

Prevalence of G6PD deficiency amongst neonates with neonatal jaundice admitted to the children ward of Sheikh Zayed Hospital Rahim Yar Khan

Raghib Iqbal, Ayesha Tahira, Zahra Riaz, Shaista Haidar, Kifayat Ullah Khan, Zahid Mehmood

Shiekh Zayed Hospital, Rahim Yar Khan Pakistan

ABSTRACT

Objective: The objective of the current study was to determine the prevalence G6PD deficiency among neonates with neonatal jaundice.

Material and Method: The current cross-sectional study was conducted at Paediatric Unit 2 Sheikh Zayed Hospital Rahim Yar Khan from May 2023 to August 2023 after taking approval from the ethical committee of the institute. 2–3 ml venous blood sample was obtained from selected group of newborns and sent to the laboratory. G-6-PD enzyme test was performed on whole blood using EDTA as an anticoagulant. Data was analyzed through SPSS version 24.

Results: A total of 212 male neonates were enrolled, including 38 (18%) preterm and 174 (82%) term. The mean (SD) serum bilirubin was 18.03 (± 13.4) mg/dL, with direct and indirect levels of 0.54 (± 0.26) mg/dL and 16.55 (± 2.91) mg/dL, respectively. Birth weight ranged from 2.0–3.6 kg (mean $\pm$ SD: 2.7 $\pm$ 0.38 kg), and the mean age at presentation was 4.5 (± 3.0) days (range: 2–17 days). Fisher's exact and chi-square tests showed no significant association between G6PD deficiency and gestational age, age at presentation, indirect bilirubin, or birth weight. The prevalence of G6PD deficiency was 19 (9%), of whom 10 (52.6%) were mildly anemic, 5 (26.3%) moderately anemic, and 4 (21.0%) had normal hemoglobin.

Conclusion: G6PD deficiency was identified as a significant contributor to neonatal jaundice, present in 9% of affected cases. These findings underscore the importance of early screening and diagnosis for timely management.

Keywords: G6PD deficiency, Neonates, Neonatal jaundice, Bilirubin.

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INTRODUCTION

Glucose-6-phosphate dehydrogenase (G6PD) is an X-linked disorder that affects over 400 million people worldwide [1]. The prevalence of X-linked disorders are higher in men than in women. But the majority of the people who are deficient are asymptomatic. Individuals with mutated alleles are at risk to excessive hemolysis and newborn jaundice. A pale complexion usually occurs during disease, following specified medication therapy, or as a result of eating Fava beans [2]. It is mostly found in high prevalence in Latin America, Africa, Asia, and Mediterranean

countries. According to recent research, the incidence of G6PD deficiency is 4.5% worldwide, with an incidence of 1.8% in Pakistan [2]. The main manifestations of G6PD deficiency include acute hemolytic anemia, newborn jaundice, and chronic non-spherocytic hemolytic anemia [3]. Patients with G6PD deficiency are 20–30 times more vulnerable to the hemolytic effects of the anti-malarial medication primaquine than those with functioning G6PD, and they can also trigger hemolytic episodes [4]. Henna is a soothing color that is used to nails and hair. It has been demonstrated in some studies to cause hemolytic episodes [4,5]. The synthetic compound Lawsone(2-hydroxy-1,4-naphthoquinone) found in henna has a structure & redox potential similar to naphthalene metabolites, which cause oxidative damage in red blood cells, especially in those with G6PD deficiency [5]. People with G6PD deficiency

Correspondence: Dr. Zahid Mehmood, Senior Registrar, Sheikh Zayed Hospital Rahim Yar Khan Pakistan

Email: zahid_mehmood232@yahoo.com

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have low haptoglobin serum levels and its fluctuate in response to inflammation, the destruction of red blood cells (RBCs), and other physiological circumstances. Because the liver-produced haptoglobin binds to released haemoglobin to create a complex that is quickly eliminated from circulation, decreased levels signify RBC hemolysis [6]. G6PD enzyme deficiency is one of the primary factors responsible for pathologic hyperbilirubinemia among neonates [7]. Hemolysis and hyperbilirubinemia are the most prevalent enzymatic disorders in blood cell disorders caused by the deficiency of G6PD enzyme. G6PD deficiency can result in hyperbilirubinemia, which can be fatal and cause kernicterus and permanent damage to the brain [8]. The pathophysiology of hyperbilirubinemia in newborns with G6PD deficiency differs from that in infants with normal G6PD. Hemolysis is now thought to be the main cause of bilirubinemia in G6PD-normal neonates, while in G6PD-deficient infants, decreased bilirubin conjugation could be the main cause of hyperbilirubinemia [9-11]. Screening procedures and clinical therapy plans can be guided by knowledge of the prevalence of this enzyme deficiencies in neonates with neonatal jaundice. Therefore, the current study was carried out with the objective to determine the prevalence G6PD deficiency among neonates with neonatal jaundice

MATERIAL AND METHODS

The current cross-sectional study was conducted at Paediatric unit 2 Sheikh Zayed Hospital Rahim Yar Khan from May 2023 to August 2023 after taking approval from the ethical committee of the institute. Non-probability sampling technique was used in our study. The overall sample size in our study was 212 by taking the prevalence of G6PD deficiency as 12% and at a confidence level of 95.0% and marginal error of 5.0% [12]. Neonates admitted with jaundice and serum bilirubin levels of 15 mg/dl for term babies & 12 mg/dl for preterm babies (*baby born before 37 weeks of pregnancy*) with hyperbilirubinemia were included. Those who had previously received

blood transfusions, had conjugated more than 20% of their total bilirubin, or had undergone additional treatments (such as phenobarbitone or metallo-porphyrins) were not excluded from the study. 5cc venous whole blood was collected from each individual in vial, for G6PD T est. (Span Diagnostic S.A.R.L, France). All the blood samples were collected in sterile syringe and mixed with Ethylenediamine tetra acetic acid (EDTA) to avoid blood from clotting. EDTA blood for G6PD screenings were placed at room temperature till the test was performed. The tests were performed within one hour of blood sampling. The test employed was in vitro determination of the activity of G6PD from the red cell hemolysate: Qualitative method, (Span Diagnostic S.A.R.L, France). The test was carried out in accordance with the following kit instructions.

2.5 ml of deionized water and 5cc of blood were mixed together to produce red cell hemolysate, which was then left to remain at room temperature for five minutes. One milliliter of the hemolysate (Step 1) was mixed with one milliliter of reagent 3 for the enzyme test. After a gentle mixing, it was incubated for at least six hours at 37°C in a water bath. At 30-minute intervals, the duration of time needed for the color to shift from its original deep blue to reddish purple was recorded. SPSS version 24 was used for data analysis. The categorical variables like anemia, gender, gestational age and G6PD deficiency were presented as frequencies and percentages; and continuous variables like serum bilirubin, indirect serum bilirubin, weight and age were reported as mean $\pm$ standard deviation. Effect modifiers like age, weight, gestational age and serum indirect bilirubin were controlled through stratification to see the effect of the variables on outcome using chi-square test Fisher's exact test and p-value of ≤ 0.05 was considered significant.

RESULTS

A total of 212 neonates admitted with indirect hyperbilirubinaemia were studied to find out the frequency of G6PD deficiency. Out of the total participants screened, 38(18%) were preterm

and 174 (82%) were term neonates (P value =0.538). All the participants were males. The mean (SD) serum bilirubin (SBR) was 18.03 (± 13.4) mg/dL. The mean direct SBR (SD) was 0.54 (± 0.26) mg/dL, while the mean indirect serum bilirubin was 16.55 (± 2.91) mg/dL (P value 0.221). The neonates enrolled in the study had weight from 2.0 to 3.6 kg, with a mean (SD) of 2.7 (± 0.375) kg. The mean (SD) age of the neonates upon presentation was 4.52 (± 3.042) days, with a range of 2–17 days (P value = 0.323). Among the study participants the prevalence of G6PD deficiency was 19(9%) as presented in table-I. Statistical analysis using

Fisher's exact test and the chi-square test showed no significant association between G6PD deficiency and gestational age, age at presentation, indirect bilirubin levels, or birth weight. Blood hemoglobin levels below 11.5 g/dl were considered anemia. Severe anemia was defined as hemoglobin below 7 g/dl, moderate anemia as hemoglobin ranging between 7 - 10 g/dl, and mild anemia as hemoglobin ranged 10 -11.5 g/dl. [20] Out of the 19 G6PD deficient individuals 10(52.6%) of them were mild anemic, 5(26.31%) were moderate anemic and 4(21.0%) had normal HB level as presented in figure-I.

Table-I: Analysis of G6PGD deficiencies stratified by several factors.

Factors	G6PD deficiency		Value of P
	No N =193 N (%)	Yes N= 19 N (%)	
Gestational age			
Preterm	36(18.6%)	4(21%)	0.538
Term	157(81.3%)	15(79%)	
Age			
0 to 6 days	157(81.3%)	16(84.2%)	0.323
7 to 28 days	36(18.3%)	3(15.7%)	
Indirect bilirubin (mg/dl)			
Below 17.5	99(51.2%)	7(36.8%)	0.221
17.5 or above	94(48.7%)	12(63.1%)	
Weight in kilograms			0.311
Below 2.5	67 (34.7%)	9(47.3%)	
2.5 or above	126(65.2%)	10(52.6%)	

Fisher exact test and chi-square test were used for the determination of P value

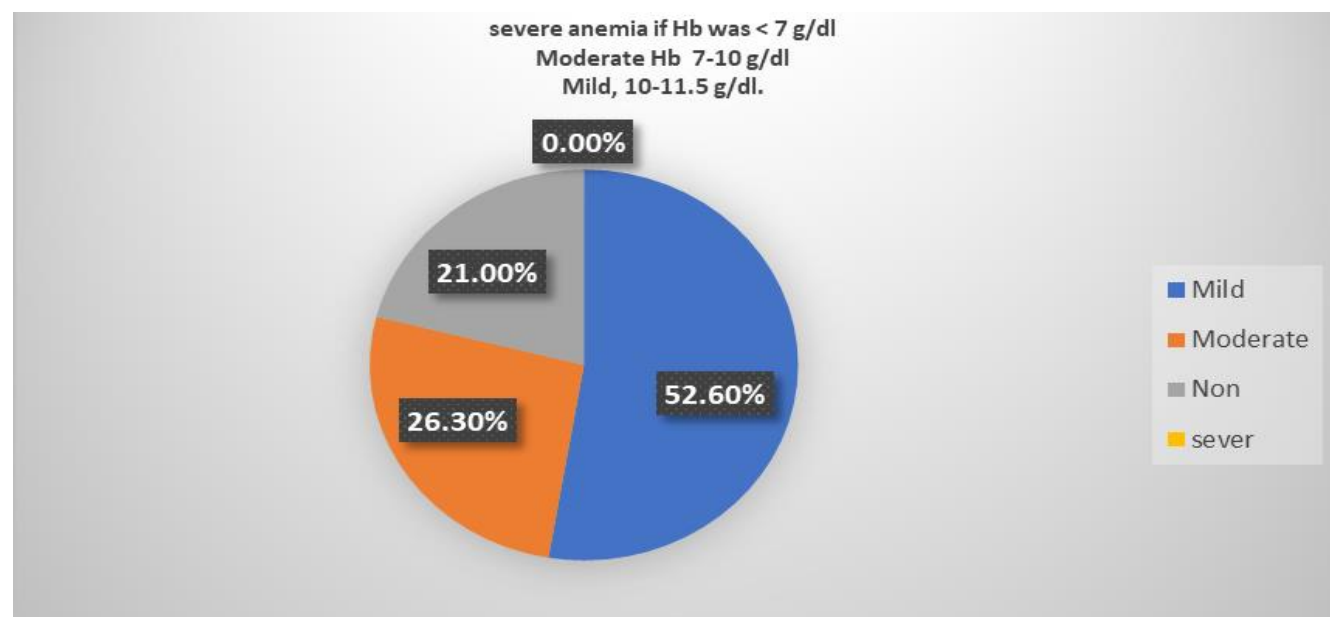


Figure-I: frequency of anemia in G6PD deficient neonates sever anemia.

DISCUSSION

A deficient level in glucose-6-phosphate dehydrogenase results in severe anemia and newborn hyperbilirubinemia [10]. It results from a mutation in the red blood cell enzyme G6PD, which produces nicotinamide adenine dinucleotide phosphate and shields RBCs from oxidative damage [11]. Due to its higher frequency in some ethnic groups, G6PD deficiency varies greatly among countries. The prevalence varies from 2.3% in Nigeria to 4.3% in Egypt and 2% in Saudi Arabia [12-13]. Males are the main victims of this X-linked disorder. Therefore, females often do not experience severe hemolytic anemia. Neonates with G6PD deficiency have no symptoms unless they are subjected to oxidative stress, which can be brought on by certain medications, illnesses, or foods like fava beans, in such a scenario, individuals may experience acute hemolysis [14]. It results in severe hyperbilirubinemia in newborns, which may cause bilirubin-induced neurological dysfunction (BIND) [15]. Neonatal G6PD deficiency screening programs should be designed based on the incidence of the illness in a community, with the goal of identifying and preventing its challenges early. A total of 212 neonates admitted with indirect hyperbilirubinaemia were studied to find out the frequency of G6PD deficiency. Out of the total participants screened 39(18%) were preterm and 174(82%) were term neonates. Among the study participants the prevalence of G6PD deficiency was 19(9%). Our findings are similar to those of research conducted at the Agha Khan Hospital in Karachi by Kumar, Kishwer, et al., in which 9% of patients had a G6PD deficiency [16]. Similarly, another study was carried out on 200 neonates with jaundice who were admitted to the intensive care unit (ICU) of Lady Reading Hospital in Peshawar were the participants of a study to find out the frequency of G-6-PD deficiency. A deficiency of G-6-PD was found in sixteen percent of the newborns [17]. Our study found that G6PD Deficiency was more frequent in the 0–6-day age group and was more prevalent in term newborns than preterm neonates. These findings are

comparable to those of the previous study conducted in Saidu teaching hospital Swat Pakistani [16]. In the present study out of the total G6PD deficient individuals 52.6% of them were mild anemic, 5(26.31%) were moderate anemic and 21.0% had normal HB level. The results of our study confirm the concept that neonatal anaemia is caused by G6PD deficiency [10]. In the present study all the participants were males. Glucose-6-phosphate dehydrogenase is an X-linked disorder and the prevalence these disorders are higher in men than in women which support our study [1]. Jaundice in neonates with G-6-PD deficiency appears somewhat earlier than in babies with other neonatal jaundice causes, including idiopathic & ABO/Rh incompatibility. A similar study was carried out by Ullah and Kumar in 2025 in which neonates with hyperbilirubinemia were screened for G6PD deficiency, with a prevalence of 8%. Their study population comprised only male neonates. Affected neonates were aged 0 to 6 days ((88.2%). these findings support our stud [19]. However, a study conducted in Lebanon showed which showed 5% prevalence which is not similar to our study. The prevalence G-6-PD deficiency varies from region to region. These varion in the incidence of this enzyme may be due to various factors such as food consumption, genetic factor and early screening for it. Therefore, it is essential to promptly detect and diagnose the cause of neonatal jaundice in order to treat it within the allotted period. When evaluating the viability, requirement, along with cost-effectiveness of any neonatal massive screening projects, focus had to be given to the incidence and impact of the problem in the population, the accessibility of treatment and follow-ups, the accessibility of economical and easy to use tests of screening, and other factors. A larger study with a higher percentage neonate is required in order to validate these findings and take into consideration other factors that could act as confounders. There is a clear correlation between severe neonatal jaundice and G-6-PD deficiency.

In order to develop, implement, and carry out treatment, prevention, and management plans that take into consideration the sociodemographic characteristics of the local population, epidemiological data collection is urgently needed.

LIMITATIONS

Despite its strengths, the study has some limitations. The absence of female neonates in the study population restricts the generalizability of findings, as G6PD deficiency, although more common in males, can also affect heterozygous females. Additionally, the study did not explore the correlation between G6PD deficiency and the severity of jaundice, the need for phototherapy, or exchange transfusion, which could have provided valuable insights into disease burden and management implications. Further study is needed to overcome these limitations.

CONCLUSION

The current study revealed that 9% of neonates with neonatal jaundice had G6PD. A significant risk factor for neonatal jaundice is deficiency of glucose-6-phosphate dehydrogenase. This study highlights glucose-6-phosphate dehydrogenase (G6PD) deficiency as a significant contributing factor to neonatal jaundice, reinforcing its importance in early screening and diagnosis.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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Declared none

AUTHORS CONTRIBUTION

Raghib Iqbal: Substantial contributions to study design, manuscript drafting, reviewing it critical for important intellectual content, final approval, accountable for all aspects of publication.

Ayesha Tahira: Substantial contributions to acquisition of data, final approval, accountable for all aspects of publication.

Zahra Riaz: Manuscript drafting, data analysis, critical review, final approval, accountable for all aspects of publication.

Shaista Haidar: Substantial contributions to study design, data interpretation, critical review, final approval, accountable for all aspects of publication.

Kifayat Ullah Khan: Acquisition of data, critical review, proofreading, final approval, accountable for all aspects of publication.

Zahid Mehmood: Critical review, proofreading, final approval, accountable for all aspects of publication.

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