

Physiological benefits to parents from undertaking skin-to-skin contact with their neonate, in a  
Neonatal Intensive Special Care Unit.

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No other additional acknowledgements and no conflict of interest.

The co-author has read and approved this article, and contributed to the substance of work.

This research study had no grant support.

Ethical approval was sought for this study and approved by The Royal Women's Hospital Human  
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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/scs.12543](https://doi.org/10.1111/scs.12543)

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Article type : Original Article

### Abstract

There has been increased focus on the use of family-centred care interventions, such as skin-to-skin contact (SSC) in Neonatal Intensive Special Care (NISC) Units over the past two decades. SSC between a parent and their neonate has previously shown to promote positive mental and emotional health in parents and assist in bonding and attachment between parent and neonate.

The purpose of this study was to investigate the effect that SSC between parent and their neonate has on the parent's heart rate (HR) and blood pressure (BP). There has been a lack of prior research investigating the physiological responses from SSC on parents, hence the need to conduct the current study.

The study was conducted as an observational cohort study at The Royal Women's Hospital NISC Unit in Melbourne, Australia. One SSC between parent and neonate was recorded, and three repeated measures analysis of variance (ANOVA) were conducted to investigate the relationship between SSC and the parent's HR, systolic BP and diastolic BP.

The study found statistically significant differences between the parent's initial HR and BP, to measurements taken during the SSC ( $p < 0.05$ ). This may suggest that parents' find SSC with their neonate to be a stress-reducing intervention whilst they are in a NISC Unit. This may in turn promote associated benefits, such as a decrease in parental depression and anxiety whilst they are in the NISC Unit, physical health benefits, as well as increased feelings of bonding between parent and their neonate.

Based on the findings, it is suggested that SSC should be promoted in NISC Units as a family-centred care intervention that lowers parent's HR and BP and may provide associated health benefits.

**Key Words:** skin-to-skin contact, kangaroo care, cuddle, parent physiological benefits, family-centred care interventions, neonatal intensive special care units, neonate, premature, oxygen respiratory support, developmental care.

**Word Count:** 3600

## Background

Skin-to-skin contact (SSC) is where a neonate has direct SSC with their parent's chest, whilst wearing only a nappy, with their legs in a frog-like position and their head turned to face the side.<sup>1</sup> The use of SSC was first introduced by medical professionals to NISC Units by Rey and Martinez in Bogota Columbia in 1978, as a way to cope with a shortage of incubators at the hospital.<sup>2-4</sup> Hospital staff had previously had to place neonates in the same incubator, which led to increased rates of infection and a higher mortality rate of premature neonates.<sup>4</sup> To avoid this, premature neonates were looked after by their mothers using 24 hours a day SSC, primarily to keep warm against their mother's skin and to assist with breastfeeding.<sup>5,6</sup>

After SSC was first documented to take place in Colombia, it was then spread to the Nordic countries in the 1980's by Wahlberg and Persson.<sup>7</sup> Sweden Neonatal Intensive Special Care (NISC) Units are currently the leaders in promoting SSC for a longer duration, and also in medical and nursing research on this topic. The health care system in Sweden provides parents of neonates who have been admitted to a NISC Unit with parental leave, which allows them the option of staying for extended periods in the NISC Unit and thus an increased opportunity for them to spend longer undertaking SSC.<sup>3</sup>

In NISC Units, SSC is offered in different ways, varying from intermittent SSC, where contact takes place for one to three hours, to continuous SSC, where it takes place for longer blocks of time, up to 24 hours a day.<sup>5,6,8-10</sup> It is recommended that SSC takes place for at least one hour when undertaken by a premature neonate, as this allows them to undertake one cycle of sleep.<sup>11,12</sup>

Kangaroo mother care is often used interchangeably with the term SSC, however there is a difference between these two terms. Kangaroo mother care is made up of three components, one of these is SSC, whilst the other two are parental support and follow up and exclusive breastfeeding.<sup>3,5</sup> For this study, SSC was the intervention under investigation, as this study focused on premature neonates and involved both mothers and fathers.

## Literature Review

Prior research on parental benefits from undertaking SSC with their neonate in a NISC Unit has primarily focused on the emotional and mental health benefits that parents, most often mothers, receive. In a systematic review, of eight articles on this topic, it was found that mothers who undertook SSC with their neonate had improved maternal outcomes, an increased sense of attachment and lower stress and anxiety levels, compared with mothers whose neonates were nursed in an incubator.<sup>2</sup> In another systematic review focusing on 16 studies, it was found that mothers who undertook SSC on a regular basis had increased levels of bonding with their neonate, as well as higher levels of maternal satisfaction and higher breastfeeding rates.<sup>12</sup> However, none of these 16 studies focused on the physiological benefits to parents and there was limited research focusing on fathers.

One study, conducted by Nimbalkar and colleagues (2014), measured physiological benefits to 52 mothers from undertaking SSC with their neonate.<sup>13</sup> Neonates who weighed more than one kilogram and were admitted to the NISC Unit were eligible to participate.<sup>13</sup> This study examined the effect that 60 minutes of SSC between mother and their neonate had on the mother's heart rate (HR), respiratory rate (RR), oxygen saturation and blood pressure (BP).<sup>13</sup> The mother's physiological measurements were recorded at the commencement of SSC, every 15 minutes during the SSC, and at the completion of the SSC.<sup>13</sup> This study showed the mothers' BP and RR reduced significantly during the SSC, but that there was no significant difference in the mothers' HR or oxygen saturation measurements during the SSC ( $p < 0.05$ ).<sup>13</sup>

Prior research that has studied parent-neonate SSC effects on the parent, have primarily focused on the effects on the parents' emotional well-being and bonding, and only one study to our knowledge, Nimbalkar et al. (2014), has examined the physical effects. The current study investigated the effect of parent-neonate SSC on both mothers' and fathers' HR and BP.

## Method

This observational cohort study was conducted at The Royal Women's Hospital (RWH) NISC Unit in Melbourne, Australia, over a period of five and a half months.

Parents of neonates admitted to the RWH NISC Unit were eligible to participate if their neonate was aged between 28-35 weeks gestation/corrected age during the SSC and receiving oxygen therapy on respiratory support. Neonates were excluded from the study if they were deemed to not be medically stable to undertake SSC, were receiving nitric oxide, sensormedics or high frequency ventilation, experienced a deterioration within the last 24 hours (as defined by the clinical team), required multiple phototherapy lights or were suffering from alcohol and drug withdrawal. As there was no available funding for interpreter services, parents who did not speak English as a first language were also excluded from the study.

At the time of informed consent being collected, information was collected on the parent's gender, age, gravida and parity of the mother, current medications and current medical conditions, especially those that could affect the parent's BP. The parent was also asked whether they had undertaken SSC with their neonate before, as it was assumed that the number of SSCs the parent had undertaken could have affected the variables under investigation. The SSC could be undertaken by the parent for the time that they wished, and that the neonate was stable. If the neonate was deemed to become unstable (as defined by the clinical team) then the neonate was returned to their incubator.

The SSC took place by the neonate's incubator, using a recliner chair, so light and noise stimulus were at a minimum. The neonate was wearing only a nappy and a beanie, and was positioned SSC on their parent's chest, with their head turned to face the side. The chair was then reclined. The neonates and parents were all positioned this way, to try and stop interactional or environmental factors affecting the findings. However, mothers and fathers were allowed to undertake SSC just like they did at other times during their stay in the NISC Unit, for example, they were allowed to talk to each other, to talk to their neonate, and have a sleep. It is important to note that as researchers, we could not fully control the NISC Unit environment, and thus other factors may have affected the parent's physiological measurements recorded during the SSC.

The primary outcome measure for parents was the effect that the SSC with their neonate had on their HR and BP. The parent had their HR and BP taken at the start of the SSC prior to the neonate being placed on their chest, at 15 minute intervals during the SSC and at conclusion of the SSC once the neonate was placed back in their incubator. The HR and BP of the parent was measured using a Criticare VitalCare 506N3-DN3 machine (Criticare Systems Inc, USA). The first two 15 minute intervals during the SSC (15 minutes and 30 minutes) was chosen for analysing the findings, as this was the same times as Nimbalkar et al.'s (2014) study, thus allowing a comparison of results.

Parents undertook SSC for variable periods of time and conclusion of SSC was determined by the wishes of the parent. No SSC in the study was terminated due to the neonate becoming unstable.

The target number of participants was 26 parent-neonate pairs. This was to find a correlation as high as 0.5, with an 80% power, between the percentage of time the adult's neonate was in a target range set by the researchers for their oxygen saturation and the length of the SSC.

The study data was analysed using Microsoft Office Excel 2013 and SPSS version 22. To investigate the relationship between SSC and the effect it had on the parent's HR, systolic BP and diastolic BP, three ANOVAs were conducted, using the four time points as the four measures of variance (the start of the SSC, at 15 minutes, at 30 minutes and once the neonate had been placed back in their incubator). A p value of less than 0.05 was considered statistically significant.

The scientific and ethical aspects of the study were approved by the Human Research Ethics Committee at the RWH and the University of Melbourne Human Research Ethics Committee. The study was conducted in accord with the 'National Statement on Ethical Conduct in Health Research (2007)'.

## Results

The sample consisted of 26 parents, 4 fathers and 22 mothers, 5 of which suffered hypotension, and 4 of which suffered hypertension, with 2 of the 4 parents suffering hypertension being fathers. One of the four participants suffering from hypertension was taking anti-hypertensives. The parents ranged from the neonate in the study being their first child, to the neonate being their fourth child and the mean age of the parents was 34 years old.

All parents in the study had undertaken SSC with their neonate prior to the study SSC, with 19 out of the 26 participants (73%) having undertaken SSC at least five times prior. The other seven parents had undertaken SSC two to five times prior to the study SSC. There was no difference in the data collected between the 19 parents who had undertaken SSC multiple times before, and those who had undertaken SSC only once or twice before. The minimum duration of SSC was 55 minutes, the maximum length of SSC was 160 minutes, and the average duration of SSC was 93 minutes.

The effect that SSC between parent and neonate has on the parents' HR and BP was initially explored by calculating the difference in the parent's HR and systolic and diastolic BP from the commencement of the study, to the measurement recorded at the end of the SSC, but prior to the neonate being placed back in their incubator. These measurements all have a mean difference between these two time points that are negative in nature, thus suggesting that during the SSC the parent's HR and BP reduced. These figures are shown in Table 1.

Looking specifically at the 4 sets of father measurements recorded for this time period, their HR decreased by an average of 5.8 BPM during the SSC, which was slightly less than the mother's average decrease of 6.3 BPM. The fathers' systolic BP decreased by an average of 1 mmHG, compared to the mothers' systolic BP decreasing by an average of 2.5 mmHG. However, the fathers' diastolic BP decreased slightly more than the mothers, which was by 4 mmHG compared to the mothers' average reduction of 3.2 mmHG.

The impact that SSC between a neonate and their parent has on the parent's HR and BP was then further explored by comparing the first few measurements of the SSC to the measurements taken when the neonate had been placed back in their incubator. The parent's HR reduces from a mean of

77.69 beats per minute (BPM) (SD = 10.11) at the initial measurement, to 73.12 BPM (SD = 10.21) at 30 minutes duration of SSC, and continues to reduce further after the neonate has been placed back in the incubator. Looking specifically at the data recorded from fathers, the average difference in HR between the initial measurement and the measurement when the neonate was placed back in their incubator was -1.75 BPM, whereas the mothers' HR difference was a reduction of 7.3 BPM. This suggests an ongoing effect from undertaking SSC to the mothers' HR but less so for fathers.

The parent's systolic and diastolic BP reduced during the first 30 minutes of the SSC, as shown in Table 2. The mean measurement once the neonate has been placed back in their incubator compared to the initial measurement is lower for systolic BP, however is higher for diastolic BP. When looking specifically at the data recorded from the fathers, the difference between the initial systolic BP and the measurement taken once the neonate was placed back in their incubator was lower for fathers, with a mean reduction of 7.3 mmHG, compared to a mean reduction of 1.7 mmHG for mothers. This suggests that for fathers, some ongoing systolic BP effect from undertaking SSC continues after the SSC has finished. The difference for diastolic BP between these two time points was also a greater reduction for fathers, as it reduced by 1.5 mmHG (from a mean of 83.5 mmHG to a mean of 82 mmHG), as opposed to increasing by 0.14 mmHG for mothers. However, as this reduction is less than the reduction in measurements recorded for during the SSC, there appears to be no ongoing effect in diastolic BP for fathers.

A repeated measures ANOVA with a Greenhouse-Geisser correction determined that HR differed statistically significantly between time points ( $F(2.250, 56.243) = 6.367, p < 0.05$ ). Post hoc tests using the Bonferroni correction revealed that the HR reduced significantly from the start of the SSC to the 30 minute duration point ( $77.69 \pm 1.98$  Vs  $73.12 \pm 2.00$ ;  $p=0.045$ ). The parental HR overall reduced significantly from the start of the SSC to when the neonate was placed back in their incubator ( $77.69 \pm 1.98$  Vs  $71.42 \pm 1.52$ ;  $p=0.007$ ).

When examining the systolic BP in the parent, Mauchly's test indicated that the assumption of sphericity had been met, ( $\chi^2(5)=1.183, p=0.947$ ). A repeated measures ANOVA determined that mean systolic BP differed statistically significantly between time points ( $F(3, 75) = 5.043, p < 0.05$ ). Post hoc tests using the Bonferroni correction revealed that the difference in systolic BP from the commencement of SSC to the 30 minute duration point was significant ( $120.15 \pm 14.41$  Vs  $114.62 \pm 13.35$ ;  $p=0.003$ ). The difference between the systolic BP at the start of the SSC to when the neonate was placed back in their incubator was not statistically significant ( $120.15 \pm 14.41$  Vs  $117.54 \pm 12.31$ ;  $p=0.69$ ).

Looking at diastolic BP in the parent, Mauchly's test indicated that the assumption of sphericity had been met, ( $\chi^2(5)=3.652, p=0.601$ ). A repeated measures ANOVA determined that mean diastolic BP differed statistically significantly between time points ( $F(3, 75) = 5.884, p < 0.05$ ).

Post hoc tests using the Bonferroni correction revealed that diastolic BP reduced significantly between the start of the SSC to the 30 minute point, ( $74.96 \pm 10.386$  Vs  $70.19 \pm 8.695$ ;  $p=0.006$ ). However, the difference between the diastolic BP at the start of the SSC to when the neonate had been placed back in their incubator was not statistically significant ( $74.96 \pm 10.386$  Vs  $74.81 \pm 10.91$ ;  $p=1.0$ ).

## Discussion

The beneficial effects for parents from undertaking SSC with their neonate have been previously researched in the area of psychosocial and mental health and have shown numerous benefits, such as improved maternal mood, increased bonding with their neonate and higher breastfeeding rates.<sup>2, 12</sup> However, there has been a lack of research into the physiological benefits to parents from undertaking SSC with their neonates, particularly in relation to fathers.

Our findings suggest that SSC does appear to have an effect on the parent's HR and BP, and thus has physiological effects for the parents. When comparing the mean HR and BP measurements taken at the commencement of the study with the measurements taken at the end of the SSC but prior to the neonate being placed back in their incubator all of the measurements have decreased. This suggests that during the SSC, the neonate had both a HR and BP lowering effect on their parent. Comparing the findings for mothers and fathers, there was a decrease in HR and BP for both during the SSC, however there was a larger decrease in the mothers' HR and systolic BP measurements, and then a larger decrease in the fathers' diastolic BP.

The parent's HR measurements continue to decrease even after the neonate has been placed back in their incubator, especially for mothers (although it did decrease for fathers too), suggesting an additional ongoing physiological effect from the SSC for the parent. It is also important to highlight that 73% of the parents stated that they were not anxious when undertaking the SSC with their neonate, as had used SSC multiple times before, and thus, anxiety and a higher HR or BP for these parents at the commencement of the SSC would have been less likely to have been a confounding variable and impacted the findings.

In the current study, the BP measurements reduced during the SSC, from the commencement of the study, to the 30 minute duration point. Once the SSC had been completed and the neonate went back in their incubator, the parent's BP had increased from what it was at the 30 minute duration point. One exception was the fathers' systolic BP, which did decrease once the SSC had concluded, thus suggesting that SSC may have a continuing effect on the fathers' systolic BP. However, as this was not the case for the diastolic BP, and due to the small sample size of fathers in the study, it is not possible to draw any conclusions and further research would need to be conducted on this.

Thus, the current study shows the SSC to have a lowering effect on the parents' BP during the first 30 minutes, apart from when the neonate is placed back in the incubator and the SSC had ended (apart from four fathers' systolic BP), where the BP increases. This is consistent to previous study findings, as the BP measurements taken during the SSC were less than the measurement taken once the SSC had finished.<sup>13</sup>

Contrary to findings reported by Nimbalkar et al. (2014), we found a statistically significant difference between the parents HR taken at the commencement of the SSC and the HR taken when the neonate was back in their incubator.<sup>13</sup> This may have been due to many factors, such as different positioning in Nimbalkar et al.'s study compared to ours (supine as opposed to slightly reclined) or differing instruments between the two studies measuring the parent's HR and BP.<sup>13</sup> However, this statistically significant finding once again suggests what appears to be an ongoing effect on parent's HR from undertaking SSC. There was also a statistically significant difference between the HR taken at commencement of SSC and at the 30 minute duration point, showing that SSC significantly affected the parent's HR during the first 30 minutes of the SSC.

### **Implications of the Findings**

Education should be provided to all NISC nurses and NISC educators, on the positive effects of SSC and the importance of promoting SSC between parent and neonate in a NISC Unit setting.

Education also needs to be provided on the physiological benefits that parents received from undertaking SSC, to parents of neonates in NISC Units. Prior research has found that parents do not always realise they are able to undertake SSC when their neonate is first born, or are hesitant to undertake SSC initially, and thus often do not ask for this contact.<sup>14</sup> Therefore NISC nurses, who have been educated on the positive physiological parental benefits that appear to result from SSC, need to then educate parents on the importance of SSC and the proven benefits, as well as promote the use of SSC, from as early on in the neonate's admission as possible.<sup>14</sup>

The study's findings, that SSC between parent and neonate causes a decrease in BP and HR whilst the SSC is being undertaken, allows the parent to lower their stress levels whilst in a NISC Unit, and thus lower their chance of post-traumatic stress disorder, anxiety and post-natal depression that have previously been found to be higher in parents whose neonate are admitted to a NISC Unit.<sup>15-</sup>

<sup>17</sup> Reducing parental HR and BP may also reduce their associated risk of heart conditions, kidney and renal conditions, and damage to their eyes, which are all associated with hypertension.<sup>18,19</sup>

### **Strengths of the Study Design**

A strength of the study is the finding that SSC between parent and neonate in a NISC Unit setting significantly reduces the parent's HR and BP. This lowering of HR and BP may have other implications for the parent's general health, as well as their emotional and mental health, all of which

are at increased risk of being affected due to the stress of having their neonate admitted to a NISC Unit. Another strength of the study is that fathers were encouraged to take part in the SSC, as there has been a previous lack of research into the effect that SSC has on fathers in a NISC Unit setting.

### **Limitations of the Study Design**

The study would have benefited from a larger sample size, as it would have provided more parental data for analysis. It would also have benefited from recruiting more fathers.

### **Recommendations for Future Research**

We recommend repeating the study with a larger sample size and recruiting more fathers, so a thorough understanding of the physiological effect from SSC to fathers, can be examined.

### **Study Conclusion**

Over a period of five and a half months, an observational cohort research study was conducted at the RWH NISC Unit in Melbourne. In this study, 26 parents and their neonates, who were aged between 28-35 weeks gestational or corrected age and requiring oxygen on respiratory support, were observed during one SSC, and the parent's physiological measurements were taken.

These were explored to determine what impact SSC has on the physiological measures of HR and BP in parents. For the parents, statistically significant differences were found in their measured HR and BP during the SSC, showing that there is an impact to the parents physiologically from undertaking SSC with their neonate. Specifically, the HR and BP were shown to decrease during the SSC. This finding is significant, as it adds to prior research that has found SSC between a parent and neonate to provide parents with emotional and mental health benefits, and shows that SSC also provides parents with physiological benefits. The physiological benefits of lowered HR and BP may also be associated with other benefits, such as a decreased risk of heart disease and kidney disease.

Our study, consistent with prior research in this area, has shown that SSC is a beneficial intervention to be utilised in a NISC Unit setting as it provides parents with physiological benefits, as well as the previously documented emotional and mental health benefits, and should be supported and used in NISC Units as often as possible.

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**Figure Legend**

Table 1. Difference in Parent's HR and BP from the first to the last recording during SSC.

Table 2. Parent's HR and BP during SSC with their Neonate.

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**Table 1. Difference in Parent's HR and BP from the first to the last recording during SSC.**

	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Standard Deviation</b>
Difference in HR (BPM)	-28	10	-6.19	8.23
Difference in Systolic BP (mmHG)	-17	14	-2.54	7.78
Difference in Diastolic BP (mmHG)	-16	12	-2.42	6.80
% difference in HR	-29	13	-7.51	9.31
% difference in Systolic BP	-11	13	-2.01	6.54
% difference in Diastolic BP	-21	20	-4.02	8.77

**Table 21. Parent's HR and BP during SSC with their Neonate.**

<b>Physiological Measurement</b>	<b>Time (Minutes)</b>	<b>Mean</b>	<b>Standard Deviation</b>
HR	0	77.69	10.11
HR	15	75.54	11.88
HR	30	73.12	10.21
HR	Post SSC	71.23	7.85
Systolic BP	0	120.15	14.44
Systolic BP	15	116.08	12.70
Systolic BP	30	114.62	13.35
Systolic BP	Post SSC	117.15	12.48
Diastolic BP	0	74.96	10.39
Diastolic BP	15	72.31	8.44
Diastolic BP	30	70.38	8.53
Diastolic BP	Post SSC	75.12	10.80