Received: 8 August 2024 | Revised: 4 November 2024 | Accepted: 6 November 2024

DOI: 10.1111/apa.17502

ACTA PÆDIATRICA NURTURING THE CHILD WILEY

ORIGINAL ARTICLE

Effect of couplet care on early parent–infant closeness among preterm infants

Ryo Itoshima[1,2,3] | Kalle Korhonen[2] | Anna Axelin[4] | Sari Ahlqvist-Björkroth[5] | Anna Hovi[1] | Liisa Lehtonen[1,2]

[1]Department of Clinical Medicine, University of Turku, Turku, Finland

[2]Department of Paediatrics and Adolescent Medicine, Turku University Hospital, Turku, Finland

[3]Life Science Research Center, Nagano Children's Hospital, Azumino, Japan

[4]Department of Nursing Science, University of Turku, Turku, Finland

[5]Department of Psychology and Speech-Language Pathology, University of Turku, Turku, Finland

Correspondence
Ryo Itoshima, Department of Clinical Medicine, University of Turku, FI-20014 Turun yliopisto, 20500 Turku, Finland.
Email: ryitos@utu.fi

Funding information
TYKS säätiö; Lastentautien Tutkimussäätiö

Abstract

Aim: To evaluate the effect of couplet care on parent–infant closeness among preterm infants.

Methods: A comparison study in a Level III neonatal intensive care unit (NICU) before and after the introduction of couplet care, including stabilising infants in the delivery unit for early skin-to-skin contact, providing mothers' postpartum care in the infant's room and providing the father's bed in the infant's room. The study included parents of preterm infants born below 35 weeks.

Results: Parents of 40 and 66 infants were included before and after couplet care was introduced, respectively. In the linear regression model, the first skin-to-skin contact happened significantly earlier after the introduction than before: mean 4.0 vs. 24.0 h after birth and mean difference −18.5 (95% confidence interval −34.8 to −2.1). A larger proportion of infants received their first skin-to-skin contact within 2 h after birth after the introduction than before (45.5% vs. 8.6%; odds ratio 13.8 [3.6–62.8]). At least one parent was present in the infant's NICU room longer after the introduction than before (mean 21.2 vs. 10.8 h per day; mean difference 10.8 [9.1–12.4]).

Conclusion: Couplet care significantly increased parent–infant closeness during the first weeks of life.

KEYWORDS
couplet care, family centred care, rooming-in, separation, skin-to-skin contact

1 | INTRODUCTION

Physical and emotional closeness is essential for the well-being of both parents and infants even when the infant needs medical care at a neonatal intensive care unit (NICU). The importance of physical closeness has been shown in earlier studies reporting that parents' more frequent visitation is associated with better neurodevelopmental and behavioural outcomes.[1,2] Mothers' high involvement in infant care, including skin-to-skin contact, holding and any other care, was associated with better cognitive and language development at 18 months of corrected age.[3] However, it is often challenging to ensure parent–infant physical closeness in a NICU. One study showed that extremely preterm infants typically spent 80% of their time in the hospital alone.[4] In particular, these

Abbreviations: 95% CI, 95% confidence interval; IQR, interquartile range; MD, mean difference; NICU, neonatal intensive care unit; OR, odds ratio.

challenges arise in the first days after birth when both the infant and the mother need medical care.[5,6] Couplet care is a concept where hospital care for both the sick newborn infant and the mother is provided close to each other.[7,8]

According to a narrow definition of couplet care, it can be defined as mothers' rooming-in with preterm infants in the NICU.[9] A wider definition of couplet care refers to non-separation from birth, including early skin-to-skin contact.[7] Early skin-to-skin contact has been shown to reduce neonatal mortality,[10] improve physiological stability in preterm infants,[11,12] reduce the mothers' depressive symptoms and promote mother-infant interaction.[13,14] In 2022, the World Health Organization recommended immediate initiation of skin-to-skin contact after birth for all preterm and/or low birth weight infants.[15]

Couplet care has become more common, especially in the North American and Nordic countries.[7,8,16] For a NICU to provide care for postpartum mothers close to their newborn infants, the changes in architecture are needed. New standards incorporate design requirements for couplet care in the NICU.[17] In addition, new policies and reorganisation of the staff resources is needed, namely having midwives in the NICU to take care of postpartum mothers.[8] We aimed to evaluate the effect of couplet care on early mother-infant and father-infant physical closeness among preterm infants. In our definition, physical closeness included skin-to-skin contact and holding in the delivery unit and the NICU, and the parents' presence and overnight stays in the NICU.

Key notes

- Couplet care includes early parent–infant skin-to-skin contact and mother's postpartum care in the infant's room in the neonatal intensive care unit.
- Although couplet care has become more common, its effect on early parent–infant closeness has not been reported.
- Our study showed that couplet care promoted earlier beginning of parent–infant skin-to-skin contact and increased parents' presence and overnight stays in the infant's room of the Level III neonatal intensive care unit.

2 | METHODS

2.1 | Study design and sample

This study was a non-equivalent two-group design which compared two different cohorts before and after the introduction of the Couplet Care Model. The study site was Turku University Hospital NICU, one of the Level III NICUs in Finland covering about 7000 deliveries per year. Before the introduction of the Couplet Care Model, the data were collected prospectively for another study to evaluate the effect of a single-family room NICU[18] and was treated as historical baseline data for this study. After the introduction of the model, the data were collected prospectively in a similar way.

The study population consisted of parents with inborn preterm infants born below 35 weeks of gestation between March and December 2018 and between December 2022 and March 2024. The families were excluded if the infant was expected to stay less than 3 days in the hospital, the infants were triplets or higher, the parents did not have language skills in Finnish, Swedish, English or Russian, the infant was in a critical condition, or the parents did not give a consent within 6 days after birth.

2.2 | The Couplet Care Model

The NICU moved into a new hospital on 10 February 2022. Couplet Care Model was introduced immediately to facilitate early parent–infant closeness. It included stabilising the infant in the delivery unit, providing postpartum care for the mother in the infant's room and providing a bed for the father/partner in the infant's room.

The policies, initial care practices, and facilities in the old hospital without the Couplet Care Model and in the new hospital with the model are described in Table 1. Early skin-to-skin contact between the parents and infants was not a common practice before the model was introduced. Very preterm infants were typically transferred from the delivery unit to the NICU on a different floor for additional procedures after initial stabilisation, usually within 30 min after birth. Postpartum mothers and their infants were admitted to separate wards on different floors. Some families had to share one room with another family as the number of NICU rooms was 14 and the average census was 17 patients in 2018. In many cases, overnight stays in the infant's NICU room were only possible for one parent due to the limited space.

Several important initiatives were undertaken in preparation for the introduction of the Couplet Care Model. Minimising parent–infant separation was chosen to be the leading priority when planning the space for obstetric and neonatal care in the new hospital.[19] Work rotations were also implemented: the neonatal nurses worked in the obstetric unit and the obstetric midwives worked in the NICU. This helped them prepare for their future collaboration in the delivery unit and NICU of the new hospital. In addition, obstetric, neonatal and operation room teams participated in the planning of how to facilitate early parent–infant skin-to-skin contact in the delivery unit. Educational sessions including simulations were carried out with the staff to learn how to support early skin-to-skin contact safely.

In the Couplet Care Model, on the other hand, full stabilisation of the infant was done in the stabilisation room within the delivery unit, including surfactant administration, any types of ventilator support, central line placement and monitoring and imaging before admission to the NICU. This enabled parents to stay with their infants while the mothers were still under observation in the delivery unit, irrespective of the infant's condition. Following necessary procedures, the parents may have been offered the

TABLE 1 Comparison of the policies, initial care practices and facilities at the old and new hospitals.

	Old hospital before Couplet Care Model	New hospital during Couplet Care Model
At delivery unit		
Procedures for infant	Only initial stabilisation was done in the resuscitation room in the delivery unit. The infants were transferred to the NICU usually within 30 min.	Full stabilisation was done in the stabilisation room in the delivery unit. The infant was transferred with the mother or father to the NICU about 2 h after the delivery.
Early skin-to-skin contact	Rarely used with sick infants	Actively promoted and considered for all infants
At NICU		
Mother's postpartum care in the NICU room of the infant	No	Yes
Mother's bed in the NICU room of the infant after discharge	Yes	Yes
Father's bed in the NICU room of the infant	On-demand if possible	Yes
Single-family room	Sometimes shared with another family	Only one family in one room

Abbreviation: NICU, neonatal intensive care unit.

opportunity for the first skin-to-skin contact in the delivery unit, depending on the medical team's decision. After approximately 2 h of stabilisation and observation in the delivery unit, the mother and the infant were transferred to the NICU. They received their care in the same NICU room, mothers from midwives and infants from the neonatal team. In addition, the new NICU rooms always provided a bed for the father. Most of the NICU rooms in the old hospital and all of those in the new hospital provided a toilet and a shower for the parents' use. Both the old and the new hospital provided a lounge for parents. An example of the NICU room layout in the new hospital is shown in another article.[7] The general policies regarding collaboration with parents and parent–infant skin-to-skin contact and holding in the NICU room did not change between the two periods; the additional early skin-to-skin contact was aimed in the delivery unit before admission to the NICU.

2.3 | Outcome measures and data collection

The outcomes included the timing of the first parent–infant skin-to-skin contact and the duration of parent's presence in the NICU room, parent–infant skin-to-skin contact and holding during the first weeks of life. In addition, the proportion of infants receiving the first skin-to-skin contact within 2 h after birth and the number of the parents' overnight stays per week in the NICU room were compared. All outcomes were assessed from the infant's perspective, for example, skin-to-skin contact with either parent and the mother's and father's perspectives separately. When parents had twin babies, the mother's or father's perspective included the presence or care with either twin baby.

The mothers and fathers separately reported the duration of their presence, skin-to-skin contact and holding of the infant using the Parent–Infant Closeness Diary.[20] The mother and the father indicated the duration of each item by drawing a line on a paper diary. The start and the end times were marked with a 5-min accuracy. The parents' presence was defined as being in the infant's NICU room. Parent–infant skin-to-skin contact was defined as the infant being held by the parent on their bare chest, with only a diaper and a cap if necessary. The term 'holding' was used when the infant had clothes on or was swaddled. The parents filled in diaries for 2 weeks or until discharge to home or transfer to another unit, if it happened within 2 weeks after the start of the diary. The total duration of each item in the diary (in hours) was divided by the total amount of diary days to get the average duration per day. An overnight stay was defined as staying in the NICU room for at least 5.5 h between midnight and 6 am. The parents' overnight stays per week were calculated by dividing the number of parent's overnight stays by the total nights during the diary period and multiplying by seven.

The parents filled in a questionnaire regarding the timing of the first skin-to-skin contact after birth and the background information shortly after the informed consent for the study was obtained. If necessary, the research nurse supplemented the data from the medical records.

2.4 | Statistical analyses

The timings of the first parent–infant skin-to-skin contacts were compared using the Wilcoxon rank sum test due to their skewed distribution. The other outcome measures were compared using the Student's *t*-test for continuous variables and Fisher's exact test for binary variables. The linear regression models were also applied to calculate mean difference (MD) with a 95% confidence interval (95% CI) and the logistic regression models to calculate the odds ratio (OR) with 95% CI. Gestational age and multiple birth were adjusted for when comparing the first parent–infant skin-to-skin contact.

Gestational age, multiple birth, parity and distance from the hospital to home were adjusted for when comparing the other measures.[21-23] The subgroup analyses were conducted for the preterm infants born <28 and ≥28 weeks of gestation. The multivariate analyses were not conducted in the subgroup analyses because the number of infants in each group was too small. The analyses were conducted using R,[24] version 4.2.2 with the R packages of the Tidyverse,[25] version 1.3.2 and lme4,[26] version 1.1–31. The R package ggplot2,[27] version 3.4.0, was used to create visualisations, including the drawing of kernel density estimation of the first skin-to-skin contact. The kernel density estimation illustrates how the probability of the first skin-to-skin contact changed over time from birth. $p < 0.05$ were considered statistically significant.

2.5 | Ethics

The Ethical Committee of the Hospital District of Southwest Finland approved the use of the historical baseline data and the prospective data collection after the introduction of the Couplet Care Model (Dnro 44/1801/2022 §432). This study was prospectively registered to ClinicalTrials.gov (NCT05655104). The pseudonymous data were stored according to the rules of the institution. Written informed consent was obtained from each parent.

3 | RESULTS

A total of 30/54 (56%) and 64/84 (76%) families who were approached before and after the introduction of the Couplet Care Model agreed to participate, and they had 40 and 72 infants born below 35 weeks of gestation, respectively. Three infants died and three families withdrew their consent in the after group. Finally, we analysed data on 40 infants from 30 families (100% of those who agreed) in the before group and 66 infants from 58 families (91%) in the after group (Figure 1).

The characteristics of the infants and parents in each group are summarised in Table 2. The study included preterm infants born from 23+0 to 34+5 weeks in the before group and from 23+2 to 34+6 weeks of gestation in the after group. Compared to the before group, the after group included a larger proportion of singleton infants (75.4% vs. 47.5%) and fewer firstborn infants (46.1% vs. 58.3%), and the parents lived further from the hospital (median 30.0 vs. 12.0 km). The other background information was comparable between the groups.

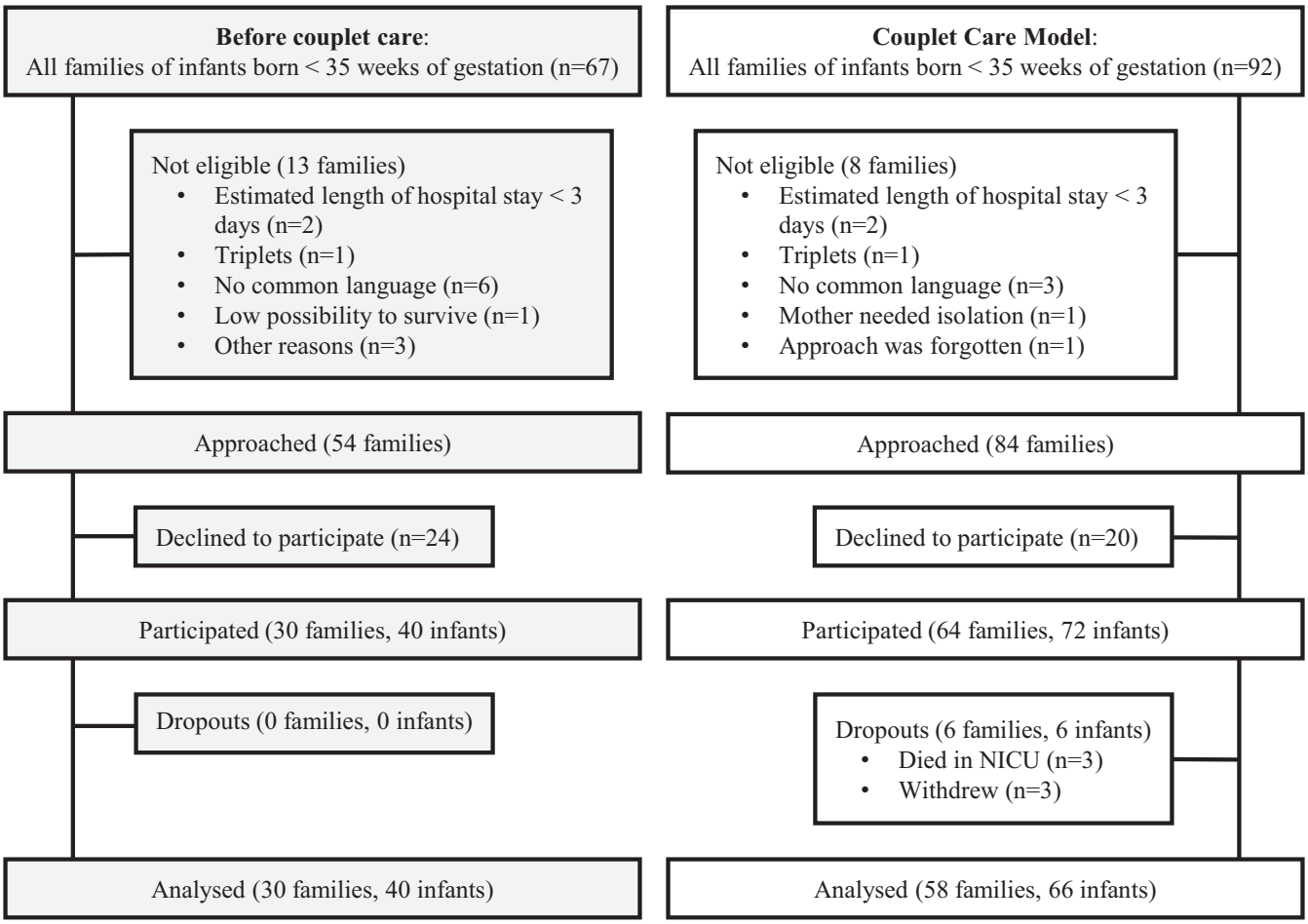

FIGURE 1 Patient flow chart describing the enrolment process before and after the implementation of the Couplet Care Model.

TABLE 2 Characteristics of infants and parents.

	Before Couplet Care Model	Couplet Care Model
Infant	**(*n* = 40)**	**(*n* = 66)**
Gestational age, median (IQR), weeks	32.0 (29.3–33.9)	31.9 (28.5–34.0)
<28 weeks, *n* (%)	6 (15.0)	15 (22.7)
Birth weight, median (IQR), g	1560 (1269–2008)	1560 (1220–2051)
Male sex, *n* (%)	20 (50.0)	34 (51.5)
Caesarean delivery, *n* (%)	29 (72.5)	42 (63.6)
Singleton, *n* (%)	19 (47.5)	49 (75.4)
Mother	**(*n* = 30)**	**(*n* = 58)**
Single parent, *n* (%)	2 (6.7)	2 (3.5)
First child, *n* (%)	14 (58.3)	18 (46.1)
Distance between home and hospital, median (IQR), km	12.0 (5.0–64.0)	30.0 (9.6–74.0)
Age, median (IQR), years	33 (29–36)	32 (29–35)
Higher education[a], *n* (%)	21 (75.0)	39 (68.4)
At paid work, *n* (%)	22 (78.6)	51 (87.9)
Smoker, *n* (%)	1 (3.3)	1 (1.7)
Father	**(*n* = 28)**	**(*n* = 55)**
Age, median (IQR), years	33 (30–36)	35 (31–39)
Higher education[a], *n* (%)	14 (53.8)	28 (57.1)
At paid work, *n* (%)	25 (92.6)	50 (90.9)
Smoker, *n* (%)	3 (11.1)	5 (9.4)

Abbreviations: IQR, interquartile range; NICU, neonatal intensive care unit.

[a]Bachelor degree or higher.

The infants received their first skin-to-skin contact at a median of 24.0 postpartum hours [interquartile range, IQR 17.5–52.0] in the before group and 4.0 h [IQR 0.4–24.0] in the after group. The change was significant in the linear regression model: the MD was −18.5 (95% CI −34.8 to −2.1). Father-infant skin-to-skin contact started at a median of 48.0 h [IQR 24.0–63.0] in the before group and 7.0 h [IQR 1.0–48.0] in the after group. The change was significant in the linear regression model: the MD −25.9 (95% CI −51.2 to −0.6). The timing of mother-infant skin-to-skin contact did not change significantly ($p = 0.09$).

Furthermore, the proportion of preterm infants who received their first skin-to-skin contact within two postpartum hours increased from 8.6% in the before group to 45.5% in the after group. The change was significant in the logistic regression model: the OR was 13.8 (95% CI 3.6–62.8). The proportion of parents who provided their first skin-to-skin contact within two postpartum hours also increased from 11.5% to 32.8% in mothers and from 4.8% to 35.2% in fathers. The increase was significant in the logistic regression models: the ORs were 5.5 (95% CI 1.4–29.9) in mothers and 19.3 (95% CI 2.9–413.7) in fathers. The comparisons relating to the first skin-to-skin contact between the before and after groups are summarised in Table 3. The kernel density estimation presented in Figure 2 shows that the maximum probability of the first parent–infant skin-to-skin contact was reached at about 24 h after birth in the before group, and at about 2 h after birth in the after group.

The amount of time when at least one parent stayed with their infant increased, from a mean ± standard deviation of 10.8 ± 4.4 h per day in the before group to 21.2 ± 2.8 h in the after group. The increase was significant in the linear regression model: the MD was 10.8 (95% CI 9.1–12.4). The mothers' presence significantly increased from 9.8 ± 3.9 h to 20.5 ± 2.9 h, and the fathers' from 5.7 ± 3.6 h to 11.5 ± 6.9 h (Table 4).

The frequency of at least one parent staying with their infant overnight increased, from a mean of 1.7 ± 2.3 nights per week in the before group to 6.4 ± 1.1 nights in the after group. The increase was significant in the linear regression model: the MD was 4.8 (95% CI 3.9–5.6). The mothers' overnight stays significantly increased from 1.3 ± 2.0 to 6.3 ± 1.1 nights per week, and the fathers' from 0.4 ± 0.8 to 3.3 ± 2.8 nights (Table 4).

The duration of skin-to-skin contact did not change significantly. The mean duration of skin-to-skin contact between the infant and either parent was 2.7 ± 2.0 h per day in the before group and 3.2 ± 2.1 h in the after group. The mothers provided skin-to-skin contact for 2.1 ± 1.4 h in the before group and 2.1 ± 1.4 h in the after group, while the fathers provided 1.3 ± 1.1 h and 1.2 ± 1.4 h, respectively. The duration of holding also did not change significantly (Table 4).

The subgroup analyses included 6 (15.0%) and 15 (22.7%) infants born <28 weeks of gestation and 34 and 51 infants born ≥28 weeks. The timing of the first skin-to-skin contact did not change significantly in infants born <28 weeks of gestation, from a median of

TABLE 3 Comparison of the first skin-to-skin contact before and after the introduction of the Couplet Care Model.

	Before Couplet Care Model	Couplet Care Model	Z[a] or OR (95% CI)	*p*-value	Linear/logistic regression model	
					MD or OR (95% CI)	*p*-value
Infant (with either parent)						
First skin-to-skin contact after birth, median (IQR), hours	24.0 (17.5, 52.0)	4.0 (0.4, 24.0)	**0.33**	**<0.001**	**−18.5 (−34.8, −2.1)**[b]	**0.03**
First skin-to-skin contact initiated ≤2 h after birth, *n* (%)	3 (8.6)	30 (45.5)	**8.7 (2.4, 48.9)**	**<0.001**	**13.8 (3.6, 62.8)**[c]	**<0.001**
Mother						
First skin-to-skin contact after birth, median (IQR), hours	24.0 (16.3, 72.0)	13.5 (0.1, 24.0)	**0.29**	**0.04**	−16.7 (−35.9, 2.4)[b]	0.09
First skin-to-skin contact initiated ≤2 h after birth, *n* (%)	3 (11.5)	19 (32.8)	3.7 (0.9, 21.5)	0.06	**5.5 (1.4, 29.9)**[c]	**0.03**
Father						
First skin-to-skin contact after birth, median (IQR), hours	48.0 (24.0, 63.0)	7.0 (1.0, 48.0)	**0.29**	**0.01**	**−25.9 (−51.2, −0.6)**[b]	**0.04**
First skin-to-skin contact initiated ≤2 h after birth, *n* (%)	1 (4.8)	19 (35.2)	**10.6 (1.5, 472.2)**	**0.007**	**19.3 (2.9, 413.7)**[c]	**0.01**

Note: Bold text indicates statistically significant results ($p < 0.05$). Abbreviations: 95% CI, 95% confidence interval; IQR, interquartile range; MD, mean difference; OR, odds ratio.

[a]Effect size of the Wilcoxon rank sum test.

[b]MD (95% CI) of the linear regression model adjusting for gestational age and multiple birth.

[c]OR (95% CI) of the logistic regression model adjusting for gestational age and multiple birth.

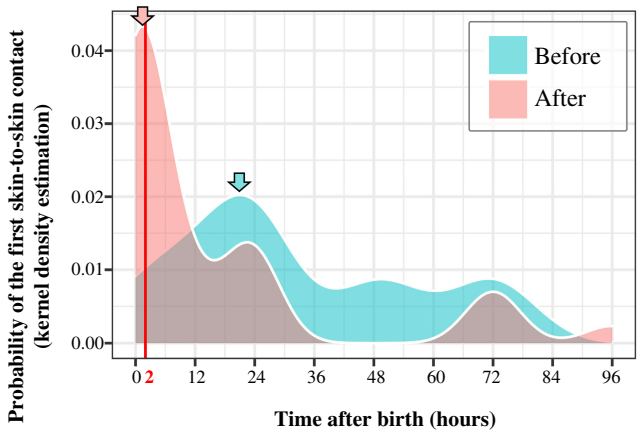

FIGURE 2 Change in probability of the first skin-to-skin contact over time from birth, using kernel density estimation. The probability reached its maximum at about 24 h after birth before the Couplet Care Model was introduced (blue area and arrow) but was shortened to about 2 h after the introduction (red area and arrow).

72.0 h in the before group to 72.0 h in the after group. On the other hand, the first skin-to-skin contact was provided significantly earlier to infants born ≥28 weeks, with a median of 24.0 postpartum hours in the before group and 1.0 h in the after group (Table 5). The proportion of the first skin-to-skin contact initiated ≤2 h after birth did not change significantly in infants born <28 weeks of gestation, whereas it increased significantly in infants born ≥28 weeks of gestation from 6.7% in the group before to 56.9% in the group after. A significant increase in parents' presence in the NICU room was found in both groups, but parents' overnight stays increased significantly only in infants born ≥28 weeks of gestation. The duration of skin-to-skin contact and holding changed in neither of the groups.

4 | DISCUSSION

This quantitative study showed how couplet care affected early parent–infant physical closeness among preterm infants in a Level III NICU. After the introduction of the Couplet Care Model, the first parent–infant skin-to-skin contact happened earlier and the parents stayed in the NICU room longer than before. However, the mean durations of skin-to-skin contact and holding did not change. In summary, parent–infant physical closeness was facilitated after the introduction of the model, except for the duration of skin-to-skin contact and holding which did not change significantly.

Our study showed that the first parent–infant skin-to-skin contact happened significantly earlier after the introduction of the model than before. The design of the facilities in the new hospital enabled the successful and safe implementation of couplet care.[7] The new facilities and care system enabled couplet care in the delivery unit before admission to the NICU. The promotion of early parent–infant closeness was also driven by the leadership in both the NICU and the delivery room. The multi-professional leadership of both obstetric and neonatal care promoted minimising parent–infant separation as a priority. They also facilitated the collaboration between the staff from obstetric, neonatal and operation room teams, and provided practical education on early skin-to-skin contact in the delivery unit for doctors, midwives and nurses in all teams. Good

TABLE 4 Comparison of parents' presence, skin-to-skin contact, holding and overnight stay before and after the introduction of the Coupet Care Model.

	Before Couplet Care Model	Couplet Care Model	Cohen's *d*[b]	*p*-value	Linear regression model[a]	
					MD (95% CI)	*p*-value
Infant (with either parent)						
Presence, mean (SD), hours/day	10.8 (4.4)	21.2 (2.8)	**2.8**	**<0.001**	**10.8 (9.1, 12.4)**	**<0.001**
Overnight stay, mean (SD), nights/week	1.7 (2.3)	6.4 (1.1)	**2.6**	**<0.001**	**4.8 (3.9, 5.6)**	**<0.001**
Skin-to-skin contact, mean (SD), hours/day	2.7 (2.0)	3.2 (2.1)	0.2	0.29	0.9 (−0.2, 2.1)	0.11
Holding, mean (SD), hours/day	1.2 (1.6)	1.5 (2.2)	0.2	0.40	0.2 (−6.8, 1.0)	0.69
Mother						
Presence, mean (SD), hours/day	9.8 (3.9)	20.5 (2.9)	**3.1**	**<0.001**	**10.7 (9.1, 12.4)**	**<0.001**
Overnight stay, mean (SD), nights/week	1.3 (2.0)	6.3 (1.1)	**2.8**	**<0.001**	**4.8 (4.0, 5.6)**	**<0.001**
Skin-to-skin contact, mean (SD), hours/day	2.1 (1.4)	2.1 (1.4)	0.05	0.94	0.3 (−0.5, 1.1)	0.48
Holding, mean (SD), hours/day	1.2 (1.5)	1.3 (1.9)	0.1	0.83	−0.0 (−0.8, 0.8)	0.99
Father						
Presence, mean (SD), hours/day	5.7 (3.6)	11.5 (6.9)	**1.1**	**<0.001**	**7.7 (4.7, 10.7)**	**<0.001**
Overnight stay, mean (SD), nights/week	0.4 (0.8)	3.3 (2.8)	**1.5**	**<0.001**	**3.6 (2.4, 4.7)**	**<0.001**
Skin-to-skin contact, mean (SD), hours/day	1.3 (1.1)	1.2 (1.4)	0.1	0.61	0.2 (−0.5, 0.9)	0.56
Holding, mean (SD), hours/day	0.3 (0.5)	0.4 (0.9)	0.1	0.51	0.3 (−0.2, 0.8)	0.20

Note: Bold text indicates statistically significant results ($p < 0.05$). Abbreviations: 95% CI, 95% confidence interval; MD, mean difference; SD, standard deviation.

[a]The linear regression model adjusted for gestational age, multiple birth, parity and distance from the hospital to home.

[b]Effect size of the Student's *t*-test.

TABLE 5 Comparison of the timing of the first skin-to-skin contact, the duration of parents' presence and their overnight stays, skin-to-skin contact and holding before and after the introduction of the Coupet Care Model in the subgroups according to the gestational age at birth.

	Before Couplet Care Model	Couplet Care Model	Z[a], OR (95% CI) or Cohen's *d*[b]	*p*-value
Infants <28 weeks of gestation				
First skin-to-skin contact after birth, median (IQR), hours	72.0 (24.0, 72.0)	72.0 (15.9, 108.0)	0.20[a]	0.40
First skin-to-skin contact initiated ≤2 hours after birth, n (%)	1 (20.0)	1 (6.7)	0.3 (0.0, 28.0)	0.45
Presence, mean (SD), hours/day	12.2 (7.2)	19.7 (4.0)	**1.3**[b]	**0.049**
Overnight stay, mean (SD), nights/week	2.3 (3.6)	5.8 (1.9)	1.2[b]	0.07
Skin-to-skin contact, mean (SD), hours/day	3.1 (2.0)	3.5 (2.3)	0.2[b]	0.70
Holding, mean (SD), hours/day	0.1 (0.2)	0.01 (0.04)	0.9[b]	0.18
Infants ≥28 weeks of gestation				
First skin-to-skin contact after birth, median (IQR), hours	24.0 (16.3, 48.0)	1.0 (0.1, 14.5)	**0.52**[a]	**<0.001**
First skin-to-skin contact initiated ≤2 h after birth, *n* (%)	2 (6.7)	29 (56.9)	**17.8 (3.8, 170.3)**	**<0.001**
Presence, mean (SD), hours/day	10.6 (3.9)	21.6 (2.3)	**3.5**[b]	**<0.001**
Overnight stay, mean (SD), nights/week	1.6 (2.1)	6.6 (0.7)	**3.2**[b]	**<0.001**
Skin-to-skin contact, mean (SD), hours/day	2.6 (2.0)	3.1 (2.1)	0.2[b]	0.37
Holding, mean (SD), hours/day	1.4 (1.7)	2.0 (2.3)	0.3[b]	0.20

Note: Bold text indicates statistically significant results ($p < 0.05$). Abbreviations: 95% CI, 95% confidence interval; IQR, interquartile range; OR, odds ratio.

[a]Effect size of the Wilcoxon rank sum test.

[b]Effect size of the Student's *t*-test.

collaboration between different teams is an essential part of couplet care for the safety of postpartum mothers and their infants.[7] However, safety concerns have been reported to be among the barriers to implementing couplet care.[5] Education has been emphasised as an important but challenging component of the implementation process of couplet care.[5,7]

Our study also shed light on the importance of the fathers in early skin-to-skin contact. After the model was introduced, the first skin-to-skin contact happened significantly earlier than before among fathers, whereas it did not change significantly among mothers. Fathers' involvement is essential to successfully implement early skin-to-skin contact, especially following a Caesarean section which makes prolonged mother-infant skin-to-skin contact more difficult to perform.[11,12] Infants' interaction skills was shown to improve at four months of corrected age when either mother or father provided early skin-to-skin contact.[14] In the Couplet Care Model, initial infant care in the delivery room facilitated fathers' participation. In addition, the staff encouraged the fathers as well as the mothers to be involved. As a result, the mothers and fathers were both equally engaged in providing early skin-to-skin contact after the introduction of the model.

The degree of prematurity affected the impact of the Couplet Care Model on the timing of the first skin-to-skin contact so that significant changes were seen only in infants born at or after 28 weeks of gestation. The literature provides evidence-base for immediate skin-to-skin contact for preterm infants born at or after 28 weeks of gestation.[28] On the other hand, parents presence increased regardless of the degree of prematurity. Future studies should evaluate the facilitators, barriers and effects of early skin-to-skin contact in extremely preterm infants.

Studies have reported improved child outomes when parents spent longer in the NICU or visited more frequenty.[1,2] In the new hospital, mothers were admitted to the same NICU room with their infants and continued staying in the same room after their discharge if they wanted. As the parents stayed with their infant in the same room after the delivery, they had to make an active decision to leave the hospital. This is different from an active decision to come to stay in the NICU room when the mother was cared for in another ward in the old hospital. In addition, the parents might have felt increased privacy and security in the new hospital, as they did not need to share the NICU room with another family. Ensuring privacy, by optimising space, is considered one of the strategies to promote parent–infant physical and emotional closeness.[29]

Another key element supporting the parents' extended presence in our study was the provision of overnight accommodation for both parents. Our study showed that the Couplet Care Model significantly increased the frequency of overnight stays of both parents. The single-family NICU rooms in the new hospital provides beds for both mothers and fathers. The parents being together may be psychologically important for the mothers, as support from their husbands or partners has been associated with fewer depressive symptoms during the postpartum period.[30,31] We also found that, after the implementation of the model, the mothers stayed in the NICU almost all nights, whereas the fathers stayed about half of the nights. The changes in mother's presence and overnight stays were larger than those of the fathers. It is often the fathers' role to take care of other children or their pets at home. In addition, fathers may be working during the period. Even though some fathers commuted from the NICU room or worked remotely from the NICU room, the duration of their presence could have suffered from work responsibilities.

To successfully implement couplet care, attitude changes and education are needed in addition to architectural changes. Resistance to change was shown to be one of the barriers to couplet care.[5] The NICU of our study had previously implemented an educational training for its staff, known as the Close Collaboration with Parents intervention, between 2009 and 2012.[32–34] Thus, the unit's existing family-centred care culture was one of the key foundations for the smooth introduction of couplet care.[7]

Even though the duration of the parents' presence in the NICU room doubled, the duration of skin-to-skin contact and holding did not change significantly. The Couplet Care Model did not include components targeting skin-to-skin contact in the NICU. Targeted interventions may be necessary to promote skin-to-skin contact. The examples of the key elements for successful implementation of skin-to-skin contact include education for the staff and parents, evidence-based protocols and sufficient preparation of the parents before birth.[28] However, the parents may have utilised their time in the NICU room engaging in other activities that are arguably equally beneficial to their infant,[3,35,36] such as singing, talking, reading, bathing, feeding, breastmilk pumping and diaper changes.[37] It could be of interest to study how these activities change after the introduction of couplet care.

Our study had some limitations. Firstly, the non-randomised study design prevented the evaluation of the effects of time, and there were some differences between the patient groups. In addition, the transition to the new hospital included factors other than couplet care: for example, the sophisticated design, brand-new furniture and spacious NICU rooms. There is a need to document the effects of different hospital designs to provide evidence for future planning teams. Lastly, the long-term effects of couplet care on parents and infants were beyond the scope of this study.

5 | CONCLUSION

The introduction of couplet care along with new hospital design promoted early parent–infant skin-to-skin contact and increased the parents' presence and overnight stays in the NICU room. The Couplet Care Model was founded on principles of family-centred care and implemented after the transition to a new hospital with suitable architecture. This neonatal care model serves as a tool to promote parent–infant relationships during neonatal care. However, further studies are needed to understand the factors that promote or inhibit the implementation of couplet care and its long-term effects.

AUTHOR CONTRIBUTIONS

Ryo Itoshima: Conceptualisation; methodology; software; data curation; validation; investigation; formal analysis; supervision; resources; visualisation; writing – original draft; writing – review and editing; funding acquisition. **Kalle Korhonen:** Conceptualisation;

methodology; data curation; investigation; validation; supervision; project administration; resources; writing – review and editing. **Anna Axelin:** Conceptualisation; methodology; investigation; validation; data curation; supervision; resources; writing – review and editing. **Sari Ahlqvist-Björkroth:** Conceptualisation; methodology; validation; investigation; writing – review and editing; data curation; supervision; resources. **Anna Hovi:** Conceptualisation; methodology; data curation; investigation; validation; writing – review and editing. **Liisa Lehtonen:** Conceptualisation; methodology; validation; investigation; project administration; data curation; supervision; resources; writing – review and editing.

ACKNOWLEDGEMENTS

We want to thank Mrs. Minna Paaso, a research nurse at Turku University Hospital, for helping us with data collection in Finland. We also acknowledge Mrs. Henna Raudaskoski for her contribution to language proofreading.

FUNDING INFORMATION

The study was supported by the Foundation for Pediatric Research in Finland and the TYKS Foundation.

CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest to declare.

ORCID

Ryo Itoshima https://orcid.org/0000-0003-3245-0906
Anna Axelin https://orcid.org/0000-0003-2743-3589
Sari Ahlqvist-Björkroth https://orcid.org/0000-0002-4478-8077
Liisa Lehtonen https://orcid.org/0000-0001-8925-2594

REFERENCES

1. Latva R, Lehtonen L, Salmelin RK, Tamminen T. Visiting less than every day: a marker for later behavioral problems in Finnish preterm infants. Arch Pediatr Adolesc Med. 2004;158(12):1153. doi:10.1001/archpedi.158.12.1153
2. Reynolds LC, Duncan MM, Smith GC, et al. Parental presence and holding in the neonatal intensive care unit and associations with early neurobehavior. J Perinatol. 2013;33(8):636-41. doi:10.1038/jp.2013.4
3. Lester BM, Salisbury AL, Hawes K, et al. 18-month follow-up of infants cared for in a single-family room neonatal intensive care unit. J Pediatr. 2016;177:84-9. doi:10.1016/j.jpeds.2016.06.069
4. Gonya J, Feldman K, Brown K, et al. Human interaction in the NICU and its association with outcomes on the brief infant-toddler social and emotional assessment (BITSEA). Early Hum Dev. 2018;127:6-14. doi:10.1016/j.earlhumdev.2018.08.010
5. Curley A, Jones LK, Staff L. Barriers to couplet Care of the infant requiring additional care: integrative review. Healthcare (Basel). 2023;11(5):737. doi:10.3390/healthcare11050737
6. Patriksson K, Selin L. Parents and newborn "togetherness" after birth. Int J Qual Stud Health Well-Being. 2022;17(1):2026281. doi:10.1080/17482631.2022.2026281
7. Klemming S, Lilliesköld S, Arwehed S, Jonas W, Lehtonen L, Westrup B. Mother-newborn couplet care: Nordic country experiences of organization, models and practice. J Perinatol. 2023;43:17-25. doi:10.1038/s41372-023-01812-3
8. White RD. Couplet care—the next frontier of Care in the Newborn Intensive Care Unit. Crit Care Nurs Clin North Am. 2024;36(1):35-9. doi:10.1016/j.cnc.2023.08.002
9. Waller-Wise R. Mother-baby care: the best for patients, nurses and hospitals. Nurs Womens Health. 2012;16(4):273-8. doi:10.1111/j.1751-486X.2012.01744.x
10. WHO Immediate KMC Study Group, Arya S, Naburi H. Immediate "kangaroo mother care" and survival of infants with low birth weight. N Engl J Med. 2021;384(21):2028-38. doi:10.1056/NEJMoa2026486
11. Linnér A, Lode Kolz K, Klemming S, et al. Immediate skin-to-skin contact may have beneficial effects on the cardiorespiratory stabilisation in very preterm infants. Acta Paediatr. 2022;111(8):1507-14. doi:10.1111/apa.16371
12. Lode-Kolz K, Hermansson C, Linnér A, et al. Immediate skin-to-skin contact after birth ensures stable thermoregulation in very preterm infants in high-resource settings. Acta Paediatr. 2023;112(5):934-41. doi:10.1111/apa.16590
13. Mehler K, Hucklenbruch-Rother E, Trautmann-Villalba P, Becker I, Roth B, Kribs A. Delivery room skin-to-skin contact for preterm infants—a randomized clinical trial. Acta Paediatr. 2020;109(3):518-26. doi:10.1111/apa.14975
14. Lilliesköld S, Lode-Kolz K, Rettedal S, et al. Skin-to-skin contact at birth for very preterm infants and mother-infant interaction quality at 4 months: a secondary analysis of the IPISTOSS randomized clinical trial. JAMA Netw Open. 2023;6(11):E2344469. doi:10.1001/jamanetworkopen.2023.44469
15. Darmstadt GL, Al Jaifi NH, Arif S, et al. New World health organization recommendations for care of preterm or low birth weight infants: health policy. EClinicalMedicine. 2023;63:102155. doi:10.1016/j.eclinm.2023.102155
16. de Salaberry J, Hait V, Thornton K, et al. Journey to mother baby care: implementation of a combined care/couplet model in a level 2 neonatal intensive care unit. Birth Defects Res. 2019;111(15):1060-72. doi:10.1002/bdr2.1524
17. White RD. Recommended standards for newborn ICU design. J Perinatol. 2020;40:2-4. doi:10.1038/s41372-020-0766-2
18. Kainiemi E, Hongisto P, Lehtonen L, Pape B, Axelin A. Effects of single family room architecture on parent–infant closeness and family centered care in neonatal environments—a single-center pre-post study. J Perinatol. 2021;41(9):2244-51. doi:10.1038/s41372-021-01137-z
19. Reijula J, Karvonen S, Petäjä H, Reijula K, Lehtonen L. Participative facility planning for obstetrical and neonatal care processes: beginning of life process. J Healthc Eng. 2016;2016:7836493. doi:10.1155/2016/7836493
20. Axelin A, Raiskila S, Lehtonen L. The development of data collection tools to measure parent–infant closeness and family-centered care in NICUs. Worldviews Evid-Based Nurs. 2020;17(6):448-56. doi:10.1111/wvn.12475
21. Pineda R, Bender J, Hall B, Shabosky L, Annecca A, Smith J. Parent participation in the neonatal intensive care unit: predictors and relationships to neurobehavior and developmental outcomes. Early Hum Dev. 2018;117:32-8. doi:10.1016/j.earlhumdev.2017.12.008
22. Franck LS, Spencer C. Parent visiting and participation in infant caregiving activities in a neonatal unit. Birth. 2003;30(1):31-5. doi:10.1046/j.1523-536X.2003.00214.x
23. Giacoia GP, Rutledge D, West K. Factors affecting visitation of sick newborns. Clin Pediatr (Phila). 1985;24(5):259-62. doi:10.1177/000992288502400506
24. R Core Team. R. A language and environment for statistical computing. https://www.R-project.org/
25. Wickham H, Averick M, Bryan J, et al. Welcome to the Tidyverse. J Open Source Softw. 2019;4(43):1686. doi:10.21105/joss.01686

26. Bates D, Mächler M, Bolker BM, Walker SC. Fitting linear mixed-effects models using lme4. J Stat Softw. 2015;67(1):48. doi:10.18637/jss.v067.i01
27. Wickham H. Ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag; 2016. https://ggplot2.tidyverse.org
28. Brimdyr K, Stevens J, Svensson K, et al. Skin-to-skin contact after birth: developing a research and practice guideline. Acta Paediatr. 2023;112(8):1633-43. doi:10.1111/apa.16842
29. Flacking R, Dykes F. "Being in a womb" or "playing musical chairs": the impact of place and space on infant feeding in NICUs. BMC Pregnancy Childbirth. 2013;13:179. doi:10.1186/1471-2393-13-179
30. Gremigni P, Mariani L, Marracino V, Tranquilli AL, Turi A. Partner support and postpartum depressive symptoms. J Psychosom Obstet Gynaecol. 2011;32(3):135-40. doi:10.3109/0167482X.2011.589017
31. Milgrom J, Gemmill AW, Bilszta JL, et al. Antenatal risk factors for postnatal depression: a large prospective study. J Affect Disord. 2008;108(1–2):147-57. doi:10.1016/j.jad.2007.10.014
32. Ahlqvist-Björkroth S, Boukydis Z, Axelin AM, Lehtonen L. Close collaboration with parents™ intervention to improve parents' psychological well-being and child development: description of the intervention and study protocol. Behav Brain Res. 2017;325:303-10. doi:10.1016/j.bbr.2016.10.020
33. He FB, Axelin A, Ahlqvist-Björkroth S, Raiskila S, Löyttyniemi E, Lehtonen L. Effectiveness of the close collaboration with parents intervention on parent-infant closeness in NICU. BMC Pediatr. 2021;21(1):28. doi:10.1186/s12887-020-02474-2
34. Ahlqvist-Björkroth S, Axelin A, Lehtonen L. Close collaboration with parents—implementation and effectiveness. Acta Paediatr. in press. doi:10.1111/apa.17210
35. Kato T, Kachi Y, Ochi M, et al. The long-term association between paternal involvement in infant care and children's psychological well-being at age 16 years: an analysis of the Japanese longitudinal survey of newborns in the 21st century 2001 cohort. J Affect Disord. 2023;324:114-20. doi:10.1016/j.jad.2022.12.075
36. Vittner D, Butler S, Smith K, et al. Parent engagement correlates with parent and preterm infant oxytocin release during skin-to-skin contact. Adv Neonatal Care. 2019;19(1):73-9. doi:10.1097/ANC.0000000000000558
37. Campbell-Yeo M, Kim T, Disher T, et al. Do single-family rooms increase parental presence, involvement, and maternal well-being in neonatal intensive care? J Perinat Neonatal Nurs. 2021;35(4):350-61. doi:10.1097/JPN.0000000000000600

How to cite this article: Itoshima R, Korhonen K, Axelin A, Ahlqvist-Björkroth S, Hovi A, Lehtonen L. Effect of couplet care on early parent–infant closeness among preterm infants. Acta Paediatr. 2024;00:1–10. https://doi.org/10.1111/apa.17502