



Research Article

Effect of Coconut Oil Massage on Weight Gain in Low Birth Weight Newborns: A Randomised Controlled Clinical Trial

Authors

Dr Sangita Mahendra Kumbhojkar¹, Dr Adil A. Raheman Akbani^{2*}

¹Associate Professor, Dept. of Paediatrics, R.C.S.M. Govt. Medical College, Kolhapur

²MBBS (Intern), R.C.S.M. Govt. Medical College, Kolhapur

*Corresponding Author

Dr Adil A. Raheman Akbani

MBBS (Intern), R.C.S.M. Government Medical College, Kolhapur

Introduction

Low birth weight (LBW) is a major health problem and a significant contributor to neonatal deaths in both industrialized and developing nations.¹ According to WHO every year about 20 million LBW baby born, 96% of them are in developing countries. LBW is common problem in our country with an incidence of 30-40% (term small for gestational age 20-30% and preterm 10-20%).²

The period of intrauterine growth and development is one of the most vulnerable periods in the human life cycle³. Any deficiency occurring during this period leads to poor growth and development of the newborn. Newborn infants require efficient and cost effective care to compensate for possible shortage of intrauterine development.⁴

Massage is one of the oldest therapeutic techniques in the world which has been used as a routine part of infant care in many cultures.⁵ Infant massage could potentially benefit both physiological and psychological health of the baby.⁶ One of the important effects of massage is

promotion of optimal infant growth and development.⁶ The mechanism of massage therapy affecting the weight gain is not yet known. Theories proposed to explain the positive effects of massage on weight gain in preterm and full term infants include hormone growth, vagal tone and gastric motility, in addition to improved circulation of blood and lymph fluids; however, need for further research has been suggested to confirm these mechanisms.⁷ Coconut oil is composed entirely of medium-chain fatty acids (MCFAs), which are a source of highly efficient cellular food. When coconut oil is applied topically, the cells absorb the MCFAs converting them into energy thus promoting weight gain⁸ and so can be used for nutritional purpose and faster weight gain in LBW infants.⁹

Effects of massaging on the growth of low birth weight infants with or without oils remain unresolved. Oil can act as heat and nutrition source, but the effect of oil individually upon the growth of low birth weight infants is not yet clear.¹⁰ Using oil during massaging makes the

massage frictionless, the skin soft causing reduction in the skin dryness.¹¹

The present study thus aims to explore if coconut oil massaging can have a positive impact on the weight gain status of low birth weight infants.

Objectives

1. To evaluate the effect of coconut oil massage on weight gain pattern in Low Birth Weight (LBW) infants admitted to NICU of a Tertiary care Teaching hospital.
2. To find the adverse effects of coconut Oil massage in Low Birth Weight infants.

Methodology

Massage: It refers to the scientific manipulation of soft tissue of the body for the purpose of normalizing those tissues and consists of manual techniques that include applying fixed or movable pressure, holding and or causing movement of or to the body.

Coconut Oil: It refers to the oil extracted from the meat of a mature coconut. The plain term 'coconut oil' is usually used for refined coconut oil or 'RBD coconut oil' i.e. Refined Bleached and Deodorized Coconut oil.

Weight Gain: It refers to a significant increase in the weight of the newborn after implementation of massage with or without oil.

Low Birth Weight (LBW): It refers to the birth weight of the newborn infant equal to or less than 2499 grams, regardless of gestational age. It is either caused by preterm birth (younger than 37 weeks of gestation) or the infant being small for gestational age or a combination of both.

The present was a hospital-based interventional study.

Study Area: The study was conducted at a neonatal intensive care unit (NICU) of a tertiary care Government Hospital of Western Maharashtra.

Study Design: Non-blinded randomized controlled clinical trial.

Study Period: The research was conducted for 6 months.

Study Population: The study population was the low birth weight newborn (birth weight <2000g) admitted to NICU of a tertiary level teaching hospital.

Sample: The low birth weight infants (birth weight <2000g) admitted to NICU at tertiary care teaching hospital, meeting the following inclusion criteria, was the sample for the study.

Inclusion Criteria

1. Newborn fed with breast milk.
2. The weight of newborn should be < 2000 gram.
3. The gestational age of newborn should be between 28-37 weeks.
4. The 'APGAR' score of 5th minute should be greater than or equal to 7.
5. No anomalies, no congenital and systemic diseases.
6. No history of hereditary diseases.

Exclusion Criteria

1. The low birth weight newborn showing symptoms of fever, neonatal sepsis, respiratory distress and muscle stiffness.
2. The low birth weight newborn showing sensitivity to coconut oil will be excluded from the study by the lack of completion of the massage period.
3. The low birth weight neonates who require oxygen supplementation, inotropes or ventilator support or had meningitis or encephalopathy.

Instrument and Techniques to be Used in the Study

The present study was a non-blinded randomized controlled clinical trial conducted in a NICU of a tertiary level teaching hospital. After explaining the aims and objectives of the study, informed consent was obtained from the parent of eligible neonates. The eligible neonates were randomized to one of the two groups by using a table of random numbers generated by the computer. The eligible low birth weight newborn in the intervention group was given massage with coconut oil and the control group was given massage without oil.

Clearance from Institutional Ethical Committee (IEC) was obtained before starting the study.

Massage Technique

There are no fixed guidelines describing the exact methodology of neonatal massage. Mathai et al, has described a standardised massage protocol which has been followed by most studies on massage therapy and adopted in this study also¹². The Mathai's massage therapy consists of both tactile and kinesthetic stimulation. Neonates between the ages of 2 days to 20 days were chosen for the study.

Three massage sessions were given in a day, each session for 10 minutes.

Oil massage was given for 10 days. For first 2 days oil massage was given by trained person and thereafter by the mother (who was taught the technique) for next 8 days. Compliance of the mother was checked regularly by the NICU Nurse. It has been shown that mothers are as effective as trained professional in delivering the massage and in addition, mothers who massage their neonates have lower depression and anxiety¹³. Babies in the control group received a massage without oil and the method of application and the monitoring was the same as in the oil groups.

The massage Session was initiated an hour after a feed to avoid regurgitation or vomiting of the feed. The infant in the intervention group was given coconut oil massage with 5mL/kg of body weight being applied per session.

During massage, the neonates were placed completely naked on a plastic cover. The nurse or the mother was instructed to warm and lubricate her hands before starting of massage and to remain silent during intervention. If the baby started crying or passed urine or stools during the session it was temporarily stopped till the baby was comfortable again. The massage protocol is as follows.

Phase I: This was done in the prone position. Twelve firm strokes with palms of the hands of 5 seconds each, were provided in each area as follows: (a) Head from forehead hairline over

scalp down to neck with alternate hands; (b) Neck from midline outwards with both hands simultaneously; (c) Shoulders from midline outwards with both hands simultaneously; and (d) Back from nape of neck down to buttocks with firm, long stroke with alternate hands.

Phase-II: This was done in the supine position. Twelve firm stroke with palms of the hands, of 5 seconds each, were provided in each area as follows: (a) Forehead - From midline, outwards with both hands simultaneously; (b) Cheeks - From side of nose, with both hands simultaneously in rotating and clockwise direction for left cheek and anticlockwise direction for right cheek; (c) Chest- 'butterfly' stroking from midline upwards, outwards, downwards and inwards back to initiating point; (d) Abdomen - From the appendix, in a clock wise direction around abdomen avoiding the epigastrium and probes, with gentle strokes; (e) Upper limbs (each separately)- from shoulders to wrist using alternate hands for stroking; (f) Lower limbs (each separately) - from hips to ankles using alternate hands for stroking; (g) Palms - from wrist to finger tips using alternate hands for stroking; and (h) Soles- from heel to toe tips using alternate hands for stroking.

Phase-III: This was done in the supine position and consisted of passive flexion and extension movements of the limbs at each large joint (shoulder, elbow, hip, knee and ankle) as 5 events of 2 seconds each in each area.

The weight of LBW neonate in both the groups was measured and recorded everyday by the NICU nurse. In this way the study was conducted for a period of 6 months and the data was collected, tabulated and analysed. Adverse effects due to the massage were also looked for but none so happened.

Instrument Used

The weight of the preterm infant was measured everyday by 'SEICO' 24 Bit Technology digital weighing machine with precision of ± 10 gm without diapers and clothes at 11 a.m. The

Refined type of coconut oil was used in this present study i.e. Refined Bleached and Deodorized Coconut oil.

Data Analysis and Data Presentation

This study was conducted for the duration of 6 months August 2017 to January 2018. After collecting the data from the study, the data was analysed by using descriptive statistics i.e. mean \pm standard deviation and frequency with percentage. The data was analyzed with Statistical Package for Social Sciences (SPSS) for Windows 24.0 (SPSS, Inc.chicago, Illinois). Independent t-test was applied to compare mean birth weight among 'coconut oil massage' group and 'only massage' group. Confidence intervals were set at 95% and p value < 0.05 were interpreted as statistically significant. The analyzed data was represented in the form of tables and graphs.

Results

Fifty five patients were excluded from the study and the design and conduct of this trial was straightforward, and we did not have any losses to follow-up. Finally, 72 neonates including 37 girls (51.3%) and 35 boys (48.6%) of gestational age between 27 – 39 weeks were evaluated. The infants mean \pm SD age in days and birth weight in grams was 9.93 ± 3.705 and 1434.17 ± 271.691 respectively. There were 36 neonates in coconut oil massage group and 36 neonates in only massage group. There were 60 preterm infants (<37 week) and 12 terms infants (>37 week). The birth weight was ranging from 940-1920 grams. Comparison of baseline characteristics of the neonates in intervention and control arm is shown in (table I) and it shows that data is comparable among the groups.

Table 1: Baseline Characteristics of the Study Groups

Variable	Coconut Oil massage	Only massage
Birth weight (gm) (Mean, SD)	1431.94 (268.54)	1436.38 (278.58)
Gestation (weeks) (Mean, SD)	31.5 (2.59)	31.36 (2.69)
Sex (Male, Female) (n)	14/22	21/15
Apgar score (Median, Range) 1 minute	9 (7-9)	9 (7-9)
Apgar score (Median, Range) 5 minute	9 (8-9)	9 (8-9)
Education of mother (in completed yrs) (Median, Range)	10 (0-15)	10 (8-15)
Maternal Age (yrs) (Mean, SD)	25.17 (4.62)	25.61(4.47)
Socio- Economic Class (Median, Range) [#]	3 (1-4)	3(2-4)
Infant age (days) (Mean, SD)	9.41 (3.41)	10.44 (3.95)
Enteral intake at enrolment (mL/kg/day) (Median, Range)	180 (120 – 300)	186 (120-300)

[#] - Socioeconomic status scale by kuppuswamy (14); SD – Standard deviation

Table 2: Comparison of the Demographic Details at Baseline

Variables	Coconut Oil massage	Only massage	t-value	p-value
Birth weight (Mean, SD)	1431.94 (268.65)	1436.39 (278.59)	-0.069	.945
Gestational age (Mean, SD)	31.56 (2.59)	31.36 (2.69)	.312	.756
Maternal Education (years) (Mean, SD)	9.97 (2.95)	10.50 (1.75)	-.923	.359
Maternal Age (Mean, SD)	25.17 (4.62)	25.61 (4.47)	-.415	.680

Table 2 shows that no statistically significant differences were seen in comparison of sociodemographic profile of infants and mothers

in terms of birth weight, mean gestational age, mean maternal education and mean maternal age.

Table 3: Comparison of Anthropometric Data in the Study Groups

Variable	Coconut Oil massage	Only massage	t value	p-value
Weight in grams (mean, SD) At Day 1	1435.83 (284.67)	1440 (285.41)	-.062	0.951
Weight in grams (mean, SD) At 10 th days	1615.83 (301.06)	1549.72 (301.08)	.932	0.355
Weight change in gm	180 (23)	109.72 (23)	12.89	0.0001*
Weight gain (g/kg/day) (mean, SD) (over 10 days)	12.81 (1.85)	7.70 (1.33)	13.42	0.00*
Duration of hospitalization Mean, SD	23.81,6.3	25.39,6.47	-1.05	0.297

*Statistically significant (p value < 0.05)

Table 3 shows comparison of anthropometric data in coconut oil massage group and in only massage group. The mean weight ± SD of infants in both groups at day 1 was 1435.83 ± 284.67 and 1440 ± 285.41 respectively. The mean weight ± SD of infants at day 10 was 1615.83 ± 301.06 and 1549.72 ± 301.08 respectively. The mean and SD of weight gain in gm during 10 days for ‘coconut oil massage’ group was 180 ± 23 gm and in ‘only massage’ group was 109.72 ± 23 gm. (Figure 1). The weight gain was greater in ‘coconut oil massage’ group than ‘only massage’ group. Independent t test shows that weight gain is

statistically significant in ‘coconut oil massage’ group than ‘only massage’ group (P=0.0001 t = 12.89) revealing the effect of intervention. Also, the mean (± SD) of weight gain in gm/kg/day in ‘coconut oil massage’ group 12.81± 1.85 was statistically higher as compared to ‘only massage’ group 7.70 ± 1.33 (P<0.0001 t = 13.42, figure 2). The mean and SD duration of hospitalization in massage with coconut oil group was 23.81 ± 6.3 and in massage without oil was 25.39 ± 6.47 in days. Independent t- test showed that the mean duration of hospital stay between two groups was not statistically significant (P= 0.297 t = -1.05).

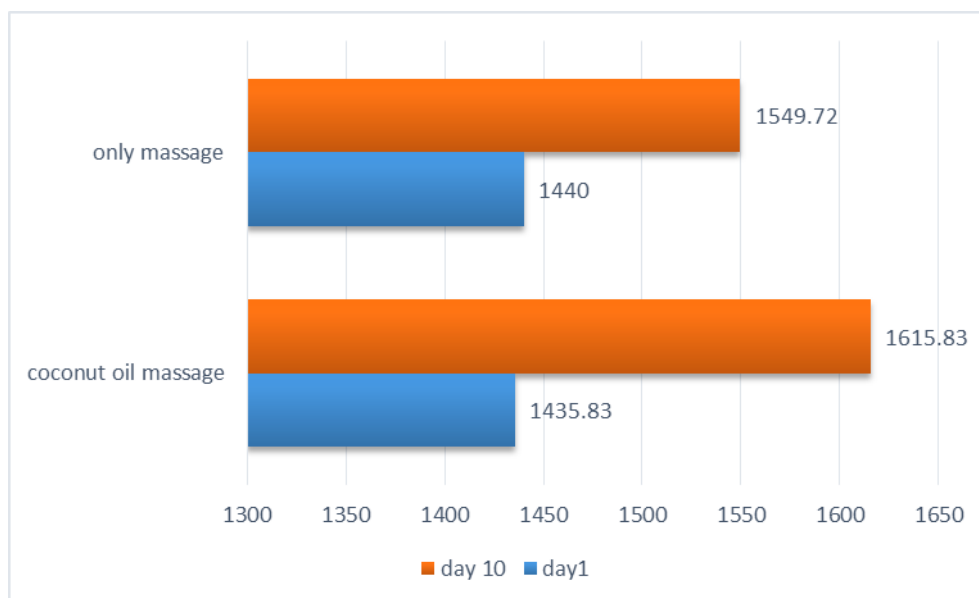


Figure 1: Weight in grams at baseline and after intervention.

Figure 1 showed the comparison of mean weight at day 1 and day 10 in both groups. The mean weight at day 1 and day 10 was 1435.38, 1440 and

1615.83, 1549.72 in coconut oil with massage group and in only massage group respectively.

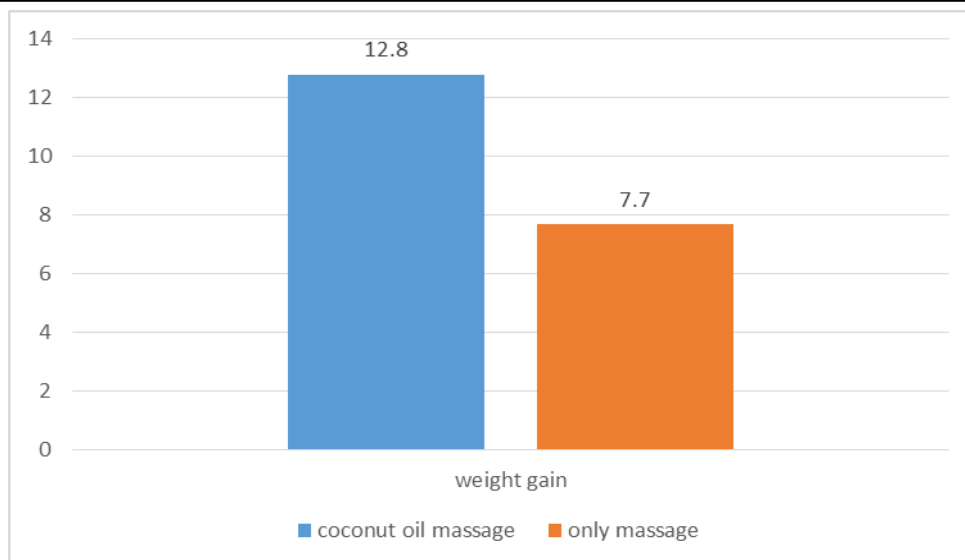


Figure 2: Weight gain in gm/kg/day across groups

Figure 2 showed that the mean weight gain in gm/kg/day during 10 days of massage in coconut oil group was 12.81 and in only massage group

was 7.70. Independent t- test revealed that this difference is statistically significant ($P < 0.0001$ $t = 13.42$).

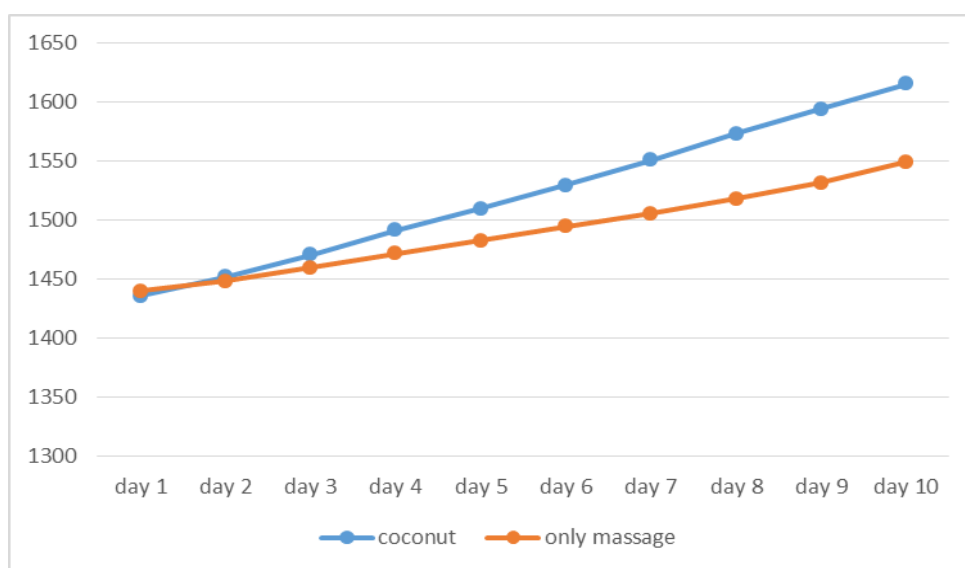


Figure 3: Daily mean weight change in both groups (n=72)

Figure 3 represents trend of infant’s mean weight change in both groups over 10 days of massage. The repeated measurement analysis showed that the weight gain over the course of 10 days was different in the two groups, and the rate of weight gain with coconut oil massage was more than in massage without oil ($P < 0.0001$).

Discussion

We examined the effect of coconut oil massage on weight gain pattern in LBW infants admitted in

NICU of tertiary care teaching Hospital in Kolhapur, a city in western Maharashtra, India. This centre receives baby from adjacent districts like Ratnagiri, Sindhudurg and Sangali also. Intolerance to food is commonly associated with LBW and preterm neonates as they have many feeding difficulties. This is more prominent for the first few days after birth. Also increasing the food volume and density may complicate their stay in NICU¹⁵. The Massage with coconut oil is traditional practise in many countries and Several

studies like Mathai, Agrawal, have already documented the somatic and neurodevelopmental benefits of tactile kinesthetic stimulation in preterm infants^{12,18}. However the adverse and beneficial effect of massage on growth of LBW infants with or without oil has remained unresolved. Thus, the researchers in this study tried to tackle this issue by conducting a clinical trial study.

The present study demonstrates significantly higher weight gain in coconut oil massage group (12.81 + 1.85 g/kg/day) compared to only massage group (7.70 + 1.33 g/kg/day) with over 10 days of massage (P value <0.0001). Duration of each massage session was 10 min for 3 times/day until 10 days and all infant's massage was performed by a trained person for first 2 days thereafter by the mother (who was taught the technique) till the next 8 days of age. The results of our study were similar to the studies done by saeedi et al, Vickers et al, Arora et al, Agrawal et al, about effect of massage on weight in LBW neonates^{16,17,10,18}. In a randomised controlled trial by Saeedi et al in Mashhad, Iran, reported that the mean weight gain on the 7th day in the oil massage group was 105±1.3gm and 52±0.1gm in the massage group; whereas 54±1.3gm weight loss was observed in the control group. In the mentioned study significant differences were observed between the oil-massage group and the other two groups, respectively (P=0.002 and P=0.000) suggesting the accelerated weight gain with medium-chain triglyceride oil massage therapy in premature neonates¹⁶.

Vickers et al, in his meta-analysis study showed that body massage increased daily weight gain of neonates by 5.1 gm on an average and also weight gain at 4-6 months¹⁷. In another study by Arora et al. showed that weight gain was significantly higher in oil massage group (11.6 ± 4.3 g/kg/day) than in the massage-only group (8.7 ± 4.6 g/kg/day) and no-massage group (8.3 ± 4.9 g/kg/day). However a notable point was that the main increase happened in height, head circumference, skin fold thickness and

behavioural score during 28 study days, in the oil-massage group. But it was not statistically meaningful when it was compared to other two groups¹⁰. Agarwal et al., examined the effect of massage therapy and oil on the sleep pattern of healthy term infants, the weight and blood circulation. They reported that massage in infants improved growth indices (weight, height, and arm and calf circumference) and also the neonates' sleep pattern. Also, among the different types of applied oil in this study (herbal oil, sesame oil, mustard oil and mineral oil), only sesame oil showed a significant improvement¹⁸.

An open randomized controlled trial was conducted by shankarnarayanan et al. to compare the effect of massage with coconut oil versus mineral oil and placebo (powder) on growth velocity and neuro-behaviour in well term (112) and preterm (112) babies. Oil massage was given by a trained person from day 2 of life till discharge, and thereafter by the mother until 31 days of age for four times a day. They concluded that coconut oil massage therapy increased weight gaining in comparison to mineral oil and control groups. In addition, the premature neonates receiving coconut oil massage therapy showed a higher increment in height compared to the control group. However, no significant difference in neurobehavioral was observed between the three groups¹⁹.

In their trial of 60 preterm neonates by Soriano et al, they reported significantly higher weight gain over a 30 days period in the oil massage group compared to those who received routine care (703 + 129 g vs 576 + 140 g; P <0.05)²⁰. In another study by Solkoff, et al, there was no significant difference in weight gain even with massage over 10 days. This study however had a sample of only 16 neonates²¹.

The quasi-experimental study by Smiti Arora et al reported that no significant increase in weight or neurobehavioral response was observed after the coconut oil massage therapy in LBW neonates for 7 days(2 times/day). This revelation was contrary to the present study where massage was given for

10 days (3 times/day). These discrepancies may be because of differences in: sample size, gestational age, and method of massage²².

The findings of this study demonstrated that coconut oil application improves the weight gain velocity in LBW infants over and above the benefits of tactile kinesthetic stimulation due to massage alone. This suggests a role for transcutaneous absorption of oil through the thin skin of the preterm and LBW neonate. The skin of a preterm baby allows significant absorption of fat, as it is thinner and more vascular¹⁹. This may also result in greater caloric intake and consequently a better weight gain²³. Fernandez, et al. in an elegant study in Mumbai reported that a significantly higher serum triglyceride levels in preterm neonates weighing 1500-2250 g after application of corn oil every four hours for three days. This was attributed to fatty acid absorption through the skin of preterm neonates and also demonstrated the value of oil massage in thermoregulation of small preterm babies²³. Soriano et al reported a significant increase in anthropometric parameters at one month of age in 30 consecutive preterm infants who were treated cutaneously with soybean oil compared to a control group, which received no cutaneous treatment. They observed an increase in linoleic acid level in neonate's blood²⁰. This is the probable mechanism of weight gain in LBW and preterm neonates reported by these studies. In addition, no relationship was found between infant weight and gender likewise in the present study^{18, 24}.

Surprisingly, there was also a finding in the present study that the mean duration of hospital stay between two groups was not statistically significant (P value >0.05). This was similar to the finding of Massaro et al study in Washington²⁵. But in the study by Mendes and Procionoy in Brazil, it was reported that massage therapy by mothers had no significant effect on the increase in weight gain in infants <1500 g. However, the hospital stay in the intervention group was 7 days less than the control group ($P = 0.007$)²⁶.

On comparison of the results of previous studies and this study, it can be indicated that topical oil administration in neonates, especially premature neonates, might be useful in temperature regulation and prevention of hypothermia in newborns²⁷. This is because the neonates have increased vascularity and high skin permeability. Also the fatty acid components of tropical oils can alter the lipid profile of the newborn's body in terms of both quality and quantity. Additionally, it can also improve the general growth in stored fat cells as a source of energy and accelerate weight gain without significantly affecting the body's lipid metabolism. Oil massage therapy can be used as a beneficial feeding method in premature neonates with problems like intolerance to feed, inability to breast feed and lack of coordination in sucking, swallowing and respiration reflexes¹⁶.

Conclusion

It can be concluded that coconut oil has a positive effect on weight gain in LBW infants. The technique of oil massage therapy is free from any complications or side effects and does not cause any deviation or complications arising from the general health of neonates. The traditional and harmless intervention of oil massage is an easy, cost effective practise improving the weight and general health of LBW neonates. The research also points to the potential value of oil massage as an essential and integrated part of daily nursing care for low birth weight neonates both in hospital and at home. Moreover, probably due to the culture of developing country like India where mother were young at the time they bore first baby; this study can help the mother to learn the technique of oil massage, thus educating the community about the benefits of coconut oil massage.

However, the study had following limitations:

1. As this study was conducted on infants weighing <2000 g, so results of this study could not be generalised to infants weighing >2000 .

2. The sample size was limited to 72 hence generalization of findings is restricted.
3. The result of this study cannot be generalized to full term, high risk, very low birth weight neonates.

However separate analysis of infants with appropriate and retarded intrauterine growth could not be done because of inadequate sample size. (whether growth retarded and appropriately grown babies benefit equally from oil massage need to be further evaluated.)

However, further studies should be encouraged to carry out effectiveness of oil massage on weight gain in LBW neonates with different weights as the individual differences can affect the rate of weight gain in individuals. The study was conducted over short period of time, further research is to be needed to determine long term effect of oil massage before generalise conclusion can be drawn. Furthermore, other studies can be carried out on comparing the effectiveness of massaging with different oil on weight gain in LBW infants.

Financial support and Sponsorship: Nil.

Conflicts of Interest: The authors declare that there is no conflict of interest.

Acknowledgement

This study is not funded by any organisation or company. The researchers sincerely appreciate the help of all mothers participated in the study, NICU staff and authorities of CPR general and teaching hospital. The authors acknowledge and thank the Institutional ethical committee, for providing the opportunity to conduct this study at CPR hospital. The author would also like to thank respectable head of paediatrics department for their cooperation and guidance in this study.

References

1. Deshpande Jayantl D., Phalke2 D.B., Bangal3 V. B., Peeyuusha4 D., Sushen4B. (2011): Maternal risk factors for low birth weight neonates: a hospital based case-

- control study in rural area of western Maharashtra. National Journal of Community Medicine; 2(3): Oct-Dec 2011; 2229 6816.
2. Maharban S. Disorders of weight and gestation. In: Maharban S, editor. Care of the newborn. 6th ed. Sagar publications; New Delhi: 2004.p. 219.
3. Teklehaimanot N, Hailu T. &Assefa H. (2014): Prevalence and factors associated with low birth weight in Axum and LaelayMaichew districts, North Ethiopia: A comparative cross sectional study. International Journal of Nutrition and Food Sciences, 2014; 3(6): 560-566.
4. Vickers A., Ohlsson A., Lacy -weight infants. Cochrane Database of Systematic Reviews (2009), 2, 34.
5. Bond, C. (2002) Positive Touch and Massage in the Neonatal Unit: A British Approach. Seminars in Neonatology, 7, 477-486.
6. Underdown A, Barlow J, Chung V and Stewart-Brown S. Massage Intervention for Promoting Mental and Physical Health in Infants Aged under Six Months. The Cochrane Database of Systematic Reviews, 2006.
7. Lee, H.-K.The Effects of Infant Massage on Weight, Height, and Mother-Infant Interaction. Journal of Korean Academy of Nursing 2006, 36, 1331-1339.
8. Fife B. Coconut Cures: Preventing and Treating Common Health Problems with Coconut. Piccadilly Books, Ltd.; 2005.
9. Solanki K, Matnani M, Kale M, Joshi K, et al. Transcutaneous absorption of topically massaged oil in neonates. Indian Pediatrics. 2005; 42(10):998-1005.
10. Arora J, Kumar A, Ranji S. Effect of oil massage on growth and neurobehavior in very low birth weight preterm neonates. Indian Pediatrics. 2005;42:1092-100. [PubMed]

11. Alison E. Translation of aromatherapy and massage for mother and child. Tehran: Sahar Gostar Publications; 2003.
12. Mathai S, Fernandez A, Mondkar J, Kanbur W. Effects of tactile-kinesthetic stimulation in preterms: A controlled trial. *Indian Pediatr* 2001; 38: 1091-1098.
13. Kulkarni A, Kaushik JS, Gupta P, Sharma H, Agrawal RK. Massage and touch therapy in neonates: the current evidence. *Indian Pediatr*. 2010;47:771-776. [PubMed].
14. Kuppuswamy B. 1976 Manual of Socio-economic status scale (urban). Manasagar. 32, Netaji Subhash Marg, Delhi.
15. Omari TI, Rudolph CD. Gastrointestinal Motility. In: Polio RA and Fox WW (Eds). *Fetal and Neonatal Physiology*. 2nd edn. Philadelphia, WB Saunders Co 1998; p. 1125-38.
16. Saeedi R, Gholami M, DinparvarSh, Kabirian M. Short communication: transcutaneous feeding: the effect of massage with coconut oil on weight gaining in preterm newborns. *Iran Red Crescent Med J* 2011; 13: 666-669.
17. Vickers A, Ohlsson A, Lacy JB, Horsley A. Massage for promoting growth and development of preterm and/or low birth-weight infants. *Cochrane Database Syst Rev*. 2004;2:CD000390. [PubMed].
18. Agarwal KN, Gupta A, Pushkarna R, et al. Effects of massage and use of oil on growth, blood flow and sleep pattern in infants. *Indian J Med Res* 2000;112:212-7.
19. Sankaranarayanan K, Mondkar JA, Chauhan MM, Mascarenhas BM, Mainkar AR, Salvi RY. Oil massage in neonates: An open randomized controlled study of coconut versus mineral oil. *Indian Pediatr*. 2005;42:877-84. [PubMed]
20. Soriano CR, Martinez FE, Jorge SM. Cutaneous application of vegetable oil as a coadjutant in the nutritional management of preterm infants. *J Pediatr Gastroenterol Nutr* 2000; 31: 387-390.
21. Solkoff N, Matuszak D. Tactile stimulation and behavioral development among low birth weight infants. *Child Psychiat Hum Dev* 1973; 6: 33-37.
22. Smriti Arora, Disha Ravindran, Shilpi Sarkar. Effect of Coconut Oil Massage on Weight and Neurobehavioral Response in LBW Babies. *International Journal of Pediatric Nursing* 2015. Vol 1, issue 2, page 1-3.
23. Fernandez A, Patankar S, Chawla C, Taskar T, Prabhu SV. Oil application in preterm babies - A source of warmth and nutrition. *Indian Pediatr* 1987; 24: 1111-1116.
24. Field T, Hernandez-Reif M, Freedman J. Stimulation programs for preterm infants. *Social Policy Report*. 2004;18:1-19.
25. Massaro AN, Hammad TA, Jazzo B, Aly H. Massage with kinesthetic stimulation improves weight gain in preterm infants. *J Perinatol* 2009; 29: 352-357.
26. Mendes EW, Procianoy RS. Massage therapy reduces hospital stay and occurrence of late-onset sepsis in very preterm neonates. *J Perinatol* 2008;28:815-20.
27. Adams-Chapman I, Hansen NI, Shankaran S, et al. Ten Year Review of Major Birth Defects in VLBW Infants. *Pediatrics* 2013;132(1):49-61.