Research Article

PREVALENCE OF IRON DEFICIENCY ANEMIA IN 12-MONTHS OLD INFANTS IN QATIF PRIMARY HEALTH CARE CENTERS

Zainab Ali Alfaraj., Areej Alelaiw., Shaher Alshehni and Marwa Shafey

Saudi Board of Family Medicine

ARTICLE INFO

ABSTRACT

Objectives This study aimed to estimate the prevalence of Iron deficiency anemia (IDA) among 12 months old infants who attended the well-baby clinic (WBC) in Qatif Primary health care centers (PHCC), from January 2018 to December 2018.

Material and Method: It was a cross sectional study descriptive study in which 12 months old infants who were registered in Qatif PHCC were the study population. A total of 406 twelve months old infants were selected randomly using the systematic random technique from all 24 well –baby clinics of Qatif PHCC. The cutoff point used to diagnose anemia was hemoglobin (HB) less than 11g/dl and Iron deficiency (ID) was serum ferritin less than 15 g/L. Data were collected by designing compilation sheets which included infant's information on age, gender and type of feeding, Hematocrit Value, Mean Capsular Volume, Mean Capsular Hemoglobin Concentration, Red Cell Distribution, Red Blood Cells, White Blood Cells, Platelets, Serum iron , Total iron binding capacity electrophoresis and G6PD level. The data were coded and analyze using the SPSS ver.22.

Categorical variables were described using numbers and percentages Gender, feeding type, HB electrophoresis, and blood group were involved in single logistic regression to assess their association with the outcome (IDA). The significant variables were then included in multiple logistic regression. The level of significance was set at P value <0.05 and CI of 95%.

Results: This study reported that the prevalence of iron deficiency anemia (IDA) was estimated at 27.1%. Out of 185 anemic infants 110 had serum ferritin less than 15 g/L, making the proportion of IDA to be 59.46 % and there was no statistically significant difference between male and female. Regarding feeding practice, IDA was less prevalent in mixed and bottled feeding (P- value<0.05). Infants with sickle cell disease (SCD) have less prevalence IDA (0.023).

Conclusion: IDA is still a problem in Saudi infants. Therefore, we recommend the implementation of health education and promotion programs to increase the awareness of mother and families regarding to their infant's health. Maintaining Screening for IDA should be continued and encouraging both breast feeding with iron supplementation.

INTRODUCTION

Anemia is defined as serum hemoglobin (Hb) < 11 g/dl and Iron deficiency (ID) in children (6month to <5 years) is defined as: ferritin < 15 microgram/liter. Thus Iron Deficiency anemia (IDA) in children (6month to <5 years) is ultimately defined as (HB <11 gm/dl and serum ferritin <15 microgram /liter).[1, 2]

IDA is a significant health problem affecting all age groups especially children in developing countries where the prevalence is as high as 50%. Globally, Iron Deficiency (ID) is assumed to be the cause of 50% of anemia and it is ranked at the 9th place among 26 risk factors included in global burden of disease (GBD, 2000) project and accounts for 841,000 deaths and 35,057,000 disability-adjusted life year's lost.[3]

The populations at risk of Iron deficiency are infants from 4 to 24 months, school age children, female adolescents, pregnant women and nursing mother.[4] The predisposing factors of ID in infants are prematurity, cesarean delivery, breast-feeding, low birth weight, gender, educational level and occupation of the mothers, family size and income. [5-12]

IDA has been linked with impaired neurocognitive development.[13] The American Academy of Pediatrics (AAP) recommends universal laboratory screening of one-year old infant by measuring hemoglobin level. [14 -18] In addition, AAP also recommends iron supplementation for breast fed infant.[14,19] The Kingdom of Saudi Arabia has embraced the AAP recommendation for screening anemia in twelve months old infant.[20] McLean *et al*. conducted a study to estimate the worldwide prevalence of anemia from 1993 to 2005 and it was estimated to be 24.8%. The highest estimated prevalence of 47.4% was among preschool aged children. Geographical variation was also noticed where people living in Asia and Africa were with the highest risk. [21] A systematic analysis of

Corresponding author: **Zainab Ali Alfaraj**
Saudi Board of Family Medicine

population representative data from 1995-2011 stated that global prevalence of anemia decreased from 47% in 1995 to 43% in 2011 and from 43% to 38% in central Asia, Middle East, and north Africa. The analysis also concluded that anemia prevalence in 2011 was the highest in south Asia and central and west Africa.[22]

A cross sectional study conducted in Iran has reported the prevalence of IDA among infants aged 12-15 months to be 26.2%.[8] In an Egyptian cross sectional study the researchers have found prevalence of anemia among 4-24 months of infants to be 66% while 43% of them had IDA.[23] Similar results were also found in Eastern Sudan where 86% of the children below 3 years of age were diagnosed with IDA .[24] Elalfy *et al*. reported high frequencies of IDA among infants that were exclusively breastfed for the first 6 months of age (62%) , who received cow milk (alone or in combination with breastfed) (77%) and who were on formula feeding (9%). The study also showed positive correlation between Hb percentage and parents' education years, and negative correlation with family size, and birth order above second order. In the same study; male IDA prevalence was higher than female.[23] A recent cross-sectional study done in Qatar estimated the prevalence of anemia at 23.5%, ID at 9.2% and IDA was 7.8% in one-year old infant attending well baby clinic in Qatar PHCC. [25] In 1987, Babiker *et al*. noticed that ID is a common problem among Saudi infants but it lacked published studies. Authors carried out study to measure the prevalence of ID in healthy Saudi children from birth to 15 months of age in king Abdulaziz and King Khalid university hospitals in Riyadh. This study showed that older age group (12-15 months) had the highest prevalence of ID which is 14.5% .According to Babiker *et al*. recommended screening for ID in 12 to 15 months infant in well baby clinic who attend for vaccination.[26]A study published in 1993 concluded that there was high prevalence of IDA and the study recommended screening for IDA .[27] The pattern of anemia among Saudi children has been investigated and reported by EL-Hazmi *et al* 1999 which showed the highest prevalence of anemia (50.54%) among the children of Al Qatif city of the eastern province of Saudi Arabia which was predominantly the hypochromic microcytic anemia.[28] Recently, a study conducted in the northwestern region of Saudi Arabia(2015) has revealed alarming prevalence of IDA (49%) which was higher among the male children (53%) than the female children (47%). This study also showed that 98% of infants with IDA were products of full-term pregnancy and 85% of infant were breast fed. [29] Both El-Hazmi and *Al Hawsawi* did not determine the underlying etiology of such type of anemia and risk factors of anemia were not investigated.[28,29]

The Saudi population in Qatif are susceptible for haemoglobinopathies and G6PD deficiency with the prevalence of 2.35%, 30.6% of these diseases respectively.[30] Our study conducted in Qatif region since it has the highest prevalence of hypochromic microcytic anemia with no recent studies have been conducted in the region in the past 19 years.[28]

Hence, our study was aimed to estimate the prevalence of IDA and its associated risk factors in Qatif city.

MATERIAL AND METHODS

It was a cross sectional study targeting 12 months old infants who were registered in Qatif PHCC between December 2019 to January 2020. Infants who were 12 months of age and attended well baby clinic for routine one-year vaccination were the study population. Infants with acute febrile illness, chronic conditions and with high white blood cells on investigation were excluded.[31-35] Assuming the prevalence of anemia to be 50.54% according to El Hazmi *et al*. with margin of error 5% at confidence level 95%, the minimum calculated sample size was 384, which was calculated using Epi info.[28,36] An additional 10% was added to compensate the missing data making the study sample to be 422.

All the 24 Primary health care Centers (PHCC) of Al Qatif region were included for this study. The number of health records at each PHCC was selected proportionally according to the center serving target population, and more samples were allocated in centers with highest population. Records for secondary data from laboratory and well-baby clinic of 12 months old infant from each PHCC were selected by random systematic sampling., using sampling interval of 31.Data were collected by designing compilation sheets which included infant's information from the medical records such as demographic information (age, gender and type of feeding), presence of IDA (Hb < 11 g/dl and serum ferritin < 15 microgram/ liter), Hematocrit(<32, anemia), Mean Capsular Volume(<71: microcytic, >89: macrocytic, 71-89:normocytic), Mean Capsular Hemoglobin Concentration(32: hypochromic, 35: hyperchromic, 33-34:normochromic), Red Cell Distribution Width(>15.8: IDA), Red Blood Cells, White Blood Cells, Platelets, Serum iron(<30:IDA), Total iron binding capacity (>450:IDA), Hb electrophoresis and G6PD level. [37-42] A pilot study on 30 records were done before starting the study to validate the data and the compillation sheet was redesigned by adding new variable which was MCHC. Content validity was done using substantial literature review and consultation with expert in the specialty of pediatrics and hematology. The data were coded and analyzed using SPSS ver.22.[43] Categorical variables were described using numbers and percentages Continuous variables were tested for normality using Shapiro - Wilk test. Gender, feeding type, HB electrophoresis, and blood group were involved in single logistic regression to assess their association with the outcome (IDA). The significant variables were then included in multiple logistic regression. The level of significance was set at P value <0.05 and CI of 95%. This study was approved by the ethical committee of Ministry of health (MOH). At the same time the permission was taken from Qatif PHCCs director and confidentiality of participant's data was assured.

RESULTS

Health records of 406 out of 422 required samples could be retrieved for this study making the response rate of 96%. Fifty percent of them were male infants. All infants were exactly 1 year of age .Almost twenty nine percent (N=117) of the infants were breastfed while 28.1% (N=114) were fed with formula milk and 43.1% (N=175) with mixed feeding (both formula and breastfed). The details of the demographic and feeding information are shown in Table 1, (Figure 1).

Table 1 Showing the demographic and feeding information of the infants

Variable	Number	Percentage
Age ; all the infants with 1 year age	406	100
Sex		
Male	203	50.0
Female	203	50.0

Feeding habit of the infants		
Breast feeding	114	28.8
Bottled feeding	117	28.1
Mixed feeding (Breast and bottle)	175	43.1

The median for hemoglobin was 11g/dl (Range; 7.1 - 14) while for MCV it was 66.55f/L (Range; 32.3 – 92.6).The mean of MCH was 22 pg (Range 21.69 - 22.32) and the median and range of serum iron and TIBC were 37 g/dl (Range;10.70-119.50) and 375g/dl (Range; 201.00-591.90) respectively. The ferratin median was 12.99 g/L (Range; 5.24 – 132.9). The details of the different laboratory characteristics of the participants are shown in table 2.

Table 2 Showing the laboratory results characteristics of 12-month-old infants attended PHCCs in Qatif region, 2018

Variable	Number	Median (Min, Max)
Hemoglobin	406	11.00 g/dl (7.10, 14.00)
Hematocrit	406	32.90 % (22.50, 62.2)
MCV	406	66.55 f/L (32.3, 92.6)
MCH (Mean, 95% CI)	406	22.00 pg (21.69, 22.32)
MCHC	406	33.50 % (26.40, 44.70)
RDW	406	15.00 % (8.70, 33.40)
RBC	406	$5.00 10^{12}$/L (1.77, 7.87)
WBC	406	$9.26 \ 10^9$/L (3.30, 21.00)
Platelets	406	$401 10^9$/L (161.00, 755.00)
Serum iron	185	37 g/dl (10.70, 119.50)
TIBC	185	375g/dl (201.00, 591.90)
Ferritin	185	12.99g/L (5.24, 132.90)

Min: Minimum   Max: Maximum   MCV: Mean Corpuscular volume   MCH: Mean Corpuscular hemoglobin   MCHC: Mean Corpuscular hemoglobin concentration   RDW: Red Cell Distribution.   RBC: Red Blood Cells   WBC: White Blood Cells   TIBC: Total Iron Binding Capacity

More than forty five percent of the infants (45.6%, N=185) were suffering from anemia (Hb<11g/dl).Among them 86% (N=160) had microcytic anemia while the rest 13.5% (N=25) had normocytic anemia. The prevalence of IDA was 27.1%. Out of 185 anemic infants 110 had serum ferritin less than 15 g/L, Hemoglobin electrophoresis showed that more than seventy three percent of the infants (73.4%, N=298) did not have haemoglobinopathies. However one quarter of them (N=101)   had sickle cell trait and only 1.5% with sickle cell disease. The prevalence of G6PD deficiency was found among 34% of infants. The details of the hematological results are shown in table 2 (Figure 3).

Table 2 Showing the details of hematological characteristics among the infants

Table (2). Anemia characteristics among 12-month-old infants attended PHCCs in Qatif region, 2018

Characteristic	No.	Percentage
Anemia (N=185)		
Microcytic anemia	160	86
Normocytic anemia	25	14
Iron Deficiency anemia (IDA) status		
Serum ferritin level <15 g/L (IDA)	110	27.09
Serum ferritin level > 15 g/L	296	72.91
Hb electrophoresis (N=406)		
Normal	298	73.40
Sickle cell trait (SCT)	101	24.88
Sickle cell disease (SCD)	7	1.72
G6PD deficiency	110	27.09

IDA was more prevalent among boys than the girls (30.9% vs. 23.6%) but it was not statistically significant (p-value 0.119).The prevalence of IDA was significantly higher among breast fed infants than those with bottle fed and mixed fed infants (42.7% Vs. 12.3% Vs. 26.3% , p- value <0.001) .The breast fed infants were more likely to develop IDA (OR;1) than those with bottle fed(OR; 0.188 ,95% CI 0.096 – 0.366)

and mixed fed (OR; 0.478 95% CI 0.291 – 0.786) on simple regression analysis. IDA was significantly more among the infants with SCD infants than those of non SCD infants (66.6% vs. 33.4%, p- value 0.010).The details of the significance of factors associated with IDA is shown in table 3.

Table 3 Showing the details of the significance of factors associated with IDA

Table (3). Factors associated with IDA in 12-month-old infants attended PHCCs in Qatif region, 2018. (single logistic regression.)

Variable		Total	IDA no. (%)	Non-IDA no. (%)	COR	95% CI	p-value
Gender	Boy (reference)	203	62 (30.5)	141 (69.5)	-	-	-
	Girl	203	48 (23.6)	155 (76.4)	0.704	0.453 – 1.094	0.119
Feeding type	Breast feeding	117	50 (42.7)	67 (57.3)	1	-	-
	Mixed feeding	175	46 (26.3)	129 (73.7)	0.478	0.291 – 0.786	< 0.001*
	Bottle feeding	114	14 (12.3)	100 (87.7)	0.188	0.096 – 0.366	0.005*
HB electro-phoresis	Normal (reference)	298	69 (23.2)	229 (76.8)	1	-	-
	SC trait	102	37 (36.3)	65 (63.7)	1.889	1.163 – 3.069	0.010*
	SCD	6	4 (66.6)	2 (33.3)	6.638	1.190 – 37.016	0.031*

IDA: Iron deficiency anemia
COR: Crude odd ratio
CI: Confidence interval
HB: Hemoglobin
SC: Sickle cell
SCD: Sickle cell disease
*Statistically significant

On multiple logistic regression analysis the only predicator for IDA was having SC trait (p-value 0.023) or SCD (p-value 0.038). This analysis also showed that type of feeding (mixed feeding (p-value 0.005) – Bottle feeding (p-value <0.001)) are protective factors against IDA.SCD infants had seven times more chance to be iron deficiency anemic when compared to normal infants (p-value = 0.038) .The details of the results on multiple logistic regression analysis is shown in table 4.

Table 4 Showing multiple logistic regression analysis details

Table (4). Multiple logistic regression analysis of factors influencing IDA among 12-month-old infants attended PHCCs in Qatif region, 2018.

Variable		AOR	95% CI	P-value
Feeding type	Breast feeding (reference)	1	1	-
	Mixed feeding	0.482	0.291 – 0.798	0.005*
	Bottle feeding	0.191	0.097 – 0.377	< 0.001*
HB electrophoresis	Normal (reference)	1	-	-
	SC trait	1.791	1.083 – 2.961	0.023*
	SCD	7.002	1.117 – 43.887	0.038*

AOR: Adjusted odd ratio
CI: Confidence interval
HB: Hemoglobin
SC: Sickle cell
SCD: Sickle cell disease
*Statistically significant

DISCUSSION

To present study was conducted to estimate the prevalence and associated risk factors of IDA among infants of one year of age in Al Qatif region of Saudi Arabia .The prevalence of anemia among infants was found to be 45.6% among these infants and the IDA proportion was 59.46% which is higher than that published global [22] (43%) , UAE [40] (anemia 36.1% and IDA 9.9%) and Kuwait (15.7%)[41] studies but lower than what have been found in other Eastern Mediterranean Region (EMR) countries such as Yemen (74%). The   WHO report

(2013) has also showed IDA among 63% of the preschoolers (children under age of 5 years).[38,39,44,45] A study conducted in Iraq among infants aged (12–24) months has concluded that 53% and 30% of infants had anemia and IDA, respectively.[12] Other study in Egypt which included 300 poor Egyptian infants, anemia was founded in 66% of infants aged between 6 to 24 months and among them, 43% had IDA.[23]

The prevalence of anemia 45.6%, and IDA 27.1% found in this study is much higher compared with many developed countries.[42,48] Male *et al*. showed that the prevalence of anemia and IDA was 9.4% and 2.3%, respectively.[42,48] The result of the present study is consistent with results of similar studies done in other parts of Saudi Arabia . In Northwestern Saudi Arabia a prevalence rate IDA was found to be 49% among children with 6-24 months of age.[29] In another study where the pattern for common anemia among Saudi children was studied by EL-Hazmi *et al* 1999, the overall prevalence of anemia was found to be 24.8% and the prevalence was higher among the children from the eastern province (41.3%) and highest in Qatif region(50.5%) Microcytic anemia was the major type of anemia in our study 86.5% which is concordant with EL-Hazmi *et al(31.1%)*. [28].

G6PD and SCD prevalence were 34%, and 1.5% respectively. One Saudi study (1998) had showed the prevalence of G6PD and SCD among infants to be 30.6% and 2.35 % respectively .[30] Gender of infants did not appear to be a factor in the prevalence of IDA as there was no statistically significant difference between male and female participants. This is consistent with Al Hawsawi *et al*. study which also did not find any significant difference of IDA among male and female infants. [29] However in an Iranian study IDA was found significantly higher among male compared with female infants (p=0.015).[8]

In the present study, the prevalence rate of IDA was found to be 42.7% in exclusively breastfed infants, 12.3% in bottle-fed infants and 26.3% in mixedfed infants. Among bottlefed infants IDA was the lowest and it was statistical significant (p-value <0.005). These results were consistent with a study conducted in Riyadh where 366 infants were screened and the only factor which was significantly associated with anemia was the status of bottle feeding among the infants, with anemia being more prevalent among children who were not bottlefed (p-value<0.01).[27]

The limitation of this study was that temporality cannot be demonstrated and due to the differences in diagnostic criteria and laboratory cut- off values in diagnosing anemia and IDA across different studies restrict the accurate comparison.

CONCLUSIONS

This study demonstrated that IDA is still a common health problem in Qatifi infants aged one-year and this may lead to serious long-term complications. We suggest further national community-based studies to estimate the prevalence of anemia, ID and IDA and other associated risk factors. To prevent IDA in Saudi infants, we recommend that all Saudi PHCC should screen for it at time of one-year vaccine, prevention can also be achieved by iron supplementation of 1mg/kg/day for term healthy infants at 4 months until iron rich food is introduced and for preterm 2mg/kg/day starting at 2 weeks and continue for the first year of life.

References

1. De Benoist, B., Cogswell, M., Egli, I., & McLean, E. (2008). Worldwide prevalence of anaemia 1993-2005; WHO Global Database of anaemia.
2. World Health Organization. (2011). *Serum ferritin concentrations for the assessment of iron status and iron deficiency in populations* (No. WHO/NMH/NHD/MNM/11.2). World Health Organization.
3. Stoltzfus, R. J. (2003). Iron deficiency: global prevalence and consequences. *Food and nutrition bulletin*, *24*(4_suppl_1), S99-S103.
4. Yip, R. (1990). The epidemiology of childhood iron deficiency: evidence for improving iron nutrition among US children. In Brain, behaviour, and iron in the infant diet (pp. 27-39). Springer, London
5. Zlotkin, S. (2003). Clinical nutrition: 8. The role of nutrition in the prevention of iron deficiency anemia in infants, children and adolescents. Cmaj, 168(1), 59-63.
6. Zhou, Y. B., Zhu, L. P., & Liu, J. M. (2014). Impact of cesarean section on placental transfusion and iron-related hematological indices in term neonates: a systematic review and meta-analysis. Placenta, 35(1), 1-8.
7. Vendt, N., Grünberg, H., Leedo, S., Tillmann, V., & Talvik, T. (2007). Prevalence and causes of iron deficiency anemias in infants aged 9 to 12 months in Estonia. Medicina, 43(12), 947.
8. Monajemzadeh, S. M., & Zarkesh, M. R. (2009). Iron deficiency anemia in infants aged 12-15 months in Ahwaz, Iran. *Indian Journal of Pathology and Microbiology*, 52(2), 182.
9. Noh, S. J., Na, B. M., & Kim, M. J. (2008). Iron deficiency and early, low-dose iron supplementation in breast-fed infants. Pediatric Gastroenterology, Hepatology & Nutrition, 11(2), 169-178.
10. Antunes, H., Santos, C., Carvalho, S., Gonçalves, S., & Costa-Pereira, A. (2012). Male gender is an important clinical risk factor for iron deficiency in healthy infants. e-SPEN Journal, 7(6), e219-e222.
11. Mohamed, A. A., & Abo-donia, A. S. (2011). Contributing Factors of Iron Deficiency Anemia among Children under Two Years Attending Family Health Centers in Alexandria. Life Science Journal-Acta Zhengzhou University Overseas Edition, 8(4), 996-1007.
12. Rasheed, N. E. (2010). Risk factors associated with iron deficiency among children admitted to paediatric emergency unit in Erbil, Iraq. *Zanco Journal of Medical Sciences* (Zanco J Med Sci), 14(3), 33-40.
13. Sherriff, A., Emond, A., Bell, J. C., Golding, J., & ALSPAC Study Team. (2001). Should infants be screened for anaemia? A prospective study investigating the relation between haemoglobin at 8, 12, and 18 months and development at 18 months. Archives of disease in childhood, 84(6), 480-485.
14. Baker, R. D., & Greer, F. R. (2010). 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, 126(5), 1040-1050.

15. Workgroup, B. F. P. S., & Committee on Practice and Ambulatory Medicine. (2017). 2017 recommendations for preventive pediatric health care. Pediatrics, 139(4).

16. Siu, A. L. (2015). Screening for iron deficiency anemia in young children: USPSTF recommendation statement. Pediatrics, 136(4), 746-752.

17. The UK NSC recommendation on Iron Deficiency Anaemia screening in children under 5 years of age. Available at: http://www.screening.nhs.uk/irondeficiency (Accessed on April 08, 2015).

18. Abdullah, K., Zlotkin, S., Parkin, P., & Grenier, D. (2011). Iron-deficiency anemia in children. Ottawa: Canadian Pediatric Surveillance Program, Canadian Pediatric Society. Retrieved May, 21, 2013.

19. American Academy of Pediatrics. Iron. In: Pediatric Nutrition, 7th, Kleinman RE, Greer FR (Eds), American Academy of Pediatrics, Elk Grove Village 2011. p.449.

20. Saudi Arabia MOH annual report 2010

21. McLean, E., Cogswell, M., Egli, I., Wojdyla, D., & De Benoist, B. (2009). Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system, 1993–2005. Public health nutrition, 12(4), 444-454.

22. Stevens, G. A., Finucane, M. M., De-Regil, L. M., Paciorek, C. J., Flaxman, S. R., Branca, F., ... & Nutrition Impact Model Study Group. (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. The Lancet Global Health, 1(1), e16-e25.

23. Elalfy, M. S., Hamdy, A. M., Maksoud, S. S. A., & Megeed, R. I. A. (2012). Pattern of milk feeding and family size as risk factors for iron deficiency anemia among poor Egyptian infants 6 to 24 months old. Nutrition research, 32(2), 93-99.

24. Mahmoud, H., Muddathir, A., Osman, S., & MA AK, K. A. (2014). Iron deficiency anemia among children under three years in Kassala, Eastern Sudan. Sudanese J Pub Heal, 9, 33-7.

25. Zainel, A. J. A. L., Osman, S. R. O., Al-Kohji, S. M. S., & Selim, N. A. (2018). Iron deficiency, its epidemiological features and feeding practices among infants aged 12 months in Qatar: a cross-sectional study. BMJ open, 8(5), e020271.

26. Babiker, M. A., Bahakim, H. M., Al-Omair, A. O. I., Al-Jishi, N., & Al-Habib, S. A. (1989). Prevalence of iron deficiency in Saudi children from birth to 15 months of age. Annals of tropical paediatrics, 9(2), 111-114.

27. Al Fawaz, I. M. (1993). Surveillance for iron deficiency anaemia at a well baby clinic in Riyadh, Saudi Arabia. SAUDI MEDICAL JOURNAL, 14, 27-27.

28. El-Hazmi, M. A. F., & Warsy, A. S. (1999). The pattern for common anaemia among Saudi children. Journal of tropical pediatrics, 45(4), 221-225.

29. Al Hawsawi, Z. M., Al-Rehali, S. A., Mahros, A. M., Al-Sisi, A. M., Al-Harbi, K. D., & Yousef, A. M. (2015). High prevalence of iron deficiency anemia in infants attending a well-baby clinic in northwestern Saudi Arabia. Saudi medical journal, 36(9), 1067.

30. Nasserullah, Z., Al Jame, A., Abu Srair, H., Al Qatari, G., Al Naim, S., Al Aqib, A., & Mokhtar, M. (1998). Neonatal screening for sickle cell disease, glucose-6-phosphate dehydrogenase deficiency and α-thalassemia in Qatif and Al Hasa. Annals of Saudi medicine, 18(4), 289-292.

31. American Academy of Pediatrics Commitee on Nutrition. Iron. In: Pediatric Nutrition, 8th, Kleinman RE, Greer FR (Eds), American Academy of Pediatrics, Itasca, IL 2019. p.561.

32. Cusick, S. E., Looker, A. C., Cogswell, M. E., Pfeiffer, C. M., & Grummer-Strawn, L. (2008). Iron-status indicators. Pediatrics, 121(3), 651-652.

33. Wanahita, A., Goldsmith, E. A., & Musher, D. M. (2002). Conditions associated with leukocytosis in a tertiary care hospital, with particular attention to the role of infection caused by Clostridium difficile. Clinical infectious diseases, 34(12), 1585-1592.

34. Lawrence, Y. R., Raveh, D., Rudensky, B., & Munter, G. (2007). Extreme leukocytosis in the emergency department. *Journal of the Association of Physicians*, 100(4), 217-223.

35. Wilson, C. B., Jones, P. W., O'leary, C. J., Hansell, D. M., Dowling, R. B., Cole, P. J., & Wilson, R. (1998). Systemic markers of inflammation in stable bronchiectasis. *European Respiratory Journal*, 12(4), 820-824.

36. Dean AG, Arner TG, Sunki GG, Friedman R, Lantinga M, Sangam S, Zubieta JC, Sullivan KM, Brendel KA, Gao Z, Fontaine N, Shu M, Fuller G, Smith DC, Nitschke DA, Fagan RF. 2011. Epi Info™, a database and statistics program for public health professionals. CDC, Atlanta, GA, USA.

37. Thomas, W. J., & Collins, T. M. (1982). Comparison of venipuncture blood counts with microcapillary measurements in screening for anemia in one-year-old infants. The Journal of pediatrics, 101(1), 32-35.

38. Daae, L. N. W., Hallerud, M., & Halvorsen, S. (1991). A comparison between haematological parameters in 'capillary' and venous blood samples from hospitalized children aged 3 months to 14 years. Scandinavian journal of clinical and laboratory investigation, 51(7), 651-654.

39. Bellamy, G. J., & Hinchliffe, R. F. (1988). Venous and skin puncture blood counts compared. Clinical & Laboratory Haematology, 10(3), 329-334.

40. d'Onofrio, G., Chirillo, R., Zini, G., Caenaro, G., Tommasi, M., & Micciulli, G. (1995). Simultaneous measurement of reticulocyte and red blood cell indices in healthy subjects and patients with microcytic and macrocytic anemia.

41. Christensen, R. D., Jopling, J., Henry, E., & Wiedmeier, S. E. (2008). The erythrocyte indices of neonates, defined using data from over 12 000 patients in a multihospital health care system. Journal of Perinatology, 28(1), 24-28.

42. Walters, M. C., & Abelson, H. T. (1996). Interpretation of the complete blood count. Pediatric Clinics, 43(3), 599-622.

43. Corp, I. B. M. (2013). IBM SPSS statistics for windows, version 22.0. *Armonk, NY: IBM Corp*.

44. WHO. Anaemia. 2013 www. emro. who. int/ healthtopics/ anaemia/index. html (accessed Jun 2014).

45. Bagchi, K. (2008). Nutrition in the eastern Mediterranean region of the World Health Organization. EMHJ-Eastern Mediterranean Health Journal, 14 (Supp.), S107-S113, 2008.

46. Miller, C. J., Dunn, E. V., Abdouni, S. F., Shaheen, H. M., & Ullah, M. S. (2004). Factors associated with iron depletion and iron deficiency anemia among Arabic preschool children of the United Arab Emirates. *Saudi medical journal*, *25*(7), 843-847.

47. Assiri, F., Al-Sumaie, M., Safar, F., Al-Saigh, F., & Hussain, D. K. (2006). Prevalence and associated factors of iron deficiency anemia among Kuwaiti children. *Bull Alex Fac Med*, *42*(2), 381-389.

48. Male, C., Persson, L. Å., Freeman, V., Guerra, A., & Van't Hof, M. A. (2001). Prevalence of iron deficiency in 12-mo-old infants from 11 European areas and influence of dietary factors on iron status (Euro-Growth study). *Acta Paediatrica*, *90*(5), 492-498

How to cite this article:

Zainab Ali Alfaraj (2021) 'Prevalence of Iron Deficiency Anemia In 12-Months Old Infants In Qatif primary Health Care Centers', *International Journal of Current Medical and Pharmaceutical Research,* 07(05), pp 5777-5782.

****