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Evaluation of the neonatal outcomes of the kangaroo mother method in Brazil

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Abstract

Objective: To evaluate the results of the kangaroo mother method in Brazil.

Methods: A prospective cohort study comparing 16 units that have or do not have the second phase of the kangaroo mother method: eight were national centers of excellence for the kangaroo mother method (study group) and eight were part of the Brazilian Neonatal Research Network (control group). A total of 985 newborn infants with birth weights of 500 to 1,749 g were enrolled. Multivariate analyses employed multiple linear regression and Poisson regression with robust adjustment.

Results: The adjusted analysis (controlled for birth weight, gestational age, Score for Neonatal Acute Physiology Perinatal Extension II, Neonatal Therapeutic Intervention Scoring System, and maternal age and educational level) demonstrated that mean length of hospital stay (p = 0.14) and intercurrent clinical conditions in the intermediate or kangaroo unit were equal for both groups. Weight (p = 0.012), length (p = 0.039) and head circumference (p = 0.006) at 36 weeks' corrected gestational age were all lower at the kangaroo units. The kangaroo units exhibited superior performance in relation to exclusive breastfeeding at discharge (69.2 vs. 23.8%, p = 0.022).

Conclusions: The evidence suggests that the humanization strategy adopted by the Brazilian Ministry of Health is a safe alternative to conventional treatment and a good strategy for promoting breastfeeding.

J Pediatr (Rio J). 2008;84(5):428-435: Kangaroo mother care, low birth weight, humanization.

Introduction

Integral care of babies and their families has become a best practice to be observed while infants are in neonatal intensive care units (NICU).[1-4] Since 1999, the Brazilian Ministry of Health has been implementing a policy of humanized care for very low birth weight newborn infants (the kangaroo

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mother method),[5] which is a proposal for humanizing neonatal care based on four basic principles: welcoming the baby and their family, respecting individual differences, promotion of skin-to-skin contact (the kangaroo position) and involving the mother in caring for her child.[6]

The kangaroo mother method was originally developed by Rey & Martinez[7] in the city of Bogota in 1979. Once clinically stable, the preterm newborn infant was placed between its mother's breasts in skin-to-skin contact. Its use was justified by the lack of incubators and the high mortality rate in Colombian maternity units.[7]

From 1984 onwards, the method was widely publicized by the United Nations Children's Fund (UNICEF). Many different authors claimed that babies cared for using the kangaroo mother method had shorter hospital stays, adequate oxygenation, higher and stabilized body temperature, fewer episodes of apnea and cried rarely.[8,9] Furthermore, their mothers breastfed more and felt secure monitoring the health of their own babies.

Experience with the method demonstrated reduction in the risk of nosocomial infection at 41 weeks' corrected gestational age (GA) and reductions in serious diseases, particularly of the respiratory system 6 months after discharge. Reductions were also detected in the risk of dissatisfaction on the part of the mother and of exclusive breastfeeding failure at discharge, while in-hospital weight gain improved.[10-19]

However, the definitions of the kangaroo method or kangaroo care that these authors have used are not uniform and vary depending on the institution described. The majority refer merely to the use of skin-to-skin contact at some point during the baby's hospital stay. In Brazil, the kangaroo mother method is an effort to humanize care that consists of three stages: admission to the NICU, care in the kangaroo unit and outpatients follow-up after hospital discharge until the baby's weight reaches 2,500 g. Skin-to-skin contact and breastfeeding are encouraged during all phases. Furthermore, during the second stage, the mother progressively and continuously assumes responsibility for caring for her child during the daytime, up until hospital discharge.[5]

There was, therefore, a need for research specifically evaluating the Brazilian experience with the kangaroo mother method, since there is insufficient scientific evidence available in the literature on the impact of this type of management on neonatal outcomes.[20]

This study aims to evaluate the neonatal results of the policy of humanized care of low-weight newborn infants (the kangaroo mother method), whereby skin-to-skin contact is part of care. More specifically, the study describes the perinatal characteristics of a sample of newborn infants whose neonatal care was either in a conventional intermediate care unit or in a kangaroo unit (the second phase of the method) and compare them in terms of length of time spent in the intermediate unit, readmission to the NICU, growth and indicators of clinical outcomes.

Methods

This was a prospective study of a cohort of newborn infants admitted to public sector neonatal units in Brazil and followed up from birth until hospital discharge. The term neonatal unit refers to the departments including the NICU and intermediate unit or kangaroo unit. Although this study was carried out during the phase of care that takes place in the intermediate or kangaroo unit, all of these services also provided intensive care. Experimental units were defined as those which had a kangaroo unit, i.e. had beds reserved for mother-and-baby rooming-in, that implemented all three stages of the kangaroo mother method and that were Ministry of Health centers of excellence. Control units used conventional intermediate care units, had good neonatal results and carried out humanization actions, but were not implementing the second stage of the kangaroo mother method mother-and-baby rooming-in – and were all part of the Brazilian neonatology network.

A total of 16 neonatal units took part in the study. Eight were Ministry of Health kangaroo mother method centers of excellence, and eight were members of Brazilian Neonatal Research Network (Rede Brasileira de Pesquisas Neonatais). Together they admit around 3,000 newborn infants per year weighing less than 1,750 g. All of them had their level of complexity classified according to the Vermont Oxford Network protocol at the Vermont Oxford Annual Meeting of 2002. The control units (conventional care) were: Instituto Fernandes Figueira/Fundação Oswaldo Cruz (Fiocruz) in Rio de Janeiro, RJ; Hospital de Clínicas de Porto Alegre/Universidade Federal do Rio Grande do Sul (HCPA/UFRGS) and Hospital São Lucas, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), both in Porto Alegre, RS; Hospital São Paulo/Universidade Federal de São Paulo (UNIFESP) and Instituto da Criança/Universidade de São Paulo (USP), both in São Paulo, SP; Faculdade de Medicina de Botucatu, Universidade Estadual de São Paulo (UNESP) in Botucatu, SP; the Centro de Atenção Integral à Saúde da Mulher (Unicamp) in Campinas, SP and the Hospital de Clínicas da Faculdade de Medicina de Ribeirão Preto (FMRP-USP) in Ribeirão Preto, SP. The study units (kangaroo care) were: Hospital Universitário Unidade Materno-Infantil (UFMA), Instituto Materno-Infantil de Pernambuco (IMIP), Hospital Geral de Itapecerica da Serra (SP) and five municipal maternity units in Rio de Janeiro: Alexander Fleming, Oswaldo Nazareth, Carmela Dutra, Herculano Pinheiro and the Instituto da Mulher Fernando de Magalhães.

Study population

Newborn infants with birth weights from 500 to 1,749 g were selected for this study since from 1,750 g onwards some services transfer babies directly to rooming-in wards soon

after birth. Newborn infants were excluded if they had major malformations, congenital TORCH infection (toxoplasmosis, rubella, cytomegalovirus, herpes simplex or syphilis), chromosomopathies, metabolic abnormalities, severe perinatal encephalopathy or necrotizing enterocolitis requiring surgery.

The criteria for transfer from the NICU to a kangaroo unit were clinical stability, weight greater than 1,250 g, full enteral nutrition (via orogastric tube or suction) and breathing room air with no record of apnea needing resuscitation with oxygen and positive pressure during the previous 5 days. In the control group, admission and discharge criteria varied depending on the institution.

Data collection

Data were collected from March 2004 to March 2005. Data collection was supervised and quality control was carried out by fieldwork coordinators who were responsible for training the local teams based on an instruction manual.

The variables representing the outcomes of admission to an intermediate unit or a kangaroo unit were: length of stay; mean weight gain in g/kg/day; weight, length and head circumference (HC) at 36 weeks' corrected GA if the baby was still in hospital at this point in time; in addition to episodes of hypothermia or hyperthermia, apnea, infection, readmission to the NICU and exclusive breastfeeding at the time of discharge.

The following were considered to be confounding variables: maternal age and educational level, number of live children, marital status, birth weight, GA at birth, SNAPPE II (Score for Neonatal Acute Physiology Perinatal Extension II)[21] and NTISS *(*Neonatal Therapeutic Intervention Scoring System - NTISS),[22] length of stay in the NICU and weight and corrected GA at transfer to the intermediate unit or kangaroo unit.

Sample size calculation

Based on a length of hospital stay of 26 days for babies with birth weights between 500 and 1,749 g and a standard deviation of 24 days, a total sample size of 756 infants would allow a difference of 4 days to be detected between mean lengths of hospital stay (relevant difference), assuming 90% power and accepting a 5% probability of type I error.

Based on a mean weight gain in g/kg/day of 14 g for babies with birth weights of less than 1,500 g, and a standard deviation of 7 g, a total sample size of 257 would allow differences of 2 g/kg/day to be detected between mean weight gains (relevant difference), assuming 90% power and a 5% probability of type I error.

For the categorical variables, 804 babies in each group would allow a relative risk of 1.7 to be detected for variables whose prevalence in the unexposed group was around 10%, with 80% power and a 5% probability of type I error. A total sample size of 948 would allow a relative risk of 2 to be detected for variables whose prevalence was 5% with 80% power and a 5% probability of alpha error. The final sample comprised 985 newborn infants, taking both groups together.

Statistical analysis

Quantitative variables are described using means and standard deviations. Comparisons of means between units were made using Student's *t* test. Categorical variables were presented in percentages. Differences in proportions between units were evaluated using the chi-square test. Multivariate analysis of quantitative variables was carried out with linear regression and binary variables were subjected to Poisson regression with robust adjustment, due to the fact that many response variables are not uncommon events. The use of logistic regression could have led to overestimation of effects.[23] All analyses were adjusted for cluster effects, since observations of individuals born at the same institution are not independent. In the case of quantitative response variables, since many of them were asymmetric and/or had flattened distributions, and in some models analysis of residuals demonstrated problems with the assumptions, all models were subjected to *bootstrapping* to test whether violating assumptions would produce different results. Since the results of linear regression and bootstrapping were similar, the results presented here were obtained by linear regression with the least squares method, since the software program available (Stata version 8.0) was not capable of providing estimates via bootstrapping that take into account the cluster effect. The project was approved by the Research Ethics Committees at each of the units involved. Representatives from each of the units signed free and informed consent before the research started, and the parents of each newborn infant also signed consent before their child was enrolled in the study.

Results

The newborn infants in the kangaroo unit (study group) were heavier and had higher GA than those in the intermediate units (control group). At the intermediate units SNAPPE II and NTISS scores were higher and mothers were older and had higher educational level. There was no difference with relation to sex distribution or maternal marital status. Mothers with many children and longer NICU stays predominated in the study group, with borderline significance (p value between 0.10 and 0.05) (Table 1).

In the adjusted analysis, the newborn infants in the kangaroo units had shorter length of hospital stay (18.9 vs. 24.1 days) than those admitted to the conventional units. The difference was 5.2 days less for the kangaroo group, with borderline significance ($p = 0.067$). After adjustment, this difference reduced to -4.3 days and was no longer significant ($p = 0.140$) (Table 2).

The newborn infants at the control units had mildly superior mean weight gain than those at the study units (15.3 vs.

Table 1 - Characteristics of the newborn infants enrolled on the study, admitted to kangaroo or conventional units (Brazil, 2005)

	Conventional units		Kangaroo units		
Variables	**n**	**Mean (SD)**	**n**	**Mean (SD)**	**p**
Birth weight	366	1,313 (302)	621	1,399 (255)	< 0.001
Gestational age	362	31.7 (2.8)	618	32.4 (2.3)	< 0.001
SNAPPE II	351	12.7 (14.2)	615	11.0 (12.2)	0.045
NTISS	322	13.0 (6.8)	615	10.4 (4.2)	< 0.001
Mother's age	357	26.6 (7.3)	619	24.8 (6.9)	< 0.001
Number of children	355	1.8 (1.7)	612	2.0 (1.6)	0.076
Length of stay in NICU	354	18.6 (18.7)	609	21.1 (20.7)	0.067
Variables	**n**	**%**	**n**	**%**	**p**
Sex					0.175
Male	161	44.2	300	48.7	
Female	203	55.8	316	51.3	
Marital status					0.224
With partner	263	79.7	455	76.2	
Without partner	67	20.3	142	23.8	
Mother's education					0.002
None	10	3.2	13	2.2	
Started primary education	96	31.0	263	43.5	
Completed primary education	89	28.7	164	27.1	
Secondary education	98	31.6	146	24.1	
Higher education	17	5.5	19	3.1	

NICU = neonatal intensive care unit; NTISS = Neonatal Therapeutic Intervention Scoring System; SD = standard deviation; SNAPPE II = Score for Neonatal Acute Physiology Perinatal Extension II.
* The totals for each variable differ as a result of missing data.

13.2 g/kg/day), with a significant difference in the raw analysis and no significance in the multivariate analysis (p = 0.220, Table 2).

In both analyses the babies in the conventional units had significantly greater mean weight at 36 weeks' corrected GA (1,709 vs. 1,552 g) than did the babies in the kangaroo units (p values of 0.013 and 0.012, Table 2).

Length at 36 weeks' corrected GA did not differ significantly in the raw analysis. However, in the adjusted analysis, length at 36 weeks' corrected GA was greater among the babies in the control group, with statistical significance (p = 0.039). The HC at 36 weeks' corrected GA was larger in the control group in both analyses (p = 0.006, Table 2).

In the raw analysis, retinopathy of prematurity was more common in the conventional units (borderline significance), while exclusive breastfeeding at discharge was more frequent among babies at the kangaroo units. There were no differences in relation to the other variables. In the adjusted analysis, only the risk of not being exclusively breastfed at discharge remained higher among the children at the conventional units (Table 3).

Discussion

In the adjusted analysis (adjusted for birth weight, GA, SNAPPE II, NTISS and maternal age and educational level), length of stay, weight gain, readmission to the ICU and intercurrent clinical conditions were all equal for the two groups. Weight, length and HC at 36 weeks' corrected GA were lower in the kangaroo units. The kangaroo units clearly had superior performance in terms of exclusive breastfeeding at discharge. No significant differences were observed between the

Table 2 - Length of stay and growth data in conventional intermediate or kangaroo unit (Brazil, 2005)

	Conventional units		Kangaroo units		Raw analysis			Adjusted analysis*		
Variables	n	Mean (SD)	n	Mean (SD)	Coef	95%CI	p	Coef	95%CI	p
Length of stay in conventional intermediate or kangaroo unit	366	24.1 (12.8)	619	18.9 (11.4)	-5.2	-10.9 to 0.4	0.067	-4.3	-10.2 to 1.6	0.140
Weight gain in conventional intermediate or kangaroo unit (g/kg/day)	333	15.3 (11.1)	602	13.2 (10.2)	-2.0	-3.7 a -0.3	0.027	-1.2	-3.3 to 0.8	0.220
Weight at 36 weeks' corrected GA	302	1,709 (380)	534	1,552 (266)	-156	-275 a -38	0.013	-191	-335 a -48	0.012
Length at 36 weeks' corrected GA	199	41.8 (3.0)	404	41.1 (2.8)	-0.7	-1.6 to 0.3	0.143	-0.9	-1.8 a -0.1	0.039
HC at 36 weeks' corrected GA	200	30.7 (2.4)	465	30.2 (1.9)	-0.5	-1.0 a -0.1	0.040	-0.7	-1.2 a -0.2	0.006

95%CI = 95% confidence interval; Coef = coefficient; GA = gestational age; HC = head circumference; SD = standard deviation.
* Models adjusted for birth weight, gestational age, SNAPPE II, NTISS, maternal age and educational level and corrected for the cluster effect (hospital of birth). The totals for each variable differ as a result of missing data.

two groups in terms of morbidity or mortality after discharge from the ICU.

The greater weight, length and HC in the conventional units at 36 weeks' corrected GA probably reflect better nutritional support while in the ICUs, since there was no difference in mean weight gain while in the conventional intermediate unit or the kangaroo unit. These data suggest that, in the study group, nutritional support may be being started later, reflecting a lower technology density in these units in terms of nutritional issues and less infrastructure for parenteral nutrition. The literature does not provide evidence that the kangaroo mother method is superior in terms of weight gain: Roberts et al.[24] and Charpak et al.[18] did not detect differences, whereas Ramanathan et al.[13] and Cattaneo et al.[25] observed greater weight gain in a kangaroo group.

In this study, there was no difference in mean hospital stay between the two groups, in contrast with the lower stays in a kangaroo group observed by Charpak et al.[18] and Cattaneo et al.[25] These data are in agreement with work published by et al.[26] and Roberts et al.[24] In contrast, Ramanathan et al.[13] and Charpak et al.[18] did find that kangaroo method babies had shorter stays.

In our study, the greatest difference detected was in terms of exclusive breastfeeding at discharge (2.34 times more frequent in the kangaroo group), in contrast with what was reported by Sloan et al.,[27] who did not detect a difference between groups. Roberts et al.[24] found equal duration of breastfeeding in kangaroo and conventional groups. Ramanathan et al.[13] analyzed babies who received kangaroo mother care after 6 weeks' follow-up and found that double the number of mothers were breastfeeding exclusively than in a control group.

There was no difference in relation to certain intercurrent clinical conditions, in contrast with Sloan et al.,[26] who observed lower frequencies of apnea and infections in a kangaroo group, with Cattaneo et al.,[25] who described reduced risk of hypothermia, and with Kadam et al.,[26] who found lower incidence of hypothermia, better oxygen saturation and lower respiratory rate in a kangaroo group. Nevertheless, this last study did not find any differences in hyperthermia, sepsis or apnea.

Certain limitations made it difficult to interpret certain data. A certain proportion of the babies may have reached a corrected GA of 36 weeks while still in the ICU. Others were discharged before reaching this age. It is probable that there was contamination in this study. All of the units had health professionals who had taken part in the human resources training promoted by the Ministry of Health kangaroo project, and many of the practices that are part of the humanized care program were also routine at the control units. Almost all of the control units had skin-to-skin contact practices and many had rooming-in and day rooms for mothers. This may have reduced or nullified any possible differences between the two groups.

There was a 15% loss of data on weight at 36 weeks' corrected GA as a result of discharge from the conventional or

Table 3 - Mortality and some clinical conditions during stay in a conventional or kangaroo unit (Brazil, 2005)

	Conventional unit		Kangaroo unit		Raw analysis			Adjusted analysis*		
Variables	**n**	**%**	**n**	**%**	**RR**	**95%CI**	**p**	**RR**	**95%CI**	**p**
Readmission to NICU										
No	352	94.9	592	94.3						
Yes	19	5.1	36	5.7	1.11	0.50-2.47	0.682	1.45	0.61-3.44	0.397
Retinopathy of prematurity										
No	168	75.0	375	84.7						
Yes	56	25.0	68	15.3	0.63	0.37-1.08	0.092	0.89	0.46-1.71	0.732
Necrotizing enterocolitis										
No	348	96.9	587	96.7						
Yes	11	3.1	20	3.3	1.07	0.40-2.85	0.893	1.33	0.54-3.29	0.536
Death										
No	364	99.5	616	99.3						
Yes	2	0.5	3	0.5	0.88	0.08-9.32	0.917	1.99	0.20-19.70	0.555
Bronchopulmonary dysplasia										
No	303	85.8	552	90.9						
Yes	50	14.2	55	9.1	0.66	0.37-1.19	0.170	1.05	0.54-2.06	0.879
Intracranial hemorrhages										
No	206	78.9	267	78.1						
Yes	55	21.1	75	21.9	1.07	0.54-2.11	0.841	1.56	0.71-3.42	0.269
Apnea										
No	307	94.5	542	96.6						
Yes	18	5.5	19	3.4	0.61	0.23-1.61	0.317	0.73	0.25-2.16	0.573
Sepsis										
No	332	92.2	590	96.1						
Yes	28	7.8	24	3.9	0.50	0.17-1.46	0.205	0.54	0.18-1.60	0.264
Hypothermia or hyperthermia										
No	347	96.9	552	91.1						
Yes	11	3.1	54	8.9	2.88	0.75-11.04	0.122	2.73	0.74-10.05	0.131
Exclusive breastfeeding at discharge										
No	275	76.2	189	30.8						
Yes	86	23.8	425	69.2	2.89	1.43-5.83	0.003	2.34	1.13-4.82	0.022

95%CI = 95% confidence interval; NICU = neonatal intensive care unit; RR = relative risk.
* Models adjusted for birth weight, gestational age, SNAPPE II, NTISS, maternal age and educational level and corrected for the cluster effect (maternity of birth). The totals for each variable differ as a result of missing data.

kangaroo intermediate unit before this GA. There were also losses of more than 20% of the sample for length and HC at 36 weeks' corrected GA. These measurements were not taken by the research teams and the cooperation of other services was necessary. Despite all of the effort expended, some losses were unavoidable. The data on retinopathy of prematurity suffered a 32.3% loss and 38.8% of the data on intracranial hemorrhages was unavailable, due to operational difficulties with carrying out the specialist ultrasound and fundoscopy examinations.

The sample size offered a good statistical power for detecting differences between the means of quantitative variables, but the power to detect differences between the percentages of categorical variables was lower.

Another difficulty was to compare our data with other results in the literature. The definition of what is meant by the kangaroo mother method is extremely heterogeneous across the literature consulted. None of these studies clearly establish that admitting the mother to intermediate care together with her baby is an indispensable element of the method, as has been defined by the Brazilian Ministry of Health. Furthermore, skin-to-skin contact is practiced according to the widest range of protocols. Additionally, although some articles describe randomized clinical trials, others are observational cohort studies. These variations in the definition of what the kangaroo mother method actually is and in study designs may well explain the differences between the studies' observations.

Inequalities in use of technology may be the reason for the lower weight, length and HC among the children from the kangaroo units observed at 36 weeks' corrected GA. On the other hand, the kangaroo units had superior performance in terms of breastfeeding promotion. The higher percentage of exclusive breastfeeding at discharge was not the result of the newborn infants in the kangaroo group having higher birth weight, older GA or because they were in less serious conditions at birth, since all of these factors were adjusted for.

In conclusion, the evidence suggests that the humanization strategy adopted by the Brazilian Ministry of Health is a safe alternative to conventional treatment and a good strategy for promoting breastfeeding.

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