.1; R Core Team, 2022).

For the network analysis, Gaussian Graphical Models (GGMs) were estimated with regularisation using the least absolute shrinkage and selection operator (LASSO), as implemented in the *qgraph* package [80] and the *bootnet* package [81] in R. The extended Bayesian information criterion (EBIC) was utilized for model selection to optimize the balance between model fit and parsimony. The resulting network structure represents individual symptoms as nodes, with edges indicating conditional dependencies between symptom pairs after controlling for all other variables in the network. Each edge weight corresponds to the partial correlation coefficient between connected nodes, representing the unique association between two symptoms while accounting for all other symptoms in the model [82]. Network visualization follows established conventions: blue edges represent positive partial correlations, red edges indicate negative partial correlations, and edge thickness is proportional to the absolute magnitude of the association. The stability of network parameters and precision of edge weights were examined through a bootstrapping procedure involving iterative case removal (1,000 bootstrap samples) using the *bootnet* package [81]. The stability coefficient quantifies the largest fraction of observations that may be omitted while preserving a minimum correlation of 0.70 between centrality measures calculated from the complete dataset and reduced samples, with 95% confidence intervals. Coefficients of .20-.50 indicate acceptable stability, .50-.70 represent good stability, and values above .70 demonstrate excellent stability [80].

To examine if the most influential interoceptive sensibility and body image features predict menopausal symptom severity, multiple regression analyses were performed. Assumptions of linearity, normality, homoscedasticity, and multicollinearity were satisfied prior to conducting the linear regression analysis. A statistical significance threshold of $p < .05$ was applied. An a priori power analysis was conducted using G*Power [83] to determine the required sample size for detecting a small-to-moderate effect ($f^2 = 0.087$) in a multiple linear regression with four predictors. With $\alpha = .05$ and desired power of 0.80, the analysis indicated that a minimum of 110 participants would be

required. The final sample of 213 participants in the current study exceeded this threshold, confirming that the analyses were adequately powered.

Centrality indices

Central nodes in the network were identified through the computation of strength centrality and strength expected influence (EI) indices. Strength centrality is defined as the sum of the absolute edge weights connecting a given node to all other nodes in the network[84]. This measure, however, has been criticised for its potential to misrepresent the influence of nodes, as it does not differentiate between positive and negative associations. In contrast, EI similarly aggregates all connections from a node but retains the sign of each edge weight, thereby incorporating both positive and negative associations [85]. Given that psychological networks frequently contain negative edges, which may represent inhibitory relationships between nodes, EI is considered a more theoretically appropriate metric for assessing centrality, as it captures the directional nature of these associations [85].

Additionally, this study examined four predefined communities within the network: menopause symptom severity (comprising urogenital, somatic, and psychological symptoms), interoceptive sensibility, body appreciation and body dissatisfaction. To evaluate the extent to which specific nodes serve as bridges between these communities, we calculated bridge expected influence (BEI). BEI quantifies the sum of all connections a given node shares with nodes in other communities[86], making it a suitable measure in networks that include both positive and negative edge weights [87]. Nodes with higher positive BEI values are interpreted as having a greater capacity to activate nodes in other communities, while lower (and more negative) BEI values indicate a stronger potential to deactivate or inhibit nodes across communities [87].

Centrality metrics were computed using the *centralityPlot* and *centralityTable* functions from the *qgraph* package [82]while bridge centrality indices were derived using the *bridge* function from the *networktools* package (<https://cran.r-project.org/package=networktools>) Statistical significance of centrality differences was evaluated through node expected influence and bridge expected influence difference tests to determine whether nodes exhibiting elevated expected influence values differed significantly from those with lower indices [81].

3. Results

3.1. Descriptive Statistics

Descriptive statistics are reported in Table 3 and 4. A total of 33.8% (n = 72) of participants were taking HRT, 66.2% (n = 141) were not taking HRT.

Table 3. Means and standard deviations of all variables included in the study.

Variable	Mean	Cronbach’s Alpha
Age	50.4 (5.06)	NA
Body Appreciation	33.49 (7.62)	0.93
Body Image State Scale	27.97 (9.41)	0.76
MAIA2: Noticing	3.68 (0.91)	0.76
MAIA2: Not Distracting	1.76 (0.98)	0.89
MAIA2: Not Worrying	2.57 (0.85)	0.69
MAIA2: Attention Regulation	2.53 (0.91)	0.89
MAIA2: Emotional Awareness	3.59 (0.91)	0.84
MAIA2: Self-regulation	2.68 (1.11)	0.89
MAIA2: Listening	2.06 (1.21)	0.90
MAIA2: Trusting	2.93 (1.14)	0.89
MRS: Somatic	5.53 (3.08)	0.70
MRS: Urogenital	4.31 (2.73)	0.71
MRS: Psychological	6.62 (3.52)	0.87

Table 4. Descriptive Statistics: mean and SD, Menopause symptom type by HRT group.

	Psychological Symptoms	Somatic Symptoms	Urogenital Symptoms
HRT user	6.611 (3.115)	7.944 (3.254)	5.097 (2.660)
Non-HRT USER	4.979 (2.926)	5.950 (3.473)	3.091(2.684)

3.2. Network Estimation and Visualisation

The network presented in Figure 1 illustrates the relationships between body appreciation, body satisfaction, interoceptive sensibility, and menopause symptom severity across psychological, somatic, and urogenital domains. To assess the stability of the network, we applied resampling and case-dropping bootstrapping procedures. Network stability was satisfactory $CS(cor = .70) = .67$, exceeding the recommended threshold of .50 [79] and supporting the reliability of both the estimated edges and centrality metrics. For edge weight accuracy, the confidence intervals were of moderate width, with some overlapping across edges. This suggests that while certain edges may not significantly differ from each other, a considerable proportion likely represent distinct associations (see Figure 2 for edge weight accuracy plots).

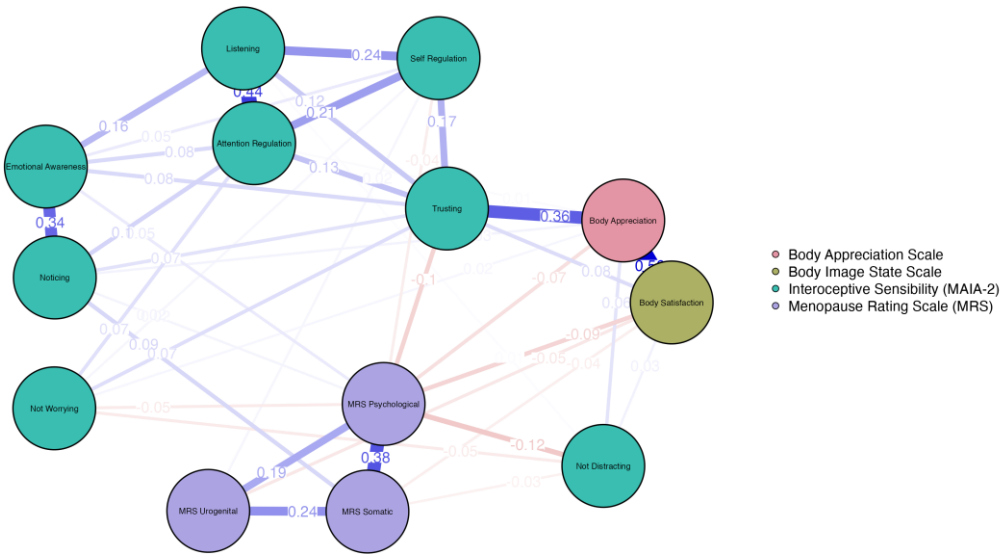


Figure 1. Partial correlation network illustrating the relationships between body appreciation, body satisfaction, interoceptive sensibility, and menopause symptom severity across psychological, somatic, and urogenital domains. Nodes represent variables, and edges reflect the strength of the regularized partial correlations between them. Blue edges indicate positive associations, while red edges indicate negative associations. Bridge edge weights represent the strength and direction of associations between nodes across predefined communities. Positive weights indicate co-activation, while negative weights suggest inhibitory relationships.

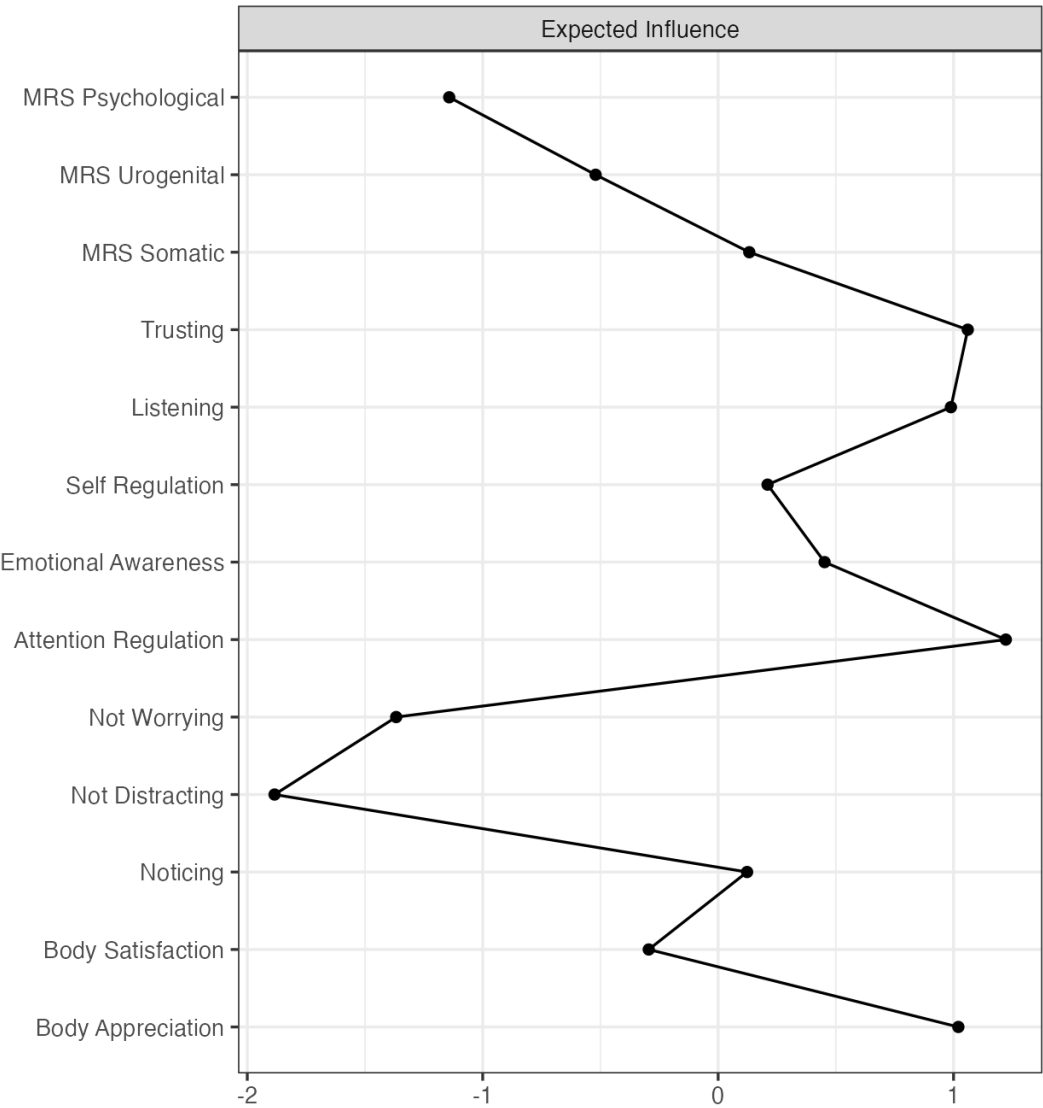


Figure 2. Expected influence of each node in the network. The graph displays the expected influence of each node in the network, representing the extent to which each variable is connected to and impacts other nodes, while accounting for both positive and negative associations.

3.3. Centrality and Expected Influence

In the current dataset, centrality strength and EI were highly correlated ($r = .71, p = .006$). Since both centrality strength and EI were correlated, and the network included both positive and negative edges, only expected influence values are interpreted, in line with established recommendations [82].

With respect to node EI, the most influential nodes in the network were Attention Regulation (EI = 1.26), Trusting (EI = 1.08), Body Appreciation (EI = 0.98), and Listening (EI = 0.98). In contrast, the least influential nodes were Not Distracting (EI = -1.90) and Not Worrying (EI = -1.30) (See Figure 2 for node EI graph). Bootstrapped difference tests indicated that Attention Regulation was significantly more influential than 75% of other nodes, Trusting exceeded 58%, Body Appreciation exceeded 67%, and Listening exceeded 75% of other nodes in terms of influence (see Figure 3 for all bootstrapped EI results).

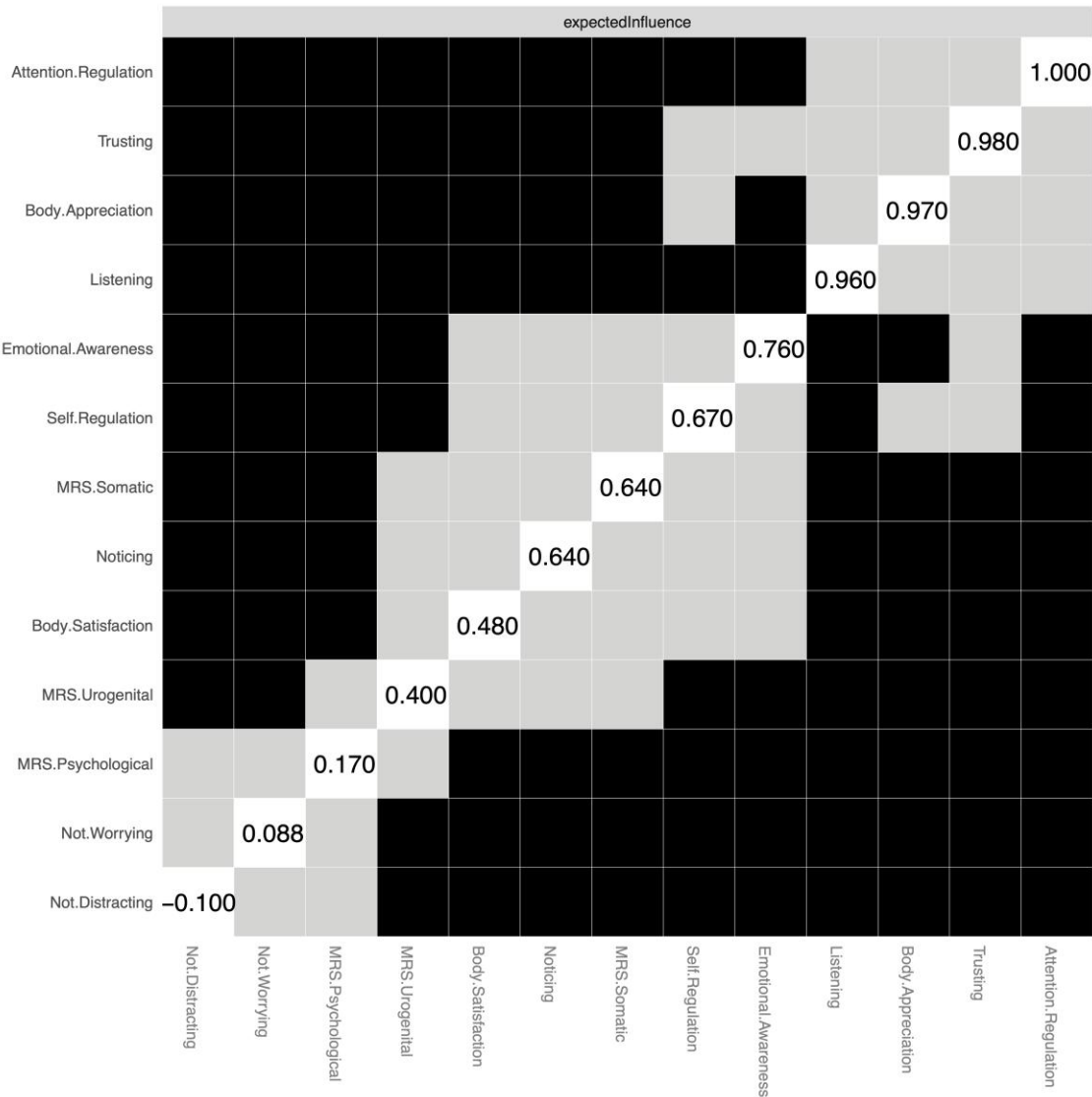


Figure 3. Bootstrapped difference test for expected influence. Grey boxes indicate no significant difference, whereas black boxes indicate a statistically significant difference ($p < .05$). Diagonal values represent the strength score of each node.

3.4. Bridge Pathways

Bridge analysis was conducted to explore influential edges in the network as well as cross-community connections to see how interoceptive sensibility and body image variables connected to the menopause symptom severity domains (somatic, urogenital, and psychological). Bridge expected influence (bridge-expected influence stability coefficient = .67) showed good stability.

As shown in Figure 1, several interoceptive sensibility and body image nodes demonstrated bridge connections to menopause symptom severity domains. Trusting was negatively associated with psychological symptoms (edge weight = -0.12), suggesting that lower levels of self-trust were linked to greater psychological symptom severity. Body satisfaction showed moderate negative associations with both somatic (-0.04) and psychological symptoms (-0.09), indicating that individuals with more severe symptoms tended to report lower body satisfaction.

Noticing was positively connected to somatic symptoms (0.09), suggesting that those who were noticed internal sensations more, reported higher somatic symptom severity. Finally, Body Appreciation was negatively linked to psychological symptoms (-0.07), indicating that individuals with higher psychological symptom severity were less likely to report body appreciation.

The Bridge EI strengths and EI differences are in Figures 4 and 5 respectively. The most influential bridge node was Body Appreciation (0.97), which had a significantly higher positive connecting influence than all other nodes in the network. The strongest inter-community edges were observed between Body Appreciation and Body Satisfaction (0.56), and between Body Appreciation and Trusting (0.35). Body Satisfaction (0.48) also demonstrated a substantial positive bridging influence, connecting strongly with multiple nodes across communities. In contrast, Menopause Psychological Symptoms (-0.4) emerged as a strong negative (inhibitory) bridge node, characterised by numerous inverse relationships with other nodes in the network. Figure 5 presents the bootstrapped difference tests for bridge expected influence.

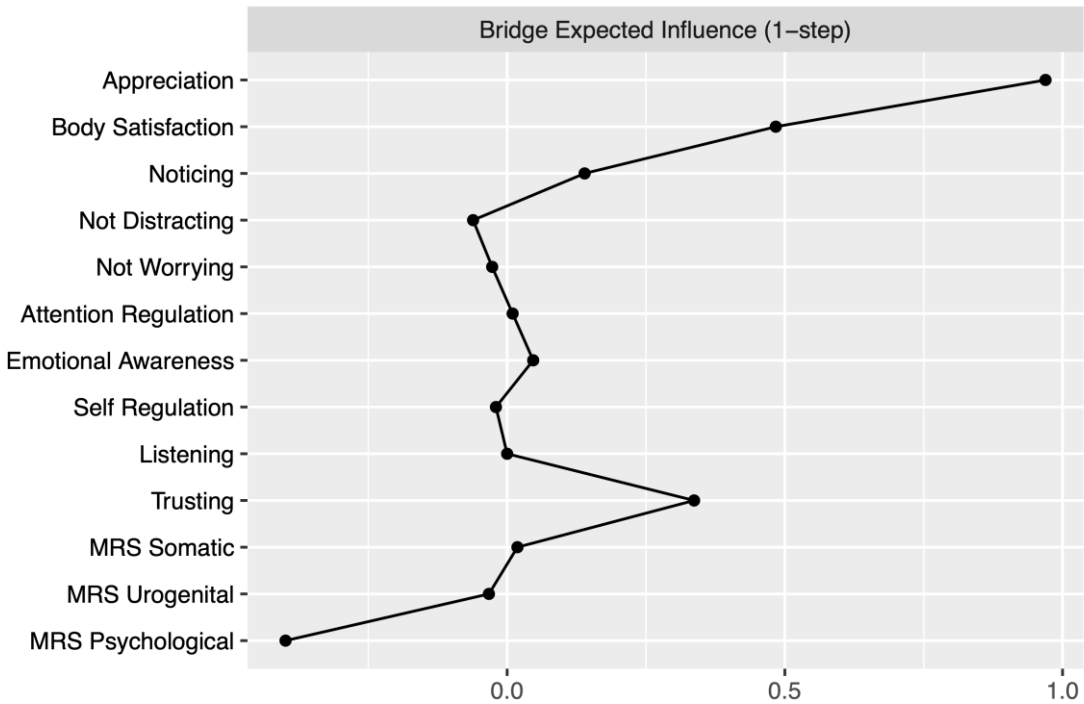


Figure 4. Bridge expected influence. The graph displays the expected influence of each node in the network, representing the extent to which each variable is connected to and impacts other nodes, while accounting for both positive and negative associations.

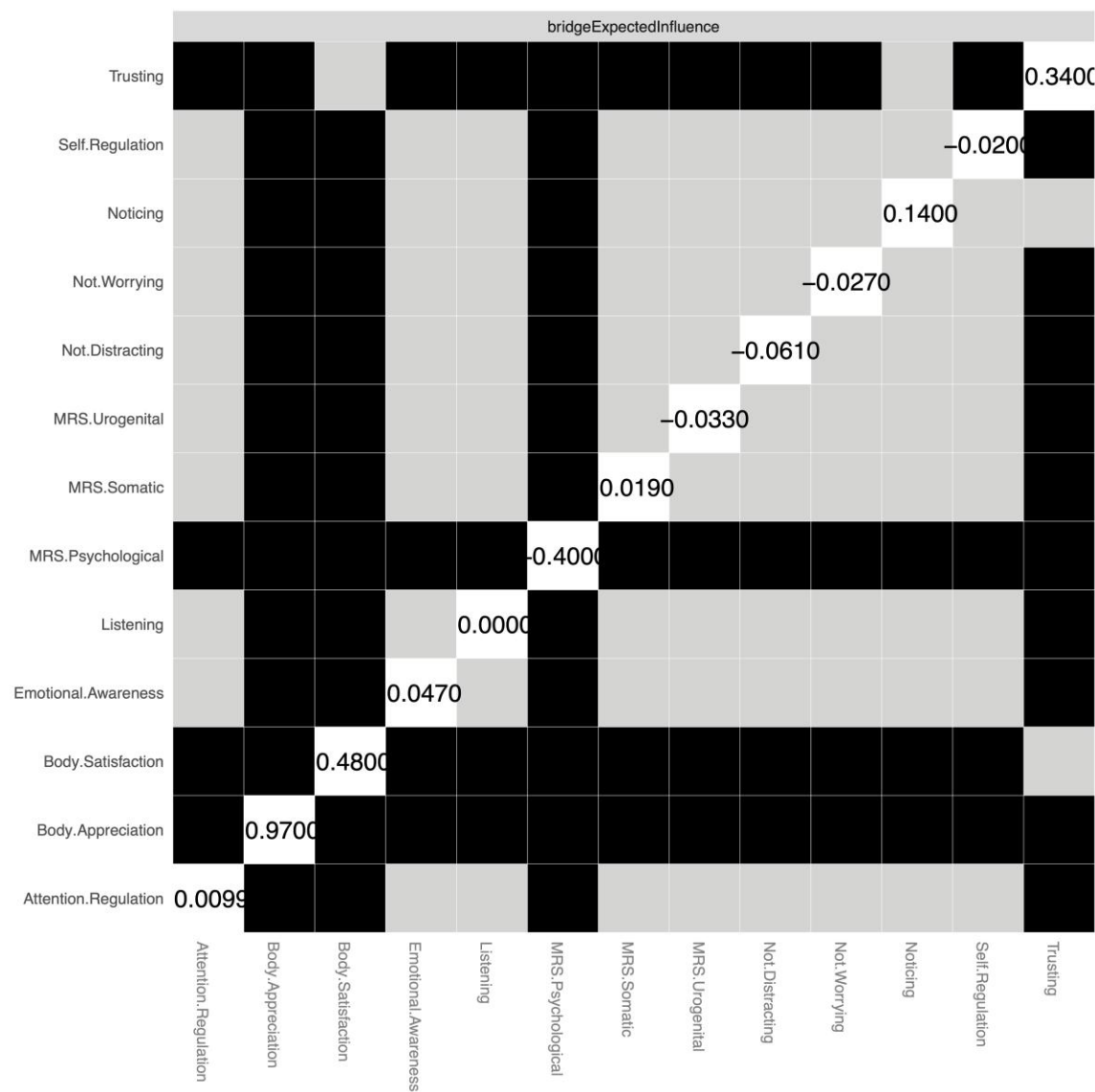


Figure 5. Bootstrapped difference test for bridge expected influence. Grey boxes indicate no significant difference, whereas black boxes indicate a statistically significant difference ($p < .05$). Diagonal values represent the strength score of each node.

3.5. Is Age Related to Menopause Symptom Severity?

A multiple linear regression was conducted to examine whether menopause symptom severity predicted age. The predictors included somatic symptoms, urogenital symptoms, and psychological symptom severity from the MRS questionnaire. And age was a dependent variable. The overall model was statistically significant $F(3, 209) = 14.35, p < .001$ and accounted for 17% proportion of the variance in age. Results indicated that somatic symptoms were a significant positive predictor of age ($\beta = .334, t = 4.17, p < .001$). Urogenital symptoms also positively predicted age ($\beta = .245, t = 3.36, p < .001$). In contrast, psychological symptoms negatively predicted age ($\beta = -.420, t = -5.29, p < .001$). These findings suggest that individuals reporting more somatic and urogenital symptoms tend to be older, while those reporting more psychological symptoms tend to be younger.

3.6. Do the Most Influential Interoceptive Sensibility and Body Image Features Predict Menopausal Symptom Severity?

Four nodes identified from the network analysis as having the highest influence (Attention Regulation, Trusting, Listening, and Body Appreciation) were selected for further investigation. Associations between these variables and menopause symptom severity were examined across the three domains: urogenital, psychological, and somatic. Separate multiple linear regression analyses were conducted for each symptom domain, with the four most influential nodes entered simultaneously as predictors. HRT status was entered as a covariate in the analysis, with HRT users entered as the reference group to see if it influenced the relationships.

The model for Somatic symptom severity was statistically significant $F(5, 207) = 5.92, p < .001$, and explained 12.5% of the variance in somatic symptom severity. Of the four predictors, only body appreciation was a significant negative predictor ($\beta = -.192, t = -2.09, p = .037$), suggesting that lower appreciation of the body was associated with greater somatic symptom severity. HRT use also significantly predicted somatic symptoms ($B = -1.41, SE = 0.43, t = -3.27, p = .001$), such that women using HRT reported higher somatic symptom scores. Interoception characteristics, including Attention Regulation ($\beta = -.04, t = -0.35, p = .73$), Trusting ($\beta = -.07, t = -0.65, p = .52$), and Listening ($\beta = .02, t = 0.24, p = .81$) were not significant predictors.

The model for Urogenital symptom severity was also statistically significant $F(5, 207) = 3.96, p = .002$, and explained 8.7% of the variance in urogenital symptoms. Among the predictors, body appreciation was a statistically negative significant predictor ($\beta = -.21, t = -2.25, p = .025$), indicating that lower body appreciation was associated with higher urogenital symptom severity. HRT use was also significantly associated with urogenital symptoms ($B = -1.02, SE = 0.39, t = -2.63, p = .009$), such that women using HRT reported higher urogenital symptom scores. Attention Regulation ($\beta = .14, t = 1.38, p = .168$), Trusting ($\beta = -.02, t = -0.22, p = .829$), and Listening ($\beta = -.07, t = -0.64, p = .525$) were not significant predictors.

Additionally, the model for Psychological symptom severity was also statistically significant $F(5, 207) = 14.05, p < .001$, with 25.3% of the variance in psychological symptoms explained by the predictors. Body appreciation was a significant predictor ($\beta = -.29, t = -3.42, p < .001$), such that greater bodily appreciation was associated with lower psychological symptom scores. Trusting also significantly negatively predicted psychological symptoms ($\beta = -.21, t = -2.20, p = .029$), indicating that lower trusting of bodily sensations was associated with higher psychological symptom severity. HRT status significantly predicted psychological symptoms ($B = -1.53, SE = 0.45, t = -3.37, p < .001$), with non-users reporting significantly lower psychological symptom scores than HRT users. Attention Regulation ($\beta = .11, t = 1.16, p = .249$) and Listening ($\beta = -.03, t = -0.36, p = .722$) were not significant predictors.

4. Discussion

In this study, we examined how three menopausal symptom domains (somatic, urogenital, and psychological) interrelate with facets of body image (body appreciation and body satisfaction) and multidimensional interoceptive sensibility in middle-aged Irish women. Using network analysis and follow-up regression models, we aimed to identify which aspects of interoceptive sensibility and body image are most central within this system and which features function as bridges between women's experience of their bodies and the severity of menopausal symptoms.

Interoceptive Sensibility, Body Image, and Central Nodes

Within the network, the most influential nodes were Attention Regulation, Trusting, Body Appreciation, and Body Listening. This pattern suggests that, in the context of middle-aged women, the capacity to intentionally direct and maintain attention toward bodily sensations, to experience one's body as safe and reliable, to hold a generally appreciative stance toward the body, and to listen to bodily cues for guidance are core elements of their embodied experience. Rather than simple

noticing of sensations, which may have a maladaptive relationship to body image [68,88]. Consistent with this interpretation, these central nodes reflect interpretative and regulatory facets of interoceptive sensibility, aligning with prior MAIA-based research demonstrating that such dimensions are more strongly related to body image outcomes than basic bodily awareness alone [17].

By contrast, Not Distracting (the tendency not to ignore, suppress, or divert attention away from uncomfortable bodily sensations) and Not Worrying (the tendency not to experience distress, anxiety, or concern in response to sensations of discomfort or pain) emerged as relatively peripheral nodes. Although these dimensions still contributed to the network, they appeared less likely to propagate change through the system if targeted directly. This is consistent with previous network analyses in younger women, where Not Distracting and Not Worrying were also weakly central in networks linking interoceptive sensibility with self-objectification and body dissatisfaction [17]. In general, these two subscales have demonstrated low reliability and internal consistency in studies [14,65,66,68] and have been noted as more peripheral in a recent network comparison of women with high and low body dissatisfaction [17]. Together, these findings suggest that simply refraining from distraction or worry about bodily sensations may be less important than actively noticing, listening, and trusting body signals for building body appreciation.

Bridge Pathways Between Menopausal Symptoms, Interoception, and Body Image

Bridge analysis indicated that a small number of nodes connected the menopause symptom domains with interoceptive and body image constructs. In particular, low levels of interoceptive trusting have repeatedly been associated with greater preoccupation with weight and shape, and this facet consistently emerges as one of the strongest predictors of body dissatisfaction across populations [14,17,18,90]. Although empirical research directly examining interoceptive processes during menopause remains limited, recent qualitative research with autistic individuals experiencing menopause illustrates how longstanding difficulties in bodily awareness and trust can exacerbate the challenges posed by menopausal bodily changes [91]. Participants described heightened sensitivity to some sensations alongside reduced awareness of others, contributing to uncertainty and mistrust in bodily signals. For individuals who had long experienced their bodily cues as unreliable or invalidated, the physiological unpredictability of menopause was described as particularly destabilising. This suggests that when bodily signals are difficult to interpret or trust, menopausal symptoms may be experienced as more disruptive, highlighting the potential protective role of adaptive interoceptive sensibility and positive body image in mid-life women.

Notably, body appreciation emerged as the strongest and most influential bridge node, exhibiting robust connections with both state body satisfaction and interoceptive trusting. The network further demonstrated that women who reported greater appreciation of their bodies tended to endorse higher trust in bodily sensations and greater momentary body satisfaction. These findings are consistent with prior work identifying interoceptive trusting as a core feature of positive body image. For example, [89] showed that body trusting was a central node within the network of women with low body dissatisfaction, indicating that encouraging women to trust their body signals may help to increase their body satisfaction. Furthermore, women in the present study who reported higher body appreciation also reported lower levels of menopause symptom severity, particularly within the psychological and urogenital domains. This aligns with findings by [29] who showed that women reporting higher body appreciation also reported better menopausal quality of life, particularly across psychosocial, physical, and sexual domains. Together, these findings suggest that body appreciation may play a key integrative role in linking menopausal experiences with interoceptive processes. More broadly, these findings are consistent with research showing that body appreciation is closely related to how interoceptive signals are experienced and interpreted [14,18,92] as well as with evidence that positive body image is associated with more adaptive responses to bodily changes across the lifespan [22,72,73].

Trusting also functioned as a key bridge node in the network. It was negatively associated with psychological symptom severity, indicating that women who experienced more depressive mood, anxiety, irritability, and exhaustion tended to report lower trust in their bodies. This finding resonates with studies linking reduced interoceptive trust to elevated depressive symptoms and broader mental health difficulties [93,94]. In the menopausal context, reduced trust in bodily sensations may contribute to greater vulnerability to mood and psychological symptoms, as women may be less likely to experience their bodies as stable and reliable sources of information [91]. This diminished bodily trust may, in turn, exacerbate psychological distress, creating a reinforcing cycle of impaired interoceptive confidence and emotional symptoms.

Noticing was positively connected to somatic symptom severity. This suggests that heightened awareness of bodily sensations may amplify the perception or salience of somatic complaints such as night sweats, hot flashes, and joint pain. Such a pattern is consistent with models of symptom perception in which increased attention to bodily sensations, particularly in the absence of strong regulatory or trusting capacities, can accentuate discomfort and symptom reporting [51,53]. Taken together, these bridge pathways highlight an important distinction. Noticing bodily sensations may exacerbate awareness of somatic discomfort, whereas trusting and appreciative engagement with the body appears to be protective, especially in relation to psychological symptoms.

Predicting Menopausal Symptom Severity

The follow-up regression analyses further clarified these relationships. Across all three symptom domains, body appreciation consistently emerged as a significant negative predictor of symptom severity. Lower levels of body appreciation were associated with greater somatic and urogenital symptoms and with higher psychological symptom burden. This converges with our network findings that positioned body appreciation as the most influential bridge node and reinforces the idea that a more accepting and appreciative stance toward the body may buffer women against the distress associated with menopausal changes.

For psychological symptoms specifically, both body appreciation and interoceptive trust were significant negative predictors. Women who felt more appreciative of their bodies and who experienced their bodies as safe and reliable reported fewer mood and psychological difficulties. This corresponds with the suggestion that positive body image and interoceptive trust lead to better emotion regulation and mental health [14,72,93] and provides evidence that shows how women relate to internal bodily cues may be particularly relevant for psychological aspects of the menopausal experience.

Interestingly, Attention Regulation and Body Listening, although highly central in the network, did not uniquely predict symptom severity in the regression models once body appreciation and trusting were taken into account. One interpretation is that these attentional dimensions may be more proximally related to interoceptive processes and body image themselves, whereas the evaluative stance, such as appreciation and trust, is most directly linked to symptom burden. Alternatively, shared variance among these interoceptive constructs may have reduced their unique predictive power, underscoring the value of a network approach for capturing their interconnected influences.

Age and HRT Patterns

Age was differentially associated with symptom domains. Higher somatic and urogenital symptom severity was linked to older age, whereas greater psychological symptom severity was associated with younger age within the 40 to 60 range. This is consistent with longitudinal work suggesting that vasomotor and urogenital symptoms often peak in later perimenopause and early postmenopause, while psychological symptoms may be more salient earlier in the transition [24,25,95]. HRT use was associated with higher reported somatic, urogenital, and psychological symptom severity. This likely reflects selection effects. Women who experience greater symptom burden are more likely to seek and receive HRT. Because menopausal stage, treatment duration, and specific HRT regimens were not assessed, causal inferences cannot be drawn. The finding

underscores the importance of considering treatment-seeking status when interpreting relationships between menopausal symptoms and psychological constructs.

Implications for Interoception, Body Image, and Women's Health

Overall, our findings support conceptualizing the menopausal transition as an embodied process in which women's experiences of internal bodily signals and their evaluative stance toward the body are tightly intertwined with symptom burden [96,97]. Interventions that directly target positive body image, such as body appreciation exercises and self-compassion-based programmes [98] may not only improve body image but also mitigate menopausal symptom distress [21]. Practices that cultivate interoceptive awareness and trust, including mindfulness-based interventions, yoga, and body-oriented therapies, may enhance women's ability to interpret fluctuating bodily signals without excessive worry or avoidance [99]. Integrating interoceptive training with psychoeducation about menopause may help women reframe bodily changes as meaningful but manageable rather than threatening. However, given the limited research examining how interoception and body image relate to the menopausal experience, substantially more work is needed to build a robust evidence base for interventions supporting women during this transition.

Strengths and Limitations

This study has several strengths. It focuses on a significantly under-researched life stage in women's health, body image, and interoception research. In line with recommendations, it focuses on women's experiences of menopausal symptom types, rather than the stage of transition [5,45], and for the first time uses network and bridge analyses to characterise the complex interplay between types of menopausal symptoms and bodily self-experience in middle-aged women.

However, several limitations must be acknowledged. First, the cross-sectional design prevents conclusions about causality or directionality. For example, it is unclear whether low body appreciation contributes to greater symptom distress, whether more severe symptoms erode body appreciation and interoceptive trust, or whether bidirectional processes are at play. Second, all measures were self-report and susceptible to reporting biases, and future work should incorporate objective measures of interoception [100].

Third, the sample comprised cisgender women residing in the Republic of Ireland recruited via convenience sampling, which may limit generalizability to more ethnically, socioeconomically, and gender-diverse populations, or to women in cultural contexts where menopause is constructed differently. Fourth, participants were not asked whether they had been pregnant or had children. Parity and pregnancy history may meaningfully influence both long-term physiological changes and women's relationships with their bodies and therefore represent an important factor to assess in future work [56]. Finally, HRT use was assessed dichotomously without information on regimen, dose, or duration, which limits the interpretability of differences between users and non-users.

Future Directions

Future research should adopt longitudinal designs that track women across the menopausal transition to map how interoceptive sensibility, body image, and symptom trajectories co-evolve over time. Experimental studies could test whether interventions that enhance body appreciation and interoceptive trust reduce menopausal symptom distress and improve psychological outcomes. Incorporating hormonal assays, objective interoceptive measures, and detailed characterisation of menopausal stage would deepen understanding of the biological and psychological mechanisms that link reproductive ageing to embodied experience.

5. Conclusions

In summary, this study demonstrates that menopausal symptom severity is closely intertwined with how women relate to their bodies, both in terms of interoceptive sensibility and positive body

image. Body appreciation and interoceptive trust emerged as key bridge processes linking menopausal symptoms to the broader network of bodily self-experience, while heightened noticing of bodily sensations related specifically to somatic symptom burden. These findings highlight body appreciation and interoceptive trust as promising psychological resources that may protect women’s mental and physical well-being during the menopausal transition and underscore the value of an interoceptive lens in understanding women’s health in midlife.

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Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
TLA	Three letter acronym
LD	Linear dichroism

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