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Impact of a digital mind–body nursing program on maternal stress, sleep quality, and psychological resilience during pregnancy

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***Abstract*---Background:** Pregnancy is accompanied by substantial physiological, emotional, and psychological changes that may increase maternal stress, disrupt sleep quality, and reduce psychological resilience. Digital mind–body nursing interventions may provide accessible and structured support to help pregnant women manage stress, improve sleep, and strengthen their ability to cope with pregnancy-related challenges. **Aim:** To evaluate the impact of a digital mind–body nursing program on maternal stress, sleep quality, and psychological resilience during pregnancy. **Subjects and Methods:** A quasi-experimental one-group pretest–posttest design was used among 100 pregnant women attending antenatal care clinics at Menoufia University Hospital. Participants were recruited using a convenience sampling technique. Data were collected using a structured interview questionnaire, a perceived stress assessment scale, the Pittsburgh Sleep Quality Index, and Connor–Davidson Resilience Scale (CD-RISC-25). The digital mind–body nursing program was delivered through mobile-based educational and supportive sessions incorporating relaxation breathing, mindfulness exercises, guided imagery, sleep-hygiene education, stress-management techniques, and positive coping strategies. The intervention was implemented over four weeks, with regular digital follow-up and reinforcement. **Results:** Following implementation of the digital mind–body nursing program, the studied pregnant women demonstrated a significant reduction in perceived stress and poor sleep quality, accompanied by a significant improvement in psychological resilience compared with their pre-intervention levels (**$p < 0.001$**). The findings indicated improved ability to manage pregnancy-related stressors, better sleep-related behaviors, and enhanced psychological coping and adaptation after the intervention. **Conclusion:** The digital mind–body nursing program was associated

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with significant improvements in maternal stress, sleep quality, and psychological resilience during pregnancy. Integrating digitally delivered mind–body strategies into routine antenatal nursing care may provide a practical approach for supporting maternal psychological well-being. **Recommendations:** Digital mind–body nursing interventions should be considered as a complementary component of antenatal care. Antenatal nurses should receive appropriate training in delivering digital stress-management, relaxation, mindfulness, and sleep-promotion strategies, with continued follow-up to support adherence and sustained maternal well-being.

***Keywords*---**Digital nursing intervention, Mind–body nursing, Pregnancy, Maternal stress, Sleep quality, Psychological resilience.

Introduction

Pregnancy is a major transitional period accompanied by substantial physiological, emotional, psychological, and social changes. Although pregnancy is generally considered a normal life event, women may experience increased emotional demands, uncertainty, physical discomfort, and concerns related to maternal and fetal health. These challenges may influence maternal psychological well-being and the overall experience of pregnancy. Therefore, contemporary antenatal care emphasizes not only the prevention and management of obstetric complications but also the promotion of maternal well-being and positive pregnancy experiences **(Davis et al., 2020).**

Maternal stress during pregnancy is an important psychological concern because pregnancy-related physical changes, changing family and social roles, concerns about childbirth, and worries about fetal health may increase perceived stress. Persistent psychological stress during pregnancy may also interact with other aspects of maternal well-being, particularly sleep and emotional adjustment. Consequently, antenatal care represents an important opportunity for healthcare professionals, including nurses, to identify psychological stressors and provide supportive interventions that promote healthy coping and adaptation during pregnancy **(Răchită et al., 2022).**

Sleep is another important component of maternal health during pregnancy. Changes in sleep duration, sleep continuity, and perceived sleep quality are frequently reported during pregnancy and may be associated with psychological health. A systematic review involving 14,648 pregnant women found meaningful associations between prenatal sleep characteristics and psychological outcomes, with poorer sleep quality and insomnia being associated with greater psychological distress, including anxiety, stress, and depressive symptoms **(Pauley et al., 2020).**

Psychological resilience is also particularly relevant during pregnancy because it reflects an individual's capacity to adapt to stress, maintain psychological functioning, and recover from challenging experiences. Strengthening resilience

may help pregnant women develop more adaptive coping strategies and maintain emotional balance when confronted with pregnancy-related physical, psychological, and social demands. Thus, interventions that address stress management while simultaneously promoting positive coping and psychological resources may provide a more comprehensive approach to maternal well-being **(Hajure et al., 2020).**

Mind–body interventions have received increasing attention as non-pharmacological approaches for promoting psychological well-being during pregnancy. These interventions may incorporate relaxation breathing, mindfulness, guided imagery, stress-management techniques, and other strategies that promote awareness of bodily responses and emotional regulation. Recent evidence examining mindfulness-based interventions among pregnant women has reported benefits for maternal psychological outcomes, supporting their potential role as complementary strategies within antenatal care **(Sari et al., 2020).**

The integration of digital technology into maternal healthcare provides an additional opportunity to deliver such supportive interventions beyond conventional face-to-face encounters. Mobile-based interventions can facilitate the delivery of structured educational materials, relaxation exercises, mindfulness practices, reminders, and follow-up support, potentially improving accessibility and continuity of care **(Knop et al., 2020)**. The WHO recognizes digital health as an evolving component of health-service delivery and identifies digital approaches as having potential to support antenatal care and communication with pregnant women **(Moise et al., 2020).**

From a nursing perspective, the combination of mind–body strategies with digital delivery may provide a structured and accessible approach for addressing several interconnected aspects of maternal well-being. Rather than focusing on stress, sleep, or coping as isolated concerns, an integrated nursing program can simultaneously provide stress-management education, relaxation and mindfulness exercises, sleep-hygiene guidance, guided imagery, and positive coping strategies. Such an approach is consistent with the WHO emphasis on antenatal care that includes communication, emotional support, psychological support, health promotion, and person-centered care **(Abdelmenem et al., 2020).** Despite the increasing availability of digital health approaches, there remains a need for structured nursing programs that integrate digitally delivered mind–body techniques with regular follow-up and reinforcement during pregnancy. Such programs may be particularly useful for supporting women in applying stress-management and sleep-promotion strategies in their daily lives. Therefore, evaluating a **Digital Mind–Body Nursing Program** that combines relaxation breathing, mindfulness, guided imagery, sleep-hygiene education, stress-management techniques, and positive coping strategies may contribute to the development of practical, nurse-led approaches for improving maternal psychological well-being during pregnancy **(Henrich et al., 2020).**

The obstetric and gynecological nurse plays a central role in implementing the Digital Mind–Body Nursing Program during pregnancy by assessing pregnant women's physical, psychological, and emotional needs, including perceived stress,

sleep patterns, coping abilities, and pregnancy-related concerns. The nurse provides individualized education and support through digital platforms and delivers the program components, including relaxation breathing, mindfulness exercises, guided imagery, sleep-hygiene education, stress-management techniques, and positive coping strategies. The nurse demonstrates and reinforces these techniques, provides digital educational materials, encourages regular practice, and conducts follow-up to monitor adherence and identify barriers. In addition, the nurse offers therapeutic communication and emotional support, encourages adaptive coping, monitors changes in stress, sleep quality, and psychological well-being, and provides individualized reinforcement. When significant psychological or obstetric concerns are identified, the nurse facilitates appropriate referral to the obstetrician or relevant healthcare professional. Thus, the obstetric and gynecological nurse serves as an educator, counselor, coordinator, and monitor, supporting pregnant women in integrating mind–body strategies into their daily lives while maintaining safe and comprehensive antenatal care **(Huang & Cui, 2022).**

Significance of the Study

Pregnancy is a period in which women may experience increased psychological demands, sleep disturbances, and difficulties in adapting to physical and emotional changes. Maternal stress and poor sleep quality may negatively influence psychological well-being and coping during pregnancy, highlighting the importance of supportive interventions within antenatal care. The World Health Organization emphasizes that antenatal care should address women's physical, emotional, and psychological needs and promote a positive pregnancy experience **(Pascal et al.,, 2020).**

Digital health approaches provide opportunities to extend nursing support beyond conventional face-to-face antenatal visits by facilitating continuous education, communication, follow-up, and reinforcement. When combined with mind–body strategies such as relaxation, mindfulness, guided imagery, stress management, and sleep-hygiene education, digital nursing interventions may provide pregnant women with practical strategies that can be incorporated into their daily routines. Digital delivery may also improve accessibility and continuity of supportive care **(Mohamed et al., 2020).**

For obstetric and gynecological nurses, integrating digital mind–body strategies into antenatal care may strengthen their role in health education, psychological support, behavioral counseling, and promotion of self-management. A structured nursing program can provide nurses with an organized framework for assessing maternal stress and sleep-related concerns, teaching appropriate coping strategies, monitoring adherence, and providing individualized follow-up. Therefore, evaluating the impact of such an intervention may provide useful evidence for expanding the role of nurses in promoting maternal psychological well-being during pregnancy **(Mohammed et al., 2020).**

Accordingly, the present study is significant because it addresses three interconnected dimensions of maternal well-being stress, sleep quality, and psychological resilience through a single nurse-led digital intervention. The

findings may provide evidence regarding the potential value of incorporating digitally delivered mind–body strategies into routine antenatal nursing practice and may support the development of accessible, structured, and sustainable approaches for promoting psychological well-being among pregnant women **(Kim et al., 2020)**.

Aim of the Study

The aim of the present study was to evaluate the impact of a digital mind–body nursing program on maternal stress, sleep quality, and psychological resilience during pregnancy.

Hypotheses of the Study

The following hypotheses were formulated:

H1: Pregnant women who receive the digital mind–body nursing program will demonstrate significantly lower perceived stress levels after the intervention compared with their pre-intervention levels.

H2: Pregnant women who receive the digital mind–body nursing program will demonstrate significantly improved sleep quality after the intervention compared with their pre-intervention levels.

H3: Pregnant women who receive the digital mind–body nursing program will demonstrate significantly higher psychological resilience after the intervention compared with their pre-intervention levels.

H4: There will be a significant relationship between changes in perceived stress, sleep quality, and psychological resilience among the studied pregnant women following implementation of the digital mind–body nursing program.

Subjects and Methods

Research Design

A quasi-experimental one-group pretest–posttest design was used to evaluate the impact of a digital mind–body nursing program on maternal stress, sleep quality, and psychological resilience during pregnancy. The studied pregnant women were assessed before implementation of the program and reassessed immediately after its completion.

Research Setting

The study was conducted at the **Antenatal Care Clinics of Menoufia University Hospital**, Menoufia Governorate, Egypt. The clinics provide routine antenatal assessment, health education, counseling, and follow-up services for pregnant women.

Subjects

A convenience sample of 100 pregnant women attending the antenatal care clinics was recruited for the study within six months.

Data collection tools:

Tool I: Structured Interview Questionnaire

The researchers developed a structured interview questionnaire after reviewing relevant literature concerning pregnancy, maternal psychological well-being, stress, sleep, and digital antenatal care. It was used to obtain baseline socio-

demographic and obstetric data from the studied pregnant women. It consisted of two parts.

Part I included socio-demographic characteristics such as age, residence, marital status, educational level, family income, availability of a smartphone, and previous experience with digital health information.

Part II covered obstetric and pregnancy-related characteristics, including gestational age, gravidity, parity, history of abortion, **Previous cesarean delivery among multiparous women**, previous pregnancy complications, current **pregnancy-related physical discomforts, Self-reported pregnancy-related stress before intervention, and Self-reported sleep problems before intervention.**

Tool II: Perceived Stress Scale (PSS-10)

The Perceived Stress Scale (PSS-10), developed by Cohen, Kamarck, and Mermelstein (1983), was used to assess the degree to which the studied pregnant women perceived their lives as stressful. The scale consists of **10 items** addressing the frequency of feelings and thoughts related to unpredictability, uncontrollability, and being overwhelmed during the preceding period. Each item is rated on a five-point Likert scale ranging from 0 = Never, 1 = Almost never, 2 = Sometimes, 3 = Fairly often, and 4 = Very often. Items 4, 5, 7, and 8 are positively worded and are reverse scored before calculating the total score. Scoring: The total PSS score ranges from 0 to 40, with higher scores indicating greater perceived stress. For descriptive interpretation, scores of 0–13 were considered low stress, 14–26 moderate stress, and 27–40 high stress. The total score was also treated as a continuous variable in the statistical analysis to evaluate changes following the intervention **(Cohen et al., 1983).**

Tool III: Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI), developed by **Buysse et al. (1989)**, was used to assess the subjective quality and patterns of sleep among the studied pregnant women during the preceding one month. The PSQI includes 19 self-rated items that generate seven clinically relevant components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component is scored from 0 to 3, with higher component scores indicating greater sleep difficulty. The seven component scores are summed to obtain the global PSQI score.

Scoring: The global score ranges from 0 to 21, where a score of 0–5 indicates good sleep quality, while a score of more than 5 indicates poor sleep quality. Thus, a lower global PSQI score after the intervention indicates improvement in sleep quality, whereas a higher score indicates poorer sleep quality (Buysse et al., 1989).

Tool IV: Connor–Davidson Resilience Scale (CD-RISC-25)

Psychological resilience was assessed using the **Connor–Davidson Resilience Scale (CD-RISC-25)** developed by **Connor & Davidson (2003)**. The scale consists of 25 items designed to assess the individual's ability to cope with stress, adapt to change, tolerate negative experiences, maintain personal competence, and recover from adversity. Each item is rated on a five-point scale from 0 to 4, where 0 = Not true at all, 1 = Rarely true, 2 = Sometimes true, 3 = Often true, and 4 = True nearly all of the time. The scores of all 25 items are summed to obtain the total resilience score. Scoring: The total score ranges from 0 to 100, with higher scores indicating greater psychological resilience and lower scores indicating lower

resilience. In the present study, the total CD-RISC score was analyzed as a continuous variable to determine changes in psychological resilience before and after implementation of the digital mind–body nursing program. No diagnostic cutoff point was imposed because the original CD-RISC-25 is primarily interpreted as a continuous resilience measure (Connor & Davidson, 2003).

Validity

The content validity of the data collection tools was established through review by a panel of **five experts** in the fields of obstetric and gynecological nursing, maternal health nursing, psychiatric and mental health nursing, and community health nursing. The experts evaluated the tools for clarity, relevance, comprehensiveness, appropriateness, and consistency with the study objectives. Their suggestions were considered, and necessary modifications were made to improve the wording, organization, and applicability of the tools before the final data collection. The standardized instruments, including the Perceived Stress Scale (PSS-10), Pittsburgh Sleep Quality Index (PSQI), and Connor–Davidson Resilience Scale (CD-RISC-25), were selected based on their established validity and previous use in research populations.

Reliability

The reliability of the study tools was assessed to determine their internal consistency and stability. Cronbach's alpha coefficient was used to assess the internal consistency of the PSS-10, PSQI, and CD-RISC-25, while the structured interview questionnaire was reviewed for consistency and clarity. A Cronbach's alpha coefficient of ≥0.70 was considered acceptable, indicating satisfactory internal consistency of the study instruments. The standardized scales also have established psychometric properties reported in their original validation studies **(Cohen et al., 1983; Buysse et al., 1989; Connor & Davidson, 2003).**

Pilot Study

A pilot study was conducted on 10% of the total study sample, representing 10 pregnant women, before commencement of the main study. The purpose of the pilot study was to assess the clarity, comprehensibility, sequence, applicability, and feasibility of the data collection tools, as well as to estimate the time required to complete the assessment. The pilot study also allowed the researchers to test the feasibility of the mobile-based delivery of the digital mind–body nursing program, including the accessibility of digital educational materials, communication, guided exercises, and follow-up procedures. Any necessary modifications were made based on the pilot participants' feedback. The women who participated in the pilot study were excluded from the final study sample to prevent possible contamination of the study results.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Nursing and the necessary official permission was obtained from the administration of the selected setting before beginning the study. The purpose, procedures, potential benefits, and participants' rights were explained clearly to each pregnant woman before enrollment. Written informed consent was obtained from every participant. Participation was voluntary, and each woman was informed that she had the right to refuse participation or withdraw from the study

at any time without affecting her antenatal care. Confidentiality and privacy were maintained throughout the study by using coded data rather than participants' names and by restricting access to the collected information to the research team. Digital communication and follow-up were conducted while maintaining the privacy and confidentiality of participants' information. The study procedures were designed to minimize any potential psychological or physical discomfort, and women requiring additional medical or psychological assessment were referred to the appropriate healthcare professional.

Phases of the Digital Mind–Body Nursing Intervention

The Digital Mind–Body Nursing Program was implemented over four consecutive weeks and consisted of structured digital educational, practical, and supportive sessions. The program was delivered by the obstetric and gynecological nurse through a mobile-based platform, with regular follow-up and reinforcement. The intervention was organized into four phases: preparation and baseline assessment, educational preparation, mind–body intervention, and reinforcement/follow-up. The program focused on helping pregnant women recognize stress and sleep-related problems, learn practical mind–body techniques, apply them in daily life, and maintain positive coping behaviors.

Phase I: Preparation and Baseline Assessment

This phase was conducted before starting the intervention. The obstetric and gynecological nurse established communication with the eligible pregnant women, explained the purpose and procedures of the program, obtained informed consent, and assessed their baseline needs. The structured interview questionnaire, PSS-10, PSQI, and CD-RISC-25 were administered before the intervention. The nurse also introduced the participants to the mobile-based communication method, explained how to access the educational materials and guided exercises, and ensured that each woman could participate in the digital sessions.

Duration: One initial session, approximately **30–45 minutes**.

Phase II: Educational Preparation and Stress Awareness

During this phase, the nurse provided education about the normal psychological and physical changes associated with pregnancy and explained the relationship between pregnancy-related stress, sleep disturbances, emotional well-being, and coping. Participants were taught how to recognize common sources and manifestations of stress and identify behaviors that could interfere with healthy sleep and psychological adjustment. The nurse introduced the concept of mind–body approaches and explained how regular practice could be incorporated into daily pregnancy routines.

Session 1: Understanding Pregnancy Stress and Emotional Changes

The session covered pregnancy-related stressors, common emotional responses, warning signs of excessive stress, and the importance of seeking appropriate support.

Session 2: Understanding Sleep During Pregnancy

The nurse discussed common causes of sleep disturbance during pregnancy, healthy sleep routines, environmental factors affecting sleep, and the importance of maintaining regular sleep and wake times.

Duration: Two digital sessions, approximately 30–40 minutes per session, delivered during the first week.

Phase III: Digital Mind–Body Training

This phase represented the main intervention component. Participants received guided digital training and practical exercises designed to reduce stress, promote relaxation, improve sleep-related behaviors, and strengthen adaptive coping.

Session 3: Relaxation Breathing

The nurse demonstrated slow, controlled breathing techniques and guided participants through repeated breathing exercises. Participants were encouraged to practice the technique regularly, particularly during periods of stress or before bedtime.

Session 4: Mindfulness and Present-Moment Awareness

Participants were introduced to simple mindfulness exercises focusing on breathing, bodily sensations, thoughts, and emotions without judgment. The nurse encouraged regular short periods of mindfulness practice.

Session 5: Guided Imagery and Relaxation

The nurse provided guided imagery exercises using calming mental images and relaxation instructions to promote emotional calmness and reduce physiological tension. Participants were encouraged to practice the exercise in a quiet environment, particularly before sleep.

Session 6: Stress-Management and Positive Coping

The session focused on identifying stressful situations, distinguishing controllable from uncontrollable stressors, problem-solving, positive self-talk, emotional regulation, social support, and adaptive coping strategies.

Session 7: Sleep-Hygiene and Bedtime Relaxation

The nurse reinforced sleep-promoting behaviors, including maintaining a regular bedtime routine, reducing stimulating activities before sleep, creating a comfortable sleep environment, limiting excessive evening screen use, and applying breathing or guided imagery before bedtime.

Duration: Five digital sessions, approximately 30–40 minutes per session, delivered during the second and third weeks.

Phase IV: Reinforcement and Digital Follow-up

The final phase focused on reinforcing the skills learned during the previous sessions and supporting continued application in daily life. The obstetric and gynecological nurse conducted regular digital follow-up to assess participants' adherence to breathing, mindfulness, guided imagery, stress-management, and sleep-hygiene practices. Participants were encouraged to discuss difficulties encountered during practice, and the nurse provided individualized feedback, motivation, reminders, and reinforcement. The importance of maintaining these practices beyond completion of the program was emphasized.

Session 8: Review, Reinforcement, and Individualized Support

The nurse reviewed all previously introduced techniques, answered participants' questions, reinforced successful behaviors, addressed barriers to adherence, and developed individualized strategies for maintaining the learned practices.

Duration: One digital session of approximately **30–40 minutes**, followed by regular mobile-based reinforcement and follow-up during the fourth week.

Phase V: Follow-up

The intervention extended over four weeks, comprising eight structured digital sessions, with each session lasting approximately 30–40 minutes. Additional brief digital reminders and supportive follow-up were provided between sessions to reinforce practice and adherence. The obstetric and gynecological nurse maintained regular communication with participants throughout the intervention

and encouraged them to integrate the learned mind–body techniques into their everyday routines. The post-intervention assessment was conducted after completion of the four-week program using the same study tools to evaluate changes in perceived stress, sleep quality, and psychological resilience.

Statistical Analysis

Data were collected, coded, tabulated, and statistically analyzed using the Statistical Package for the Social Sciences (SPSS), version 26. Data were checked for completeness, consistency, and accuracy before analysis. Descriptive statistics were used to summarize the characteristics of the studied pregnant women and the study variables. Frequencies and percentages were used for categorical variables, while means and standard deviations (Mean ± SD) were used for quantitative variables. The Perceived Stress Scale (PSS-10), Pittsburgh Sleep Quality Index (PSQI), and Connor–Davidson Resilience Scale (CD-RISC-25) total scores were analyzed as continuous variables. The paired-samples t-test was used to compare the mean pre-intervention and post-intervention scores of perceived stress, sleep quality, and psychological resilience when the data met the assumptions of parametric testing. For categorical classifications of stress, sleep quality, and resilience, the McNemar test was used to compare paired pre- and post-intervention proportions where appropriate. The Pearson correlation coefficient (r) was used to examine relationships among changes in perceived stress, sleep quality, and psychological resilience when the assumptions for Pearson correlation were satisfied. The level of statistical significance was set at $p < 0.05$, while $p < 0.001$ was considered highly statistically significant. A p-value ≥ 0.05 was considered statistically non-significant. All statistical tests were two-tailed.

Results:

Table (1): Distribution of the Studied Pregnant Women According to Their Socio-Demographic Characteristics (N = 100)

Socio-demographic characteristics	No.	%
Age (years)		
20–<25	24	24.0
25–<30	38	38.0
30–<35	25	25.0
≥35	13	13.0
Mean ± SD	**28.4 ± 5.1**	
Residence		
Rural	62	62.0
Urban	38	38.0
Educational level		
Basic/secondary education	29	29.0

Socio-demographic characteristics	No.	%
Diploma	31	31.0
University education	40	40.0
Occupation		
Housewife	68	68.0
Working	32	32.0
Marital status		
Married	100	100.0
Family income		
Insufficient	27	27.0
Sufficient	56	56.0
More than sufficient	17	17.0
Smartphone availability		
Yes	100	100.0
No	0	0.0
Previous experience with digital health applications		
Yes	36	36.0
No	64	64.0

Table (1) shows that 38.0% of the studied pregnant women were aged 25–<30 years, with a mean age of 28.4 ± 5.1 years. More than three-fifths (62.0%) lived in rural areas. Regarding education, 40.0% had university education, whereas 29.0% had basic or secondary education. More than two-thirds (68.0%) were housewives. All studied women were married and had access to a smartphone, which facilitated participation in the digital nursing program. However, only 36.0% had previous experience with digital health applications.

Table (2): Distribution of the Studied Pregnant Women According to Obstetric and Pregnancy-Related Characteristics (N = 100)

Obstetric and pregnancy-related characteristics	No.	%
Gestational age		
First trimester	24	24.0
Second trimester	43	43.0
Third trimester	33	33.0
Gravidity		
Primigravida	39	39.0
Multigravida	61	61.0
Parity		

Obstetric and pregnancy-related characteristics	No.	%
Nullipara	42	42.0
One or more previous births	58	58.0
History of abortion		
No	76	76.0
Yes	24	24.0
Previous cesarean delivery among multiparous women		
No	34	34.0
Yes	24	24.0
Previous pregnancy-related complications		
No	71	71.0
Yes	29	29.0
Current pregnancy-related physical discomforts		
No/minimal	28	28.0
Moderate	51	51.0
Severe	21	21.0
Self-reported pregnancy-related stress before intervention		
No/mild	32	32.0
Moderate	48	48.0
High	20	20.0
Self-reported sleep problems before intervention		
No	29	29.0
Yes	71	71.0

Table (2) demonstrates that 43.0% of the studied women were in the second trimester, while 33.0% were in the third trimester. More than three-fifths (61.0%) were multigravida and 58.0% had experienced one or more previous births. Nearly one-third (29.0%) reported previous pregnancy-related complications. Regarding current pregnancy-related discomforts, 51.0% reported moderate discomfort and 21.0% reported severe discomfort. Before the intervention, 48.0% perceived a moderate level of pregnancy-related stress and 20.0% reported a high level. Sleep problems were also common, being reported by 71.0% of the participants.

Table (3): Distribution of the Studied Pregnant Women According to Perceived Stress Scale Items Before and After the Digital Mind–Body Nursing Program (N = 100)

PSS-10 items	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Paired t-test	p-value
Felt upset because of unexpected events	2.61 ± 0.91	1.42 ± 0.78	10.42	<0.001
Felt unable to control important things	2.48 ± 0.94	1.36 ± 0.74	9.86	<0.001
Felt nervous or stressed	2.77 ± 0.89	1.45 ± 0.76	11.63	<0.001
Felt confident about handling personal problems*	1.82 ± 0.86	2.71 ± 0.81	-8.04	<0.001
Felt things were going your way*	1.76 ± 0.88	2.65 ± 0.79	-7.92	<0.001
Felt unable to cope with things to be done	2.35 ± 0.91	1.31 ± 0.73	9.32	<0.001
Able to control irritations*	1.91 ± 0.85	2.69 ± 0.78	-7.16	<0.001
Felt on top of things*	1.73 ± 0.82	2.62 ± 0.76	-8.11	<0.001
Felt anger because of things outside control	2.28 ± 0.93	1.28 ± 0.71	8.76	<0.001
Felt difficulties were piling up	2.47 ± 0.92	1.34 ± 0.72	9.91	<0.001

*Reverse-scored items.

Table (3) reveals a marked improvement across all perceived-stress items following the digital mind–body nursing program. The mean scores of negatively worded stress items decreased substantially after the intervention, particularly for feeling nervous or stressed and feeling upset because of unexpected events. Conversely, the reverse-scored positive coping items showed increased mean scores after the program. All observed pre–post differences were statistically significant at $p < 0.001$.

Table (4): Comparison of the Total Perceived Stress Score among the Studied Pregnant Women Before and After the Digital Mind–Body Nursing Program (N = 100)

Total PSS-10 score	Pre-intervention	Post-intervention	Paired t-test	p-value
Mean ± SD	23.18 ± 5.42	13.36 ± 4.18	15.87	<0.001
Minimum–maximum	11–36	5–25		

Table (4) demonstrates a clear reduction in the total perceived stress score after implementation of the digital mind–body nursing program. The mean PSS-10 score decreased from 23.18 ± 5.42 before the intervention to 13.36 ± 4.18 after the intervention. This difference was statistically highly significant (paired $t = 15.87$, $p < 0.001$).

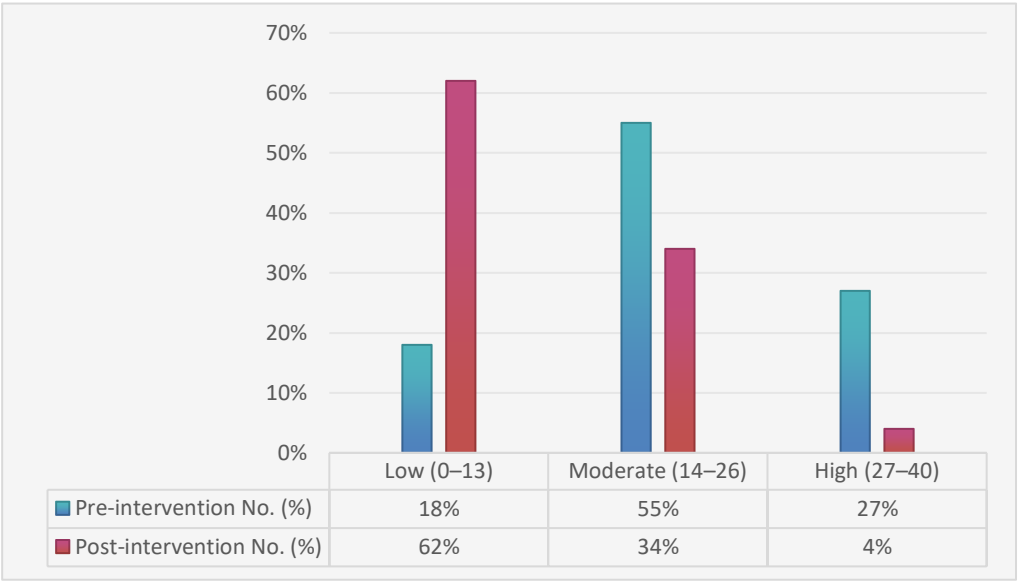


Figure (1): Distribution of the Studied Pregnant Women According to Their Level of Perceived Stress Before and After the Digital Mind–Body Nursing Program (N = 100)

Figure (1) indicates a favorable shift in the distribution of perceived stress levels following the intervention. Before the program, more than half of the women (55.0%) had moderate stress and 27.0% had high stress, whereas only 18.0% had low stress. After the intervention, the proportion with low stress increased to 62.0%, while moderate stress decreased to 34.0% and high stress declined markedly to 4.0%.

Table (5): Comparison of Pittsburgh Sleep Quality Index Components among the Studied Pregnant Women Before and After the Digital Mind–Body Nursing Program (N = 100)

PSQI component	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Paired t-test	p-value
Subjective sleep quality	1.82 ± 0.71	0.91 ± 0.62	9.87	<0.001
Sleep latency	1.76 ± 0.83	0.94 ± 0.68	8.26	<0.001
Sleep duration	1.51 ± 0.78	0.83 ± 0.65	7.18	<0.001
Habitual sleep efficiency	1.34 ± 0.81	0.71 ± 0.59	6.43	<0.001
Sleep disturbances	1.72 ± 0.66	0.93 ± 0.57	8.94	<0.001
Use of sleep medication	0.42 ± 0.61	0.21 ± 0.45	3.72	<0.001
Daytime dysfunction	1.49 ± 0.75	0.78 ± 0.61	7.54	<0.001
Global PSQI score	**10.06 ± 3.21**	**5.31 ± 2.47**	**12.04**	**<0.001**

Table (5) shows improvement in all seven PSQI components after the digital mind–body nursing program. The greatest improvements were observed in subjective sleep quality, sleep latency, and sleep disturbances. The global PSQI score decreased from 10.06 ± 3.21 before the intervention to 5.31 ± 2.47 after the intervention. All component-level differences were statistically significant at $p < 0.001$, indicating improvement in multiple dimensions of sleep quality rather than in a single aspect of sleep.

Table (6): Comparison of Global Pittsburgh Sleep Quality Index Scores among the Studied Pregnant Women Before and After the Digital Mind–Body Nursing Program (N = 100)

Global PSQI score	Pre-intervention	Post-intervention	Paired t-test	p-value
Mean ± SD	10.06 ± 3.21	5.31 ± 2.47	12.04	<0.001
Minimum–maximum	4–17	1–12		

Table (6) demonstrates a statistically significant improvement in overall sleep quality after the intervention. The mean global PSQI score decreased from 10.06 ± 3.21 at baseline to 5.31 ± 2.47 after the program. Since higher PSQI scores indicate poorer sleep quality, this reduction represents an improvement in sleep quality. The difference was statistically highly significant ($p < 0.001$).

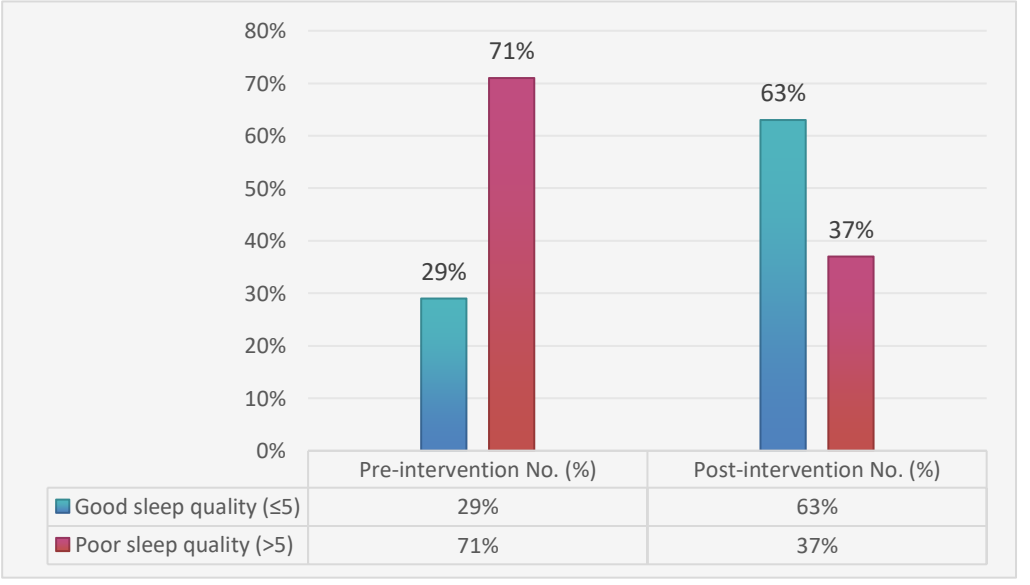


Figure (2): Distribution of the Studied Pregnant Women According to Sleep Quality Before and After the Digital Mind–Body Nursing Program (N = 100)

Figure (2): shows a substantial improvement in the categorical distribution of sleep quality. Before the intervention, 71.0% of pregnant women had poor sleep quality compared with only 29.0% who had good sleep quality. After completion of the digital mind–body nursing program, the proportion with good sleep quality increased to 63.0%, while poor sleep quality decreased to 37.0%.

Table (7): Comparison of Selected Domains of Psychological Resilience among the Studied Pregnant Women Before and After the Digital Mind–Body Nursing Program (N = 100)

Resilience domains	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Paired t-test	p-value
Personal competence/tenacity	24.18 ± 5.21	31.47 ± 4.72	-10.35	<0.001
Trust in personal instincts	8.62 ± 2.31	11.24 ± 2.08	-8.46	<0.001
Positive acceptance of change	8.14 ± 2.17	10.71 ± 1.94	-8.91	<0.001
Control	6.31 ± 1.82	8.21 ± 1.64	-8.02	<0.001
Spiritual influences	3.24 ± 1.13	4.16 ± 0.91	-6.21	<0.001
Total CD-RISC-25 score	**50.49 ± 9.42**	**65.79 ± 8.17**	**13.02**	**<0.001**

Table (7) demonstrates improvement across the different dimensions of psychological resilience following the intervention. Mean scores increased in personal competence and tenacity, trust in personal instincts, positive acceptance of change, perceived control, and spiritual influences. The total resilience score increased from 50.49 ± 9.42 before the intervention to 65.79 ± 8.17 after the intervention, with a statistically significant difference ($p < 0.001$).

Table (8): Comparison of Total Connor–Davidson Resilience Scale Scores among the Studied Pregnant Women Before and After the Digital Mind–Body Nursing Program (N = 100)

Total CD-RISC-25 score	Pre-intervention	Post-intervention	Paired t-test	p-value
Mean ± SD	50.49 ± 9.42	65.79 ± 8.17	13.02	<0.001
Minimum–maximum	29–72	43–84		

Table (8) reveals a significant increase in psychological resilience after participation in the digital mind–body nursing program. The mean CD-RISC-25 score increased from 50.49 ± 9.42 before the intervention to 65.79 ± 8.17 after the intervention. The difference was statistically highly significant ($p < 0.001$).

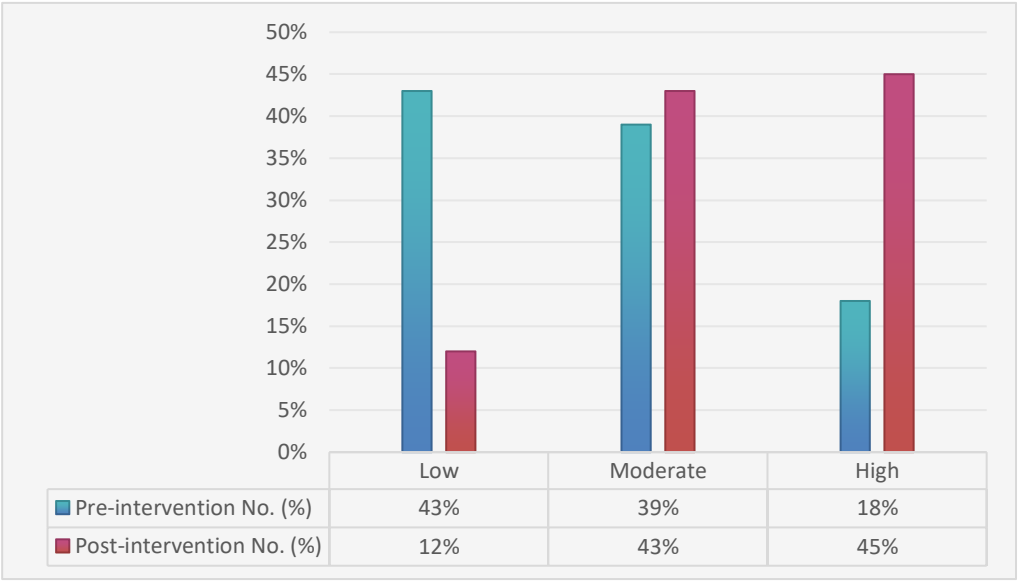


Figure (3): Distribution of the Studied Pregnant Women According to Their Descriptive Level of Psychological Resilience Before and After the Digital Mind–Body Nursing Program (N = 100)

Figure (3) demonstrates a favorable shift toward higher descriptive levels of resilience after the intervention. Before the program, 43.0% of the women were classified as having low resilience and only 18.0% had high resilience. Following the program, the proportion with low resilience decreased to 12.0%, whereas high resilience increased to 45.0%. The moderate-resilience category remained relatively stable, increasing from 39.0% to 43.0%.

Table (9): Correlation between Changes in Perceived Stress, Sleep Quality, and Psychological Resilience among the Studied Pregnant Women (N = 100)

Variables	Change in perceived stress	Change in PSQI score	Change in resilience
Change in perceived stress	1		
Change in PSQI score	r = 0.52, p < 0.001	1	
Change in resilience	r = -0.48, p < 0.001	r = -0.44, p < 0.001	1

Table (9) demonstrates statistically significant relationships among the changes in the major study outcomes. The change in perceived stress was positively correlated with the change in PSQI score ($r = 0.52$, $p < 0.001$). In addition, change in perceived stress was negatively correlated with change in resilience ($r = -0.48$, $p < 0.001$). Similarly, improvement in sleep quality was negatively correlated with improvement in resilience ($r = -0.44$, $p < 0.001$).

Discussion

Pregnancy is a critical period in which physical, hormonal, emotional, and social changes can substantially influence maternal psychological well-being. Stress and sleep disturbances are common during pregnancy and may negatively affect daily functioning, emotional adjustment, and quality of life. At the same time, psychological resilience represents an important protective resource that may help women adapt to pregnancy-related challenges and cope with stressful experiences. Addressing these interconnected aspects is therefore important within comprehensive antenatal nursing care. The increasing availability of smartphones and digital health resources also provides opportunities to extend supportive nursing care beyond conventional clinical encounters and facilitate convenient access to evidence-based self-management strategies. Accordingly, examining approaches that simultaneously address maternal stress, sleep, and resilience is clinically relevant for strengthening holistic and accessible antenatal care **(Chauhan & Potdar, (2022).**

The findings indicated that the largest proportion of the studied pregnant women were aged 25–<30 years, with a mean age of 28.4 ± 5.1 years. More than three-fifths were from rural areas, two-fifths had university education, and more than two-thirds were housewives. All participants were married and had access to smartphones, whereas only slightly more than one-third had previous experience with digital health applications. This profile suggests that although smartphone access was universal, previous exposure to digital health technologies was relatively limited. The availability of smartphones among all participants provided an important practical basis for implementing a digitally delivered nursing intervention, while the limited previous experience emphasizes the importance of simple, user-friendly digital content and initial technical orientation.

Similar observations by **Chen et al., (2021)** have been reported in digital perinatal interventions, where digital delivery has been considered a potentially accessible approach for pregnant women who may face barriers to conventional face-to-face psychological interventions. However, the present finding of universal smartphone availability may differ from populations in settings with lower digital access, limiting direct generalization to pregnant women with restricted access to mobile technology.

The obstetric characteristics showed that most participants were in the second or third trimester, while multigravida women represented the majority. Moderate and severe pregnancy-related physical discomforts were also relatively common, and nearly half of the women reported moderate stress before the intervention. These characteristics are clinically relevant because pregnancy involves substantial physical, emotional, and behavioral changes that may influence perceived stress and sleep. Previous literature has similarly recognized pregnancy as a period associated with increased stress and psychological and sleep-related difficulties. However, the distribution of gestational age and obstetric characteristics varies considerably across previous intervention studies, which may contribute to differences in intervention response and limits direct comparison of effect magnitude across studies **(Lucena et al., 2020).**

The findings demonstrated statistically significant improvements across all PSS-10 items following the digital mind–body nursing program. Negative stress-related experiences decreased, whereas positively worded coping-related items increased. These findings are consistent **with Kim et al., (2020)** the growing literature supporting digital and mindfulness-based approaches for psychological distress during pregnancy. A recent systematic review and meta-analysis of digital stress-management interventions involving pregnant women found an overall significant reduction in stress compared with control conditions, with mindfulness- and education-focused strategies showing favorable effects. Similarly, **Sharma et al., (2021)** a recent meta-analysis of digital and face-to-face mindfulness-based interventions reported significant reductions in stress among pregnant women receiving digital interventions. Thus, the present findings are broadly consistent with contemporary evidence supporting digitally delivered interventions as an adjunct to antenatal care.

The findings demonstrated a substantial decrease in the total PSS-10 score intervention to 13.36 ± 4.18 after intervention. This finding supports the overall effectiveness of the program in reducing perceived stress within the studied sample. It is in agreement with **Zhang et al., (2019)** a randomized controlled trial by of a digital guided self-help mindfulness-based intervention among pregnant women, which reported significant reductions in maternal psychological distress following a six-week digital intervention. It is also consistent with **Mefrouche et al., (2019)** evidence from recent digital-health reviews indicating that digitally delivered interventions can reduce stress symptoms during pregnancy. Nevertheless, not all previous evidence has demonstrated a significant effect on stress. For example, an earlier 2023 meta-analysis of digital mindfulness interventions found significant effects for depression and anxiety but did not detect a statistically significant pooled effect on stress. This discrepancy may be related to differences in intervention content, duration, baseline stress level, outcome measurement, adherence, and study design.

The findings provided additional evidence of a favorable change in perceived stress, with an increase in the proportion of women classified as having low stress and a marked reduction in the proportion classified as having high stress. The statistically significant Bowker/McNemar-type analysis indicates that the distribution of stress categories changed after the intervention. This pattern is compatible with research **Al-Ghareeb et al., (2020)** showing that mindfulness-based and digital psychological interventions may support emotional regulation and reduce psychological distress during pregnancy. However, because the present study used a one-group pretest–posttest design, the observed change should be interpreted as an improvement following the intervention rather than definitive proof that the intervention alone caused the change. Natural changes across gestation, repeated assessment, regression toward the mean, and other antenatal experiences may also contribute.

The findings revealed significant improvement in all PSQI components, accompanied by a reduction. Improvements were particularly evident in subjective sleep quality, sleep latency, and sleep disturbances. These findings are consistent with intervention research by **Shamabadi et al., (2022)**indicating that mindfulness-based approaches may improve sleep-related outcomes during

pregnancy. A randomized clinical trial involving pregnant women in the second and third trimesters found that mindfulness training significantly improved sleep quality and was accompanied by reductions in anxiety, stress, and depression. More recent evidence from a randomized controlled trial of a digital mindfulness intervention specifically targeting prenatal insomnia by **Wang et al., (2021)** also demonstrated significant short-term improvement in insomnia symptoms. Therefore, the current findings are broadly consistent with evidence suggesting that mindfulness-based strategies may influence sleep through reductions in cognitive arousal, worry, and stress.

In contrast, the present findings differ from an earlier systematic review and meta-analysis of digital cognitive-behavioral interventions for pregnant women, by **Mancinelli et al., (2022)** found significant benefits for depression and anxiety but did not demonstrate a significant pooled improvement in sleep quality.

Similarly, an earlier systematic review of interventions for sleep problems during pregnancy by **Bacaro et al., (2020)** concluded that the evidence for mindfulness and other interventions was promising but still limited by the small number of high-quality randomized trials. The stronger sleep improvement observed in the present study may therefore be related to the integrated nature of the intervention, which combined mind–body strategies with nursing education and stress-management components rather than addressing sleep as an isolated outcome. Differences in the baseline severity of sleep problems, intervention content, duration, and measurement tools may also explain the inconsistent findings across studies.

The categorical results strengthen the interpretation of improved sleep quality, as the proportion of women with good sleep quality increased afterward, while poor sleep quality declined. This pattern is consistent with **Bacaro et al., (2020)** that observed reduction in the continuous PSQI score and with research identifying stress and psychological factors as important correlates of sleep during pregnancy. Nevertheless, the persistence of poor sleep quality in more than one-third of participants after the intervention indicates that pregnancy-related physiological changes and obstetric discomforts may continue to influence sleep even after psychological and behavioral improvement.

The improvement in psychological resilience observed after implementation of the Digital Mind–Body Nursing Program was evident across all assessed resilience domains. The total CD-RISC-25 score increased **after the intervention**, with significant improvements in personal competence, trust in personal instincts, acceptance of change, control, and spiritual influences. This pattern suggests that the intervention was associated with strengthening several psychological resources that may facilitate adaptive coping with pregnancy-related challenges. **A similar improvement was reported by** Naderpour et al. (2021)**, who found significantly higher resilience among pregnant women following resiliency training.** The agreement may be related to the use of structured psychological strategies designed to enhance coping resources and adaptive responses. Likewise, Faradonbe et al. (2020) **reported significant improvement in resilience following mindfulness training among women with unwanted pregnancy**, which further supports the relevance of mindfulness-oriented

approaches for enhancing psychological adaptation during pregnancy. **In contrast, differences in intervention duration, sample characteristics, pregnancy circumstances, and measurement procedures may explain variations in the magnitude of improvement between studies.** Nevertheless, the consistent direction of findings across these studies supports the incorporation of resilience-enhancing strategies into antenatal nursing interventions.

The significant associations identified among perceived stress, sleep quality, and resilience highlight the interconnected nature of these psychological outcomes during pregnancy. The positive correlation between changes in perceived stress and PSQI scores indicates that changes in stress occurred in the same direction as changes in PSQI scores, whereas the negative correlations between changes in stress and resilience and between changes in PSQI and resilience indicate that reductions in stress and improvements in sleep quality occurred alongside increased resilience. **This pattern is consistent with** Li et al. (2016), **who found significant relationships between prenatal maternal stress, sleep quality, and resilience among pregnant women.** Their findings showed that higher prenatal stress was associated with poorer sleep quality, while greater resilience was associated with better sleep quality. **Thus, the current findings reinforce previous evidence that stress, sleep, and resilience are closely related dimensions of maternal psychological well-being.**

The relationship between perceived stress and sleep quality can also be understood in light of the protective role attributed to psychological resilience during pregnancy. **Zou et al. (2022) similarly reported that perceived stress was positively associated with insomnia symptoms and that resilience moderated this association among pregnant women.** This agreement suggests that resilience may represent an important psychological resource that is associated with better adaptation to stress and fewer sleep-related difficulties. Therefore, although both studies demonstrate significant relationships among stress, resilience, and sleep, the present findings reflect coordinated changes following the nursing program rather than a tested moderating mechanism.

The observed inverse relationship between stress and resilience is further supported by evidence linking resilience with pregnancy-related psychological distress. Tuxunjiang et al. (2022) **found significant associations between pregnancy stress, resilience, and prenatal anxiety and reported that resilience partially mediated the relationship between pregnancy stress and prenatal anxiety.** These findings are compatible with the present observation that lower stress was associated with higher resilience after the intervention and reinforce the importance of resilience as a psychological resource during pregnancy.

Conclusion

Based on the findings of the present study, the study concluded that implementation of the digital mind–body nursing program was accompanied by significant improvements in the psychological and sleep-related outcomes of the studied pregnant women. The intervention was associated with reduced perceived

stress, improved sleep quality, and enhanced psychological resilience. Significant associations among these outcomes further indicated that maternal stress, sleep, and resilience were closely interrelated. These findings support the potential role of digitally delivered mind–body nursing care as a supportive component of antenatal nursing practice. Nevertheless, interpretation should consider the one-group pretest–posttest design and the absence of a control group.

Recommendations

Based on the findings of the present study, the following recommendations are suggested:

- Incorporating digital mind–body nursing support into routine antenatal nursing services where appropriate.
- Providing pregnant women with practical digital resources for relaxation, breathing, mindfulness, sleep hygiene, and adaptive coping.
- Offering brief digital orientation and technical support for women with limited previous experience with digital health applications.
- Including stress and sleep screening within routine antenatal nursing assessment to facilitate early identification of women requiring additional support.
- Establishing referral pathways for women with persistent or severe psychological or sleep-related difficulties.
- Encouraging collaboration between maternity nurses, obstetric providers, mental-health professionals, and digital-health specialists when implementing such programs.
- Conducting randomized controlled studies with larger and more diverse samples to determine the effectiveness of the intervention compared with usual antenatal care.
- Undertaking longer-term follow-up studies to assess maintenance of benefits during late pregnancy and the postpartum period.
- Assessing program adherence, acceptability, usability, and cost-effectiveness before wider implementation in antenatal services.
- Using the continuous CD-RISC-25 score as the principal resilience outcome, while treating researcher-defined resilience categories as descriptive rather than diagnostic classifications.

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