

A Descriptive Study on Management of Neonatal Jaundice in Children Hospital Lahore

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ABSTRACT
Introduction: Jaundice is a common and usually harmless condition in newborn babies, which refers to the yellow colour of the skin and whites of the eyes that happens when there is too much bilirubin in the blood. Bilirubin is a pigment produced by your baby's red blood cells. Lack of uniform guidelines and standard practice parameters for diagnosis and management of neonatal jaundice often leads many babies to develop unnoticed hyperbilirubinemia causing kernicterus and long term poor neurological sequlae.**Objective:** What are the techniques/medical treatment adopted in the children's hospital, Lahore to manage the neonatal jaundice? **Materials & methods:** 100 babies with neonatal jaundice was considered for the research work. Self-structures questionnaires and convenient sampling techniques were adopted to collect the data from the participants.**Results:** The total outcome of the study revealed that there were 100 neonates with an average age of $\bar{X}$= 2.47 days; standard deviation= 0.9, indicating that neonatal jaundice occurred most frequently between 1 and 7 days after birth. The average maternal age was $\bar{X}$=27.68 years old, with a standard deviation of 3.68. Neonatal jaundice affects 62% of preterm newborns with low birth weight. While nursing had a $p<0.05$ relationship with the prevalence of NNJ. In the hospital, 80 percent of non-breastfed newborns were diagnosed with neonatal jaundice. There was an association between Apgar score and NNJ. The result showed a corresponding increase in the occurrence of NNJ as the Apgar score decreases. Phototherapy was found to be a more accurate technique for surviving newborns with NNJ, with a survival percentage of 95.65%. **Conclusion:** Literally, Antenatal and neonatal care should be improved and supported by all health care stakeholders if child millennium development goals would be achieved.
Keywords: Neonatal jaundice, Pakistan, management, phototherapy, Intensive phototherapy, EBT, pre-term, term, American Academy of Pediatrics, hyperbilirubinaemia, glucose-6-phosphate dehydrogenase (G6PD), NH (Neonatal hyperbilirubinaemia), neonates, findings, neonatal ward etc.
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INTRODUCTION

Jaundice is a common and usually harmless condition in newborn babies, which refers to the yellow colour of the skin and whites of the eyes that happens when there is too much bilirubin in the blood. Bilirubin is a pigment produced by your baby's red blood cells. Normally, it passes through the liver, which releases it into the intestines as bile (a liquid that helps with digestion). Jaundice happens when bilirubin builds up faster than it can be broken down by a newborn baby's liver. This is because newborns make more bilirubin than adults do and also because their liver is still developing and might not be capable enough to remove all the bilirubin from the blood. Sometimes your baby's intestines absorb bilirubin that would normally leave the body in the stool. Neonatal jaundice (NNJ) occurs in 60% of term and 80% of preterm babies. Despite NNJ being one of the commonest neonatal conditions there are no national practice guidelines for its management in our country. Lack of uniform guidelines and standard practice parameters for diagnosis and management of neonatal jaundice often leads many babies to develop unnoticed hyperbilirubinemia causing kernicterus and long term poor neurological sequlae. This review after briefly discussing the epidemiology and pathophysiology of neonatal jaundice provides evidence based pragmatic guidelines for the diagnosis and management of neonatal jaundice in resource limited countries like Pakistan.

Jaundice is one of the most common causes of medical attention in neonates (Wan A et. al., 2016). Approximately 50-70% of the term babies and 80% of the preterm babies develop jaundice within seven days of life (Ng MCW, How CH, 2015). Close observation of bilirubin level and its trend in affected newborns is required, as very high serum bilirubin levels may cause neurological damage and even death. Jaundice within 24 hours signifies a high rate of bilirubin production and requires immediate care and management (Ullah S, Rahman K, Hedayati M, 2016). After this age significant hyper-bilirubinaemia is the total serum bilirubin (TSB) above the threshold level that may require medical intervention like phototherapy and/ exchange transfusion. Its value varies according to gestational and neonatal ages but is 205 µmol/L in neonates >35weeks of gestation at 24 hours of age (NICE, 2018).

The core principles of jaundice management include prevention, identification and assessment of babies at risk of developing hyperbilirubinaemia and treatment with phototherapy or if indicated (Maisels MJ, 2015; Bhandari V, 2017). Management of hyperbilirubinemia involves interpretation of TSB or TcB levels on a

nomogram based on the baby's gestation, age and birth weight. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line, except for babies less than 1000 g. If baby is greater than 12 hours old with TSB level 1–50 micromol/L below the line repeat the TSB within 6–24 hours. Babies under phototherapy: Consider measuring the TSB 4–6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12–24 hourly. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12–24 hours. If baby presents with TSB above threshold an exchange transfusion is indicated if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy. Use the following medications with caution in a baby with hyperbilirubinaemia as they may cause bilirubin to be displaced from albumin binding sites. Refer to an Australian pharmacopoeia for complete drug information (Digoxin, Diazepam, Salicylates, Diuretics e.g. frusemide and hydrochlorothiazide (Webstercare, 2017). Ceftriaxone, Ibuprofen, Sulfamethoxazole such as in trimethoprim/sulfamethoxazole (cotrimoxazole) or other sulphur medications is contraindicated in a jaundiced or at risk of jaundice baby. Potentially interfere with several steps of bilirubin metabolism and can markedly increase the risk of bilirubin encephalopathy (AMH, 2017).

Neonatal jaundice (NNJ) is a common condition affecting 60% of the healthy newborns. Total serum bilirubin (TSB) rises because of imbalance between bilirubin production and ability to conjugate and clear the bilirubin load which occurs as a result of increased red cell metabolism. Most of the cases are caused by physiological jaundice and is usually harmless. Certain risk factors are associated with severe neonatal hyperbilirubinaemia. These include prematurity, low birth weight (LBW), jaundice in the first 24 hours of life, mother with blood group O or rhesus (RH) negative, Glucose-6-Phosphate dehydrogenase (G6PD) deficiency, rapid rise of TSB, high pre-discharge bilirubin level, cephalohematomas or bruises, babies of diabetic mothers and family history of severe NNJ in siblings (Wan A et. al., 2016).

High serum bilirubin >425-510µmol/L (25-30 mg/dL) can cross the blood-brain barrier and lead to acute or chronic bilirubin toxicity. Acute bilirubin toxicity can progress from poor feeding, lethargy, high-pitch cry, hypo- or hypertonia, ultimately leading to fever, apnoea, seizures and death. Chronic toxicity or kernicterus is characterized by dyskinetic cerebral palsy (CP), hearing deficits and sometimes intellectual deficits. Guidelines have been formulated by the American Academy of Paediatrics (AAP) and the National Institute for Health and Clinical Excellence (NICE) in the United Kingdom for the management of neonatal jaundice. Guidelines should be followed for the management of these cases as hyperbilirubinaemia can lead to toxicity. Rapid bilirubin reduction can be achieved by using intensive phototherapy (IP), exchange transfusion (ET) and drugs. Contemporary phototherapy was discovered in England when the skin of babies having daily sunshine was seen to be less jaundiced than unexposed skin. It was also noticed that exposure of a blood tube with pre-exchange transfusion blood sample to sunlight resulted in a lower level of bilirubin than the unexposed sample. (Maisels MJ, 2015).

IP is the choice of management for lowering bilirubin in 2- 4 hours, while ET can reduce bilirubin in 1-2 hours. Phototherapy and ET are the mainstay of treatment for NNJ. Blue light (380-550nm) is the most effective treatment. However, certain side effects, like skin rashes, vomiting, diarrhoea and temperature irregularities, may be seen. ET, an invasive procedure, is occasionally indicated for NNJ, especially in the presence of bilirubin encephalopathy. The procedure may be associated with serious complications like apnoea, necrotizing enterocolitis, and sepsis in up to 5% cases. Intravenous immunoglobulins (IVIGs) can be used in patients with incompatibility between blood groups A, B, O, AB (ABO) and Rh.

Phototherapy is the most common treatment used in Pakistan for Jaundice in babies to decrease the level of bilirubin to a safe range. In rate cases, extremely high levels of bilirubin may require an exchange of blood. Phototherapy should be instituted when the total serum bilirubin level is at or above 15 mg per dL (257 mol per L) in infants 25 to 48 hours old, 18 mg per dL (308 mol per L) in infants 49 to 72 hours old, and 20 mg per dL (342 mol per L) in infants older than 72 hours.

Several treatment approaches have been described for neonatal hyperbilirubinemia and include phototherapy, enhanced nutrition, intravenous immunoglobulin, and neonatal exchange transfusion (G. Kiliç and Y. H. Bal, 2021). In recent years, massage therapy has been introduced as a new method in the treatment and care of neonates with jaundice (H. Nawaz, M. Aslam, and T. Rehman, 2021). Massage can also promote physical and intellectual improvement, immunity, bone mineral density, sleep, digestion and absorption, and emotional connection between mothers and infants (M. Singh, 2018). Currently, the effect of massage on neonatal growth and health care is well established (D. Bahig Anwr, 2020). But, there is no general agreement about the effect of massage on neonatal jaundice. In this situation, meta-analyses are one of the best methods for scientifically accumulating all the available evidence and can offer the best and most reliable sources of evidence. Based on the latest meta-analysis conducted by Zhang et al. in 2018, massage therapy can significantly decrease serum and transcutaneous bilirubin levels (M. Zhang, L. Wang, Y. Wang, and J. Tang, 2019).

A meta-analysis on risk factors for severe neonatal hyperbilirubinaemia in LMICs also showed that infants at risk of severe hyperbilirubinaemia in LMICs are associated with maternal and neonatal factors that can be

effectively addressed by available interventions to curtail the disease burden prevailing in the affected countries Olusanya BO, Osibanjo FB, Slusher TM (2015). It is recommended to perform laboratory investigations to assess bilirubin levels in the serum of any infant with jaundice. Management and treatment should be started when there is pathological jaundice. Generally, if the jaundice starts within less than 24 hours following birth, it is considered pathological and managed as a hemolytic jaundice. All these investigations must be acquired: blood group, RH type, DCT, packed cell volume, blood smear, RBCs morphology, reticulocytes count, and G6PD enzyme levels. These investigations will diagnose most causes and etiologies of hemolytic jaundice. Phototherapy should be started in these cases and continued until the bilirubin level sufficiently decreases. When there is any suspicion that there might be encephalopathy and/or kernicterus, exchange transfusion must be immediately started regardless of the levels of bilirubin in the serum (Althomali R et al, 2018).

Some facilities provide the option for phototherapy in the home for babies with mild to moderate jaundice. Manage the baby's care and follow up according to local protocols. If the baby's TSB is at exchange transfusion level it is a medical emergency and requires urgent management. The aim of an exchange transfusion is to rapidly reduce the TSB by removing small aliquots of blood from the baby and replacing it with donor blood components (Harsha L, Priya J, Khushali KS, Reshmi B, 2015). Phototherapy especially intensive for a high risk baby can decrease the need for an exchange transfusion. Babies who develop anaemia due to haemolysis may require supplementation of folic acid and iron. Folic acid aids in the maturation of RBC, babies who are low in folic acid are anaemic and fail to thrive. Iron is critical for growth and CNS development and iron deficiency is associated with impaired neurological and behavioural development (Berglund SK, Westrup B, Domellof M, 2015). However, iron supplementation is rarely required. Most babies with significant haemolysis recycle iron from their own red cells, so there may be a greater risk of iron overload than iron deficiency.

Types of Neonatal Jaundice (NNJ)

Physiological (normal) jaundice: Most newborns have this mild jaundice because their liver is still maturing. It often appears when your baby is 2 to 4 days old and disappears by 1 to 2 weeks of age.

Jaundice of prematurity: This is common in premature babies since their bodies are even less ready to excrete bilirubin effectively. To avoid complications, they'll be treated even when their bilirubin levels are lower than those of full-term babies with normal jaundice.

Breastfeeding jaundice: Jaundice can happen when breastfeeding babies don't get enough breast milk due to difficulty in feeding. This is not caused by a problem with the breast milk itself, but by the baby not getting enough of it.

Breast milk jaundice: In very rare cases of breastfed babies, jaundice is caused by substances in breast milk that can make the bilirubin level rise.

Blood group incompatibility: If a mother and baby have different blood types, the mother's body might produce antibodies that destroy the infant's red blood cells, which increases bilirubin in your baby's blood.

Phototherapy limits for newborns born before 38 weeks of pregnancy. One long-standing and widely used method for determining the threshold for phototherapy in preterm newborns is to use the following basic formulae:

Bilirubin in micromol/litre = (gestational age × 10) – 100

Moreover, the use of phototherapy continuously is associated with better outcomes than its use intermittently. It is recommended not to interrupt phototherapy except during breastfeeding.

Type of phototherapy are as follows.

Conventional phototherapy: This is used in mild and non-hemolytic neonatal jaundice.

Intensive phototherapy: This is use in more severe cases, severe elevations in bilirubin, hemolytic jaundice, or failure of the conventional phototherapy to relieve the jaundice.

Exchange transfusion: This is used to remove antibodies that are causing hemolysis and is used in Rh Isoimmunization and ABO Incompatibility.

80% of healthy neonates present with some degree of hyperbilirubinemia after birth, however, only 5-10% would require therapy to prevent damage or treat the cause of jaundice. Neonatal jaundice can be classified as physiological and pathological and can have several causes such as breast milk feeding, blood group incompatibility, hemolysis, or genetic defects of enzymes in the bilirubin metabolism pathway. Therefore, early diagnosis and management is essential. Neonatal jaundice can be treated using phototherapy, pharmacological agents, intravenous immunoglobulins and exchange transfusion in severe cases. We conducted this research work at Children's Hospital, Lahore in order to determine what were the precautionary measures used by them to manage the neonatal jaundice by hospital staff.

1.1. Problem statement

Phototherapy, intensive phototherapy, and intravenous immunoglobulin, exchange transfusion and TcBR

nomogram was done to manage the neonatal jaundice in the literature. Whereas some findings showed that there was an inverse relationship between massage therapy and reduction of neonatal jaundice. Massage can also promote physical and intellectual improvement, immunity, bone mineral density, sleep, digestion and absorption, and emotional connection between mothers and infants. In our research work, phototherapy, intensive phototherapy, EBT used to manage the neonatal jaundice in Pakistan. This research is consisted of only one hospital's data of Lahore district whereas might be the data of other hospitals of Lahore district and Punjab districts may vary. Data from other districts of Lahore, Punjab and Pakistan required to find other ways so that neonatal jaundice may manage in very effective and efficient way. Because phototherapy is an expensive procedure and can perform only in large institutions then what about the small hospitals? Message therapy found very economical way to manage NNJ then we must find out other ways and healthcare professionals also educated about the early management of neonatal jaundice in Pakistan.

1.2. Significance of the study

The findings of this study may help health professionals to obtain a better understanding of NNJ (Neonatal Jaundice) and contribute to literature. As a result, the findings will guide health practitioner to take immediate and positive steps to diagnose and manage neonatal jaundice in early stages so that burden of disease may reduce in Pakistan. It will also aid in the provision of advising on more effective adaptation methods. The findings could help to add to the body of knowledge in the field of paediatrics and pave the way for more research.

1.3. Objectives

The objective of this study was to provide evidence-based guidance on the management of NNJ, specifically addressing the following:

Diagnosis and Assessment

i. Treatment
ii. Prevention of Severe Jaundice
iii. Referrals and Follow-up

1.4. Research questions

1. How to monitor a baby with jaundice in the hospital?
2. What are the criteria/indications used in the neonatal ward of children's hospital, Lahore for starting and stopping phototherapy in babies with neonatal hyperbilirubinaemia?
3. What was the best modality of giving phototherapy (clinical and cost-effectiveness)?
4. Which factors affect the relationship between neonatal hyperbilirubinaemia and kernicterus or other adverse outcomes (neurodevelopmental, auditory)?

1.5. Operational definition of neonatal jaundice

Neonatal jaundice is the yellowing discoloration of the skin and sclera of a neonate, which is caused by increased levels of bilirubin in the blood.

1.6. Operational definition of management

The process of controlling how something is done or used.

REVIEW OF LITERATURE

Neonatal jaundice (NNJ) is a common problem that affects 60% of healthy babies. The imbalance between bilirubin synthesis and the ability to conjugate and remove the bilirubin load that arises as a result of enhanced red cell metabolism causes total serum bilirubin (TSB) to rise. When there is pathological jaundice, management and treatment should begin immediately. If the jaundice appears less than 24 hours after delivery, it is usually deemed pathological and treated as hemolytic jaundice. Blood group, RH type, DCT, packed cell volume, blood smear, RBC morphology, reticulocytes count, and G6PD enzyme levels are all tests that must be obtained.

The prospective study was conducted (M. A. Farhan, M. I. Ali, A. Faraz, et al, 2020) at King Khalid Hospital, Al Majmaah, Saudi Arabia, from September 2015 to September 2018, and comprised neonates with hyperbilirubinaemia who were managed using the National Institute for Health and Clinical Excellence 2010 guidelines. The outcomes were measured in terms of decrease in total serum bilirubin and clinical improvement. Data was analyzed using SPSS 25. Of the 233 subjects, there were 119(51%) girls and 114(49%) boys. Phototherapy was used in 162(69.5%) cases, intensive phototherapy in 36(15.5%) and intravenous immunoglobulin in 35(15%). Exchange transfusion was done in 2(0.85%) patients. All the 233(100%) patients improved with the management and total serum bilirubin significantly reduced ($p<0.05$). Newer techniques were

found to have a vital role in the management of neonatal hyperbilirubinaemia.

(Mohammad Faisal S, Zeeshan A, Asad M Ahmad, 2019) administered a research in which a total of 284 babies with ages ranging between 2-7 days, more than 35 weeks of gestation and more that 2000 grams of weight, were enrolled. Visual assessment of dermal jaundice was done in these neonates by a trained pediatric resident. Two zones were arbitrarily defined; one above nipple line and the other below it. The point of most distal dermalicterus was recorded on proforma mentioning the corresponding zone. Serum samples were then sent for laboratory measurement of total bilirubin within one hour of visual assessment. Jaundice in these zones was compared with corresponding total serum bilirubin. Significant hyperbilirubinaemia was defined as total serum bilirubin (TSB) more than 205 micromol/litre. Parents of 4 babies (1.61%) did not give consent for the blood test and 31 babies (10.91%) were lost to follow up. Data of remaining 249 neonates revealed that absence of visual jaundice below the nipple line had sensitivity of 100% and specificity of 73.23% in ruling out significant hyperbilirubinaemia. Absence of jaundice below the nipple line was a reliable screening tool for screening significant hyperbilirubinaemia after 24 hours of age in otherwise healthy babies more than 35 weeks of gestation and more than 2000 grams of weight.

The usefulness of massage therapy in the treatment of neonatal jaundice has been shown in earlier literature, but the topic of how much massage can lower the mean of bilirubin in neonates with jaundice has been addressed in this review (M. A. Farhan, M. I. Ali, A. Faraz, et al, 2020).We conducted a meta-analysis using the random-effects model. For any level of intervention, we calculated the overall mean difference (MD) with 95% confidence intervals (CI). Twenty studies were included in our meta-analysis. 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 (95% CI: -0.67, -0.06; $I2$ = 66 %), 50-60 minutes massage during the experiment -0.41 (95% CI: -0.95, 0.13; $I2$ = 84%), and ≥101 minutes massage during the experiment -1.20 (95% CI: -1.63, -0.78; $I2$ = 83%). The heterogeneity across studies was mild to moderate. The presence of a dose-response relationship favors the causal relationship between massage therapy and reduction of neonatal jaundice.

(Shah M, Arif S, Ali S, et al, 2017) have evaluated a care improvement initiative regarding neonatal jaundice in a large hospital in Karachi, the largest city in Pakistan. TcB screening of visibly jaundiced, otherwise well babies was implemented and clinical characteristics and jaundice-related outcomes were compared in the 6 months before vs 6 months after implementation. There was a 79% reduction in the number of blood samples taken for TSB quantification following TcB implementation; at the same time the proportion of infants receiving phototherapy increased (6% after vs 4% before implementation of TcB). Overall this is a useful uncontrolled before-after study, and the first to investigate the effectiveness of using a TcB device to diagnose neonatal jaundice in a Pakistani population. Whereas the current study indicated that TcB screening may be useful in a large institution, the price of TcB devices and logistical challenges were obvious barriers to implementation in primary healthcare settings in low-income and lower-middle-income countries. Proper education of communities and healthcare providers remains essential to increase awareness of the main risk factors for severe hyperbilirubinaemia, and facilitate early recognition, timely referral for evaluation and treatment, and adequate follow-up.

Phototherapy and exchange transfusion were the predominant treatments for hospital patients, according to (Olusanya, et al., 2016). Case definition for SNH and treatment thresholds for phototherapy and exchange transfusion varied across studies. The minimum TSB threshold for clinically significant jaundice across studies was 10–12 mg/dL for term infants. In general, phototherapy was commenced at approximately TSB ≥12 mg/dL (204 μmol/L) in otherwise healthy normal weight (≥2500 g) babies. Exchange transfusion was indicated at TSB ≥20 mg/dL (340 μmol/L) in apparently healthy term infants and sometimes at TSB <20 mg/dL (340 μmol/L) in very ill term infants with or without features of kernicterus. Exchange transfusion was indicated in preterm at TSB> 10 mg/dL per kilogram body weight. in one survey, the vast majority (94%) of 63 phototherapy devices tested in twelve referral level hospitals delivered irradiances of ≤10 μW/cm ^{2}/nm and none were ≥30 μW/cm ^{2}/nm. This finding was corroborated in another report in which 76 “functional” phototherapy devices across 16 hospitals were evaluated. The functionality of the devices was frequently compromised by erratic power supply and breakdowns due to poor device maintenance. High rates of exchange transfusion were therefore common due to sub-therapeutic phototherapy and lack of intensive phototherapy especially in combination with late presentation of outborn babies with NNJ.

This study regarding management of neonatal jaundice by (Thielemans L et al., 2021) near the Thailand-Myanmar border found a high NH (Neonatal hyperbilirubinaemia) incidence during the first week of life (249 per 1000 livebirths) among neonates delivered from 28 weeks gestation in an environment where neonatal care but not intense neonatal care is accessible. There were 1710 neonates included of 2628 women attending the facility during the study period, and 95.3% (1630/1710) completed the one-month follow up. Nearly half the population were migrants 53.1% (908/1710) not refugees, with 27.1% (464/1709) of mothers of young maternal age (<20 years), one in three were primigravida and 35.3% (604/1710) were illiterate. Birth included 92.9% (n =

1589) spontaneous vaginal delivery, 5.0% (86/1710) caesarean section and 2.0% (35/1710) instrumental delivery. Delayed cord clamping, 84.5% (1298/1536) was routine for births in the SMRU facilities where most births occurred 89.9% (n = 1536) but not at home 3.6% (n = 61) or in other hospitals/clinics 6.6% (n = 113). The mean birth weight ± standard deviation was 3001 ± 420 grams (n = 1699). Nearly all neonates, 96.6% (1651/1710), were breastfed from birth, 20.4% (346/1699) were SGA, and 4.9% (84/1710) were premature (minimum GA in this cohort was 29^{+3} weeks^{+days}). One in three neonates were transferred from the post-natal ward to the SCBU during their first week of life for a median [IQR] 5 days. : 8.3% (142/1710) had severe infections, 26.0% (441/1699) weight loss ≥7%, and 14.9% (253/1702) polycythaemia. While a range of other variables were examined: HIV 0.1% (2/1710), syphilis 0.6% (10/1710), smoking 9.3% (158/1709), overweight before delivery 23.9% (399/1671), twins 1.2% (n = 20), use of oxytocin 11.8% (198/1677), being born small for gestational age 20.4% (346/1699), use of naphthalene for storing the clothes 5.4% (92/1710),resuscitation at birth 3.5% (57/1710), sibling with a history of jaundice 16.7% (187/1120), admission to SCBU in the first week of life 31.2% (533/1710); they are not further presented as they did not feature significantly in later analysis, or as per methods were collinear with another variable. Based on the results from the current study, a decision to modify the current guidelines using a combination of TSB levels and risk factors was implemented, aiming to provide the earliest diagnosis and treatment to those the most at risk of NH while still providing adequate monitoring and follow up to those deemed less at risk. As 6 in 10 neonates <38 weeks developed NH within 24 h, preventive PT for neonates <35 weeks, and for those born 35 to 37 weeks with risk factors, was implemented using a simple checklist. For those born 38 weeks or more the checklist aims to alert the staff to neonates with an increased risk to develop NH so they can plan for the follow-up. This study demonstrated that mortality and potentially crippling morbidity from severe NH (Neonatal hyperbilirubinaemia) can be managed in a resource limited setting that can provide screening for TSB and offer phototherapy based on guidelines.

A meta-analysis including research involving African patients (Erdeve O, 2020) revealed that the overall size of NJ in Sub-Saharan Africa was 28 percent. Neonates with glucose-6-phosphate dehydrogenase (G6PD) deficiency (OR 2.42, 95% CI 1.64 to 3.56) and neonates that had a blood type that was incompatible with their mother's (OR 3.3, 95% CI 1.96 to 5.72) were more likely to develop hyperbilirubinaemia. Therefore, early identification and care strategies should be developed for the newborns affected by G6PD deficiency and blood type incompatibility. WHO recommends a universal screening programme in all regions with a prevalence of G6PD deficiency of 3%–5% or more in men? Low-cost interventions remain feasible where routine blood type testing and universal G6PD deficiency screening are currently unavailable. It is obvious that parallel to the heterogeneity of LMIC, offered low-cost interventions may not be so low-expense let alone so easy, especially, education of parents and healthcare workers is a very complicated subject that may be affected by multiple factors changing with time and region. In addition, appropriate neonatal follow-up of newborns is also difficult to manage even in HIC due to requiring up-to-Date protocols. But, public awareness and parental training for the identification of the signs of NNJ (Neonatal Jaundice).

In this population-based cohort study conducted by (Jenny Alken et al., 2019) of 992, 378 live-born children in Sweden from 2008 to 2016, 67 newborns were exposed to serum bilirubin levels of 30 mg/dL (510 μmol/L) or higher, of whom 13 developed kernicterus. Root cause analysis indicated that 11 of these 13 kernicterus cases (85%) were potentially avoidable because they were associated with suboptimal screening, diagnosis, or treatment. Data analysis was performed between September 2017 and February 2018. Data are presented as number and proportions (percentages or rates per 100 000 live births), mean (SD or 95% CIs,) or as median (range) values. We used *t* tests to compare maximum bilirubin levels between infants with hazardous hyperbilirubinemia who developed kernicterus and those who did not. A 2-sided $P < .05$ was considered statistically significant. Analyses were conducted using IBM SPSS, version 23 (SPSS Inc). Among 992 378 live-born infants (958 051 term births and 34, 327 near-term births), 494 (320 boys; mean [SD] birth weight, 3505 [527] g) developed extreme hyperbilirubinemia (50 per 100 000 infants), 6.8 per 100 000 infants developed hazardous hyperbilirubinemia, and 1.3 per 100 000 infants developed kernicterus. Among 13 children developing kernicterus, brain injury was assessed as potentially avoidable for 11 children based on the presence of 1 or several of the following possible causes: untimely or lack of predischarge bilirubin screening (n = 6), misinterpretation of bilirubin values (n = 2), untimely or delayed initiation of treatment with intensive phototherapy (n = 1), untimely or no treatment with exchange transfusion (n = 6), or lack of repeated exchange transfusions despite indication (n = 1). The primary outcome was kernicterus, defined as hazardous neonatal hyperbilirubinemia followed by cerebral palsy, sensorineural hearing loss, gaze paralysis, or neurodevelopmental retardation. Secondary outcomes were health care professional adherence to national guidelines using a predefined protocol with 10 key performance indicators for diagnosis and treatment as well as assessment of whether bilirubin-associated brain damage might have been avoidable. Hazardous hyperbilirubinemia in near-term or term newborns still occurs in Sweden and was associated with disabling brain damage in 13 per million births. For most of these cases, health care professional noncompliance with best practices was identified, suggesting that a substantial proportion of these cases might have been avoided.

(Hussain AS et al., 2017) conducted a cross-sectional survey of all babies admitted to a Karachi, Pakistan Hospital neonatal ward from September 1, 2016 to September 30, 2017, with a gestational age of 37 weeks or more and a birth weight of more than 2500 g who developed clinical jaundice within the first 24 hours of life but within the first seven days of life. They anticipated a sample size of around 1500 eligible babies in each phase. TcBR nomogram was made using American Academy of Pediatrics (AAP) guidelines for phototherapy threshold. A new line was drawn 2mg/dL (34.2µmol/L) below the phototherapy line for low-risk babies and was named as TcBR line because literature review revealed a variation of ±1mg/dL (17.1µmol/L) in results of TcBR and TSBR. For simplification, the high and intermediate risk lines were removed from the chart since those babies were not the study population and their management wad being done according to the hospitals jaundice protocol. The lines were colour coded. Phototherapy line was of red colour, whereas TcBR line was blue coloured. This modification in the AAP nomogram was called as TcBR nomogram. NICE guidelines 2016 for the management of neonatal hyperbilirubinaemia recommended the use of TcBR for the screening of babies who were >24hours old and >35weeks. We aimed to improve the quality of care given to our neonates by reducing the number of blood bilirubin samples using TcBR nomogram on babies who were low risk and >24hours old. We believed that this would decrease the requirement of blood bilirubin samples for TSBR and also reduced cost, infections, pain and delay in discharge from hospital. If the results would be suggestive and favourable, this protocol would be incorporated into our hospitals phototherapy protocol. Result showed that rapid bilirubin reduction can be achieved by using intensive phototherapy (IP), exchange transfusion (ET) and drugs. IP was the choice of management for lowering bilirubin in 2-4 hours while ET can be reduced bilirubin in 1-2 hours. Phototherapy and ET were the mainstay of treatment for NNJ (Neonatal Jaundice) in Pakistan.

It is crystal clear from the above findings of the literature that approximately 50-70% of the term babies and 80% of the preterm babies develop jaundice within seven days of life. If the jaundice appears less than 24 hours after delivery, it is usually deemed pathological and treated as hemolytic jaundice. When there is pathological jaundice, management and treatment should begin immediately. Phototherapy, intensive phototherapy, and intravenous immunoglobulin, Exchange transfusion was done to manage the neonatal jaundice. The usefulness of massage therapy in the treatment of neonatal jaundice has been shown in earlier literature, there was an inverse relationship between massage therapy and reduction of hyperbilirubinemia. Newer techniques were found to have a vital role in the management of neonatal hyperbilirubinaemia.

METHODOLOGY

3.1. Research design

On the basis of evidence available in the contemporary literature, it was descriptive study in nature held at neonatal ward of children's hospital, Lahore from Dec-2021 to May-2022.

3.2. Population & sample

100 babies with neonatal jaundice was considered for the research work.

3.3. Inclusion & exclusion criteria

a. Inclusion criteria
- 100 babies admitted to neonatal ward with NNJ (Neonatal jaundice) after 24 hours of life but within 7 days of life.
- Only those babies considered for the research work whose parents gave written informed consent.

b. Exclusion criteria
- The babies with non-occurrence of NNJ were excluded from the research work.
- The babies whose parents were unwilling to sign written informed consent.

3.4. Sample size & sampling

100 babies of neonatal ward of children's hospital, Lahore were recruited in the study. Sample size was determined by using the following formula:

$$n = \frac{z^2 \times p.q}{e^2}$$

P = 0.5; Q = 1-p = 1-0.5= 0.5

Z = standard deviation = 1.96 ; e = error = 0.1

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.1)^2}$$

$$n = \frac{3.84 \times 0.25}{0.01}$$

$$n = 96$$

Thus a more suitable sample of n=100 considered for the study.

3.5. Data collection method
Self-structured questionnaires were used in order to collect data from the participants.

3.6. Ethical consideration
An informed written consent acquired from the participants. Confidentiality and an anonymity be assured by using codes instead of participant's name on the questionnaire. Ethical principles in identifying and observing the participants applied by an informed consent from the participant. No risks involved in the study nor any monetary gains will be available for the participants.

3.7. Data Analysis
The statistical package for social sciences (SPSS) version 23 used for data analysis. Descriptive and inferential statistics used at a 0.05 level of significance. $P < 0.05$ considered statistically significant. So far as, data arrangement was concerned, identification numbers given to the questionnaires for counting and management purpose. For the analysis, of the demographic data, appropriate descriptive statistical tools used, to measures standard deviation, frequencies and percentages. The results displayed in tables and charts was also be assessed.

RESULTS
Neonatal jaundice (NNJ) affects 60% of term babies and 80% of preterm neonates. Despite the fact that NNJ is one of the most common newborn diseases, our country lacks national practice standards for its therapy. Because there are no consistent rules or practice parameters for diagnosing and treating neonatal jaundice, many babies acquire undiagnosed hyperbilirubinemia, which can cause kernicterus and long-term neurological problems. Following a brief discussion of the epidemiology and pathophysiology of newborn jaundice, this study presents evidence-based pragmatic guidelines for the diagnosis and therapy of neonatal jaundice in resource-constrained countries such as Pakistan. The current study took place at the neonatal ward of the Children's Hospital, Lahore, where 100 newborns with neonatal jaundice were evaluated to see how they were managed in the hospital.

4.1. Socio-demographic data of newborns with neonatal jaundice
A total of 100 babies with neonatal jaundice were studied at the neonatal department of the children's hospital in Lahore. 41 percent of neonates were 1-2 days old, 21 percent were 3-4 days old, and 38 percent were 5-6 days old. During the study, the average age of the neonates was $\bar{X}$= 2.47 days (S.D = ± 0.9). The study took into account 55 percent boy newborns and 45 percent girl neonates. During this study, the maternal age of the neonates was computed using the mean value $\bar{X}$= 27.68 years (S.D = ± 3.68) as the mean. According to the education of the mothers of neonates, 10% had non-formal education, 23% had elementary education, 30% had secondary class certificate, 22% had graduation level education, and the remaining 25% had master level education, as indicated in (Table No. 1.)(Fig. 4.1. to Fig. 4.4.).

Table 4.1. Socio-demographic data of newborns with neonatal jaundice

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE NEONATES		
Variables	**Children with jaundice (Frequency)**	**%ge**
Age (Days)		
1-2	41	41.00
3-4	21	21.00
5-6	38	38.00
≥7	0	0.00
Total	**100**	**100.00**
$\bar{X}$= 2.47 days ; standard deviation= ± 0.9		
Sex		
Boys (Neonates)	55	55.00
Girls (Neonates)	45	45.00
Total	**100**	**100.00**
Maternal Age (Years)		
21-25	25	25.00
26-30	43	43.00
31-35	22	22.00
36-40	10	10.00
Total	**100**	**100.00**
$\bar{X}$= 27.68 ; standard deviation= ± 3.68		
Maternal Education		
Non-formal	10	10.00
Primary	23	23.00
Secondary	30	30.00
Graduation	22	22.00
Masters	15	15.00
Total	**100**	**100.00**

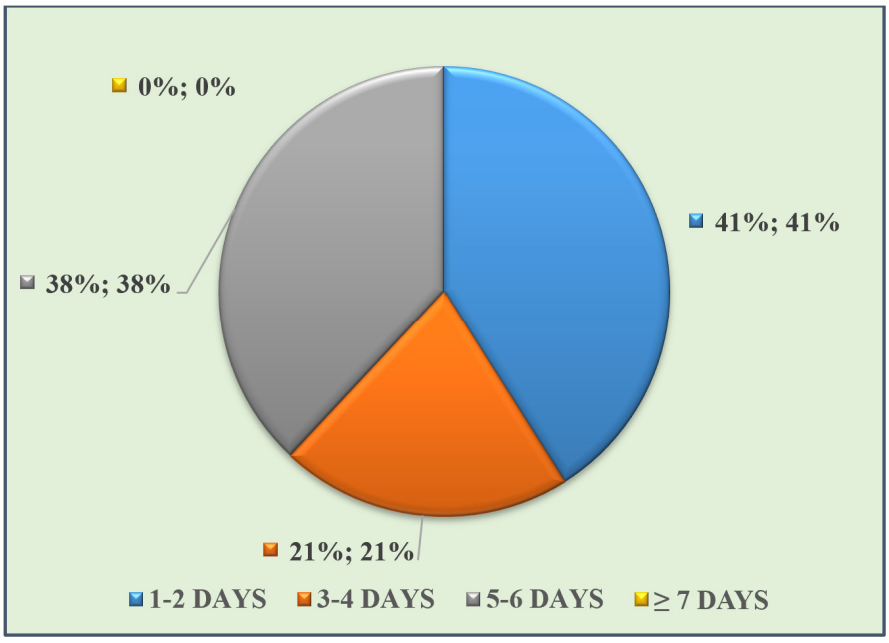

Figure 4.1. Age of neonates (Days)

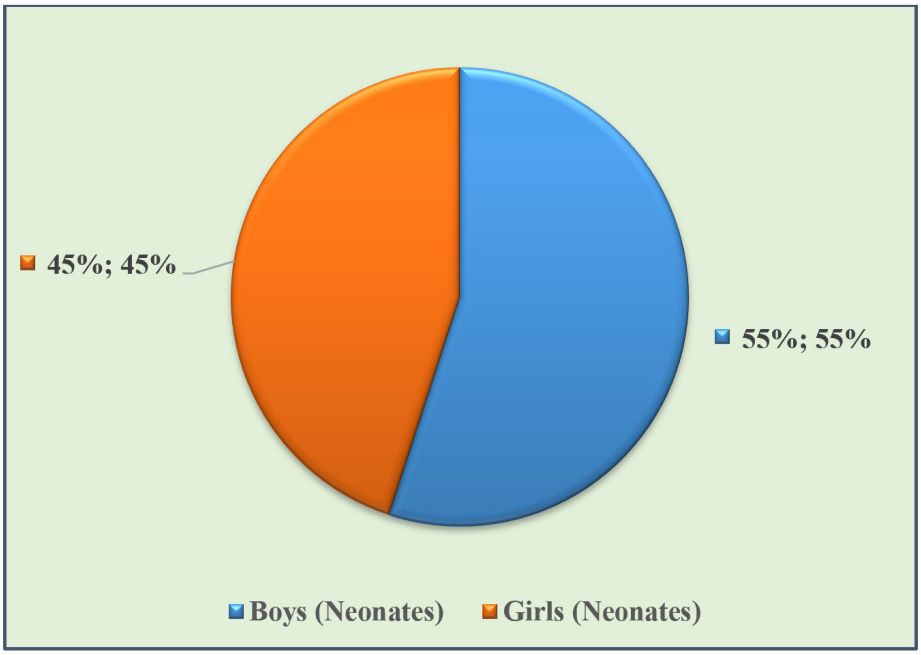

Figure 4.2. Gender classification

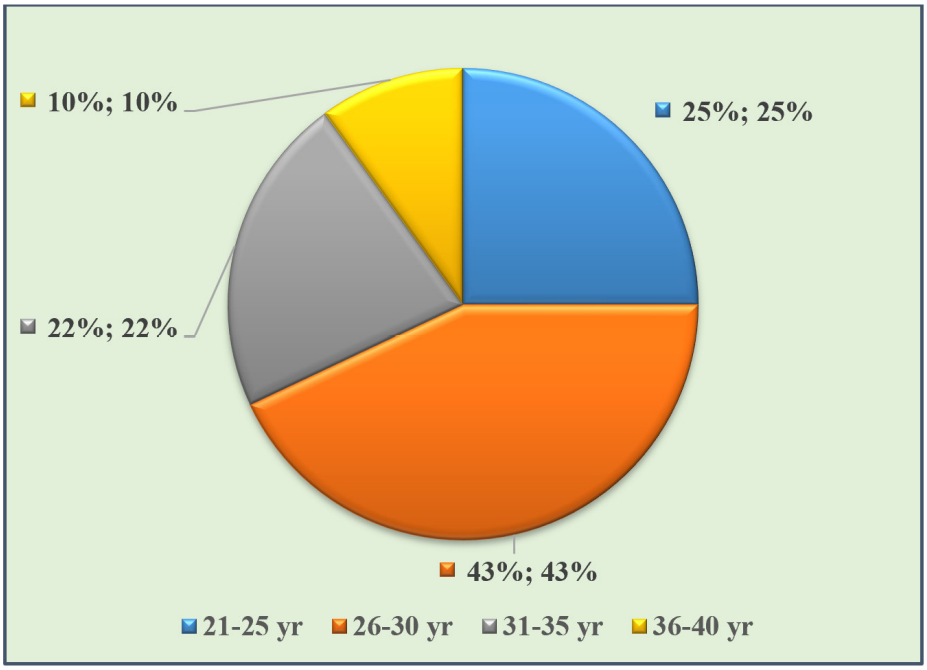

Figure 4.3. Maternal age of neonates

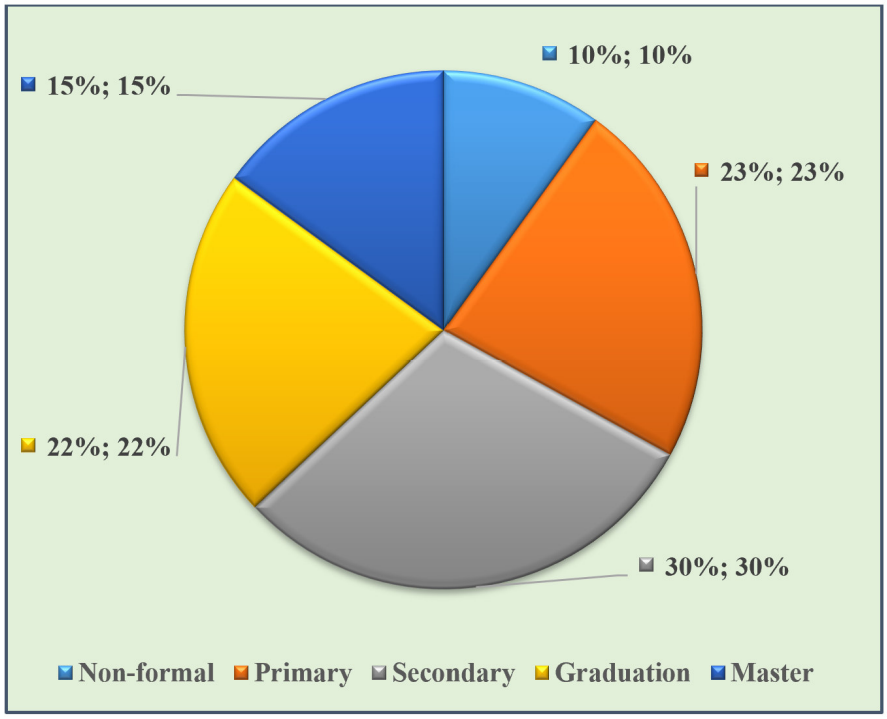

Figure 4.4. Maternal qualification of neonates

Table 4.2. Analysis of Association between Identifiable Risk Factors and the Occurrence of NNJ

Variables	Frequency	%age		
Gestational Age				
Preterm	62	62.00		
Term	33	33.00		
Post-date	5	5.00		
Total	**100**	**100.00**		
X^2= 1.00; P= 0.00	**Significant p<0.05**			
Birth Weight				
Low birth weight	65	65.00		
Normal	22	22.00		
Macrosomia	13	13.00		
Total	**100**	**100.00**		
X^2= 1.00; P= 0.00	**Significant p<0.05**			
Booking status				
Booked	77	77.00		
Unbooked	23	23.00		
Total	**100**	**100.00**		
X^2= 1.00; P= 0.00	**Significant p<0.05**			
Neonatal sepsis				
Present	41	41.00		
Absent	59	59.00		
Total	**100**	**100.00**		
X^2= 1.00; P= 0.00	**Significant p<0.05**			
APGAR score				
Good	10	10.00		
Mild	29	29.00		
Moderate	6	6.00		
Severe	55	55.00		
Total	**100**	**90.00**		

X^2= 0.98; P= 0.04
Significant p<0.05

Variables	Frequency	%age		
Breastfeeding				
EBF	65	65.00		
Mixed	12	12.00		
Not breastfed	23	23.00		
Total	**100**	**100.00**		
X^2= 1.00; P= 0.00	**Significant p<0.05**			
History of naphthalene use				
Positive use	95	5.00		
Nil	5	95.00		
Total	**100**	**100.00**		
X^2= 0.86; P= 0.03 Significant p<0.05				

4.2. Analysis of Association between Identifiable Risk Factors and the Occurrence of NNJ

The study with newborn jaundice at the children's hospital in Lahore comprised 100 neonates. There was a substantial link between risk variables and the occurrence of NNJ, according to the findings. The chi-square test was used to examine if there was a link between certain parameters and newborn jaundice. In a group of 100 neonates, 62 percent were born prematurely, 33 percent were born full term, and the remaining 5% were born after date. As indicated in (Table No. 4.2. Fig. No. 4.5.), gestational age had a direct impact on the occurrence of NNJ, as the chi-square test revealed X^2= 1.00 and p-value<0.05. In the study, 100 neonates were presented, with 65 percent having low birth weight, 22 percent having normal weight, and the remaining 13 percent having macrosomia. As shown in (Table No. 4.2. Fig. No. 4.6.), the chi-square test revealed a direct relationship between birth weight and the occurrence of NNJ in neonates with a value of X^2= 1.00 and a p-value of 0.05.

The study included 100 newborns with neonatal jaundice, with 77 percent booked and 23 percent un-booked status, p-value<0.05 indicating that there was significant link between booking status and the prevalence of NNJ. Neonatal sepsis was found in 41 percent of the neonates, while 59 percent were found to be free of it and it has significant association with NNJ depicted p-value<0.05. In the study, 80% of neonates were not breastfed, and the chi-square test revealed a value of X^2= 1.00, p-value<0.05 as shown in (Table No. 4.2. Fig. No. 4.7.). Likewise, the Apgar score showed significant association with the occurrence of NNJ as p<0.05. Overall findings of the risk factors determined that they were significant association with the prevalence of NNJ.

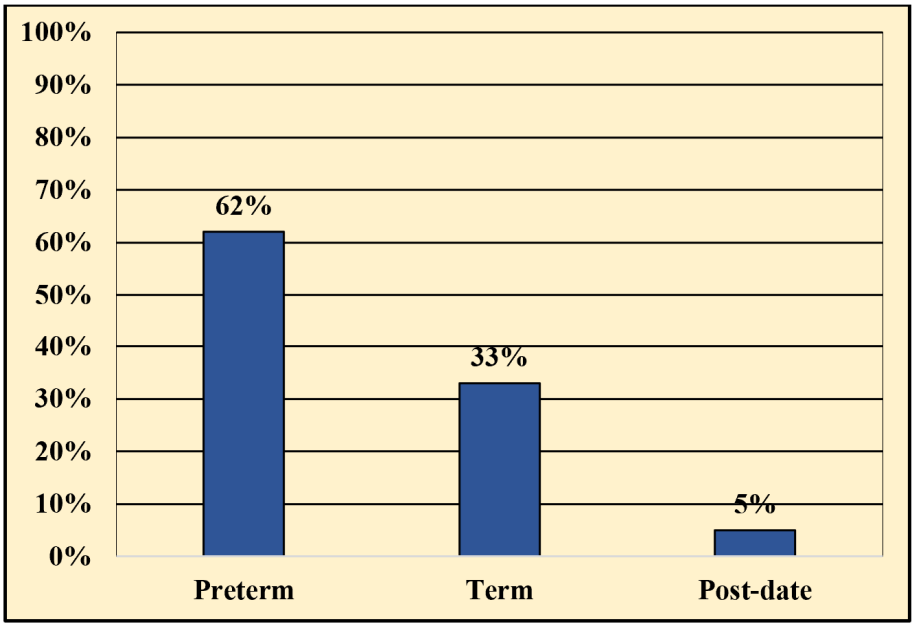

Figure 4.5. Gestational age of neonates

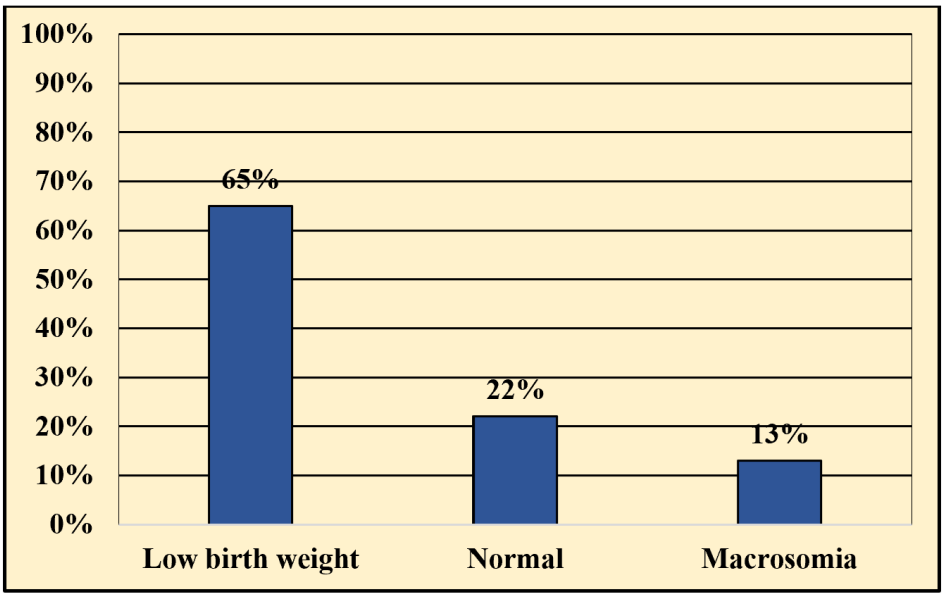

Figure 4.6. Birth weight of neonates

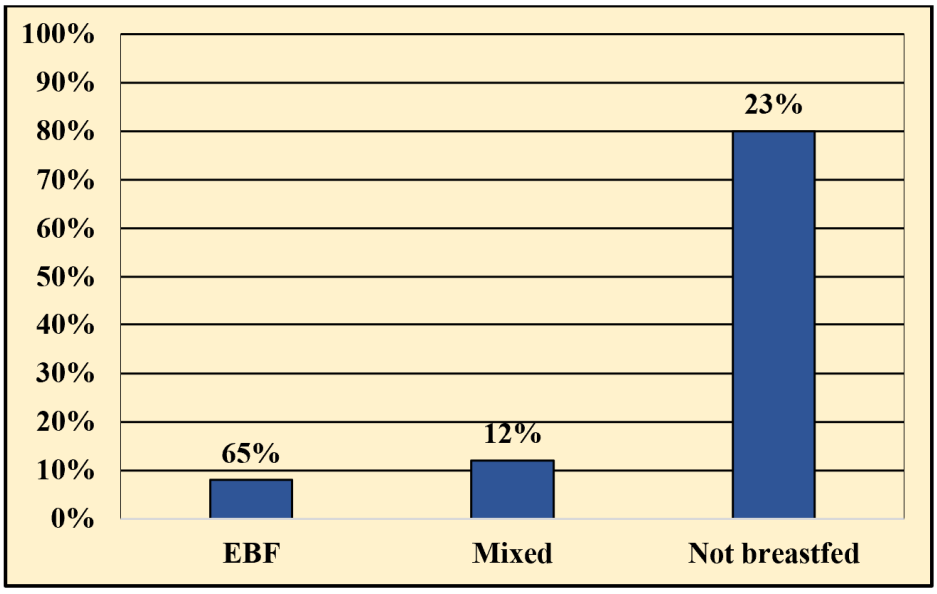

Figure 4.7. Breastfeeding status of neonates

Table 4.3. Treatment modality and their Outcomes in 100 neonates diagnosed neonatal jaundice

Forms of treatment	Improved	Died	Frequency	%age	Survival rate %age
Phototherapy alone	66	3	69	69.00	95.65
EBT alone	0	0	0	0.00	0.00
Phototherapy + EBT	12	2	14	14.00	85.71
Phototherapy + Chemotherapy	7	1	8	8.00	87.50
EBT, Phototherapy + Chemotherapy	8	1	9	9.00	88.89
Total	93	7	100	100.00	-

4.3. Treatment modality and their outcomes in 100 neonates diagnosed neonatal jaundice

A total of 100 newborn babies with neonatal jaundice were included in the study, which was held at the neonatal ward of the children's hospital in Lahore to examine neonatal jaundice management in that facility. The phototherapy method was conducted on 69 percent of infants, with 66 percent improving and 3 percent dying, resulting in a 95.65% survival rate. Phototherapy + EBT was used on 14 percent of the patients, with 12 percent improving their health and 2 percent dying; the method had an 85.71 percent survival rate, as seen in

the graph (Table No. 4.3 and Fig. No. 4.8. to 4.9).

There were 100 neonates in the research, and 8 percent were given phototherapy and chemotherapy, with 7 percent improving and 1 percent dying. As a result, the procedure's survival rate was 87.50 percent. (EBT, phototherapy, and chemotherapy) treatment was used to treat neonatal jaundice in 9% of the neonates, with 8 percent improving and 1 percent dying during treatment, resulting in an overall survival rate of 88.89 percent, as shown in the graph (Table No. 4.3. and Figure no. 4.10 to 4.11.).

4.4. Final result of 100 neonates regarding management of neonatal jaundice

The total outcome of the study revealed that there were 100 neonates with an average age of $\bar{X}$= 2.47 days; standard deviation= 0.9, indicating that neonatal jaundice occurred most frequently between 1 and 7 days after birth. The average maternal age was $\bar{X}$=27.68 years old, with a standard deviation of 3.68. Neonatal jaundice affects 62% of preterm newborns with low birth weight. While nursing had a $p<0.05$ relationship with the prevalence of NNJ. In the hospital, 80 percent of non-breastfed newborns were diagnosed with neonatal jaundice. There was an association between Apgar score and NNJ. The result showed a corresponding increase in the occurrence of NNJ as the Apgar score decreases. Phototherapy was found to be a more accurate technique for surviving newborns with NNJ, with a survival percentage of 95.65%.

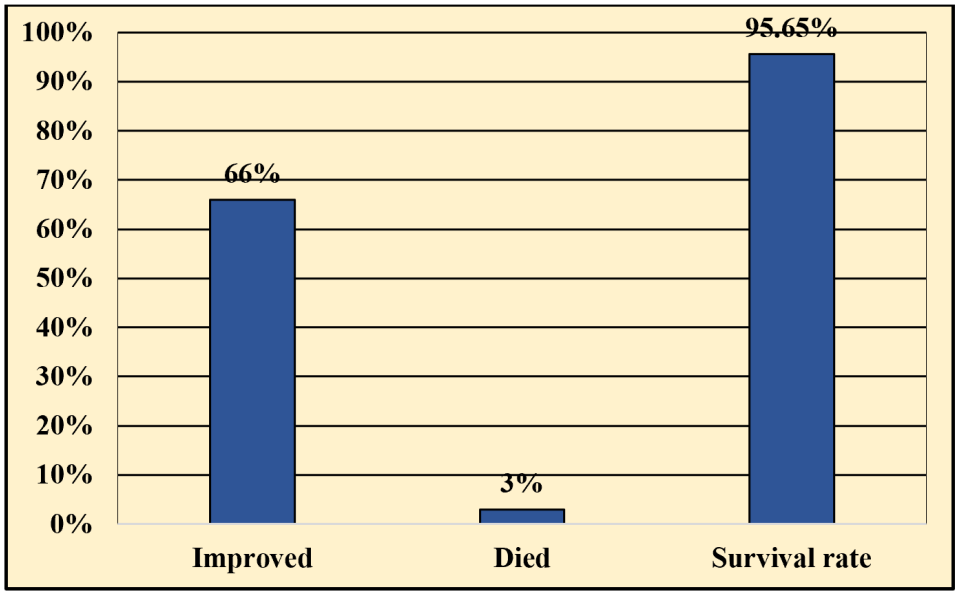

Figure 4.8. Outcome of phototherapy treatment

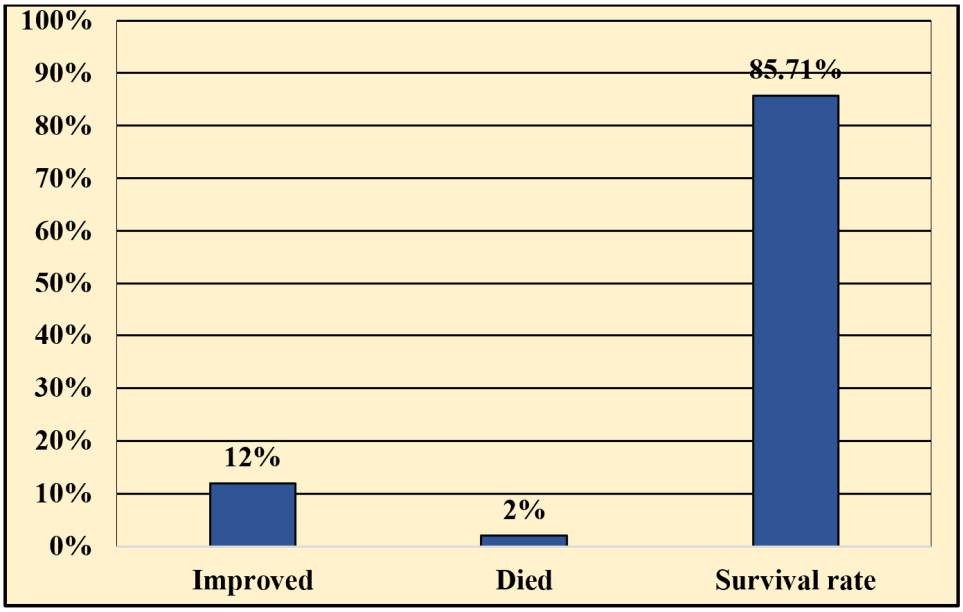

Figure 4.9. Outcome of phototherapy + EBT treatment

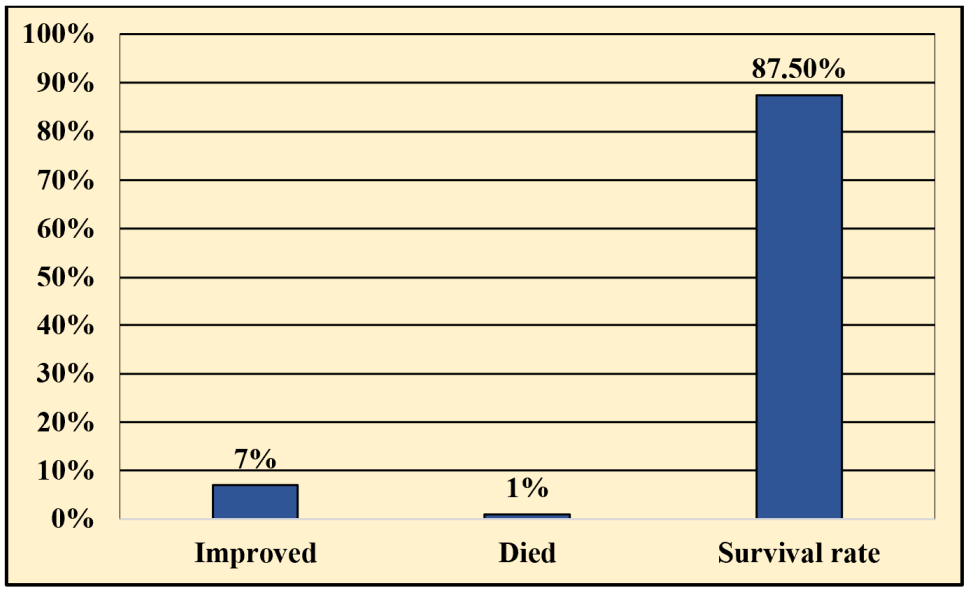

Figure 4.10. Outcome of phototherapy + chemotherapy treatment

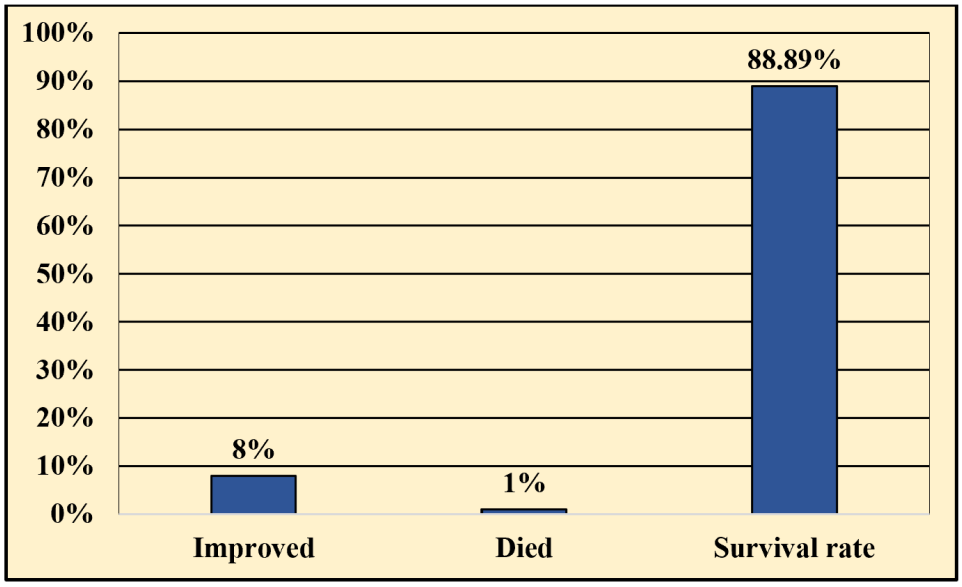

Figure 4.11. Outcome of EBT + phototherapy + chemotherapy treatment

5.1. DISCUSSION

At the children's hospital in Lahore, 100 newborns were studied for newborn jaundice. The total outcome of the study revealed that there were 100 neonates with an average age of $\bar{X}$= 2.47 days; standard deviation= 0.9, indicating that neonatal jaundice occurred most frequently between 1 and 7 days after birth. The average maternal age was $\bar{X}$=27.68 years old, with a standard deviation of 3.68.

Neonatal jaundice is a highly frequent disorder that affects up to 60% to 80% of preterm newborns in their first week of life, according to the literature. In this study a total 100 neonates were admitted into the special care baby unit of the paediatrics department of the hospital. In our studies 62% preterm babies were diagnosed with NNJ within 1-2 days of life. Our findings in accordance with the findings (Wan A et. al., 2016) included prematurity, low birth weight (LBW), jaundice in the first 24 hours of life. So, our study supported other literature which showed that NNJ was common among preterm babies in the first week of life. Our findings also related with the findings of (Thielemans L et al., 2021) regarding management of neonatal jaundice by near the Thailand-Myanmar border found a high NH (Neonatal hyperbilirubinaemia) incidence during the first week of life (249 per 1000 livebirths) among neonates delivered from 28 weeks gestation in an environment where neonatal care but not intense neonatal care is accessible.

The etiological risk factors associated with neonatal jaundice were male sex, maternal age, maternal education status, birth weight, booking status, neonatal sepsis, Apgar score, breastfeeding and history of

naphthalene use. Some literature showed that the male sex is the leading cause of NNJ, it is also determined in our findings that 55% of male sex was effected with NNJ.

The study included 100 newborns with neonatal jaundice, with 77 percent booked and 23 percent un-booked status, p-value<0.05 indicating that there was significant link between booking status and the prevalence of NNJ. Neonatal sepsis was found in 41 percent of the neonates, while 59 percent were found to be free of it and it has significant association with NNJ depicted p-value<0.05. Neonatal sepsis is seen as third leading cause of NNJ. As our study also determined that absence of neonatal sepsis increased the risk of NNJ as shown in the Table. No. 4.2. In the sample of 100 neonates 10% having good Apgar score, 29% with mild, 6% moderate level of Apgar score and 55% of neonates had severe level of Apgar score. The Apgar score showed significant association with the occurrence of NNJ as chi-square value 0.98 and p<0.05 recorded.

Significantly, a good number of 65% neonates were on breastfeeding, 12% were using mixed and 23% neonates were not breastfed. The chi-square test was performed to see the association showed X^2= 1.00; P= 0.00 which is as p-value<0.05. A total of 100 newborn babies with neonatal jaundice were included in the study, which was held at the neonatal ward of the children's hospital in Lahore to examine neonatal jaundice management in that facility. The phototherapy method was conducted on 69 percent of infants, with 66 percent improving and 3 percent dying, resulting in a 95.65% survival rate. Phototherapy + EBT was used on 14 percent of the patients, with 12 percent improving their health and 2 percent dying; the method had an 85.71 percent survival rate, as seen in the graph (Table No. 4.3 and Fig. No. 4.8. to 4.9).

There were 100 neonates in the research, and 8 percent were given phototherapy and chemotherapy, with 7 percent improving and 1 percent dying. As a result, the procedure's survival rate was 87.50 percent. (EBT, phototherapy, and chemotherapy) treatment was used to treat neonatal jaundice in 9% of the neonates, with 8 percent improving and 1 percent dying during treatment, resulting in an overall survival rate of 88.89 percent, as shown in the graph (Table No. 4.3. and Figure no. 4.10 to 4.11.).

In our study phototherapy was found to be a more accurate technique for surviving newborns with NNJ, with a survival percentage of 95.65% and our study was in accordance with the prospective study was conducted (M. A. Farhan, M. I. Ali, A. Faraz, et al, 2020) at King Khalid Hospital, Al Majmaah, Saudi Arabia, from September 2015 to September 2018, and comprised neonates with hyperbilirubinaemia who were managed using the National Institute for Health and Clinical Excellence 2010 guidelines. The outcomes were measured in terms of decrease in total serum bilirubin and clinical improvement. Data was analyzed using SPSS 25. Of the 233 subjects, there were 119(51%) girls and 114(49%) boys. Phototherapy was used in 162(69.5%) cases. All the 233(100%) patients improved with the management and total serum bilirubin significantly reduced (p<0.05). Phototherapy was found most effective treatment to manage NNJ. Newer techniques were found to have a vital role in the management of neonatal hyperbilirubinaemia.

As in our study 66% improved with phototherapy treatment with the survival rate of 95.65%. Phototherapy + EBT survival rate found 85.71% in our study while phototherapy and chemotherapy survival rate found to be 87.50% and EBT, Phototherapy + chemotherapy having survival rate of 88.89%. In literature findings and overall findings phototherapy found to be more effective treatment to manage the neonatal jaundice. Then what about the new techniques of NNJ. Our research also in accordance with the findings of (G. Kiliç and Y. H. Bal, 2021) where several treatment approaches have been described for neonatal hyperbilirubinemia and include phototherapy, enhanced nutrition, intravenous immunoglobulin, and neonatal exchange transfusion.

What initiatives are taken by our health sector to find effective and efficient way to manage the neonatal jaundice as phototherapy is an expensive procedure and can't be run in small institutions. Then here what about the research of (H. Nawaz, M. Aslam, and T. Rehman, 2021) massage therapy has been introduced as a new method in the treatment and care of neonates with jaundice Massage can also promote physical and intellectual improvement, immunity, bone mineral density, sleep, digestion and absorption, and emotional connection between mothers and infants (M. Singh, 2018). Currently, the effect of massage on neonatal growth and health care is well established (D. Bahig Anwr, 2020).

Here we would like to say that what about the recommendations of WHO? It recommended a universal screening programme in all regions with a prevalence of G6PD deficiency of 3%–5% or more in men? Low-cost interventions remain feasible where routine blood type testing and universal G6PD deficiency screening are currently unavailable. It is obvious that parallel to the heterogeneity of LMIC, offered low-cost interventions may not be so low-expense let alone so easy, especially, education of parents and healthcare workers is a very complicated subject that may be affected by multiple factors changing with time and region. But, public awareness and parental training for the identification of the signs of NNJ (Neonatal Jaundice). Are these recommendation being ignored in our country?

Here there is a need to take cost-effective steps to overcome the disease and for this purpose public awareness is mandatory step. Without public awareness it would be difficult for us to find out other remedies to manage the NNJ and for the reduction of NNJ. Pakistan is facing lot of problems in health sector might be economical and political instability are the main causes. Why health minister doesn't take any initiative to

disseminate health awareness among the population of Pakistan as socio-demographic variables are also constituting in the prevalence of NNJ as well as how etiological factors can be improved? What is the role of nursing and other paramedical staff in the management of NNJ? If some neonates died during the phototherapy treatment as shown in our findings then why not other safe procedures may adopted to improve the health of neonates. As phototherapy is an expensive procedure then what steps are being taken for cost-effective treatment? What is the role of NGOs in spreading the awareness about diseases and neonatal health among public? Why nurses are not playing any role in this regard? Nurses are the assets of our country and we think they can play an optimum role in managing the diseases by disseminating awareness among patients. What is the role of electronic media? Why TV commercials aren't playing any role to aware general public of Pakistan? Although literacy rate is very low but every person having TV facilities in our country. Why advertising companies aren't spreading health awareness among the nation of Pakistan?

5.2. CONCLUSION

A total of 100 babies with neonatal jaundice were studied at the neonatal department of the children's hospital in Lahore. 41 percent of neonates were 1-2 days old, 21 percent were 3-4 days old, and 38 percent were 5-6 days old. During the study, the average age of the neonates was $\bar{X}$= 2.47 days (S.D = ± 0.9). The study took into account 55 percent boy newborns and 45 percent girl neonates. During this study, the maternal age of the neonates was computed using the mean value $\bar{X}$= 27.68 years (S.D = ± 3.68) as the mean. The etiological risk factors associated with neonatal jaundice were male sex, maternal age, maternal education status, birth weight, booking status, neonatal sepsis, Apgar score, breastfeeding and history of naphthalene use as showing $p<0.05$. Phototherapy was found most effective treatment to manage NNJ with survival rate of 95.65%. Literally, Antenatal and neonatal care should be improved and supported by all health care stakeholders if child millennium development goals would be achieved.

5.3. Recommendations

- Health minister must take any attempt to raise health awareness among Pakistan's population.
- Etiological factors must be improved through dissemination of information regarding antenatal and neonatal care among general public.
- Nurses and other paramedical workers should play role in NNJ management.
- NGOs must contribute in raising public knowledge about illnesses and neonatal health.
- Advertising corporations can spread information to increasing health awareness throughout Pakistan.

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