Prevalence of anemia in exclusively breastfed full term babies between 3-6 months of age

Rajakumar Marol*, Renuka Marol

Department of Pediatrics, Shivajyoti Institute of Child Health, Haveri, Karnataka, India

Received: 17 November 2020
Revised: 12 January 2021
Accepted: 13 January 2021

*Correspondence:
Dr. Rajakumar Marol,
E-mail: dr.rajakumar71@gmail.com

ABSTRACT

Background: WHO recommends exclusive breast feeding for 6 months without examination for anemia. However there are concerns about the feasibility and safety of this recommendation. Cochrane review studies especially in developing countries, suggest that exclusive breastfeeding up to 6 months without iron supplementation may compromise the hematologic status of children leading to IDA and its consequences. So the question arises; does absolute breast feeding protect infants from anemia during first 6 months of life? The present study was conducted to estimate the prevalence of anemia in exclusively breastfed babies between 3-6 months of age.

Methods: This was a retrospective study conducted between January 2019 and December 2019 at Shivajyoti Institute of Child Health-Haveri, in exclusively breastfed infants aged between 3-6 months who attended OPD and underwent complete blood count examination. Hemoglobin levels were collected and anemia was defined and classified as per WHO criteria for 6-24 months old children.

Results: Out of 81 infants 52 were males and 29 were females. Age wise, 26 babies were 3 months, 34 were 4 months and 21 were 5 months old. A total of 71 children had anemia: 49 mild, 20 moderate and 2 severe. The prevalence of anemia was 87.6% and it was highest (92.3%) at 3 months of age.

Conclusions: Exclusively breastfed infants between 3-6 months are at increased risk of anemia. Therefore infants after 3 months, should be evaluated for anemia and iron deficiency which is the commonest cause of anemia. Such infants should be supplemented with oral iron in addition to exclusive breast feeding for 6 months, to prevent adverse effects of IDA on infants’ growth and development.

Keywords: Anemia, Exclusive breast feeding, Fullterm baby, Prevalence

INTRODUCTION

Anemia is a major public health issue around the globe, particularly in developing countries and among children less than 2 years of age.1,2 Worldwide, anemia affects up to one-half of children younger than five years.3 Despite the existence of a national anemia-control programme, the prevalence of anemia in India between 2000 and 2005 increased from 75.3% to 80.9% in children aged 6 to 36 months.4 According to NIHFS survey conducted in 2015-16, prevalence of anemia in children between 6-59 months was 57.2% in urban areas and 63.4% in rural areas in Karnataka, India.5

Anemia is a status of reduced level of hemoglobin concentration in blood to a value >2 SDs below the age-specific mean.6 Microcytic anemia due to iron deficiency is the most common type of anemia in children. Iron deficiency (ID) is the most common nutritional disorder in the world and is the leading cause of anemia especially in developing countries.7 The prevalence of iron deficiency anemia (IDA) remains high in late infancy and early childhood.8 As IDA accounts for highest number of
cases of anemia in infants, simple estimation of Hb level in infants represents IDA. However, IDA in infants remains under diagnosed as most infants are asymptomatic and do not undergo blood tests unless reasonable clinical events are present. IDA, which can be associated with cognitive issues, is prevented and treated with iron supplements or increased intake of dietary iron.

Hemoglobin (Hb) cut-off values to define anemia have been established for groups of different ages and sex, starting from the age of 6 months by World Health Organization (WHO). However, it is not defined for infants <6 months old, so the cut-off value for children aged 6 months to 5 years (11 gm/dl) is sometimes applied. However, according to Magnus Domellof, Hb of less than 10.5 mg/dl was considered as cutoff values for diagnosing anemia in children between 3-6 months. In a Swedish study, Lomnerdal et al suggested a cut-off value of 10 mg/dl for infants aged 4-8 months on the basis of the Hb distribution observed among healthy Swedish infants. Hemoglobin levels in children are primarily related to iron stores. The concentration of iron in human milk is relatively low and so iron is supplied mainly from iron stores from birth until 6 months of age. Thus, factors affecting iron stores like maternal anemia and early cord clamping can decrease Hb levels in infants.

During the first months of life, Hb declines from the very high level at birth to its lowest level at 6-10 week of age. This decrease is known as the “physiologic anemia of the newborn”. After Hb has reached its lowest level at ~2 months of age, it slowly increases again and becomes more or less stable at 6-9 months of age. So full term infants are thought to have adequate iron stores until 6 months of age and is known that absolute breast feeding will protect full-term babies from anemia, especially IDA. Thus before the age of 6 months, only preterm infants and infants with low birth weight (<2500 gm) are considered at-risk of IDA because of their low iron stores and are prescribed iron supplements. This is one of the reasons for the lack of prevalence data and the absence of good cut-off values for infants <6 month old. Thus, American Academy of Pediatrics (AAP) has concluded that universal screening for anemia should be performed with determination of Hb concentration at approximately 1 year of age and universal screening for anemia before that and in newborns is not warranted.

In 2001, the WHO recommended exclusive breastfeeding (EBF) for the first 6 m of life (EBF-6), replacing its previous recommendation of EBF for first 4 to 6 months. EBF-6 was reaffirmed by WHO in 2012.; however, concerns continue to be raised about the feasibility and safety of this recommendation and some have called for its re-examination. It is known that exclusive breastfeeding protects children from IDA, as full-term infants are thought to have adequate iron stores until 6 months of age but increasingly studies report that iron reserves received by the child in the last trimester of pregnancy runs out between 4 and 6 months after birth, even in exclusively breastfed babies. In support of this, the Cochrane review suggests that exclusive breastfeeding up to 6 months without iron supplementation may compromise the hematologic status of infants and children. Thus the AAP recommends that full-term, exclusively breastfed infants start 1 mg per kg per day of elemental iron supplementation at four months of age until appropriate iron-containing foods are introduced. Iron plays an important role in many metabolic processes, including oxygen transport, oxidative metabolism and cellular growth. During infancy, IDA is associated with more risk of infectious diseases, impaired growth, increased incidence of breath holding spells and febrile seizures.

The first 6 months of life which is vulnerable to ID and IDA is also a time of rapid brain growth and child development. It is widely accepted that iron deficiency can have long-term consequences that are often irreversible. Several studies have found that reversal of the anemia did not improve standardized test scores in children. In many studies IDA has been linked to cognitive and socioemotional difficulties and to poor fine and gross motor development among young children. Infants who experience ID or IDA are at increased risk for low scores on tests of mental performance and may be fearful, inattentive and solemn with low levels of initiation and exploration. Children who were anemic early in life are more likely to experience academic problems at 10 years of age compared to children who were not anemic. In addition to the direct effects of ID on brain functioning, evidence from electrophysiological studies suggests delayed brain maturation in infants with IDA.

Therefore, ID and severe anemia should be prevented and/or treated at as young an age as possible. There are very few studies conducted to assess anemia in exclusively breast fed infants because of the notion that breast feeding will protect from anemia especially IDA. So the present study was conducted to estimate the prevalence of anemia in exclusively breastfed babies between 3-6 months of age so that we can identify, prevent and treat anemia and its consequences at an early age.

METHODS

Design and setting

This was a retrospective observational study conducted between January 2019 and December 2019 in a level 2 pediatric hospital, Shivajyoti Institute of Child Health-Haveri situated at a district place in Karnataka state in Southern India catering mainly rural children from low socioeconomic background.
Inclusion criteria

Exclusive breastfed term infants aged between 3-6 months of age (90 days to 180 days) who attended OPD of the hospital and had undergone complete blood count (CBC) examination for some minor ailments. According to AAP, CBC is not advised routinely in all infants unless there is clinical suspicion of anemia and risk factors for anemia. So CBC was not done for all infants but done for those who presented with pallor and some illnesses. According to AAP, CBC is not advised routinely in all infants unless there is clinical suspicion of anemia and risk factors for anemia. So CBC was not done for all infants but done for those who presented with pallor and some illnesses.

Exclusion criteria

Children born prematurely, intrauterine growth retarded babies, those with repeated infections, severe infections, babies with supplements, bottle feeds and haemoglobinopathies were excluded from the study.

The patients’ data and Hb levels were collected from the hospital software. All the infants were looked for anemia and its severity. Since, there is no established cut off available for hemoglobin concentration to diagnose anemia in infants <6 months, the WHO definition of anemia for infants above 6 months, i.e. hemoglobin concentration <11 gm/dl was used to diagnose anemia for babies between 3-6 months and it was also used to assess for severity; severe <7 mg/dl, moderate 7.00-8.9 mg/dl and mild 9.00-10.9 mg/dl. In addition, the cut-off values suggested by Domelloff et al (<10.5 mg/dl) and Lonnerdal et al (<10 mg/dl) were also used. So the infants were assessed for all 3 cutoff values i.e. <10 mg mg/dl, <10.5 mg/dl and <11 mg/dl.

Statistical analysis

All the data were entered into MS-Excel and later exported to SPSS Version 23. Results were presented in terms of frequencies and percentages.

Ethical clearance

The study was conducted as per the recommendations of the institutional ethical committee and in conformation with the Declaration of Helsinki.

RESULTS

Totally 575 infants aged 3-6 months attended OPD during study period. Out of them, 108 infants had their CBC done for various reasons and for pallor. After excluding 27 babies as per our exclusion criteria, 81 infants matched the selection criteria and remained as study group.

Out of 81 infants in the study group, 11 had URI with pallor, 38 had ALRI and another 11 had gastroenteritis with pallor. Two each presented with UTI, Febrile convulsions, Rickettsial fever, septicemia and laryngomalacia. Remaining 11 children had different minor illnesses but none had severe life threatening illness.

Among 81 infants, 52 were males and 29 were females. According to age 26, 34 and 21 babies were belonging to 3, 4 and 5 months respectively. Mean age was 4 month and Hb was 9.7 mg/dl. Median Hb was 9.6 mg/dl.

Figure 1: Prevalence of anemia based on Hb level.

A total of 71 children had anemia as per WHO criteria of <11 gm% of Hb, giving a prevalence of anemia of 87.6%. However if we take 10.5 mg% as cut off value 67 (82.7%) had anemia and for 10 mg%, 51 (62.9%) had anemia (Figure 1).

Figure 2: Age distribution of anemia.

Figure 3: Sex distribution of anemia.
Out of 71, 24 (92.3%) babies with age of 3 months, 29 (85.3%) aged 4 months and 18 (85.7%) aged 5 months had anemia (Figure 2). Segregating by gender, 48 males and 23 females were anemic (Figure 3).

On classifying anemia based on severity as per WHO criteria for assessing severity of anemia in infants above 6 months, it was found that 49 had mild, 20 had moderate and 2 had severe anemia (Figure 4).

![Classification of Anemia based on Severity](image)

**Figure 4: Severity of anemia.**

**DISCUSSION**

In our study, the prevalence of anemia was 87.6%. A study conducted by Hemachitra et al to assess the prevalence of anemia in 3-6 months old babies with a similar cut off value of Hb showed a prevalence of 65.8%. In Asia, the prevalence of anemia in children under 2 years of age may exceed 90%. The prevalence of anemia among fullterm infants may be as high as 80% at 3-6 months and 90% at 6-9 months of age.

The extremely high prevalence of anemia in absolutely breast fed infants between 3-6 months of age is similar to the prevalence of anemia observed in children above 6 months. According to NHFS-III, 79% children under 3 years were anemic and in 6-23 months, 81.8% were anemic. Our own prospective study conducted over a period of one year during 2019 in the same institution yielded 93.5% prevalence of anemia in children aged between 6 to 23 months. A study conducted in Odisha yielded 94% prevalence of anemia in under 5 year children. In a study conducted in Burma, the prevalence of anemia in children between 6-36 months was 72.65%.

We tried to find out the cause of anemia in the study group. Babies had no evidence of hookworm infestation, malaria, recurrent diarrhea, recurrent infections and malnurishment which can cause anemia in this age group. Alpha thalassemia trait is uncommon in this area.

A number of studies, conducted largely among infants aged 6-12 months, found that infants born to anemic mothers had a lower Hb concentration. Eighty percent of the iron present in a newborn term infant is accumulated during the third trimester of pregnancy. Hemachitra et al, in their study confirmed that low haemoglobin and poor weight gain in term 3-6 months old babies were significantly associated with maternal anemia in last trimester. In support of this, various studies conducted to know the prevalence of anemia in mothers around this region showed high prevalence of anemia in pregnant mothers. Prevalence of anemia in antenatal mothers was 73% in Belgaum and 96.5% in Koppal, Karnataka India, whereas it was 98% in Sonipat Haryana India. Recently it has also been proved by different studies that time of umbilical cord clamping at the time of delivery also affects Hb levels in infants. These studies have reported that late-timing of cord clamping, might be associated with better hemoglobin values, higher stores of iron at 6 months of age and lower incidence of anemia. Delayed umbilical cord clamping (approximately 120 to 180 seconds after delivery) is associated with improved iron status (ferritin levels) at two to six months of age.

As per previous literature available, it was understood that the breastfeeding protected children from ID/IDA until the 4th month of age. So surveillance is required by the 4th month after birth in order to identify children in need of iron supplementation in fully breastfed babies when they reach 4 months instead of 6 months of age. Therefore it is recommended that exclusive breastfed term infants receive an iron supplementation of 1 mg/kg per day, starting at 4 months of age and continued until appropriate iron-containing complementary foods have been introduced. However in our study, out of 71 infants with anemia, 24 babies out of 26 (92.3%) at 3 m of age had anemia. This suggests that anemia is common even at 3 months of age necessitating iron supplementation at 3 months.

Eventhough the study population in the present study is biased towards sick children, high prevalence value is unexpected and alarming. One of the reason for higher prevalence of anemia in the present study could be the high prevalence of maternal anemia in this region. The timing of cord clamping could not be assessed in our study. The other factors could be, majority of the children were poor, rural and from low socioeconomic status. Low socioeconomic status can play a role in different ways, including poorer nutritional status of the mother, maternal anemia and hence poorer fetal nutrition. One more reason is delayed initiation of iron supplementation.

Limitations of study is that there were no definitive cutoff points for Hb level to define anemia in infants between 3-6 m for better understanding of prevalence of anemia in this age group. The study being a hospital based study it does not reflect the prevalence of anemia in general population. Serum ferritin levels to know the iron status could not be studied as it was a retrospective study.
CONCLUSION

Prevalence of anemia in fullterm exclusively breastfed babies between 3-6 months of age who visited OPD for minor ailments and tested for CBC is 86.5%. As iron deficiency accounts for majority of anemias in developing countries, any anemia in infants, by default should be considered as IDA and has to be corrected at the earliest to prevent grave and irreversible consequences of IDA on infants’ growth and development. Anemia in infants can be addressed through delayed cord clamping, preventing maternal anemia and oral iron therapy starting at 3-4 months along with exclusive breast feeding for 6 months as per WHO recommendation without requirement of complimentary foods before 6 months. There is also need for prospective studies involving larger number of children to determine Hb cut-off values to define anemia in infants between 3-6 months of age.

ACKNOWLEDGEMENTS

Authors would like to thank Mr. Rohitkumar Marol, an undergraduate in University of Rochester, NY, USA for his support in drafting and critical analysis of this manuscript.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. WHO/Vitamins and minerals- Available at: https://www.who.int/nutrition/publications/vitamins Minerals/en/. Accessed on 10 November 2020.
2. WHO. The global prevalence of anemia in 2011. World Health Organization. Geneva: Switzerland; 2015.
3. WHO/Worldwide prevalence of anaemia 1993-2005. http://whqlibdoc.who.int/publications/2008/9789241596657_eng.pdf. Accessed 10 Nov 2020
4. Pasricha SR, Black J, Muthayya S, Shet A, Bhat V, Nagaraj S, et al. Determinants of anemia among young children in rural India. Pediatrics. 2010;126(1):e140-9.
5. Bharati S, Pal M, Bharati P. Prevalence of anaemia among 6 to 59-month-old children in India: the latest picture through the NFHS-4. J Biosoc Sci. 2020;52(1):97-107.
6. Baker RD, Greer FR. Committee on Nutrition American Academy of Pediatrics. Diagnosis and prevention of iron deficiency and iron-deficiency anemia in infants and young children (0-3 years of age). Pediatrics. 2010;126(5):1040-50.
7. United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition (ASC/SCN) International Food Policy Research Institute (IFPRI). Fourth Report of the World Nutrition Situation. Geneva, Switzerland; 2000.
8. Huang Y, Wang L, Huo J, Wu Q, Wang W, Chang S, et al. Prevalence and causes of anaemia in children aged 6-23 months in rural Qinghai, China: findings from a cross-sectional study. BMJ Open. 2019;9(9):e031021.
9. Joo EY, Kim KY, Kim DH, Lee JE, Kim SK. Iron deficiency anemia in infants and toddlers. Blood Res. 2016;51(4):268-73.
10. Wang M. Iron deficiency and other types of anemia in infants and children. Am Fam Phys. 2016;93(4):270-8.
11. De Pee S, Bloem MW, Sari M, Kiess L, Yip R, Kosen S. The high prevalence of low hemoglobin concentration among Indonesian infants aged 3-5 months is related to maternal anemia. J Nutr. 2002;132(8):2215-21.
12. Domellöf M, Dewey KG, Lönnertal B, Cohen RJ, Hernell O. The diagnostic criteria for iron deficiency in infants should be reevaluated. J Nutr. 2002;132(12):3680-6.
13. Domellöf M, Cohen RJ, Dewey KG, Hernell O, Rivera LL, Lönnerdal B. Iron supplementation of breast-fed Honduran and Swedish infants from 4 to 9 months of age. J Pediatr. 2001;138(5):679-87.
14. Dhanasekaran R, Sumitha A, Suguna. Impact of maternal anaemia on cord blood haemoglobin. Int J Contemp Pediatr 2019;6:1235-8.
15. Dallman PR, Siimes M, Stekel A. Iron deficiency in infancy and childhood. Am J Clin Nutr. 1980;33(1):86-118.
16. Yip R. Age related changes in iron metabolism. In: Brock JH, Halliday JW, Pippard MJ, Powell LW, eds. Iron Metabolism in Health and Disease. Academic Press, London, UK: WB Saunders; 1994:427-448.
17. Dewey KG, Chaparro CM. Session 4: Mineral metabolism and body composition iron status of breast-fed infants. Proc Nutr Soc. 2007;66(3):412-22.
18. Morealeda C, Rabinovich NR, Menéndez C. Are infants less than 6 months of age a neglected group for anaemia prevention in low-income countries? Am J Trop Med Hygiene. 2018;98(3):647-9.
19. Irwin JJ, Kirchner JT. Anemia in children. Am Fam Phys. 2001;64(8):1379-86.
20. Kramer MS, Kakuma R. Optimal duration of exclusive breastfeeding. Cochrane Database Syst Rev. 2012;2012(8):CD003517.
21. World Health Organization. The Optimal Duration of Exclusive Breastfeeding: Report of an Expert Consultation. Geneva; 2001. Available at: https://www.who.int/nutrition/publications/optimal_duration_of_exc_bfeeding_report_eng.pdf. Accessed on 12 January 2021.
22. Dube K, Schwartz J, Mueller MJ, Kalhoff H, Kersting M. Iron intake and iron status in breastfed infants during the first year of life. Clin Nutr. 2010;29:773-8.
23. Friel JK, Aziz K, Andrews WL, Harding S, Courage ML, Adams RJ. A double-masked, randomized control trial of iron supplementation in early infancy in healthy term breast-fed infants. J Pediatr. 2003;143:582-6.

24. Marques RF, Taddei JA, Lopez FA, Braga JA. Breastfeeding exclusively and iron deficiency anemia during the first 6 months of age. Revista da Associação Médica Brasileira. 2014;60(1):18-22.

25. Sills R. Iron deficiency anemia. In: Kingman RM, Staton BF, St Game III JW, Schrutz. Nelson textbook of Pediatrics 20th edn. Elsevier: Philadelphia; 2016:455.

26. Hemachitra J, Monish A. Risk of infant anemia in 3-6 months old babies and its association with maternal anemia. Int J Contemp Pediatr. 2018;5(3):938.

27. Peirano PD, Algarin CR, Chamorro R, Reyes S, Garrido MI, Duran S, et al. Sleep and neurofunctions throughout child development: lasting effects of early iron deficiency. Pediatr Gastroenterol Nutr. 2009;48(1):S8-15.

28. Beard JL, Hendricks MK, Perez EM, Murray-Kolb LE, Berg A, Vernon-Feagans L, et al. Maternal iron deficiency anemia affects postpartum emotions and cognition. J Nutr. 2005;135(2):267-72.

29. Black MM, Quigg AM, Hurley KM, Pepper MR. Iron deficiency and iron-deficiency anemia in the first two years of life: strategies to prevent loss of developmental potential. Nutr Rev. 2011;69(1):S64-70.

30. World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. 2011. Available at: https://apps.who.int/iris/handle/10665/85839. Accessed on 12 January 2021.

31. Kotecha PV. Nutritional anaemia in young children with focus on Asia and India. Indian J Community Med. 2011;36(1):8-16.

32. Lutter CK. Iron deficiency in young children in low-income countries and new approaches for its prevention. J Nutr. 2008;138:2523-8.

33. Marol RN, Marol RR, Marol RR. Prevalence of anemia in children with acute lower respiratory tract infection: a case control study in children between 6 months to 23 months. Int J Contemp Pediatr. 2020;7:1573-7.

34. Sahu T, Sahani NC, Patnaik L. Childhood anemia- a study in tribal area of Mohana block in Orissa. Indian J Community Med. 2007;32(1):43-5.

35. Strauss MB. Anemia of infancy from maternal iron deficiency in pregnancy. J Clin Invest. 1933;12(2):345-53.

36. Colomer J, Colomer C, Gutierrez D, Juber A, Nolasco A, Donat J, et al. (1990) Anaemia during pregnancy as a risk factor for infant iron deficiency: report from the Valencia Infant Anaemia Cohort (VIAC) study. Paediatr Perinat Epidemiol. 1990;4:196-204.

37. Prashant D. Prevalence of anemia among pregnant women attending antenatal clinics in rural field practice area of Jawaharlal Nehru Medical College, Belagavi, Karnataka, India. Int J Community Med Public Health. 2017;4(2):537.

38. Seema BN. Prevalence of anemia among pregnant women in rural Koppal: a study from teaching hospital, Koppal, India. Int J Reprod Contracept Obstet Gynecol. 2017;6(9):3792-5.

39. Mangla M, Singla D. Prevalence of anaemia among pregnant women in rural India: a longitudinal observational study. Int J Reprod Contracept Obstet Gynecol. 2016 Dec 15;5(10):3500-5.

40. Chaparro CM, Neufeld LM, Alavez GT, Cedillo REL, Dewey KG. Effect of timing of umbilical cord clamping on iron status in Mexican infants: a randomized controlled trial. Lancet. 2006;367:1997-2004.

41. Van Rheeuen PF, Brabin BJ. A practical approach to timing cord clamping in resource poor settings. BMJ. 2006;333:954-8.

42. Hutton EK, Hassan ES. Late versus early clamping of the umbilical cord in full-term neonates: systematic review and meta-analysis of controlled trials. JAMA. 2007;297(11):1241-52.

43. Andersson O, Hellström-Westas L, Andersson D, Domellöf M. Effect of delayed versus early umbilical cord clamping on neonatal outcomes and iron status at 4 months: a randomised controlled trial. BMJ. 2011;343:d7157.

44. Census Data 2001- Census of India. Available at: https://censusindia.gov.in/2011-common/census_data_2001.html. Accessed on 10 November 2020.

Cite this article as: Marol R, Marol R. Prevalence of anaemia in exclusively breastfed full term babies between 3-6 months of age. Int J Contemp Pediatr 2021;8:300-5.