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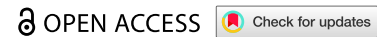


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RESEARCH ARTICLE



A randomized controlled trial investigating the impact of coping strategies training for fathers during pregnancy on postnatal depression among couples

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ABSTRACT

Background: Postpartum depression (PPD) is a significant public health concern affecting both mothers and fathers, with paternal well-being being a crucial yet often neglected factor in family mental health.

Objective: The present study investigated the impact of coping strategies training for fathers during pregnancy on couples' PPD.

Methods: A randomized controlled trial was conducted comprising 86 couples experiencing first-time pregnancy (43 per group) in Qazvin, Iran, in 2024. The intervention group received five virtual sessions (45–60 min each) on coping strategies, while the control group received routine prenatal education through their routine prenatal care visits.

Results: Post-intervention, couples' perceived stress scores decreased significantly at the first and second follow-up in the intervention vs. control group. The training significantly increased problem-focused strategy scores by 2.76 points among mothers (standardized mean difference [SMD] = 1.51) and 1.89 points among fathers (SMD = 0.99) compared to controls at one-month postpartum, while reducing emotion-focused coping among mothers by –2.23 points (SMD = –1.03) and among fathers by –1.71 points (SMD = –0.77). PPD scores were significantly lower in the intervention group (mean difference of –5.51 among women and –4.55 among men; both $p < 0.001$).

Conclusion: Antenatal coping strategies training for fathers can be an effective intervention to mitigate PPD by reducing their stress.

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Pregnancy; postpartum depression; coping strategies; perceived stress; father education

Introduction

The perinatal period encompassing pregnancy, childbirth, and transition to parenthood represents a time of profound joy for families, which also brings significant psychological and social changes for parents [1]. Two common psychological states during this period are postpartum blues and postpartum depression. Postpartum blues, experienced by approximately 80% of women within the first two weeks after delivery, is a natural and transient condition characterized by fatigue, anxiety, and alterations in sleep and appetite patterns. These symptoms typically resolve spontaneously between 7–14 days postpartum [2,3]. Postpartum depression constitutes a serious and persistent disorder that may continue for months or even years. This clinical condition presents with symptoms including marked energy depletion, diminished libido, and suicidal ideation [4,5].

Depression, particularly postpartum depression (PPD), constitutes a significant mental health concern during the perinatal period. In Iran (where the present study was conducted), studies report an average PPD prevalence of 25.3%, although rates vary substantially by region from 7.1% to 43.5%, reflecting

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socioeconomic and geographic disparities [6,7]. As a leading cause of preventable maternal morbidity, PPD incidence peaks during the first six months postpartum [8,9]. The etiology appears multifactorial, including physiological changes from pregnancy and childbirth, as well as stress due to diminished autonomy and environmental adjustments [10,11].

PPD is not exclusive to mothers, with fathers also being vulnerable to its effects. Research indicates paternal depression prevalence rates of 4.8%–10% during the prenatal period and 6.6%–13.6% postpartum [12,13]. A recent systematic review confirmed that paternal PPD remains a prevalent and clinically significant issue, with its own unique set of risk factors and detrimental consequences for family well-being [14]. Paternal PPD most commonly arises within the first three to six months postpartum, mirroring the peak period for maternal PPD [15]. The etiology of paternal perinatal depression is multifactorial, encompassing hormonal changes, sleep deprivation, the transition to fatherhood, financial pressures, and a lack of social support and preparedness [16–18]. Unlike maternal PPD, paternal depression often manifests through symptoms such as social withdrawal, irritability, and (in extreme cases) aggressive behavior. These symptoms can have significant consequences, including impaired child development and increased family psychological distress [17,19]. Importantly, a strong bidirectional association exists between maternal and paternal depression, where symptom severity in one parent may exacerbate symptoms in the other [19].

Multiple factors contribute to postpartum stress – including hormonal fluctuations, sleep deprivation, and diminished social support – which may progress to clinical depression if unaddressed. Empirical evidence identifies infant feeding difficulties, maternal sleep deficiency, and inadequate social support as key predictors of postpartum stress among women [20], all of which are established risk factors for depression. Moreover, stressful birth experiences and significant lifestyle changes can trigger maladaptive stress responses that heighten vulnerability to depressive disorders [21].

This stress-depression pathway affects both parents bidirectionally. While mothers face biological stressors that predispose them to depression, fathers struggle with life transitions and increased responsibilities [18,22] that may manifest as depressive symptoms through different mechanisms. Crucially, this shared stress burden creates a reciprocal dynamic where one parent's deteriorating mental health exacerbates the other's risk of postpartum depression [23]. These findings collectively underscore the necessity of couple-centered frameworks in PPD prevention and treatment [24].

The first six months postpartum represent a critical window where support is most impactful, coinciding with peak stress and fatigue levels [19]. Support, particularly from partners, plays a pivotal role in reducing PPD [25] because spousal social support has been shown to have a moderately inverse and significant association with maternal PPD [26]. Despite the importance of spouse support during perinatal period, many fathers lack awareness of their role during this transition, often experiencing feelings of exclusion [16].

Effective support in postpartum period manifests in two key forms: emotional support (empathy, positive reinforcement) and practical support (childcare assistance, household help) [27]. Inadequate family–community support exacerbates postpartum stress, while structured interventions enhancing paternal engagement and efficacy during the postpartum period has been associated with improved maternal mental health and quality of life [28,29]. Targeted education for fathers on postpartum stress management can improve family dynamics and reduce couple's anxiety [30].

Successful adaptation to parenthood requires simultaneous biological adjustments (e.g. hormonal changes), psychological resilience (e.g. coping strategies) and social integration (e.g. partner involvement) [31]. Mothers with strong adaptive capacities demonstrate greater parenting self-efficacy and lower stress [9,32]. Tripartite support systems, combining social networks, adaptive coping, and active father participation significantly improve maternal mental health outcomes [33]. Appropriate coping strategies are crucial for stress management and depression prevention during the perinatal period [34].

These strategies are broadly categorized into three types of (i) problem-focused coping (active problem-solving, seeking information); (ii) emotion-focused coping (emotional regulation, reframing); and (iii) maladaptive/avoidant coping (denial, self-blame, withdrawal) [35]. Maladaptive strategies (e.g. denial, self-blame, emotional distancing) significantly increase postpartum depression risk [36,37]. Mothers relying on emotion-focused or avoidant coping are particularly vulnerable to depressive symptoms [32,38]. In contrast, adaptive coping strategies especially when combined with strong social support, enhance maternal resilience against childbirth-related stressors [39,40].

The postpartum period presents families with significant transitions that require effective spousal support and adaptive coping strategies. While cross-sectional studies have established associations between coping strategies and postpartum mental health outcomes [41–43], no previous intervention studies have ever examined the efficacy of coping skills training for preventing postpartum depression (PPD) among couples. This represents a critical knowledge gap, given two key findings from prior research including: (i) *dyadic nature of PPD*: PPD is a shared crisis among couples, where spousal support serves as a vital buffer against postpartum stressors [8,26]; and (ii) *paternal influence*: fathers play a unique role in maternal mental health engagement during this period [44], yet their potential as agents of change remains understudied [45].

As one of the first intervention trial targeting paternal coping skills training during pregnancy, the present study addresses three unmet needs that consider: (i) proactive intervention during pregnancy (vs. reactive postpartum treatment); (ii) the application of dyadic focus with simultaneous measurement of both parents outcomes; and (iii) coping skills as a modifiable mediator between support and PPD. The hypothesized pathway for designing present study was that antenatal coping training for fathers might improve paternal support (both emotionally and practically), which can enhance maternal coping skills and subsequently reduced dyadic PPD incidence.

The study was designed to investigate the effect of antenatal coping strategies training for fathers on postpartum depression in couples. It was hypothesized that: (i) antenatal coping strategies training for fathers would be effective in reducing couples postpartum depression (H_1); (ii) antenatal coping strategies training for fathers would be effective in reducing couples perceived stress (H_2), and (iii) antenatal coping strategies training for fathers would be effective in improving couples coping strategies (H_3).

Methods

Study design

The present study was a two-arm, prospective, parallel-group randomized controlled trial (RCT) with a 1:1 allocation ratio. It was designed to evaluate the effect of antenatal coping strategies training for fathers in preventing postpartum depression (PPD) among couples. The study was conducted in Qazvin, Iran, from April to December 2024. The CONSORT guidelines for non-pharmacological interventions was adhered to in the present study [46].

Participants

Eighty-six couples, each consisting of a first-time pregnant woman and her spouse, were recruited from urban comprehensive health centers in Qazvin, Iran. Participants were required to meet the following inclusion criteria: first-time pregnancy (primigravida) with a singleton gestation; gestational age between 30 and 32 weeks at the time of recruitment; residence in Qazvin for the duration of the study period; ownership of a smartphone with reliable internet access; at least basic literacy (reading and writing proficiency) in Farsi; and willingness of both partners to participate and provide written informed consent. The gestational age window of 30–32 weeks was selected to allow sufficient time for intervention delivery before childbirth while ensuring pregnancy viability. The requirement for smartphone/internet access was necessary for the delivery of the virtual intervention, and residential stability was essential to ensure complete follow-up participation. The primigravida criterion was implemented to control for potential confounding effects of parity on psychological outcomes. The exclusion criteria were: being identified as having a high-risk pregnancy (e.g. due to medical complications in the mother or fetus); a self-reported history of any psychological disorder (for either partner); a prior history of abortion or stillbirth; and participation in any other concurrent antenatal mental health intervention.

Recruitment

A multi-stage cluster sampling technique was employed to ensure a representative geographic sample across Qazvin, Iran. This process involved four key stages: (i) first, the city was divided into five distinct

geographic zones (north, east, south, west and center); (ii) second, two comprehensive health centers were randomly selected from each zone, creating ten total recruitment clusters; (iii) third, electronic medical records at each center were used to identify all potentially eligible pregnant women at 30–32 weeks gestation; and (iv) finally, potential participants were contacted for a structured telephone screening interview. Couples who met all eligibility criteria and provided written informed consent were subsequently enrolled in the study and underwent the randomization process.

Randomization and concealment

Eligible participants were randomly assigned to either the antenatal coping strategies training group or the sham control group using a permuted block randomization method with a block size of four. To ensure allocation concealment and minimize selection bias, randomization sequences were generated via a web-based random number generator [47] and securely stored in sequentially numbered, opaque, sealed envelopes by an independent researcher not involved in recruitment or intervention delivery. The use of permuted block randomization helped maintain approximate balance between groups throughout recruitment, while opaque envelopes ensured that neither participants nor researchers could influence group assignment. Figure 1 presents the study's CONSORT flow diagram from recruitment to analysis.

Sample size estimation

The sample size was determined based on measure of effect reported by Dennis et al. (2020) in a telephone-based nurse-delivered interpersonal psychotherapy for postpartum depression (OR = 0.22, $d = -0.83$) [48]. With $\alpha = 0.05$, power = 80%, and accounting for 10% attrition, 86 couples (43 per group) were required to detect a 30% between-group difference in PPD incidence.

Intervention protocol

Intervention group

The antenatal coping strategies training for expectant fathers was delivered individually through their selected virtual platforms (e.g. *WhatsApp*, *Rubika*, etc.) at participants preferred times to optimize their engagement. The intervention comprised five 45–60 min sessions combining didactic instruction, interactive Q&A, and supplementary educational materials. Table 1 provides the content of the antenatal coping strategies training program for expectant fathers. Each session began with a review of previous content and participant feedback, followed by new material covering stress management techniques, problem-solving strategies, and couples communication skills. Participants could access ongoing support between sessions via telephone, text, or social media. This flexible, participant-centered approach – featuring multimodal delivery (verbal, written, and practical components) and adaptable scheduling – was designed to overcome logistical barriers while maintaining intervention fidelity. The virtual format proved particularly effective for this population, offering privacy for sensitive discussions and scalability for potential broader implementation, while still allowing for personalized adjustments based on individual needs and progress.

Intervention fidelity

To ensure intervention fidelity was maintained throughout the study, a multi-faceted approach was implemented, guided by the National Institutes of Health (NIH) Behavior Change Consortium (BCC) recommendations [49]. The intervention was delivered by a single facilitator, and a clinical consultant in midwifery with expertise in cognitive-behavioral therapy and perinatal health, who was rigorously trained on a structured session-by-session manual. This manual detailed core objectives, key points, and activities for each of the five sessions to ensure consistency in content delivery. The facilitator participated in weekly supervision meetings with the principal investigator to review progress and uphold protocol adherence. Participant engagement was monitored through attendance records and tracking of between-session assignments. Moreover, to objectively evaluate fidelity, a random sample of 20% of the virtual sessions were audio-recorded (with participant consent) and rated by an independent rater (clinical psychologist).

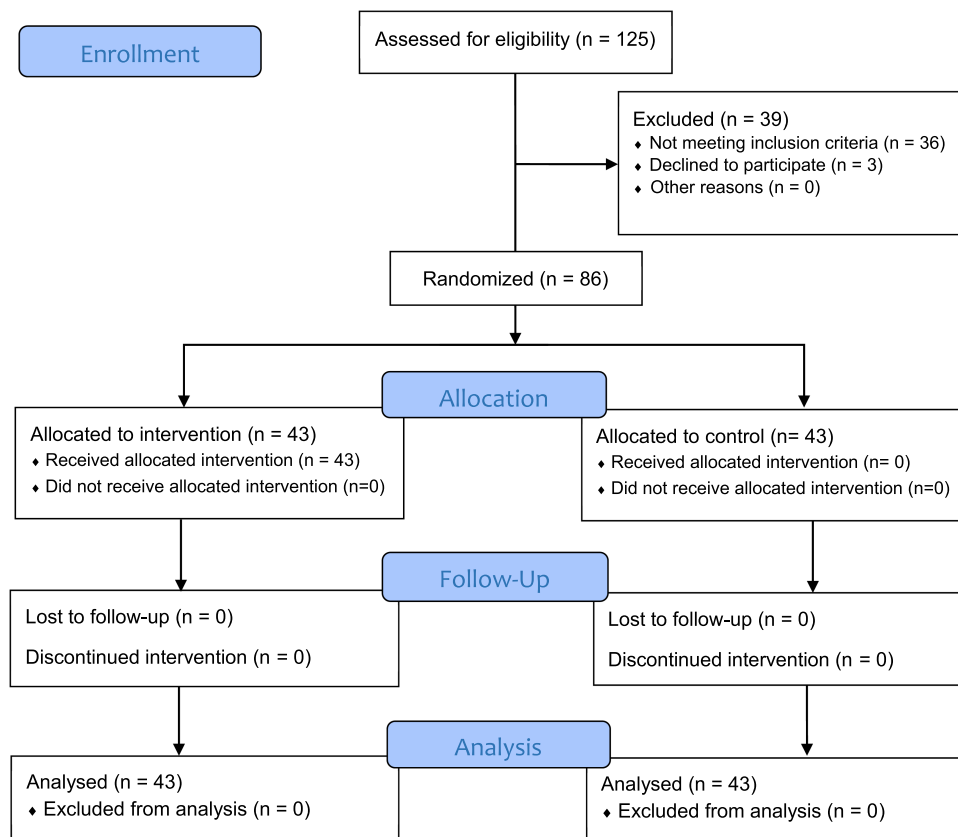


Figure 1. CONSORT flow diagram.

Table 1. Counseling program for antenatal coping strategies training of expectant fathers.

Session no.	Title	Objectives and activities	Assignments
1	Introduction to depression: causes and contributing factors	Understanding the nature of depression, its symptoms, and the role of genetic, environmental, and psychological factors	Learn about depression, its causes, and related symptoms
2	Self-care principles	Teaching meditation, emotion regulation strategies, and mindfulness exercises	Healthy lifestyle, walking, meditation, deep breathing, goal-setting, mindfulness
3	Depression management skills	Expressing feelings (anxiety/depression), understanding PPD symptoms, somatic symptoms, and strategies to reduce symptoms. Exploring the link between lack of spousal support and PPD.	Identifying negative thoughts, exercise, nature exposure, facing fears, gratitude journaling, adequate sleep, socializing
4	Cognitive restructuring: challenging misconceptions about PP	- Addressing misconceptions about non-pharmacological methods - Highlighting effectiveness of non-drug approaches - Identifying common non-drug methods - Easy learning of coping strategies	Understanding depression myths, lifestyle changes, problem-solving techniques
5	Coping strategies for stress and depression	- Review of previous concepts - Teaching various coping strategies - Practice and evaluation of strategies - Problem-focused strategies - Home exercises - Emotion-focused strategies - Practical implementation with feedback	Applying problem-solving techniques and practicing coping styles

This audit confirmed that over 90% of the key intervention components were delivered in the assessed sessions.

Control group

The control group received routine prenatal education through their routine prenatal care visits.

Participant retention

To mitigate participant turnover and ensure high retention, several proactive strategies were implemented. These included offering logistical flexibility by delivering the virtual intervention at times convenient for participants to minimize scheduling conflicts, maintaining open communication channels for support between sessions via telephone or messaging apps, and employing a reminder system for sessions and assessments through short message sending. The intervention itself was designed to be concise and delivered through user-friendly, familiar virtual platforms to reduce participant burden and technological barriers. These combined measures contributed to the high retention rate and complete data collection for the primary outcome measure.

Blinding

It was not feasible to blind participants or the intervention facilitator to group assignment due to the nature of the psychosocial intervention. However, the outcome assessor and the data analyst were blinded to allocation to minimize assessment bias.

Variables and measures

The primary outcome measure in present study was postpartum depression and the secondary outcomes were perceived stress and coping strategy. In present study, demographic information, postpartum depression, coping with stressful situations, and perceived stress were assessed using the following measures:

Demographic Information Checklist

This checklist included the woman's and her spouse's age, the couple's levels of education, the couple's occupations, the family's perceived economic status, the desire to become pregnant (from the woman's and her husband's view), and the gestational age.

Edinburgh Postnatal Depression Scale (EPDS)

The 10-item EPDS [50] was used to screen couples depressive symptoms starting at six weeks postpartum. While maternal and paternal postnatal depression (PND) can be assessed using diagnostic interviews based on criteria such as those in the DSM-5 [51] or other symptom inventories such as the Beck Depression Inventory (BDI) [52], the EPDS is a well-validated and the most widely used screening tool that specifically assesses perinatal depression among both mothers and fathers. It has been shown to have good sensitivity and specificity for detecting major depression among men during their partner's perinatal period [14,53]. Items (e.g. *"I have been able to laugh and see the funny side of things"*) are rated on a four-point Likert (0 = *As much as I always could* to 3 = *Not at all*), and produces total scores ranging from 0 to 30, with scores ≥ 12 indicating probable postpartum depression [54]. The psychometric properties of the Persian version have been confirmed [55]. Good internal consistency of this scale was verified in present study with a Cronbach's α of 0.76 for female participants and 0.73 for male participants.

Coping Inventory for Stressful Situations-Short Form (CISS-SF)

The CISS-SF [56] is a 21-item scale that was used to assess three coping styles (seven items each): problem-focused (active problem-solving strategies with items such as *"Focus on solving the problem step-by-step"*), emotion-focused (emotional regulation behaviors with items such as: *"Blame myself for having gotten into this situation"*), and avoidant coping (stress disengagement behaviors with items such as: *"Try to forget the whole thing"*). Items are rated on a five-point Likert scale (1 = *very low* to 5 = *very high*), and produces scores on each subscale ranging from 7 to 35. Higher scores indicate greater reliance on the particular coping style. The psychometric properties of the Persian version have been confirmed [57]. Good internal consistency of this scale was verified in present study. For male participants, the Cronbach's α was 0.81 for avoidant coping, 0.83 for problem-focused coping, and 0.91 for emotion-focused coping. For female participants, the Cronbach's α was 0.84 for avoidant coping, 0.88 for problem-focused coping, and 0.89

for emotion-focused coping. The internal consistency for the overall scale was very good (Cronbach's $\alpha = 0.85$).

Perceived Stress Scale (PSS-14)

The 14-item PSS [58] was used to assess general stress levels over the preceding month by assessing thoughts and feelings about stressful events, perceived control, and coping ability. Items (e.g. *"In the past month, how often have you felt confident about your ability to handle your personal problems?"*) are rated on a five-point Likert scale (0 = *never* to 4 = *very often*). Total scores range from 0–56, and higher scores indicate greater perceived stress. The psychometric properties of the Persian version have been confirmed [59]. Good internal consistency of this scale was verified in present study with Cronbach's α of 0.82 for male participants and 0.83 for female participants.

Measurement time points

At baseline, pregnant women and their spouses completed the Demographic Information Checklist, CISS-SF, and PSS-14. To evaluate intervention effects, both groups completed the CISS-SF, and PSS-14 at three time points of pre-intervention, post-intervention, and one-month postpartum. The EPDS was administered to both parents at one-month postpartum.

Data quality control

A multi-faceted approach was employed to ensure data quality throughout the study. First, the outcome assessor was trained on the precise administration protocol for each psychometric instrument (EPDS, CISS-SF, PSS-14) to ensure consistency and completeness of all measures. Second, automated checks were implemented within the digital data entry (e.g. using SPSS) to prevent out-of-range values for all items, eliminating missing data at the point of data entry. Third, a manual data auditing procedure was conducted by a research assistant who was blinded to group allocation. This involved cross-checking a randomly selected 20% of the collected forms against the original electronic entries for transcription errors, with no discrepancies found. Finally, logical consistency checks were performed during data cleaning ahead of the analysis (e.g. ensuring gestational age fell within the 30–32-week window at baseline). These rigorous steps ensured the accuracy, completeness, and reliability of the dataset used for all analyses.

Statistical analysis

All data were analyzed using IBM SPSS Statistics (v.27) following a comprehensive analytical protocol. Initial assessments for between-group comparison of demographic variables was done using Imbens and Rubin's criteria [60], where standardized mean differences <0.25 for continuous variables and absolute percentage differences $<10\%$ for categorical variables indicated balanced distribution of participants in study groups [60]. Normality assumptions were confirmed through Shapiro–Wilk tests ($p > 0.05$), visual inspection of histograms, and evaluation of distribution parameters (skewness $<|2|$ kurtosis $<|7|$) [61]. All analyses were conducted according to the intention-to-treat (ITT) principle, including all randomized participants in the groups to which they were originally allocated. There were no missing data for the primary outcome (postpartum depression) at the one-month postpartum assessment, ensuring a complete ITT analysis.

Primary analyses included repeated-measures ANOVA–ANCOVA with Mauchly's sphericity test and Bonferroni post-hoc corrections for longitudinal coping/stress data (three time points), and between-groups ANOVA–ANCOVA for postpartum depression (single assessment at 30 days). Partial eta-squared and standardized mean difference (SMD) based on Cohen's d were used to assess the measure of intervention effect. The values of partial eta-squared (η^2) are interpreted as negligible effect (<0.01), small effect (0.01–0.06), medium effect (0.06–0.14), and large effect (>0.14) and Cohen's d (SMD) is interpreted as minimal effect (<0.2), small effect (0.2–0.5), medium effect (0.5–0.8), and large effect (>0.8) [62]. All statistical tests used $p < 0.05$.

Ethical considerations

The study protocol was approved by the Research Council and Ethics Committee of Qazvin University of Medical Sciences (Ethics Code: IR.QUMS.REC.1402.397) and was registered with the Iranian Registry of Clinical Trials (Registration Code: IRCT20240220061061N1). Written informed consent emphasized voluntary participation and data confidentiality (anonymized coding). Participants could withdraw anytime without affecting clinical care.

Results

Demographic characteristics

Table 2 provides the participants demographic characteristics. The intervention ($n = 43$) and control ($n = 43$) groups were comparable in most baseline characteristics, although the intervention group was slightly older (mean age 29.7 years vs. 26.6 years, $p = 0.01$). Both groups had similar distributions of education levels ($\approx 60\%$ university level attainment), employment status (all spouses employed), and socioeconomic status ($>80\%$ reporting “fair” economic status). No significant differences were observed in marital duration, gestational age, or living arrangements ($p > 0.20$ for all). However, based on Imbens and Rubin's criteria [60], age, spouse age, marriage duration, and gestational age appeared to be imbalanced between study groups and were adjusted as covariates in all statistical analysis.

Perceived stress

The analysis showed significant intervention effects on perceived stress for both mothers and fathers (Table 3, Figure 2). Among women, the intervention group showed progressive stress reduction from baseline ($M = 23.77$) to one-month postpartum ($M = 22.20$), while controls exhibited increased stress ($M = 25.14$ to $M = 28.47$). The between-group difference became significant post-intervention (MD [95% CI] = -3.75 [-6.64 , -0.85], $SMD = -0.52$) and peaked at one-month follow-up (MD [95% CI] = -6.27 [-8.75 , -3.80], $SMD = -1.12$), with a large overall group effect (partial $\eta^2 = 0.212$). For men, more pronounced effects emerged. The intervention group demonstrated sustained stress reduction ($M = 19.67$ to $M = 16.81$) versus control group increases ($M = 22.51$ to $M = 24.02$). Between-group differences were significant at both post-intervention (MD [95% CI] = -3.69 [-6.13 ; -1.25], $SMD = -0.67$) and follow-up (MD [95% CI] = -7.21 [-9.43 , -5.00],

Table 2. Demographic characteristics of participants.

Variables		Intervention ($n = 43$) Mean (SD)	Control ($n = 43$) Mean (SD)	t (p)
Age (in years)		29.65 (5.48)	26.56 (5.67)	2.57 (0.01)
Spouse age (in years)		33.60 (4.70)	32.37 (4.29)	1.27 (0.21)
Marriage duration (in years)		4.70 (2.89)	4.00 (2.74)	1.15 (0.25)
Gestational age (in weeks)		31.05 (0.79)	31.28 (0.88)	-1.29 (0.20)
		N (%)	N (%)	χ^2 (p)
Education	Below diploma	4 (9.3)	7 (16.3)	1.58 (0.67)
	High school diploma	12 (27.9)	12 (27.9)	
	University	27 (62.8)	24 (55.8)	
Spouse education	Below diploma	2 (4.6)	5 (11.6)	2.71 (0.44)
	High school diploma	11 (25.6)	7 (16.3)	
	University	30 (69.8)	31 (72.1)	
Job	Housewife	29 (67.4)	26 (60.5)	0.45 (0.50)
	Employed	14 (32.6)	17 (39.5)	
Spouse job	Employed	43 (100)	43 (100)	
Economic status	Weak	2 (4.7)	4 (9.3)	0.82 (0.66)
	Fair	37 (86.0)	36 (83.7)	
	Good	4 (9.3)	3 (7.0)	
Living condition	Independent	35 (81.4)	37 (86.0)	0.34 (0.56)
	With families	8 (18.6)	6 (14.0)	

SD: standard deviation. t (p): t statistics (p -value). χ^2 (p): chi-square statistics (p -value).

Table 3. Results of analysis of variance–covariance for repeated measures (RM ANOVA–ANCOVA) assessing the effect of intervention on perceived stress.

Participant group	Measurement time points	Group		Between group comparison <i>t</i> -value (<i>p</i>)	Mean difference [95% CI]	Standardized mean difference [95% CI]	Repeated measure analysis of variances results		
		Intervention (<i>n</i> = 43)	Control (<i>n</i> = 43)				Effect	<i>F</i> (<i>p</i>)	Partial η^2
Female	Before intervention	23.77 (7.49)	25.14 (7.36)	–0.86 (0.39)	–1.37 [–4.56, 1.81]	–0.19 [–0.61, 0.24]	Time	0.51 (0.48)	0.006
	Immediately after intervention	22.20 (6.57)	25.94 (6.57)	6.63 (0.01)	–3.75 [–6.64, –0.85]	–0.52 [–0.95, –0.09]	Group	21.22 (<0.001)	0.212
Male	One month after childbirth	22.20 (5.62)	28.47 (5.62)	25.44 (<0.001)	–6.27 [–8.75, –3.80]	–1.12 [–1.57, –0.66]	Group*time	2.45 (0.12)	0.030
	Before intervention	19.67 (6.90)	22.51 (6.69)	–1.94 (0.06)	–2.84 [–5.75, 0.08]	–0.42 [–0.84, 0.01]	Time	0.003 (0.96)	0.000
	Immediately after intervention	19.34 (5.52)	23.03 (5.52)	9.08 (0.003)	–3.69 [–6.13, –1.25]	–0.67 [–1.10, –0.23]	Group	34.02 (<0.001)	0.301
	One month after childbirth	16.81 (5.01)	24.02 (5.01)	41.98 (<0.001)	–7.21 [–9.43, –5.00]	–1.44 [–1.91, –0.97]	Group*time	6.24 (0.02)	0.073

N.B. Covariates adjusted in model were age, spouse age, marriage duration, gestational age and baseline scores.
95% CI: 95% confidence interval.

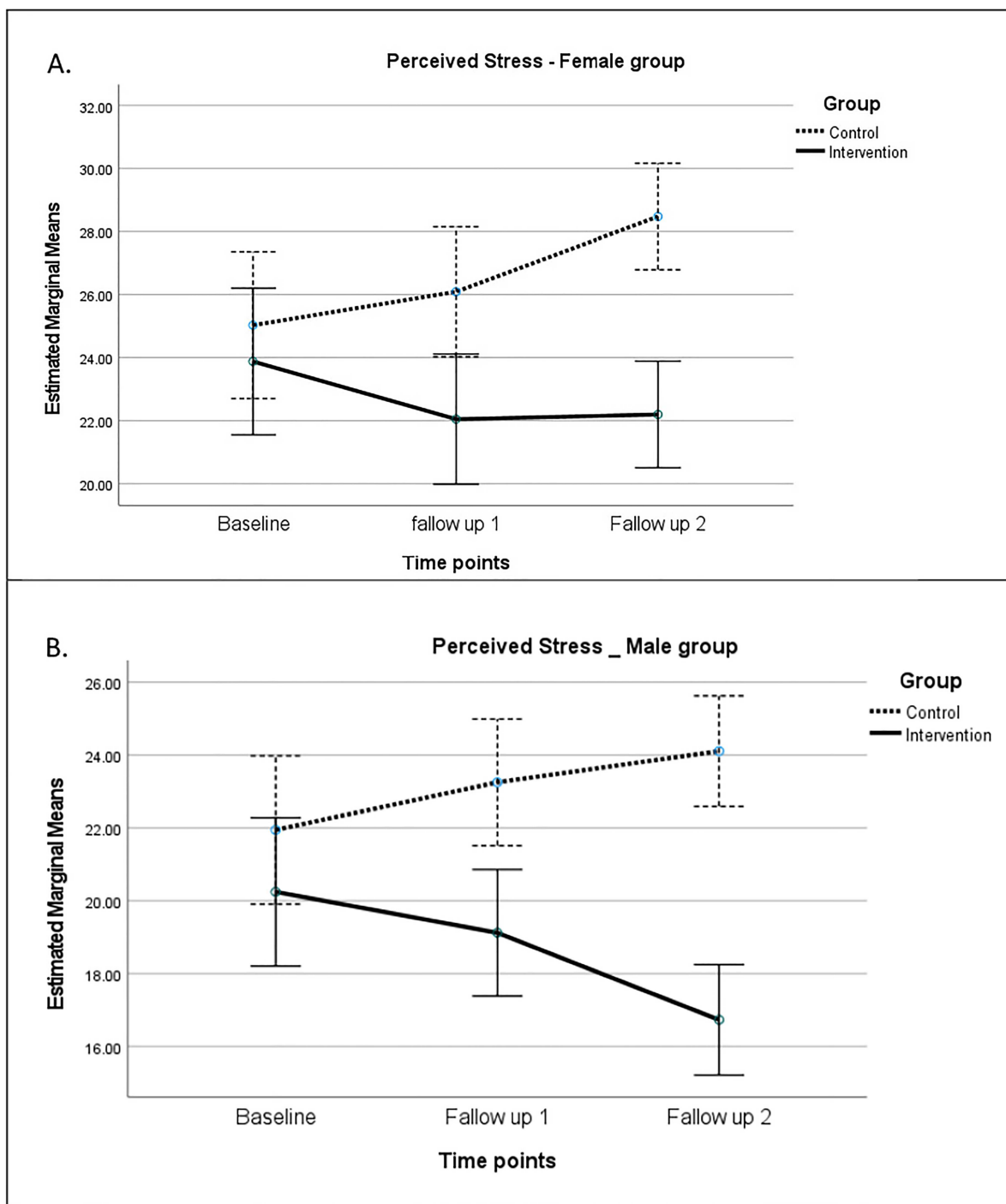


Figure 2. Trends in Perceived Stress Scale scores across study time points by group allocation. Panel (A) shows scores for women and Panel (B) for their spouses. The intervention group received antenatal coping strategies training, while the control group received routine care. Measurement points: T1 (Baseline, 30–32 weeks gestation), T2 (Post-intervention, ~36 weeks gestation), T3 (One-month postpartum). Error bars represent standard error of the mean (SEM)/standard deviation (SD).

SMD = -1.44), with very large group effects (partial $\eta^2 = 0.301$). Significant group $\times$ time interactions for men ($F = 6.24, p = 0.02$) suggested the intervention's benefits amplified over time. The coping skills training effectively buffered perinatal stress, with particularly strong benefits for fathers that intensified over time.

Coping strategies among female participants

The repeated measures ANCOVA showed significant improvements in adaptive coping strategies among women receiving the intervention (Table 4, Figure 3). For task-oriented coping, the intervention group demonstrated progressive increases from baseline ($M = 24.77$) to one-month postpartum ($M = 27.06$), while controls remained stable ($M = 24.26$ to $M = 24.30$). Between-group differences became significant post-intervention ($MD [95\% CI] = 1.61 [0.70, 2.51]$, $SMD = 0.78$) and further strengthened at follow-up ($MD [95\% CI] = 2.76 [1.95, 3.57]$, $SMD = 1.51$), with large overall (partial $\eta^2 = 0.087$, $p < 0.008$) and interaction (partial $\eta^2 = 0.196$, $p < 0.001$) effects. For emotion-oriented coping, while no immediate post-intervention differences emerged, the intervention group showed clinically significant reductions at follow-up ($M = 19.36$ vs. control $M = 21.59$; $MD [95\% CI] = -2.23 [-3.18, -1.28]$, $SMD = -1.03$), with moderate time $\times$ group interaction (partial $\eta^2 = 0.125$, $p < 0.001$). Avoidance coping remained stable across groups (all $p > 0.12$), suggesting the intervention specifically enhanced adaptive (task-oriented) rather than reduced maladaptive strategies. The intervention effectively promoted problem-solving skills and emotional regulation among women, with effects intensified in postpartum. The lack of avoidance-coping changes may reflect its situational utility during early parenting. These results highlighted the program's capacity to enhance adaptive stress management among perinatal women.

Coping strategies among male participants

The analysis showed significant gender-specific patterns in coping strategy modification among men following the intervention (Table 5, Figure 4). For task-oriented coping, the intervention group showed progressive improvement from baseline ($M = 26.70$) to one-month postpartum ($M = 27.56$), while controls remained stable ($M = 25.67$). Between-group differences reached significance post-intervention ($MD [95\% CI] = 1.02 [0.03, 2.02]$, $SMD = 0.45$) and expanded at follow-up ($MD [95\% CI] = 1.89 [1.04, 2.73]$, $SMD = 0.99$), with small-to-moderate effect sizes (partial $\eta^2 = 0.049$ – 0.077). For emotion-oriented coping, a delayed intervention effect emerged at follow-up, with the intervention group demonstrating significantly lower scores ($M = 18.43$) compared to controls ($M = 20.13$; $MD [95\% CI] = -1.71 [-2.63, -0.78]$, $SMD = -0.77$). Avoidance coping remained unchanged across groups (all $p > 0.32$), mirroring findings among women. While the intervention effectively enhanced adaptive coping among men, the effects were less pronounced than among women. The delayed reduction in emotion-focused coping suggests fathers may require longer to integrate emotional regulation skills. The consistent lack of impact on avoidance strategies across genders indicates this may represent a stable coping tendency during early parenting transitions. These findings underscore the importance of gender-tailored approaches in perinatal coping interventions.

Postnatal depression

The ANCOVA results demonstrated substantial intervention effects on postnatal depression (PND) symptoms assessed one-month postpartum. Female participants in the intervention group exhibited significantly lower depression scores ($M = 6.76$, $SD = 3.92$) compared to controls ($M = 12.27$, $SD = 3.92$), with a large between-group difference ($MD [95\% CI] = -5.51 [-7.24, -3.79]$, $SMD = -1.41$). Male participants showed even more pronounced benefits, with intervention participants displaying markedly reduced PPD scores ($M = 3.79$, $SD = 2.25$) versus controls ($M = 8.33$, $SD = 2.25$), yielding an exceptionally large effect size ($MD [95\% CI] = -4.55 [-5.54, -3.56]$, $SMD = -2.02$).

Interpretation

The coping skills training program produced robust, gender-specific protective effects against postnatal depression (Table 6). The greater effect size observed among men may reflect their baseline psychological vulnerability during the perinatal period or greater responsiveness to skill-based interventions. For women, the absolute reduction of 5.51 points on the EPDS in the present study surpasses the suggested minimal clinically important difference (MCID) of three points [63], suggesting the intervention yielded not just statistical but clinically meaningful benefits. These findings highlight the intervention's dual benefit for

Table 4. Results of analysis of variance–covariance for repeated measures (RM ANOVA–ANCOVA) assessing the effect of intervention on Coping Inventory for Stressful Situations among female participants.

Variable	Measurement time points	Group		Between group comparison t-value (p)	Mean difference [95% CI]	Standardized mean difference (95% CI)	Repeated measure analysis of variances Results		
		Intervention (n = 43)	Control (n = 43)				Effect	F (p)	Partial η^2
Avoidance coping	Before intervention	18.49 (4.32)	17.77 (3.59)	0.84 (0.40)	0.72 [−0.98, 2.42]	0.18 [−0.24, 0.61]	Time	2.43 (0.12)	0.030
	Immediately after intervention	18.06 (2.56)	18.36 (2.56)	0.29 (0.59)	−0.31 [−1.44, 0.83]	−0.12 [−.54, 0.31]	Group	0.01 (0.91)	0.000
	One month after childbirth	18.11 (2.56)	18.92 (2.56)	2.04 (0.16)	−0.81 [−1.94, 0.32]	−0.32 [−0.74, 0.11]	Group*time	1.80 (0.18)	0.022
Task-oriented coping	Before intervention	24.77 (3.64)	24.26 (3.55)	0.65 (0.52)	0.51 [−1.05, 2.06]	0.14 [−0.29, 0.57]	Time	2.75 (0.08)	0.034
	Immediately after intervention	26.23 (2.04)	24.62 (2.07)	12.47 (<0.001)	1.61 [0.70, 2.51]	0.78 [0.35, 1.22]	Group	7.39 (0.008)	0.087
	One month after childbirth	27.06 (1.82)	24.30 (1.83)	46.04 (<0.001)	2.76 [1.95, 3.57]	1.51 [1.03, 1.99]	Group*time	18.98 (<0.001)	0.196
Emotion-oriented coping	Before intervention	22.16 (4.80)	21.70 (4.26)	0.48 (0.64)	0.47 [−1.48, 2.41]	0.10 [−0.32, 0.53]	Time	1.01 (0.37)	0.013
	Immediately after intervention	21.08 (2.27)	21.62 (2.27)	1.21 (0.29)	−0.53 [−1.53, 0.47]	−0.24 [−0.66, 0.19]	Group	0.70 (0.40)	0.009
	One month after childbirth	19.36 (2.16)	21.59 (2.16)	21.83 (<0.001)	−2.23 [−3.18, −1.28]	−1.03 [−1.48, −0.58]	Group*time	11.32 (<0.001)	0.125

N.B. Covariates adjusted in model were age, spouse age, marriage duration, gestational age and baseline scores.
95% CI: 95% confidence interval.

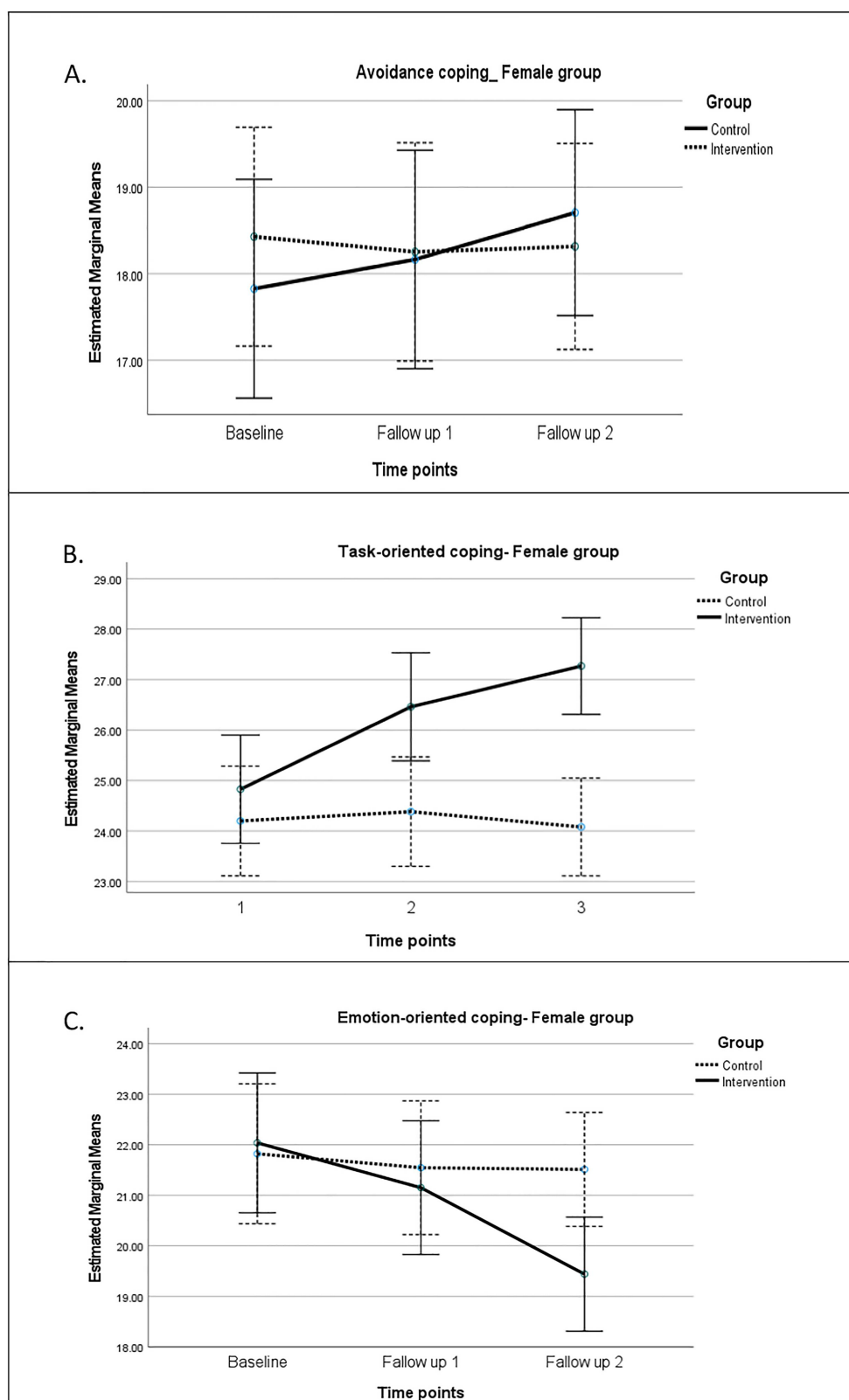


Figure 3. Trends in women's coping strategy scores across study time points by group allocation. Mean scores for (A) avoidant coping, (B) problem-focused coping, and (C) emotion-focused coping, as assessed using the Coping Inventory for Stressful Situations-Short Form (CISS-SF). The intervention group received antenatal coping strategies training for fathers, while the control group received routine prenatal education. Measurement points: T1 (Baseline, 30–32 weeks gestation), T2 (Post-intervention, ~36 weeks gestation), T3 (One-month postpartum). Error bars represent the standard error of the mean (SEM).

Table 5. Results of analysis of variance–covariance for repeated measures (RM ANOVA–ANCOVA) assessing the effect of intervention on Coping Inventory for Stressful Situations among male participants.

Variable	Measurement time points	Group		Between group comparison <i>t</i> -value (<i>p</i>)	Mean difference [95% CI]	Standardized mean difference [95% CI]	Repeated measure analysis of variances Results		
		Intervention (<i>n</i> = 43)	Control (<i>n</i> = 43)				Effect	<i>F</i> (<i>p</i>)	Partial η^2
Avoidance coping	Before intervention	17.56 (4.98)	16.81 (3.22)	0.82 (0.41)	0.74 [−1.06, 2.55]	0.18 [−0.25, 0.60]	Time	0.08 (0.93)	0.001
	Immediately after intervention	17.75 (2.59)	17.58 (2.59)	0.09 (0.77)	0.17 [−0.97, 1.31]	0.07 [−0.36, 0.49]	Group	0.29 (0.59)	0.004
	One month after childbirth	17.46 (2.62)	17.93 (2.62)	0.65 (0.43)	−0.47 [−1.62, 0.69]	−0.18 [−0.60, 0.24]	Group*time	1.02 (0.32)	0.013
Task-oriented coping	Before intervention	26.70 (4.11)	25.67 (2.69)	1.37 (0.18)	1.02 [−0.47, 2.52]	0.30 [−0.13, 0.72]	Time	1.49 (0.23)	0.018
	Immediately after intervention	26.93 (2.25)	25.91 (2.25)	4.16 (0.045)	1.02 [0.03, 2.02]	0.45 [0.03, 0.88]	Group	6.64 (0.01)	0.077
	One month after childbirth	27.56 (1.91)	25.67 (1.91)	19.78 (<0.001)	1.89 [1.04, 2.73]	0.99 [0.54, 1.44]	Group*time	4.14 (0.03)	0.049
Emotion-oriented coping	Before intervention	18.70 (5.60)	20.58 (4.92)	−1.66 (0.10)	−1.88 [−4.14, 0.38]	−0.36 [−0.78, 0.07]	Time	0.94 (0.39)	0.012
	Immediately after intervention	20.11 (2.35)	19.82 (2.35)	0.30 (0.59)	0.29 [−0.76, 1.33]	0.12 [−0.30, 0.55]	Group	4.22 (0.04)	0.050
	One month after childbirth	18.43 (2.09)	20.13 (2.09)	13.51 (<0.001)	−1.71 [−2.63, −0.78]	−0.77 [−1.20, −0.33]	Group*time	4.81 (0.01)	0.057

N.B. Covariates adjusted in model were age, spouse age, marriage duration, gestational age and baseline scores.
95% CI: 95% confidence interval.

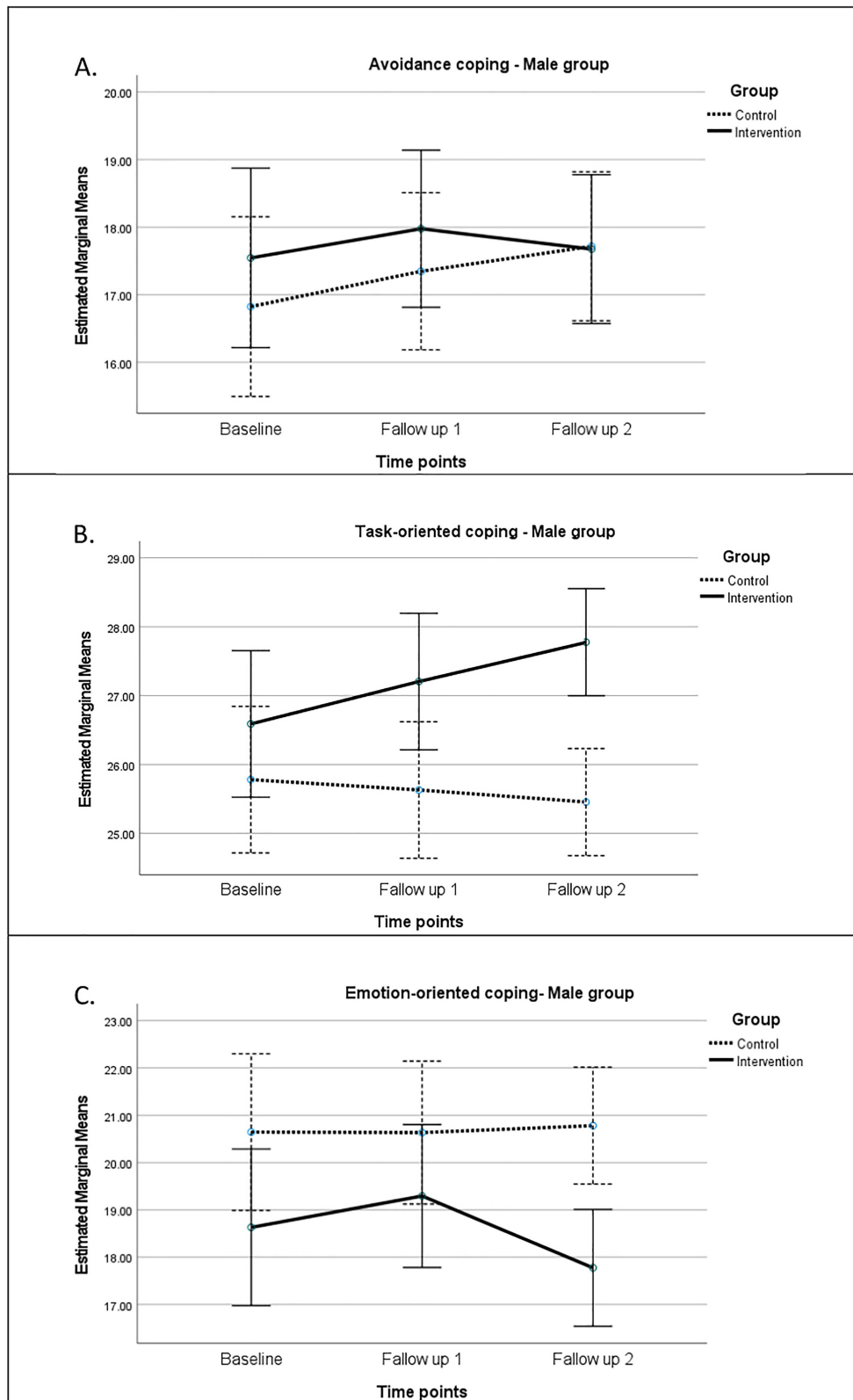


Figure 4. Trends in spouses coping strategy scores across study time points by group allocation. Mean scores for (A) avoidant coping, (B) problem-focused coping, and (C) emotion-focused coping, as assessed using the Coping Inventory for Stressful Situations-Short Form (CISS-SF). The intervention group received antenatal coping strategies training, while the control group received routine prenatal education. Measurement points: T1 (Baseline, 30–32 weeks gestation), T2 (Post-intervention, ~36 weeks gestation), T3 (One-month postpartum). Error bars represent standard error of the mean (SEM).

Table 6. Results of analysis of variance–covariance (ANOVA–ANCOVA) assessing the effect of intervention on postnatal depression measured one month after childbirth.

Participant group	Group		Between group comparison <i>t</i> -value (<i>p</i>)	Mean difference [95% CI]	Standardized mean difference [95% CI]
	Intervention (<i>n</i> = 43)	Control (<i>n</i> = 43)			
Female	6.76 (3.92)	12.27 (3.92)	40.38 (<0.001)	−5.51 [−7.24, −3.79]	−1.41 [−1.88, −0.93]
Male	3.79 (2.25)	8.33 (2.25)	83.39 (<0.001)	−4.55 [−5.54, −3.56]	−2.02 [−2.54, −1.50]

parental mental health and suggest its particular value for addressing the often-overlooked challenge of paternal postnatal depression. The results support the implementation of couple-inclusive perinatal mental health interventions.

Discussion

The present study demonstrated that antenatal coping skills training for fathers significantly reduced postpartum depression and perceived stress among couples (supporting H_1 and H_2). The intervention differentially enhanced adaptive coping strategies, with women showing immediate task-oriented improvements and men demonstrating gradual gains in both problem-solving and emotional regulation (supporting H_3). While avoidance coping remained unchanged, the findings underscore the value of gender-sensitive, couple-focused interventions for perinatal mental health.

Effect on postpartum depression

The present study showed clinically significant reductions in postpartum depression (PPD) symptoms for both parents in the intervention group. Women demonstrated substantial improvement, while men showed even greater symptom reduction. The significant reduction in maternal PPD symptoms observed in the present study, following a father-focused coping intervention, aligns with findings from other support-based models. For instance, a recent multicenter RCT demonstrated that a midwife-led breastfeeding support group for mothers also effectively reduced EPDS scores at four months postpartum [64]. The magnitude of the reduction in paternal PPD symptoms in the present study appears comparable to the treatment effects found in recent study of group parenting program for established paternal PPD evaluated by Husain et al. [65].

This suggests that preventative, skill-building interventions during pregnancy may be a powerful strategy to reduce the incidence and severity of paternal PPD before it becomes clinically significant. The intervention's success supports Mayers et al.'s [8] findings regarding fathers need for coping resources, but extends this evidence by demonstrating that targeted skills training can directly mitigate PPD symptoms among both parents. These results underscore the dual benefit of father-inclusive interventions and advocate for integrating paternal mental health support into routine perinatal care.

Effect on perceived stress

The present study demonstrated significant reductions in perceived stress for both men and women in the intervention group compared to controls, with men showing particularly robust improvements. These findings align with existing evidence that prenatal stress management programs enhance psychological resilience during the transition to parenthood [66]. The sustained stress reduction observed postpartum underscores the long-term benefits of equipping fathers with coping tools, which may disrupt the bidirectional stress transmission between partners identified in prior research [23].

When fathers are better prepared and less anxious, they can provide more effective support to their partners, thereby improving overall couple dynamics. These results complement Bayrami et al.'s [67] findings on the stress-buffering effects of psychological hardiness and social support, while extending this evidence by demonstrating that targeted coping skills training for fathers can directly mitigate perinatal stress among both parents. The intervention's dual impact on parental stress highlights the value of couple-focused approaches in perinatal care.

Effect on coping strategies

The intervention significantly enhanced adaptive coping strategies among participants, with gender-specific patterns emerging. Women in the intervention group showed marked reductions in emotion-focused coping, while men demonstrated substantial improvements in problem-focused strategies. These results align with Lazarus and Folkman's transactional stress model [68], confirming the intervention's success in promoting adaptive coping mechanisms. Notably, avoidant coping remained unchanged in both groups, suggesting its persistent utility during early parenting transitions and highlighting potential areas for refinement in future interventions, such as incorporating CBT techniques [69].

The strengthened coping skills among men may indirectly benefit maternal mental health through enhanced partner support, as evidenced by improved dyadic functioning among intervention couples [70]. These findings extend previous research by demonstrating that father-targeted coping skills training can effectively modify maladaptive patterns identified in maternal studies (e.g. [34,42]), while corroborating the stress-buffering role of social support [67]. The differential coping responses underscore the value of gender-tailored approaches in perinatal interventions.

Virtual mode of provision

The implementation of virtual platforms for coping skills training represents an innovative advancement in antenatal care delivery. Online interventions offer an accessible and cost-effective approach, particularly in urban settings with strained healthcare resources [71]. The flexibility of online sessions significantly enhanced paternal engagement by overcoming traditional barriers such as scheduling conflicts and clinic attendance hesitancy, a crucial advantage given fathers' historically low participation rates in perinatal programs. These findings align with global digital health transformation trends accelerated during the COVID-19 pandemic, which demonstrated the viability of telehealth for mental health interventions [72]. As outlined in a recent clinical review, current first-line treatment solutions for PPD (such as psychotherapy) are effective yet often face barriers related to accessibility, stigma, and a primary focus on the mother [73]. The intervention's virtual format in present study, not only maintained therapeutic fidelity but also introduced unique benefits including geographic accessibility for hard-to-reach populations, temporal flexibility accommodating work-family demands, reduced stigma through private participation, and scalability potential for broader implementation.

Potential implications for child development

Beyond the immediate improvements in parental mental health, the significant reductions in postpartum depression and stress observed in the present study may have critical downstream implications for infant development. Extensive evidence has established that parental postnatal depression, among both mothers and fathers, is a major risk factor for adverse child outcomes, including insecure attachment patterns, increased emotional and behavioral difficulties, and compromised cognitive development [74,75]. By mitigating depressive symptoms and enhancing adaptive coping skills among fathers, the present study's intervention likely contributed to a more supportive and stable family system. This improved dyadic functioning has the potential to disrupt the intergenerational transmission of risk, thereby promoting more secure infant-parent relationships and healthier developmental trajectories [76]. Future studies with longer-term follow-up are essential to directly assess the intervention's efficacy on child cognitive, emotional, and behavioral outcomes, which represents the logical next step in this research trajectory.

Strengths and limitations

The present RCT demonstrated three key methodological advances: a rigorous randomized design minimizing selection bias, successful paternal engagement through innovative online delivery, and validated gender-sensitive outcome measures. The intervention's digital format effectively addressed systemic barriers of fathers' low willingness to participate compared to in-person programs. These findings significantly extend previous research by demonstrating that brief (five-session), skills-based training for fathers can simultaneously improve maternal and paternal PPD symptoms as well as dyadic stress management.

While the virtual delivery format was a strength in the present study's urban setting, facilitating accessibility and engagement, it also presents a potential limitation for generalizability. The intervention's reliance on smartphone ownership and internet access may exclude digitally underserved populations, including those in rural areas or from lower socioeconomic backgrounds where such technology and connectivity are not guaranteed. To ensure equitable access to the benefits of this intervention, future implementation efforts must consider alternative or hybrid delivery models. These could include delivering the core content through low-tech modalities such as structured telephone calls, SMS-based support, or group sessions at local community health centers. Additionally, public health initiatives aimed at improving digital infrastructure are crucial to bridge this digital divide and prevent the exacerbation of health inequities.

When interpreting the present study findings, some other limitations other should be considered: (i) the one-month postpartum assessment precluding evaluation of long-term outcomes during critical infant developmental windows (3–12 months); (ii) limited generalizability due to the homogeneous urban sample from one area may not reflect diverse cultural–socioeconomic contexts; (iii) an absence of qualitative data on fathers real-world skill application; (iv) unchanged avoidance coping suggesting a need for adjunctive CBT components; and (v) using self-reported measures being associated with social desirability and memory recall biases.

Future research directions

The promising findings of the present study point to several valuable avenues for future research. First, to evaluate the long-term efficacy of the intervention, follow-up assessments at 6- and 12-month postpartum are essential. This would determine whether the observed benefits on parental mental health and coping strategies are sustained throughout the infant's first year, a critical period of development. Second, future studies should include direct measures of parent-child interaction, infant attachment security, and child developmental outcomes to assess the potential downstream effects of improved parental well-being. Third, investigation of the cost-effectiveness of the online intervention such as its feasibility when delivered by midwives or nurses within standard prenatal care is needed. This would be crucial for scaling and real-world adoption. Finally, exploring the intervention's efficacy in more diverse populations, including multiparous couples, adolescents, and those from varying socioeconomic and cultural backgrounds, would help establish its generalizability.

Conclusion

The present randomized controlled trial provided robust evidence that virtual coping skills training for expectant fathers significantly improved perinatal mental health outcomes for both parents. The intervention demonstrated clinically meaningful reductions in postpartum depression symptoms, sustained stress reduction with large effect sizes, gender-specific coping enhancements with Increased task-oriented strategies among mothers, and improved problem-solving and emotional regulation in fathers. These findings can be used in clinical practice which supports integrating brief (five-session) virtual father-focused training into routine prenatal care. The findings also highlight the need for guidelines addressing paternal mental health in perinatal services and establishes a foundation for hybrid (online plus in-person) intervention models.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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