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Multimodal non-hormonal intervention with phytoestrogen nutrition and Damask rose aromatherapy improves quality of life in early menopausal women: a quasi-experimental study

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ABSTRACT

Early menopause and perimenopause are increasingly recognized as critical women's health issues due to their substantial hormonal instability, heightened symptom burden, and negative impact on quality of life. Safe non-hormonal interventions remain limited, particularly in community settings, despite growing evidence supporting phytoestrogens and mind body therapies. This study aimed to evaluate the effectiveness of a 12-week holistic intervention integrating phytoestrogen nutrition, Damask rose aromatherapy, and guided relaxation on hormonal regulation, metabolic markers, menopausal symptoms, and quality of life among early menopausal and perimenopausal women. Using a quasi-experimental design, 44 participants received soy-based dietary supplementation, nightly aromatherapy, and structured relaxation practices, with pre-post assessments of estradiol, lipid profile, fasting glucose, Menopausal Rating Scale (MRS), and Menopause-Specific Quality of Life Questionnaire (MENQOL). The intervention produced significant improvements across all domains, including increased estradiol ($p < 0.001$), reduced low-density lipoprotein (LDL) and fasting glucose ($p = 0.001–0.003$), and substantial reductions in menopausal symptoms and psychological distress ($p < 0.001$). Early menopausal women exhibited greater improvements, reflecting their higher biological sensitivity to multimodal interventions. These findings demonstrate the potential of integrated, non-hormonal strategies to address complex menopausal changes, with practical implications for community-based women's health programs. Study limitations include the modest sample size and quasi-experimental design, highlighting the need for larger controlled trials.

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1. INTRODUCTION

Early menopause has increasingly been recognized as a global women's health concern due to its substantial impact on physical and psychological well-being [1], [2]. This condition, defined as the cessation of ovarian function before the age of 45, is preceded by the perimenopausal phase, during which fluctuating

and progressively declining levels of estrogen and progesterone begin to disrupt neuroendocrine balance [3] [4]. These hormonal changes initially manifest as sleep disturbances, mood variability, anxiety, and difficulties in concentration [5]. As women transition into early menopause, estrogen decline becomes more pronounced, resulting in more persistent vasomotor symptoms, emotional dysregulation, and a marked reduction in overall quality of life [6]-[8].

This phenomenon warrants particular attention in developing countries such as Indonesia, where access to hormonal therapy, psychological counseling, and integrative menopausal care remains limited [9], [10]. In Central Java, women in perimenopause and early menopause often face restricted availability of comprehensive, culturally tailored health services. Existing care tends to focus predominantly on physical symptoms, while psychological and social dimensions critical for emotional adaptation during hormonal transition are frequently overlooked [11]-[13]. These gaps can exacerbate stress, heighten anxiety, and increase depressive symptoms, thereby hindering women's ability to cope effectively with ongoing hormonal changes [14]-[16].

Given these challenges, there is an urgent need for safe, non-hormonal, holistic, and culturally appropriate interventions that support women during this transition. One promising approach involves combining Damask rose-based aromatherapy with structured psychological support [17], [18], both of which may enhance relaxation, stabilize mood, improve sleep quality, and strengthen women's emotional adjustment from perimenopause through early menopause [19], [20]. The central question addressed in this study is: Can sensory therapy delivered through a Damask rose aromatherapy gel pillow when combined with psychological support improve emotional well-being, sleep quality, and overall quality of life in perimenopausal and early menopausal women? This question is relevant because most previous studies have examined aromatherapy and psychological support separately rather than as an integrated therapeutic model.

This study is grounded in the biopsychosocial framework, which posits that women's well-being is shaped by interactions among biological, psychological, and social factors. The decline in estrogen during perimenopause and early menopause affects not only physiological regulation but also reduces emotional adaptability and coping capacity. Aromatherapy has been shown to stimulate parasympathetic activity, thereby reducing stress levels, while psychological support based on self-efficacy theory enhances women's ability to manage emotional and physical changes associated with menopause.

Previous research has demonstrated that aromatherapy particularly using Rosa damascena essential oil promotes relaxation, alleviates anxiety, and improves sleep quality among menopausal women [21]-[23]. Likewise, psychological interventions aimed at strengthening self-efficacy have been effective in reducing stress and depressive symptoms. However, the integration of both approaches into a unified intervention remains underexplored, especially within Southeast Asian cultural contexts [15], [24]. Furthermore, the application of aromatherapy using gel pillows represents an innovative, safe, and practical modality for home use, yet it has received limited empirical evaluation.

This study is one of the first initiatives in Indonesia to develop and evaluate a combined, evidence based non hormonal intervention tailored specifically to the needs of perimenopausal and early menopausal women. The novelty lies in integrating Damask rose aromatherapy gel pillows with structured psychological support in a culturally sensitive and community-based framework. This approach aims not only to address physical symptoms but also to strengthen emotional resilience and social well-being.

The primary objective of this study is to examine the effects of Damask rose aromatherapy gel pillows combined with psychological support on improving well-being and quality of life among perimenopausal and early menopausal women in Central Java, Indonesia. By providing empirical evidence, this study contributes to the development of scalable, culturally grounded non-hormonal interventions that can be incorporated into primary healthcare services. Ultimately, the findings aim to enrich international scientific literature on non-hormonal menopausal therapy while advancing midwifery and women's health practices in the Indonesian context.

2. METHOD

The study population consisted of women experiencing early menopause and perimenopause residing in the districts of Sukoharjo, Boyolali, and Karanganyar in Central Java, Indonesia. This population was selected due to the substantial variation in menopausal conditions and the limited utilization of non-hormonal, food-based interventions, particularly those using locally available phytoestrogen rich ingredients. A two-stage stratified random sampling technique was applied to ensure representative selection. Stratification was first conducted by geographic area (Sukoharjo, Boyolali, and Karanganyar) and subsequently by menopausal stage (early menopause and perimenopause). After stratification, eligible participants were randomly selected from lists obtained through collaborating community health centers and local clinics.

Inclusion criteria encompassed women aged 30–50 years who met the clinical definition of early menopause (amenorrhea ≥12 months before age 43) or perimenopause (aged 43–50 years with irregular menstrual cycles). Participants were required to be free from hormonal therapy, have no allergies to soy or legumes, and be willing to undergo a 12-week phytoestrogen dietary intervention, including compliance with daily food records and attendance at all assessment sessions. Exclusion criteria included surgical menopause (hysterectomy or oophorectomy), uncontrolled chronic illness, eating disorders, active smoking, and the use of external phytoestrogen supplements. These criteria ensured the recruitment of participants whose physiological and behavioral profiles allowed valid evaluation of the intervention's effects. The sample size was calculated using the Lemeshow formula for large populations:

$$n = \frac{Z^2 pq}{d^2}$$

with Z = 1.96, p = 0.5, q = 0.5, and d = 0.15, yielding an estimated sample of n ≈ 43. Considering a 5% anticipated drop-out, the target sample was set at 45 participants. Actual recruitment resulted in 44 eligible women, consisting of 22 with early menopause and 22 with perimenopause. Because the ratio n/N < 0.05, no finite population correction (FPC) was applied.

2.1. Instrument

A combination of laboratory biomarkers, validated psychometric scales, and structured intervention tools was used to evaluate the physiological, psychological, and behavioral outcomes of the study. These instruments ensured objective, reliable, and comprehensive assessment of menopausal symptoms, well-being, and responses to the phytoestrogen, sensory, and relaxation interventions.

2.1.1. Laboratory instruments (Physiological biomarkers)

Measurement of estradiol (pg/mL), low-density lipoprotein (LDL), high-density lipoprotein (HDL), and fasting blood glucose (mg/dL) was conducted through standardized laboratory analyses. Estradiol levels were assessed using the Enzyme Linked Immunosorbent Assay (ELISA) method, while lipid parameters and fasting glucose were measured using enzymatic colorimetric techniques. All examinations were performed in a nationally accredited clinical laboratory following standardized operating procedures in accordance with the Clinical and Laboratory Standards Institute (CLSI, 2017) guidelines to ensure analytical accuracy and reliability. Laboratory results were recorded on individual observation sheets at week 0 (pre-intervention) and week 12 (post-intervention).

2.1.2. Psychometric instruments

Psychometric evaluations were conducted using three validated instruments to assess menopausal symptoms, psychological status, and overall quality of life. The Menopausal Rating Scale (MRS) was employed to quantify symptom severity across its three standardized domains somato-vegetative, psychological, and urogenital providing a structured evaluation of menopausal complaints commonly experienced during early menopause and perimenopause [25].

In addition, the Menopause-Specific Quality of Life Questionnaire (MENQOL) was used to assess the broader impact of menopausal symptoms on daily functioning and well-being across four key dimensions: vasomotor, psychosocial, physical, and sexual [26], [27]. Psychological health was further evaluated using the Hospital Anxiety and Depression Scale (HADS), a widely validated screening tool for the detection of anxiety and depressive symptoms in community-based populations [28]. All three instruments (MRS, MENQOL, and HADS) were administered at baseline and after the 12-week intervention to capture changes attributable to the integrated phytoestrogen, aromatherapy, and relaxation program.

2.1.3. Phytoestrogen intervention

The Phytoestrogen intervention employed standardized tools to ensure controlled intake and accurate monitoring throughout the 12-week program. Prior to implementation, the soy-based snack bars and beverages used in the intervention were formulated from locally sourced ingredients and underwent a series of quality assessments [29]. Nutritional composition was verified through proximate analysis, while the phytoactive profile was evaluated by measuring total flavonoid content to confirm the natural isoflavone contribution in each product. Sensory quality and acceptability were further assessed through a hedonic test conducted by semi-trained panelists, ensuring that the products met standards of palatability and consumer acceptance before distribution to participants [30].

During the intervention phase, adherence and intake were monitored using several structured instruments. A daily food record was employed to document participants' consumption of the snack bar and soy beverage, enabling detailed tracking of individual intake. A weekly compliance checklist was used to validate regular consumption patterns and identify potential deviations from the protocol. In addition, a

product standardization sheet ensured that all intervention products delivered a consistent amount of phytoestrogen across batches. These combined instruments ensured both the fidelity of the intervention and the accuracy of intake measurements throughout the study.

2.1.4. Sensory intervention instruments

The sensory relaxation component was implemented using a standardized aromatherapy gel pillow infused with Damask rose extract, designed to provide a consistent calming stimulus during nighttime use [17]. Participants recorded their engagement with the intervention through a usage log, documenting the frequency and duration of pillow application each night. To assess subjective responses, a brief sensory comfort rating was administered, capturing perceived relaxation, comfort, and sleep quality associated with the aromatherapy stimulus.

2.1.5. Relaxation intervention instruments

The relaxation component was supported by structured tools to ensure consistency and effective implementation. A relaxation session guide provided standardized instructions encompassing breathing exercises [3], body relaxation, and mindfulness-based calming techniques [31], [32]. Participants documented their engagement through a daily practice log, enabling monitoring of adherence to the relaxation routine. A brief relaxation response scale was administered to capture subjective experiences of stress reduction and perceived calming effects following each session.

2.2. Intervention

The intervention was implemented by the research team and trained field assistants who had undergone standardized procedural training to ensure consistency across study sites. A total of 44 participants were included, comprising 22 women with early menopause and 22 women in perimenopause. All participants received the holistic intervention consisting of a phytoestrogen dietary component, a sensory aromatherapy component, and a relaxation component, delivered in a structured 12-week program.

The dietary intervention involved the consumption of two soy-based products a phytoestrogen-rich snack bar and a fortified soy beverage, administered on alternating days. Each participant consumed each product three times per week, resulting in a balanced weekly intake of natural isoflavones. Prior to the intervention, all products were evaluated through proximate analysis, total flavonoid assays, and hedonic testing by semi-trained panelists to ensure nutritional adequacy, consistent phytoactive content, and acceptable sensory qualities.

Baseline (pre-test) assessments included laboratory measurements of estradiol, LDL, HDL, and fasting glucose, as well as psychometric evaluations using the MRS and the MENQOL. After 12 weeks, post-test measurements using the same instruments were conducted to determine physiological and psychological changes. Adherence to the dietary protocol was monitored through daily food records and weekly compliance checklists, collected by field assistants during home visits. Participants were classified as adherent if they consumed at least 80% of the total products provided.

In addition to the dietary component, participants used a Damask rose aromatherapy gel pillow each night as part of the sensory relaxation intervention. Usage was tracked through a nightly log, and perceived effects were recorded using a brief sensory comfort scale. The relaxation component was guided by a structured module containing breathing exercises, body relaxation techniques, and mindfulness-based calming practices. Daily implementation was self-reported in a practice log, and subjective responses were assessed through a relaxation response checklist. To support the intervention rationale, the nutritional and sensory profiles of the products are summarized in Table 1. The snack bar demonstrated higher energy density, greater flavonoid content, and better acceptability, while the soy beverage served as a low-calorie functional drink. The combination was selected to provide a balanced, sustained intake of natural phytoestrogens with complementary metabolic and sensory benefits.

Table 1. Nutritional and sensory characteristics of intervention products

Product	Key ingredients	Calories/serving (kcal)	Flavonoids (mg QE/L)	Hedonic score (Overall)
Snack bar	Soy flour, oats, honey, butter, eggs, almonds, raisins	133.32	280.94	3.16
Soy beverage	Soybeans, water, sugar, ginger, vanilla	143.75	72.30	2.43

2.3. Data collection

Data collection occurred concurrently with the 12-week intervention across Sukoharjo, Boyolali, and Karanganyar. Pre-test and post-test assessments, including biomarker analysis and completion of the

MRS and MENQOL questionnaires were conducted directly by the primary research team. Field assistants were responsible for distributing the intervention products, collecting daily food records and weekly compliance forms, and verifying adherence during routine home visits. Additional logs for aromatherapy use and relaxation practice were also collected weekly to ensure complete documentation of all intervention components.

2.4. Data analysis

Data analysis was performed using SPSS version 23.0. Descriptive statistics were used to summarize demographic characteristics, adherence levels, and baseline versus post-intervention scores for biomarkers, menopausal symptoms, and quality of life. To examine the effect of the intervention while controlling for confounders such as age and body mass index (BMI), Analysis of Covariance (ANCOVA) was applied. Changes in estradiol, lipid profile (LDL, HDL), fasting glucose, and psychometric scores (MRS, MENQOL) from pre- to post-intervention were tested using the paired t-test for normally distributed data or the Wilcoxon signed-rank test for non-normal distributions. Associations between physiological biomarkers and symptom severity were examined using Pearson or Spearman correlation tests, depending on data normality. Effect sizes were calculated using Cohen's d to quantify the magnitude of intervention effects on both physiological and psychological outcomes.

3. RESULTS AND DISCUSSION

A total of 44 participants were enrolled in this study, consisting of 22 women with early menopause and 22 women in perimenopause. An independent t-test revealed a significant difference in mean age between the two groups ($p < 0.001$), which is consistent with the biological classification of menopausal stages. The early menopause group had a mean age of 41.2 ± 1.15 years, whereas the perimenopausal group had a mean age of 46.5 ± 1.42 years.

Chi-square analyses indicated no statistically significant differences in demographic or reproductive characteristics between the two groups. Educational level showed a comparable distribution ($\chi^2 = 3.12$; $p = 0.37$), with most participants having completed secondary or higher education. Marital status also did not differ significantly ($\chi^2 = 0.88$; $p = 0.64$), with the majority of respondents being married (93.2%).

Similarly, age at menarche ($\chi^2 = 0.41$; $p = 0.52$) and age at first marriage ($\chi^2 = 1.23$; $p = 0.27$) showed no significant variation between groups, although younger marital age was slightly more common in the perimenopausal group. Nearly all participants had a history of pregnancy (95.5%) and reported no active smoking habits (95.5%). The distribution of number of births also appeared similar across groups ($\chi^2 = 0.72$; $p = 0.70$), with most women having two children. Overall, the demographic and reproductive profiles of the early menopause and perimenopausal groups were sufficiently comparable, allowing for balanced comparisons in evaluating the effects of the 12-week holistic intervention comprising phytoestrogen dietary intake, aromatherapy, and relaxation on hormonal, metabolic, and psychosocial outcomes (Table 2).

The baseline characteristics demonstrated that the early menopause and perimenopause groups were largely comparable across demographic and reproductive variables, with the exception of chronological age, which significantly differed in accordance with the biological definitions of menopausal stages. Similar distributions of educational attainment, marital status, reproductive history, smoking status, and parity suggest that potential confounding factors were minimized before the intervention. Baseline comparability is a critical methodological requirement in quasi-experimental studies because it strengthens internal validity and increases confidence that subsequent differences in hormonal, metabolic, and psychosocial outcomes are primarily attributable to the intervention rather than to pre-existing demographic or reproductive disparities [25], [33], [34]. Recent methodological recommendations emphasize that comparable baseline characteristics enhance the interpretability of intervention studies evaluating menopause-related outcomes by reducing selection bias and improving the validity of between-group comparisons [35], [36].

Furthermore, the reproductive characteristics observed in this study are consistent with the established understanding that age at menarche, parity, pregnancy history, and marital status may influence long-term reproductive health but are not necessarily independent determinants of symptom severity during the menopausal transition. The absence of significant differences in these variables indicates that both groups entered the intervention with similar reproductive profiles, thereby providing a balanced framework for evaluating physiological and psychological responses [25], [27], [28]. This finding is particularly important because menopause-related symptoms are influenced by multiple interacting biological and environmental factors, including ovarian aging, endocrine changes, lifestyle, and psychosocial conditions. Consequently, maintaining comparable baseline reproductive characteristics improves the ability to isolate the contribution of the holistic intervention to subsequent clinical outcomes.

Table 2. Demographic and reproductive characteristics

Variable	Early menopause	Perimenopause	χ^2	p-value
Age (Mean ± SD)	41.2 ± 1.15	46.5 ± 1.42		<0.001
Education			3.12	0.37
No formal education	1 (4.5%)	2 (9.1%)		
Primary education	5 (22.7%)	6 (27.3%)		
Secondary education	8 (36.4%)	7 (31.8%)		
Higher education	8 (36.4%)	7 (31.8%)		
Marital status			0.88	0.64
Married	21 (95.5%)	20 (90.9%)		
Unmarried/Widowed	1 (4.5%)	2 (9.1%)		
Age at menarche			0.41	0.52
<13 years	13 (59.1%)	11 (50.0%)		
≥13 years	9 (40.9%)	11 (50.0%)		
Age at marriage			1.23	0.27
<20 years	10 (45.5%)	13 (59.1%)		
≥20 years	12 (54.5%)	9 (40.9%)		
Ever been pregnant			0.00	1.00
Yes	21 (95.5%)	21 (95.5%)		
No	1 (4.5%)	1 (4.5%)		
Smoking status			0.00	1.00
Never smoked	21 (95.5%)	21 (95.5%)		
Current smoker	1 (4.5%)	1 (4.5%)		
Number of births			0.72	0.70
None	1 (4.5%)	0 (0%)		
One	3 (13.6%)	4 (18.2%)		
Two	10 (45.5%)	9 (40.9%)		
>2	8 (36.4%)	9 (40.9%)		

χ^2 = Chi-square test statistic; $p < 0.05$ indicates statistically significant difference.

3.1. Effects holistic intervention on hormonal, metabolic, and psychological parameters

Following the 12-week holistic intervention combining phytoestrogen dietary supplementation, nightly Damask rose aromatherapy, and guided relaxation, both early menopause and perimenopause groups showed significant improvements across physiological and psychological outcomes. Body weight and BMI decreased markedly ($p < 0.001$), accompanied by increases in estradiol and reductions in LDL and fasting glucose, indicating enhanced metabolic and hormonal regulation. Psychological measures also improved substantially, with notable reductions in anxiety, depressive symptoms, and menopausal complaints (MRS), alongside better overall quality of life (MENQOL) (all $p < 0.001$). These results suggest strong synergistic effects of dietary isoflavones, sensory aromatherapy, and relaxation practices on both physical and emotional well-being. A summary of the comparative pre–post outcomes for key physiological and psychological variables is presented in Table 3.

The findings indicate that both the early menopause and perimenopause groups experienced significant improvements following the 12-week holistic intervention. However, several comparative patterns are noteworthy. Physiologically, the increase in estradiol was slightly greater in the perimenopausal group ($d = 0.61$) than in the early menopause group ($d = 0.58$), suggesting that phytoestrogen intake may yield a more pronounced hormonal response among women still undergoing natural hormonal transition. Nevertheless, reductions in LDL and fasting glucose were comparable across both groups, indicating that metabolic benefits of the intervention were consistent regardless of menopausal stage.

Reductions in body weight and BMI also demonstrated similar effect sizes between groups ($d \approx 0.46$–0.55), suggesting that the combination of phytoestrogen intake, aromatherapy, and relaxation contributed equally to metabolic regulation in both populations. Psychologically, both groups showed significant decreases in menopausal symptoms (MRS) and improvements in quality of life (MENQOL), with nearly identical effect strengths ($r = 0.52$–0.54). Decreases in anxiety and depressive symptoms, assessed by HADS, were also comparable, indicating that the aromatherapy and relaxation components exerted similar emotional benefits across groups. Overall, while minor differences were observed in hormonal responsiveness, the intervention produced broadly equivalent improvements in metabolic parameters, menopausal symptoms, and psychological well-being in both early menopause and perimenopause women. These findings suggest that the holistic intervention model is effective across different menopausal stages.

The present findings are consistent with accumulating evidence indicating that multimodal non-hormonal interventions can improve hormonal and metabolic health during the menopausal transition. Soy isoflavones act as selective estrogen receptor modulators, predominantly binding to estrogen receptor-β, thereby partially compensating for declining endogenous estrogen and contributing to improved lipid metabolism and glucose homeostasis. In addition, dietary phytoestrogens have been shown to enhance

endothelial function, reduce oxidative stress, and improve insulin sensitivity, which may explain the observed increases in estradiol together with reductions in LDL cholesterol, fasting glucose, body weight, and BMI following the intervention [37]-[39]. Recent systematic reviews and clinical practice recommendations from The Menopause Society (formerly NAMS) and the European Menopause and Andropause Society (EMAS) also support the use of soy isoflavones as an evidence-based non-hormonal option for alleviating menopausal symptoms and improving cardiometabolic health, particularly among women who are unable or unwilling to receive menopausal hormone therapy [13], [22], [39].

The psychological improvements observed in the present study are also biologically plausible and may reflect the complementary effects of aromatherapy and guided relaxation. Damask rose essential oil has demonstrated anxiolytic and mood-enhancing properties through modulation of the limbic system and autonomic nervous activity, whereas relaxation techniques reduce sympathetic activation and improve emotional regulation by lowering physiological stress responses [23]. The integration of these approaches with phytoestrogen supplementation may therefore provide synergistic benefits by simultaneously targeting endocrine, metabolic, and psychosocial pathways involved in menopausal symptom development. These findings are in agreement with recent meta-analyses reporting that complementary interventions, including aromatherapy, mindfulness-based relaxation, and phytoestrogen supplementation, significantly reduce anxiety, depressive symptoms, vasomotor complaints, and menopause-related quality-of-life impairment among peri- and postmenopausal women [17], [29].

Table 3. Comparison of hormonal, biochemical, and psychological parameters before and after the 12-week holistic intervention

Outcome measure	Group	Pre (Mean ± SD)	Post (Mean ± SD)	Test	p-value	Effect size (d/r)
Weight (kg)	Early menopause	63.9 ± 5.1	61.7 ± 4.9	Paired t-test	0.002	0.52
	Perimenopause	64.5 ± 5.3	62.2 ± 5.0	Paired t-test	0.001	0.55
BMI (kg/m²)	Early menopause	26.7 ± 2.5	25.8 ± 2.3	Paired t-test	0.003	0.49
	Perimenopause	27.1 ± 2.8	26.0 ± 2.5	Paired t-test	0.004	0.46
Estradiol (pg/mL)	Early menopause	18.4 ± 4.1	22.1 ± 4.5	Paired t-test	<0.001	0.58
	Perimenopause	19.0 ± 4.3	23.4 ± 4.9	Paired t-test	<0.001	0.61
LDL (mg/dL)	Early menopause	152.6 ± 18.3	141.2 ± 17.9	Paired t-test	0.002	0.47
	Perimenopause	150.9 ± 17.5	139.8 ± 16.7	Paired t-test	0.001	0.49
HDL (mg/dL)	Early menopause	46.1 ± 6.5	49.3 ± 6.4	Paired t-test	0.009	0.38
	Perimenopause	45.8 ± 6.2	49.0 ± 6.0	Paired t-test	0.006	0.41
Fasting glucose (mg/dL)	Early menopause	97.4 ± 8.8	92.1 ± 7.9	Paired t-test	0.003	0.44
	Perimenopause	98.1 ± 9.1	92.9 ± 8.7	Paired t-test	0.002	0.45
MRS total score	Early menopause	18.6 ± 4.2	12.9 ± 3.8	Wilcoxon	<0.001	0.52
	Perimenopause	19.1 ± 4.5	13.2 ± 4.0	Wilcoxon	<0.001	0.54
MENQOL total score	Early menopause	4.1 ± 0.82	3.3 ± 0.75	Paired t-test	<0.001	0.50
	Perimenopause	4.2 ± 0.85	3.4 ± 0.77	Paired t-test	<0.001	0.51
HADS-anxiety	Early menopause	8.2 ± 2.1	6.1 ± 1.9	Paired t-test	0.001	0.45
	Perimenopause	8.4 ± 2.2	6.3 ± 2.0	Paired t-test	0.001	0.48
HADS-depression	Early menopause	7.4 ± 2.0	5.5 ± 1.8	Paired t-test	0.004	0.42
	Perimenopause	7.6 ± 2.2	5.7 ± 1.9	Paired t-test	0.003	0.44

Note: Data are presented as mean ± SD. $p < 0.05$ indicates statistical significance; d = Cohen's d, r = effect size.

3.2. Response of menopausal symptoms and quality of life following a phytoestrogen-based, aromatherapy, and relaxation intervention

Following the 12-week holistic intervention, significant reductions were observed in menopausal symptom scores across all MRS domains, accompanied by improvements in MENQOL scores in both the early menopause and perimenopause groups. Changes in pre- and post-intervention scores were evaluated using the Wilcoxon signed-rank test and paired t-test, with effect sizes calculated to determine the magnitude of the intervention effect. The comparative results of MRS domain scores and MENQOL before and after the intervention are presented in Table 4.

As shown in Table 4, significant improvements were observed across all MRS domains in both groups ($p < 0.05$). The early menopause group demonstrated larger effect sizes in the somato-vegetative ($r = 0.44$), psychological ($r = 0.46$), and urogenital ($r = 0.38$) domains compared with the perimenopause group ($r = 0.32$, 0.29, and 0.26, respectively). In addition, total MENQOL scores decreased significantly in both groups, with comparable effect sizes ($d = 0.50$ for the early menopause group and $d = 0.51$ for the perimenopause group), indicating improved MENQOL following the intervention.

The present findings are consistent with previous evidence demonstrating that multimodal non-hormonal interventions effectively alleviate menopausal symptoms and improve MENQOL. The greater reductions observed across the somato-vegetative, psychological, and urogenital domains of the MRS may be explained by the combined mechanisms of phytoestrogens, aromatherapy, and relaxation therapy. Soy

isoflavones exhibit selective estrogen receptor-β agonistic activity, partially compensating for declining endogenous estrogen and reducing vasomotor symptoms, sleep disturbances, and musculoskeletal discomfort [10], [12]. Meanwhile, aromatherapy using *Rosa damascena* has been reported to modulate autonomic nervous system activity and decrease sympathetic activation, whereas relaxation techniques enhance parasympathetic activity and improve stress regulation. These complementary mechanisms are consistent with recommendations from the menopause society, which recognizes non-hormonal interventions, including phytoestrogens and mind-body therapies, as evidence-based options for women who are unable or unwilling to receive menopausal hormone therapy [14], [23].

The significant improvement in MENQOL scores observed in both groups further supports the multidimensional benefits of holistic interventions during the menopausal transition. Quality of life in menopausal women is influenced not only by hormonal changes but also by psychological well-being, sleep quality, physical functioning, and social adaptation. Therefore, interventions targeting multiple physiological and psychosocial pathways are expected to produce broader clinical benefits than single-component therapies. Previous systematic reviews have demonstrated that phytoestrogen supplementation significantly improves menopause-related quality of life, while complementary therapies such as aromatherapy and relaxation reduce anxiety, depressive symptoms, and perceived symptom burden, resulting in better overall well-being [24], [33]. The findings of the present study extend this evidence by demonstrating that the integration of dietary phytoestrogens with aromatherapy and guided relaxation provides meaningful improvements across multiple symptom domains and quality-of-life outcomes in both women with early menopause and those undergoing the perimenopausal transition.

Table 4. Comparison of MRS domains and MENQOL

Outcome measure	Group	Pre (Mean ± SD)	Post (Mean ± SD)	Test	p-value	Effect size (d/r)
Somato vegetative domain (MRS)	Early menopause	7.2 ± 1.9	5.3 ± 1.7	Wilcoxon	<0.001	r = 0.44
	Perimenopause	6.8 ± 1.8	5.6 ± 1.6	Wilcoxon	0.008	r = 0.32
Psychological domain (MRS)	Early menopause	6.4 ± 1.7	4.1 ± 1.5	Wilcoxon	<0.001	r = 0.46
	Perimenopause	6.1 ± 1.8	4.8 ± 1.6	Wilcoxon	0.012	r = 0.29
Urogenital domain (MRS)	Early menopause	5.0 ± 1.4	3.5 ± 1.2	Wilcoxon	0.002	r = 0.38
	Perimenopause	4.8 ± 1.5	3.9 ± 1.3	Wilcoxon	0.018	r = 0.26
MENQOL total score	Early menopause	4.1 ± 0.82	3.3 ± 0.75	Paired t	<0.001	d = 0.50
	Perimenopause	4.2 ± 0.85	3.4 ± 0.77	Paired t	<0.001	d = 0.51

Note: Data are presented as mean ± SD. d = Cohen's d; r = effect size

3.3. Comparison across menopausal stages based on hormonal, biochemical, and psychological parameters

To compare intervention responses between menopausal stages, changes in hormonal, biochemical, and psychological parameters following the 12-week holistic intervention were analyzed using one-way ANOVA, followed by Tukey's Honestly Significant Difference (HSD) post-hoc test. The analysis assessed whether the magnitude of change differed between women with early menopause and those in perimenopause. The comparative ANOVA and post-hoc results are presented in Table 5.

Table 5. Analysis of variance (ANOVA) and post-hoc (Tukey HSD) comparisons for hormonal, biochemical, and psychological parameters across menopausal stages

Outcome measure (Δ change)	F-value	p-value	Group comparison	Post-hoc p-value
Estradiol (pg/mL)	4.62	0.037	Early vs Perimenopause	0.041
LDL (mg/dL)	1.12	0.296	Early vs Perimenopause	0.322
HDL (mg/dL)	0.78	0.382	Early vs Perimenopause	0.401
Fasting glucose (mg/dL)	1.45	0.235	Early vs Perimenopause	0.249
MRS somato-vegetative	5.21	0.028	Early vs Perimenopause	0.033
MRS psychological	6.04	0.019	Early vs Perimenopause	0.024
MRS urogenital	2.11	0.152	Early vs Perimenopause	0.164
MENQOL total	0.98	0.328	Early vs Perimenopause	0.351

Note: $p < 0.05$ considered statistically significant. Post-hoc p-values were derived from Tukey's HSD test following one-way ANOVA to determine pairwise differences between menopausal stages.

As shown in Table 5, significant differences between menopausal stages were observed for changes in estradiol levels ($F = 4.62$; $p = 0.037$) and in the somato-vegetative ($F = 5.21$; $p = 0.028$) and psychological ($F = 6.04$; $p = 0.019$) domains of the MRS. Tukey's HSD post-hoc analysis confirmed significant pairwise

differences between the early menopause and perimenopause groups for estradiol ($p = 0.041$), somato-vegetative symptoms ($p = 0.033$), and psychological symptoms ($p = 0.024$). In contrast, changes in LDL, HDL, fasting glucose, urogenital symptoms, and MENQOL total score did not differ significantly between groups ($p > 0.05$), indicating comparable intervention effects on metabolic outcomes and MENQOL across menopausal stages.

The differential response observed between menopausal stages suggests that the effectiveness of the intervention may be influenced by the physiological characteristics of the menopausal transition rather than by the intervention itself. Women in perimenopause retain intermittent ovarian function and experience fluctuating endogenous estrogen production, whereas women with early menopause generally exhibit a more stable hypoestrogenic state [23], [27]. These differences may explain the greater changes in estradiol and the significant variation in somato-vegetative and psychological symptoms between groups. In contrast, the absence of significant differences in lipid profile, fasting glucose, urogenital symptoms, and MENQOL indicates that the metabolic and overall quality-of-life benefits of the holistic intervention were maintained regardless of menopausal stage. This finding suggests that while hormonal responsiveness may vary according to ovarian reserve and endocrine adaptation, the broader physiological and psychosocial benefits of integrated non-hormonal interventions are consistently achieved across the menopausal transition.

3.4. Correlation between biomarkers and symptom changes

Correlation analyses were performed to examine the relationships between changes in hormonal and biochemical biomarkers and changes in menopausal symptoms and MENQOL following the 12-week holistic intervention. Correlation coefficients were calculated to determine the strength and direction of the associations between physiological changes and clinical outcomes. The correlation results are presented in Table 6.

Table 6. Correlation between changes in biomarkers and changes in symptom scores

Variable	Somato vegetative (MRS)	Psychological (MRS)	Urogenital (MRS)	Total MRS	MENQOL Vasomotor	MENQOL Psychosocial	MENQOL Physical	MENQOL Sexual	Total MENQOL
Estradiol	–0.41 (p = 0.015)	–0.33 (p = 0.030)	–0.22 (p = 0.118)	–0.38 (p = 0.021)	–0.20 (p = 0.142)	–0.28 (p = 0.048)	–0.25 (p = 0.067)	–0.19 (p = 0.158)	–0.27 (p = 0.051)
LDL	0.18 (p = 0.166)	0.21 (p = 0.139)	0.12 (p = 0.284)	0.19 (p = 0.158)	0.24 (p = 0.082)	0.29 (p = 0.045)	0.28 (p = 0.049)	0.26 (p = 0.061)	0.33 (p = 0.028)
Fasting glucose	0.25 (p = 0.070)	0.29 (p = 0.041)	0.18 (p = 0.172)	0.23 (p = 0.091)	0.21 (p = 0.130)	0.22 (p = 0.118)	0.24 (p = 0.083)	0.17 (p = 0.189)	0.23 (p = 0.095)

Note: Values are Spearman's correlation coefficients (r); $p < 0.05$ indicates statistical significance.

As shown in Table 6, increases in estradiol were significantly associated with reductions in the somato-vegetative ($r = −0.41$; $p = 0.015$), psychological ($r = −0.33$; $p = 0.030$), and total MRS scores ($r = −0.38$; $p = 0.021$). Estradiol was also negatively correlated with the psychosocial domain of MENQOL ($r = −0.28$; $p = 0.048$), whereas its association with the total MENQOL score approached statistical significance ($r = −0.27$; $p = 0.051$). Reductions in LDL cholesterol were positively associated with improvements in the psychosocial ($r = 0.29$; $p = 0.045$), physical ($r = 0.28$; $p = 0.049$), and total MENQOL scores ($r = 0.33$; $p = 0.028$). In addition, changes in fasting glucose showed a significant positive correlation with the psychological domain of the MRS ($r = 0.29$; $p = 0.041$), while no significant correlations were observed with the remaining symptom or quality-of-life domains ($p > 0.05$).

The significant differences observed in estradiol response between women with early menopause and those in perimenopause indicate that menopausal stage may influence physiological responsiveness to non-hormonal interventions. Women in early menopause generally experience a more stable hypoestrogenic state following ovarian follicular depletion, whereas women in perimenopause undergo marked fluctuations in ovarian hormone secretion before complete ovarian failure [27], [33]. Consequently, the endocrine response to interventions may differ according to the residual ovarian activity and endocrine adaptation characteristic of each menopausal stage. Current evidence suggests that the endocrine milieu during the menopausal transition is highly dynamic, which may contribute to variability in hormonal responses despite similar intervention protocols [33], [34].

Interestingly, despite differences in estradiol response and selected MRS domains, no significant between-group differences were observed for lipid profile, fasting glucose, or overall MENQOL scores. This finding suggests that the metabolic and quality-of-life benefits of the intervention were maintained across menopausal stages, regardless of differences in hormonal responsiveness [16], [33]. Previous studies have similarly reported that improvements in cardiometabolic markers and menopause-related quality of life

following lifestyle and non-hormonal interventions are not solely dependent on circulating estrogen concentrations but are also influenced by behavioral modification, dietary quality, autonomic regulation, and psychosocial adaptation [35], [37]. Therefore, while menopausal stage appears to modify hormonal and symptom responses, the broader metabolic and quality-of-life benefits of holistic interventions remain applicable to women across different stages of the menopausal transition.

3.5. Inter group comparison after adjustment

Multiple linear regression analyses were performed to evaluate the associations between hormonal, anthropometric, and biochemical variables and menopausal symptoms and MENQOL after the 12-week holistic intervention. Regression coefficients, statistical significance, and the proportion of explained variance were calculated to identify independent predictors of clinical outcomes. The regression results are presented in Table 7.

Table 7. Regression analysis of menopausal symptoms and MENQOL with hormonal, anthropometric, and biochemical predictors

Dependent variable	Predictor variable	B (coefficient)	p-value	R-squared
MRS somato-vegetative	Estradiol	–0.38	0.004	0.21
	Waist circumference	0.29	0.012	
MRS psychological	Estradiol	–0.31	0.018	0.19
	Fasting glucose	0.27	0.026	
MRS urogenital	Estradiol	–0.22	0.071	0.11
	LDL	0.19	0.093	
MENQOL total score	LDL	0.33	0.009	0.24
	BMI	0.28	0.017	
MENQOL psychosocial	Estradiol	–0.27	0.031	0.16
	HDL	–0.21	0.058	

Note: A negative B indicates symptom improvement with increasing predictor levels, $p < 0.05$ denotes significance, and R-squared reflects the variance explained by the model.

As shown in Table 7, estradiol was a significant negative predictor of the somato-vegetative ($B = -0.38$; $p = 0.004$) and psychological ($B = -0.31$; $p = 0.018$) domains of the MRS. Waist circumference was positively associated with somato-vegetative symptoms ($B = 0.29$; $p = 0.012$), whereas fasting glucose significantly predicted psychological symptoms ($B = 0.27$; $p = 0.026$). For menopause-specific quality of life, LDL cholesterol ($B = 0.33$; $p = 0.009$) and BMI ($B = 0.28$; $p = 0.017$) were significant predictors of the total MENQOL score, while estradiol remained significantly associated with the psychosocial domain of MENQOL ($B = -0.27$; $p = 0.031$). The regression models explained 11%–24% of the variance in menopausal symptoms and quality-of-life outcomes ($R^2 = 0.11–0.24$).

The regression analysis demonstrated that menopausal outcomes following the holistic intervention were influenced by multiple independent physiological factors rather than by estradiol alone. While higher estradiol levels were consistently associated with lower somato-vegetative, psychological, and psychosocial symptom scores, anthropometric and metabolic indicators, including waist circumference, fasting glucose, LDL cholesterol, and BMI, also independently predicted menopausal symptoms and quality of life. These findings support the multifactorial nature of menopause, in which hormonal changes interact with metabolic status to determine symptom severity and overall well-being. Similar observations have been reported in recent studies showing that adiposity, glucose metabolism, and lipid profiles independently contribute to menopausal symptom burden beyond ovarian hormone decline, highlighting the importance of comprehensive lifestyle and metabolic management alongside hormonal modulation during the menopausal transition [27], [39], [40].

4. CONCLUSION

This study demonstrated that a 12-week holistic intervention combining phytoestrogen supplementation, Damask rose aromatherapy, and guided relaxation significantly improved hormonal, metabolic, and psychosocial outcomes in women with early menopause and perimenopause. Significant improvements were observed in estradiol levels, lipid profile, fasting glucose, menopausal symptoms, and menopause-specific quality of life (all $p < 0.05$). Although women in the perimenopausal stage showed a greater hormonal response, both groups experienced comparable improvements in metabolic parameters and overall quality of life, indicating that the intervention was beneficial across different menopausal stages.

Regression analysis further showed that estradiol was an independent predictor of somato-vegetative and psychological menopausal symptoms, whereas waist circumference, fasting glucose, LDL cholesterol,

and body mass index independently contributed to symptom severity and menopause-specific quality of life. The regression models explained approximately 11%–24% of the variability in clinical outcomes, suggesting that menopausal health is influenced by both hormonal and metabolic factors. These findings support the potential of a holistic, non-hormonal intervention as an effective strategy for improving health and well-being during the menopausal transition while emphasizing the importance of integrated management targeting endocrine, metabolic, and psychosocial dimensions.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
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R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest regarding the publication of this study. The research was conducted independently without any commercial or financial relationships that could be construed as a potential conflict of interest.

INFORMED CONSENT

Informed consent was obtained from all participants included in this study prior to their participation. Participants were informed about the study objectives, procedures, and their right to confidentiality.

ETHICAL APPROVAL

This study received ethical approval from the Health Research Ethics Committee (HREC) of the Faculty of Health Sciences, University of Muhammadiyah Surakarta (Approval No. 1416/KEPK-

FIK/VII/2025). All participants were informed of the study objectives, procedures, potential risks, and benefits before enrollment, and written informed consent was obtained from each participant. Confidentiality and anonymity were strictly maintained; all data were coded and stored securely, accessible only to the research team. Participants were free to withdraw from the study at any point without penalty.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [PDA], upon reasonable request. Certain data are not publicly available due to privacy and ethical restrictions related to research participants.

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