

Integrating Sustainable Development Goals into Nursing Care: Impact of an Eco-Parenting Intervention on Maternal Climate Anxiety and Infant Socio-Emotional Development

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Abstract

Background: Climate change is increasingly recognized as a threat to maternal and child well-being, with climate-related concerns potentially contributing to maternal climate anxiety and affecting parenting behaviors and early child development. Integrating the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), into nursing care may provide an innovative approach to supporting environmentally responsible parenting while promoting healthy infant development. **Aim:** To evaluate the impact of an eco-parenting nursing intervention integrating Sustainable Development Goals on maternal climate anxiety and infants' socio-emotional development. **Methods:** A quasi-experimental pre–post intervention study was conducted among 100 mothers and their infants. **Setting:** The sample was attending maternal and child health care (Dar El-Salmaa AbdAllah in Sohag City). Data were collected using a structured maternal and infant assessment questionnaire, the Climate Anxiety Scale, an Eco-Parenting Knowledge and Practices Assessment Scale, and an Infant Socio-Emotional Development Assessment Scale. The intervention consisted of structured nursing education and practical activities addressing climate change awareness, environmentally sustainable parenting, reduction of household waste, safe and sustainable infant-care practices, energy and water conservation, responsible consumption, nature-based activities, emotional coping with climate concerns, and responsive parent–infant interaction. The program was delivered over 4 weeks through two sessions per week, followed by post-intervention assessment. **Results:** Following implementation of the eco-

parenting intervention, mothers demonstrated a significant improvement in knowledge and sustainable parenting practices and a significant reduction in climate-anxiety levels compared with their pre-intervention scores ($p < 0.001$). In addition, infants demonstrated significant improvement in socio-emotional development indicators, including emotional regulation, social responsiveness, interaction with caregivers, and adaptive behaviors ($p < 0.001$). A significant relationship was also observed between improved maternal eco-parenting practices and better infant socio-emotional outcomes. **Conclusion:** Integrating SDGs into nursing care through an eco-parenting intervention may be an effective and feasible approach to reducing maternal climate anxiety while strengthening environmentally responsible parenting and supporting healthy infant socio-emotional development. **Recommendations:** Incorporating climate-sensitive education and sustainable parenting practices into maternal and child nursing services may contribute to both family well-being and the achievement of health- and environment-related SDGs.

Keywords: Eco-Parenting; Infant Development; Maternal Climate Anxiety; Socio-Emotional Development; Sustainable Development Goals.

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Introduction

Climate change has emerged as one of the most important global public health challenges, with consequences extending across the life course and disproportionately affecting pregnant women, newborns, and young children. Increasing temperatures, heatwaves, air pollution, floods, droughts, water insecurity, food insecurity, and other climate-related hazards can adversely affect maternal and infant health. Pregnant women may experience increased risks of hypertensive disorders, gestational diabetes, preterm birth, low birth weight, and stillbirth, while infants and young children are particularly vulnerable because of their physiological dependence, immature thermoregulation, and developing immune and neurological systems. Beyond direct physical effects, climate-related disruptions may interfere with access to health services, nutrition, safe water, sanitation, and stable caregiving environments. Therefore, climate change should be considered not only an environmental problem but also an important determinant of maternal, newborn, and child health that requires preventive and health-promoting interventions within nursing practice (World Health Organization, 2023).

In addition to its physical consequences, climate change has increasingly been associated with psychological distress, including worry, fear, helplessness, sadness, and anxiety regarding the future. For mothers and other

caregivers, concerns about the environmental conditions in which their children will grow may become particularly salient because parenting involves responsibility for children's present and future well-being (Ojala et al., 2021). Research examining parents' experiences of raising children in the context of climate change has identified feelings of anxiety, sadness, hopelessness, guilt, uncertainty, and disempowerment. Such emotional responses may influence parents' perceptions of risk, coping abilities, and everyday parenting practices. Consequently, addressing maternal climate anxiety is important because supporting mothers to transform climate-related concerns into constructive knowledge, adaptive coping, and feasible protective behaviors may strengthen family resilience rather than allowing environmental concerns to become a source of persistent psychological distress (Gaziulusoy, 2020).

The family environment represents an important context through which infants experience emotional security, social interaction, behavioral regulation, and early developmental stimulation. Responsive parenting, characterized by sensitive caregiver responses, positive parent-infant interaction, emotional availability, and developmentally appropriate stimulation, provides an important foundation for healthy socio-emotional development. Within the context of climate change, eco-parenting can extend these principles by integrating environmentally

responsible behaviors into everyday family life, such as conserving water and energy, reducing household waste, choosing safer and more sustainable products, encouraging contact with nature, and adopting climate-sensitive infant-care practices (Proulx et al., 2024). Importantly, eco-parenting should not be viewed solely as environmental behavior; when combined with responsive caregiving and emotional support, it may create opportunities for mothers to develop a sense of agency and competence while providing infants with safe, stimulating, and emotionally supportive environments. Climate-resilient parenting therefore represents a potentially valuable approach for connecting environmental sustainability with early childhood well-being (Lobo et al., 2024).

The Sustainable Development Goals (SDGs) provide a global framework for addressing interconnected health, social, educational, and environmental challenges. Several SDGs are particularly relevant to maternal and infant nursing care. SDG 3, which aims to ensure healthy lives and promote well-being for all at all ages, directly supports maternal and child health promotion; SDG 4 emphasizes inclusive and equitable quality education and lifelong learning; SDG 12 promotes sustainable consumption and production patterns; and SDG 13 calls for urgent action to combat climate change and its impacts. Integrating these goals into nursing interventions can transform sustainability from a broad international agenda into practical family-level behaviors. Maternal education about climate-health risks, sustainable consumption, household resource conservation, environmentally safe infant care, and climate-related coping strategies can simultaneously support health promotion, health education, responsible consumption, and climate action. Thus, SDG-oriented nursing care may provide an integrated framework for addressing both immediate family health needs and longer-term environmental sustainability (Ferrando et al., 2025).

Nurses occupy a strategic position in translating climate-health knowledge into practical interventions because of their continuous contact with mothers, infants, families, and communities. Climate-sensitive nursing care can include assessing families' understanding of climate-related health risks, providing individualized education, promoting preventive behaviors, supporting psychological coping, encouraging sustainable household practices, and strengthening parents' confidence in protecting children from environmental hazards. Such interventions are especially relevant in

maternal and child health settings, where nurses can integrate climate-health education with routine counseling related to nutrition, hygiene, infant safety, developmental stimulation, and parenting. The World Health Organization has emphasized the need for health systems and programs to recognize the specific vulnerabilities of women, newborns, and children and to strengthen climate resilience across the life course. Accordingly, nursing interventions that combine health promotion, environmental sustainability, and psychosocial support may contribute to a more comprehensive model of family-centered climate-resilient care (World Health Organization, 2024).

Despite increasing recognition of climate change as a threat to maternal and child health, practical nursing interventions that simultaneously address maternal climate anxiety, sustainable parenting behaviors, and infant socio-emotional development remain relatively limited. This gap is particularly important in community and maternal-child health settings, where nurses can reach mothers during the early years of children's development and provide culturally appropriate, practical, and family-centered education. Developing an eco-parenting nursing intervention that integrates SDGs 3, 4, 12, and 13 may provide mothers with the knowledge, coping skills, and practical behaviors needed to respond constructively to climate-related concerns while maintaining responsive interactions with their infants. Therefore, the present study aims to evaluate the impact of an eco-parenting nursing intervention integrating Sustainable Development Goals on maternal climate anxiety and infants' socio-emotional development among mothers. The study is based on the premise that empowering mothers through climate-sensitive education and sustainable parenting practices may reduce climate-related psychological distress while strengthening family resilience and promoting healthier early childhood development (Strong et al., 2025).

Significance of the Study

Climate change represents an emerging threat to maternal and infant health, with environmental hazards and climate-related concerns potentially contributing to maternal climate anxiety and influencing parenting practices and early childhood development. The present study is significant because it introduces an innovative eco-parenting nursing intervention that integrates selected Sustainable

Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), into maternal and child nursing care. The intervention may empower mothers with practical knowledge and skills to adopt environmentally responsible parenting behaviors, manage climate-related concerns, conserve household resources, reduce waste, and provide safe and responsive care for their infants. Moreover, strengthening mothers' adaptive coping and eco-parenting practices may contribute to reducing climate anxiety while creating supportive family environments that promote infants' emotional regulation, social responsiveness, caregiver interaction, and adaptive behaviors. The study may also strengthen the role of nurses in delivering climate-sensitive, family-centered, and sustainability-oriented health education and provide a feasible community-based model for translating global SDGs into practical maternal and child health services.

Aim:

To evaluate the impact of an eco-parenting nursing intervention integrating Sustainable Development Goals on maternal climate anxiety and infants' socio-emotional development.

Research Hypotheses

H1: Mothers who receive the eco-parenting nursing intervention integrating Sustainable Development Goals will demonstrate significantly higher levels of knowledge regarding climate change, maternal–infant health, and sustainable parenting practices after the intervention compared with their pre-intervention levels.

H2: Mothers who receive the eco-parenting nursing intervention will demonstrate significantly improved sustainable eco-parenting practices after the intervention compared with their pre-intervention practices.

H3: Mothers who receive the eco-parenting nursing intervention will experience a significant reduction in climate-anxiety levels after the intervention compared with their pre-intervention levels.

H4: Infants of mothers who receive the eco-parenting nursing intervention will demonstrate significantly improved socio-emotional

development after the intervention compared with their baseline levels.

H5: There will be a significant negative relationship between mothers' eco-parenting practices and their climate-anxiety levels after the intervention, such that better eco-parenting practices will be associated with lower climate anxiety.

H6: There will be a significant positive relationship between improved maternal eco-parenting practices and infants' socio-emotional development after the intervention.

Subjects and Methods

Research Design

A quasi-experimental one-group pretest–posttest research design was used to evaluate the impact of an eco-parenting nursing intervention integrating selected Sustainable Development Goals (SDGs) on maternal climate anxiety and infants' socio-emotional development.

Setting

The study was conducted at Dar El-Salmaa AbdAllah in Sohag City, Sohag Governorate, Egypt, where mothers and their infants attended maternal and child health care services.

Subjects

A convenience sample of 100 mothers and their infants was recruited.

Tools of Data Collection

Four tools were used for data collection.

Tool I: Structured Maternal and Infant Assessment Questionnaire, developed by the researcher based on relevant literature (**World Health Organization, 2020**), consisted of two parts: maternal sociodemographic characteristics, including age, residence, educational level, occupation, marital status, family size, income, and exposure to environmental problems; and infant characteristics, including age, sex, birth order, breastfeeding status, health status, and history of chronic illness. This tool was used for descriptive purposes and was not included in the intervention outcome score.

Tool II: Climate Change Anxiety Scale (CCAS) adapted from **Clayton and Karazsia (2020)** was used to assess mothers' climate-related psychological distress and functional impairment. The adapted version included 13 items rated on a five-point Likert scale ranging from 1 = never to 5 = almost always, with a total score ranging from 13 to 65; higher scores indicated greater climate anxiety. Scores were classified as low (<50%), moderate (50–<75%), and high ($\geq 75\%$).

Tool III: Eco-Parenting Knowledge and Practices Assessment Scale was developed by the researcher based on relevant literature (**Jo & Kim, 2026** and **World Health Organization, UNICEF, World Bank Group, ECDAN, & PMNCH, 2018**), and the principles of SDGs 3, 4, 12, and 13. It consisted of 40 items divided into 20 knowledge items and 20 practice items. Knowledge items were scored 1 for a correct response and 0 for an incorrect or “don’t know” response, giving a total of 0–20; knowledge was categorized as poor (<50%), fair (50–<75%), and good ($\geq 75\%$). Practice items were rated as 0 = never, 1 = sometimes, and 2 = always, giving a total score of 0–40; practices were categorized as unsatisfactory (<60%) and satisfactory ($\geq 60\%$). The scale covered climate-health awareness, waste reduction, water and energy conservation, responsible consumption, sustainable infant care, nature-based activities, and responsive parenting. Its content was guided by contemporary environmental-parenting research and the WHO/UNICEF nurturing-care framework.

Tool IV: Infant Socio-Emotional Development Assessment Scale was adapted by the researcher based on WHO and UNICEF recommendations for nurturing care and early childhood development (**World Health Organization, UNICEF, World Bank Group, ECDAN, & PMNCH, 2018; World Health Organization, 2020**). It included 25 items covering emotional regulation, social responsiveness, parent–infant interaction, communication and social engagement, and adaptive behaviors. Each item was scored 0 = rarely/not yet, 1 = sometimes, and 2 = usually, resulting in a total score of 0–50; scores were interpreted as low (<50%), moderate (50–<75%), and good ($\geq 75\%$), with higher scores indicating more favorable socio-emotional development. The content of this tool was consistent with the WHO/UNICEF Nurturing Care Framework, which emphasizes responsive caregiving and early learning as essential components of healthy early childhood development.

Validity

The content validity of the data collection tools was established through review by a panel of **five experts** in maternal and child health nursing, community health nursing, pediatric nursing, and public health. The experts evaluated the tools for relevance, clarity, comprehensiveness, appropriateness of wording, and suitability of the items for the study population. Their recommendations were considered, and items were modified, reworded, added, or omitted accordingly. The researcher-developed tools, particularly the Eco-Parenting Knowledge and Practices Assessment Scale and the Infant Socio-Emotional Development Assessment Scale, were evaluated to ensure that their items adequately represented the intended domains.

Reliability

The reliability of the study tools was assessed to determine their **internal consistency and stability**. Internal consistency was evaluated using **Cronbach's alpha coefficient** for the Climate Anxiety Scale, Eco-Parenting Knowledge and Practices Assessment Scale, and Infant Socio-Emotional Development Assessment Scale. A Cronbach's alpha coefficient of ≥ 0.70 was considered acceptable for research purposes. For the knowledge component may be used to assess internal consistency. The reliability assessment was conducted before the main data collection to ensure that the instruments produced consistent measurements.

Pilot Study

A pilot study was conducted on 10% of the total study sample, involving 10 mothers and their infants, before commencement of the main fieldwork. The pilot study was conducted to assess the clarity, readability, sequence, comprehensiveness, cultural appropriateness, and feasibility of the data collection tools, as well as to estimate the time required for completing the questionnaires and implementing the intervention sessions. The pilot participants were selected using the same eligibility criteria as the main sample but were excluded from the final study sample to avoid potential contamination or familiarity with the intervention and assessment procedures. Minor modifications were made to the wording and organization of some items according to the pilot participants' feedback.

Ethical Considerations

Before conducting the study, ethical approval was obtained from the responsible institutional research ethics committee (No/ 155-9-2025), and official permission was obtained from the relevant authorities at the study setting. The study followed internationally recognized principles for research involving human participants, including respect for autonomy, beneficence, non-maleficence, justice, privacy, and confidentiality. Each mother was informed about the purpose, procedures, expected duration, potential benefits, and voluntary nature of participation. Written informed consent was obtained from each mother before enrollment. Mothers were informed that participation was voluntary and that they could withdraw from the study at any time without affecting the health services provided to them or their infants. Confidentiality was maintained by assigning codes instead of names to questionnaires and storing collected information securely. No identifying information was disclosed in reports or publications. Because the study involved mothers and infants, particular attention was given to protecting the dignity, privacy, safety, and welfare of both mothers and their children.

Phases of the Eco-Parenting Nursing Intervention

The eco-parenting nursing intervention was implemented over 4 weeks, with two sessions per week, for a total of 8 sessions. Each session lasted approximately 45–60 minutes and included brief educational presentation, group discussion, demonstration, practical activities, and take-home assignments. The intervention was organized into four sequential phases: assessment and preparation, implementation, reinforcement, and post-intervention evaluation.

Phase I: Assessment and Preparation

Session 1: Baseline Assessment and Introduction to Eco-Parenting

The first session focused on establishing rapport with mothers, explaining the purpose and importance of the program, and assessing their baseline needs. The researcher explained the relationship between climate change, maternal well-being, infant health, parenting, and sustainable family practices. Mothers completed the baseline assessment tools, including the Climate Anxiety Scale, Eco-Parenting Knowledge and Practices

Assessment Scale, and Infant Socio-Emotional Development Assessment Scale. The concept of eco-parenting was introduced as a practical approach that combines child health, responsive parenting, environmental responsibility, and climate resilience. Mothers were encouraged to identify common environmental challenges in their households and discuss their concerns about climate change.

Session 2: Climate Change, Maternal Anxiety, and Infant Health

This session addressed common climate-related hazards and their potential effects on mothers and infants, including excessive heat, air pollution, water insecurity, food-related risks, and extreme weather events. Mothers learned how climate-related concerns may contribute to worry and anxiety and were introduced to simple coping strategies, including controlled breathing, problem-solving, seeking reliable information, focusing on achievable actions, and avoiding excessive exposure to distressing climate information. Practical discussion emphasized transforming climate-related worry into constructive protective behaviors.

Phase II: Eco-Parenting Knowledge and Skill Development

Session 3: Sustainable Household Practices and Responsible Consumption

The third session focused on practical environmentally responsible behaviors within the household. Mothers were educated about waste reduction, reuse, recycling, reduction of single-use plastics, responsible purchasing, and appropriate disposal of household and infant-care waste. Demonstrations were used to show how everyday parenting decisions can reduce unnecessary environmental exposure and household waste. Mothers were encouraged to develop a simple household sustainability plan identifying behaviors they could realistically adopt.

Session 4: Water, Energy, and Safe Sustainable Infant Care

This session addressed water and energy conservation while maintaining safe infant care. Mothers learned practical methods for reducing unnecessary water and electricity consumption, safe food and water handling, appropriate infant hygiene, adequate ventilation, and protection of infants from excessive heat and other environmental hazards. Emphasis was placed

on maintaining health and safety while avoiding unnecessary resource consumption. Mothers practiced identifying safe and sustainable alternatives for common infant-care activities.

Phase III: Responsive and Nature-Based Eco-Parenting

Session 5: Nature-Based Activities and Infant Stimulation

The fifth session focused on the relationship between safe contact with nature, play, stimulation, and infant development. Mothers were taught how to provide age-appropriate nature-based activities while maintaining infant safety. Examples included supervised outdoor observation, sensory exploration, exposure to natural sounds and textures, simple movement activities, and interactive play. Mothers were encouraged to use available natural environments without requiring expensive materials. The session emphasized that nature-based activities should be combined with active maternal supervision and responsive interaction.

Session 6: Responsive Parenting and Infant Socio-Emotional Development

This session emphasized the importance of responsive caregiving and positive mother–infant interaction. Mothers learned to recognize infant cues, respond appropriately to crying and distress, provide comfort, use eye contact and verbal interaction, encourage reciprocal play, and support emotional regulation. Demonstrations and role-play were used to practice responsive responses to common infant behaviors. Mothers were also encouraged to integrate sustainable activities with emotionally supportive interaction, such as talking to the infant during outdoor activities, playing with reusable materials, and exploring nature together.

Phase IV: Integration, Practice, and Reinforcement

Summary of the Intervention Sessions

Week	Session	Main Content
1	Session 1	Introduction, baseline assessment, climate change and eco-parenting
	Session 2	Climate-related maternal anxiety and infant health

Session 7: Integrating SDGs into Everyday Parenting

The seventh session integrated the intervention content with the selected Sustainable Development Goals. Mothers were introduced to practical family-level applications of:

- SDG 3 – Good Health and Well-being: protecting maternal and infant health from environmental risks.
- SDG 4 – Quality Education: increasing mothers' knowledge and health literacy.
- SDG 12 – Responsible Consumption and Production: reducing waste and promoting responsible use of household resources.
- SDG 13 – Climate Action: adopting practical behaviors that contribute to climate adaptation and environmental protection.

Mothers worked through practical scenarios and identified how daily parenting decisions could contribute to these goals. The session also reinforced strategies for managing climate anxiety through constructive action and family participation.

Session 8: Review, Reinforcement, and Family Eco-Parenting Plan

The final session reviewed the main concepts and skills presented throughout the program. Mothers participated in discussion, question-and-answer activities, demonstrations, and practical problem-solving exercises. Misconceptions were corrected and successful behavioral changes were reinforced. Each mother developed a simple personalized eco-parenting plan identifying sustainable behaviors, climate-health protective practices, responsive parenting activities, and strategies for maintaining emotional well-being. Mothers were encouraged to continue applying the learned practices at home. At the end of the program, the researcher conducted the post-intervention assessment using the same outcome measures administered at baseline.

Week	Session	Main Content
2	Session 3	Waste reduction and responsible consumption
	Session 4	Water/energy conservation and sustainable infant care
3	Session 5	Nature-based activities and infant stimulation
	Session 6	Responsive parenting and socio-emotional development

Week	Session	Main Content
Week 4	Session 7	Integrating SDGs 3, 4, 12, and 13 into parenting

Session 8 Review, reinforcement, individualized eco-parenting plan, and post-test

Educational methods: short lectures, group discussion, brainstorming, demonstration and re-demonstration, role-play, problem-solving, question-and-answer, visual materials, and take-home assignments.

Educational materials: illustrated booklet, posters, pictures, practical demonstrations, scenario cards, and simple home-based activity guides.

Statistical Analysis

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS Statistics software, version 26. Descriptive statistics were used to summarize the characteristics of the studied mothers and their infants. Frequencies and percentages were calculated for categorical variables, while means and standard deviations (Mean $\pm$ SD) were used to describe continuous variables and total scale scores. The Shapiro-Wilk test was used to assess the normality of

continuous data. For comparison of mothers' climate-anxiety scores, eco-parenting knowledge and practices, and infants' socio-emotional development scores before and after implementation of the intervention, the paired-samples t-test was used for normally distributed continuous variables; the Wilcoxon signed-rank test was used when data were not normally distributed. For categorical variables, the McNemar test was used to compare paired proportions before and after the intervention. Pearson's correlation coefficient (r) was used to examine the relationship between maternal eco-parenting practices, climate-anxiety scores, and infant socio-emotional development scores when variables met parametric assumptions, while Spearman's rank correlation coefficient (rho) was used for non-parametric data. Multiple linear regression analysis may be used to identify significant predictors of infant socio-emotional development, including maternal eco-parenting practices and climate-anxiety scores, while controlling for relevant maternal and infant characteristics. The 95% confidence interval (CI) was reported where appropriate. Statistical significance was considered at $p < 0.05$, while $p < 0.001$ was considered highly statistically significant. A p-value of ≥ 0.05 was considered statistically non-significant.

Results:

Table 1. Distribution of the Studied Mothers According to Their Socio-demographic Characteristics (N = 100)

Sociodemographic characteristics	No.	%
Age (years)		
18–<25	27	27.0
25–<35	48	48.0
≥ 35	25	25.0
Residence		
Rural	61	61.0
Urban	39	39.0
Educational level		
Illiterate/read and write	14	14.0
Basic/secondary education	47	47.0
University or higher	39	39.0

Sociodemographic characteristics	No.	%
Occupation		
Housewife	68	68.0
Working	32	32.0
Marital status		
Married	96	96.0
Widowed/divorced	4	4.0
Family size		
≤ 4 members	43	43.0
> 4 members	57	57.0
Monthly family income		
Insufficient	54	54.0
Sufficient	46	46.0
Previously received climate-health information		
Yes	23	23.0
No	77	77.0

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Table 1 illustrates the sociodemographic characteristics of the studied mothers. Nearly half of the mothers (48.0%) were aged 25–<35 years, indicating that the majority were within the typical childbearing and active parenting age group. More than three-fifths (61.0%) were living in rural areas, which may reflect differences in access to environmental-health information and formal educational resources. Regarding education, almost half of the mothers (47.0%) had basic or secondary education, while 39.0% had university education or higher.

Table 2. Distribution of the Studied Infants According to Their Characteristics (N = 100)

Infant characteristics	No.	%
Age (months)		
6–<12	38	38.0
12–<18	35	35.0
18–24	27	27.0
Sex		
Male	53	53.0
Female	47	47.0
Birth order		

Table 2 shows that 38.0% of the infants were aged 6–<12 months, followed by 35.0% aged 12–<18 months and 27.0% aged 18–24 months. The distribution by sex was relatively balanced, with a slight predominance of males (53.0%) compared with females (47.0%). First-born infants represented the largest proportion (42.0%), which may indicate that a substantial

The majority of mothers (68.0%) were housewives, potentially allowing them to have substantial involvement in daily infant care and household environmental practices. Almost all mothers (96.0%) were married. More than half (57.0%) belonged to families with more than four members, and 54.0% reported insufficient monthly family income. Notably, only 23.0% of mothers had previously received information related to climate and health, while the large majority (77.0%) had not received such information.

Infant characteristics	No.	%
First	42	42.0
Second	35	35.0
Third or more	23	23.0
Current health status		
Healthy	82	82.0
Minor/recurrent health problems	18	18.0
Breastfeeding status		
Currently breastfed	58	58.0
Not currently breastfed	42	42.0

proportion of mothers were experiencing early parenting responsibilities. The majority of infants (82.0%) were reported to be generally healthy, whereas 18.0% had minor or recurrent health problems. More than half of the infants (58.0%) were still breastfed at the time of assessment.

Figure 1. Mothers' Climate Anxiety Levels Before and After Implementation of the Eco-Parenting Nursing Intervention (N = 100)

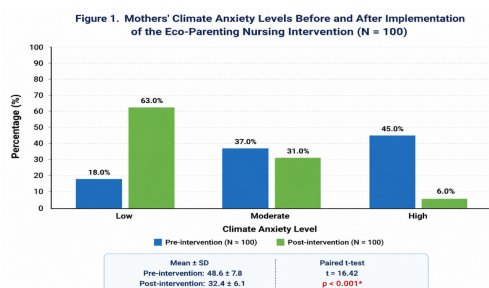


Figure 1 demonstrates a substantial improvement in mothers' climate-anxiety profile following implementation of the eco-parenting nursing intervention. Before the intervention, almost half of the mothers (45.0%) demonstrated high climate anxiety, compared with only 6.0% after the intervention.

Conversely, the proportion of mothers with low climate anxiety increased markedly from 18.0% before the intervention to 63.0% afterward. The mean climate-anxiety score decreased from 48.6 ± 7.8 at baseline to 32.4 ± 6.1 after the intervention. The highly significant paired comparison ($t = 16.42$, $p < 0.001$).

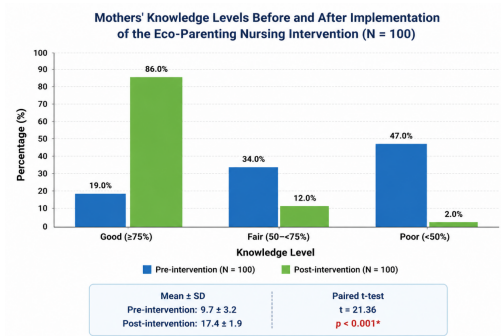


Figure 2. Mothers' Eco-Parenting

Figure 2 reveals a pronounced improvement in mothers' eco-parenting knowledge following the intervention. Prior to the program, almost half of the mothers (47.0%) had poor knowledge, whereas only 19.0% demonstrated good knowledge. Following the intervention,

Knowledge Levels Before and After the Intervention (N = 100)

the proportion with good knowledge increased dramatically to 86.0%, while poor knowledge declined to only 2.0%. The mean knowledge score increased from 9.7 ± 3.2 to 17.4 ± 1.9 . The highly significant paired t-test ($t = 21.36$, $p < 0.001$)

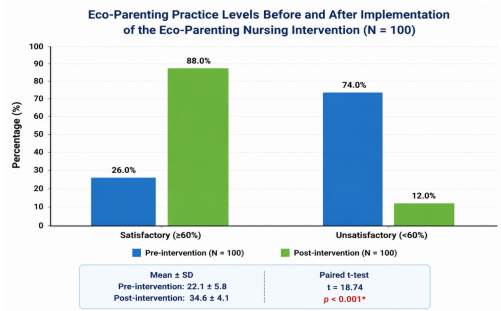


Figure 3. Mothers' Eco-Parenting Practice

Figure 3 demonstrates a substantial positive change in mothers' sustainable parenting practices after participation in the intervention. At baseline, nearly three-quarters of mothers (74.0%) had unsatisfactory eco-parenting practices, whereas only 26.0% demonstrated satisfactory practices. After the intervention,

Levels Before and After the Intervention (N = 100)

satisfactory practices increased considerably to 88.0%, while unsatisfactory practices declined to 12.0%. The mean practice score also increased from 22.1 ± 5.8 to 34.6 ± 4.1 . The highly significant paired t-test ($t = 18.74$, $p < 0.001$) .

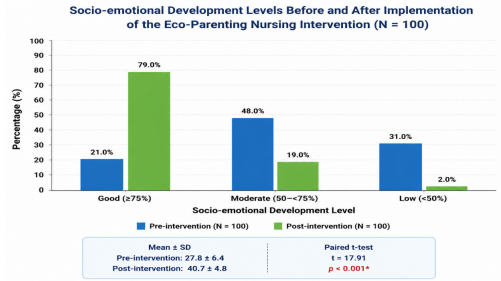


Figure 4 indicates a clear improvement in infants' socio-emotional development following the intervention. Before implementation, only 21.0% of infants demonstrated good socio-emotional development, while 31.0% were classified as having low development and 48.0% had moderate development. Following the intervention, the proportion with good socio-

emotional development increased substantially to 79.0%, whereas the proportion with low development decreased to only 2.0%. The mean socio-emotional development score increased from 27.8 ± 6.4 before the intervention to 40.7 ± 4.8 afterward. This improvement was statistically highly significant ($t = 17.91$, $p < 0.001$).

Figure 4. Infants' Socio-Emotional Development Levels Before and After the Eco-Parenting Intervention (N = 100)

Table 3. Comparison of Mothers' Mean Scores Regarding Climate Anxiety, Eco-Parenting, and Infants' Socio-Emotional

Development Before and After the Intervention (N = 100)

Study variables	Pre-intervention Mean $\pm$ SD	Post-intervention Mean $\pm$ SD	t-value	p-value
Climate anxiety	48.6 $\pm$ 7.8	32.4 $\pm$ 6.1	16.42	<0.001*
Eco-parenting knowledge	9.7 $\pm$ 3.2	17.4 $\pm$ 1.9	21.36	<0.001*

Table 3 provides an overall comparison of the principal study outcomes before and after implementation of the eco-parenting nursing intervention. The findings demonstrate a consistent and statistically significant pattern of improvement across the major intervention outcomes. Maternal climate anxiety showed a

Table 4. Correlation between Mothers' Eco-Parenting Practices, Climate Anxiety, and Infants' Socio-Emotional Development After the Intervention (N = 100)

Variables	Climate anxiety	Eco-parenting practices	Infant socio-emotional development
Climate anxiety	1	-0.54	-0.41

Table 4 demonstrates significant relationships among the principal study variables following implementation of the intervention. A significant **negative correlation** was observed between maternal climate anxiety and eco-parenting practices ($r = -0.54$, $p < 0.001$). A

Table 5. Predictors of Infants' Socio-Emotional Development After the Intervention (N = 100)

Predictor variables	β	t	p-value
Eco-parenting practices	0.48	6.21	<0.001*
Climate anxiety	-0.24	-3.18	0.002*

Study variables	Pre-intervention Mean $\pm$ SD	Post-intervention Mean $\pm$ SD	t-value	p-value
Eco-parenting practices	22.1 $\pm$ 5.8	34.6 $\pm$ 4.1	18.74	<0.001*
Infant socio-emotional development	27.8 $\pm$ 6.4	40.7 $\pm$ 4.8	17.91	<0.001*

*Statistically significant at $p < 0.05$.

substantial reduction, while both eco-parenting knowledge and practices increased considerably after the intervention. At the same time, infants' socio-emotional development scores improved significantly. All observed differences were highly statistically significant ($p < 0.001$).

Variables	Climate anxiety	Eco-parenting practices	Infant socio-emotional development
Eco-parenting practices	-0.54	1	0.62
Infant socio-emotional development	-0.41	0.62	1

significant **positive correlation** was found between eco-parenting practices and infant socio-emotional development ($r = 0.62$, $p < 0.001$). In contrast, maternal climate anxiety was negatively correlated with infant socio-emotional development ($r = -0.41$, $p < 0.001$).

Predictor variables	β	t	p-value
Maternal educational level	0.16	2.14	0.035*
Infant age	0.11	1.47	0.145
Family income	0.09	1.21	0.229

Model: $R^2 = 0.51$; Adjusted $R^2 = 0.48$; $F = 19.72$; $p < 0.001$, *Statistically significant.

Table 5 identifies the factors independently associated with infants' socio-emotional development following the intervention. Eco-parenting practices emerged as the strongest positive predictor of infant socio-emotional development ($\beta = 0.48$, $p < 0.001$). Climate anxiety was an independent negative predictor ($\beta = -0.24$, $p = 0.002$), suggesting that higher maternal anxiety remained associated with less favorable infant socio-emotional outcomes even after accounting for other variables. Maternal educational level also showed a significant positive association ($\beta = 0.16$, $p = 0.035$). In contrast, infant age and family income were not statistically significant predictors in the final model. Overall, the regression model explained approximately 51% of the variance in infant socio-emotional development.

Discussion:

The present study revealed that nearly half of the studied mothers were aged 25–<35 years, less than two thirds lived in rural areas, more than two thirds were housewives, and more than half reported insufficient family income. Furthermore, only less than one quarters had previously received information related to climate change and health. These findings indicate that most mothers had limited previous exposure to climate-health education, supporting the need for community-based nursing interventions. This finding is in agreement with **Kotera et al. (2025)**, who reported that parents' experiences and knowledge concerning climate change were important factors influencing their climate-related concerns and responses. Similarly, **Jo and Kim (2026)** emphasized that environmental parenting represents an important but relatively underdeveloped area of preventive parenting and highlighted the need for greater attention to parents' environmental-health behaviors. However, the present study differs from studies conducted in higher-resource settings, where parents may have greater access to climate-health information and environmental education. This difference may be related to variations in educational opportunities, socioeconomic circumstances, availability of health information, and differences between community and healthcare systems.

The present study demonstrated a significant reduction in maternal climate anxiety following the eco-parenting nursing intervention, with high anxiety decreasing post intervention, while the mean score declined. This improvement

may be attributed to providing mothers with understandable information about climate-related health risks, practical protective behaviors, and coping strategies that transformed climate-related concerns from a perceived uncontrollable threat into manageable actions. This finding is in agreement with **Vukušić Rukavina et al. (2021)**, who found that climate-change experiences were associated with cognitive-emotional and functional impairment among parents and suggested that psychological and behavioral approaches may help parents manage climate-related distress. **It is also consistent with Pinho (2025)**, who reported an association between parental identity, climate-change anxiety, and pro-environmental behaviors. However, the present study differs from these previous studies because it evaluated an active nursing intervention rather than simply examining associations between climate anxiety and parental characteristics. The greater improvement observed in the present study may therefore be related to the combination of education, coping strategies, behavioral activation, and repeated reinforcement delivered over eight sessions.

The current study revealed a marked improvement in mothers' eco-parenting knowledge after the intervention. Good knowledge increased post intervention, whereas poor knowledge declined, with a highly significant increase in the mean knowledge score. This improvement may be explained by the structured educational content, visual materials, interactive discussions, demonstrations, and repeated reinforcement used during the eight sessions. This finding is in agreement with **Liu & Kaida, (2024)**, who demonstrated that environmental parenting is a distinct and measurable domain of parental behavior and emphasized the importance of increasing parents' awareness of behaviors that protect children from environmental risks. Similarly, **Bang, (2021)** emphasized the importance of caregiver education and support in promoting healthy child development. However, the present study extends previous evidence by integrating environmental-health knowledge with climate anxiety, sustainable household behaviors, and infant development within one nursing intervention. Thus, the improvement in knowledge observed in the current study may reflect the benefit of presenting environmental concepts within familiar maternal and infant health contexts.

The present study showed a substantial improvement in mothers' eco-parenting

practices, as satisfactory practices increased post intervention, while unsatisfactory practices decreased. The mean practice score also increased significantly. The improvement may be attributed to the practical nature of the intervention, which moved beyond information provision to demonstrations, household sustainability planning, problem-solving, and home-based assignments. This finding is strongly supported by **Jia et al., (2022)**, who developed the Environmental Parenting Scale and demonstrated that environmental parenting includes proactive parental behaviors aimed at reducing children's exposure to environmental risks. The present finding is also consistent with **Pasquariello et al., (2025)**, who reported an association between parental identity and pro-environmental behavior. However, the present study differs from van **Burgsteden et al., (2024)** who evaluated following a structured nursing intervention, rather than being assessed only as an existing parental characteristic. This distinction suggests that maternal and child nurses may have an important role in translating environmental awareness into sustainable daily parenting behaviors.

The present study demonstrated a significant improvement in infants' socio-emotional development following the intervention. The proportion of infants with good socio-emotional development increased after the intervention, while low development decreased. The mean score increased significantly. This improvement may be explained by the intervention's emphasis on responsive caregiving, recognition of infant cues, emotional support, reciprocal communication, interactive play, and safe nature-based activities. This finding is in agreement with **WHO (2020)** emphasized that responsive caregiving and opportunities for early learning are essential components of optimal early childhood development. However, the present study differs from most previous responsive-parenting interventions because environmental sustainability and climate-health education were integrated with responsive caregiving. Therefore, the observed developmental improvement may reflect the combined influence of improved maternal knowledge, increased responsiveness, and greater engagement in developmentally appropriate parent–infant activities.

The present study found a significant negative correlation between maternal climate anxiety and eco-parenting practices after the intervention, indicating that mothers who demonstrated better sustainable parenting

practices tended to report lower climate anxiety. One possible explanation is that engaging in achievable environmental actions may increase mothers' perceived control, self-efficacy, and sense of contribution, thereby reducing feelings of helplessness associated with climate change. This finding is consistent with **Qin et al., (2024)**, who identified relationships between parental identity, climate-change anxiety, and pro-environmental behaviors. **Jackson et al. (2024)** similarly reported that climate-related experiences and behavioral engagement were associated with dimensions of climate anxiety among parents.

The present study identified a significant positive correlation between maternal eco-parenting practices and infant socio-emotional development. This indicates that mothers with stronger sustainable and responsive parenting behaviors tended to have infants with better socio-emotional outcomes. The relationship may be explained by the fact that several eco-parenting activities included in the intervention such as nature-based play, interactive activities, communication with the infant, recognition of infant cues, and responsive caregiving simultaneously promote environmental responsibility and developmental stimulation. This finding is in agreement with **Wang et al., (2022)** emphasized the importance of responsive caregiving and early learning opportunities during early childhood. However, the present study extends previous evidence by linking environmental parenting with infant socio-emotional development, whereas previous research has generally examined responsive caregiving and environmental parenting as separate domains. This integrated finding suggests that sustainable parenting activities can potentially be designed to serve both environmental and developmental purposes.

A significant negative correlation was observed between maternal climate anxiety and infant socio-emotional development, suggesting that higher maternal climate anxiety was associated with less favorable infant socio-emotional outcomes. This relationship may occur because persistent anxiety can consume maternal psychological resources and potentially interfere with emotional availability, concentration, and consistent responsiveness during parent–infant interactions. **This finding is in agreement with Soomro et al. (2024)**, who found longitudinal associations between climate-change anxiety and parenting practices and suggested that climate anxiety may represent an additional psychological burden

for parents. It is also consistent with the findings of **Turgut et al. (2026)**, who identified cognitive-emotional and functional impairment associated with climate-change concerns among parents. However, the present study cannot establish a direct causal relationship between maternal climate anxiety and infant development, because infant development is influenced by multiple maternal, infant, family, and environmental factors. Thus, the current finding should be interpreted as evidence of a significant association rather than proof of causation.

The regression analysis showed that eco-parenting practices were the strongest positive predictor of infant socio-emotional development, while climate anxiety was a significant negative predictor. Maternal educational level was also positively associated with infant socio-emotional development, whereas infant age and family income were not significant predictors. The strong positive contribution of eco-parenting practices is consistent with **Spiteri (2026)**, who conceptualized environmental parenting as a proactive parental behavior intended to protect children's health from environmental risks. The present study, however, extends these findings by demonstrating that eco-parenting practices remained a significant predictor when climate anxiety and selected sociodemographic characteristics were considered simultaneously. Nevertheless, because the present study used a relatively small convenience sample and a one-group design, the regression findings should be considered preliminary and should be confirmed through larger controlled longitudinal studies.

Overall, the present findings demonstrate that the eco-parenting nursing intervention was associated with significant improvements in maternal climate anxiety, eco-parenting knowledge, eco-parenting practices, and infant socio-emotional development. This overall pattern is consistent with **Rodney-Wolf et al. (2026)**, who highlighted the psychological and parenting implications of climate anxiety among parents, and with **Nikstat & Riemann, (2023)**, who emphasized the importance of environmental parenting as a distinct area of parental behavior. The findings are also compatible with **Ahun et al., (2023)**, which emphasize caregiver responsiveness, parental education, early learning, and supportive family environments as essential foundations for child development. However, the present study differs from much of the existing literature because it combines climate-health education,

climate-anxiety coping, environmental sustainability, responsive parenting, and infant socio-emotional development within one nurse-led intervention. This integrated approach may explain the simultaneous improvement across maternal and infant outcomes and supports the potential value of incorporating SDGs 3, 4, 12, and 13 into maternal and child nursing services. Nevertheless, the absence of a control group means that the findings should be interpreted as evidence of intervention-associated improvement rather than definitive proof of causality.

Limitations of the Study

The present study had some limitations that should be considered when interpreting its findings. First, the use of a quasi-experimental one-group pretest-posttest design limits the ability to establish a definitive causal relationship because there was no control group for comparison. Second, the use of a convenience sample of 100 mothers and their infants from one maternal and child health setting in Sohag City may limit the generalizability of the findings to mothers and infants in other geographical or healthcare settings. Third, some maternal outcomes, particularly eco-parenting practices and climate anxiety, were assessed using self-reported measures, which may be affected by recall bias or social desirability bias. Fourth, the intervention was implemented over a relatively short period of 4 weeks, and therefore the sustainability of behavioral changes and their longer-term effects on infant socio-emotional development could not be fully determined. Finally, infant socio-emotional development may be influenced by several factors, including maternal characteristics, family environment, socioeconomic conditions, and infant temperament, which cannot be completely controlled within a short-term community-based intervention.

Conclusion

Based on the findings of the present study, it was suggested that integrating Sustainable Development Goals into maternal and child nursing care through an eco-parenting intervention may represent a feasible and effective approach for promoting climate-resilient family practices. The intervention was associated with significant improvements in mothers' knowledge and sustainable eco-parenting practices and a significant reduction in maternal climate anxiety. In addition, infants

demonstrated significant improvements in socio-emotional development, particularly in emotional regulation, social responsiveness, caregiver interaction, communication, and adaptive behaviors. The observed relationship between improved maternal eco-parenting practices and better infant socio-emotional outcomes further highlights the potential importance of the maternal caregiving environment during early childhood. Thus, integrating SDG 3, SDG 4, SDG 12, and SDG 13 into routine maternal and child nursing interventions may simultaneously address health promotion, education, environmental responsibility, climate action, and early childhood development.

Recommendations

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

- Integrating climate-sensitive nursing education into routine maternal and child health services to increase mothers' awareness of climate-related risks to maternal and infant health.
- Incorporating eco-parenting education into community and maternal-child nursing programs, focusing on practical behaviors such as waste reduction, responsible consumption, water and energy conservation, and environmentally safe infant care.
- Including climate-anxiety screening and supportive counseling as part of comprehensive maternal health education, particularly for mothers expressing persistent concerns about climate change and their children's future.
- Promoting responsive parenting and nature-based activities as low-cost strategies for supporting infant socio-emotional development while encouraging positive family engagement with the environment.
- Developing illustrated Arabic educational booklets and digital educational materials that translate SDGs into simple, culturally appropriate, and practical parenting behaviors that mothers can implement at home.
- Strengthening nurses' capacity in climate-health education through continuing education programs addressing climate change, sustainable healthcare, eco-parenting, maternal psychological well-being, and early childhood development.
- Integrating SDGs 3, 4, 12, and 13 into maternal and child health nursing curricula and community health programs to strengthen the connection between health promotion and environmental sustainability.
- Establishing follow-up programs after the initial intervention to reinforce sustainable parenting behaviors and assess whether improvements in climate anxiety and infant socio-emotional development are maintained over time.
- Conducting future randomized controlled studies with larger and more diverse samples and comparison groups to provide stronger evidence regarding the effectiveness of eco-parenting nursing interventions.
- Conducting longitudinal studies to examine the long-term effects of eco-parenting interventions on maternal climate anxiety, sustainable family behaviors, and children's socio-emotional and developmental outcomes.

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