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Original Article

# Kangaroo supported diagonal flexion positioning: Positive impact on maternal stress and postpartum depression risk and on skin-to-skin practice with very preterm infants

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ABSTRACT

*Purpose:* To test the effects of a new skin-to-skin Supported Diagonal Flexion (SDF) positioning on maternal stress, postpartum depression risk and skin-to-skin daily practice, in comparison with the usual Kangaroo Care in Upright positioning, during the first weeks after very premature birth.

*Design:* Thirty-four mothers and their very preterm infants were assigned to one of the two Kangaroo Care positioning, either the Upright (n = 17) or the SDF positioning (n = 17). Maternal risk for depression and stress feelings were assessed through questionnaires before the first kangaroo care, 15 days later and at 40 weeks and 3 months corrected age. Data on daily kangaroo care practice was collected during 15 consecutive days starting from the very first skin-to-skin session.

*Results:* The depression risk score was significantly lower in SDF positioning mothers after 15 days of skin-to-skin practice and at 40 weeks and 3 months corrected age. In the SDF group, mothers chose to practice Kangaroo Care during a significantly longer period of time per session.

*Conclusion:* Our results support the hypothesis of a positive impact of SDF Kangaroo positioning on maternal postpartum risk of depression and skin-to-skin practice.

Premature birth is associated with high stress and anxiety levels in parents (Segre et al., 2014; Spinelli et al., 2013; Forcada-Guex, 2011; Davis, 2003), including post-traumatic stress (Anderson and Cacola, 2017; Holditch-Davis et al., 2015). In their meta-analysis, Wisner et al. (2013) pointed out that 40% of mothers with a preterm (PT) baby presented postpartum depressive (PPD) symptoms. Moreover, Bergström et al. (2012) observed that women who were not offered counselling during their infant's stay in the NICU had a 60% increase in the risk for PPD onset. Several studies found that early parental stress could influence the interrelationship between preterm birth and PPD (Carson et al., 2015; Gray et al., 2013; Lefkowitz et al., 2010).

Several factors causing major parental stress have been reported in the literature. Some authors pointed out that very low birth weight, associated to prematurity and its heightened medical risks, can greatly increase parental stress, specifically in relation with the survival and health of the PT baby (Kawafha, 2018; Singer et al., 2003). Dudek-Shriber (2004) highlighted that younger, married and more educated mothers report higher levels of stress, whereas Carter et al. (2007) reported that singlehood, low income and low educational attainment negatively impact parental stress, regardless of the newborn's gestational age. Authors also noted that for mothers, high stress is associated with lower income, living with a partner and an abnormal pregnancy scan. Other predictors of stress include length of stay, extreme prematurity and cardiovascular diagnosis (Dudek-Shriber, 2004). Parents describe preterm birth, but also hospitalization and aftermath, as traumatic events (Kantrowitz-Gordon et al., 2016), in particular when they have no previous NICU experience (Carter et al., 2007). Baía et al. (2016) found that mothers rate the overall hospitalization experience as more stressful than the median for every subscales of the Parental Stressor Scale, with the 'Parental role alteration' subscale rated as the

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**Abbreviations**

| | |
|---|---|
| PPD | Postpartum depression |
| PT | Preterm |
| ELBW | Early Low Birth Weight |
| NICU | Neonatal intensive care unit |
| SSC | Skin-to-skin contact |
| KC | Kangaroo Care |
| SDF positioning | Supported diagonal flexion positioning |
| EPDS | Edinburgh postpartum depression scale |
| PSS | Parental stressor scale |
| PPQ | Perinatal post-traumatic stress disorder questionnaire |

most stressful. Moreover, higher maternal anxiety during the neonatal intensive care unit (NICU) stay is associated with less efficient parenting from birth to preschool age (Zelkowitz and Papageorgiou, 2005). Neri (2015) observed higher prevalence of depressive and anxious symptoms in early low birth weight (ELBW)'s mothers and according to Silverstein et al. (2010), depressed mothers of ELBW infants, aged 11 months to 4 years, had a negative perception of their infant's behavior, in particular regarding their social abilities.

The literature focusing on interactions between parents and their PT has reported a negative impact of maternal stress (Neri, 2015; Muller-Nix et al., 2004) and PPD (Korja et al., 2008) on the quality of early interactions. Muller-Nix et al. (2004) found that prematurity reduces mothers' responsiveness, as they appear less sensitive and more intrusive with their infants at a corrected age of 6 months. This result adds to Lester et al. (1995)'s results showing less touching, vocalizing and gazing of mothers with PT infants. Forcada-Guex et al. (2011) suggested that this impact on parental behaviors could be due to post-traumatic stress disorder, which creates a permanent latent preoccupation about infant health and affects parents' ability to embrace their role and build adapted early affective relationships. To break this deleterious loop in a highly medicalized environment, some authors pointed out the necessity to adopt a more human approach by favoring more parent-PT infant contact from the very beginning (Roué et al., 2017). SSC contact (SSC) is currently the only relational multisensory care method offered to a mother and her infant immediately after birth in NICUs. SSC is widely practiced by positioning the baby between the mother's breasts, in an upright position, chest to chest (WHO, 2003).

The SSC situation is suitable for consistent and reciprocal interaction. Based on the Kangaroo Care (KC) program included in the Newborn Individualized Development Care Assessment Program, such relational care has numerous well-known positive effects on the development of PT infants (Athanasopoulou and Fox, 2014). These benefits include an improvement of cognitive development, a reduction of the frequency of infections as well as positive results on sleeping, crying, thermal regulation, weight gain, heart and respiratory rate, energy expenditure and oxygenation (Dodd, 2005; Hall and Kirsten, 2008; Ludington-Hoe, 2011). In addition, positive results on mother-infant interaction, maternal mood and sense of adaptation have been evidenced for infants and their families (Herizchi et al., 2017; Cho et al., 2016; Charpak et al., 2005; Tallandini et al., 2006; Scalembra, 2006; Tessier et al., 2011).

In their recent meta-analysis, Athanasopoulou and Fox (2014) pointed out controversial results concerning the effect of KC on maternal mood. Indeed, some studies showed an improvement of maternal mood in mothers who practiced KC vs. mothers who did not (De Macedo et al., 2007; Feldman et al., 2002; Tallandini and Scalembra, 2006; Tessier et al., 1998), whereas others did not (Ahn et al., 2010; Miles et al., 2006; Roberts et al., 2000; Whitelaw et al., 1988). Tessier et al. (1998) reported that mothers who practiced KC felt more competent during care with their PT infant and were less affected by separation. Athanasopoulou and Fox (2014) explained that these divergent results could be due to methodological limitations, such as the way KC was practiced. Indeed, KC is likely to vary substantially in different NICUs, in particular when comparing continuous and

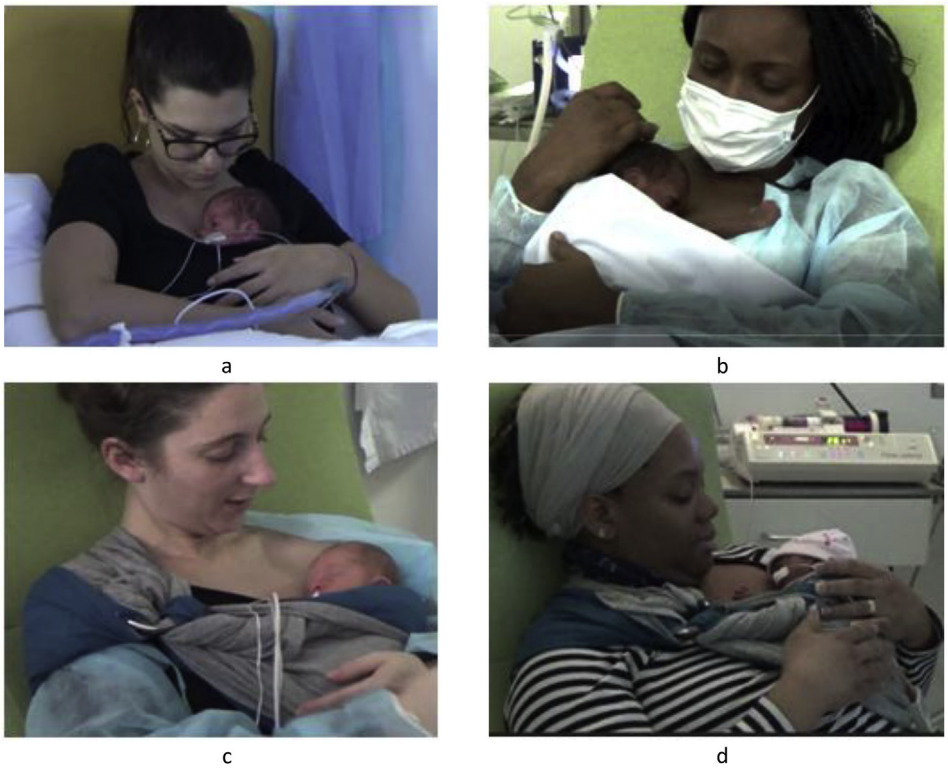


**Fig. 1.** Upright positioning (1a and 1b) and Supported Diagnonal Flexion (SDF) positioning (1c and 1d).

intermittent KC.

Buil et al. (2016) investigated the impact of positioning during SSC sessions on mother and infant well-being and on mother-infant communication. They conducted an observational, prospective, single-center study using an innovative kangaroo 'supported diagonal flexion' (SDF) positioning. This positioning was developed in their NICU according to recent recommendations promoting a 'semi reclined positioning' (Ludington-Hoe et al., 2008; Nyqvist et al., 2010). The results support the idea that the kangaroo SDF positioning technique is physiologically safe and has obvious immediate benefits on mothers' infant-directed communicative behaviors (Buil et al., 2016). Moreover, authors observed a significant decrease of the risk of postnatal depression with the new SDF positioning in comparison with the usual positioning practiced in the NICU where the study was conducted. However, Buil et al. (2016)'s study was solely observational and had some limitations in its design.

This monocentric longitudinal matched-pair case-control study aimed to test the effect of a new SSC SDF positioning on maternal stress and PPD risk in comparison with KC in Upright positioning. A secondary aim was to determine if and how SDF positioning influenced the way SSC was practiced by mothers every day during the first weeks after very premature birth.

## 1. Methods

### 1.1. Participants

The study was conducted from May 2015 to June 2016, in a level III NICU at the *Center Hospitalier Intercommunal de Créteil* (France). Among the 59 very preterm births (27 < 32 weeks' gestation) which occurred during the inclusion period, 53 met inclusion criteria (no secondary neurological and or severe medical conditions linked to premature birth, i.e., no neurological defects due to several vascular hemorrhage (IVH grade III or IV), no incapacitating physical or psychological disease in the mother). Seven mothers refused to participate, and two inclusions were missed. Among the remaining 44 births, two were lost during follow-up and eight were multiple births which were not included in the present report. The final sample thus included 34 very preterm and their mothers.

### 1.2. Procedure

#### 1.2.1. Case-control matching

The first 17 dyads were proposed the KC positioning usually practiced in the NICU were the study was conducted, i.e. chest to chest between the mother's breasts, in an upright position, with a breastfeeding nursing pillow (see Fig. 1a). Nurses of the NICU trained to the practice of the new SDF positioning during a month. This new KC SDF positioning was proposed to 17 dyads ('case' dyads) matched to the first 17 dyads on newborns' gestational age and weight ('control' dyads). The same team of nurses proposed Upright and SDF positioning. The two KC positionings represented the same daily workload.

In KC SDF positioning, the baby is off-center and semi-reclined on the mother's chest, chest-to-chest (Buil et al., 2016). The position is characterized by a slightly flexed body axis, with the limbs retracted in a preventive posture and the head in line with the body axis to prevent side-to-side toppling and to free respiratory permeability (Nyqvist et al., 2010), moderately externally rotated hips in flexion-abduction (Vaivre-Douret et al., 2004), with adducted shoulders (Ferrari et al., 2007). The baby's head turns toward the mother's face and is located between the nipple and the clavicle. His/her arms and legs are flexed, in a naturally adopted asymmetrical tonic neck posture (Casaer, 1979), according to the baby's term and comfort. The baby is naked and positioned inside the mother's clothes, a baby wrap adjusted around the two is used to support and help maintain the baby's posture and to relieve the mother. The chosen tool is a knitted baby wrap, with a special density of ± 300 gr/m2, made of 95% cotton and 5% elastane, allowing 2 way stretching. The baby wrap is placed over the mother's clothes with an asymmetric diagonal special knot that allows precise adjustment to both morphologies, while maintaining the baby in the desired posture (see Fig. 1b). In both positions, the mother is comfortably seated in an adjustable armchair, her back inclined 40°, with a toe-clip, dim light and a quiet atmosphere.

#### 1.2.2. Risk of depression and stress measurement

Participating mothers filled in the following questionnaires when they were alone and handed them back to the researcher (AB) in a sealed envelope.

Risk for PPD was assessed using the Edinburgh Postpartum Depression Scale (EPDS). EPDS is a 10-item self-rating scale designed to screen a broad population for perinatal depression risk (Cox et al., 1987). This scale covers the symptomatology commonly associated with depression, excluding somatic dimensions such as fatigue and appetite variations, which are often found during the ante- and postnatal periods. Each item is scored on a 4-point scale (0–3), with a total score ranging from 0 to 30. It can be completed and scored quickly and has a high level of acceptability. The French validated version was used (Guedeney et al., 1995). Mothers were invited to fill the EPDS four times: before the first SSC session, 15 days later (before the SSC session), at 40 weeks of corrected age, and at 3 months of corrected age.

Parental stress was assessed using the Parental Stressor Scale: Neonatal Intensive Care Unit (PSS:NICU) (Miles et al., 1993). The PSS:NICU is a 26-item self-rating questionnaire designed to measure parental perception of stressors arising from the physical and psychosocial environment of the NICU. It includes three scales: Parental role alterations, Sight and sounds of the Unit, and Infant behavior and appearance. The parent answers each item either by using 'na' if not applicable, or on a five-point Likert scale, ranging from 'no stress' to 'extreme stress'. We used the French validated version (Faure et al., 2008). As the PSS requires that mothers have had prolonged contact with their baby, we used it 15 days after the first SSC session (before the SSC session).

The Perinatal Post-traumatic stress disorder Questionnaire (PPQ) (Quinnell and Hynan, 1999) is a 14-item self-rating questionnaire based on Diagnostic and Statistical Manual of Mental Disorders (4th edition) criterion, which assesses the presence of maternal post-traumatic stress symptoms during the past month. Items relate to their experience of their infant's birth and the perinatal period in general. We used the French validated version (Pierrehumbert et al., 2004). The PPQ is designed to be used at least 1 month after the traumatic event; we therefore offered it to mothers at 40 weeks of corrected age and at 3 months of corrected age.

#### 1.2.3. SSC data collection

Data on KC practice were collected during 15 consecutive days, from the first SSC session onwards. As in most high-tech NICU settings, our study's NICU proposes intermittent KC, once to several times a day and for a variable number of days (Nyqvist et al., 2010). The nurses of our study's NICU had been involved in development care for many years. They routinely offer parents to practice SCC rapidly after birth. They are in charge of a maximum of 3 PT infants at a time. Hence, mothers said they felt free to practice SSC and to end the sessions whenever they wanted, according to their baby's health and to the nursing daily care organization. Nurses recorded every session practiced by the 34 mothers during 15 days, as well as their respective durations. All the information was reported and thus accessible in the medical file. Socio-demographic, Ob/Gyn, delivery and birth data were also obtained from medical files.

### 1.3. Statistical analysis

The analyses were performed using Stata for Windows (version 14;

StataCorp). Conditional logistic regression was conducted with maternal age, parity, gestational age, birthweight, length of stay in NICU and length of stay in the Division of Neonatal Pediatrics as potential confounders.

### 1.4. Ethical considerations

All mothers were offered to participate to the research study on a voluntary basis, within the first two days postpartum, and in all cases before the first SSC session. Every mother whose baby met the inclusion criteria was informed of the research by a letter in the NICU. Mothers gave a written informed consent before participating. An initial information-based meeting was organized prior to data collection. This research was approved by the French Local Ethics Consulting Committee for the Protection of Persons (IRB n 2015120001072).

## 2. Results

Table 1 shows sociodemographic characteristics, ObGyn and delivery data associated to the two groups. No significant difference was found between the two groups of mothers.

Regarding birth data, PT babies seemed more at risk in the SDF group, with more births before 28 weeks GA, more newborns under 1000 g, and fewer newborns breathing spontaneously. However, there was no significant difference between the two groups of babies (see Table 2).

### 2.1. Maternal stress and depression risk

The first measures of the risk of depression (before the first SSC session), were quite comparable for the SDF positioning group and the usual positioning group, with EPDS scores of 13.8 and 12.9 respectively (see Table 3). After 15 days of KC practice, both scores fell under 10, a decrease that appeared significantly higher in the SDF group positioning after adjustment. Furthermore, the EPDS score remained significantly lower at 40 weeks and 3 months of corrected age in the SDF positioning group, compared to the Upright positioning one.

Regarding PSS:NICU scores after 15 days of KC practice, all but the parental role alteration scores were lower in the SDF positioning group. However, these differences did not reach significance. This was also the case for the maternal PPQ score at 40 weeks and 3 months of corrected age, which seemed lower in SDF mothers, but the difference was not significant.

### 2.2. Maternal KC practice

Table 4 presents data collected on KC practice during the first 15 days of practice. It shows that mothers practiced KC on average four times a week, with no difference between groups. Regarding the mean duration of SSC sessions, Fig. 2 shows that nine mothers, out of the 17 in the SDF positioning group, chose to stay on average longer in SSC than any mother did in the Upright positioning group. Indeed, we observed significant differences in the mean and maximum durations (before and after adjustment; see Table 4).

**Table 1**
Sociodemographic, ObGyn and Delivery data according to skin to skin positioning.

| | SDF positioning | | Usual positioning | | p value |
|---|---|---|---|---|---|
| | N = 17 | | N = 17 | | |
| | mean (sd) | n (%) | mean (sd) | n (%) | |
| **Socio-demographic data** | | | | | |
| Mothers' age (years) | 30.4 (1.46) | | 28.9 (0.95) | | .387 |
| ≥ 30 | | 11 (65%) | | 9 (53%) | .728 |
| Living with partner | | | | | |
| Yes | | 15 (88%) | | 16 (94%) | 1 |
| Employment status | | | | | |
| Employed | | 13 (76%) | | 13 (76%) | 1 |
| **ObGyn data** | | | | | |
| Gestity before pregnancy | 2.35 (1.17) | | 2.59 (1.94) | | .671 |
| Yes | | 13 (76%) | | 11 (65%) | .708 |
| Parity before pregnancy | 0.47 (0.62) | | 0.88 (0.99) | | .157 |
| Nulliparous | | 10 (59%) | | 8 (47%) | .732 |
| Early pregnancy loss | 0.88 (0.93) | | 0.82 (1.24) | | .876 |
| Yes | | 10 (59%) | | 7 (41%) | .494 |
| Late pregnancy loss | | | | | |
| Yes | | 2 (12%) | | 1 (6%) | 1 |
| Previous history of Preterm Birth/Low Birth Weight | | | | | |
| Yes | | 2 (12%) | | 2 (12%) | 1 |
| ObGyn Hospitalization during ongoing pregnancy | | | | | |
| Yes | | 11 (65%) | | 15 (88%) | .225 |
| High Risk Pregancy | | | | | |
| Yes | | 13 (76%) | | 15 (88%) | .656 |
| Intra Uterine Growth Restriction | | 7 | | 8 | .730 |
| High Blood Pressure/Pre Eclampsia | | 5 | | 6 | .714 |
| Premature delivery threat | | 1 | | 3 | .553 |
| **Delivery data** | | | | | |
| Reason | | | | | |
| Spontaneous | | 2 (12%) | | 1 (6%) | 1 |
| Labour induction | | 15 (88%) | | 16 (94%) | |
| Fetal heart rate abnormalities | | 11 | | 6 | |
| Intra Uterine Growth Restriction | | 8 | | 5 | |
| High Blood Pressure/Pre Eclampsia | | 8 | | 3 | |
| Delivery type | | | | | |
| Vaginal delivery | | 1 (6%) | | 4 (24%) | .335 |
| Caesarean section | | 16 (94%) | | 13 (76%) | |

**Table 2**
PT infant's data at birth, at first skin to skin and 15 days later, according to skin to skin positioning.

| | SDF positioning | | Usual positioning | | p value |
|---|---|---|---|---|---|
| | N = 17 | | N = 17 | | |
| | mean (sd) | n | mean (sd) | n | |
| Birth data | | | | | |
| Gender | | | | | |
| Girl | | 11 (65%) | | 7 (41%) | .174 |
| Weight (g) | 1080 (244) | | 1184 (294) | | .272 |
| < 1000 | | 7 (41%) | | 4 (24%) | .276 |
| 1000-2000 | | 10 (59%) | | 13 (76%) | |
| Gestational age (w) | 29.7 (2.7) | | 30.0 (1.24) | | .532 |
| < 28 | | 3 (18%) | | 0 (0%) | na |
| 28 to < 32 | | 14 (82%) | | 17 (100%) | |
| Apgar | | | | | |
| Apgar 1 | 7.1 (2.7) | | 7.9 (2.6) | | .409 |
| Apgar 2 | 9.0 (1.7) | | 8.7 (2.2) | | .665 |
| Spontaneous breathing | | | | | |
| Yes | | 3 (18%) | | 6 (35%) | .251 |
| Data at first skin to skin | | | | | |
| Age (days) | 3.5 (1,8) | | 3.2 (2,1) | | .677 |
| Weight (g) | 1031 (208) | | 1115 (280) | | .338 |
| < 1000 | | 8 (47%) | | 4 (24%) | .157 |
| 1000-2000 | | 9 (53%) | | 13 (76%) | |
| Data at 15 days after first skin to skin | | | | | |
| Age (days) | 18.1 (2.2) | | 18.1 (2.8) | | |

## 3. Discussion

In the present study, our first aim was to test the effect of the new KC SDF positioning on maternal stress and PPD, in comparison with the KC in Upright positioning. Our results confirmed the hypothesis of a positive impact on maternal mood, assessed through EPDS, but not on stress, assessed through PSS:NICU and PPQ. Converging with most studies on the relation between KC practice and maternal mood (Athanasopoulou and Fox, 2014), we observed a decrease in the risk of depression in both groups, at the second and third assessments. However, SDF positioning was associated with a greater decrease15 days after the first SSC session, confirming Buil et al. (2016)'s observations, but also at 40 weeks and 3 months of corrected age, whereas the score tended to stagnate at 40 weeks of corrected age in the Upright positioning group.

At birth, the risk of depression was quite similar in mothers of both groups, even though slightly higher in the SDF group, which could be explained by sensitively more at risk pregnancies and more vulnerable newborns in this group. Besides, the significant decreases, respectively after 15 days of KC practice and at 40 weeks and 3 months of corrected age, were obtained after adjustment on mother and infant characteristics. This decrease in the risk of depression supports the idea that SDF positioning has positive short- and long-term effects on mothers, who appeared to feel less overwhelmed or vulnerable at the time of assessment (Cox et al., 2014).

Our second aim was to determine if and how SDF positioning impacted the way SSC is practiced by mothers during the first weeks after very premature birth. Our results evidence that in the SDF group, mothers chose to practice longer KC sessions. Keeping in mind that mothers freely initiated and ended intermittent KC (when non-medical contraindication), this result strongly supports the idea that mothers in the SDF positioning group felt more comfortable to prolong this moment. Indeed, the innovative SDF positioning offers an opportunity for both mother and infant to discover each other and communicate in synchrony (Feldman and Eidelman, 2007). This might relate to what SDF positioning offers: eyes-to-eyes contact, postural and tonic adjustment of the preterm, as well as the envelope brought by the baby wrap.

Neu and Robinson (2010) compared KC with traditional holding (with a blanket) and found better mother-baby interaction in the KC group. The added value of KC could be attributed to close physical contact and maximized touch. Our results are in line with this work and go further, for they support the hypothesis that SSC behaviors are more complex than a mere increase in shared feelings. Indeed, by changing the way mother and baby are together in close contact during the care, the quality of mutual communication appears more varied, rich and adjusted (Buil et al., 2017a,b; Gratier and Devouche, 2017). This dedicated moment positively acts upon each partner's well-being, which in turn positively influences the quality of the relationship, thus creating a virtuous loop. From this point of view, rather than the amount of close contact, it might be the quality of the experience that matters most, in terms of behavioral and affective interactions (Stern, 1995) and tonic-emotional dialogue (De Ajuriaguerra, 1983).

**Table 3**
EPDS, PSS:NICU and PPQ scores according to positioning.

| | SDF positioning | | Usual positioning | | | | |
|---|---|---|---|---|---|---|---|
| | N = 17 | | N = 17 | (sd) | p value | | adjusted |
| | mean | (sd) | mean | | | | p value |
| Edinburgh Postnatal Depression Scale | | | | | | | |
| EPDS score during the 72h postpartum | 13.8 | 7.1 | 12.9 | 5.0 | .679 | | .778[a] |
| EPDS score 15 days after firth skin to skin | 7.0 | 4.4 | 9.0 | 2.7 | .115 | | .030[b] * |
| EPDS score at 40 weeks corrected age | 3.4 | 3.7 | 4.1 | 1.1 | .095 | | .036[c] * |
| EPDS score at 3 months corrected age | 1.8 | 2.4 | 5.2 | 3.8 | .012 | * | .028[c] * |
| Parental Stressor Scale 15 days after first skin to skin | | | | | | | |
| Total score | 69.9 | 29.1 | 74.5 | 22.6 | .632 | | .312[b] |
| Infant behavior and appearance score | 18.1 | 6.0 | 20.9 | 6.3 | .222 | | .110[b] |
| Parental role alteration score | 27.2 | 15.1 | 26.0 | 11.1 | .802 | | .695[b] |
| Sights and sounds score | 24.6 | 11.8 | 27.6 | 10.7 | .475 | | .326[b] |
| Perinatal Post-traumatic stress disorder Questionnaire | | | | | | | |
| Total score at 40 weeks corrected age | 3.5 | 2.9 | 4.8 | 2.4 | .185 | | .519[c] |
| Total score at 3 months corrected age | 2.5 | 3.2 | 4.3 | 2.4 | .144 | | .134[c] |

*$p < .05$.
[a] Adjusted on maternal age, parity, gestational age and birthweight.
[b] Adjusted on maternal age, parity, gestational age and birthweight and length of stay in NICU.
[c] Adjusted on maternal age, parity, length of stay in NICU and length of stay in Division of Neonatal Pediatrics.

**Table 4**
Data on SCC practice according to positioning.

| | SDF positioning | | Usual positioning | | p value | | adjusted | |
|---|---|---|---|---|---|---|---|---|
| | N = 17 | | N = 17 | | | | | |
| | mean | (sd) | mean | (sd) | | | p value[a] | |
| Number of skin-to-skin sessions per week | 3.8 | 1.6 | 4.3 | 1.8 | .377 | | .358 | |
| Mean duration of a session (in minutes) | 103 | 27.2 | 77 | 17.5 | .003 | *** | .004 | *** |
| Min duration of a session (in minutes) | 54 | 20.8 | 41 | 17.6 | .061 | | .054 | |
| Max duration of a session (in minutes) | 160 | 42.0 | 122 | 37.1 | .008 | ** | .016 | * |

*$p < .05$; **$p < .01$; ***$p < .005$.
[a] Adjusted on maternal age, parity, gestational age, birthweight and length of stay in NICU.

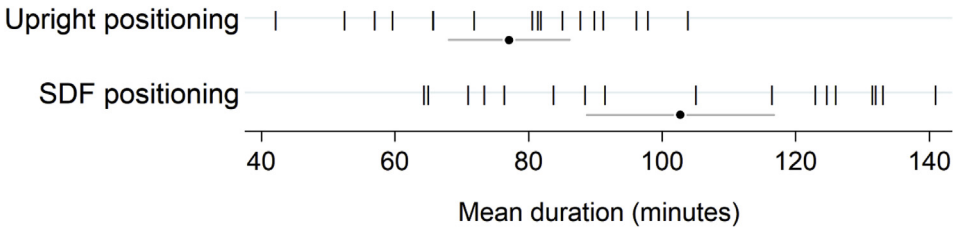


**Fig. 2.** SSC mean duration per woman according to positioning. Each vertical dash represents a woman. Below mean duration per group and 95%CI.

## 4. Conclusion

The Kangaroo supported diagonal flexion positioning has a positive impact on maternal stress, postpartum depression risk and skin-to-skin practice with very preterm infants. Much more than a cuddly moment, SCC is an opportunity to empower mothers: to help them feel competent by interacting with their baby and by experimenting positive responsiveness. The kangaroo SDF positioning makes this primary encounter more successful by offering more eyes-to-eyes contact and better postural and tonic adjustment. Although a larger study cohort would have improved the robustness of our evidence, our results provide the first valuable evidence of the benefits associated with kangaroo SDF positioning and plead for the necessity to reconsider the kangaroo positioning technique guidelines specifically in high technology NICUs.

## Limitations

In our study, previous history of depression was unknown. Some information was available in the medical file but it was fragmentary and thus not reliable. Moreover, we excluded mothers with previous psychiatrics treatments. We focused our analysis on KC practice during a 15-day period to reduce the risk of missing data. Indeed, day-to-day KC follow-up during a longer period, and all the more until 40 weeks of corrected age, would have been difficult in terms of feasibility, as some mothers were back at home, and others had stopped SSC. The 15-day period provided a relevant reflection of the frequency and duration of maternal spontaneous natural KC practices.

## Conflicts of interest

The authors declare that they have no competing interest.

## Ethics

This research was approved by the French Local Ethics Consulting Committee for the Protection of Persons (IRB n 2015120001072).

## Role of the funding source

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