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Original article

Self-efficacy, quality of life, physical activity and educational interventions in menopausal women: A cross-sectional and pre–post study using Bayesian structural equation modelling

Daniele Magistro [a,b], Roberto Vagnetti [a,c], Paul Ansdell [d], Jessica Piasecki [a,*]

[a] Sport, Health and Performance Enhancement Research Centre (SHAPE), Nottingham Trent University, Nottingham, NG11 8NS, UK
[b] School of Health Sciences, Faculty of Environmental & Life Sciences, University of Southampton (Building 67/Room 4013), Highfield, Southampton, SO17 1BJ, UK
[c] The University of Manchester, Oxford Road, Manchester, M13 9BL, UK
[d] School of Sport, Exercise and Rehabilitation, Northumbria University, Newcastle, NE1 8ST, UK

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ABSTRACT

Objectives: This two-part study aimed to confirm a theoretical model that integrates self-efficacy with menopause symptoms, quality of life and physical activity; and to determine the associations between self-efficacy and menopause knowledge following an education intervention.
Study design: The cross-sectional study involved 86 menopausal women (mean age = 55.57, SD = 7.44). Additionally, a pre–post design was employed after a half-day educational intervention (presentations, interactive polls and open discussions) with 51 women (mean age = 52.81, SD = 4.62).
Main outcome measures: The impact of menopausal symptoms on quality of life (QoL) was assessed via the Perimenopausal Depression Scale and the Utian Quality of Life Scale. Physical activity was measured with the International Physical Activity Questionnaire. Self-efficacy was assessed with the General Self-Efficacy Scale. An ad hoc questionnaire pre- and post-events determined level of knowledge regarding menopause.
Results: Bayesian structural equation modelling confirmed the model. Physical activity exhibited a negative association with menopause symptoms (mean estimate = −1.69, 95 % CI [−3.08, −0.28]), and its relationship with quality of life (mean estimate = 1.35, 95 % CI [−0.24, 2.93]) was mediated by symptoms (mean estimate = 0.75, 95 % CIs [0.12, 1.51]). The detrimental impact of symptoms on quality of life (mean estimate = 4.42, 95 % CIs [2.22, 6.59]) was partially mediated by self-efficacy (mean estimate = −0.24, 95 % CIs [−0.38, −0.11]). Self-efficacy ($r = 0.47$, $p < .001$) was significantly correlated with improvements in knowledge.
Conclusions: Increased physical activity could reduce menopausal symptoms and thereby enhance quality of life during the menopause. Higher levels of self-efficacy support better symptom management via improvements in menopause-related knowledge.

1. Introduction

Menopause is defined as the cessation of menstruation for 12 months and is a part of the aging process, occurring in most females between the ages of 45–55, caused by the loss of ovarian follicular function and a decline in circulating blood estrogen and progesterone levels [1]. Menopause can be a challenging phase of the lifespan involving a number of physiological and psychological changes. The menopausal transition encompasses a spectrum of symptoms including vasomotor, cardiovascular, genitourinary, mood, cognitive, sleep, libido, and bone-related issues, all of which can adversely affect quality of life and aspects of daily life [2]. Symptoms related to menopause typically last for a median of 4.5 years, although in some cases, they can persist for over a decade [3].

Hormone therapy is commonly used to address menopausal symptoms, as estrogen-based therapies are typically effective and generally yield favourable outcomes for females under 60 years old [4]. However, there have been shown to be a number of non-hormonal alternatives that also help to manage symptoms [4]. Physical activity has been shown to positively influence the mental well-being of older adults as well as

* Corresponding author.
E-mail addresses: D.magistro@soton.ac.uk (D. Magistro), roberto.vagnetti@manchester.ac.uk (R. Vagnetti), p.ansdell@northumbria.ac.uk (P. Ansdell), jessica.piasecki@ntu.ac.uk (J. Piasecki).

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being widely recognized for its overall beneficial impact on physical health [5] and quality of life [6].

Females who engage in high or moderate levels of physical activity experience less severe menopausal symptoms [7]. While these findings suggest that physical activity could be a valuable tool for symptom management, the extent of its benefits may depend on psychological factors that shape how individuals engage in and respond to activity, with beliefs about one's ability to manage challenges being particular influential [6]. Such beliefs, known as self-efficacy reflect an individual's confidence in motivating themselves, using cognitive resources, and taking necessary actions to manage challenging situations [8]. They influence a range of health-related behaviours [9], including medication adherence [10], managing emotions [11], dealing with pain [12], and coping with stress [13]. Among menopausal females, stronger self-efficacy acts as a protective factor, improving quality of life [14].

These psychological resources are also critical for learning, influencing the mental effort individuals invest when engaging with challenging material [15]. With regards to menopause, females often lack adequate and consistent information, and typically seek advice and guidance only when their symptoms start to manifest [16]. Improving menopause-related knowledge early and systematically could empower females to take proactive steps in symptom management, potentially strengthening their quality of life. Comprehensive menopause education strategies are essential and should encompass a multifaceted approach, including implementation in schools, workplaces, social media platforms, public involvement and public health initiatives [17] in order to enhance both the quality of life and symptom management for menopausal females [18]. However, robust evidence regarding the impact of community-level interventions remains limited.

In summary, current evidence suggests physical activity may reduce menopausal symptoms, and the relationship between these symptoms and quality of life is mediated by self-efficacy skills. Herein, part 1 of the research aims to verify this model in menopausal females and to assess the presence of total or partial indirect mediations. Specifically, it is expected that the relationship between physical activity and quality of life is mediated by menopause symptoms, with physical activity to be negatively associated with menopause symptoms - indicating higher physical activity levels correlate with fewer reported symptoms; and that individuals' self-efficacy resources mediate the negative link between menopause symptoms and quality of life.

Furthermore, this study proposes that self-efficacy plays a dual role during the menopausal transition. Part 2 focuses on implementing an educational intervention on menopause through knowledge exchange activities. The primary goal is to assess whether public involvement in community-level events can enhance females' understanding of menopause. Additionally, we anticipate any enhancements will correlate with participants' self-efficacy resources.

This research aims to improve quality of life during menopause by addressing symptom management and psychological empowerment. We test whether physical activity is associated with fewer symptoms and better quality of life, and whether self-efficacy mediates this relationship. We also evaluate whether a community-based educational intervention enhances menopause knowledge and strengthens self-efficacy. Together, these studies offer a comprehensive, low-cost strategy to support females during the menopausal transition.

2. Study 1

2.1. Method

2.1.1. Procedure and participants

Peri and postmenopausal females above 45 years old, were recruited for the study, defined according to the NICE guidelines [19]. Participants were recruited from local Women's health centres and university email lists in the United Kingdom. They were formally provided information regarding the study and asked to participate if they met the eligibility criteria. All participants then completed a health screen and informed consent before taking part in the study. The study was approved by the University ethical committee (project number 1757046). A total of 86 females took part in the study, (mean age = 55.57, SD = 7.44), with the majority of participants having (87 %) a tertiary (college or university degree) or secondary (13 %) level of education. Most participants were married (63 %), 16 % indicated they were cohabitating, 10 % were divorced or separated and 11 % were single or widowed. One out of five (20 %) reported to not perform regular exercise.

2.1.2. Measures

The *Peri-menopausal Depression Scale* (MENO-D, [20]) is a 12-item self-reported questionnaire designed to evaluate the severity of menopausal symptoms. It assesses symptoms across twelve areas, including paranoid thinking, self-esteem, isolation, anxiety, sexual interest, low energy, somatic symptoms, weight changes, memory, concentration, irritability, and sleep disturbances with each of these symptoms rated on a scale from 0 to 4 (4 being most severe). The symptoms are then clustered into five main factors: somatic, cognitive, self-related, sleep-related, and sexual symptoms. The scale was selected as it covers a wide psychological symptomatology related to menopause. The total score on the MENO-D can range from 0 to 48.

The *Utian Quality of Life Scale* (UQOL, [21]) is a self-reported 23-item questionnaire designed to assess perceived quality of life in females during menopause. Participants respond to each of the 23 statements using a 5-point Likert scale, where 1 = "Not true of me," 3 = "Moderately true of me," and 5 = "Very true of me." Scores from these responses relate to four dimensions of quality of life: occupational, health, emotional and sexual, which represent the subscales of the questionnaire. The total score, reflecting overall perceived quality of life in women going through menopause, was then calculated and used in the analysis.

The short form of the *International Physical Activity Questionnaire* (IPAQ, [22]) is a self-reported retrospective questionnaire used to assess individuals' physical activity over the previous seven days. It measures time spent in moderate, vigorous, and walking intensity physical activities, as well as time spent sitting. Participants report the number of days per week and the time spent per day engaging in physical activities within each domain. Responses are then scored to calculate the amount of moderate-to-vigorous physical activity (MVPA), which have been converted in MET-minutes per week. The IPAQ total score (MET-minutes per week) was analysed as a continuous variable.

The General Self-Efficacy Scale (GSES; [23]) measures the trait-like general dimensions of self-efficacy, defined as individuals' perceived ability to perform across various situations and contexts, which develops from a person's lifetime experiences of successes and failures. The GSES is an 8-item questionnaire using a 5-point Likert scale (1: "Strongly Disagree" to 5: "Strongly Agree"). It includes statements such as "I will be able to successfully overcome many challenges" and "Even when things are tough, I can perform quite well" to evaluate participants' self-efficacy in different contexts.

All instruments employed in this study are validated English-language measures: the MENO-D [20], the Utian Quality of Life Scale [21], the IPAQ-Short Form [22], and the General Self-Efficacy Scale [9,23]. These measures have been widely used in UK and international research, supporting their validity for the present sample.

2.2. Statistical analysis

Pearsons's correlations were preliminary performed to confirm the relationships between the variables in the model. Bayesian Structural Equation Modelling (BSEM) was conducted to test the proposed model given the proposed advantages of employing the BSEM lies in its ability to provide reliable results even with small sample sizes [24]. BSEM is particularly beneficial in mediation analysis as it avoids imposing

restrictive assumptions, including those related to indirect effects. Parameter estimates were obtained via MCMC simulation, yielding posterior means, standard errors, standard deviations, and 95 % credible intervals (CIs). Strongly informative priors were not specified because no sufficiently robust prior evidence was available to justify their use. Diffuse priors (Normal 0, 10^2) were used for the primary analysis to allow the data to dominate the posterior estimates. Weakly informative priors (Normal 0, 5^2) were then applied in a sensitivity analysis to assess the robustness of the results, providing minimal regularisation. A 500-iteration burn-in and tuning of 0.35 were used. Convergence (C.S. < 1.002) was confirmed with diagnostics and visual checks. Model fit was evaluated using Posterior Predictive P (PPP), where values near 0.50 indicated good fit and <0.10 suggested rejection. Indirect effects were tested, and a sample size of 80 met the 20:1 rule [25].

2.3. Results

Correlations indicated that all the variables considered in the model were significantly correlated, results are reported in Table S1 of the supplementary file. The mean value of MENO-D was 10.18 (±8.08), UQOL was 71.28 (±10.01), GSES was 3.31 (±0.80), and MVPA was 643.93 min (±586.59). The model achieved convergence with C.S. <1.002, which was confirmed through visual inspection of time-series plots and autocorrelation plots for each parameter. Additionally, PPP = 0.50 indicated a good fit of the data. The sensitivity analysis indicated convergence of the results, further confirming the reliability of the outputs irrespective of the prior used. A significant and negative association was found between MVPA and the total score of the MENO-D (mean estimate = −1.69, SE = 0.009, 95 % CIs [−3.08, −0.28], small effect: standardised β = −0.21). The symptoms related to menopause negatively affected quality of life during menopause (mean estimate = −0.20, SE = 0.001, 95 % CIs [−0.42, −0.01], small effect: standardised β = −0.16). Physical activity was not significantly associated with reported quality of life (mean estimate = 1.35, SE = 0.013, 95 % CIs [−0.24, 2.93], standardised β = −0.13), instead we found a significant total indirect mediation from MVPA to UQOL that passed through menopause symptoms (mean estimate = 0.75, SE = 0.004, 95 % CIs [0.12, 1.51], small effect: standardised β = 0.10). Menopause symptoms were significantly and negatively associated with self-efficacy (mean estimate = −0.05, SE = 0.001, 95 % CIs [−0.06, −0.04], large effect: standardised β = −0.55), which, on the other hand, presented a positive significant association with quality of life (mean estimate = 4.42, SE = 0.013, 95 % CIs [2.22, 6.59], medium effect: standardised β = 0.35). The presence of a significant indirect effect (mean estimate = −0.24, SE = 0.001, 95 % CIs [−0.38, −0.11], small effect: standardised β = −0.10) indicated that self-efficacy resources could partially mediated the negative impact that menopausal symptoms have on quality of life. Results with standardised coefficients are summarised in Fig. 1.

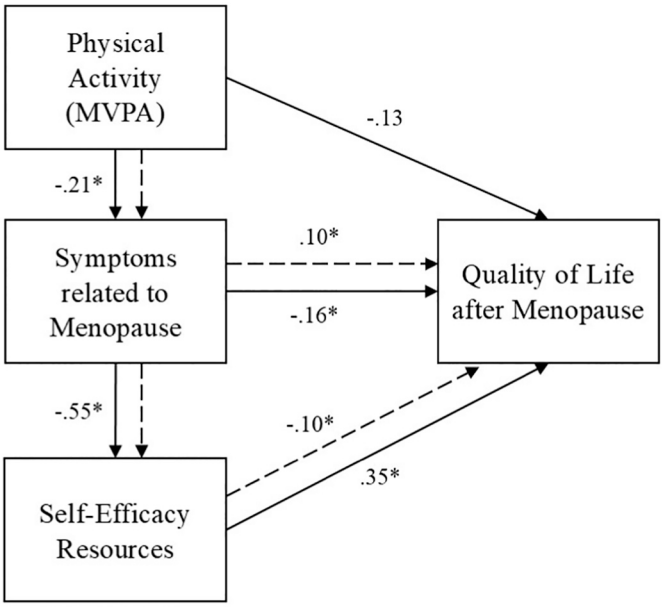

Fig. 1. Results obtained from BSEM. Arrows indicate direct association, those with dashed lines indicate indirect effects due to mediation. Values of standardised coefficients (noted above) are reported. *denotes a significant association.

3. Study 2

3.1. Method

3.1.1. Procedure and participants

In addition to data collection described above, a knowledge transfer event was compiled to deliver an education session specific to the menopause.

These events were conducted at the University and involved the participation of experts in different topics related to menopause (specifically; nutrition, thermoregulation, physical activity, muscle health and brain health). Whilst participants were recruited from the same procedure described in Study 1, the events were also open to the general public. In this context, the results obtained herein are those of a subsample of females above 45 years old again categorised as perimenopausal or post-menopausal according to NICE guidelines, as described above. A retrospective pre-post design was performed two days after the educational intervention to assess changes in knowledge related to the topic, the advantage of this approach is to reduce response shift bias induced by the new knowledge of a topic [26]. A total of 51 with a mean age of 52.81 years (SD = 4.62) were utilised within the sub sample. Among the participants, only 4 % were retired, 61 % were married, 20 % were cohabitating, 10 % were divorced or separated, and 9 % indicated that they were single or had another status. Additionally, 78.4 % reported exercising regularly (three times per week).

3.1.2. Educational intervention

The educational intervention took place across one afternoon on 6th Sept 2023. Prior to attending there was a brief online questionnaire sent to all registrants, this comprised of general characteristic questions as well as Quality of life, lifestyle profile and self-efficacy. At the event there were a series of 5 presentations to improve knowledge and awareness on health and well-being during menopause, lasting around 15 min each, on topics of nutrition, thermoregulation, muscle health, active lifestyle, and psychological and mental well-being. Prior to the presentations taking part there were a series of questions to assess baseline knowledge utilising a mentimeter app. The first was ‘what do you currently know about the menopause’ which allowed for open ended responses. The second was how much do you know about (insert the topic here) in relation to the menopause. The participants then ranked their knowledge from 1 to 7 (7 being expert) on each of the topics that were to be presented. After each presentation there were 3 opportunities to interact via the app; 1- an open form to submit questions 2- asking for participants thoughts and experiences regarding to the presented topic and the menopause and 3- asking if there are any topics in that area that they would like to know more about. After the concluding presentation the knowledge scale was repeated. Finally, 2 days after the event all registrants again were asked to complete a second questionnaire asking them to rank (1–7) their knowledge on the topics covered in the session for both pre and post the event.

3.1.3. Measures

As a primary outcome a questionnaire was implemented to assess participants self-reported perception of knowledge regarding the topics considered during the pre- and post-event assessments. The

questionnaires comprehended four items measured on a 7-point Likert scales evaluating: the understanding of the menopause (Overall Understanding), physical activity during the menopausal transition (Physical Activity; linked with muscle health and active lifestyle topics), psychological and mental well-being (Psychological Well-being) and knowledge related to health factors (Health Impacts; linked with nutrition and thermoregulation topics). The GSES was administered as secondary outcome.

3.2. Statistical analysis

Shapiro–Wilk tests indicated that the data were not normally distributed. Differences between pre- and post-intervention measures were analysed using the Wilcoxon signed rank test. Spearman correlation was performed to assess the association between self-efficacy and the knowledge gained, calculated as the sum of pre-intervention knowledge minus the sum of post-intervention knowledge. The reliability of the pre- and post-intervention items was assessed using the Spearman-Brown coefficient, indicating good reliability for the items related during the pre- (0.89) and post-intervention (0.86).

3.3. Results

The analysis indicated that participants reported significant improvements in knowledge related to menopause from pre to post the event; ($Z = -3.98$, $p < .001$), including health factors associated with menopause ($Z = -3.68$, $p < .001$), knowledge of physical activity during menopause ($Z = -3.36$, $p < .001$), and psychological well-being factors related to menopause ($Z = -3.09$, $p < .001$). The knowledge improvements were significantly associated with self-efficacy resources ($r = 0.47$, $p < .001$). A summary of the results is depicted in Fig. 2.

4. Discussion

The present study confirmed a model that integrates physical activity, menopausal symptoms, self-efficacy resources, and quality of life in females through menopause indicated that menopausal symptoms have a negative association with quality of life. Additionally, it demonstrated that engaging in physical activity may help alleviate symptoms related to menopause [7]. However, the analysis of indirect effects revealed an important finding: the relationship between physical activity and quality of life is completely mediated by perceived symptoms. This suggests that increasing physical activity may not directly improve quality of life unless it effectively alleviates menopausal symptoms. Thus, engaging in physical activity itself is not directly associated with a better quality of life, rather, it has positive effects on various domains, such as physiological and psychological aspects, involved in menopausal symptoms

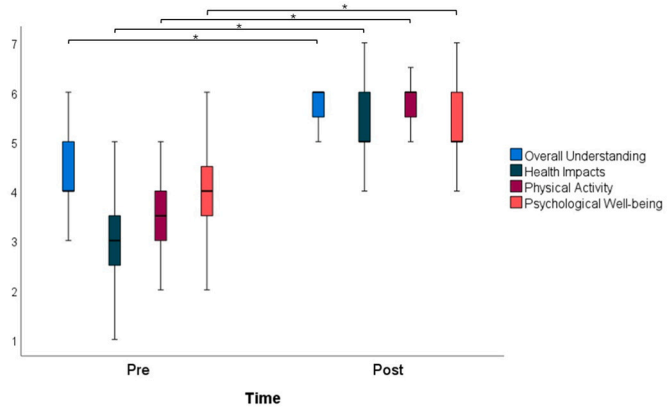

Fig. 2. Boxplot of the scores reported before and after the educational intervention. *Indicates $p < .05$.

which subsequently may contribute to improving quality of life. In practical terms, this indicates that higher levels of moderate-to-vigorous physical activity (MVPA) indirectly improve quality of life by reducing the severity of menopausal symptoms. In other words, women who are more physically active tend to experience fewer symptoms, which in turn enhances their perceived quality of life during the menopausal transition.

Additionally, it was noted that a person with higher self-efficacy resources tends to behave more actively in addressing challenges and experiences less helplessness [27]. Thus, while negative symptoms adversely affect the perceived quality of life, an individual's confidence in their ability to control motivation and behavior may mediate this negative impact. Self-efficacy resources help in managing symptoms by enhancing people's perceived ability to implement behaviours that prevent, recognise, and relieve these symptoms [28] whilst also enhancing people's motivation, perseverance, competence, and efforts [28]. This study reinforces the importance of self-efficacy as a core psychological resource in managing menopause-related symptoms and improving quality of life in menopausal females. Consistent with previous research, interventions grounded in self-efficacy theory and individual empowerment models have been shown to significantly enhance quality of life over time, with effects sustained up to three months post-intervention [14]. Moreover, structural equation modelling from a larger-scale study [29] suggests that self-efficacy, alongside body image and meaning in life, acts as one of the strongest predictors of quality of life, accounting for a substantial portion of its variance. While our findings support the implementation of self-efficacy-enhancing strategies, particularly in relation to the menopause an area relatively under researched, further longitudinal data is needed to evaluate their long-term effectiveness, optimal delivery methods, and integration with other psychosocial variables in diverse populations. However, whilst this first study indicates that the intervention strategies could benefit females during the menopausal transition, it is important to note that more evidence on intervention effectiveness and design is currently needed.

Educational strategies to strengthen self-efficacy; our findings align with evidence that self-efficacy is trainable via skills-based educational approaches that target self-regulatory resources. Effective components include specific goal setting, action planning and implementation intentions (linking when/where/how to act), self-monitoring with feedback, and coping/problem-solving plans for anticipated barriers; these techniques reliably increase exercise self-efficacy and physical activity in midlife/older adults [30,31]. Group-based formats can add vicarious learning and social persuasion, while behavioural/health coaching offers personalised goal review and accountability, both associated with self-efficacy gains and behavior change. In menopausal populations specifically, self-efficacy–based education has improved quality of life and health literacy [32], and emerging group-based physical programmes for *peri*/post-menopausal women report feasibility and preliminary efficacy [33]. Consequently, future menopause education should explicitly incorporate these elements (e.g., brief coaching or group workshops with action-planning, self-monitoring tools, and coping-planning exercises) to strengthen self-efficacy and, in turn, symptom management and quality of life.

Part 2 of this study indicates that engaging in events related to menopause can enhance people's perceived knowledge on various topics associated with menopause. Implementing educational interventions can increase awareness and understanding of the menopausal transition and can be conducted at a relatively low cost. Educational interventions are feasible to be implemented at the community level, contributing to a multifaceted approach, such as public health initiatives [34] and within social prescribing interventions. Importantly, in this context, self-efficacy resources may play a pivotal role, in that, self-efficacy can positively influence learning performance, as higher self-efficacy is correlated with better learning outcomes. Herein, improvements in knowledge were linked to higher self-efficacy among participants. Thus,

enhancing self-efficacy among menopausal females may not only improve their quality of life but also enhance their ability to gather new information and understand the menopausal transition more effectively.

Despite these interesting findings, this study has some limitations. The study has a limited sample size, and although BSEM analysis has been implemented as it is reliable in such cases, studies with larger sample sizes should be conducted to confirm these results. The model is built using a cross-sectional design; therefore, future work should seek to test with longitudinal data and in intervention frameworks. Knowledge about menopause has been evaluated using an ad hoc questionnaire, however a standardised test specifically designed to assess this knowledge is not available. Another limitation of this study is the absence of exclusion criteria, which may have introduced heterogeneity into the sample and influenced the observed associations. Menopausal stage was not used for stratification or statistical control, which may limit interpretability across transition phases; future research should examine whether the observed relationships differ between peri- and post-menopausal groups. Formal power analysis was not conducted because inference in Bayesian SEM focuses on posterior distributions and their precision rather than null-hypothesis rejection. Instead, we report posterior means and 95 % credible intervals for all paths, which provide a direct indication of estimate precision. Additionally, prior sensitivity analysis was performed to confirm that conclusions were robust to reasonable alternative prior specifications. Recruitment through health centres and universities likely resulted in a sample with higher educational attainment and potentially greater health awareness or motivation than the general population. Future research should include more socio-economically and educationally diverse participants to improve generalisability, as well as information on the long term impact, with interventions carried out over a much longer time frame. In addition, the study relied on self-reported questionnaires, which could be affected by recall effects or social desirability, potentially influencing the accuracy of the responses.

In conclusion, these studies indicate that increased physical activity indirectly enhances quality of life during menopause, primarily by reducing menopausal symptoms. Higher self-efficacy further supports this pathway by helping women manage symptoms more effectively. Importantly it was indicated that higher levels of self-efficacy can also support symptom management and knowledge about menopause. Educational interventions at the community level have been shown to improve knowledge regarding menopause; however, learning is influenced by self-efficacy skills. A novel aspect of our work is the application of Bayesian Structural Equation Modelling, which allowed us to robustly test indirect effects and mediations despite the modest sample size. This methodological approach provides a rigorous framework for understanding complex psychosocial pathways and demonstrates the value of Bayesian analysis in menopause and women's health research. Finally, our findings highlight self-efficacy as a practical and modifiable target for community-based interventions. Educational programmes, group-based initiatives, and coaching strategies that enhance self-efficacy may improve women's capacity to manage menopausal symptoms and sustain better quality of life. These insights could help develop new strategies to assist relevant populations in managing the menopausal transition and should be more widely and consistently implemented across work places and community settings to ensure females are able to maintain a high quality of life through this critical time within the lifespan. To build towards this dissemination it is vital that future studies look to recruit from diverse and representative populations, conducting interventions over a longer time frame, which may be achieved through a multi-centre study approach.

Contributors

All authors participated in data collection and analysis, and in the drafting and revising the paper. All authors saw and approved the final version and no other person made a substantial contribution to the paper.

Ethical approval

All experimental procedures were performed within institutional guidelines and were approved by Nottingham Trent University ethics committee (project number 1757046, Approved May 2023). All participants completed a health screen and informed consent before taking part in the study.

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. Data will be made available on request.

Declaration of competing interest

The authors declare that they have no competing interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.maturitas.2025.108774.

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