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Research Article

Effect of Nesting on Physiological Stability and Behavioral Responses among Preterm Newborns in a Special Newborn Care Unit

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ABSTRACT
Background: Preterm newborns have immature physiological and neurobehavioral regulatory systems and are particularly susceptible to environmental stressors encountered within neonatal care settings. Frequent handling, excessive sensory stimulation, and inadequate postural support may contribute to physiological instability and behavioral disorganization. Nesting is a simple developmental supportive-care intervention that provides containment, promotes flexion and midline orientation, and may facilitate physiological and behavioral regulation.
Objective: To evaluate the effect of a structured nesting intervention on physiological stability and behavioral responses among preterm newborns admitted to a Special Newborn Care Unit.
Methods: A quantitative, pre-experimental one-group pre-test–post-test study was conducted among 50 preterm newborns admitted to the Special Newborn Care Unit of Maharaja Krishna Chandra Gajapati (MKCG) Medical College and Hospital, Berhampur, Odisha, India. Participants were recruited using non-probability purposive sampling. Eligible newborns were less than 10 days of age, born before 37 completed weeks of gestation, clinically stable, and free from major congenital anomalies. The intervention consisted of structured positioning within a soft U-shaped nest for 6 hours daily over three consecutive days. Heart rate and respiratory rate were assessed as physiological outcomes, while behavioral responses were evaluated using a structured neonatal behavioral assessment tool. Pre-test and post-test outcomes were compared using paired t-tests, and chi-square analysis was used to examine associations between post-intervention behavioral response and selected participant characteristics.
Results: Following the nesting intervention, the mean heart rate decreased from 171.3 ± 15.5 beats/min at pre-test to 148.4 ± 9.1 beats/min at post-test, with a mean reduction of 22.9 beats/min. The mean respiratory rate decreased from 64.5 ± 13.1 to 47.6 ± 9.1 breaths/min, representing a mean reduction of 16.9 breaths/min. Behavioral response scores demonstrated a substantial improvement, increasing from 7.46 ± 1.18 at pre-test to 12.84 ± 1.25 at post-test, with a mean difference of 5.38 points. The improvement in behavioral scores was statistically significant ($t = 20.9$, $p < 0.001$). No statistically significant associations were observed between post-intervention behavioral response and the selected demographic and clinical characteristics ($p > 0.05$).
Conclusion: Structured nesting was associated with improved physiological stability and behavioral organization among preterm newborns. Its simplicity, low resource requirements, and compatibility with routine neonatal nursing care support its potential application as a developmental supportive-care strategy for clinically stable preterm newborns. However, the findings should be interpreted in view of the pre-experimental design and absence of a comparison group. Larger randomized controlled studies are recommended to establish the independent effectiveness of nesting and determine its longer-term developmental implications.

Keywords: Nesting, Preterm Newborns, Physiological Stability, Behavioural Organization, Developmental Supportive Care, Special Newborn Care Unit.

INTRODUCTION

Preterm birth, defined as birth before 37 completed weeks of gestation, remains a major concern in neonatal healthcare. Preterm new-borns are particularly susceptible to physiological instability because of the immaturity of their respiratory, cardiovascular, neurological, and thermoregulatory systems. The extent of vulnerability varies with gestational age and may require specialized monitoring and supportive care during the neonatal period.

The transition from intrauterine to extra uterine life can be challenging for preterm new-borns. Within neonatal care environments, exposure to light, noise, temperature fluctuations, repeated handling, diagnostic procedures, and therapeutic interventions may increase stress and affect sleep–wake patterns, motor activity, autonomic regulation, and cardiorespiratory stability. Immature muscle tone and a tendency toward limb extension may also make it difficult for preterm new-borns to maintain a flexed and midline-oriented posture.

Developmental supportive-care interventions have consequently become an important component of neonatal nursing practice. Nesting is a positioning intervention that provides gentle containment and supportive boundaries around the newborn. By promoting flexion and midline orientation, nesting may reduce excessive extension and uncoordinated movements while providing tactile and positional support. This contained position may contribute to comfort, behavioral organization, self-regulation, and physiological stability.

Previous investigations have reported potential benefits of nesting and supportive positioning on physiological and behavioral outcomes among preterm and low-birth-weight newborns. However, the effects of nesting may vary according to gestational age, clinical condition, positioning technique, duration of intervention, and care environment. Evidence from routine Special New-born Care Unit (SNCU) settings is therefore important for evaluating the practical usefulness of this low-cost developmental intervention.

Considering the physiological vulnerability of preterm new-borns and the need for feasible supportive-care measures, evaluation of structured nesting within routine neonatal nursing practice is clinically relevant. Therefore, the present study was conducted to evaluate the effect of structured nesting on physiological parameters and behavioral responses among preterm new-borns admitted to a Special New-born Care Unit.

Objective

The study aimed to evaluate the effect of structured nesting on physiological parameters and behavioural responses among preterm new-borns admitted to a Special New-born Care Unit.

Research Hypotheses

H_1: There will be a statistically significant difference between the pre-test and post-test physiological parameters of preterm newborns following the structured nesting intervention.

H_2: There will be a statistically significant difference between the pre-test and post-test behavioral response scores of preterm newborns following the structured nesting intervention.

H_3: There will be a statistically significant association between post-intervention behavioral response categories and selected demographic and clinical characteristics of preterm newborns.

MATERIALS AND METHODS

Study Design

A quantitative, pre-experimental, one-group pre-test–post-test design was employed to evaluate changes in physiological parameters and behavioral responses following the structured nesting intervention.

The study design was represented as:

$O_1 \rightarrow X \rightarrow O_2$

Where **O_1** represented the pre-test assessment, **X** represented the structured nesting intervention, and **O_2** represented the post-test assessment.

This design enabled comparison of each newborn's physiological and behavioral outcomes before and after exposure to the intervention.

Study Setting

The study was conducted in the Special Newborn Care Unit (SNCU) of Maharaja Krishna Chandra Gajapati (MKCG) Medical College and Hospital, Berhampur, Ganjam, Odisha, India. The SNCU provides specialized care and continuous monitoring for newborns requiring enhanced neonatal medical and nursing support.

Study Population

The target population comprised preterm newborns requiring admission to a Special Newborn Care Unit. The accessible population consisted of clinically stable preterm newborns

admitted to the selected SNCU during the study period and fulfilling the predefined eligibility criteria.

Sample Size and Sampling Technique

The study included 50 preterm newborns who fulfilled the eligibility criteria. Participants were recruited using a non-probability purposive sampling technique. Potential participants were screened according to gestational age, chronological age, clinical stability, and the presence or absence of relevant medical conditions before enrollment.

The final sample consisted of newborns who were clinically appropriate for the positioning intervention and whose parents or legally authorized representatives provided informed consent for participation.

Inclusion Criteria

Preterm new-borns were eligible if they were admitted to the selected SNCU, had gestational age <37 completed weeks, were <10 days old, clinically stable, free from major congenital anomalies, and not receiving invasive mechanical ventilation or critical cardiovascular support.

Exclusion Criteria

Newborns requiring invasive mechanical ventilation, critical cardiovascular support, emergency surgery, or those with major congenital anomalies were excluded.

Ethical Considerations

Administrative permission and institutional ethical approval were obtained before data collection. Written informed consent was obtained from the parents/legal guardians after explaining the study purpose, procedures, voluntary participation, and confidentiality. Participants could withdraw at any time without affecting routine care.

Data Collection Instruments

Data were collected using a structured tool comprising three sections. Section A recorded sociodemographic and clinical characteristics, including newborn age, gender, birth weight, gestational age, birth order, mode of delivery, and maternal age. Section B recorded heart rate (beats/min) and respiratory rate (breaths/min) using routine neonatal monitoring equipment. Section C assessed behavioral responses across five domains: orientation/social interaction, sleep-related behavior, muscle tone, motor activity, and autonomic stability. Each domain was scored on a three-point scale, yielding a total score of 1–15, categorized as poor (1–5), average (6–10), or good (11–15), with higher scores indicating better behavioral organization.

Reliability of the Instruments

The physiological assessment tool demonstrated test-retest reliability of 0.89, while the behavioral assessment tool showed an inter-rater reliability coefficient of 0.78, indicating acceptable measurement consistency.

Intervention Protocol

Following baseline assessment, a soft U-shaped nest was prepared using clean rolled blankets and appropriately sized for each newborn. Infants were positioned in a flexed, contained, and midline-oriented posture with supported limbs and feet. Nesting was provided for 6 hours daily (08:00–14:00) for three consecutive days, alongside routine neonatal care and monitoring. Post-test assessment was performed after completion of the intervention using the same procedures as the baseline assessment.

Data Collection Procedure

Following ethical and administrative approval, eligible newborns were enrolled after obtaining parental consent. Baseline physiological and behavioral assessments were performed before nesting. The intervention was subsequently administered for 6 hours daily for three days, after which the same outcomes were reassessed. All observations were documented using standardized data collection forms.

Statistical Analysis

Data were analysed using descriptive and inferential statistics. Frequencies and percentages summarized categorical variables, while means and standard deviations summarized continuous variables. Paired t-tests were used to compare pre-test and post-test physiological and behavioral scores. Chi-square tests assessed associations between post-intervention behavioural categories and selected characteristics. Statistical significance was set at $p < 0.05$.

Socio-demographic and Clinical Characteristics of the Preterm Newborns

A total of 50 preterm newborns were included in the study. The majority of newborns (68.0%) were aged 0–5 days, while 32.0% were aged 6–10 days. Female newborns constituted

56.0% of the sample, compared with 44.0% males.

Regarding birth weight, 64.0% of the newborns weighed 1001–1500 g, while 36.0% weighed 1501–2500 g. None of the newborns had a birth weight below 1000 g. With respect to gestational age, 54.0% were born at 32–<37 weeks, 44.0% at 28–<32 weeks, and 2.0% at <28 weeks.

In terms of birth order, 42.0% of the newborns were firstborn, 30.0% were second-born, and 28.0% were third-born. Most newborns (74.0%) were delivered by normal vaginal delivery, while 26.0% were delivered by lower-segment caesarean section; none were delivered by instrumental delivery. Regarding maternal age, 50.0% of the newborns had mothers aged 20–26 years, followed by 26.0% aged 27–32 years, 16.0% aged <20 years, and 8.0% aged >32 years.

Table 1. Socio-Demographic and Clinical Characteristics of the Preterm Newborns (N = 50)

Characteristic	Category	N (%)
Age Of Newborn	0–5 Days	34 (68.0)
	6–10 Days	16 (32.0)
Gender	Female	28 (56.0)
	Male	22 (44.0)
Birth Weight	≤1000 G	0 (0.0)
	1001–1500 G	32 (64.0)
	1501–2500 G	18 (36.0)
Gestational Age	<28 Weeks	1 (2.0)
	28–<32 Weeks	22 (44.0)
	32–<37 Weeks	27 (54.0)
Birth Order	Firstborn	21 (42.0)
	Second-Born	15 (30.0)
	Third-Born	14 (28.0)
Mode Of Delivery	Normal Vaginal Delivery	37 (74.0)
	LSCS	13 (26.0)
	Instrumental Delivery	0 (0.0)
Maternal Age	<20 Years	8 (16.0)
	20–26 Years	25 (50.0)
	27–32 Years	13 (26.0)
	>32 Years	4 (8.0)

Effect of Nesting on Physiological Parameters

The comparison of physiological parameters before and after the nesting intervention demonstrated reductions in both heart rate and respiratory rate.

The mean heart rate decreased from 171.3 ± 15.5 beats/min before the intervention to 148.4 ± 9.1 beats/min after the intervention, representing a mean reduction of 22.9 beats/min.

Similarly, the mean respiratory rate decreased from 64.5 ± 13.1 breaths/min at pre-test to 47.6 ± 9.1 breaths/min at post-test, representing a mean reduction of 16.9 breaths/min.

The observed differences were statistically significant at the 0.05 level.

Table 2. Comparison of Pre-Test and Post-Test Physiological Parameters (N = 50)

Physiological Parameter	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	Significance
Heart Rate (Beats/Min)	171.3 ± 15.5	148.4 ± 9.1	22.9	P < 0.05*
Respiratory Rate (Breaths/Min)	64.5 ± 13.1	47.6 ± 9.1	16.9	P < 0.05*

*Statistically significant at the 0.05 level.

These findings indicate that physiological parameters moved toward a more stable resting range following implementation of the nesting intervention.

Comparison of Pre-test and Post-test Behavioral Response Scores

The behavioral response scores improved across all assessed domains following the nesting intervention. The mean score for orientation increased from 1.56 ± 0.23 in the pre-test to 2.56 ± 0.24 in the post-test, with a mean difference of 1.00. The mean score for quality of sleep increased from 1.44 ± 0.24 to 2.78 ± 0.28, representing the largest domain-specific improvement (mean difference = 1.34). Similarly, the mean scores for muscle tone, motor activity, and autonomic response increased from 1.54 ± 0.23 to 2.62 ± 0.25, from 1.42 ± 0.25 to 2.48 ± 0.24, and from 1.50 ± 0.23 to 2.40 ± 0.23, respectively. The overall behavioral response score increased from 7.46 ± 1.18 in the pre-test to 12.84 ± 1.25 in the post-test, with a mean improvement of 5.38 points.

Table 3. Comparison of Pre-Test and Post-Test Behavioral Response Scores among Preterm Newborns (N = 50)

Behavioural Domain	Maximum Score	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference
Orientation	3	1.56 ± 0.23	2.56 ± 0.24	1.00
Quality Of Sleep	3	1.44 ± 0.24	2.78 ± 0.28	1.34
Muscle Tone	3	1.54 ± 0.23	2.62 ± 0.25	1.08
Motor Activity	3	1.42 ± 0.25	2.48 ± 0.24	1.06
Autonomic Response	3	1.50 ± 0.23	2.40 ± 0.23	0.90
Total	15	7.46 ± 1.18	12.84 ± 1.25	5.38

Overall, the findings demonstrate an improvement in behavioral response scores following the nesting intervention, with the greatest improvement observed in the quality-of-sleep domain.

Behavioural categories

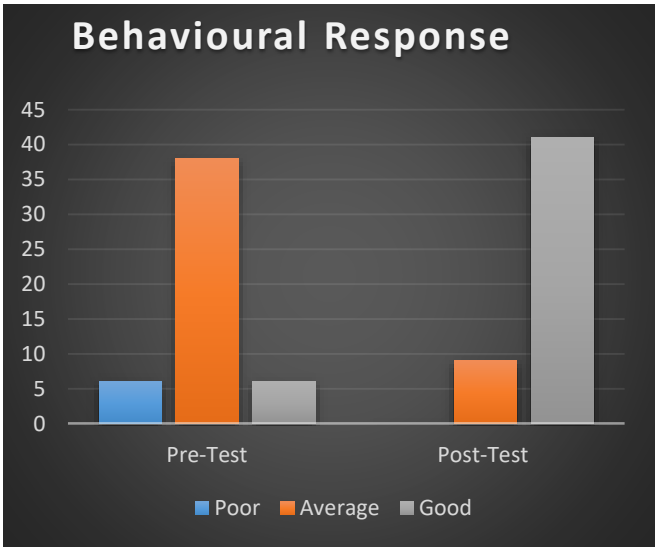

Fig-1 Behavioural Categories Reflects Good Behavioural Response Increased From 12.0% Before Nesting To 82.0% After Nesting, While The Proportion Classified As Poor Decreased From 12.0% To 0%.

Effect of Nesting on Behavioral Responses

The mean behavioral response score increased substantially following the nesting intervention. The mean pre-test behavioral response score was 7.46 ± 1.18, which increased to 12.84 ± 1.25 in the post-test, representing a mean improvement of 5.38 points.

A paired t-test demonstrated a statistically significant difference between the pre-test and post-test behavioral response scores ($t = 20.9$, $df = 49$, $p < 0.001$). The observed t-value exceeded the critical value of approximately 2.00 at the 0.05 level of significance, indicating that the improvement in behavioral response

scores following nesting was statistically significant.

Table 4. Effect of Nesting on Behavioral Response Scores among Preterm Newborns (N = 50)

Variable	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	Paired T	P-Value
Behavioral Response Score	7.46 ± 1.18	12.84 ± 1.25	5.38	20.9	<0.001

Paired t-test; df = 49. Statistical significance was considered at $p < 0.05$.

The significant increase in behavioral response scores indicates improved behavioral organization among the preterm newborns following the nesting intervention. Thus, the null hypothesis stating that there would be no significant difference between pre-test and post-test behavioral response scores was rejected.

Effect of Nesting on Physiological Responses

The physiological parameters demonstrated significant changes following the nesting intervention. The mean heart rate decreased from 171.3 ± 15.5 beats/min in the pre-test to 148.4 ± 9.1 beats/min in the post-test, with a mean reduction of 22.9 beats/min. Similarly, the mean respiratory rate decreased from 64.5 ± 13.1 breaths/min to 47.6 ± 9.1 breaths/min, representing a mean reduction of 16.9 breaths/min.

Paired t-test analysis demonstrated statistically significant pre-test to post-test differences in both physiological parameters. The calculated t-value was 8.8 for heart rate and 6.9 for respiratory rate, both exceeding the critical value of approximately 2.00 at the 0.05 level of significance (df = 49). These findings indicate a statistically significant change in physiological responses following the nesting intervention.

Table 5. Effect of Nesting on Physiological Parameters among Preterm Newborns (N = 50)

Physiological Parameter	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	Paired T	P-Value
Heart Rate (Beats/Min)	171.3 ± 15.5	148.4 ± 9.1	22.9	8.8	<0.001*
Respiratoryrate (Breaths/Min)	64.5 ± 13.1	47.6 ± 9.1	16.9	6.9	<0.001*

Note: Paired t-test; df = 49. Statistical significance was considered at $p < 0.05$.

Hypothesis Testing

The paired t-test demonstrated statistically significant differences between pre-test and post-test scores for heart rate, respiratory rate, and behavioral responses following the nesting intervention. The null hypothesis that there would be no significant difference between pre-test and post-test physiological and behavioral response scores was therefore rejected at the 0.05 level of significance.

The behavioral response score showed a particularly marked improvement, with a mean difference of 5.38 points and a paired t-value of 20.9 (df = 49, $p < 0.001$).

A chi-square test was also planned to examine the association between post-test behavioral response categories and selected socio-demographic and clinical characteristics. The results of these analyses should be reported separately with the corresponding χ^2 values, degrees of freedom, and p-values.

Association between Post-intervention Behavioral Response and Selected Characteristics

Chi-square analysis was performed to determine whether the post-intervention behavioral response categories were associated with selected demographic and clinical characteristics of the preterm newborns. The analysis showed no statistically significant association between post-intervention behavioral response and any of the characteristics examined.

The calculated χ^2 values were 0.59 for age of the newborn, 0.57 for gender, 0.11 for birth weight, 0.49 for gestational age, 0.67 for birth order, 2.00 for mode of delivery, and 1.70 for maternal age. All calculated χ^2 values were lower than the critical χ^2 value of 3.84 at the 0.05 level of significance (df = 1). Therefore, none of the examined characteristics demonstrated a statistically significant association with the post-intervention behavioral response.

These findings suggest that the improvement in behavioral response following the nesting intervention was not significantly associated with the selected demographic and clinical characteristics of the preterm newborns.

Table 6. Association between Post-Intervention Behavioral Response and Selected Characteristics of the Preterm Newborns (N = 50)

Selected Characteristic	X^2 Value	Critical X^2 Value	Interpretation
Age Of Newborn	0.59	3.84	Not Significant
Gender	0.57	3.84	Not Significant
Birth Weight	0.11	3.84	Not Significant
Gestational Age	0.49	3.84	Not Significant
Birth Order	0.67	3.84	Not Significant
Mode Of Delivery	2.00	3.84	Not Significant
Maternal Age	1.70	3.84	Not Significant

DISCUSSION

This study examined the effect of structured nesting on physiological and behavioral responses among preterm newborns admitted to a Special Newborn Care Unit. After three days of nesting, both physiological parameters and behavioral scores showed improvement. Mean heart rate decreased from 171.3 ± 15.5 to 148.4 ± 9.1 beats/min, while mean respiratory rate decreased from 64.5 ± 13.1 to 47.6 ± 9.1 breaths/min. These changes indicate a favorable shift in the observed physiological responses following the intervention.

The reduction in heart rate and respiratory rate may be associated with the supportive positioning achieved through nesting. By providing gentle boundaries and maintaining a flexed and contained posture, nesting may reduce unnecessary movement and environmental stress while supporting physiological regulation. This approach is particularly relevant for preterm newborns because of their immature neuromuscular and autonomic regulation.

Behavioral responses also improved substantially after the intervention. The mean behavioral score increased from 7.46 ± 1.18 before nesting to 12.84 ± 1.25 after nesting, with a mean difference of 5.38 points. This change was statistically significant ($t = 20.9$, $df = 49$, $p < 0.001$). Among the assessed domains, quality of sleep showed the greatest improvement, followed by muscle tone, motor activity, orientation, and autonomic response. The findings indicate better behavioral organization after the nesting intervention.

The observed behavioral improvement may be related to the containment and flexion supported by nesting. A well-supported posture can help preterm newborns maintain physiological alignment, limit disorganized movements, and promote periods of sleep and rest. These effects may contribute to improved behavioral regulation during neonatal care.

No significant association was identified between post-intervention behavioral response and the selected characteristics of the newborns and mothers, including age, gender, birth weight, gestational age, birth order, mode of delivery, and maternal age. Thus, the improvement observed in behavioral responses was not significantly associated with any of the characteristics examined. This finding should, however, be interpreted cautiously because of the relatively small sample size and the absence of a comparison group.

From a nursing-care perspective, structured nesting is a practical supportive measure that can be incorporated into the care of appropriate preterm newborns. Correct positioning, regular assessment, infection-control measures, and monitoring of physiological status remain essential during its use. Nesting should complement established medical and nursing care rather than serve as a substitute for standard neonatal management.

Overall, the findings suggest that structured nesting may be beneficial in supporting physiological regulation and behavioral organization among preterm newborns. Larger controlled studies with longer follow-up are needed to establish the consistency and longer-term effects of this intervention.

Strengths of the Study

The study has several practical strengths. It evaluated a simple, non-pharmacological nursing intervention requiring minimal equipment and assessed both physiological and behavioral outcomes. The intervention was implemented in a routine SNCU environment, increasing its practical relevance to neonatal nursing care. Standardized intervention and

observation procedures also supported consistent assessment across participants.

Limitations

The study has several limitations. The one-group pre-test–post-test design without a control group limits causal interpretation because other clinical or environmental factors may have influenced the outcomes. Purposive sampling and the relatively small sample of 50 newborns from a single SNCU restrict generalizability. The intervention was evaluated over only three days, preventing assessment of sustained effects. In addition, behavioral outcomes may be influenced by the characteristics and measurement properties of the assessment instrument.

CONCLUSION

Structured nesting was associated with improved physiological parameters and behavioral responses among preterm newborns in the study setting. Heart rate and respiratory rate decreased following the intervention, while behavioral response scores improved significantly.

Nesting may serve as a feasible developmental supportive-care measure for clinically stable preterm newborns when appropriately implemented and monitored. However, the findings should be interpreted as evidence of pre-post improvement rather than definitive evidence of causation. Further controlled studies with larger samples, multiple centers, standardized assessment tools, and longer follow-up are warranted.

Recommendations

- Structured nesting may be considered as part of developmental supportive nursing care for clinically stable preterm new-borns.
- Neonatal nurses should receive training in standardized and safe nesting techniques.
- Randomized controlled studies with larger samples should be conducted to determine the independent effect of nesting.
- Multicentre research should be undertaken to improve the generalizability of findings.
- Future studies should assess additional outcomes, including oxygen saturation, sleep organization, feeding tolerance, weight gain, and duration of hospitalization.
- Long-term studies should examine the potential relationship between early supportive positioning and neurodevelopmental outcomes.

Declarations

Ethical Approval

Ethical approval was obtained from the appropriate institutional ethics committee, and administrative permission was secured from the concerned authorities of the study setting. Written informed consent was obtained from the parents or legally authorized representatives before enrolment.

Consent for Participation

Written informed consent was obtained from the parent or legally authorized representative of each participating newborn.

Conflict of Interest

The authors declare no conflict of interest related to this study.

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Author Contributions

Biswal S.: Conceptualization, methodology, data collection, intervention implementation, data analysis, interpretation, and manuscript preparation.

Tripathy K.: Supervision, methodological guidance, interpretation of findings, and critical revision of the manuscript.

Mahapatro S.: Supervision, methodological guidance, interpretation of findings, and critical revision of the manuscript.

Nag S.: data collection, intervention implementation, data analysis, interpretation, and manuscript preparation.

Murmu J.: Supervision, methodological guidance, data analysis, interpretation, manuscript editing

All authors reviewed and approved the final manuscript.

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