

Dietary Phytoestrogens and Their Clinical Impact on Postmenopausal Women in Rural India: A Controlled Case Study of Shamli District, Uttar Pradesh

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Abstract: *Background: Menopause is accompanied by declining ovarian estrogen production and a range of vasomotor, psychological, somatic and urogenital symptoms. Dietary phytoestrogens, particularly soy isoflavones and lignans from flaxseed, have been investigated as low-cost food-based strategies for supporting postmenopausal health. Evidence from clinical trials is heterogeneous, and there is limited district-level evidence from rural North India.*

Objective: The present study evaluates the clinical impact of a daily 30 g soybean–flaxseed dietary supplement, formulated in a 60:40 ratio, among postmenopausal women in rural Shamli district. Outcomes included Menopause Rating Scale (MRS) scores, serum lipid profile and bone-density values.

Methods: Raw data supplied for 500 women were analyzed as two groups of 250 each. The experimental group received 30 g/day of the soybean–flaxseed blend; the control group received no supplement. Pre- and post-intervention MRS scores, lipid parameters and bone-density values were compared within groups using paired t-tests and between groups using independent t-tests of change scores. Baseline-adjusted ANCOVA was additionally used to reduce the influence of baseline differences between groups.

Results: Mean total MRS score decreased from 25.89 to 20.94 in the experimental group (mean change –4.94; paired $p < 0.001$), whereas the control group increased from 25.53 to 27.08 (change +1.55; $p < 0.001$). The between-group difference in change was highly significant ($p < 0.001$). In the experimental group, total cholesterol decreased by 8.17 mg/dL, triglycerides by 4.94 mg/dL and LDL-C by 5.83 mg/dL, while HDL-C increased by 5.12 mg/dL. Bone-density values improved by 0.242 units in the experimental group, while the control group declined by 0.242 units. All these between-group differences were statistically significant. Baseline-adjusted analyses remained significant for MRS, lipid outcomes and bone density.

Conclusion: Within the supplied dataset, the soybean–flaxseed intervention was associated with favorable changes in menopausal symptom scores, lipid profile and bone-density values compared with the non-supplemented control group. The findings support further investigation of culturally acceptable plant-food interventions for rural postmenopausal women. Because the supplied spreadsheet does not document allocation method, adherence, exact intervention duration or laboratory assay details, causal interpretation should remain cautious.

Keywords: phytoestrogens; soybean; flaxseed; postmenopausal women; Menopause Rating Scale; lipid profile; bone density; rural India; Shamli; dietary intervention.

I. INTRODUCTION

Menopause is a natural stage of the female life course characterized by permanent cessation of menstruation following loss of ovarian follicular activity. The transition into postmenopause is accompanied by substantial endocrine changes,

especially a reduction in circulating endogenous estrogen. These changes can influence thermoregulation, sleep, mood, musculoskeletal health, urogenital tissues and cardiometabolic risk. Although menopause itself is physiological, the symptoms experienced by women may substantially affect daily functioning and quality of life.

The experience of menopause is not uniform. Age, years since menopause, body composition, physical activity, dietary pattern, social environment, access to healthcare and cultural attitudes all influence symptom expression and management. In rural communities, women may have less access to specialized menopause services and may rely on household foods, traditional practices and primary healthcare. Consequently, food-based interventions that are affordable, locally acceptable and nutritionally meaningful deserve systematic evaluation.

Phytoestrogens are plant-derived, non-steroidal compounds that can interact with estrogen receptors and other biological pathways. The major dietary groups include isoflavones, lignans and coumestans. Soybean is particularly rich in isoflavones such as genistein and daidzein, while flaxseed is a prominent dietary source of lignans. Importantly, phytoestrogens are not equivalent to endogenous estrogen or hormone replacement therapy. Their biological effects are weaker, tissue-dependent and influenced by metabolism and gut microbiota.

Recent evidence remains mixed but clinically relevant. A 2024 systematic review and meta-analysis of randomized trials reported no statistically significant overall improvement in menopausal symptoms or quality of life with soy isoflavones, although depressive symptoms were reduced in the pooled analysis. Other meta-analyses have reported improvements in selected lipid outcomes and modest effects on bone-related outcomes. This variation indicates that formulation, dose, duration, baseline diet and participant characteristics matter.

The present study is important because it examines a food-based intervention rather than an isolated pharmaceutical preparation. The intervention combines soybean and flaxseed in a 60:40 ratio and supplies 30 g of the blend daily. Such a formulation has practical relevance in rural settings because soybean and flaxseed can be incorporated into a food-based nutrition programme rather than relying exclusively on expensive supplements.

Shamli district, situated in western Uttar Pradesh, offers a relevant rural setting for this investigation. The district administration reports a substantial rural administrative network comprising hundreds of revenue villages and gram panchayats. The local context provides an opportunity to examine whether a culturally adaptable plant-food intervention can be associated with measurable changes in menopausal health.

II. REVIEW OF LITERATURE

Clinical research on phytoestrogens has focused mainly on vasomotor symptoms, bone health, cardiovascular risk markers and possible estrogenic effects. Soy isoflavones have received the greatest attention because genistein and daidzein can interact with estrogen receptors, with a relative preference for estrogen receptor beta. This receptor activity has led to interest in phytoestrogens as selective, weak estrogenic compounds rather than direct estrogen replacements.

Earlier systematic reviews of phytoestrogens for vasomotor symptoms found inconsistent results. The Cochrane review of phytoestrogens for menopausal vasomotor symptoms concluded that the overall evidence was not sufficiently consistent to establish a clear treatment effect, although some genistein-rich interventions appeared promising. A later systematic review and meta-analysis of plant-based therapies reported modest reductions in hot flashes and vaginal dryness but emphasized heterogeneity among trials.

More recent evidence continues to show mixed effects. A 2024 meta-analysis of five randomized trials involving 425 climacteric women found no statistically significant pooled improvement in menopausal symptoms or quality of life with soy isoflavones, although depressive symptoms improved. This is important when interpreting the present study: a large within-study reduction in MRS scores is encouraging, but it should be considered in the context of the wider evidence base rather than treated as proof that phytoestrogens invariably relieve menopause.

Cardiometabolic outcomes have shown somewhat more consistent signals. A 2023 meta-analysis of randomized trials in postmenopausal women reported reductions in triglycerides and modest increases in HDL cholesterol with isoflavone intake, particularly among women younger than 65 years. A 2024 systematic review of unfermented soy

products found reductions in total cholesterol and triglycerides and an increase in HDL cholesterol, while the effect on LDL cholesterol was less consistent.

Bone health is another important concern after menopause. A meta-analysis of randomized trials reported modest improvements in bone mineral density at the lumbar spine, femoral neck and total hip with soy isoflavone intake, although effects differed according to duration, dose, time since menopause and participant characteristics. Other reviews focusing on bone turnover markers have suggested possible favorable trends but emphasize the need for further research.

Flaxseed contributes a different phytoestrogenic profile, being especially rich in lignans. It also contributes dietary fiber, alpha-linolenic acid and other nutrients. The combination of soybean and flaxseed therefore provides a broader food matrix than an isolated isoflavone capsule. Nevertheless, because the supplied dataset does not contain direct measurements of isoflavone or lignan content, the present study evaluates the intervention at the food-blend level and does not claim a quantified phytoestrogen dose.

III. RATIONALE, RESEARCH GAP AND OBJECTIVES

3.1 Research Gap

Most published intervention studies have examined soy protein, soy isoflavone extracts or standardized phytoestrogen preparations. Comparatively fewer studies have evaluated a combined soybean–flaxseed food intervention among rural Indian postmenopausal women. Rural diets also differ from controlled clinical diets, and the effects observed in one population cannot automatically be generalized to women in western Uttar Pradesh.

A second gap concerns integrated outcomes. Menopausal symptoms, serum lipids and bone health are often studied separately. The supplied Shamli dataset provides a rare opportunity to examine all three domains in the same controlled pre–post study. This allows a broader interpretation of the possible clinical relevance of a plant-based intervention.

3.2 Aim

To assess the clinical impact of a daily 30 g soybean–flaxseed dietary supplement provided in a 60:40 ratio among postmenopausal women in rural Shamli district, Uttar Pradesh.

3.3 Specific Objectives

- To compare pre- and post-intervention Menopause Rating Scale scores in the experimental and control groups.
- To assess changes in psychological, somatic and urogenital domains of menopausal symptoms.
- To determine changes in total cholesterol, triglycerides, HDL-C and LDL-C.
- To assess changes in recorded bone-density values.
- To compare the magnitude of change between the supplemented and non-supplemented groups.
- To examine whether group differences remain after adjustment for baseline outcome values.
- To interpret the findings in relation to existing clinical evidence on dietary phytoestrogens.

3.4 Hypotheses

H1: The experimental group will show a greater reduction in total MRS score than the control group. H2: The experimental group will show more favorable changes in lipid profile than the control group. H3: The experimental group will show a more favorable change in recorded bone-density values than the control group.

IV. MATERIALS AND METHODS

4.1 Study Design

The dataset represents a controlled pre–post intervention study. Five hundred postmenopausal women are represented: 250 in an experimental group and 250 in a control group. The experimental group received the dietary intervention, while the control group did not receive the supplement. Because the spreadsheet does not state that participants were randomized, the design is described conservatively as a controlled intervention study rather than a randomized controlled trial.

4.2 Study Setting

The study is framed as a rural case study of Shamli district, Uttar Pradesh. The district is part of western Uttar Pradesh and contains a large rural population distributed across villages and gram panchayats. The rural setting is particularly relevant for a food-based intervention because dietary practices, affordability and local availability can determine feasibility and adherence.

4.3 Participants and Groups

The analytic sample consisted of 500 women. The experimental group contained 250 women and the control group contained 250 women. The MRS worksheets contain age for each participant. The mean age was 58.16 years in the experimental group and 57.93 years in the control group, indicating close similarity in age at baseline.

4.4 Dietary Intervention

The experimental intervention consisted of 30 g of a soybean–flaxseed blend per day, prepared in a 60:40 ratio. On a weight basis, this corresponds to approximately 18 g soybean and 12 g flaxseed per daily 30 g portion. The spreadsheet does not provide laboratory quantification of genistein, daidzein, lignans or total phytoestrogen content; therefore, the intervention is described as a soybean–flaxseed phytoestrogen-rich food blend rather than assigning an unverified milligram phytoestrogen dose.

4.5 Outcome Measures

The principal clinical outcome was the Menopause Rating Scale (MRS), represented in the workbook through psychological, somatic and urogenital domains and a total score. Biochemical outcomes included total cholesterol, triglycerides, HDL-C and LDL-C. Bone density was represented by a numerical BMD/T-score-type measure. Anthropometric data for 500 women were also present and were used for baseline descriptive characterization; because the sheet does not explicitly label them as pre/post paired measurements, they were not used to infer intervention-related anthropometric change.

4.6 Statistical Analysis

Continuous variables were summarized using means and standard deviations. Within-group pre–post changes were tested with paired t-tests. Between-group differences in change scores were examined using independent-samples t-tests with unequal-variance estimation. Because several baseline outcome differences were present, baseline-adjusted ANCOVA models were additionally fitted with post-intervention outcome as the dependent variable, baseline outcome as a covariate and group as the predictor. A two-sided p value below 0.05 was treated as statistically significant.

V. BASELINE CHARACTERISTICS

The raw data indicate that the two groups were similar in age but not perfectly balanced for every clinical outcome. This is important for interpretation. Baseline differences were therefore explicitly considered in the statistical analysis rather than assuming that all observed post-intervention differences were attributable to the intervention.

Group	Age, y	MRS total	TC mg/dL	TG mg/dL	HDL-C mg/dL	LDL-C mg/dL	Bone-density value
Experimental (n=250)	58.16	25.89	205.12	149.51	47.57	105.11	-2.492
Control (n=250)	57.93	25.53	196.84	146.64	58.01	99.80	-1.946

The experimental group had a slightly higher mean baseline total cholesterol (205.12 vs 196.84 mg/dL) and triglycerides (149.51 vs 146.64 mg/dL), lower HDL-C (47.57 vs 58.01 mg/dL), higher LDL-C (105.11 vs 99.80 mg/dL), and a lower mean bone-density value (–2.492 vs –1.946). These differences indicate that simple post-test comparisons alone would be inadequate. The analysis therefore emphasizes within-group changes, between-group change scores and baseline-adjusted models.

5.1 Baseline Anthropometry

Measure	Experimental	Control	p value
Weight (kg)	63.54	61.78	0.003
Height (cm)	162.62	159.33	0.000
BMI (kg/m ²)	24.03	24.00	0.901
Waist circumference (cm)	82.78	81.97	0.050
Hip circumference (cm)	95.85	95.70	0.769
Waist-hip ratio	0.86	0.86	0.422

The anthropometric worksheet contains one record for each of 500 women, with the first 250 corresponding to the control group and the second 250 to the experimental group based on the participant numbering sequence. Mean BMI was almost identical between groups (24.03 vs 24.00 kg/m²), while the experimental group had greater mean height and weight. Because no explicit pre/post labels are provided for this sheet, these values are treated as baseline descriptive data rather than intervention outcomes.

VI. RESULTS: MENOPAUSAL SYMPTOMS

The most striking pattern in the supplied data was the divergence in total MRS scores between the two groups. The experimental group improved across all three domains, whereas the control group showed worsening scores. The MRS total score fell by 4.94 points in the experimental group and increased by 1.55 points in the control group.

Outcome	Exp pre	Exp post	Exp change	Ctrl pre	Ctrl post	Ctrl change	Between-group p
Psychological domain	9.85	7.50	-2.34	9.70	10.16	+0.46	<0.001
Somatic domain	10.08	8.42	-1.66	9.95	10.53	+0.58	<0.001
Urogenital domain	5.96	5.12	-0.84	5.87	6.47	+0.60	<0.001
Total MRS	25.89	20.94	-4.94	25.53	27.08	+1.55	<0.001

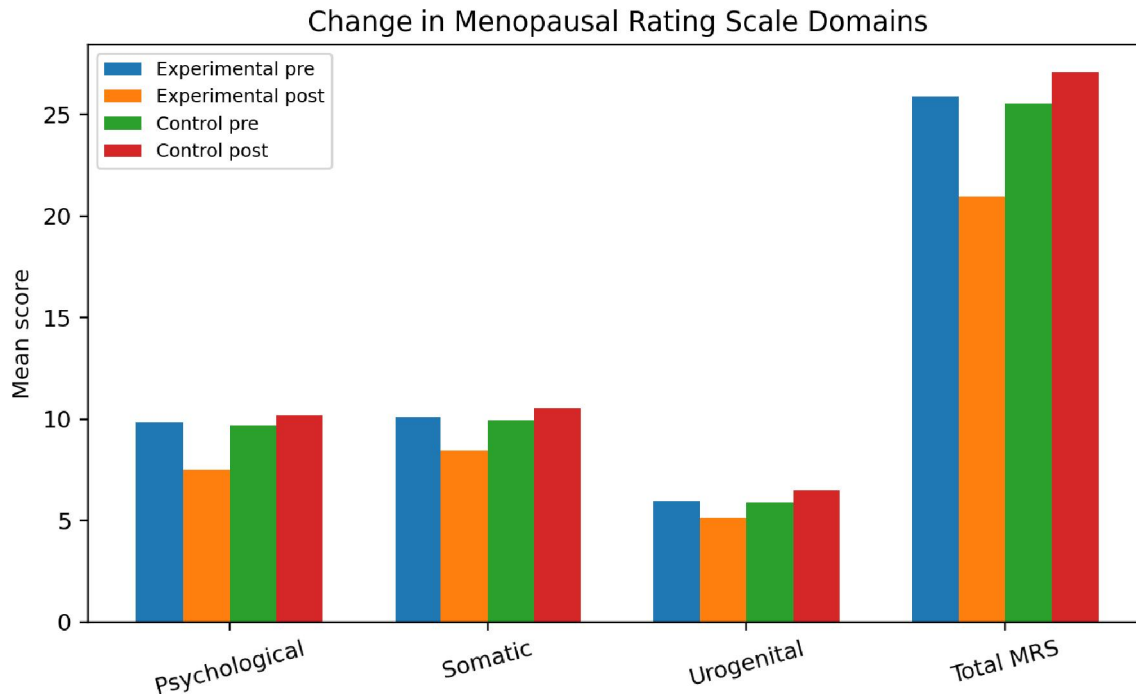


Figure 1. Mean MRS domain and total scores before and after the intervention.

The experimental psychological score decreased from 9.85 to 7.50, a mean reduction of 2.34 points. The somatic score decreased from 10.08 to 8.42, a reduction of 1.66 points. The urogenital score decreased from 5.96 to 5.12, a reduction of 0.84 points. All within-group paired comparisons were statistically significant at $p < 0.001$.

In contrast, the control group showed increases in psychological score (9.70 to 10.16), somatic score (9.95 to 10.53) and urogenital score (5.87 to 6.47). The between-group differences in change were highly significant for all domains. The largest standardized separation was observed for total MRS, with a change-score difference of approximately 6.50 points in favor of the experimental group.

VII. MRS SEVERITY PATTERN AND CLINICAL INTERPRETATION

For descriptive interpretation, the total MRS scores were classified using commonly used MRS severity bands: 0–4 no or little symptoms, 5–8 minor symptoms, 9–15 moderate symptoms and 16 or more severe symptoms. These categories are presented as descriptive groupings and should not be interpreted as diagnostic categories.

MRS category	Experimental pre	Experimental post	Control pre	Control post
No/little	0	2	0	0
Minor	14	30	14	0
Moderate	28	48	32	38
Severe	208	170	204	212

At baseline, 208 of 250 experimental women (83.2%) were in the severe category and 28 (11.2%) were in the moderate category. After the intervention, the number classified as severe fell to 170 (68.0%), while moderate and minor categories increased. Two women entered the no/little symptom category. In the control group, the number classified as severe increased from 204 (81.6%) to 212 (84.8%), while no women were classified as minor or no/little at post-test.

This distributional shift complements the mean-score analysis. It suggests that the intervention was associated not merely with a small numerical reduction in average MRS but with movement of a subset of participants toward lower symptom-severity categories. Nevertheless, because the study was not documented as randomized and the intervention duration/adherence are not specified in the spreadsheet, these findings should be described as an observed controlled association rather than definitive proof of causality.

7.1 Baseline-adjusted analysis

ANCOVA provided an additional safeguard against baseline imbalance. After adjustment for baseline MRS total score, the estimated adjusted group difference in post-intervention MRS was -6.46 points in favor of the experimental group ($p < 0.001$). The model explained approximately 94.9% of the variance in post-test MRS. This strengthens the inference that the observed group separation was not simply a consequence of baseline MRS differences.

VIII. RESULTS: LIPID PROFILE

The lipid results showed a consistent favorable direction in the experimental group. Total cholesterol, triglycerides and LDL-C decreased, whereas HDL-C increased. The control group showed small increases in total cholesterol and triglycerides and a modest increase in HDL-C, while LDL-C increased on average.

Lipid	Exp pre	Exp post	Exp change	Paired p	Ctrl pre	Ctrl post	Ctrl change	Between p
Total cholesterol	205.12	196.95	-8.17	<0.001	196.84	198.51	+1.66	<0.001
Triglycerides	149.51	144.58	-4.94	<0.001	146.64	148.40	+1.75	<0.001
HDL-C	47.57	52.69	+5.12	<0.001	58.01	58.60	+0.59	<0.001
LDL-C	105.11	99.28	-5.83	<0.001	99.80	108.13	+8.33	0.008

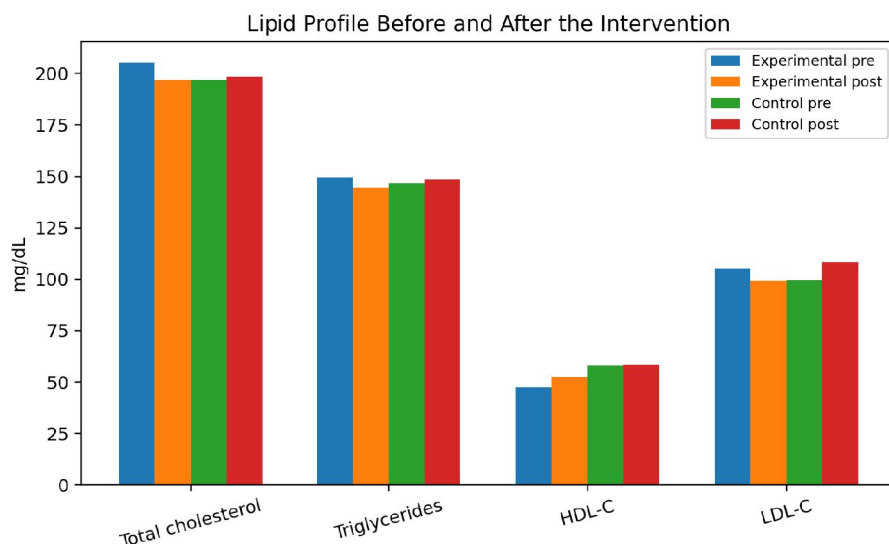


Figure 2. Mean lipid concentrations before and after the intervention.

The experimental group showed a mean reduction of 8.17 mg/dL in total cholesterol, 4.94 mg/dL in triglycerides and 5.83 mg/dL in LDL-C, together with a mean increase of 5.12 mg/dL in HDL-C. All four within-group changes were

statistically significant at $p < 0.001$. The between-group change comparisons were also statistically significant for all four parameters.

The magnitude of the observed changes is directionally compatible with clinical literature suggesting that soy-containing diets can improve selected lipid outcomes in postmenopausal women, although the present intervention cannot be reduced to soy isoflavones alone because the blend also contained flaxseed and the exact phytoestrogen content was not measured. Recent meta-analyses have reported reductions in triglycerides and modest increases in HDL-C with isoflavone intake and reductions in total cholesterol and triglycerides with unfermented soy products.

IX. BASELINE-ADJUSTED LIPID ANALYSIS

Because the experimental group started with a less favorable lipid profile for several variables, baseline-adjusted analyses are particularly important. ANCOVA models used post-intervention values as the dependent variable, baseline value as the covariate and group as the main predictor.

Outcome	Adjusted coefficient	group	p value	Model R ²
Total cholesterol	-7.52		<0.001	0.883
Triglycerides	-6.12		<0.001	0.901
HDL-C	+2.86		<0.001	0.802
LDL-C	-12.69		0.018	0.030

After baseline adjustment, the experimental group remained significantly different from the control group for all lipid outcomes. The adjusted group coefficient was -7.52 mg/dL for total cholesterol, -6.12 mg/dL for triglycerides, $+2.86$ mg/dL for HDL-C and -12.69 mg/dL for LDL-C, all statistically significant at the 0.05 level. The stronger adjusted LDL-C separation than the raw change-score estimate illustrates why baseline adjustment is useful when the two groups do not start at exactly the same level.

These findings should not be interpreted as evidence that the intervention alone explains every lipid change. Diet outside the intervention, physical activity, medication use, adherence and laboratory variability were not available in the spreadsheet. The appropriate conclusion is that the supplied intervention group experienced a favorable lipid trajectory compared with the control group after statistical adjustment.

X. RESULTS: BONE DENSITY

Bone density showed opposite trajectories in the two groups. The experimental group's mean recorded value increased from -2.492 to -2.250 , an improvement of approximately 0.242 units. The control group's value decreased from -1.946 to -2.188 , a decline of approximately 0.242 units.

Group	Pre mean	Post mean	Mean change	Paired p	Between-group p
Experimental	-2.492	-2.250	+0.242	<0.001	<0.001
Control	-1.946	-2.188	-0.242	<0.001	—

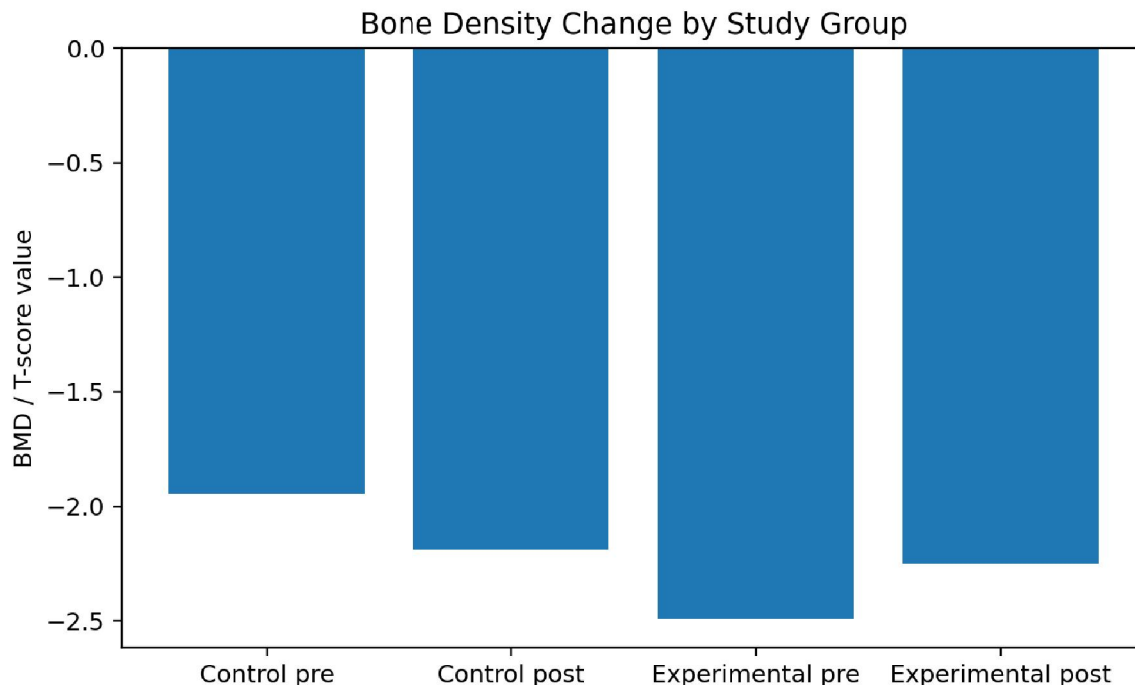


Figure 3. Mean recorded bone-density values before and after the intervention.

The experimental within-group change was statistically significant, as was the deterioration in the control group. The between-group difference in change was approximately 0.484 units ($p < 0.001$). Baseline-adjusted ANCOVA also showed a significant adjusted group coefficient of approximately +0.289 ($p < 0.001$).

The finding is biologically plausible in the context of existing literature suggesting that soy isoflavones may modestly slow postmenopausal bone loss. A meta-analysis of randomized trials reported statistically significant improvements in lumbar-spine, femoral-neck and total-hip bone mineral density with soy isoflavone interventions. However, the present spreadsheet does not identify the instrument, site of measurement, whether the values are T-scores or BMD in g/cm^2 , or the exact time interval between assessments. Therefore, the numerical change should be reported exactly as recorded, without overinterpreting it as a definitive change in fracture risk.

XI. INTEGRATED DISCUSSION

The central finding of the Shamli case study is the concordant direction of change across three outcome domains. The experimental group receiving 30 g/day of the soybean-flaxseed blend showed lower menopausal symptom burden, a more favorable lipid profile and improvement in the recorded bone-density measure. The control group, in contrast, showed worsening MRS scores and bone-density values and less favorable changes in most lipid parameters.

The MRS finding is particularly notable because the intervention group improved in psychological, somatic and urogenital domains rather than in only one symptom cluster. The total MRS reduction of 4.94 points represents a clinically meaningful-looking change in the context of the raw data, but clinical importance should ultimately be judged using validated minimal clinically important difference thresholds and, ideally, participant-level responder analyses. The present analysis therefore uses the safer term 'favorable change' rather than claiming a universally clinically significant effect.

The lipid findings are consistent with a broader literature suggesting that soy foods and isoflavones can modestly improve lipid metabolism in postmenopausal women. The present total-cholesterol reduction of 8.17 mg/dL was larger

than the pooled effect reported in some meta-analyses of isolated soy products, while the HDL increase of 5.12 mg/dL was also relatively substantial. This may reflect the combined food matrix, baseline dyslipidemia, study population or other unmeasured dietary changes. It may also partly reflect regression toward the mean. These possibilities should be considered in future controlled studies.

The bone-density result is also directionally consistent with literature on soy isoflavones and postmenopausal bone health. However, bone remodeling occurs over months to years, and a large change over an unspecified study period warrants careful verification of measurement methods and timing. If the raw values represent T-scores, the movement from -2.49 to -2.25 is clinically interesting but should not be equated with reversal of osteoporosis. If they represent another index, interpretation differs. The original instrument and units should therefore be documented in the final submission.

The intervention itself is nutritionally interesting. Soybean supplies protein and isoflavones, while flaxseed supplies lignans, fiber and alpha-linolenic acid. A 60:40 blend may therefore have effects beyond phytoestrogen receptor activity. The study should consequently be described as an evaluation of a soybean–flaxseed dietary intervention, with phytoestrogen content as the principal mechanistic rationale, rather than as a pure pharmacological phytoestrogen trial.

XII. CLINICAL AND PUBLIC HEALTH IMPLICATIONS

The findings have potential relevance for community nutrition and women's health programmes in rural India. A 30 g/day food-based supplement is comparatively simple to administer, can be prepared from recognizable plant foods and may provide multiple nutrients in addition to phytoestrogenic compounds. If future studies confirm the findings under well-controlled conditions, such an approach could complement—not replace—clinical care for postmenopausal women.

12.1 Implications for Menopausal Symptom Management

Women with troublesome hot flashes, sleep problems, mood symptoms, joint discomfort or urogenital complaints should be assessed individually. A dietary intervention may be offered as part of healthy eating, but severe or persistent symptoms require appropriate medical evaluation. The current evidence does not support presenting soy or flaxseed as an equivalent substitute for hormone therapy.

12.2 Implications for Cardiovascular Risk

The favorable lipid changes in the experimental group are relevant because postmenopausal women may experience an adverse shift in cardiometabolic risk. Nevertheless, nutrition advice should remain broader than one supplement. Adequate fiber, vegetables, fruits, whole grains, pulses, healthy fats, physical activity, smoking avoidance and appropriate medical treatment of dyslipidemia remain central components of cardiovascular prevention.

12.3 Implications for Bone Health

Postmenopausal bone health requires adequate calcium, vitamin D, protein, weight-bearing activity and fall prevention. Phytoestrogen-rich foods may be considered one component of an overall dietary pattern, but they should not replace osteoporosis screening or pharmacological therapy when clinically indicated.

12.4 Rural Feasibility

A major strength of the intervention concept is its potential cultural and economic acceptability. Soybean and flaxseed can be incorporated into flour mixes, roasted preparations, laddoo-type formulations or other locally acceptable foods, subject to dietary counseling and safety considerations. Future implementation should assess taste, gastrointestinal tolerance, adherence, cost and household acceptability.

XIII. STRENGTHS AND LIMITATIONS

13.1 Strengths

- Large analytic sample of 500 postmenopausal women with equal group sizes.
- Controlled pre–post design with multiple clinically relevant outcomes.
- Direct assessment of menopausal symptoms using MRS domains and total score.

- Concurrent assessment of lipid profile and bone-density values.
- Use of between-group change analysis and baseline-adjusted ANCOVA rather than relying only on post-test means.
- Food-based intervention using a clearly stated 60:40 soybean–flaxseed ratio and 30 g/day dose.

13.2 Limitations

- The supplied spreadsheet does not state the method of group allocation; therefore randomization cannot be claimed.
- The exact intervention duration is not stated in the raw data and should be inserted from the original study protocol before journal submission.
- Adherence/compliance data are not included.
- Actual dietary intake outside the intervention was not available.
- The precise isoflavone and lignan content of the 30 g blend was not chemically quantified in the supplied data.
- Medication use, physical activity, calcium/vitamin D intake and other potential confounders were not available.

XIV. CONCLUSION

This controlled case study of 500 rural postmenopausal women in Shamli provides evidence of a strong favorable association between a daily 30 g soybean–flaxseed blend and several health outcomes. The experimental group showed a 4.94-point reduction in total MRS score compared with a 1.55-point increase in the control group. Psychological, somatic and urogenital domains all improved in the experimental group.

The intervention group also showed favorable lipid changes: total cholesterol fell by 8.17 mg/dL, triglycerides by 4.94 mg/dL and LDL-C by 5.83 mg/dL, while HDL-C increased by 5.12 mg/dL. Recorded bone-density values improved by approximately 0.242 units in the experimental group and declined by approximately 0.242 units in the control group. Between-group and baseline-adjusted analyses remained statistically significant.

The results are compatible with a growing literature suggesting that soy-derived phytoestrogens may have modest benefits for selected cardiometabolic and bone outcomes, although evidence for menopausal symptoms remains heterogeneous. The present study adds a rural Indian food-based perspective by evaluating soybean and flaxseed together rather than an isolated pharmaceutical phytoestrogen.

The appropriate overall conclusion is therefore that the soybean–flaxseed dietary intervention was associated with favorable changes in menopausal symptom burden, lipid profile and recorded bone-density values in the supplied Shamli dataset. Confirmation through randomized, adequately blinded or pragmatic community trials with known intervention duration, adherence monitoring, quantified phytoestrogen content and validated clinical outcomes is recommended before making strong causal or therapeutic claims.

XV. RECOMMENDATIONS

1. Repeat the study with documented random allocation or matched allocation procedures.
2. Record the exact duration of the 30 g/day intervention and participant adherence.
3. Quantify genistein, daidzein and major flaxseed lignans in the intervention material.
4. Collect detailed dietary intake, physical activity, medication and calcium/vitamin D data.
5. Use standardized laboratory methods and clearly specify the bone-density instrument, anatomical site and units.
6. Assess clinically meaningful MRS response and quality-of-life outcomes in addition to mean score changes.
7. Consider longer follow-up to determine whether lipid and bone changes persist.
8. Develop culturally appropriate rural nutrition education materials around legumes, soy, seeds, whole grains and overall healthy dietary patterns.

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