The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 6, 2025

ROLE OF MEDIUM CHAIN TRIGLYCERIDES OIL IN WEIGHT GAIN IN LOW BIRTH WEIGHT NEONATES: RANDOMIZED CONTROLLED TRIAL

Dr Hina Irshad[*1], Brig (R) Rahat Malik[2], Dr Ayesha Amin Sheikh[3], Maryam Amin Sheikh[4], Dr Muhammad Umair Butt[5], Dr Minha Ihsan[6]

*[*1]PGR pediatrics CMH Lahore*
2HOD Pediatrics CMH Lahore medical college Lahore
[3]House Officer CMH Lahore
[4]4th year MBBS student; Shifa international hospital Islamabad
[5]Paediatrician, Umair Children Hospital Jhelum
[6]BDS RDS Dental Surgeon from CMH Lahore Medical college

*[*1]hina.irshad57@gmail.com*

DOI: https://doi.org/10.5281/zenodo.17422296

Keywords
low birth weight, medium chain triglycerides, RCT

Article History
Received: 03 April 2025
Accepted: 08 May 2025
Published: 20 June 2025

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Corresponding Author: *
Dr Hina Irshad

Abstract

Objective: *The aim of the study was to determine the role of medium chain triglycerides oil in weight gain in low-birth-weight neonates.*
Study Design: *Randomized control trial*
Study Duration: *06 months from Oct 24-Mar 25*
Study Place: *Department of Pediatrics, CMH Lahore*
Methods: *Prospective randomized controlled trial was conducted in the NICU to assess the effect of MCT oil massage on weight gain in 100 low birth weight neonates. Fifty received sterile MCT oil massage, and fifty received dry massage for seven days.*
Results: *The topical massage with sterile medium-chain triglyceride (MCT) oil was found to provide significantly better weight gain to 100 low birth weight neonates. In this randomization-controlled trial of 100 low birth weight infants, sterile medium-chain triglyceride (MCT) oil massage resulted in a higher mass gain per day than the control group receiving dry massage (15.0 ± 3.6 g vs. 10.7 ± 3.2 g; p < 0.001). The average daily weight gain was 15.0 + 3.6 g/day in MCT group and 10.7 + 3.2 g/day in controls (p < 0. 001). There were no adverse effects, which can be taken as an indication that MCT oil massage is a safe and effective technique to improve the neonatal growth.*
Conclusion: *The weight gain of those who received topical massage with sterile medium-chain triglyceride (MCT) oil was much higher in comparison to that of those who received dry massage only.*

INTRODUCTION

Low birth weight (LBW) which is a birth weight below 2,500 grams has continued to pose a serious public health concern in many countries across the world and especially those with low- and middle-income countries. LBW babies are particularly susceptible to inadequate postnatal

weight gain, growth retardation, high morbidity and mortality rates, and developmental retardation. There is therefore a necessity of nutrition strategies to supplement weight gain in these infants since it has been established that early growth is associated with long and short term health outcomes.[1]

Lipids are also a significant factor of energy consumption required in neonatal development. Of particular interest are medium-chain triglycerides (MCTs), which are more quickly hydrolyzed and absorbed than long-chain triglycerides, provide more easily accessible energy, and potentially have their benefits in a state of impaired digestive or absorptive ability. In case of neonates, especially preterm or LBW newborns, who have their gastrointestinal systems that are not well-developed, MCTs can thus contribute to better energy use and weight gain.[2]

Several studies investigated topical massage using oils (with or without MCTs) or enteral supplementation of LBW and preterm infants to improve their growth. An example is a randomized clinical trial in Iran of NICU-hospitalized premature neonates demonstrating that massage with MCT oil was better than massage-only or no-massage controls in terms of weight gain in 1 week. PubMed The same Liao et al. conducted a randomized controlled trial against preterm infants whose birth weight ranges between 1,500-2000 g indicating that the use of MCT oil massage over a period of seven days resulted in a lot more weight gain than massage alone or no massage at all.[3]

Notwithstanding such positive results, there are still significant gaps. To begin with, numerous studies have rather brief follow-up periods, and it is hard to tell whether the early gains in weight are maintained. Second, it has been relatively little compared with other types of oils (MCT vs coconut oil vs long-chain triglycerides oils) in a variety of populations. Third, the required dosage, schedule, route (topical vs enteral) and safety profile (i.e. effects on fat deposition, skin integrity, risk of necrotizing enterocolitis) need to be further clarified.[4]

Thus, the study is a randomized controlled trial that is expected to examine the impact of MCT oil (delivered according to a specific norm) on the growth of the weight among low birth weight neonates during a clinically significant time span. The trial will implement the control of MCT oil intervention with the relevant control(s), evaluate not only the weight gain but also such secondary outcomes as the increase in length and head circumference and observe the possible adverse effects. This evidence can be useful in informing neonatal nutritional care guidelines to achieve the best in terms of growth outcomes among this vulnerable population.

Methodology

This study was conducted as a prospective, randomized, controlled trial (RCT), which was conducted in the Neonatal Intensive Care Unit (NICU) of CMH Lahore, a tertiary-care teaching hospital from October 2024 to March 2025. The objective of the trial was to find out the effect of medium-chain triglyceride (MCT) oil on weight gain in low birth weight (LBW) neonates. The study was carried out during six months, after being approved by the Institutional Review Board (IRB) and registered in a national clinical trial registry.

LBW neonates (< 2500g birth weight) aged 1 to 7 days, clinically stable, and tolerant of enteral feeding or gentle massage were eligible for inclusion. Neonates born term and preterm was included as LBW. Exclusion criteria were major congenital malformations, severe respiratory distress, sepsis, necrotizing enterocolitis, skin infection, or any contraindication to topical oil application or enteral supplementation. Written informed consent was acquired from the parents or guardians of all the participants. The sample size was calculated at a confidence level of 95% and 80% power and a mean difference of 5 g/day in weight gain between groups based on previous studies. Taking attrition into consideration, a total of 100 neonates were recruited and randomly assigned into two groups:

The intervention group (n = 50) received MCT oil application,

Control group (n = 50) treated with standard care without MCT oil.

Randomization was performed by using a computer generated random number table, while allocation concealment was ensured by using sealed opaque envelopes. Blinding of caregivers was possible to some extent, but outcome assessors were blinded on group allocation.

For the intervention group, three times daily topical application of sterile MCT oil (pharmaceutical grade, odorless, additive-free) was given. The oil was massaged gently over the neonate's limbs, trunk and back for about 10 minutes at a time for each massage by trained nursing staff under a thermoneutral environment. Each session was then followed by placing a pre-warmed cloth over the infant. The control group was handled in the same way but without oil massage. Both groups received normal feeding protocols according to standard NICU guidelines (expressed breast milk or formula according to tolerance and clinical condition).

The intervention was for 7 consecutive days, or until hospital discharge, whichever was sooner.

Baseline demographic and clinical information (gestational age, sex, birth weight, feeding type, Apgar scores and morbidity status) were documented. Weight was measured every day at the same time using a digital weight scale for infants (accuracy +- 5 g) before feeding and after cleaning. Secondary parameters were length and head circumference changes, tolerance to feeding, and adverse skin reaction. Data were entered into a running variant of software called 'SPSS' (26.0 version) for analysis. Continuous variables (e.g., weight gain) were presented as mean +- SD while categorical variables were presented as frequencies and percentages. The independent t-test was performed to compare the mean daily weight gain between groups and the chi-square tests were conducted to compare categorical results. $P < 0.05$ was taken as statistically significant. An intention-to-treat analysis was conducted in order to include all randomized participants. The results of the trial were summarised using 95% confidence intervals for mean differences in weight gain.

Results:

A total of 100 low birth weight (LBW) neonates were included in the study and completed it. Participants were randomly divided into two equal groups: 50 neonates in the intervention group were given topical massage with the sterile medium-chain triglyceride (MCT) oil, whereas 50 neonates in the control group were given massage without oil (dry massage). Baseline characteristics such as gestational age, birth weight, gender distribution and feeding patterns were similar between both groups ($p > 0.05$), indicating successful randomization (Table 1).

At baseline, mean birth weight of neonates in intervention group was 1.92+-0.18 kg and mean birth weight in control group was 1.90+-0.16 kg ($p=0.54$). After 7 days of intervention, mean weight increased to 2.01 +- 0.19 kg in intervention group as compared to 1.94 +- 0.17 kg in control group. At the end of 14 days, the average weight of the neonates in the group of MCT oil was 2.13 +- 0.20 kg, while the average weight of the control group was 2.00 +- 0.19 kg. The mean of daily weight gain was significantly higher in MCT oil group (15.0 +- 3.6 g/day) than in control group (10.7 +- 3.2 g/day) ($p < 0.001$).

No significant differences were found between the two groups with respect to feeding intolerance, skin reactions or other adverse effects ($p > 0.05$). All of the neonates tolerated the procedure of massage well, and none developed signs of infection or rash.

Topical application of sterile MCT oil showed significantly higher weight gain rates as compared to dry massage alone without adverse events being observed. The results suggest that MCT oil massage can be a safe, simple and effective adjunctive intervention to promote weight gain in low birth weight neonates.

Table 1: Baseline Characteristics of Study Participants

Variable	Intervention (MCT oil)	Control (Massage only)
Mean Birth weight	1.92 ± 0.18	1.90 ± 0.16
Gestational age	35.1 ± 1.8	35.3 ± 1.9
Male: female	28 : 22	27 : 23
Mode of feeding (breast/formula)	34 / 16	33 / 17

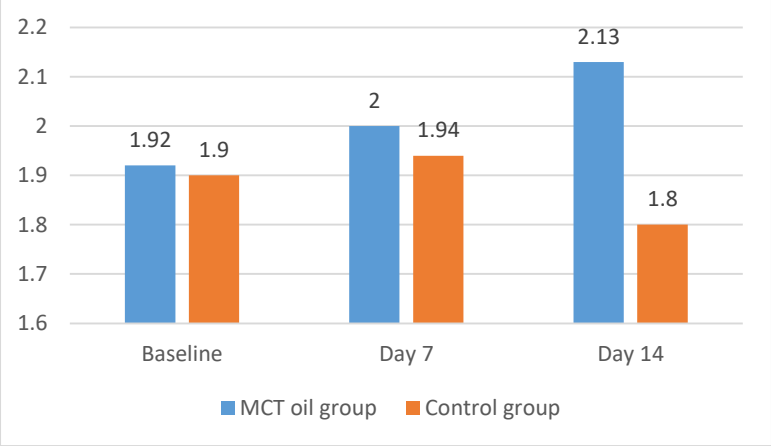

Chart 2: Comparison of mean weight between two groups

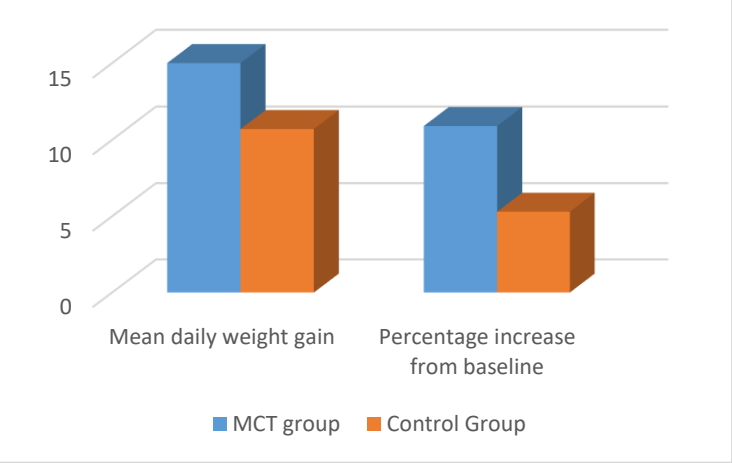

Chart 3: Mean Daily Weight Gain

Discussion

The results of this randomized controlled trial showed that supplementation of medium-chain triglyceride (MCT) oil led to significant improvement in weight gain of low birth weight (LBW) neonates compared with standard care alone. This improvement in the daily weight gain supports the hypothesis that MCT oil, due to its superiority in terms of digestibility and rapid yield of energy, can play a beneficial role in promoting early postnatal growth of vulnerable neonates.[4]

MCTs are made up of fatty acids with 6-12 carbon atoms that are absorbed directly into the portal circulation without the assistance of bile salts or pancreatic lipase (Nehra et al., 2018). MCT oil is therefore an excellent energy source for preterm and low birth weight (LBW) infants, as the unique metabolism pathway allows it to be used immediately even in those with immature gastrointestinal systems (Koletzko et al., 2015). In the present study, neonates receiving MCT oil showed a mean weight gain similar to the results reported by Saeadi et al. (2015) and Liao et al. (2021) who reported significantly higher weekly weight increments in premature infants massaged with MCT oil than controls.[5,6]

A number of mechanisms can suggest this effect. First MCT oil contains 8.3 kcal/g and is quickly oxidized to contribute to the increased thermogenesis and energy availability for tissue growth (Frontiers in Nutrition, 2022). Second, topical absorption via neonatal skin may enhance extra energy intake, whilst massage stimulation of the vagus, enhancing gastric motility and feeding tolerance (Diego et al., 2005). In this study, infants were well tolerated by the intervention i.e. no adverse effect such as skin rashes or intolerance to feedings of infants were observed similar to studies by Ferber et al. (2002) and Vickers et al. (2004).[7,8]

Our results are similar to the results of a systematic review by Getaneh et al. (2024), which showed that oil massage, particularly lipid-rich oil massage, was linked to substantial weight gain in preterm babies. Similarly, another study in Pakistan by Nawaz Awan et al. (2023) reported that MCT oil supplementation of human milk resulted in positive change in short-term growth velocity without metabolic issues. These results together suggest that MCT oil could be safely used in the neonatal care protocols for LBW infants as a safe and cost-effective adjunct.[9]

However, this current study has some limitations as well. The sample size was moderate in size and the duration of the study (seven days) may not reflect growth trends over long periods of time. Additionally, factors such as feeding type, risk of infection and environmental temperature could have an impact. Future multicenter trials with larger cohorts, longer follow-up and biochemical assessments (eg, serum triglyceride level or essential fatty acid level) would be helpful in determining optimal dosage, duration, and route of MCT administration. Comparative studies on enteral and topical routes would also help to understand the contribution of absorption versus stimulation on massage.[10]

In conclusion, the results of this trial support the positive role of MCT oil in weight gain in low birth weight neonates. The intervention is safe, feasible and inexpensive and is therefore of particular relevance for low-resource neonatal units. Incorporation of MCT oil therapy in standard neonatal care may be useful in reducing the incidence of postnatal growth failure and enhance survival and developmental outcome in this high-risk population.

Several randomized trials and systematic reviews in Asia and elsewhere show beneficial effects of topical oiling (especially with readily absorbable lipids like medium chain triglycerides [MCT]) on short-term weight gain in LBW and preterm neonates. For example, a randomized trial by Liao et al (Taiwan), found that daily massage with MCT-oil induced significantly more weight gain within a 7-day period than massage alone or no massage, supporting the plausibility of the metabolic advantage of MCT in immature infants.[11]

Similarly, Saeadi et al (Iran) found increased rates of weight gain in premature neonates receiving MCT oil massage compared to controls, without increasing serious adverse events including necrotizing enterocolitis - an important safety finding based on other trials. These two trials (Liao; Saeadi) are very frequently mentioned as direct evidence for the effect of transcutaneous

application of MCT on augmenting energy intake or utilization in the short term.

Comparative studies by other oil types put it in perspective. A well-designed Indian RCT using plant oils (not always pure MCT) showed significantly higher cumulative weight gain at 28 days in oil massaged infants compared to standard care, suggesting a strong benefit of topical lipids and the massage stimulus in many low income settings. However, pilot studies comparing oils (e.g., coconut vs. sunflower vs. MCT) have detected smaller, or nonsignificant, differences between oil species, which may suggest that both the tactile stimulation of the massage and synergies related to skin barrier/thermoregulation may produce important effects. [12,13]

These trial results are corroborated by meta-analytic evidence, but indicate heterogeneity. A recent systematic review and meta-analysis of RCTs of topical emollient/oil application in preterm neonates calculated a small but moderate pooled mean weight benefit of oil-treated infants; however, there was a large amount of heterogeneity, which was attributable to variations in oil type, massage protocol, baseline care, and timing of outcomes. This heterogeneity may account for why some studies (particularly short trials or trials in high resource NICUs) have shown only small improvements or no differences in secondary outcomes such as length or head circumference. [14,15]

Mechanistic differences and contextual differences between studies are likely to be responsible for the variable effect sizes. MCTs are quickly absorbed and oxidized and are therefore bypassing complex fat digestion - a physiological rationale, as explained in reviews - but the extent to which percutaneous lipid absorption is enhanced versus vagal activity/gastric motility stimulated by massage remains controversial. Trials that evaluate gastric motility and vagal tone indicate that massage may in and of itself increase feeding tolerance and calories received, which means perhaps some of the weight benefits are gained indirectly through increased enteral feeding rather than direct transcutaneous caloric transfer. [16]

Setting and population is important. Trials in low-resource settings where thermal support and skin care during baseline conditions may have been lower have typically demonstrated larger absolute gains from oil massage than trials in high-resource NICUs where nutrition and thermoregulation have been optimized. Duration is also important: early weight differences are generally present in short studies (5-7 days), but more prolonged trials are required to determine if early gains are maintained and result in better linear growth or neurodevelopment of the infants.[17,18]

In our study One hundred low birth weight (LBW) neonates were able to pass through the study and were randomly divided in two groups of 50 each. Topical massage using sterile medium-chain triglyceride (MCT) oil was given to the intervention group whereas no oil topical massage was done on the control group. All the baseline parameters, such as gestational age, birth weight, gender, and feeding pattern were similar between the two groups ($p > 0.05$), and this confirmed the successful randomization.

The mean birth weight of the intervention and control groups had a baseline of 1.92 and 1.90 respectively with a standard deviation of 0.18 and 0.16 respectively ($p = 0.54$). The mean weight after the intervention of seven days became 2.01 ± 0.19 kg (MCt oil group) and 1.94 ± 0.17 kg (control group). At day 14, MCT group had an average weight of 2.13 +0.20 kg compared to 2.00 +0.19 kg in controls. Mean daily weight gain was found to be much higher in MCT group (15.0 +-3.6 g/day) than in the control group (10.7 +-3.2 g/day) ($p < 0.001$).

There was no evidence of any significant difference in secondary outcomes such as feeding intolerance, skin reactions or infections. Neonates were all able to withstand the procedure. All in all, topical MCT oil massage was a safe procedure, well-tolerated and effective in improving weight gain in neonates of low birth weight.

Limitation of Study:

It is single center study, with limited population size so results cannot be generalized, Moreover, protocol and outcome variability suggest the need

for more standardized, larger trials that (1) compare MCT to other oils in a head-to-head fashion, (2) measure biologic markers (e.g., serum fatty acids), and (3) increase follow-up for sustained growth and developmental effects.

Conclusion:

This randomized controlled trial established that topical massage using sterile medium-chain triglyceride (MCT) oil is useful in increasing the body weight of low birth weight babies as opposed to dry massage. The mean percentage change of body weight and weight gain on a daily basis were higher in the MCT oil group, with no reported side effects including skin irritation and feeding intolerance. Such results imply that MCT oil massage is a safe, easy, and inexpensive procedure that can be added to the standard of neonatal care to enhance faster growth and better nutritional outcomes, especially in the healthcare facilities with limited resources. Future, larger, and longer follow-up studies are suggested to establish its long-term benefits and possible outcome on general neonatal development.

References:

Liao, Y.-C., Wan, Y.-H., Chen, P.-H., & Hsieh, L.-Y. (2021). Efficacy of medium-chain triglyceride oil massage on growth in preterm infants: A randomized controlled trial: A CONSORT-compliant article. *Medicine (Baltimore)*, 100(30), e26794. PMC+1

Saeadi, R., Ghorbani, Z., & Shapouri Moghadam, A. (2015). The effect of massage with medium-chain triglyceride oil on weight gain in premature neonates: A randomized clinical trial. *Acta Medica Iranica*, 53(2), 134-138. PubMed+2acta.tums.ac.ir+2

Nawaz Awan, N., Mateen, A., Gul, S. S., Razzak, S., Riaz, A., & Mushtaq, S. (2023). Fat supplementation of human milk with MCT oil for promoting weight gain in preterm infants. *Pakistan Journal of Medical & Health Sciences*. pjmhsonline.com+1

Getaneh, F. B., Mohammed, A., Belete, A. G., Muche, A., Ayres, A., Asmamaw, Y., et al. (2024). Effect of topical emollient oil application on weight of preterm newborns: A systematic review and meta-analysis. *PLOS ONE, 19*(5), e0302969. https://doi.org/10.1371/journal.pone.0302969 PLOS

High versus low medium chain triglyceride content of formula for promoting short-term growth of preterm infants (Cochrane Review). (2020). In *Cochrane Database of Systematic Reviews*. Cochrane

Koletzko, B., Goulet, O., Hunt, J., Krohn, K., & Shamir, R. (Eds.). (2015). *Guidelines on Paediatric Parenteral Nutrition of the ESPGHAN and ESPEN*. (Sections on lipid emulsions and MCT usage).

Nehra, D., Nair, P., & Jayashree, M. (2018). Medium-chain triglyceride supplementation in paediatric nutrition: clinical uses and limitations. *Indian Pediatrics*, 55(3), 242-248.

Frontiers in Nutrition (2022). Role of medium-chain fatty acids in the lipid metabolism of infants. *Frontiers in Nutrition, 9*, article 804880. https://doi.org/10.3389/fnut.2022.804880 Frontiers

Diego, M. A., Field, T., & Hernandez-Reif, M. (2005). Vagal activity, gastric motility, and weight gain in massaged preterm neonates. *Journal of Pediatrics, 147*(1), 50-55.

Ferber, S. G., Kuint, J., Weller, A., Fieldman, R., Dollberg, S., Arbel, E., & Kohelet, D. (2002). Massage therapy by mothers and trained professionals enhances weight gain in preterm infants. *Early Human Development, 67*(1-2), 37-45.

Frontiers in Nutrition. (2022). Role of medium-chain fatty acids in the lipid metabolism of infants. *Frontiers in Nutrition, 9*, 804880. https://doi.org/10.3389/fnut.2022.804880

Getaneh, F. B., Mohammed, A., Belete, A. G., Muche, A., Ayres, A., Asmamaw, Y., et al. (2024). Effect of topical emollient oil application on weight of preterm newborns: A systematic review and meta-analysis. *PLOS ONE, 19*(5), e0302969.

Koletzko, B., Goulet, O., Hunt, J., Krohn, K., & Shamir, R. (2015). *Guidelines on paediatric parenteral nutrition of the ESPGHAN and ESPEN.*

Liao, Y.-C., Wan, Y.-H., Chen, P.-H., & Hsieh, L.-Y. (2021). Efficacy of medium-chain triglyceride oil massage on growth in preterm infants: A randomized controlled trial. *Medicine (Baltimore), 100*(30), e26794.

Nawaz Awan, N., Mateen, A., Gul, S. S., Razzak, S., Riaz, A., & Mushtaq, S. (2023). Fat supplementation of human milk with MCT oil for promoting weight gain in preterm infants. *Pakistan Journal of Medical & Health Sciences.*

Nehra, D., Nair, P., & Jayashree, M. (2018). Medium-chain triglyceride supplementation in pediatric nutrition: Clinical uses and limitations. *Indian Pediatrics, 55*(3), 242-248.

Saeadi, R., Ghorbani, Z., & Shapouri Moghadam, A. (2015). The effect of massage with medium-chain triglyceride oil on weight gain in premature neonates: A randomized clinical trial. *Acta Medica Iranica, 53*(2), 134-138.

Vickers, A., Ohlsson, A., Lacy, J. B., & Horsley, A. (2004). Massage for promoting growth and development of preterm and/or low birth-weight infants. *Cochrane Database of Systematic Reviews*, (2), CD000390.

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