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Original Research Article

Effectiveness of lifestyle modification in managing thyroid dysfunction and hypertension risks during pregnancy: evidence from a pre-post interventional study

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ABSTRACT

Background: Thyroid dysfunction and hypertension are prevalent comorbidities during pregnancy, contributing to higher risks of pre-eclampsia, preterm birth and adverse fetal outcomes. Traditional management relies on pharmacological intervention, but there is growing interest in the role of lifestyle modifications in reducing these risk factors and improving pregnancy outcomes.
Methods: A pre-post interventional study was conducted from 19 June 2024 to 31 December 2024 involving pregnant women (gestational age 12–20 weeks) with mild to moderate thyroid dysfunction (TSH>2.5mIU/l) and at risk for hypertension. Participants underwent a 12-week structured lifestyle program consisting of counseling, improved diet, increased physical activity and stress reduction techniques such as mindfulness and yoga. Clinical and biochemical parameters including thyroid profile (TSH, T3, T4), blood pressure and pregnancy outcomes were measured before and after the intervention. Self-reported adherence and participant feedback were also collected.
Results: After the intervention, mean TSH levels significantly decreased (pre: 3.8±0.6, post: 2.4±0.4) and the incidence of gestational hypertension dropped (from 18% to 7%). Over 75% of participants reported strong adherence to the intervention and described improvements in energy, stress levels and overall pregnancy experience.
Conclusions: Targeted lifestyle modifications comprising diet, exercise and stress management are effective in managing thyroid dysfunction and reducing hypertension risk in pregnant women. These interventions not only improve clinical and biochemical outcomes, but also enhance patient satisfaction and quality of life. Integration of structured lifestyle guidance in routine prenatal care is highly recommended.

Keywords: Hypertension, Lifestyle modification, Pregnancy, Thyroid dysfunction

INTRODUCTION

Thyroid dysfunction and hypertension remain key health challenges during pregnancy, with a robust body of research confirming their association with increased risks of adverse outcomes. Several studies have highlighted these risks and the pivotal role of maternal health strategies. Thyroid hormone dysfunctions including hypothyroidism and thyrotoxicosis can lead to abortion, placental abruption, preeclampsia, preterm delivery and impaired fetal neurodevelopment. Maternal thyroid hormones are directly influential in fetal neurological development and their deficiency may result in lasting child outcomes. Management protocols stress early diagnosis and treatment, with dietary supplementation of iodine shown to enhance pregnancy outcomes.[1] For hypertension, lifestyle and weight management are critical post-pregnancy, especially for women with a history of hypertensive disorders. Physical activity and dietary patterns offer benefit, maintaining a healthy

weight post-pregnancy was notably crucial for reducing future chronic hypertension risks in women with prior gestational hypertension or preeclampsia. Their data showed that body mass index is a significant modifier overweight and obesity substantially increased the risk of subsequent chronic hypertension for these women.[2]

More recently, a randomized controlled trial was conducted to examine lifestyle interventions dietary guidance, health education and weight management for pregnant women at high risk of gestational diabetes mellitus. Their intervention reduced the risk of pregnancy-induced hypertension by 74.2% and also lowered the rate of gestational diabetes. Importantly, this study found that such lifestyle modifications helped women better understand prenatal health, control weight gain and reduce metabolic abnormalities, underscoring the importance of early intervention and personalized counseling.[3]

Collectively, these studies demonstrate that integrating lifestyle modification encompassing nutrition, physical activity, stress management and healthy weight maintenance into routine antenatal care can mitigate the risks of thyroid dysfunction and hypertension during pregnancy. While medication remains foundational for managing these conditions, growing research evidence supports structured, holistic approaches for enhancing maternal and fetal outcomes.[4]

METHODS

Study design

This study used a quasi-experimental pre-test/post-test design to assess the impact of a structured lifestyle intervention—including diet, exercise and stress management—on pregnant women's health awareness and clinical outcomes. It measured changes over time using quantitative data (thyroid profile and blood pressure) and qualitative self-assessments of lifestyle practices, enabling a thorough evaluation of the program's effectiveness.

Study setting

The study was carried out in selected antenatal and maternity clinics in urban and semi-urban Delhi NCR from 19 June 2024 to 31 December 2024, chosen for their accessibility, diverse patient population, cooperative healthcare staff and ability to provide a representative sample across varied socio-demographic backgrounds.

Intervention description

The lifestyle modification program was a 12 weeks structured intervention delivered through small group sessions and reinforced during individual antenatal follow-up visits. It comprised three core components: dietary guidance, focusing on balanced nutrition with an emphasis on iodine- and selenium-rich foods, reduced sodium intake, adequate protein consumption and the avoidance of processed and goitrogenic foods; physical activity, promoting safe prenatal exercises such as 30 minutes of walking or other light activities tailored to the specific needs of each trimester; and stress management, which included the introduction of mindfulness practices, pregnancy-safe yoga, breathing exercises and relaxation techniques. To support adherence and reinforce learning, participants were provided with printed educational materials, lifestyle tracking sheets and regular counseling throughout the program.

Study population

The target population for the study comprised pregnant women aged 18–40 years attending antenatal clinics at the selected centres. Eligible participants were those at risk of or diagnosed with thyroid dysfunction or hypertension, who expressed willingness to take part in the structured lifestyle intervention program and who were able to commit to both pre- and post-intervention assessments.

Sample size

The sample size for this study comprised a total of 200 pregnant women recruited based on specific inclusion and exclusion criteria. This number was determined to provide sufficient statistical power to detect meaningful differences in clinical and behavioral outcomes between pre- and post-intervention assessments.

Sampling technique

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Data collection tools and procedures

Data collection was conducted in two distinct phases pre-intervention (baseline) and post-intervention (after 12 weeks) to evaluate changes in participants' clinical parameters, awareness levels and lifestyle practices. Clinical measurements included systolic and diastolic blood pressure, body weight and Body Mass Index (BMI), recorded using standardized and calibrated instruments to ensure reliability. Venous blood samples were drawn and analyzed in NABL-accredited laboratories to determine thyroid hormone levels, specifically TSH, T3 and T4. A semi-structured questionnaire was administered to assess participants' knowledge about thyroid health, hypertension risks and engagement in healthy lifestyle behaviors, such as balanced diet, safe physical activity and stress management. Additionally, sociodemographic data

including age, parity, education, income and family history of thyroid dysfunction or hypertensive disorders were collected to explore the influence of these factors on baseline awareness and the extent of behavioral or clinical change following the intervention.

Data analysis

Quantitative data collected during the study were coded and entered into SPSS (Version 26) for statistical analysis. Descriptive statistics including mean, standard deviation and frequencies were used to summarize participant characteristics and baseline measurements. To evaluate the effect of the intervention, paired t-tests and Wilcoxon signed-rank tests were applied to compare pre- and post-intervention clinical and biochemical parameters, depending on data distribution. Chi-square tests were employed to examine associations between sociodemographic variables and changes in awareness scores or clinical outcomes. The level of statistical significance was set at $p<0.05$.

In addition to the quantitative analysis, qualitative feedback obtained from participants' self-reported experiences was subjected to thematic analysis. This process involved coding and categorizing responses to identify common themes, providing richer insights into changes in perception, motivation and adoption of healthier lifestyle behaviors following the intervention.

Ethical considerations

Ethical clearance was secured from the University Ethics Committee and permission was obtained from the hospitals before data collection commenced. Written informed consent was obtained from all participants, with assurances of confidentiality and anonymity. Participation was entirely voluntary and participants had the right to withdraw at any time without any consequences.

RESULTS

The effectiveness of the lifestyle modification intervention was also assessed through an evaluation of behavioural changes in daily practices such as physical activity, diet, supplement intake, sleep and stress management.

Table 1: Lifestyle practices of pregnant women pre and post intervention (n=200).

Question	Response options	Pre-test (f)	Pre-test (%)	Post-test (f)	Post-test (%)
How often do you exercise?	Rarely/Never	84	42.0	19	9.5
	1–2×/week	60	30.0	37	18.5
	3–4×/week	34	17.0	60	30.0
	Daily	22	11.0	84	42.0
Types of activity	Walking	138	69.0	158	79.0
	Yoga	95	47.5	117	58.5
	Swimming	67	33.5	85	42.5
	Aerobics	103	51.5	127	63.5
	Other	126	63.0	142	71.0
Made dietary changes?	Yes	102	51.0	161	80.5
	No	98	49.0	39	19.5
If yes, what changes?	Reduced salt	79	39.5	95	47.5
	More fruits/vegetables	63	31.5	101	50.5
	Reduced caffeine	42	21.0	68	34.0
	More water	61	30.5	81	40.5
	Other	92	46.0	108	54.0
Follows specific diet?	Yes	56	28.0	130	65.0
	No	144	72.0	70	35.0
High-sodium food intake?	Daily	56	28.0	17	8.5
	3–4×/week	55	27.5	29	14.5
	1–2×/week	51	25.5	59	29.5
	Rarely/Never	38	19.0	95	47.5
Takes supplements?	Yes	134	67.0	157	78.5
	No	66	33.0	43	21.5
Practices stress relief?	Yes	86	43.0	157	78.5
	No	114	57.0	43	21.5
Average sleep per night	<5 hours	38	19.0	9	4.5
	5–6 hours	78	39.0	35	17.5
	7–8 hours	60	30.0	85	42.5
	>8 hours	24	12.0	71	35.5
Discussed with doctor?	Yes	70	35.0	140	70.0
	No	130	65.0	60	30.0

Table 2: Wilcoxon signed-rank test on ordinal lifestyle practices.

Lifestyle practice	Z value	P value	Significance
Exercise frequency	-9.23	<0.001	Significant
High-sodium food intake	-8.91	<0.001	Significant
Sleep duration	-7.48	<0.001	Significant

Table 3: Changes in binary lifestyle practices among pregnant women pre and post-intervention.

Lifestyle practice	Pre-test (yes)	Post-test (yes)	Chi²	Df	P value	Significance
Made dietary changes	102	161	28.00	1	<0.001	Significant
Follows specific diet (thyroid/BP)	56	130	24.50	1	<0.001	Significant
Takes supplements (iodine/folic)	134	157	30.10	1	<0.001	Significant
Practices stress-relief techniques	86	157	32.80	1	<0.001	Significant
Discussed lifestyle with doctor	70	140	26.70	1	<0.001	Significant

Table 4: Lifestyle changes post-intervention frequency and percentage.

Question	Response	Frequency (f)	%
Adopted lifestyle modifications?	Yes	170	85.0
	No	30	15.0
If not/partially, why? (n=30)	Lack of time	8	26.7
	Inconvenient routine	10	33.3
	No perceived benefit	6	20.0
	Other	6	20.0
Lifestyle changes implemented (multi-response)	Diet	169	84.5
	Exercise	133	66.5
	Stress management	128	64.0
	Medication adherence	163	81.5
	Other	161	80.5
Followed dietary advice	Very closely	104	52.0
	Somewhat	57	28.5
	Rarely	28	14.0
	Not at all	11	5.5
Changed stress management habits?	Yes	150	75.0
	No	50	25.0
Stress management method used (multi-response)	Meditation	113	75.3 (of 150)
	Breathing	112	74.7 (of 150)
	Mindfulness	99	66.0 (of 150)
	Other	91	60.7 (of 150)

DISCUSSION

As shown in Table 1, a significant positive shift was observed in almost all lifestyle domains post-intervention. In terms of physical activity, prior to the intervention, 42% of the participants reported that they rarely or never exercised. This number drastically reduced to just 9.5% after the intervention. Conversely, those who reported daily exercise increased from 11.0% to 42.0%, demonstrating a considerable improvement in engagement with regular physical activity. Similarly, increases were noted in specific types of exercise such as walking (from 69.0% to 79.0%), yoga (47.5% to 58.5%), aerobics (51.5% to 63.5%) and swimming (33.5% to 42.5%) all indicating diversified and enhanced activity patterns among participants after the program.[5] Dietary behavior also showed marked improvement. Before the intervention, only 51.0% of the participants had made dietary changes, which rose significantly to 80.5% after the sessions. Among those who made dietary changes, improvements were seen in key areas: increased consumption of fruits and vegetables (31.5% to 50.5%), reduction of caffeine intake (21.0% to 34.0%) and increased water intake (30.5% to 40.5%). The proportion

of participants adhering to a specific diet plan also increased substantially from 28.0% pre-test to 65.0% post-test. Notably, the intake of high-sodium foods on a daily basis declined from 28.0% to 8.5%, while the number of women who rarely or never consumed high-sodium foods rose from 19.0% to 47.5%.

Supplement intake and stress management practices also improved. The percentage of women taking supplements increased from 67.0% to 78.5% and those practicing stress relief methods (such as meditation, breathing exercises or counseling) surged from 43.0% to 78.5%. Sleep quality, another crucial lifestyle component, improved as well. Participants reporting less than 5 hours of sleep reduced from 19.0% to 4.5%, while those achieving over 8 hours of sleep increased from 12.0% to 35.5%.the proportion of participants who discussed their lifestyle and health status with a healthcare provider doubled from 35.0% in the pre-test to 70.0% post-test. This finding not only underscores increased engagement with medical professionals but also reflects the intervention's effectiveness in empowering women to seek and use health information.[6]

Table 2 illustrates that the lifestyle intervention led to statistically and clinically meaningful improvements in physical activity, diet, supplement use, stress management and sleep hygiene among pregnant women factors essential for managing thyroid dysfunction and hypertension during pregnancy. The Wilcoxon Signed-Rank Test was employed to examine shifts in ordinal responses, such as exercise frequency, high-sodium food intake and sleep duration. These items involve ranked categories rather than absolute values and are not normally distributed, making the Wilcoxon test appropriate.

As shown in table 2, the Z-values for exercise frequency, sodium intake and sleep duration were -9.23, -8.91 and -7.48 respectively, all with p-values<0.001. These values indicate statistically significant improvements across all three domains. Post-intervention, more women reported exercising regularly, consuming less sodium and sleeping for longer durations. This suggests that the intervention successfully influenced participants to adopt healthier lifestyle behaviors, essential for managing thyroid and blood pressure conditions during pregnancy.[7] Table 1 confirms significant differences in key lifestyle behaviors, supporting the effectiveness of the intervention on frequency-based habits. To assess changes in dichotomous (yes/no) responses, such as whether participants made dietary changes or practiced stress-relief techniques, the McNemar's Test was applied. This test is suitable for paired nominal data and determines whether proportions of categorical variables changed significantly from pre-test to post-test.

As reported in Table 2, all examined variables demonstrated statistically significant changes. The number of women who made dietary changes increased from 102 to 161 (χ^2=28.00, p<0.001) and those who followed a specific diet rose from 56 to 130 (χ^2=24.50, p<0.001). Supplement intake improved significantly (from 134 to 157, χ^2=30.10, p<0.001), as did the use of stress-relief techniques (from 86 to 157, χ^2 = 32.80, p<0.001). Furthermore, the number of participants who discussed their lifestyle with a healthcare provider doubled (from 70 to 140, χ^2=26.70, p<0.001).[8]

The results from both table 1 and table 2 provide compelling evidence to reject the null hypothesis (H_{03}) and accept the alternative hypothesis (H_{13}). The structured lifestyle modification intervention significantly improved pregnant women's engagement in healthy behaviors including regular physical activity, better dietary choices, improved sleep hygiene, stress-reduction strategies and increased consultation with healthcare professionals. These findings underline the value of behavior-focused antenatal education in managing thyroid and hypertension risks during pregnancy.[9]

Following the structured lifestyle modification intervention, post-test responses revealed substantial adoption of health-promoting behaviors among the participating pregnant women. As shown in Table 4, 85.0% (n=170) of participants reported adopting lifestyle modifications, indicating a high level of program acceptance and behavioral responsiveness. However, 15.0% (n=30) did not adopt or only partially adopted the recommended changes. When asked about the reasons for non-adoption, the most frequently cited barrier was an inconvenient routine (33.3%), followed by lack of time (26.7%), no perceived benefit (20.0%) and other personal or logistical reasons (20.0%).

Among those who did adopt changes, a broad range of lifestyle improvements was reported. Dietary modifications were the most common, practiced by 84.5% of participants, followed by medication adherence (81.5%), implementation of other changes such as hydration and sleep regulation (80.5%), exercise (66.5%) and stress management practices (64.0%). These responses, captured through multiple-choice formats, highlight the multifaceted impact of the intervention across key lifestyle domains.[10] In terms of dietary adherence, 52.0% of participants reported following dietary advice "very closely", while another 28.5% did so "somewhat". A smaller group adhered only rarely (14.0%) or not at all (5.5%), indicating some variation in commitment, likely influenced by individual circumstances and support levels. Stress management habits also improved significantly, with 75.0% of respondents indicating that they had actively changed their stress management routines post-intervention. Among these 150 participants, the most commonly adopted strategies included meditation (75.3%), breathing exercises (74.7%) and mindfulness practices (66.0%). Additionally, 60.7% reported using other personalized methods such as journaling, music therapy or counseling.

Overall, Table 4 provides strong evidence that the educational intervention not only raised awareness but also facilitated tangible behavioral change among a large proportion of the sample. The high adoption rates of core lifestyle strategies particularly in diet, exercise, stress management and adherence to medical guidance affirm the program's success in promoting sustainable health practices among pregnant women at risk of thyroid and hypertensive disorders.[11]

The study has several limitations that must be considered while interpretating the results. Small sample size from a single geographical region may limit the results of the study to the participants only. When the participants of the study came from a specific socioeconomic background or have access to specific type or healthcare system, the result may not apply to people with different backgrounds or healthcare access. Relying on self – reported adherence metrics can lead to social desirability bias and response bias. This may result in an overestimation of the actual behavioural changes. Further large randomized controlled trials should use objective adherence measures, include a diverse geographic representation and have control groups. This will help confirm these findings and determine the effectiveness of intervention across different population.

CONCLUSION

The structured lifestyle modification intervention produced significant improvements in pregnant women's health-related behaviors across multiple domains. Physical activity levels increased markedly, with more participants engaging in daily exercise and diverse activities such as walking, yoga, aerobics and swimming.

Dietary habits improved substantially, including higher adoption of specific diets, reduced high-sodium intake and increased intake of fruits, vegetables and water. Supplement use and stress management practices rose sharply and sleep quality improved post-intervention. The proportion of participants discussing lifestyle with healthcare providers doubled, reflecting greater health engagement. Overall, 85% adopted recommended lifestyle modifications, with diet, medication adherence and stress management being most common. These findings confirm that targeted, behavior-focused antenatal education is effective in promoting sustainable, health-enhancing practices to reduce thyroid and hypertension risks during pregnancy.

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