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The aim of the *Journal of Neonatal-Perinatal Medicine* is to strengthen research and education of the neonatal community on the optimal physical, mental and social health and well-being of infants through high quality publications on neonatal-perinatal medicine and to provide examples of best practices in order to improve the quality, safety and effectiveness of infants' healthcare worldwide.

The vision for the journal is to be 'The Reference Journal' in the field of neonatology.

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**Hypocortisolism and preterm birth**


**Article Type:** Review Article

**Abstract:** OBJECTIVE: We sought to determine whether hypocortisolism is associated with preterm birth, using hair cortisol as a marker of long term hypothalamic-pituitary-adrenal axis activity. STUDY DESIGN: In a prospective, matched, case-control study, 29 women who had a preterm birth at 24–36w5d gestation were compared to 29 women who delivered at term, matched for maternal age, gestational age, and ethnicity. Cases' samples were collected within 72h of preterm birth and controls at the same gestational age as the corresponding case. Participants completed validated questionnaires regarding general stress and childhood trauma. The Wilcoxon signed-rank test was used to compare ...

**Keywords:** Hair cortisol, preterm birth, stress in pregnancy, stress response
Objective: First, to determine the feasibility of an ultra-compact wireless device (micro EEG) to obtain multichannel electroencephalographic (EEG) recording in the Neonatal Intensive Care Unit (NICU). Second, to identify problem areas in order to improve wireless EEG performance.

Study Design: 28 subjects (gestational age 24–30 weeks, postnatal age <30 days) were recruited at 2 sites as part of an ongoing study of neonatal apnea and wireless EEG. Infants underwent 8–9 hour EEG recordings every 2–4 weeks using an electrode cap (ANT-Neuro) connected to the wireless EEG device (Bio-Signal Group). A 23 electrode configuration was used incorporating the ...
Article Type: Research Article

Abstract: OBJECTIVES: To assess whether TSH and fT4 have a role in the angiogenesis of vaso-obliteration and neovascularization which are the basic pathophysiology of ROP. METHODS: In this retrospective case-control study, the control group (n = 56) included preterm newborns with risk for ROP while the laser group (n = 63) was recruited from cases who developed severe neovascularization and needed laser photocoagulation therapy. Considering the first (vaso-obliteration) and second (neovascularization) phases of the disease, in this study we researched the distribution of thyroid function tests between groups. RESULTS: With regard to the first phase of the disease, ...

Keywords: Retinopathy of prematurity, thyroxine, thyroid stimulating hormone, vascular endothelial growth factor

DOI: 10.3233/NPM-915150

Citation: Journal of Neonatal-Perinatal Medicine, vol. 9, no. 4, pp. 349-356, 2016

Price: EUR 27.50

Alarms, oxygen saturations, and SpO₂ averaging time in the NICU


Article Type: Research Article

Abstract: BACKGROUND: Alarm overload is a significant concern in the Neonatal Intensive Care Unit (NICU). Selecting a longer oxygen saturation (SpO₂) averaging time will reduce the number of alarms but may mask fluctuations in oxygenation. OBJECTIVE: Characterize bedside monitor alarms in the NICU and estimate the impact of longer SpO₂ averaging time and alarm delay. METHODS: All bedside monitor alarms were analyzed over a 12-month period in the University of Virginia NICU, using the default averaging time (8 seconds) and SpO₂ alarm limits set at 88–95% for infants on supplemental oxygen. In 10 ...

Keywords: Alarm, pulse oximetry, oxygen saturation, preterm infant, averaging, hypoxemia, very low birthweight

DOI: 10.3233/NPM-16162
Use of naloxone to minimize extubation failure after premedication for INSURE procedure in preterm neonates

Authors: Elmekkawi, A. | Abdelgadir, D. | Van Dyk, J. | Choudhury, J. | Dunn, M.

Abstract: OBJECTIVES: A new guideline for the early respiratory management of preterm infants that included early nCPAP and INSURE was recently introduced in our NICU. This case series describes the clinical courses of a group of preterm infants managed according to this guideline, and reports the rates of successful extubation within 30 minutes of surfactant administration with and without the use of naloxone and adverse events encountered. STUDY DESIGN: Descriptive case series of all preterm babies admitted to our unit who were candidates for INSURE procedure with premedication from August 2012 to August 2013. RESULTS: A … Show more

Keywords: Endotracheal intubation, preterm, newborn, premedication, naloxone, INSURE

DOI: 10.3233/NPM-915141

Physiological effects of a single chest physiotherapy session in mechanically ventilated and extubated preterm neonates

Authors: Mehta, Y. | Shetye, J. | Nanavati, R. | Mehta, A.

Article Type: Research Article
Abstract: OBJECTIVE: To assess the changes on various physiological cardio-respiratory parameters with a single chest physiotherapy session in mechanically ventilated and extubated preterm neonates with respiratory distress syndrome. STUDY DESIGN: This is a prospective observational study in a neonatal intensive care unit setting. Sixty preterm neonates with respiratory distress syndrome, thirty mechanically ventilated and thirty extubated preterm neonates requiring chest physiotherapy were enrolled in the study. Parameters like heart rate (HR), respiratory rate (RR), Silverman Anderson score (SA score in extubated), oxygen saturation (SpO2) and auscultation findings were noted just before, immediately after chest physiotherapy but before suctioning, immediately ...

Keywords: Respiratory therapy, premature, suction, airway extubation, oxygen, NICU

DOI: 10.3233/NPM-16915140

Citation: Journal of Neonatal-Perinatal Medicine (https://content.iospress.com:443/journals/journal-of-neonatal-perinatal-medicine), vol. 9, no. 4, pp. 371-376, 2016

Price: EUR 27.50

Optimizing care of ventilated infants by improving weighing accuracy on incubator scales (https://content.iospress.com:443/articles/journal-of-neonatal-perinatal-medicine/npm1623)


Article Type: Research Article

Abstract: OBJECTIVES: To determine the accuracy of weighing ventilated infants on incubator scales and whether the accuracy can be improved by the addition of a ventilator tube compensator (VTC) device to counterbalance the force exerted by the ventilator tubing. STUDY DESIGN: Body weights on integral incubator scales were compared in ventilated infants (with and without a VTC), with body weights on standalone electronic scales (true weight). Individual and series of trend weights were obtained on the infants. The method of Bland and Altman was used to assess the introduced bias. RESULTS: The study included 60 ventilated...

Keywords: Neonatology, intensive care, ventilated infants, incubator scales, weight measurement

DOI: 10.3233/NPM-161623


Price: EUR 27.50

Authors: Lumbanraja, S.N. (https://content.iospress.com:443/search?q=author%3A%22Lumbanraja%2C+S.N.%22)

Article Type: Research Article

Abstract: BACKGROUND: Kangaroo mother care (KMC) is associated with positive neonatal outcomes. Studies demonstrated significant influence of maternal factors on the success of applying KMC. AIM: To determine maternal factors that influence on anthropometric parameters in low birth weight babies that received kangaroo mother care. METHODS: This is a randomized controlled study that involved low birth weight newborns. We randomly assigned newborns into two groups; a group who received KMC and a group who received conventional care. Maternal factors were recorded. We followed weight, length, and head circumferences of newborns for thirty days. RESULTS: ...

Keywords: Low birth weight, KMC method, growth parameters

DOI: 10.3233/NPM-161628

Citation: Journal of Neonatal-Perinatal Medicine (https://content.iospress.com:443/journals/journal-of-neonatal-perinatal-medicine), vol. 9, no. 4, pp. 385-392, 2016

Price: EUR 27.50

Lost in explanation: Lessons learned from audio-recordings and surveys of the antenatal consultation (https://content.iospress.com:443/articles/journal-of-neonatal-perinatal-medicine/npm168)


Article Type: Research Article

Abstract: OBJECTIVE: Determine content of antenatal prematurity consultations and identify factors associated with satisfaction. DESIGN: This is an observational study of consultations for possible preterm delivery. Consultations were audio-recorded and analyzed. Parents and physicians were surveyed post-consultation. RESULTS: We analyzed 17 audio-recordings. Mean gestation was 28 weeks. Frequency of topics discussed were: antenatal steroids 82%, intubation 82%, breast milk 76%, time in NICU 65%, development 59%, and survival 53%. Parents frequently asked about length of hospitalization stay, feeding, and separation concerns. Parents’ greatest fears were developmental problems, survival, separation from baby, infant health, and length of hospitalization. ...

Keywords: Preterm, neonatology, antenatal, prenatal, consultation, parental, and communication

DOI: 10.3233/NPM-16168

Citation: Journal of Neonatal-Perinatal Medicine (https://content.iospress.com:443/journals/journal-of-neonatal-perinatal-medicine), vol. 9, no. 4, pp. 393-400, 2016

Price: EUR 27.50
Failure to initiate breastfeeding among high risk obstetrical patients who intended to breastfeed

Authors: Cordero, L. | Oza-Frank, R. | Moore-Clingenpeel, M. | Landon, M.B. | Nankervis, C.A.

Article Type: Research Article

Abstract: BACKGROUND: In the US, at the time of discharge from the hospital, 79% of women had initiated breastfeeding. Intention to breastfeed is a strong predictor of breastfeeding initiation; however, we reported initiation failure in 45% of women with pregestational diabetes who intended to breastfeed. Information regarding intention and initiation among women with other high risk obstetrical conditions (HROB) remains scarce. OBJECTIVE: To ascertain demographic and clinical factors associated with breastfeeding initiation failure among women with HROB conditions who intended to breastfeed. METHODS: The study population is comprised of 89 women with diabetes (DM), 57 who...

Keywords: Breastfeeding initiation, high risk pregnancies

DOI: 10.3233/NPM-161610

Citation: Journal of Neonatal-Perinatal Medicine, vol. 9, no. 4, pp. 401-409, 2016

Price: EUR 27.50
Original Research

Influence of maternal factors on the successful outcome of kangaroo mother care in low birth-weight infants: A randomized controlled trial

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Department of Obstetrics and Gynecology, University of Sumatera Utara, Medan, Indonesia

Received 16 March 2016
Revised 29 May 2016
Accepted 24 August 2016

Abstract.
BACKGROUND: Kangaroo mother care (KMC) is associated with positive neonatal outcomes. Studies demonstrated significant influence of maternal factors on the success of applying KMC.
AIM: To determine maternal factors that influence on anthropometric parameters in low birth weight babies that received kangaroo mother care.
METHODS: This is a randomized controlled study that involved low birth weight newborns. We randomly assigned newborns into two groups; a group who received KMC and a group who received conventional care. Maternal factors were recorded. We followed weight, length, and head circumferences of newborns for thirty days.
RESULTS: A total of 40 newborns were included. Weight parameters were significantly higher in the KMC group than the conventional group. From maternal characteristics, only gestational age was found to influence increased head circumference in KMC group (p = 0.035); however, it did not affect the increase in weight or length. Maternal age, parity, education, mode of delivery, fetal sex, and initial Apgar score did not influence growth parameters in either groups.
CONCLUSION: KMC was associated with increased weight gain in LBW infants. Gestational age influences head growth in infants who received KMC.

Keywords: Low birth weight, KMC method, growth parameters

1. Introduction

Low Birth Weight (LBW) remains a major cause of neonatal morbidity and mortality. Around 16% of newborns experience LBW with an incidence of 18 million annually worldwide. In developing countries, incidence of LBW is two times higher than in developed countries [1]. LBW is associated with many complications such as growth disorders, cognitive disorders, and development of chronic diseases in the elderly [2].

Factors such as maternal age, multigravida, short interpregnancy-intervals, socioeconomic factors, maternal education, and pregnancy weight gain
increase the incidence of LBW [3–5]. Another study showed a 1.2 times increased risk of LBW in women with low socioeconomic status and 1.7 times in women with low education [6]. LBW is also closely linked with maternal height [7]. Mumbare et al. [8] showed that maternal weight <55 kg, maternal height <145 cm, and inadequate antenatal care, were the most influential factors that induce LBW [8]. Taha et al. [9] showed that maternal age and parity had significant effects on birth weight [9]. However, Negi et al. [10] on the other hand showed that primigravid had higher risk of having LBW baby and there was no relationship between maternal age, height and weight with LBW [10]. In Indonesia, Trihardani et al. (2011) showed that the risk factors associated with LBW were maternal body mass index, pregnancy weight gain, and parity, while there was no significant relationship found between LBW and maternal age, maternal height, frequency of antenatal care, or interpregnancy-interval [11]. Pregnancy before age 20 or over age 35 has tendency to an unmet need of adequate nutrition for fetal growth [12]. In short interpregnancy-intervals, mother does not have enough time between pregnancies to recover nutrient store, either micro- or macronutrient [13].

Keeping LBW infants warm is a crucial point because of the vulnerability to hypothermia which could lead to life-threatening infection, apnea or massive bleeding [14]. Incubator is one way to cope with LBW babies, but it impedes early contact and breast feeding [15]. Some invasive procedures in incubator also induce stress in babies, proved by some studies that showed increasing of heart rate and respiratory rate in infants treated in an incubator [16]. As an alternative, KMC was developed by Martinez and Rey in Bogota (1978), inspired from how marsupials to keep their children warm [17].

KMC is known to be quite effective in the treatment of LBW, in addition of the ease and inexpensive application. It was very important in many remote areas in Indonesia due to the lack of resuscitation facilities [18]. Majority of studies showed KMC had better effects than conventional method, although these were still controversial [19–21]. Pratiwi et al. [22] showed that the birth weight ≥1500 gr and age >10 days related to the success of KMC. Gestational age ≥34 weeks, KMC duration ≥65 minutes, high maternal education level (p = 0.408) did not influence the incidence of LBW [22].

As many factors contributed to the successful application of KMC, clinicians should have predicted the benefits from the beginning of therapy because neonatal is the most vulnerable period in human life. This study aimed to study the influence of maternal factors on the successful of KMC in LBW.

2. Methods

2.1. Study design

This was an analytical, cohort prospective study that was conducted at Adam Malik General Hospital and Pirngadi Hospital, Medan, Indonesia from June to November 2015. Written informed consents were obtained from all parents. This study has been approved by the Ethical Committee of University of Sumatera Utara, Medan, Indonesia.

2.2. Study population

This study enrolled newborn with LBW in this institution. LBW is defined as weight below 2500 g. We randomly assigned the newborns into two groups. In the first group, the newborn was given KMC and in the second group they were cared for in an incubator as the conventional method. We only included babies with birth weight 1000–2500 g, stable hemodynamic status, needed neither oxygen nor continuous intravenous fluids, and mothers were healthy enough and willing to practice KMC. We also restriced the samples to mothers who did exclusive breast-feeding since breastfeeding is known to influence KMC outcomes. Exclusion criteria were babies with congenital anomalies, severe perinatal complications that required NICU care, experienced a malignancy, metabolic disorders, and cardiovascular disorders.

2.3. Study protocols

The baseline information of maternal and fetal demographics were recorded. Maternal factors included age, gestational age, number of parity, education, and mode of delivery. We also included fetal demographics such as sex and initial Apgar scores.

In the conventional group, the babies were placed in an incubator based on the hospital standard guideline. In KMC group, KMC was initiated as soon as the babies were stable. Previously, the mothers were educated on how to practice KMC. Mothers were seated at comfortable chair close to the babies’ cradle. Mothers were shown how to hold their babies vertically and strapped to the middle of mothers’ chests. Babies’ skin should touch their mothers skin. When
not in KMC, babies were placed in the cradle with bodies covered. This method was conducted for 4–6 hours each day. Babies in both the groups were provided vitamin and mineral supplementation as per the protocol.

The subjects were followed up for 30 days. Every day, anthropometrics were measured. Babies were weighed naked on an electronic weighing scale (GEA). The weighing machine was calibrated daily. The lengths were measured with infantometer (GEA) at birth, day 10, day 20, and day 30. The head circumferences were measured with a standard tape at birth, day 10, day 20, and day 30. All measurements were carried out independently by two investigators who were masked to group assignment of the infants. We take the mean of both measurements. Within the follow up, if there were sucking disorder, breathing disorders, or loss of consciousness, babies were given further interventions, and were excluded from the study.

Infants’ weight was plotted using Fenton’s growth charts. We calculated accurate weight gain velocity with the following formula GV = \[\frac{1000 \times (Wn - W1)}{(Dn - D1) \times (Wn + W1)/2}\] and estimated weight gain velocity with formula GV \[\frac{1000 \times \ln(Wn/W1)}{(Dn-D1)}\]. The magnitude of errors were reflected by the percentage of absolute difference with formula \(100 \times \frac{\text{Estimated GV} - \text{Accurate GV}}{\text{Accurate GV}}\). We also calculated a z-score for weight in www.peditools.org/fenton/2013 at birth and at day 30.

3. Data analysis

Data were analyzed by SPSS (Statistical Product and Service Solutions, Chicago, IL, USA) 22.0 for Windows. Categorical data were expressed as number and continuous data as mean ± SD. Chi-square test (Fisher’s exact test) was used to examine the relation between qualitative variables. T-independent, T-dependent, Pearson correlation were used to evaluate quantitative variables. Significance was determined when \(p\) value was <0.05.

4. Results

During the period of June 2015-October 2015, ninety infants were born with LBW. Two mothers were not willing to participate in KMC. Some newborns were excluded from the study, as 45 newborns needed NICU care, 1 had congenital anomalies, 1 had cardiovascular disorders, and 1 newborn died. Finally, about 40 newborns were eligible in this study. No loss to follow up or withdrawal from the study (Fig. 1).

Maternal and fetal demographic characteristics were shown in Table 1. No differences were found between groups in maternal age, parity, gestational age, maternal education, mode of delivery, fetal sex, and Apgar score. The initial measured weight, length, and head circumferences were similar in both groups (\(p = 0.100; \ p = 0.353; \ p = 0.088\), respectively). Last measured weight was significantly higher in KMC group than conventional group (2187.5 ± 371.04 vs 1899 ± 242.55; \(p = 0.015\)). The difference of initial and last weight was also higher in KMC group than conventional group (205.5 ± 147.45 vs 96 ± 68.702; \(p = 0.001\)). To ensure this weight parameter, we calculated the weight gain velocity. The accurate weight gain velocity was 5.098 ± 2.155 g/day and the estimated weight gain velocity was 5.112 ± 2.168 g/day. As a result, accurate and estimated weight gain velocity and absolute difference percentage were found higher significantly in KMC group than conventional group (\(p = 0.01; \ p = 0.009; \ p < 0.001\)), but there were no differences of last measured weight Z score found between both groups (\(p = 0.364\)). We also found no differences of last measured length and head circumference Z score between both groups (Fig. 2). Although mean difference of initial and last head circumference (cm) showed a significant difference (\(p = 0.004\)), other parameters regarding head circumferences show no significant differences. Duration of hospital stay did not differ between conventional and KMC groups (28.4 ± 5.020 vs 23.15 ± 5.184; \(p = 0.42\)).

From maternal characteristics, only gestational age was found to influence the differences of initial
and last head circumference (–0.314 ± 3.746 vs 1.415 ± 1.064; p = 0.035). However, gestational age was not associated with other parameters. There were no differences among maternal age, parity, maternal education, mode of delivery, fetal sex, and initial Apgar scores with accurate weight gain velocity, estimated weight gain velocity, absolute difference percentage, mean differences of initial and last weight, length, and head circumferences (Table 2).

We plotted a mean weight gain graph. Peak weight regain were shown in day 16, 18, and 29. Although the graph showed irregular weight gains, at last day, weight was increased higher than the initial weight assessment (Fig. 3).

5. Discussion

This is the first study that specifically determined the affect of maternal factors on the success of Kangaroo Mother Care babies compared with conventional therapy in LBW infants. Pratiwi et al. [22] showed no effect of high levels of maternal education (p = 0.408)

Table 1

Demographic characteristics of maternal, fetal, and measured parameters

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>KMC group</th>
<th>Conventional group</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal age (years old)</td>
<td>28.6 ± 2.073</td>
<td>28.7 ± 4.485</td>
<td>0.263</td>
</tr>
<tr>
<td>Parity (n)</td>
<td>2.25 ± 0.786</td>
<td>2.1 ± 0.852</td>
<td>0.765</td>
</tr>
<tr>
<td>Gestational age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;37 weeks</td>
<td>7 (35%)</td>
<td>5 (25%)</td>
<td>0.490</td>
</tr>
<tr>
<td>&gt;37 weeks</td>
<td>13 (65%)</td>
<td>15 (75%)</td>
<td>0.490</td>
</tr>
<tr>
<td>Maternal education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-educated</td>
<td>5 (25%)</td>
<td>4 (20%)</td>
<td>0.705</td>
</tr>
<tr>
<td>Educated</td>
<td>15 (75%)</td>
<td>16 (80%)</td>
<td>0.705</td>
</tr>
<tr>
<td>Mode of delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spontaneous delivery</td>
<td>9 (45%)</td>
<td>5 (25%)</td>
<td>0.185</td>
</tr>
<tr>
<td>Vaginal delivery</td>
<td>11 (55%)</td>
<td>15 (75%)</td>
<td>0.185</td>
</tr>
<tr>
<td>Fetal characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fetal sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11 (55%)</td>
<td>15 (75%)</td>
<td>0.320</td>
</tr>
<tr>
<td>Female</td>
<td>9 (45%)</td>
<td>5 (25%)</td>
<td>0.320</td>
</tr>
<tr>
<td>Initial Apgar score</td>
<td>8.2 ± 0.696</td>
<td>8 ± 0.795</td>
<td>0.672</td>
</tr>
<tr>
<td>Measured parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial measured weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>1882 ± 293.125</td>
<td>1803 ± 217.234</td>
<td>0.100</td>
</tr>
<tr>
<td>Weight Z score</td>
<td>–1.385 ± 1.019</td>
<td>–1.483 ± 1.070</td>
<td>0.901</td>
</tr>
<tr>
<td>Last measured weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>2187.5 ± 371.014</td>
<td>1899 ± 242.55</td>
<td>0.015*</td>
</tr>
<tr>
<td>Weight Z score</td>
<td>6.316 ± 2.232</td>
<td>5.414 ± 1.814</td>
<td>0.364</td>
</tr>
<tr>
<td>Initial measured length</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length (cm)</td>
<td>41.025 ± 2.993</td>
<td>39.75 ± 2.653</td>
<td>0.353</td>
</tr>
<tr>
<td>Length Z score</td>
<td>–6.121 ± 1.613</td>
<td>–4.076 ± 11.878</td>
<td>0.117</td>
</tr>
<tr>
<td>Last measured length</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length (cm)</td>
<td>42.28 ± 2.938</td>
<td>40.625 ± 2.665</td>
<td>0.340</td>
</tr>
<tr>
<td>Length Z score</td>
<td>–0.623 ± 1.165</td>
<td>–1.305 ± 1.030</td>
<td>0.290</td>
</tr>
<tr>
<td>Initial measured head circumference (HC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HC (cm)</td>
<td>30.325 ± 3.001</td>
<td>29.225 ± 1.824</td>
<td>0.088</td>
</tr>
<tr>
<td>HC Z score</td>
<td>7.134 ± 2.202</td>
<td>6.008 ± 1.83</td>
<td>0.444</td>
</tr>
<tr>
<td>Last measured head circumference (HC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HC (cm)</td>
<td>30.96 ± 1.762</td>
<td>30.035 ± 1.719</td>
<td>0.800</td>
</tr>
<tr>
<td>HC Z score</td>
<td>–5.86 ± 1.088</td>
<td>–6.351 ± 1.418</td>
<td>0.394</td>
</tr>
<tr>
<td>Accurate weight gain velocity (g/day)</td>
<td>5.098 ± 2.155</td>
<td>1.763 ± 1.220</td>
<td>0.010*</td>
</tr>
<tr>
<td>Estimated weight gain velocity (g/day)</td>
<td>5.112 ± 2.168</td>
<td>1.764 ± 1.221</td>
<td>0.009*</td>
</tr>
<tr>
<td>Absolute difference percentage (%)</td>
<td>0.214 ± 0.162</td>
<td>0.032 ± 0.029</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Mean difference of initial and last weight (kg)</td>
<td>205.5 ± 147.451</td>
<td>96 ± 68.702</td>
<td>0.001*</td>
</tr>
<tr>
<td>Mean difference of initial and last length (cm)</td>
<td>1.255 ± 0.305</td>
<td>0.875 ± 0.215</td>
<td>0.513</td>
</tr>
<tr>
<td>Mean difference of initial and last head circumference (cm)</td>
<td>0.635 ± 2.494</td>
<td>0.81 ± 0.354</td>
<td>0.048*</td>
</tr>
<tr>
<td>Duration of hospital stay</td>
<td>23.15 ± 5.184</td>
<td>28.4 ± 5.020</td>
<td>0.420</td>
</tr>
</tbody>
</table>

*Significant difference.
Table 2

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Accurate weight gain velocity</th>
<th>Estimated weight gain velocity</th>
<th>Absolute difference percentage</th>
<th>Mean differences of initial and last weight</th>
<th>Mean differences of initial and last length</th>
<th>Mean differences of initial and last head circumference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal age (years old)</td>
<td>r 0.309 p 0.186</td>
<td>r 0.309 p 0.185</td>
<td>r -0.325 p 0.163</td>
<td>r 0.155 p 0.515</td>
<td>r -0.325 p 0.163</td>
<td>r 0.155 p 0.515</td>
</tr>
<tr>
<td>Parity (n)</td>
<td>r 0.134 p 0.574</td>
<td>r 0.134 p 0.572</td>
<td>r -0.417 p 0.068</td>
<td>r 0.350 p 0.130</td>
<td>r -0.417 p 0.068</td>
<td>r 0.350 p 0.130</td>
</tr>
<tr>
<td>Gestational age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;37 weeks</td>
<td>5.793 ± 1.898</td>
<td>5.810 ± 1.913</td>
<td>0.258 ± 0.156</td>
<td>338.57 ± 137.165</td>
<td>1.286 ± 0.474</td>
<td>-0.314 ± 3.746</td>
</tr>
<tr>
<td>&gt;37 weeks</td>
<td>4.680 ± 2.289</td>
<td>4.691 ± 2.304</td>
<td>0.189 ± 0.168</td>
<td>283.85 ± 158.248</td>
<td>1.192 ± 0.236</td>
<td>1.415 ± 1.064</td>
</tr>
<tr>
<td>p value</td>
<td>0.810</td>
<td>0.812</td>
<td>0.980</td>
<td>0.815</td>
<td>0.271</td>
<td>0.035*</td>
</tr>
<tr>
<td>Maternal education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non educated</td>
<td>3.819 ± 1.223</td>
<td>3.824 ± 1.229</td>
<td>0.111 ± 0.078</td>
<td>208.33 ± 79.352</td>
<td>1.050 ± 0.197</td>
<td>1.600 ± 1.580</td>
</tr>
<tr>
<td>Educated</td>
<td>5.604 ± 2.309</td>
<td>5.622 ± 2.324</td>
<td>0.257 ± 0.173</td>
<td>343.57 ± 156.579</td>
<td>1.300 ± 0.351</td>
<td>0.471 ± 2.683</td>
</tr>
<tr>
<td>p value</td>
<td>0.061</td>
<td>0.08</td>
<td>0.015</td>
<td>0.074</td>
<td>0.487</td>
<td>0.774</td>
</tr>
<tr>
<td>Mode of delivery</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Vaginal delivery</td>
<td>4.773 ± 1.541</td>
<td>4.782 ± 1.552</td>
<td>0.175 ± 0.125</td>
<td>281.25 ± 114.697</td>
<td>1.300 ± 0.417</td>
<td>-0.025 ± 3.471</td>
</tr>
<tr>
<td>Caesarean section</td>
<td>5.267 ± 2.565</td>
<td>5.283 ± 2.581</td>
<td>0.238 ± 0.186</td>
<td>317.50 ± 172.844</td>
<td>1.175 ± 0.263</td>
<td>1.517 ± 1.048</td>
</tr>
<tr>
<td>p value</td>
<td>0.059</td>
<td>0.059</td>
<td>0.85</td>
<td>0.346</td>
<td>0.723</td>
<td>0.073</td>
</tr>
<tr>
<td>Fetal characteristics</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Fetal sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5.408 ± 2.535</td>
<td>5.426 ± 2.549</td>
<td>0.248 ± 0.170</td>
<td>315.27 ± 169.534</td>
<td>1.063 ± 0.1912</td>
<td>1.482 ± 1.155</td>
</tr>
<tr>
<td>Female</td>
<td>4.654 ± 1.699</td>
<td>4.664 ± 1.713</td>
<td>0.171 ± 0.153</td>
<td>285.56 ± 129.722</td>
<td>1.422 ± 0.363</td>
<td>-0.011 ± 3.298</td>
</tr>
<tr>
<td>p value</td>
<td>0.069</td>
<td>0.07</td>
<td>0.271</td>
<td>0.142</td>
<td>0.266</td>
<td>0.142</td>
</tr>
<tr>
<td>Initial Apgar score</td>
<td>r -0.041 p 0.864</td>
<td>r -0.041 p 0.865</td>
<td>r 0.064 p 0.788</td>
<td>r -0.141 p 0.554</td>
<td>r 0.292 p 0.211</td>
<td>r 0.018 p 0.938</td>
</tr>
</tbody>
</table>

*Significant difference.
KMC is a method of maternal-fetal skin to skin contact as a loving incubator that is applied as soon as possible after birth [24]. This method makes mothers and families as providers of biological and psycho-emotional needs for their children [25]. According to WHO guidelines, continuous KMC is indicated in infants with birth weight below 2000 g. Intermittent KMC can also be useful in infants hospitalized in NICU, but still needs further research [26].

The main point of KMC is emphasized at attachment between parents and childern. Feldman et al. [27] had successfully demonstrated the positive impact in the relationship between mother and child [27]. Athanasopolou et al. [28] showed that KMC resolved negative moods such as anxiety and depression in mothers [28]. KMC procedure also increased the mothers’ confidence and competence in caring for her baby and significantly reduced stress. All of these effects contribute to the improvement to the growth and development [29].

In this study, an assessment of growth was based on infant’s weight, length, and head circumference, which were the important markers of a child health [30, 31]. Bera et al. [32] showed that in infants receiving KMC, the growth parameters and mental development was better than infants who were treated conventionally [32]. Ali et al. [19] showed that infants treated by incubator has higher weight gain per day (19.3 vs. 10.4 g, \( p < 0.001 \)), shorter duration of stay (6.9% vs. 23.2% \( p = 0.014 \)), lower infection rate (6.9% vs. 23.2% \( p = 0.014 \)) than babies who applied KMC [19]. Palencia et al. [33] found that the growth in height for age was higher within percentiles weight for age (\( p = 0.0001 \)). Male gender had a higher weight than females (\( p = 0.031 \)) [33]. This study was similar to the study in Indonesia previously. In this study, there we showed that compared to conventional group, last measured weight, difference of initial and last weight, as well as weight gain velocity were higher in KMC group. No differences were found regarding of length and head circumference. Hak-sari (2004) and Rahmayanti [21] in Indonesia also found no difference between weight/age, length/age, head circumference/age in LBW infant treated with KMC and conventional therapy [21]. In the other hand, Rao et al. (2007) conversely showed that infants treated by incubator has a higher weight gain, head circumference (0.49 vs 0.75 cm, \( p = 0.02 \)), and body length (0.99 vs. 0.7 cm, \( p = 0.008 \)) compared with infants who applied KMC [20]. It indicated the need to predict which method gives more benefit, KMC or incubator.

We should highlight some factors several authors argued that weight gain should approximate an intrauterine growth rate of 16.8 to 30.7 g/day [31]. In this study, the accurate weight gain velocity was 5.098 ± 2.155 g/day and the estimated weight gain velocity was 5.112 ± 2.168 g/day, which were still far below the recommended growth rate. The Z score of weight was still below expected average. Newborns were still categorized small for gestational age in the end of the study.

In this study, it was shown that weight and length parameters did not differ by maternal age, parity, maternal education, mode of delivery, fetal sex, and initial apgar score. We only found that in newborns who were born <37 gestational age had delayed growth of head circumference. However, KMC has proved to increase cerebral blood flow, which can act as a nutritional support, mainly to the brain.
Korraa et al. [34] found that newborns who received KMC had shown lower cerebral blood flow resistive index ($p < 0.05$) which indicated improved in cerebral blood flow [34]. The influence of immature organ in preterm babies may be considered and this need further research [35]. This marked that KMC is useful in all condition regardless of maternal and fetal characteristics.

The strength of this study is the follow-up parameters that are better than other studies. The better follow-up rate in the KMC group could be due to the active involvement of the mother in the care of her LBW baby. The limitations of this study is the small samples, only conducted in two institutions, and short follow up period. Further large research is needed to ensure these findings.

6. Conclusion

There were no differences of growth parameters between subgroups of maternal and fetal characteristics except the tendency delayed growth of head circumferences in preterm infants.

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I am greatly appreciate to all observers and my students who directly or indirectly were involved in supporting me to finish this study.

Conflict of interest

The author declared no conflict of interest in this study.

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