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# Hyperbilirubinemia and Neonatal Massage Bringing Traditional Indian Practices Back to Life

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**Abstract**

Neonatal hyperbilirubinemia refers to the yellowish discolouration of skin and elevation of serum bilirubin levels based on the day of life and period of gestation as mentioned in the American Academy of Paediatrics guidelines [1]. Elevated serum bilirubin levels for prolonged period of time can cause kernicterus, which is a type of fatal neonatal jaundice [2]. While kernicterus is fatal in approximately 5% neonates, 80% survivors encounter neurodevelopmental problems[3]. In most cases, jaundice is benign and no intervention is required. However 50% of the cases have clinical significant jaundice that require treatment to lower serum bilirubin levels in order to prevent neurotoxicity[4]. As we work towards the Sustainable Development Goals of improving neonatal mortality and the goal of decreasing morbidity, severe neonatal jaundice needs to be addressed as a preventable cause of both – most effectively addressed with a package approach which includes maternal, community and healthcare provider education[5]. At all settings of healthcare and living this can be managed with traditional practice of massaging newborn from the very beginning of life. Sense of touch is developed in the foetus just before the 34$^{th}$ week. Nature begins massaging of foetus in uterus prior to the birth[6]. An experimental research design was utilised, involving 42 hemodynamically stable neonates with physiological jaundice, born at or above 36 weeks of POG without any congenital abnormalities, receiving phototherapy were included in the study. They were divided and randomly allocated into control and intervention group by using Urn method. The control group received only phototherapy whereas the intervention group received body massage alongwith conventional phototherapy. The conceptual framework adopted for this study was based on Roy's Adaptation Model given by Sister Callista L. Roy (1939). The prominent nursing theory aims to explain or define the provision of nursing. Ethical clearance was received from Institutional ethical committee, Armed Forces Medical college. Data was analysed, frequencies and percentages were calculated to show distribution of subjects according to baseline variables. Descriptive statistics like mean and standard deviation were computed to describe the change total serum bilirubin before and after in both the groups, change in frequency of defecation and urination. Kruskal-Wallis test was done to assess effectiveness of post intervention bilirubin in both groups . Chi-Square test was done for association with the demographic variable. Major findings of study depicted that mean reduction in serum bilirubin levels in both the groups were highly effective and was comparatively more significant in intervention group(t=10.91) as compared to control group(t=8.83) by using unpaired t test analysis with table value of 2.09. The practice of massaging newborn under phototherapy units is effective in reducing the duration of exposure to light and hence prevent causing harm to retina and fertility of babies.

**Keywords:** Hyperbilirubinemia, Neonatal massage, phototherapy, defecation frequency, urination frequency

## 1. Introduction

Neonatal massage is a common traditional practice in India and many other countries. Massage therapy help in reducing the neonatal stress and development of parental bonding with the child. Most cases of neonatal jaundice are caused by unconjugated bilirubinaemia, which occurs due to excessive bilirubin formation and inability of the neonatal liver to clear the bilirubin rapidly enough from the blood circulation. Elevated serum bilirubin levels at the early stage of life can lead to permanent brain damage[7]. Nature begins massaging of foetus in uterus prior to the birth. Initially the fetus moves and floats in the uterus environment and as time passes, the ambient hold it tighter adding to its endearment, and gradually convert to contractions which induce pressure and stimulation of its skin and other body organs[6]. Body massage i.e. effleurage technique help in increasing the lymphatic drainage and as a result in return help in elimination of bilirubin to be excreted from body as stercobilin and urobilinogen[8]. In the neonate, hyperbilirubinemia is usually due to a combination of an increased bilirubin load and decreased bilirubin elimination[9].

As one of the oldest complementary therapies with its 2000years of history, massage is using for preserving well-being or accelerating recovery process[6]. Hyperbilirubinemia, or jaundice, is a life threatening disorder in newborns. It is a multifactorial disorder with many symptoms[10]. The goal of treatment in neonatal hyperbilirubinemia is to prevent serum bilirubin levels from reaching neurotoxic levels[11].

## 2. Background

Neonatal period is of immense importance for the proper development of healthy life of newborn baby. During this period the neonatal mortality is very high. Hyperbilirubinemia was known Charak and Sushruta, Hippocrates also gave a description of jaundice. Neonatal massage is a natural way for caregivers to improve health, sleep patterns, growth and development and reduce colic[2]. Severe neonatal jaundice remains an important contributor to neonatal morbidity and mortality, especially in the African and south east Asian regions[5]. About 21.99% neonates of all neonatal admissions had diagnosis of neonatal jaundice between WHO regions ranging from 30.61% South-east Asia[12]. Many studies have been done previously to know the causes of hyperbilirubinemia in newborns but more studies are required from different geographical areas to see the burden and causes of neonatal jaundice so that a collective effort can be made to decrease the burden of neonatal mortality and morbidity resulting from neonatal hyperbilirubinemia[13].

## 3. Scope of Study

This study shall open the doors for reducing the timing consumed and phototherapy exposure given to the newborns which has higher chances to cause retinal damage and diarrhoea, bronze baby syndrome and enhance the maternal child bonding. The study will also prevent insensible water loss from body and enable mother to feed the baby exclusively breastmilk without any mental stress and trauma.

## 4. Primary Objectives

4.1 To assess the total serum bilirubin level before phototherapy in Control and interventional group.

4.2 To assess the total serum bilirubin level after phototherapy in Control group.

4.3 To assess the total serum bilirubin level after body massage and phototherapy in Interventional group.

4.4 To compare the pre test and post test total serum bilirubin level in control and Interventional group.

4.5 To associate between effectiveness of post interventional neonatal hyperbilirubinemia among control and interventional group with selected demographic variables.

## 5. Primary Hypothesis

5.1 Ho (1): There is no difference in reduction of total serum bilirubin level among study groups. HI (I): There is a difference in reduction of total serum bilirubin level among study groups.

5.2 Ho (2): There is no association of mean reduction of total serum bilirubin level among study groups with selected demographic variables.

HI (2): There is an association of mean reduction of total seru4553m bilirubin level among study groups with selected demographic variables.

## 6. Assumptions of the study

6.1 All the mothers will be able to give care to the child with the same level of effort while giving body massage to newborns.

6.2 All the mothers are equally capable of recording the accurate frequency of urine and stool output.

6.3 The phototherapy equipments used in wards are of same irradiance being the same hospital setup for all the samples.

## 7. Limitations of the study

7.1 Time duration for data collection is only 6 weeks, which makes it difficult to receive variety of traits of population for data collection.

7.2 Only one setup is being used to maintain homogeneity of the phototherapy equipment used in the study.

7.3 Sampling size could not be increased due to time constraint for data collection phase.

7.4 Sampling is done in time frames and simple random sampling can not be performed.

## 8. Ethical measures

Institutional Ethical Clearance (IEC) was obtained 6 months prior to the onset research from IEC, Armed Forces Medical College Pune. An informed written assent was obtained from all participants in English, Hindi and Marathi language as per the understanding of parents. The assent forms were validated by language experts for correctness of the information in respective languages.

## 9. Conceptual framework

The conceptual framework adopted for this study was based on Roy's Adaptation Model given by Sister Callista L. Roy (1939). Roy conceptualizes the person in a holistic perspective. Individual aspects of parts act together to form a unified being. Additionally, as living systems, persons are in constant interaction with their environments. Between the system and the environment occurs an exchange of information,

matter, and energy. Characteristics of a system include inputs, outputs, controls, and feedback. The environment is a stimulus or input that requires a person to adapt. These stimuli can be positive or negative. Application of Roy's adaptation to this study - In this study input is identified as - breakdown of fetal RBCs causing physiological jaundice evidenced by yellowish discolouration of sclera and skin after 48hrs of life. Here, this input process can be controlled by phototherapy which helps in excretion of this unconjugated bilirubin from body as stercobilin and urobilinogen. This process of excretion is influenced by the amount of breastfeeding, duration of phototherapy, the frequency of excretion of urine and stool and insensible water loss due to thermoregulation. As an output variable there is decrease in serum bilirubin level of the newborn baby. As a result the symptoms of physiological jaundice is relieved.

The mode of adaptation as per Roy's Adaptation theory is physiologic mode of adaptation since physiological jaundice is resulting as a result of breakdown of fetal RBCs.

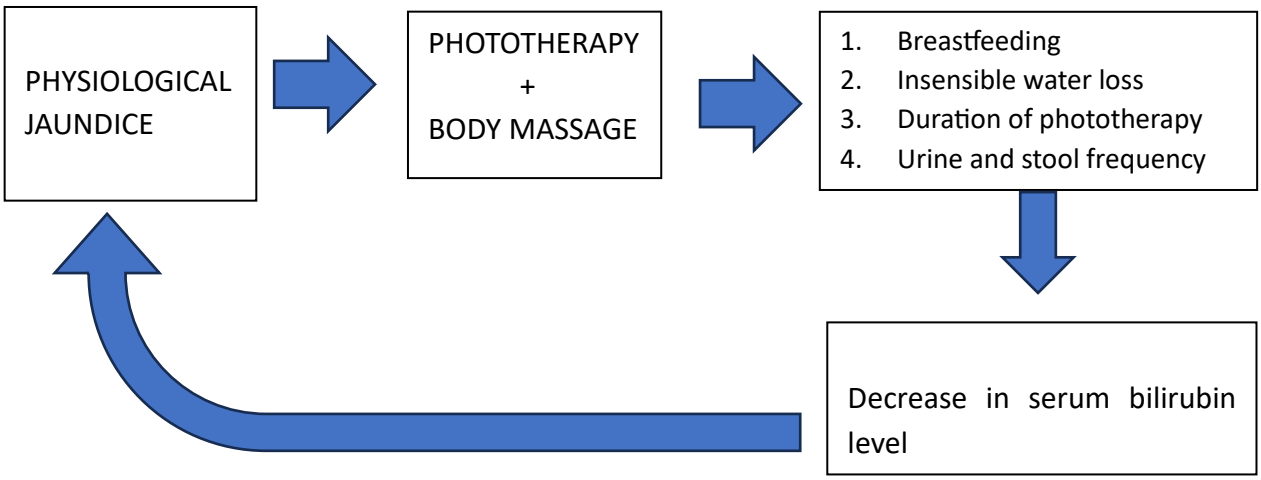
9.1 Behaviour / mode of adaptation : Physiologic adaptation mode

9.2 Stimuli : Focal stimuli – Breakdown of fetal red blood cells

Contextual stimuli – Hydration status, Inadequate breastfeeding

Residual stimuli – Neonatal jaundice in sibling

**Figure 1 : Conceptual framework of study**




10. **Review of literature**

In the present study the review of literature is organised under following five heads, as follows -

10.1 Literature related to prevalence of neonatal hyperbilirubinemia.

10.2 Literature related to clinical assessment of neonatal hyperbilirubinemia.

10.3 Literature related to body massage and serum bilirubin values in neonatal hyperbilirubinemia.

10.4 Literature related to body massage and association with defecation and urination frequency.

The focus of this study is to identify whether body massage aids in reducing the neonatal hyperbilirubinemia more effectively than conventional phototherapy alone. It also identifies whether there is an association between the mean reduction of serum bilirubin and body massage. Brief overview of literature review is given as follows:

10.1.1 Javaid Iqbal et al. (2023) published the article in International Journal of Research in medical sciences and stated that in GMC Rajouri out of 339 babies 472 babies i.e. 56.63% newborns developed jaundice after 72hrs of birth requiring care and specified the need of prevention from dangerous complication of neonatal hyperbilirubinemia[14] .

10.2.1 Dip Sankar Banerjee et al. (2023) mentioned about use of various non invasive techniques to identify neonatal jaundice. The study presented a review on existing modalities in screening of neonatal jaundice as well as estimation of bilirubin levels in neonates[15].

10.3.1 Marjan Shahbazi et al. (2022) conducted a meta analysis wherein 20 studies were included. Cochrane, PubMed, Scopus, and Web of Science, were searched for review of literature. There was a positive and significant increasing dose-response trend between massage therapy and the mean reduction of bilirubin in neonates with hyperbilirubinemia as follows: <50 minutes massage during the experiment 0.36, 50-60 minutes massage during the experiment -0.41 and ≥101 minutes massage during the experiment -1.20 [7].

10.4.1 Elif Dogan et al. (2022) from Istanbul university- Cerrahpasa, conducted a RCT. TcB device and data collection was used to study 61 newborns. Body massage was given for 10 minutes before phototherapy in experimental group and bilirubin levels were recorded 2 hours after the phototherapy in both groups. The diapers were changed 8 times a day, every 3 hours. It was found that there was a significant (p=0.0001) decrease in bilirubin levels in experimental group from day 3. The frequency of defecation on 2nd and 3rd day increased significantly (p=0.0001) in experimental group[16].

## 11. Methodology

Quantitative research approach was used with experimental research design and total 42 hemodynamically stable neonates with physiological jaundice, born at or above 36 weeks of POG without any congenital abnormalities, receiving phototherapy were included in the study. Neonates of mothers with BOH and Rh incompatibility were excluded. Defecation and urination frequency along with TsB values were recorded with other demographic variables. Sample size calculation was done as per the following formula –

Desired level of confidence = 95 %

Power of study = 90%

$Z\alpha = 1.96$ and $Z\beta = 1.64$

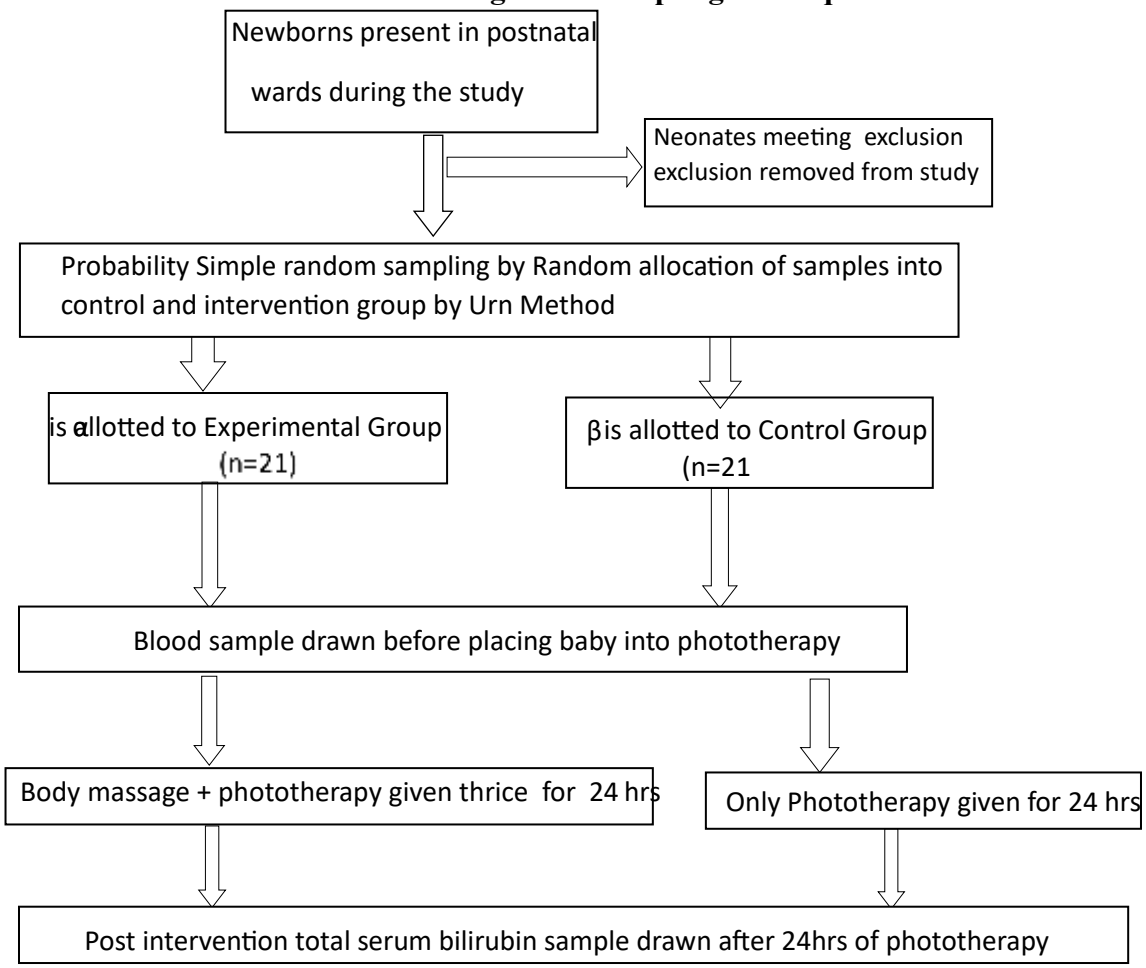
Absolute precision, E = 2%

Number of sample in each group : $n = 2 (Z\alpha + Z\beta)^2 \times E^2 = 21$

Total sample size = 42

Neonates were randomly allocated into control and intervention group by Urn method. It has two parameters such as α (control) and β (intervention). These parameters refer to two balls (red and white). While α may be white or red, β represents the other color. One of the balls is randomly selected. If the selected ball is white, the individual is assigned to α group. If it is red, the individual is assigned to the β group. This process is repeated in each assignment.

**Figure 2: Sampling technique**




The tool consisted of 2 sections:

Section A : Questionnaire for sociodemographic variables and baseline data Section B : Kramer Score (for assessment purpose of neonatal hyperbilirubinemia) and Total serum bilirubin values (TsB) twice i.e. before the intervention and after the intervention.

With the shifting of mothers to post natal wards from labor room, they were given a paper to record the defecation and urination output from day 1 of life, which was beneficial in obtaining the accurate frequency of the defecation and urination. Babies who were found to be having physiological jaundice by Kramer score and advised for phototherapy by pediatrician were prepared to be placed under phototherapy device. Prior to placement into phototherapy, serum bilirubin sample was taken and sent to laboratory for reports. In this study this is called the pre test TsB whereas another sample was taken after 24hrs of phototherapy which is called post test TsB. After sending the pre test TsB, baby was well breastfed by the mother, she was educated about the care of child in phototherapy device, proper covering of eyes and genitalia was ensured with baby eye shield and baby diaper. After 1 hour of feeding followed by phototherapy babies in intervention group were provided massage by the researcher every 8$^{th}$ hourly. The massage was given thrice for each baby, following the series of steps. Massage of newborn may be done using a lubricant (oil) to avoid friction between the surfaces.[46] The Field's massage therapy was used consisting of both tactile and kinesthetic stimulation, given for 15 minute sessions starting with 5 minutes

of tactile stimulation followed by 5 minutes of kinesthetic stimulation and ending again with 5 min of tactile stimulation[17].

**11. Data Analysis**

The data was organized in MS Excel worksheet and analysed with SPSS 23 software. Frequencies and percentages were calculated to show distribution of subjects according to baseline variables. Descriptive statistics like mean and standard deviation were computed to describe the change total serum bilirubin before and after in both the groups, change in frequency of defecation and urination. Kruskal-Wallis test was done to assess effectiveness of post intervention bilirubin in both groups . Chi-Square test was done for association with the demographic variable. The analysis and interpretation of data of the study are based on data collected through validated tool inclusive of two sections as mentioned -

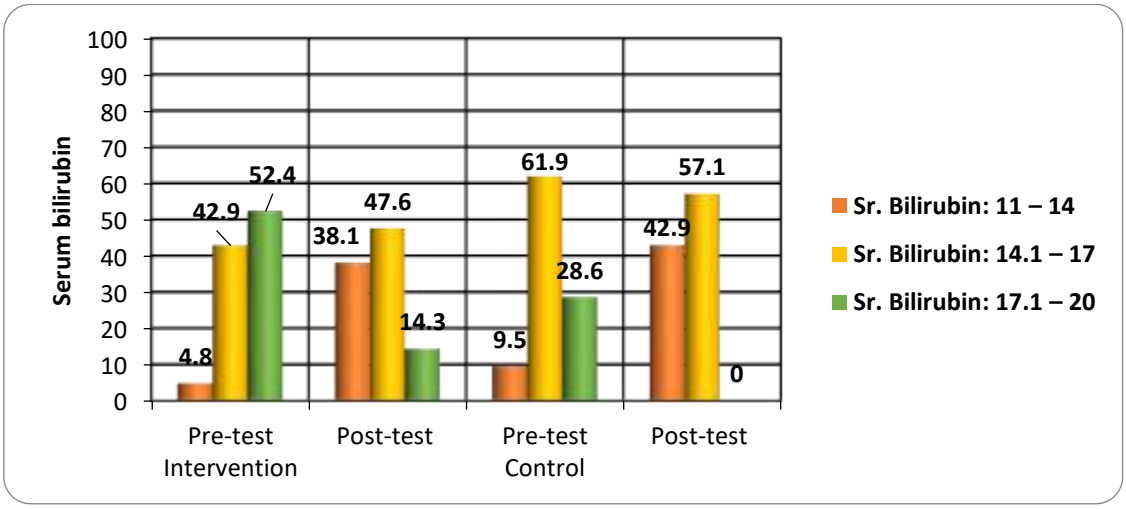
11.1 Data on demographic variable of neonates in control and intervention group.

**Table 3 : Demographic variables**

| Parameters | | **Intervention (%)** | **Control (%)** | **Chi-square P Value** |
|---|---|---|---|---|
| Gestational age (Wks) | 36 – 38 | 8 (38.1) | 9 (42.9) | 0.10 P=0.75 |
| | 38 – 40 | 13 (61.9) | 12 (57.1) | |
| Present age (Days) | 2 | 5 (23.8) | 7 (33.3) | 1.20 P=0.55 |
| | 3 | 9 (42.9) | 10 (47.6) | |
| | 4 | 7 (33.3) | 4 (19) | |
| Parity | Primi | 9 (42.9) | 11 (52.4) | 0.38 P=0.54 |
| | Multi | 12 (57.1) | 10 (47.6) | |
| Birth weight (Kgs) | 2.5 – 3 | 13 (61.9) | 14 (66.7) | 0.10 P=0.75 |
| | >3 | 8 (38.1) | 7 (33.3) | |

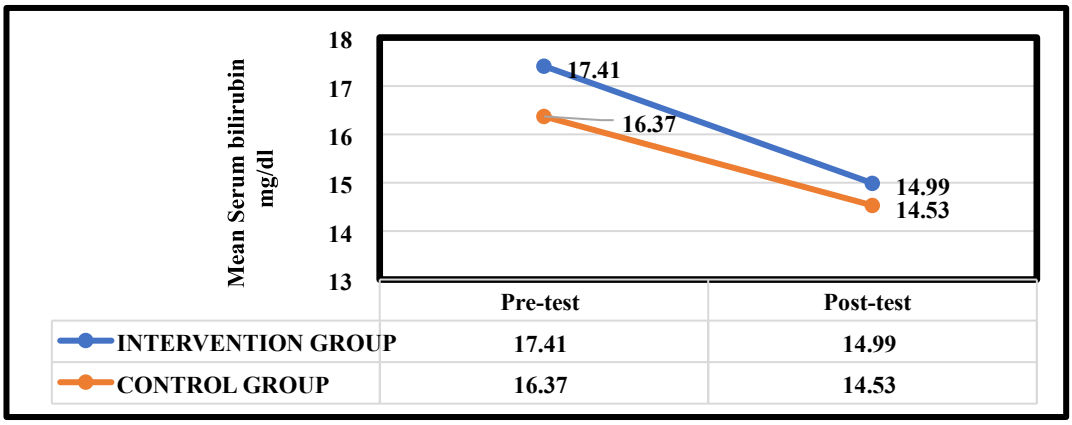
11.2 Data on pre test and post test total serum bilirubin level in control and intervention group.

**Figure 3: Distribution of neonates as per serum bilirubin values**




11.3 Data on comparison of pre test & post test total serum bilirubin level in both groups.

**Figure 4 : Comparison of mean pre test & post test serum bilirubin levels in both groups**




In the above figure, the p value was significant, however paired t test value indicated that effectiveness was comparatively more significant in intervention group (t=10.91) than control group (t=8.83).

11.4 Change in frequency of defecation pre test and post test in control and intervention group.

**Table 3 : Comparison of defecation frequency in study groups**

| **Parameters** | | **Intervention (%)** | **Control (%)** | **Chi-square** | **P Value** |
|---|---|---|---|---|---|
| **Freq. of Defecation / Day** Pre intervention | 0 – 2 | 13 (61.9) | 7 (33.3) | 4.37 | P=0.037 |
| | 3 – 4 | 8 (38.1) | 12 (57.1) | | |
| | 5 – 6 | 0 | 2 (9.5) | | |
| **Freq. of Defecation / Day** Post intervention | 0 – 2 | 3 (14.3) | 7 (33.3) | 3.77 | P=0.052 |
| | 3 – 4 | 10 (47.6) | 11 (52.4) | | |
| | 5 – 6 | 8 (38.1) | 3 (14.3) | | |

11.5 Data on correlation between frequency of defecation per day and total serum bilirubin level in study groups

| **Freq. of Defecation/Day & total serum bilirubin** | **r Value** | **P Value** |
|---|---|---|
| Pre-test | 0.09 | 0.70 |
| Post-test | - 0.05 | 0.85 |

Using t-test correlation coefficient to identify relationship between defecation frequency and total serum bilirubin in intervention group indicated linear correlation i.e. statistically there is neither positive nor negative correlation between defecation frequency and total serum bilirubin values of pre test (p=0.70) and post test (p=0.85) in intervention group.

**Figure 6 : Correlation between post test serum bilirubin and defecation frequency in intervention group**

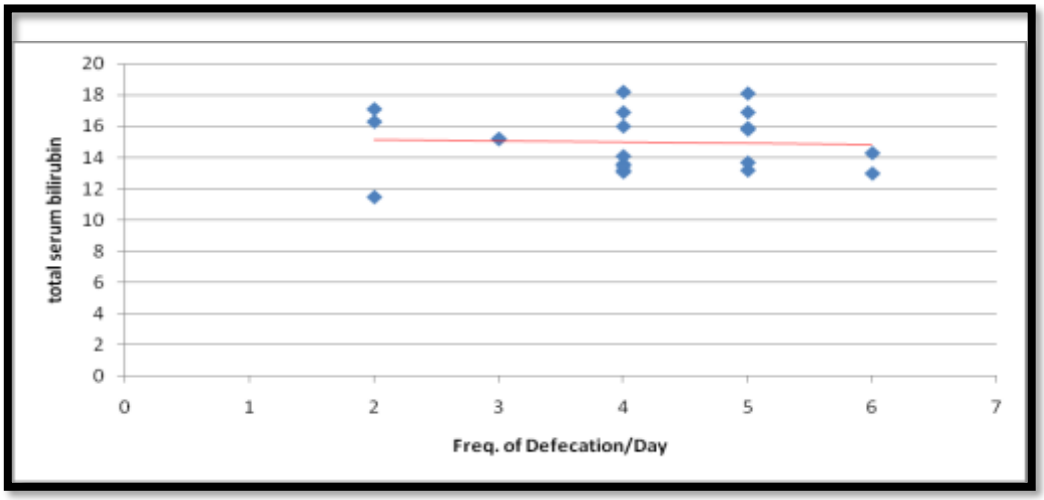



Figure 6. depicts linear correlation between defecation frequency and post test total serum bilirubin values in intervention group. Linear relation shows strong relation between these two variables.

**Figure 7 : Correlation between post test serum bilirubin and defecation frequency in control group**

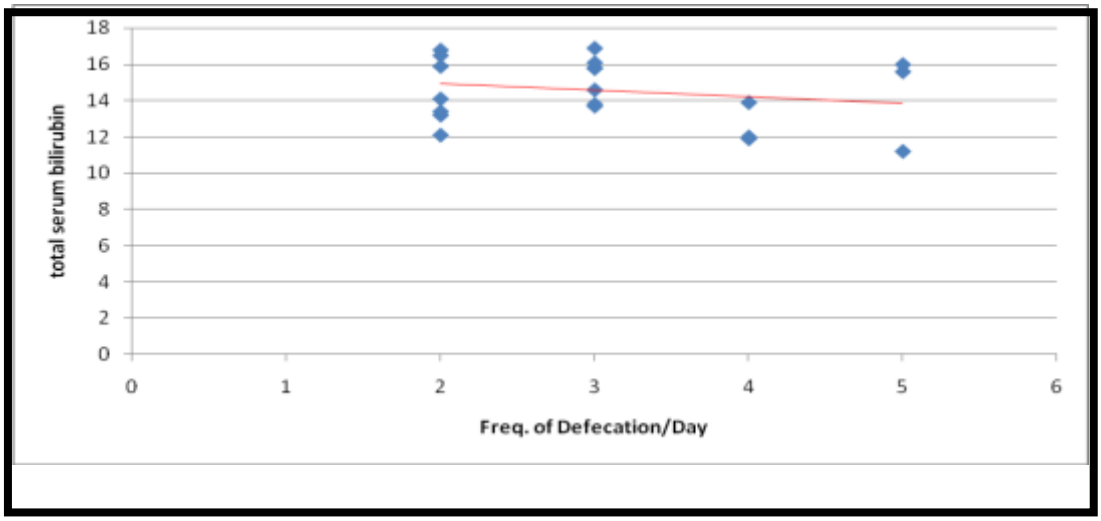



Figure 7. depicts negative correlation (-0.208) between defecation frequency and post test total serum bilirubin values in control group. Negative correlation indicates weak relation between these two variables.

## 12. Discussion

12.1 Rimpy et al. (2017) [18], in their study identified that the comparison of mean pre test and post test serum bilirubin level in experimental and group were statistically significant (p=0.01).

12.2 Chien-Heng Lin et al. (2012) [19], indicated in their study mean post test serum bilirubin level in experimental group (13.9±1.2) was significantly lower than control group (14.5±0.8) on day 2.

12.3 Razie Lori Kenari et al. (2020) [16], mentioned in their study the mean post test serum bilirubin level in field massage group (12.55±1.92) was comparatively lower than control group (15.09±1.55) after 24 hours of phototherapy.
12.4 Zahra Jazayeri et al. (2021) [20], also depicted in their study that the mean post test serum bilirubin level in body massage group (10.42±1.202) was significantly (p=0.000) lower than control group (11.92±0.953).

These findings are congruent with the present study. The mean post test serum bilirubin level in experimental group (14.99±1.861) was lower than control group (14.53±1.765).

**Figure 7 : Comparison of post test total serum bilirubin values of this study with other studies**

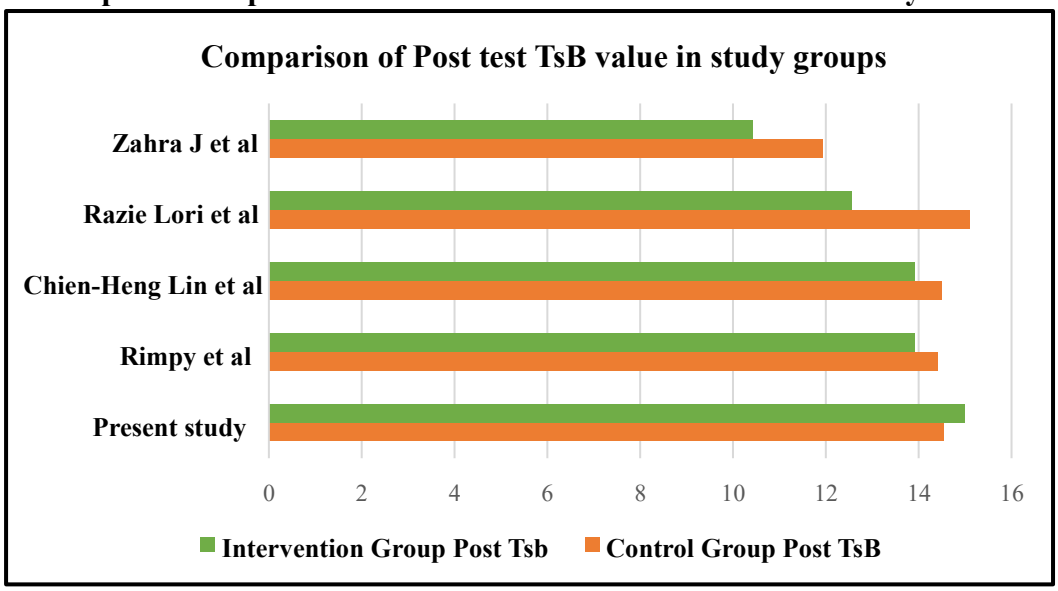



**Figure 8 : Comparison of defecation frequency among study groups**

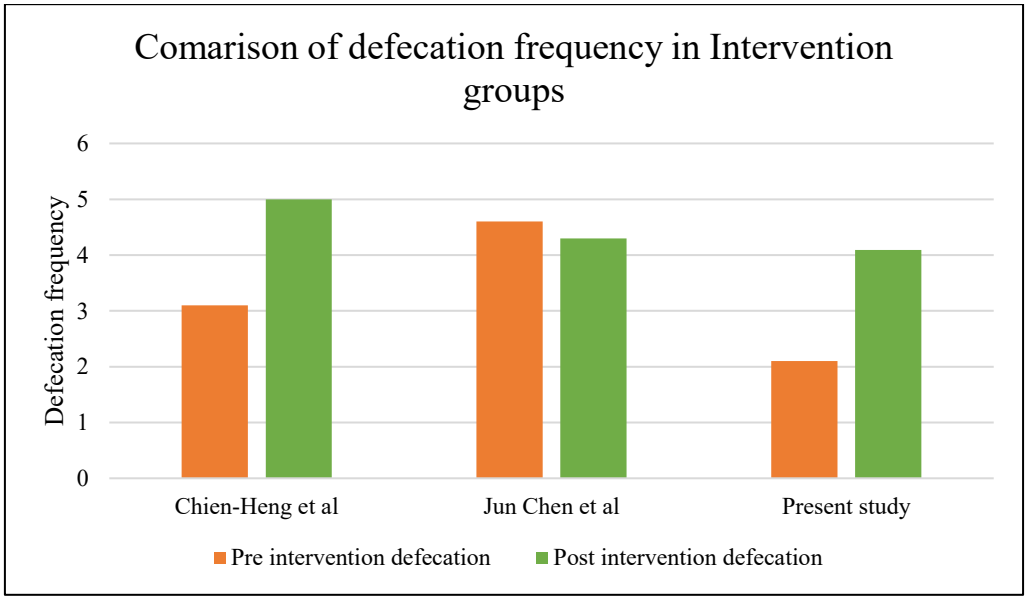


Figure 8, shows that, Chien-Heng Lin et al. (2012) [18], depicted that by 2nd day of massage group showed higher mean defecation frequency (5.0±1.5) as compared to day 1 (3.1±1.7), which was more as compared to mean defecation frequency in control group (3.0±2.0 on day 1 & 4.3±1.5 on day 2). Jun Chen et al. (2015) [21], also indicated in their study that the mean stool frequency of massaged infants on day 1 (4.6) and day 2 (4.3) was significantly ($p<0.05$) higher than that of control group (day 1: 3.3 & day 2: 2.6).
In this study also the mean defecation frequency of experimental group was statistically significant ($p=0.052$) as compared to control group ($p=0.37$).

**13. Implications of this study**

The results of this study applies to the medical care provided by nurses and doctors at various healthcare levels. The findings of this study can be utilized for further researching into the modifiable factors related to treatment of neonatal hyperbilirubinemia. A comparative study can be done among neonates with and without hyperbilirubinemia to evaluate the important risk factors associated with it. A study can be conducted by including more variables which contribute to neonatal hyperbilirubinemia. The utility of clinical assessment tool used in this study can be evaluated by further studies in the future. Research should be done to identify and rule out the complications associated with prolonged phototherapy exposure by follow up of the newborns on OPD basis. This research should enable the young nurse researchers to generate evidences for different complimentary methods of nursing care to reduce neonatal hyperbilirubinemia in daily practice.

14. **Recommendations**

Through this study it is recommended to accept neonatal body massage as a routine care practice in post natal wards of the hospitals. It is also evidenced that the body massage provided to the newborn aids in increasing the defecation frequency and increasing the process of excretion of bilirubin in the form of stercobilin hence reducing the duration of stay in phototherapy machine. The earlier the baby is on mother's bed it ensures multiple benefits to both the newborn and mother for their psychological as well as physiological well being. Massage therapy has evidenced to be reducing bilirubin at faster rate and preventing neonate from fatal kernicterus. Massage therapy also helps the neonate from the complications associated with prolonged phototherapy like – bronze baby syndrome, risk of harm to cornea, risk of infertility in male baby, skin infections and other nosocomial infections. It also recommends to conduct this study in various healthcare sectors where phototherapy devices are not much effective due to issues with funding with respect to repair and the hospitals where over crowding of babies is present. It will aid in reducing usage of phototherapy device for one baby and will lead to availability of the same for other babies by decreasing waiting period. It is also recommended for the hospitals to educate and conduct neonatal massage sessions for mothers in hospital setting before their discharge to home. Mothers may be motivated to form and join neonatal massage groups at home settings with the help of Asha workers or as self help group in community settings, here they can come together and care for their babies together as well as the ANMs and Asha workers can be aid in assessing and reffering of at risk newborns at the earliest. It is recommended to observe and record the urine and stool frequency output of the newborns to be done by mothers as well and to inculcate same to be practiced at home also. This study opens the path for other researchers to identify the association of body massage and frequency of urination and frequency of defecation with serum bilirubin levels at larger scales.

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