

ORIGINAL ARTICLE

Effect of Group Counseling based on Theory of Planned Behavior on Health Promotion Lifestyle in Mothers with Overweight and Obesity during Postpartum Period: A Randomized Controlled Trial

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Received: 1 February 2026 Revised: 24 August 2026 Accepted: 25 August 2026

Online Published: 6 September 2026

ABSTRACT

Background: Overweight and obesity are significant risk factors for chronic diseases, with their prevalence being a major concern during pregnancy and postpartum. This study aimed to determine the effect of group counseling based on the Theory of Planned Behavior (TPB) on health promotion lifestyle in mothers with overweight and obesity during the postpartum period.

Methods: In a randomized controlled trial conducted from July 2021 to March 2022 in Urmia, Iran, 104 mothers with overweight or obesity were randomly assigned to either an intervention or a routine care group. Data were collected using demographic and Health-Promoting Lifestyle Profile II (HPLP-II) questionnaires. The intervention group received six weeks of TPB-based group counseling via WhatsApp. HPLP, as the primary outcome, was measured at three distinct time points including prior before the intervention, and one month and three months after the completion of the intervention. Data were analyzed using SPSS software version 20.0 through repeated measures analysis of variance, Chi-square, and independent t-tests. A p-value of $P < 0.05$ was considered statistically significant.

Results: The mean age of the participants was 27.06 ± 5.98 years. In the intervention group, significant improvements were observed from baseline to onemonth followup in total and the mean scores of HPLP of the subscales ($P < 0.001$), except for nutrition and spiritual growth ($P > 0.05$). These gains were sustained three months after intervention ($P < 0.05$). Nutrition showed a delayed effect, with a mean score improvement from the baseline to three months after the intervention ($P = 0.005$) and from one month to three months after the intervention ($P = 0.008$). Spiritual growth also showed a delayed but significant improvement from one month to three months postintervention ($P < 0.001$), but no significant changes were observed from baseline to one month or baseline to three months ($P > 0.05$).

Conclusion: The WhatsAppbased TPB intervention effectively improved healthpromoting behavior. It supports the feasibility of using theorydriven digital platforms in women with overweight and obesity during the postpartum period.

The trial registration number: IRCT20210811052148N1

Keywords: Health Behavior; Mothers; Obesity; Postpartum Period; Theory of Planned Behavior

Please cite this article as: Nikkhah F, Moghaddam Tabrizi F, Didarloo AR, Gharaaghaji-Asl R. Effect of Group Counseling based on Theory of Planned Behavior on Health Promotion Lifestyle in Mothers with Overweight and Obesity during Postpartum Period: A Randomized Controlled Trial. IJCBNM. 2026;14(4):295-312. doi: 10.30476/ijcbnm.2026.103965.2595.

INTRODUCTION

Nowadays, obesity and overweight are important risk factors for chronic illnesses, and their prevalence is a major concern.¹ The prevalence of overweight and obesity in Iranian adults (aged >18 years) is 35.26% and 21.38%, respectively.² Pregnancy and the postpartum period are among the main causes of obesity in women. After delivery, women face challenges related to body weight and lifestyle.³ These changes, along with the new responsibilities of childcare, lead to a decline in maternal self-care capacity.⁴ Moreover, women after delivery are occupied with caring for the baby and tend to put their own health as the second priority. Furthermore, healthcare providers often focus more on child care than on the mother's mental and physical health.⁵ Mothers in the postpartum period encounter several barriers to maintaining a healthy lifestyle, including lack of social support, low energy and motivation, procrastination, and financial constraints.⁶

A health-promoting lifestyle (HPL) is one of the key factors that influence public health and helps reduce the risk of diseases. In fact, it represents a positive approach to life and can improve people's health and well-being. In this regard, HPL has a potential effect on reducing chronic illness and its risk factors and promoting people's quality of life.⁷

The Theory of Planned Behavior (TPB) is one of the most commonly applied theoretical frameworks for describing health behaviors.⁸ Its application extends across various domains, including diet- and weight-related behaviors such as fat intake, healthy eating, and weight control.^{9, 10} The theory assumes that individuals are rational actors who make deliberate decisions based on available information. However, some researchers argue that, despite its rationality assumption, the TPB can still inform the design of behavior-change interventions, even for behaviors that have become habitual. According to TPB, the best predictor of actual behavior is a person's intention to perform that behavior. Specifically, the theory proposes that a more

positive attitude toward the behavior, together with a supportive subjective norm and higher perceived behavioral control (PBC), leads to a stronger intention and, consequently, a greater likelihood that the behavior will be carried out.^{8, 11}

One study showed that applying the TPB to HPL in women at risk of cardiovascular disease led to a significant increase in HPL and TPB constructs in the experimental group six months after the intervention. Additionally, mean blood pressure, fasting blood glucose, and smoking rates decreased in the experimental group six months post-intervention.¹² Another study demonstrated that TPB-based education was recommended for maintaining and improving self-care behaviors and health literacy in patients with type 2 diabetes and other chronic diseases.¹³

Women widely use information technology and mobile applications to access pregnancy- and postpartum-related information. Given the potential of mobile-based interventions, such as WhatsApp, to deliver cost-effective, flexible, and interactive health education, there is a clear need for evidence-based interventions grounded in robust theoretical frameworks. While using platforms like WhatsApp for health counseling has established benefits,^{14, 15} the primary knowledge gap lies in the application of validated psychosocial theories (such as the TPB) to design such interventions for specific groups, such as overweight and obese mothers during the postpartum period.

The postpartum period is a critical and vulnerable phase during which mothers face numerous physical and psychological challenges.⁶ Adopting a healthy lifestyle is paramount for their own well-being and their central role in family health. The rationale for selecting the TPB in this study is its focus on key determinants of behavior, including attitudes, subjective norms, and PBC, which can specifically explain the barriers and facilitators related to lifestyle changes (e.g., nutrition, physical activity, and self-care in postpartum mothers). A study confirmed that these TPB constructs collectively explained

a substantial proportion of the variance in both behavioral intention and actual behavior related to weight management during the perinatal period.¹⁶

Therefore, the study aimed to determine the impact of group counseling using the TPB delivered through WhatsApp on HPL in mothers with overweight or obese during the postpartum period.

MATERIALS AND METHODS

This parallel randomized controlled trial was conducted on 104 women who had recently given birth (within 6-8 weeks); they were recruited from community health centers in Urmia, Iran, from July 2021 to March 2022. The control group received routine postpartum care from health centers. The intervention group, in addition to routine care, participated in structured group counseling sessions based on the TPB, which were delivered via WhatsApp and focused on promoting a healthy lifestyle. Eligible individuals were contacted and invited to participate. Inclusion criteria consisted of maternal age between 18 and 42 years; prepregnancy or early pregnancy body mass index (BMI) classified as overweight (≥ 25 kg/m²) or obese (≥ 30 kg/m²); physical and mental capacity to perform routine daily activities; literacy and consistent access to a smartphone and the Internet; infant not admitted to the neonatal intensive care unit; no prior participation in a structured health promotion or lifestyle education program; pregnancy without major medical complications (e.g., preeclampsia, gestational diabetes); no diagnosis of acute or chronic physical conditions (e.g., cardiovascular disease, uncontrolled endocrine disorders, severe musculoskeletal limitations); or mental health conditions that could interfere with their participation or lifestyle modification. Lack of willingness to continue participation at any stage and concurrent enrollment in any other formal health education or counseling program outside the study protocol were the exclusion criteria.

The required sample size was calculated

based on data from a study by Fakari et al.,¹⁷ focusing on the mean difference in the attitude construct of the TPB questionnaire between the two independent groups. Using the G*Power software (version 3.1) and entering the reported parameters in the two groups (Mean $\pm$ SD group 1: 71.13 $\pm$ 35.40; and Mean $\pm$ SD group 2: 64.11 $\pm$ 11.30), with an alpha (α) level of 0.05 and a power (1- β) of 0.80, we determined 47 participants as the minimum sample size required for each group. To account for a potential attrition rate of 10% in each group, we increased the final sample size to 52 participants per group, resulting in a total of 104 postpartum women to be enrolled in the study.

$$n = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2 (s_1^2 + s_2^2)}{(x_1 - x_2)^2}$$

First, the city was divided into three clusters based on economic status. From each cluster, two health centers were randomly selected and then randomly allocated to either the control or intervention group, resulting in six centers (three per group). For allocation, the letters “A” (intervention) and “B” (control) were written on an equal number of cards. Each of the six selected centers was then randomly assigned to either the intervention or control group by drawing one of these cards. A researcher not involved in participants’ recruitment or data collection performed the randomization procedure. The researcher then visited the selected centers, and from an initial pool of 137 postpartum women meeting the BMI criteria, 104 eligible participants were enrolled. Due to natural variations in the number of eligible women attending each health center, the number of participants per center ranged from 15 to 19 (Figure 1). Given the nature of the behavioral intervention, it was not possible to blind the participants or the intervention facilitators to the group assignment. However, to minimize bias in outcome assessment, the data analyst was blinded to group allocation until the final analysis was complete.

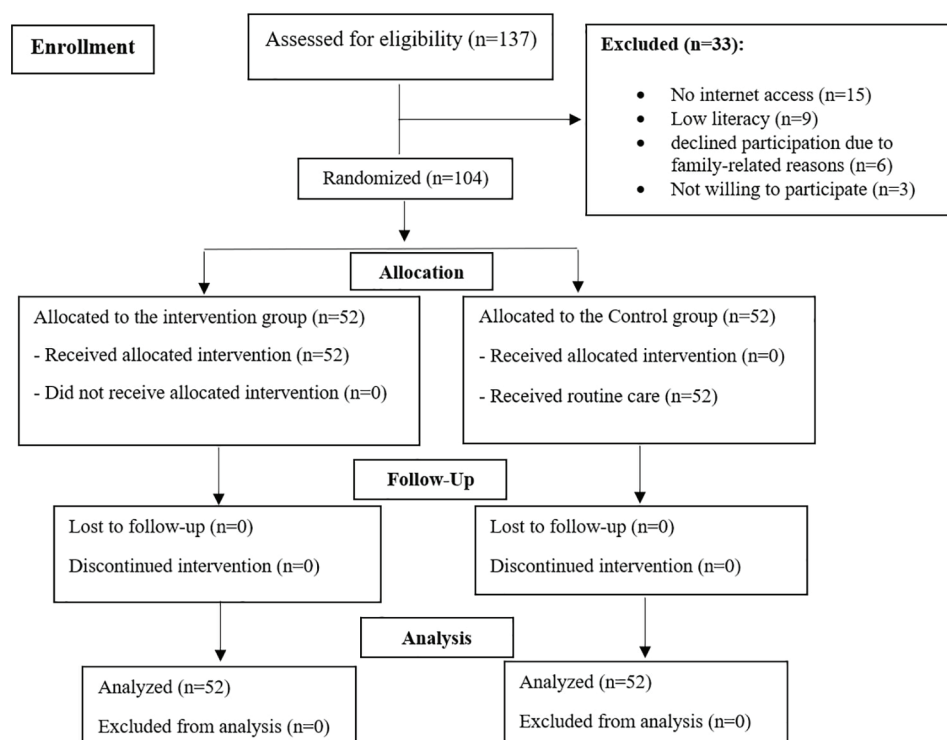


Figure 1: Consort flow diagram of the study

The intervention was designed to promote health behaviors across all dimensions of the HPLP-II, including health responsibility, nutrition, physical activity, spiritual growth, interpersonal relations, and stress management. Each weekly session initiated with a guiding question related to a specific health dimension and common postpartum challenges, such as adapting to new maternal responsibilities, managing body image concerns, coping with fatigue and sleep disruption, addressing postpartum mood changes, navigating family dynamics, and finding time for self-care and infant-care demands. Through guided discussions, the participants were encouraged to share personal experiences and practical strategies for integrating healthy behaviors, such as finding time for physical activity, preparing nutritious meals, and practicing stress management. They explored solutions for securing social support, delegating tasks, and communicating needs with partners and family members. A core message reinforced throughout was the importance of prioritizing their own physical and mental health as a fundamental requirement for sustaining effective motherhood and safeguarding their newborn's well-being.

To operationalize the TPB framework within the intervention, we employed several strategies. To shape attitudes and behavioral intention, we linked self-care directly to long-term maternal efficacy and infant care quality, and incorporated structured action-planning and goal-setting exercises (e.g., "I intend to walk for at least 20 minutes on three days this week"). To strengthen subjective norms, the group itself served as a supportive social network, and the participants were encouraged to involve key family members to normalize health-promoting behaviors within the family context. To enhance PBC, the content focused on skill-building, problem-solving, and time-management strategies to overcome key barriers like lack of time, aiming to empower participants to integrate self-care as a sustainable priority within their daily routines. The mapping of TPB constructs to each Health-Promoting Lifestyle Profile II (HPLP-II) dimension across the six weekly sessions is shown in Table 1.

The 52 participants in the intervention group were divided into five groups of 10 to 11 members each. The program was then delivered over six weeks via five separate WhatsApp groups.

Table 1: The content of the intervention program based on the Theory of Planned Behavior

Session	Health Promotion Subscale	Theory of Planned Behavior (Domain Integration)	Key Activities (via WhatsApp Group)	Weekly Homework / Action Goal	Primary Challenge & Facilitative Strategy
1	Foundation & Trust Building: Establishing a foundation of trust and psychological safety among mothers and the facilitator, creating a safe environment for self-disclosure and collaboration.	-Attitude: Foster a positive view of the program by introducing its psychological and practical benefits. -Subjective Norms: Establish the group as a normative support system by collaboratively setting group rules. -Perceived Behavioral Control: Build confidence in participation by setting very simple, achievable goals in the first session. -Intention: Form a conscious commitment to the process by having each mother write a personal commitment statement.	- Introductions and group rule-setting (to reduce entry anxiety). - Pre-test questionnaire completion (to establish a baseline). - Guided brainstorming on postpartum challenges (to identify shared needs). - Sharing of personal experiences (to normalize feelings and reduce isolation).	1. Complete a personal commitment statement (to increase accountability). 2. Identify and list three main personal challenges (for more precise goal-setting in later sessions).	-Challenge: Initial hesitancy and difficulty building trust in an online space. -Strategy: Emphasize shared experiences, strict confidentiality, and a non-judgmental atmosphere to reduce concerns.
2	Health Responsibility: Taking responsibility for physical health, meaning awareness of bodily needs and taking regular, deliberate action to maintain well-being.	-Attitude: Link self-monitoring to effective and mindful motherhood, rather than viewing it as an extra chore. -Subjective Norms: Encourage mothers to involve their partner or a family member in supporting their self-care routine. -Perceived Behavioral Control: Develop skills for daily self-checks so mothers can easily assess their own physical and emotional state. -Intention: Set a specific, actionable self-monitoring plan for daily check-ins.	- Educational content on the importance of health responsibility. - Discussion on recognizing bodily signs (fatigue, pain, bleeding, mood changes). - Problem-solving exercise to find short “time windows” throughout the day for self-care.	Complete and discuss a 5-day self-care checklist with a designated support person (e.g., partner or mother), to double accountability.	- Challenge: Perceived lack of time to focus on personal health. - Strategy: Reframe self-care as a core maternal duty and promote consistent micro-actions (small but regular steps).
3	Physical Activity & Nutrition: Combining safe postpartum physical activity and healthy nutrition to restore energy and physical health.	-Attitude: Highlight benefits of physical activity for increased energy and improved mood, not just weight loss. -Subjective Norms: Encourage sharing goals with family members to gain their encouragement and active support. -Perceived Behavioral Control: Plan together for practical barriers (fatigue, lack of time) and find realistic solutions. -Intention: Commit to small, achievable actions that are specific and measurable.	- Provide multimedia content on postpartum physical activity (e.g., safe walking videos). - Discussion on basic nutritional needs (hydration, protein, fiber). - Sharing ideas for simple, healthy meals and snacks among group members.	1. Schedule and log two 10-minute walks per week. 2. Implement one positive dietary change (e.g., increasing vegetable or water intake).	- Challenge: Severe fatigue and an “all-or-nothing” mindset (if I can’t do it perfectly, I won’t do it at all). - Strategy: Promote the philosophy that “something is better than nothing” and use the group for practical idea exchange.

Table 1: Continued

Session	Health Promotion Subscale	Theory of Planned Behavior (Domain Integration)	Key Activities (via WhatsApp Group)	Weekly Homework / Action Goal	Primary Challenge & Facilitative Strategy
4	Spiritual Growth: Finding inner peace and meaning in the role of motherhood, going beyond just physical activities.	- Attitude: Value inner peace as a vital resource for better caregiving and patience. - Subjective Norms: Discuss how the mother's personal calm and spiritual well-being positively benefit the entire family. - Perceived Behavioral Control: Practice brief, accessible mindfulness techniques (even just 5 minutes) that fit into a busy day. - Intention: Schedule a specific daily time for a chosen spiritual or reflective practice.	- Discussion on defining spiritual growth from each mother's personal perspective (can be meditation, prayer, nature walks, etc.). - Sharing short guided meditations or reflective prompts via the group. - Brainstorming ways to integrate brief moments of peace into the daily hustle of childcare.	Practice "5 Golden Minutes" of a chosen spiritual or reflective activity daily and journal the experience each day.	- Challenge: Guilt over taking time for oneself and viewing it as non-essential or selfish. - Strategy: Frame spiritual practice as "mental nutrition" that is essential for building patience and resilience in motherhood.
5	Interpersonal Relations: Developing effective communication skills, asking for help, and building a strong support network.	- Attitude: Frame asking for help as a sign of strength and wisdom, not a weakness. - Subjective Norms: Practice directly enlisting support from the social network (family and friends). - Perceived Behavioral Control: Build skills in assertive communication (expressing needs without aggression or passivity). - Intention: Plan one specific, concrete request for support and commit to delivering it.	- Role-play exercises via text or audio messages on using "I" statements (e.g., "I need your help with..."). - Group discussion on building and strengthening a supportive network. - Sharing strategies for delegating household or childcare tasks to others.	Initiate one purposeful conversation to express a need or appreciation, and make one specific, practical request for help from a specific person.	- Challenge: Feelings of guilt and feeling like a burden when asking for assistance. - Strategy: Normalize the need for help during the postpartum period; build confidence through rehearsal and peer validation within the group.
6	Stress Management: Learning practical skills to reduce tension and maintain calmness in challenging situations.	- Attitude: Position stress management as a learnable skill (not an innate trait) that can be improved with practice. - Subjective Norms: Encourage group sharing of effective coping techniques to create a synergistic learning environment. - Perceived Behavioral Control: Master a quick stress-reduction tool (e.g., diaphragmatic breathing) that can be used anytime. - Intention: Create a personal post-program maintenance plan to continue the healthy habits independently.	- Teaching a specific breathing technique (e.g., the 4-7-8 method for rapid anxiety reduction). - Review of overall progress and sharing of success stories within the group. - Collaborative creation of maintenance strategies for sustaining healthy routines.	Develop a personal sustainability plan outlining 2-3 key habits to continue and strategies for anticipated obstacles after the program ends.	- Challenge: Maintaining new routines without the group structure and external support. - Strategy: Consolidate learned skills, plan for potential setbacks, and emphasize the continued availability and encouragement of peer support even after the formal sessions end.

The intervention, including all brainstorming and problem-solving activities, was conducted independently for each group to ensure manageability, active engagement, and a safe environment for self-disclosure. The mothers had the opportunity to express their daily experiences and feelings in both private and group settings. They were also encouraged to share the educational content with their partners and family members.

Weekly homework assignments focused on identifying personal barriers and facilitators to a healthy lifestyle. The participants were guided to set self-formulated goals related to key health behaviors, including sleep hygiene, physical activity, nutrition, stress management, interpersonal relationships, and spiritual growth for mental well-being. These assignments were tailored to align with each participant's knowledge, attitudes, behavioral intentions, and PBC (Table 1). Participants were asked to send their completed tasks privately and independently to the researcher via WhatsApp throughout the week, without sharing them publicly at the time of submission. Under the supervision of the second and third authors, the first author reviewed each submission individually, provided personalized and confidential feedback to every participant, and subsequently encouraged them to voluntarily share their experiences or assignment summaries in the main group if they felt comfortable doing so; this approach maintained psychological safety while simultaneously fostering normative peer support and collaborative learning through voluntary sharing. Additionally, the first and second researchers remained actively present in all groups throughout each week to offer clarifications, answer questions, and provide gentle reminders, thereby ensuring timely and meaningful completion of the weekly tasks.

The intervention was performed by the first author, F.N., who holds a master's degree in Midwifery Counseling. In addition to her relevant academic background, she has completed specialized workshops on health education models and holds a certification

to conduct such interventions. All content, educational materials, and discussion guides for the intervention program were developed based on a comprehensive literature review and under the direct supervision and guidance of the second author, F.M.T., and the third author, M.H., a faculty member and psychiatrist. The content was then reviewed and approved by a panel of 12 faculty members specializing in health education and reproductive health to determine its validity and relevance for the target population.

HPLP as primary outcome was measured at three distinct time points for all participants to assess both the immediate and sustained effects of the intervention. The first assessment (T0) was conducted at baseline, before the intervention. The second assessment (T1) took place one month after the completion of the sixsession program, and the third assessment (T2) was done three months postintervention.

Data were collected using a basic characteristics questionnaire and the HPLP-II scale. The basic characteristics included maternal age, BMI, educational attainment and occupation of both the woman and her spouse, perceived family income sufficiency, type of delivery and breast feeding, and health-related behaviors such as smoking and exercise patterns.

HPLP-II has 52 items in domains of 9 items for nutrition, 8 for physical activity, 9 for spiritual growth, 9 for health responsibility, 8 for stress management, and 9 items for interpersonal relations. All the items are scored on a Likert scale of 1 to 4 (Never=1, Sometimes=2, Often=3, Always=4). Each dimension of HPLP-II is scored separately, and a total score is calculated for the entire questionnaire. Each subscale and the total scale are interpreted continuously, meaning that an increase in scores reflects improvement in the respective domain. It should be noted that the HPLPII does not have a specific clinical cutoff point for categorization; instead, scores are evaluated as continuous measures to assess the degree of engagement in healthpromoting behaviors. The alpha reliability coefficient for

the total scale is 0.92; alpha coefficients for the subscales range from 0.70 to 0.90.¹⁸ In the present study, the Persian translated version of the 52-item HPLP was used. The Persian version was evaluated by Mohammadi et al., and its reliability (internal confidence) was 0.82 for the total scale, ranging from 0.64 to 0.91 for the subscales.¹⁹

Baseline demographic and clinical characteristics, as well as HPLPII subscale and total scores, were compared between the intervention and control groups using independent ttests for continuous variables

and chisquare tests for categorical variables. To examine the effect of the intervention over time, repeatedmeasures analysis of variance (ANOVA) was conducted to compare the mean scores of the HPLPII and its subscales across the three assessment time points (baseline, onemonth followup, and threemonth followup). For significant groupbytime interactions, pairwise comparisons with Bonferroni adjustment were made. Statistical analyses were performed using SPSS software (version 20.0; IBM Corp., Armonk, NY, USA). The significance level for all tests was set at $P<0.05$.

Table 2: Comparison of basic characteristics between the intervention and control groups

Characteristics	Control group (Mean±SD)	Intervention group (Mean±SD)	P value
Age (year)	27.48±5.99	26.65±5.97	0.48*
Body Mass Index (kg/m ²)	27.81±1.60	28.14±1.81	0.49*
	N (%)	N (%)	
Smoking			
Yes	10 (19.23)	8 (15.38)	0.60**
No	42 (80.77)	44 (84.62)	
Type of delivery			
Vaginal	26 (50.00)	23 (44.23)	0.55**
Cesarean	26 (50.00)	29 (55.77)	
Exercise			
Low 30 min	26 (50.00)	29 (55.76)	0.53***
30-60 min	24 (46.16)	23 (44.24)	
More 60 min	2 (3.84)	0 (0.00)	
Home ownership			
Rental	21 (40.38)	27 (51.92)	0.23**
Owner's	31 (59.62)	25 (48.08)	
Participants' education			
High school & Diploma	15 (28.84)	15 (28.84)	0.82**
College educated	37 (71.16)	37 (71.16)	
Participants' occupation			
Housekeeper	34 (65.38)	35 (67.31)	0.83**
Employee	18 (34.62)	17 (32.69)	
Husband's education level			
High school & Diploma	27 (51.92)	26 (50.00)	0.84**
College educated	25 (48.08)	26 (50.00)	
Husband's Occupation			
Governmental job	32 (61.53)	31 (59.62)	0.84**
Self-Employee	20 (38.47)	21 (40.38)	
Economic status			
Enough Relatively	25 (48.08)	31 (59.62)	0.34**
Enough	22 (42.31)	19 (36.54)	
Insufficient	5 (9.61)	2 (3.84)	
Breast feeding			
Exclusive	26 (50.00)	31 (59.61)	0.20**
Nonexclusive	26 (50.00)	21 (40.39)	

*Independent t-test; **Chi-Square; ***Fisher Exact Test

Ethics Committee of Urmia University of Medical Sciences approved this study (Ethical code: IR.UMSU.REC.1400.177). Written informed consent was obtained before data gathering. Participants were fully conscious of the research and the right to leave the study at any time. They were informed that the study participation was anonymous and that their personal information was secured throughout the study. Adhering to ethical principles, participants in the control group were offered

access to the intervention program materials after they had completed their final follow-up questionnaires.

RESULTS

There was no attrition during the study period; all 104 participants (52 in each group) were successfully followed up and assessed one month and three months after the completion of the intervention (Figure 1). The mean age

Table 3: Comparison of the total and sub-scale scores of Health-Promoting Lifestyle Profile between the intervention and control groups at baseline

Variable	Intervention Group (Mean±SD)	Control Group (Mean±SD)	P value*
Health Responsibility	20.23±2.70	19.21±2.32	0.13
Physical Activity	15.63±2.45	14.61±2.06	0.12
Nutrition	19.23±2.70	19.21±2.32	0.97
Spiritual Growth	18.02±3.66	18.31±4.36	0.72
Interpersonal Relations	20.98±2.84	19.87±2.66	0.13
Stress Management	18.01±1.85	18.05±2.30	0.93
Health-promoting lifestyle profile total score	112.90±10.51	107.94±10.81	0.15

*Independent t-test

Table 4: Comparison of health-promoting lifestyle profile and its subscales mean scores in the intervention and control groups at baseline, 1 month, and 3 months after the intervention using repeated-measures analysis of variance

Variable	Time	Intervention (n=52) Mean±SD	Control (n=52) Mean±SD	Group Effect F, P value	Time Effect F, P value	Group*Time Interaction F, P value
Health responsibility	Baseline	20.23±2.70	19.21±2.32	47.29, <0.001	0.96, 0.38	11.81, <0.001
	1-month	22.35±3.93	18.10±2.63			
	3-month	21.91±3.91	18.09±2.62			
Physical Activity	Baseline	15.63±2.45	14.61±2.06	67.18, <0.001	32.93, <0.001	85.49, <0.001
	1-month	23.35±3.30	13.84±3.07			
	3-month	23.09±3.20	14.05±2.40			
Nutrition	Baseline	19.23±2.70	19.21±2.32	0.06, 0.79	14.50, <0.001	5.98, 0.004
	1-month	19.33±2.87	18.71±2.40			
	3-month	20.77±2.84	18.70±2.39			
Spiritual Growth	Baseline	18.02±3.66	18.31±4.36	0.73, 0.39	15.86, <0.001	0.34, 0.68
	1-month	17.06±3.47	17.73±4.70			
	3-month	19.09±3.62	18.75±4.69			
Interpersonal Relations	Baseline	20.98±2.84	19.87±2.66	46.24, <0.001	22.72, <0.001	19.29, <0.001
	1-month	25.63±4.70	20.36±4.10			
	3-month	24.82±4.44	19.48±2.99			
Stress Management	Baseline	18.01±1.85	18.05±2.30	42.40, <0.001	7.42, 0.001	32.78, <0.001
	1-month	21.05±2.13	16.94±2.09			
	3-month	19.90±2.06	17.55±2.32			
Health-promoting lifestyle profile total score	Baseline	112.90±10.51	107.94±10.81	229.90, <0.001	188.22, <0.001	154.19, <0.001
	1-month	127.76±10.74	105.70±11.18			
	3-month	124.80±11.78	105.63±11.63			

of all the participants in the study was 27.06 ± 5.98 years. Baseline demographic and clinical characteristics were comparable between the intervention and control groups, with no statistically significant differences observed ($P > 0.05$) (Table 2).

Using an independent t-test, we compared the mean scores of all HPLP-II subscales and total scores between the intervention and control groups at baseline. Findings revealed no significant differences in any subscale or total score ($P > 0.05$) (Table 3).

Table 5: Pairwise comparisons of time and groups regarding the mean scores of HPLPII total and subscales using Bonferroni posthoc test

Variable	Group	Times	Mean Difference (SE)	95% Confidence Interval	P value
Health Responsibility	Intervention	T0-T1	2.12 (0.57)	1.00, 3.24	<0.001
		T0-T2	1.68 (0.60)	0.50, 2.86	0.004
		T1-T2	-0.44 (0.55)	-1.52, 0.64	0.69
	Control	T0-T1	-1.11 (0.50)	-2.09, -0.13	0.02
		T0-T2	-1.12 (0.52)	-2.14, -0.10	0.03
		T1-T2	-0.01 (0.48)	-0.95, 0.93	0.99
Physical Activity	Intervention	T0-T1	7.72 (0.76)	6.23, 9.21	<0.001
		T0-T2	7.46 (0.72)	6.05, 8.87	<0.001
		T1-T2	-0.26 (0.68)	-1.59, 1.07	0.99
	Control	T0-T1	-0.77 (0.62)	-1.99, 0.45	0.31
		T0-T2	-0.56 (0.58)	-1.70, 0.58	0.58
		T1-T2	0.21 (0.55)	-0.87, 1.29	0.85
Nutrition	Intervention	T0-T1	0.10 (0.51)	-0.90, 1.10	0.99
		T0-T2	1.54 (0.55)	0.46, 2.62	0.005
		T1-T2	1.44 (0.53)	0.40, 2.48	0.008
	Control	T0-T1	-0.50 (0.48)	-1.44, 0.44	0.49
		T0-T2	-0.51 (0.50)	-1.49, 0.47	0.50
		T1-T2	-0.01 (0.46)	-0.91, 0.89	0.99
Spiritual Growth	Intervention	T0-T1	-0.96 (0.62)	-2.18, 0.26	0.17
		T0-T2	1.07 (0.65)	-0.21, 2.35	0.14
		T1-T2	2.03 (0.60)	0.85, 3.21	<0.001
	Control	T0-T1	-0.58 (0.70)	-1.96, 0.80	0.68
		T0-T2	0.44 (0.73)	-1.00, 1.88	0.82
		T1-T2	1.02 (0.68)	-0.32, 2.36	0.20
Interpersonal Relations	Intervention	T0-T1	4.65 (0.72)	3.24, 6.06	<0.001
		T0-T2	3.84 (0.70)	2.47, 5.21	<0.001
		T1-T2	-0.81 (0.68)	-2.14, 0.52	0.35
	Control	T0-T1	0.49 (0.69)	-0.86, 1.84	0.75
		T0-T2	-0.39 (0.65)	-1.66, 0.88	0.82
		T1-T2	-0.88 (0.67)	-2.19, 0.43	0.31
Stress Management	Intervention	T0-T1	3.04 (0.42)	2.22, 3.86	<0.001
		T0-T2	1.89 (0.38)	1.15, 2.63	<0.001
		T1-T2	-1.15 (0.40)	-1.93, -0.37	0.004
	Control	T0-T1	-1.11 (0.45)	-1.99, -0.23	0.02
		T0-T2	-0.50 (0.43)	-1.34, 0.34	0.42
		T1-T2	0.61 (0.41)	-0.19, 1.41	0.20
Health-promoting lifestyle profile total score	Intervention	T0-T1	14.86 (2.12)	10.70, 19.02	<0.001
		T0-T2	11.90 (2.34)	7.31, 16.49	<0.001
		T1-T2	-2.96 (1.78)	-6.45, 0.53	0.12
	Control	T0-T1	-2.24 (2.05)	-6.26, 1.78	0.52
		T0-T2	-2.31 (2.11)	-6.45, 1.83	0.49
		T1-T2	-0.07 (1.60)	-3.21, 3.07	0.99

T0: Baseline; T1: One month after the intervention; T2: Three months after the intervention

Repeated measures ANOVA revealed a significant group by time interaction for total HPLP score ($F=154.19$, $P<0.001$) and for all subscales ($P<0.05$) except for spiritual growth ($F=0.34$, $P=0.68$) (Table 4).

Pairwise comparisons with Bonferroni adjustment were performed to further explore the significant groupbytime interactions. Findings revealed that the intervention group showed significant improvements from baseline to onemonth followup in total and all subscales mean scores of HPLP ($P<0.001$), except for nutrition and spiritual growth ($P>0.05$). These gains were maintained at three months after the intervention ($P<0.05$). Nutrition mean score improved significantly from baseline to three months after the intervention ($P=0.005$) and from one month to three months after the intervention ($P=0.008$). Spiritual growth mean score also demonstrated a delayed but significant improvement from one month to three months postintervention in the intervention group ($P<0.001$); however, no significant changes were observed from baseline to one month ($P=0.17$) or from baseline to three months ($P=0.14$). The control group showed no significant differences over time in the mean scores of total and all subscales ($P>0.05$), except for stress management from baseline to one month later ($P=0.02$) and health responsibility from baseline to one month ($P=0.02$) and to three months ($P=0.03$). The significant differences were due to worsening of stress management and health responsibility (Table 5).

DISCUSSION

The findings of the present study demonstrated that a TPB-based intervention delivered via WhatsApp groups was effective in promoting health-promoting lifestyles among mothers with overweight and obesity during the postpartum period. Significant improvements were observed in the total HPLP score and most subscales in the intervention group compared to the control group, with spiritual growth showing a delayed but significant improvement at threemonth

followup. These findings highlight the potential of theorybased interventions delivered through digital platforms during the postpartum period and align with the growing global trend toward using theoretical approaches in health intervention design.²⁰⁻²²

Pairwise comparisons further elucidated the patterns of change over time. In the intervention group, improvements from baseline to one month were significant for all domains except for nutrition and spiritual growth. These gains were largely sustained in comparison from baseline to three months, with nonsignificant declines from one month to three months after intervention in the total score of HPLP, physical activity, interpersonal relations, health responsibility, and stress management. Nutrition demonstrated a delayed effect, with significant improvement only at three months, while spiritual growth did not show the effect. These domainspecific temporal patterns provide important insights for designing future interventions.

The most pronounced intervention effect was observed for physical activity. A review study that focused on physical activity in pregnancy and postpartum among Iranian women identified barriers at three levels: intrapersonal (e.g., lack of time, fatigue, traditional beliefs), interpersonal (e.g., lack of spousal/family support), and environmental (e.g., lack of safe spaces) with facilitators including electronic educational resources and social support.²³ The present intervention addressed these barriers through WhatsApp-delivered content, weekly goal setting, and peer experience sharing, enhancing self-efficacy for physical activity. The improvement in physical activity at follow-ups with a nonsignificant decline from one to three months confirms that the intervention successfully enhanced PBC by providing practical strategies and peer support, enabling mothers to overcome barriers such as fatigue and lack of time. The review also emphasized the need for culturally appropriate interventions and skilled providers, both of which were incorporated in this study.

Evidence supports technologybased, theorydriven postpartum physical activity interventions. The EMoms study, a 16week smartphonebased postpartum weight loss program integrating TPB with Learning and Social Cognitive Theories, demonstrated feasibility through daily weight/step tracking and weekly tips. The findings revealed that participants with high adherence to the intervention achieved significant weight loss, underscoring that engagement and adherence are critical factors for the success of such digital interventions.²⁴ Another study on identifying behavioral phenotypes associated with digital intervention response found that postpartum women with lower baseline steps and less psychosocial distress walked 1,335 more steps per day in the intervention arm.²⁵ A systematic review confirmed that mHealth apps combining scalability, personalization, and theoretically grounded behavior change techniques improved maternal physical activity outcomes;²⁶ a qualitative meta-synthesis reinforced their acceptability.²⁷ Collectively, these findings align with the present study, confirming that TPB-grounded digital interventions incorporating personalized feedback and social support can effectively promote postpartum physical activity across diverse cultural contexts.

In Iran, while theory-driven digital interventions specifically targeting postpartum physical activity remain limited, a mobile-application intervention during pregnancy significantly improved physical activity levels among Iranian women.²⁸ Additionally, TPB constructs including attitude, subjective norms, and PBC have been shown to predict postpartum physical activity intention in Iranian mothers,²⁹ supporting the theoretical rationale for the present intervention.

Although stress management scores declined slightly from one to three months, this decline was not statistically significant, and the scores remained significantly higher than those at baseline. This pattern may indicate a gradual reduction in the immediate effect of the intervention, suggesting that periodic

reinforcement or booster sessions could be beneficial to maintain peak improvements over longer periods. The significant impact of the intervention on stress management is consistent with other findings. A systematic review demonstrated that various non-pharmacological interventions, including support groups, home visit programs, telephone counseling, and social network-based programs can significantly reduce postpartum stress.³⁰ Furthermore, another study showed that the “Mom Supports Mom” peer support intervention was effective in reducing depressive and anxiety symptoms in women during postpartum and improving their health-related quality of life.³¹ In the present study, the WhatsApp groups not only delivered the educational content but also provided a platform for emotional peer support, aligning with international evidence on the effectiveness of social support-based interventions. In Iranian culture, where collectivist values and family support play a pivotal role, this type of social support is particularly important and can serve as a protective factor against postpartum stress.

The improvement in interpersonal relations in the intervention group is another valuable finding consistent with evidence. A study examining ethnic differences in facilitators and barriers to lifestyle management after childbirth found that Asian women faced additional barriers compared to Oceanian women, despite having stronger health knowledge and practical skills. These additional barriers were largely cultural in nature, including traditional confinement practices, intergenerational expectations, and social isolation highlighting the need for culturally tailored interventions that address the unique challenges faced by Asian women in postpartum.³² The present intervention, which encouraged mothers to share educational content with their spouses and extended family members, may have helped mitigate some of these cultural barriers by fostering family engagement and communication, thereby contributing to the observed improvements

in interpersonal relations. In Iran, the family is recognized as the most important supportive institution during the postpartum period, and encouraging mothers to share educational content with their spouses and family members played an effective role in improving their interpersonal relationships. This is supported by a study that found that both spousal and family supports were strong predictors of maternal functioning in Iranian women during the postpartum. Women with low spousal support had significantly lower maternal functioning scores compared to those with high spousal support; similarly, low family support was associated with significantly lower maternal functioning.³³ These findings indicate that receiving support from both the spouse and family members can improve maternal functioning, highlighting the importance of family-centered approaches in postpartum health interventions. This family-centered approach aligns with the Iranian cultural emphasis on family bonds.

The increase in health responsibility in the intervention group reflects a shift in mothers' attitudes toward self-care. In Iranian culture, mothers typically prioritize their infants' and families' needs over their own, often viewing self-care as a secondary concern.³⁴ ³⁵ The culturally adapted clinical guideline for postpartum care in Iran, published in 2024, emphasizes maternal care as one of four core components and provides 56 recommendations across the domains, including maternal care, neonatal care, health promotion interventions, and post-cesarean care.³⁶ The present intervention, which emphasized the positive outcomes of self-care and provided practical strategies for time management and prioritization, aligned with the recommendations of this clinical guideline. The observed improvement in health responsibility aligns with the findings from a recent quasi-experimental study in Iran, which reported that TPB-based education significantly enhanced HPL scores among women at risk for cardiovascular disease.¹² This suggests that TPB-based interventions

can effectively shift maternal attitudes toward self-care, even in cultural contexts where self-care is traditionally undervalued.

Although no significant between-group difference was observed for nutrition at one month, pairwise comparisons revealed a delayed effect, with significant improvement at three months in the intervention group. This delay may be explained by the postpartum confinement period deeply rooted in Iranian culture, during which grandmothers and female relatives often control food preparation, limiting maternal autonomy over dietary choices in the early postpartum weeks. Consequently, the WhatsApp-based counseling may not have been able to compete with daily face-to-face reinforcement of traditional dietary practices. This suggests that the significant time effect likely captures the natural transition from grandmother-controlled to self-managed eating after the confinement period, rather than a true intervention effect.

A study demonstrated that behavioral interventions based on diet and physical activity could be effective in reducing postpartum weight in women with recent gestational diabetes.³⁷ Another study indicated that low-intensity interventions delivered in primary care and community settings can provide more equitable and scalable weight management support for women during postpartum period.³⁸ However, in Iran, deeply rooted traditional beliefs about postpartum nutrition constitute a major barrier to changing nutritional behaviors. A study found that the majority of Iranian mothers in the puerperal period consumed warm beverages and avoided spicy foods, while consumption of sweet and fatty foods was also common.³⁹ These findings highlight the powerful influence of intergenerational transmission of dietary practices during the postpartum period. Despite the lack of a significant group effect, the significant time effect observed in both groups suggests that nutritional behaviors may naturally shift as mothers gradually regain autonomy over their dietary choices

after the traditional confinement period. This underscores the need for future interventions to adopt a family-centered approach that actively involves grandmothers and other key family members in the educational process to address intergenerational food culture transmission and facilitate sustainable dietary changes among mothers in the postpartum period.

Spiritual growth did not show immediate improvement; however, pairwise comparisons revealed a delayed but significant increase from one month to three months postintervention in the intervention group. This finding suggests that the intervention performed may have gradually influenced the mothers' spiritual wellbeing, with effects becoming evident only at the later followup. The relatively high baseline scores in both groups may have created a ceiling effect, making rapid improvement difficult.⁴⁰ Additionally, spiritual growth typically requires deeper, more timeintensive processes that extend beyond a sixweek behavioral intervention.^{41, 42} The delayed effect observed in this study aligns with evidence indicating that changes in spiritual wellbeing often necessitate longerterm approaches.^{43, 44} Given the cultural significance of spirituality in Iran, where religiosity has been shown to have relieving effects on postpartum wellbeing,⁴⁵ future interventions may benefit from incorporating explicit spiritual or religious content, such as prayer therapy or meditation, alongside TPBbased counseling to accelerate and strengthen the effects on this domain. However, the delayed significant improvement observed in the present study suggests that even general behavioral counseling can gradually influence spiritual growth over time, which is a promising finding.

A key feature of this study was the use of WhatsApp as a delivery platform. Given its widespread access and daily use among Iranian women, WhatsApp provided a familiar, lowcost, and accessible medium for educational interventions. Our findings align with a review which confirmed the effectiveness and acceptability of social

mediabased health promotion interventions among women of reproductive age.⁴⁶

The use of TPB as the theoretical framework is a strength of this research. A study confirmed that TPB constructs robustly predicted weight management behaviors in primiparous women.¹⁶ In our intervention, TPB constructs were operationalized as mechanisms for behavior change: attitudes via linking selfcare to positive maternalinfant outcomes, subjective norms through supportive peer groups and family involvement, and PBC through problemsolving and timemanagement skillbuilding. Another study also showed that TPBbased interventions using peer groups and social networks significantly improved TPB construct scores.⁴⁷ These findings highlight the TPB's adaptability to different cultural contexts and its effective operationalization through digital platforms to promote postpartum health behaviors.

Despite promising findings, this study had several limitations. First, the inability to blind participants and intervention facilitators due to the nature of the behavioral intervention might have influenced the results. Second, the three-month follow-up period, while appropriate for assessing sustainability of changes, cannot guarantee long-term maintenance of health behaviors. Future studies with longer follow-up periods (e.g., six months or one year) are recommended. Third, the study population consisted of urban mothers with Internet access and smartphones, limiting generalizability to rural or underserved mothers.

CONCLUSION

This study demonstrates that a TPBbased educational intervention delivered via WhatsApp is an effective and feasible approach for promoting healthpromoting lifestyles among mothers with overweight and obesity during the postpartum period. Given the widespread use of social media in Iran, such interventions can serve as a lowcost, scalable, and complementary approach to postpartum health promotion.

Future research should move toward designing more comprehensive interventions with explicit spiritual or religious content tailored to the specific needs of diverse populations of Iranian mothers.

Acknowledgement

This article is derived from a master thesis in midwifery consultation. The authors would like to thank the honorable Research Vice President of Urmia University of Medical Sciences, and all participants for their cooperation in this study.

Authors' Contribution

F.M.T. and A.D. contributed to the study conception and design. F.N. performed data collection. F.M.T. and R.G. performed data analysis and interpretation. F.N. and F.M.T. wrote the first draft of the manuscript. A.D. and R.G. critically revised the manuscript. All authors reviewed and approved the final manuscript; they accept responsibility for its content and integrity. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Funding source

This study was supported financially by Urmia University of Medical Sciences (Grant number: 10604).

Conflict of Interest

None Declared.

Declaration on the Use of AI

This manuscript was edited using artificial intelligence tools, including ChatGPT, solely to enhance language clarity and readability. The authors have thoroughly reviewed and verified all scientific content and editorial modifications and take full responsibility for the final manuscript.

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