

# Cost and Effectiveness Analysis of Kangaroo Mother Care and Conventional Care Method in Low Birth Weight Neonates in Tabriz 2010-2011

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## ABSTRACT

**Objective:** This study aimed to compare the cost and effectiveness of Kangaroo mother care (KMC) and conventional methods of care in low birth weight (LBW) neonates. **Materials and Methods:** A retrospective economic evaluation conducted in Al-Zahra Teaching Maternity Hospital of Tabriz, Iran by participating 45 LBW and preterm neonate in each therapeutic groups (90 neonates). Convenience sampling used to select participants from KMC and conventional care method (CCM) (incubator) groups in 2010-2011. Baseline characteristics, therapeutic interventions, resources utilization data and clinical events during the initial hospitalization and at 2-month follow-up were collected according a detailed case report forms. Data are described as mean (standard deviation) and no (percentage) and were compared with Student's *t*-test,  $\chi^2$  and Fisher exact test between groups.  $P \leq 0.05$  were considered to be statistically significant. Data were analyzed using the SPSS-16 statistical package. **Result:** The mean birth weight (BW) of the patients in KMC group was 1240.89 (5.98) g and in CCM was 1133.78 (139.06) g, hence differences in BW was statistically significant ( $P < 0.001$ ). Greatest cause of problem in groups was icter and after that preterm birth and House Dust Mite (HDM) with icter were the most frequent problem between neonates. In 2 months follow-up period, 3.7% of infants cared with KMC and conventional methods died respectively ( $P = 0.078$ ). Daily weight gain was 12.28 g in KMC group and 9.65 g in conventional group ( $P = 0.011$ ). The mean cost of hospitalization per individual infant for KMC was 3539.47\$, whereas for Conventional group was 2907.27\$. **Conclusion:** KMC promoted weight gain in LBW infants better than conventional care. Although KMC's unit cost is a little higher than Conventional method, but comparing its positive outcomes on breastfeeding's and mortality it can be considered as cost effective method.

### Key words:

Conventional care method, cost, effectiveness, kangaroo mother care, low birth weight neonates

## INTRUDUCTION

Low birth weight (LBW) infants particularly for those weighing  $<2000$  g at birth are among the major issues of concern in child and maternal care services. However, maintaining the weight at an appropriate level diminishes the frequency and duration of undesirable episodes caused by low weight. Although Kangaroo mother care (KMC) is becoming a common method of care worldwide because of its close body contact with mother and its human nature of care,<sup>[1-3]</sup> but it is still not in practice in some countries.<sup>[3-5]</sup> There is not enough evidence to support its effectiveness in regards to its safety and flexibility to adopt to different care settings such as home, but it is being utilized to balance the efficient use of the resources.<sup>[6]</sup> The introduction Kangaroo care has resulted in improved preterm infant outcome including decreased infant pain sensation and stress, improved breast-feeding success as well as improved preterm infant development and growth in the neonatal Intensive Care Unit (NICU).<sup>[7-9]</sup> The KMC use has been associated with improvements in short and long-term neonatal care health outcome to date.<sup>[10-13]</sup> Recent studies

have demonstrated that KMC also enhances maternal well-being and parental satisfaction and decreases risk for postpartum depression and strengthened parents motivation to be with their infant.<sup>[10-12,14]</sup> Few studies has compared and indicate that KMC as specific method of care involves mother in care team activities as integral to infant health, is one of the early and key initiatives to the concept of developmental care practices.<sup>[11,15,16]</sup> LBW infants

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particularly for those weighing <2000 g at birth are among the major issues of concern in child and maternal care services. However, maintaining the weight at an appropriate level diminishes the frequency and duration of undesirable episodes caused by low weight. Although, KMC is becoming a common method of care worldwide because of its close body contact with mother and its human nature of care,<sup>[1-3]</sup> but it is still not in practice in some countries.<sup>[3-5]</sup> There is not enough evidence to support its effectiveness in regards to its safety and flexibility to adopt to different care settings such as home, but it is being utilized to balance the efficient use of the resources.<sup>[6]</sup> The introduction Kangaroo care has resulted in improved preterm infant outcome, including decreased infant pain sensation and stress, improved breast-feeding success as well as improved preterm infant development and growth in the NICU.<sup>[7-9]</sup> The KMC use has been associated with improvements in short and long-term neonatal care health outcome to date.<sup>[10-13]</sup> Recent studies have demonstrated that KMC also enhances maternal well-being and parental satisfaction and decreases risk for postpartum depression and strengthened parents motivation to be with their infant.<sup>[10-12,14]</sup> Few studies has compared and indicate that KMC as specific method of care involves mother in care team activities as integral to infant health, is one of the early and key initiatives to the concept of developmental care practices.<sup>[11,15,16]</sup> KMC method has been used worldwide to care for infants with LBW.<sup>[17]</sup> Its impacts on improved breast-feeding, as well as improved preterm infant development and growth in the NICU is considered as a success.<sup>[7-9]</sup> KMC potentially enhances the maternal well-being and parental satisfaction and decreases risk for postpartum depression.<sup>[10-12]</sup> In contrast to conventional care in KMC mother is the integral focus and it integrates humane factors such as skin to skin contacts of mother and infant into the care process, which are important in infant's development and growth.<sup>[9]</sup> Some of the previous works report the underscored neonatal nurse barriers in key aspects of developmental care that involved parental partnerships.<sup>[16,18]</sup> In other words, KMC method interacts with developmental factors, and processes, thereby creating a natural environment, which in turn significantly increases infant's capacity. Due to this, it accelerates infant's development and increases the weight of the infant.<sup>[11]</sup> The purpose of this study was to compare the cost and effectiveness of KMC and conventional methods of care (CCM) in LBW neonates. The purpose of this study was to compare the cost and effectiveness of KMC and conventional methods of care in LBW neonates.

## MATERIALS AND METHODS

This is a retrospective economic evaluation study conducted in Al-Zahra Central Teaching Maternity Hospital of Tabriz, Iran. Al-Zahra Hospital is the Central Obstetrics and

Gynecology Hospital in the Northwest of Iran. This hospital covers full range of available care regard to preterm neonates and contains level 3 NICU and neonatal wards. KMC method was performed as a routine care in this hospital. Mothers who accept to perform KMC were included in KMC group, and those who did not were allocated for CMC group.

The study participants include 90 (45 neonate in each group) LBW (under 1500 g) and preterm neonate who were hospitalized in hospital. The mothers provided skin to skin contact with neonates at least 1 h each course and every day at least 3 times this action was taken. The babies assigned to CMC group were managed under either servo controlled radiant warmers or in a cradle under hot lamps in NICU. Convenience sampling used to select participants from KMC and CCM (incubator) groups in 2010-2011.

Detailed case report forms that included baseline patient characteristics, procedural details, and clinical events during the initial hospitalization and at 2 months follow-up were completed by research coordinators according medical records. The costs of each procedure were determined by standard "bottom-up" cost-accounting methods. Detailed resource utilization was recorded for each procedure, and the costs of each item were estimated on the basis of the hospital acquisition cost for the item in 2010. All other hospital costs were determined by "top-down" accounting methods based on each hospital's annual accounting report.

Continuous, normally distributed data are described as mean (standard deviation [SD]) and were compared with independent Student's *t*-test. Cost data are described as mean (SD) values and were compared by independent Student's *t*-test. Nominal data were reported as frequencies and percentages and compared with  $\chi^2$  and Fisher exact test between groups. The foreign exchange rate used in the analysis was 9350 Iranian Rials = 1 USD (2010). Unit costs for mother accommodation cost were obtained from publicly available sources regard to three star hotel price with indirect contact with institutions and experts. Data were analyzed using the SPSS-17 statistical package (SPSS, Chicago, IL, USA).  $P \leq 0.05$  were considered to be statistically significant.

## RESULT

The mean birth weight (BW) of the patients in KMC group was 1240.89 (5.98) g and in CCM was 1133.78 (139.06) g, hence differences in BW was statistically significant ( $P < 0.001$ ). On the other hand, result indicate significant differences regard to delivery method between groups and KMC group have more cesarean section than CCM ( $P = 0.02$ ) [Table 1].

Findings relate to primary diagnosis in two groups indicate there are no significant differences between groups. Greatest cause of problem in groups was icter and after that preterm birth and HDM with icter were the most frequent problem between neonates [Table 2].

Study findings-related to frequency of therapeutic intervention in each group indicate more than 46.7% of participants in KMC group and 37.8% in CCM have been under phototherapy. Furthermore, for 20% of patients in KMC group were used Nasal Continuous Positive Airway Pressure (N\_CPAP) + intermittent mandatory ventilation + phototherapy treatment package and in CCM group 15.6% get under this treatment package. Only one neonate in CCM groups used surfactant. Although, result indicate no statistically significant differences between two groups regards to therapeutic intervention in hospitalization period [Table 3].

Table 4 indicates that all children survived while in the hospital. In two period of follow-up 0% and 3.7% of infants cared with KMC and conventional methods died, respectively ( $P = 0.078$ ). According to result, there was no significant difference in hospitalization rate in 2 months follow-up between groups. Breast feeding rate was 35.6% and 20% in those cared with KMC and conventional methods, respectively ( $P = 0.099$ ). Further analysis of data shows that 28.9% and 20% of infants cared with KMC and conventional method were breast feeding and breast feeding together with supplement dried milk, respectively ( $P = 0.327$ ). In KMC group, mean length of stay in NICU was 18.93 days, whereas in conventional group mean length of stay was prolonged to 23.49 days ( $P = 0.205$ ). Daily weight gain was 12.28 g in KMC group and 9.65 g in conventional group with  $P = 0.011$ . There were no significant differences in primary diagnosis of HDM, icter, sepsis, preterm, icter + transient tachypnea of the neonatal (TTN), HDM + icter, and HDM + TTN between both groups [Table 2]. The mean cost of hospitalization per individual infant for KMC was 3539.47\$ whereas for Conventional group was 2907.27\$. The hospitalization items of cost include room/ancillary, staff, and accommodation [Table 4]. Baseline clinical characteristics, risk factors, and frequency of therapeutic intervention in each group are summarized in Tables 1 and 3, respectively. These were not statistically significant except for BW ( $P < 0.001$ ), week of gestation ( $P = 0.096$ ), cesarean ( $P = 0.02$ ), preeclampsia ( $P = 0.042$ ), and preterm birth ( $P < 0.001$ ).

## DISCUSSION

Findings of our study shows that, KMC not only played a role in promoting maternal involvement in the care procedures, but also created a positive attitude to accept the

**Table 1: Baseline clinical characteristics and risk factor**

Characteristics	Mean (SD)		95% CI	P
	KMC	Conventional care method		
Birth weight (g)	1240.89 (5.98)	1133.78 (139.06)	65.29-148.91	<0.001
Week of gestation (week)	30.38 (2.43)	29.56 (2.18)	-0.15-1.79	0.096
Apgar				
Apgar 1	6.73 (1.66)	6.44 (1.79)	-0.43-1.01	0.428
Apgar 5	8.64 (1.13)	8.71 (1.4)	-0.06-0.46	0.795
Mather's age (year)	28.2 (5.59)	28.93 (5.74)	-3.10-1.64	0.543
	Number (%)			
Delivery method				
Cesarean section	37 (82.2)	27 (60)		0.02
Normal delivery	8 (17.8)	18 (40)		
Gender				
Male	27 (60)	27 (60)		0.999
Female	18 (40)	18 (40)		
Preeclampsia	10 (22.2)	19 (42.2)		0.042
Twin	8 (17.8)	11 (24.4)		0.438
Oligohydramnios	3 (6.7)	3 (6.7)		0.999
IUGR	1 (2.2)	3 (6.7)		0.306

SD – Standard deviation; CI – Confidence interval; IUGR – Intrauterine growth restriction; KMC – Kangaroo mother care

**Table 2: primary diagnosis in two groups**

Characteristics	Number (%)		P
	KMC	Conventional care method	
HDM	7 (15.6)	5 (11.1)	0.535
Icter	17 (37.8)	20 (44.4)	0.520
Sepsis	-	1 (2.2)	0.315
preterm	10 (22.2)	9 (20.2)	0.796
Icter + TTN	2 (4.4)	-	0.153
HDM + icter	8 (17.8)	10 (22.2)	0.598
HDM + TTN	1 (2.2)	-	0.315

TTN – Transient Tachypnea of the Neonatal; HDM – House dust mite ; KMC – Kangaroo mother care

**Table 3: Frequency of therapeutic intervention in each group**

Characteristics	Number (%)		P
	KMC	Conventional care method	
N_CPAP	2 (4.4)	4 (8.9)	0.398
Phototherapy	21 (46.7)	17 (37.8)	0.393
N_CPAP+IMV	1 (2.2)	1 (2.2)	0.999
N_CPAP+IMV+phototherapy	9 (20)	7 (15.6)	0.581
Blood transfusions+phototherapy	4 (8.9)	2 (4.4)	0.398
N_CPAP+phototherapy	5 (11.1)	8 (17.8)	0.368
Surfactant+IMV+phototherapy	3 (6.7)	2 (4.4)	0.694
Surfactant	-	1 (2.2)	0.315
N_CPAP+IMV+surfactant	-	2 (4.4)	0.153

KMC – Kangaroo mother care; IMV – Intermittent mandatory ventilation; N\_CPAP – Nasal Continuous positive airway pressure

**Table 4: Initial hospital events, resource consumption, and costs mean (SD)**

Characteristics	Mean (SD)		95% CI	P
	KMC	Conventional care method		
Hospitalization in NICU (day)	18.93 (16.35)	23.49 (17.48)	(-11.65-2.53)	0.205
Hospitalization in neonatal ward (day)	17.73 (9.95)	19.53 (8.56)	(-5.69-2.09)	0.360
Weight in discharge (g)	1688.22 (312.41)	1534.44 (119.06)	(53.98-253.63)	0.003
Daily weight gain (g)	12.28 (6.18)	9.65 (2.82)	(0.61-4.65)	0.011
	Number (%)			
Breastfeeding rate 2 month after discharge	16 (35.6)	9 (20)		0.099
Breastfeeding along dry milk 2 month after discharge	13 (28.9)	9 (20)		0.327
Re-hospitalization after 2 month	9 (20)	9 (20)		0.999
Mortality rate within 2 month	0	3 (6.7)		0.078
Costs*				
Room/ancillary	2911.34 (2088.61) \$	2116.90 (1281.36) \$		0.033
Staff costs	484.06 (347.27) \$	790.37 (478.41) \$		<0.001
Mother accommodation cost	144.06 (103.35) \$	-		<0.001
Total index hospitalization	3539.47 (2539.23) \$	2907.27 (1759.77) \$		0.174

\*9280 rials=1\$; KMC – Kangaroo mother care; SD – Standard deviation; CI – Confidence interval; NICU – Neonatal intensive care units

mother as a member of care team, which was an important factor in accelerating the weight gain of the infant. Although a statistically significant reduction in the mortality in KMC group was not found. Findings of some studies were similar to our findings.<sup>[7,8]</sup> Although the humane and some procedural aspects of KMC, which includes the skin-to-skin contact, exclusive breastfeeding and early discharge with an adequate follow-up<sup>[1,2]</sup> are the mechanism justifying its continued use in care for LBW infants, but there is not still enough evidence to support the effectiveness and safety of KMC safe utilization in the community/home settings and its effects on growth has not been yet demonstrated.<sup>[19]</sup> Furthermore, according to the result of current study KMC in comparison to CMC Leads to lower complication such as mortality rate, hospitalization and need to therapeutic intervention, and better outcomes such as breastfeeding and daily weight gain, but it appears not be statistically significant in the case of some indicators must be due to the limited sample size.

There are still some other findings that report “there is insufficient data regarding the effect of KMC on growth parameters, acceptability of Kangaroo care and long-term outcomes.”<sup>[1,2]</sup> Thereby the findings of this clinical study showed that KMC promoted weight gain more effectively than conventional method. Existing evidence and further analysis of our data demonstrates that KMC might be effective in shortening the duration of hospital stay, (18.93 days vs. 23.49 day), increasing the rate of success in daily weight gain (12.28 g vs. 9.65 g), and promoting rate of breast feeding (35.6% vs. 20%). Increased rate of breast feeding along with artificial milk 2 months after discharge (28.9% vs. 20%) was also observed, which were also appreciated by Whitelaw and Sleath, Suman *et al.* and Charpak and Figueroa.<sup>[1-3]</sup>

Our findings showed that none of the infants neither in KMC nor in conventional care had serious complications or side-effects and all of them discharged hospital, but three neonates were being died during the study period. In this regards, Suman *et al.* found KMC reduces morbidities in LBW infants.<sup>[3]</sup> In our study, time taken for weight gain was significantly shortened with KMC than in those cared with Conventional method (11 [4.18] days vs. 24.24 [11.16] days). The result of Ramanathan *et al.* study confirms our findings and report better weight gain in KMC group (15.9 ± 4.5 g/day vs. 10.6 ± 4.5 g/day  $P < 0.05$ ).<sup>[20]</sup>

According to study finding, also hospitalization period in KMC group were shorter than CMC group, but, there was no significant differences between KMC and CMC regards to in NICU (18.93 [16.35] days vs. 23.49 [17.48] days) and in neonatal ward (17.73 [9.95] days vs. 19.53 [8.56] days). Furthermore, Gathwala *et al.* and Ramanathan, *et al.* find the duration of hospital stay was significantly shorter in the KMC group, therefore Gathwala, *et al.* reported duration of hospital stay in the KMC group (3.56 ± 0.57 days) compared with control group (6.80 ± 1.30 days)<sup>[21]</sup> and Ramanathan, *et al.* reported 27.2 (7) versus 34.6 (7) days in KMC and control group, respectively ( $P < 0.05$ ).<sup>[20]</sup>

Cost of treatment with KMC came out to be significantly higher than that with conventional method (3539.47\$ vs. 2907.27\$) In fact, although the staff cost was lower in KMC (484.06\$ vs. 790.37\$), but the observed difference in total unit cost was mainly due to room/ancillary (2911.34\$ vs. 2116.90\$) and mothers accommodation costs (144.06\$ vs. 00.00\$). No statistically significant differences in frequency or type of interventions, reaction or side-effect were observed in any of infants cared with

KMC or conventional method. Only small differences in therapeutic interventions were reported, which are common, and they were present in both the KMC and the Conventional groups. According to Parmar *et al.* KMC 85% decrease use of heating devices in the NICU and 79% of health care workers report no increase in their work load.<sup>[22]</sup>

In conclusion, KMC promoted weight gain in LBW infants better than Conventional care. The effectiveness of KMC in weight gain may be explained by its humane and psychosocial effect. Although KMC's unit cost is a little higher than Conventional method, but comparing its positive outcomes it can be considered a cost effective method.

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