

## **Original Research Article**

# **The burden of disease and risk factors of iron deficiency anemia in preschool children attending The Well-Baby Clinic in the National Guard primary Health Care Centers in the western region of Saudi Arabia**

---

### **ABSTRACT:**

**Aims:** To estimate the burden and risk factor of Iron Deficiency Anemia (IDA) in preschool children attending well-baby clinics in primary health care centers of the National Guard in Jeddah.

**Study design:** Cross Sectional study design

**Place and Duration of Study:** This study was carried out in the primary health care centers of the National Guard Hospital in Jeddah, Saudi Arabia, which are the specialized polyclinic namely Iskan clinic district and Bahra Clinic. The study was started on 26 September, 2018 to January 2020.

**Methodology:** A cross-sectional study included all preschool children aged 2-5 years attending well-baby clinics. Data were collected by distributing a self-developed and validated questionnaire to parents or guardians in waiting areas outside the well-baby clinics.

**Results:** A total of 286 participants met the inclusion criteria. Anemia was found in 9.8% children. The prevalence of IDA among the participants was only 6.3%, but it was the most common compared to other types of anemia. The only findings that were found statistically significant with anemia were family history ( $P = 0.001$ ) and use of supplement ( $P = 0.000$ ).

### **Conclusion:**

IDA is still the most prevalent type of anemia; however, it was found in only 6.3% participants. The only statistically significant factors associated with anemia were positive family history and supplement intake.

*Keywords: IDA, Iron Deficiency Anemia, Preschool children, Risk factors, Well baby clinic.*

## **1. INTRODUCTION**

The term "burden of disease" was used by the Harvard School of Public Health, the World Bank, and the World Health Organization in the 1990s to define the mortality and long-term health problems caused by diseases, accidents, and health conditions in all parts of the globe [1]. Measurement of disease burden is critical because the empirical proof is vital for achieving international public health, and global health policy should be determined on precise and reliable health data. Badly informed strategy could be one of the causes, why efforts to increase public health, endangering the achievement of the Development Goals in the health sector.

Nothing could be more vital to a parent than assuring that their child grows up healthy and happy. The primary concern is for their well-being and safety. Once the child is three to five years old, they begin school. Parents are encouraged to make their children express inherent interest and discover as much about the environment surrounding them throughout this phase of development, popularly known as the "preschool years." This age is crucial due to brain, language, and learning development and the need to have some special attention. A youngster also become even more autonomous at this age. Some of the common health conditions in preschool kids are gastroenteritis, ear infection, cold, anemia, conjunctivitis, asthma, mumps, Pediculosis, measles, pinworm, and many others [2].

Anemia is defined as a hemoglobin concentration of less than 11 g/dL in children. Anemia was found to be prevalent in 56.6 percent of the population. The significant prevalence of anemia shows that it might be a contributing factor in hospitalization, especially given the short length of stay and the likelihood that the patient was anemic at the time of enrollment. According to the World Health Organization, Iron Deficiency Anemia is a global dietary problem. At least one-third of the population has been anemic at some point in their lives.

Since children are more susceptible to anemia, this is particularly crucial. It could be attributed to the patients' poor overall dietary condition, including their microelement intake. Increased penetration of supplements and fortifying programs, as well as other measures aimed at preventing and controlling anemia, are strongly advised [3].

There could be many reasons for anemia among in the children. One of the most common type is Iron Deficiency Anemia. As we reviewed the literature, a gap and limited studies regarding assessing the exact burden of iron deficiency anemia in preschool children was found. However, the specific risk factors for developing iron-deficiency anemia have much more studies when compared to the burden of iron deficiency anemia; these risk factors could vary significantly from one country or region to another. Thereby, the current study aimed to assess and estimate the burden of iron deficiency anemia among preschool children and identify the significant and most common risk factors of iron deficiency anemia in National Guard primary health care centers.

## 2. MATERIAL AND METHODS

A cross-sectional study was carried out in the primary health care centers of the National Guard Hospital in Jeddah, Saudi Arabia, which are the specialized polyclinic namely Iskan clinic district and Bahra Clinic. The study was started on 26 September, 2018 to January 2020.

The study population were preschool children aged 2-5 years who attended the well-baby clinics. The sample size was calculated using the EPI info program from the hospital medical records. Based on a 95% confidence interval, 5% of the total targeted population has a 5% margin of error. The estimated sample size was 286 participants.

The study was conducted using a self-developed and validated questionnaire to parents or guardians in waiting areas outside well-baby clinics. The questionnaire consisted of socio-demographic variables like age, gender. Moreover, Clinical variables like past medical history, family history, and any associated comorbidities or allergies with anemia were considered. Lastly, nutritional variables were considered, including the amount and variety of food consumed throughout the week and breastfeeding history. Variables were represented as mean and standard deviation.

A convenient non-probability sampling technique was employed to collect the data from the participants. Data were coded, entered, and analyzed using the Statistical Package for Social Science (SPSS) version 23. Qualitative data were expressed in numbers and percentages. Then was

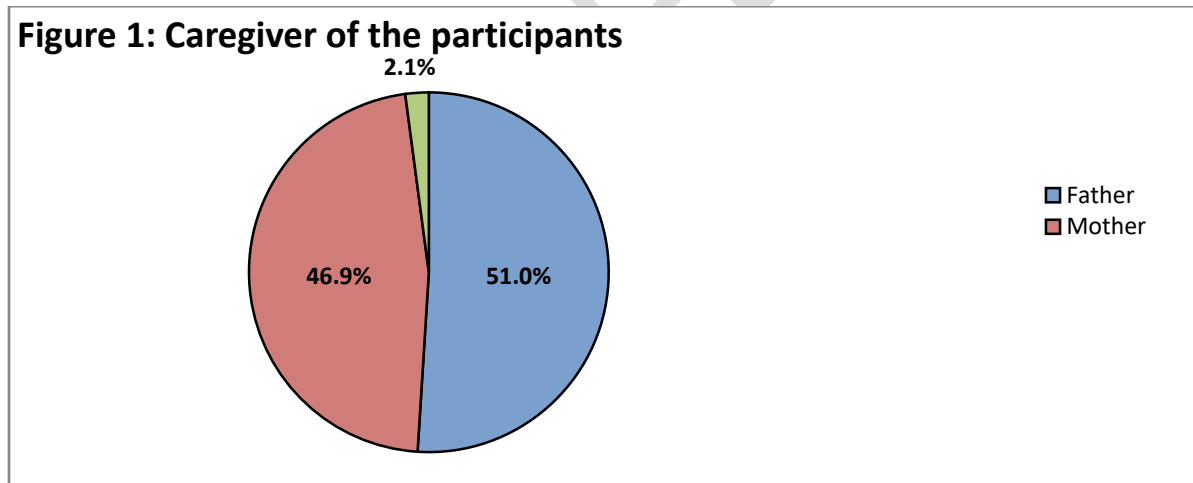
interpreted using the Chi-square test and Fisher exact test, and a p-value less than 0.05 was considered significant.

### 3. RESULTS AND DISCUSSION

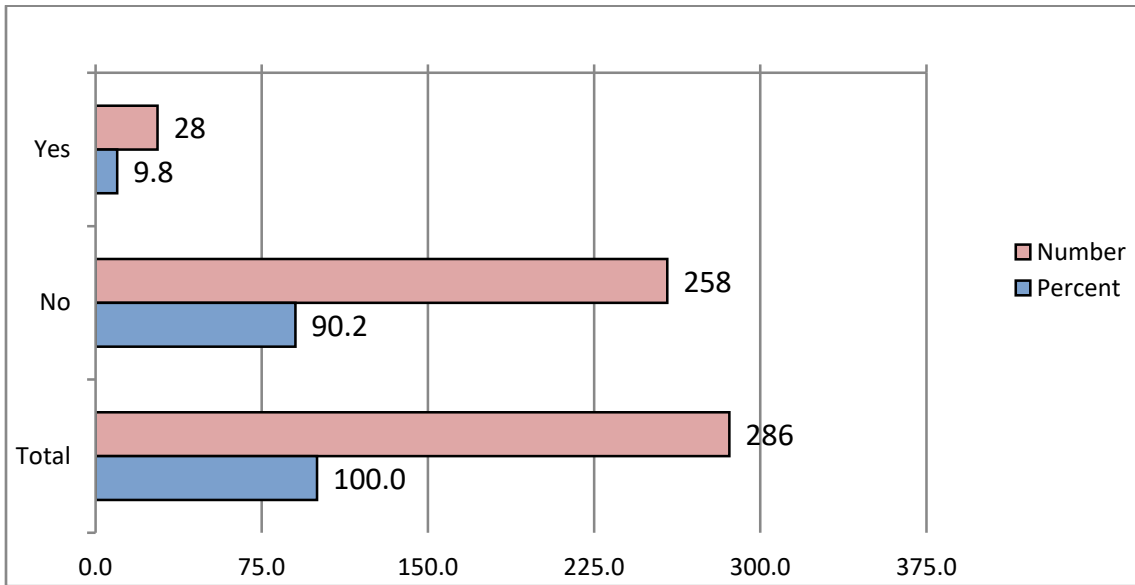
A total of 286 preschool children aged 2-5 years were included in this study. The average age of the children was  $3.6 \pm 0.9$  years. Around 144 (50.3%) of the participating children were males, while 142 (49.7%) were females. The average height of the children was  $97.9 \pm 13.9$  cm, and the average weight was  $16.5 \pm 12.3$  kg. The majority of the children ( $n=146$ , 51%) and their caregivers who attended the clinic were their fathers, 134 (46.9%) their caregiver were their mothers, and 6 (2.1%) their caregiver were their relatives (Table 1, Figure 1).

**Table 1: Characteristics of the participants**

| Variable    | Mean | SD    |
|-------------|------|-------|
| Age (Years) | 3.6  | 0.915 |
| Height (cm) | 97.9 | 13.89 |
| Weight (Kg) | 16.5 | 12.31 |



The overall prevalence of anemia among the study participants was 9.8% (Figure 2).



**Figure 2: Prevalence of anemia in preschool children**

Among the anemic children (n=28), the most reported type of anemia was IDA (64.3%), followed by G6PD anemia (25%). The least reported anemia was vitamin D deficiency associated with iron deficiency anemia (vitamin D has recently been found to be affecting hepcidin levels besides its role in primary iron absorption), anemia of chronic disease, and sickle cell anemia; each of them was reported by 3.6% of the children (Table 2).

**Table 2: Types of anemia (n=286)**

| Type of anemia            | Frequency | Percent |
|---------------------------|-----------|---------|
| G6PD                      | 7         | 2.4%    |
| IDA                       | 18        | 6.3%    |
| Vit-D def. anemia         | 1         | 0.3%    |
| Anemia of chronic disease | 1         | 0.3%    |
| SCA                       | 1         | 0.3%    |
| Not anemic                | 258       | 90.2%   |
| Total                     | 286       | 99.8%   |

Comparing different socio-demographic factors among children with IDA against those free of IDA, all variables including gender, care giver, educational level of parents, parents' marital status, parents' occupation, housing, housing type, other caregivers in the absence of parents, and smoking of the parents were found to be non-significantly different between IDA groups as the calculated p values was found to be 0.969, 0.394, 0.279, 0.451, 0.499, 0.522, 0.975, 0.213 and 0.208, respectively (Table 3).

**Table 3: Association between socio-demographic characteristics and iron deficiency anemia in children attending the PHC of NGHA in Jeddah (n=286).**

| Variable                   | Category     | IDA          |             | Total     | P-value |
|----------------------------|--------------|--------------|-------------|-----------|---------|
|                            |              | Yes<br>N (%) | No<br>N (%) |           |         |
| Gender                     | Male         | 14 (9.7)     | 130 (90.3)  | 144 (100) | 0.969   |
|                            | Female       | 14 (9.9)     | 128 (90.1)  | 142 (100) |         |
| Care Giver                 | Father       | 11 (7.5)     | 135 (92.5)  | 146 (100) | 0.394   |
|                            | Mother       | 16 (11.9)    | 118 (88.1)  | 134 (100) |         |
|                            | Relative     | 1 (16.7)     | 5 (83.3)    | 6 (100)   |         |
| Education level of parents | Illiterate   | 2 (18.2)     | 9 (81.8)    | 11 (100)  | 0.279   |
|                            | Elementary   | 3 (25)       | 9 (75)      | 12 (100)  |         |
|                            | Intermediate | 1 (4.3)      | 22 (95.7)   | 23 (100)  |         |

|                               |             |          |            |           |       |
|-------------------------------|-------------|----------|------------|-----------|-------|
|                               | High school | 12 (10)  | 108 (90)   | 120 (100) |       |
|                               | University  | 10 (8.3) | 110 (91.7) | 120 (100) |       |
| <b>Parents marital status</b> | Married     | 27 (9.7) | 250 (90.3) | 277 (100) | 0.451 |
|                               | Divorced    | 1 (25)   | 3 (75)     | 4 (100)   |       |
|                               | Widow       | 0 (0)    | 5 (100)    | 5 (100)   |       |
| <b>Parents occupation</b>     | Student     | 2 (22.2) | 7 (77.8)   | 9 (100)   | 0.499 |
|                               | Employed    | 16 (9.9) | 146 (90.1) | 162 (100) |       |
|                               | Retired     | 0 (0)    | 7 (100)    | 7 (100)   |       |
|                               | Housewife   | 10 (9.3) | 98 (90.7)  | 108 (100) |       |
| <b>Housing</b>                | Rental      | 16 (11)  | 131 (89)   | 147 (100) | 0.522 |
|                               | Owned       | 12 (8.7) | 127 (91.3) | 139 (100) |       |
| <b>Housing type</b>           | RV          | 7 (10.3) | 61 (89.7)  | 68 (100)  | 0.975 |
|                               | Apartment   | 19 (9.7) | 176 (90.3) | 195 (100) |       |

|  |                     |          |            |           |              |
|--|---------------------|----------|------------|-----------|--------------|
|  | Traditional housing | 2 (8.7)  | 21 (91.3)  | 23 (100)  |              |
| <b>Other caregivers, in the absence of parents</b> | Relatives           | 21 (9.9) | 192 (90.1) | 213 (100) | <b>0.213</b> |
|  | Housemaid           | 1 (4.5)  | 21 (95.5)  | 22 (100)  |              |
|  | Nursery             | 2 (33.3) | 4 (66.7)   | 6 (100)   |              |
|  | Other               | 4 (8.9)  | 41 (91.1)  | 45 (100)  |              |
| <b>Smoking</b>                                     |                     | 17 (8.4) | 186 (91.6) | 203 (100) | <b>0.208</b> |

Comparison of family history, allergy, and supplement or medication intake by the children with IDA revealed that children with a family history of anemia had a significantly higher IDA prevalence than those without a family history (20.3% vs. 6.5%) ( $P = 0.001$ ). Also, a significantly higher prevalence of IDA was observed among children taking supplements than children not taking supplements (30.3% vs. 7.1%) ( $P = 0.000$ ). Other variables were found to be non-significantly different between IDA groups (Table 4).

**Table 4: Association between family history, allergy, and supplement or medication intake and IDA in preschool children attending the PHC of NGHA in Jeddah (n=286)**

| Variable              | Category | IDA          |             | Total    | P-value      |
|-----------------------|----------|--------------|-------------|----------|--------------|
|                       |          | Yes<br>N (%) | No<br>N (%) |          |              |
| <b>Family history</b> | Yes      | 14 (20.3)    | 55 (79.7)   | 69 (100) | <b>0.001</b> |

|                              |     |           |            |           |       |
|------------------------------|-----|-----------|------------|-----------|-------|
| <b>of anemia</b>             | No  | 14 (6.5)  | 203 (93.5) | 217 (100) |       |
| <b>Other comorbidities</b>   | Yes | 7 (15.9)  | 37 (84.1)  | 44 (100)  | 0.138 |
|                              | No  | 21 (8.7)  | 221 (91.3) | 242 (100) |       |
| <b>Allergy to medication</b> | Yes | 1 (14.3)  | 6 (85.7)   | 7 (100)   | 0.685 |
|                              | No  | 27 (9.7)  | 252 (90.3) | 279 (100) |       |
| <b>Allergy to food</b>       | Yes | 6 (18.2)  | 27 (81.8)  | 33 (100)  | 0.085 |
|                              | No  | 22 (8.7)  | 231 (91.3) | 253 (100) |       |
| <b>Taking supplements</b>    | Yes | 10 (30.3) | 23 (69.7)  | 33 (100)  | 0.000 |
|                              | No  | 18 (7.1)  | 235 (92.9) | 253 (100) |       |
| <b>Taking medications</b>    | Yes | 2 (20)    | 8 (80)     | 10 (100)  | 0.269 |
|                              | No  | 26 (9.4)  | 250 (90.6) | 276 (100) |       |

Breastfeeding variables which include breastfeeding, duration of breastfeeding, types of milk used with breastfeeding and for children who were not breastfed and duration of feeding in not breastfed children were compared among children with IDA against those free of IDA; the results showed that there is no significant association between these variables and IDA (Table 5).

**Table 5: Association between Breastfeeding and IDA in preschool children attending the PHC of NGHA in Jeddah (n=286)**

| Variable | Category | IDA | Total | P-value |
|----------|----------|-----|-------|---------|
|----------|----------|-----|-------|---------|

|  |                        | <b>Yes<br/>N (%)</b> | <b>No<br/>N (%)</b> |           |       |
|--|------------------------|----------------------|---------------------|-----------|-------|
| <b>Breastfeeding</b>                                 | Yes                    | 23 (10.7)            | 192 (89.3)          | 215 (100) | 0.369 |
|  | No                     | 5 (7)                | 66 (93)             | 71 (100)  |       |
| <b>Duration of<br/>breastfeeding</b>                 | 1-6 months             | 13 (13.7)            | 84 (86.6)           | 97 (100)  | 0.361 |
|  | 6-12 months            | 2 (5.1)              | 37 (94.9)           | 39 (100)  |       |
|  | 1-2 years              | 8 (10.1)             | 71 (89.9)           | 79 (100)  |       |
| <b>Types of milk<br/>used with<br/>breastfeeding</b> | Purely<br>breastfed    | 23 (10.7)            | 192 (89.3)          | 215 (100) | 0.790 |
|  | Industrialized<br>milk | 5 (7.5)              | 62 (92.5)           | 67 (100)  |       |
|  | Pasteurized<br>milk    | 0 (0)                | 3 (100)             | 3 (100)   |       |
|  | Fresh milk             | 0 (0)                | 1 (100)             | 1 (100)   |       |
| <b>Type of milk<br/>for children</b>                 | Industrialized<br>milk | 5 (7.5)              | 62 (92.5)           | 67 (100)  | 0.790 |

|  |                  |         |           |          |       |
|--|------------------|---------|-----------|----------|-------|
| <b>who are not breastfed</b>                         | Pasteurized milk | 0 (0)   | 3 (100)   | 3 (100)  |       |
|  | Fresh milk       | 0 (0)   | 1 (100)   | 1 (100)  |       |
| <b>Duration of feeding in not breastfed children</b> | 1-6 months       | 1 (20)  | 4 (80)    | 5 (100)  | 0.225 |
|  | 6-12 months      | 1 (20)  | 4 (80)    | 5 (100)  |       |
|  | 1-2 years        | 3 (4.9) | 58 (95.1) | 61 (100) |       |

Comparison of nutritional intake and IDA revealed that children who did not eat sugars had a significantly higher prevalence of IDA compared to those who eat sugars 1-2 per week, 3-4 per week, or daily ( $P = 0.029$ ). Other variables were found to be not significantly different between IDA groups (Table 6).

**Table 6: Association between nutritional intake and IDA in preschool children attending the PHC of NGHA in Jeddah (n=286)**

| Food source                                   | Times per week | IDA          |             | Total     | P-value |
|---|----------------|--------------|-------------|-----------|---------|
|   |                | Yes<br>N (%) | No<br>N (%) |           |         |
| <b>Meat, chicken, and fish (Protein food)</b> | Does not eat   | 3 (23.1)     | 10 (76.9)   | 13 (100)  | 0.262   |
|   | 1-2 per week   | 8 (12.9)     | 54 (87.1)   | 62 (100)  |         |
|   | 3-4 per week   | 10 (8)       | 115 (92)    | 125 (100) |         |

|                                  |              |           |            |           |       |
|----------------------------------|--------------|-----------|------------|-----------|-------|
|                                  | Daily        | 7 (8.1)   | 79 (91.9)  | 86 (100)  |       |
| <b>Vegetables<br/>and fruits</b> | Does not eat | 0 (0)     | 15 (100)   | 15 (100)  | 0.131 |
|                                  | 1-2 per week | 12 (12.5) | 84 (87.5)  | 96 (100)  |       |
|                                  | 3-4 per week | 6 (5.8)   | 97 (94.2)  | 103 (100) |       |
|                                  | Daily        | 10 (13.9) | 62 (86.1)  | 72 (100)  |       |
| <b>Dairy<br/>products</b>        | Does not eat | 0 (0)     | 3 (100)    | 3 (100)   | 0.325 |
|                                  | 1-2 per week | 0 (0)     | 17 (100)   | 17 (100)  |       |
|                                  | 3-4 per week | 5 (7.2)   | 64 (92.8)  | 69 (100)  |       |
|                                  | Daily        | 23 (11.7) | 174 (88.3) | 197 (100) |       |
| <b>Carbohydrate<br/>s</b>        | Does not eat | 2 (33.3)  | 4 (66.7)   | 6 (100)   | 0.254 |
|                                  | 1-2 per week | 2 (9.1)   | 20 (90.9)  | 22 (100)  |       |
|                                  | 3-4 per week | 8 (10.7)  | 67 (89.3)  | 75 (100)  |       |
|                                  | Daily        | 16 (8.7)  | 167 (91.3) | 183 (100) |       |

|                   |              |           |            |           |       |
|-------------------|--------------|-----------|------------|-----------|-------|
| <b>Lentils</b>    | Does not eat | 15 (15)   | 85 (85)    | 100 (100) | 0.183 |
|                   | 1-2 per week | 10 (7.5)  | 124 (92.5) | 134 (100) |       |
|                   | 3-4 per week | 2 (5.7)   | 33 (94.3)  | 35 (100)  |       |
|                   | Daily        | 1 (5.9)   | 16 (94.1)  | 17 (100)  |       |
| <b>Dry fruits</b> | Does not eat | 13 (15.3) | 72 (84.7)  | 85 (100)  | 0.125 |
|                   | 1-2 per week | 12 (8.8)  | 125 (91.2) | 137 (100) |       |
|                   | 3-4 per week | 3 (7)     | 40 (93)    | 43 (100)  |       |
|                   | Daily        | 0 (0)     | 21 (100)   | 21 (100)  |       |
| <b>Sugars</b>     | Does not eat | 3 (50)    | 3 (50)     | 6 (100)   | 0.029 |
|                   | 1-2 per week | 3 (8.1)   | 34 (91.9)  | 37 (100)  |       |
|                   | 3-4 per week | 6 (10.5)  | 51 (89.5)  | 57 (100)  |       |
|                   | Daily        | 16 (8.6)  | 170 (91.4) | 186 (100) |       |
| <b>Caffeine</b>   | Does not eat | 22 (11.7) | 166 (88.3) | 188 (100) | 0.395 |
|                   | 1-2 per week | 4 (6.9)   | 54 (93.1)  | 58 (100)  |       |

|  |              |         |           |          |  |
|--|--------------|---------|-----------|----------|--|
|  | 3-4 per week | 2 (7.7) | 24 (92.3) | 26 (100) |  |
|  | Daily        | 0 (0)   | 14 (100)  | 14 (100) |  |

Iron deficiency anemia is a well-known dietary problem, and it is the most common nutritional disease in children and pregnant women. Hence children are more susceptible to anemia; as reported in the study by Awasthi S. et al., [4], it is crucial to study the burden and risk factors regarding (IDA). This study was aimed to estimate the burden of disease of Iron Deficiency Anemia (IDA) in preschool children attending well-baby clinics in primary health care centers of the National Guard in Jeddah.

The overall prevalence of anemia among the study participants was 9.8%, of a total of 286 participants included in this study. A slightly lower prevalence was found in a harmonious study conducted by Zho et al., showing a prevalence of only 6.2% among preschool children [5]. A higher prevalence of anemia was reported by Fañony et al., 2020 [6], who stated that anemia was found in 44.4% children. Another higher prevalence of anemia was reported in a study conducted in India by John et al., 2019 [7], who found that anemia was 30%. In a survey carried out in Saudi Arabia by Alqahtani et al., 2019 [8], the prevalence of anemia was 26.4% but the highest prevalence was reported in another study, showing the prevalence of anemia among preschool children reaching more than 70% [9]. This significantly lower prevalence of IDA in the current study could be attributed to the overall improvement in dietary conditions in Saudi Arabia including adequate and sufficient micronutrients intake in addition to increased food fortification programs.

Our results revealed that the most reported type of anemia was IDA (64.3%) followed by G6PD anemia (25%), which is similar to the findings of Fañony et al., 2020 [6] and the results of other study conducted by Da Silva et al., [10], who found that the most prevalent type of anemia is IDA (46.0%).

Comparing different socio-demographic factors among children with IDA against those free of IDA, all variables (gender, care giver, educational level of parents, parents' marital status, parents' occupation, housing, housing type, other caregivers in the absence of parents, and smoking of the parents) were found to be not significantly different between IDA groups. This result is similar to results reported by Hussein et al., 2014 [11]. They found that the prevalence of anemia was not significantly associated with any of the studied demographic and socioeconomic factors (sex, economic status of the family, mother's literacy, or family size). Also, a similar result was reported in a study carried out by John et al., 2019 [7]. They stated that equal proportion ( $P = 0.84$ ) of boys (25.0%) and girls (26.4%) and a similar proportion ( $P = 0.75$ ) of well-nourished (26.2%) and moderately nourished (23.3%) had IDA; this was also found to be contradictory to other study conducted by Sudha et al., showing higher prevalence of iron deficiency anemia among females when compared to males by more than 32% [12] While in a study conducted by Faysal et al., 2020 [13], more male children were affected by IDA than females.

In this study, Breastfeeding variables which include breastfeeding, duration of breastfeeding, types of milk used with breastfeeding, and for children who were not breastfed and duration of feeding in not breastfed children, did not have a significant effect on the prevalence of IDA. Similar findings were found in another study conducted by Kounnavong et al., who reported no effect of breastfeeding in

the prevalence of IDA [14]. In contradiction to the study conducted by Fançony et al., 2020 [6] reported that among 6-to-23-month-old children, IDA was associated with continued breastfeeding. Nutritional supplements intake was found to be significantly associated with IDA ( p-value = 0.00) children not taking nutritional supplements were having higher prevalence of anemia compared to others who take micronutrient supplements. Similar findings were reported in the study which carried out by Berglund which reported reduced prevalence of IDA with increased supplementary nutrients intake [15].

#### **4. CONCLUSION**

IDA is still the most prevalent type of anemia; however, it was found in only 6.3% participants. The only statistically significant factors associated with anemia were positive family history and supplement intake. Further studies are required to identify the highly prevalent and high-risk areas of IDA.

UNDER PEER REVIEW

## CONSENT (WHERE EVER APPLICABLE)

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication.

## ETHICAL APPROVAL (WHERE EVER APPLICABLE)

All patients' data is confidential and ethical approval was received from the Institutional Review Board at King Abdullah International Medical Research Centre, National Guard Health Affairs (NGHA), Jeddah, Saudi Arabia.

## REFERENCES

1. O'Donovan M, Gapp C, Stein C. Burden of disease studies in the WHO European Region—a mapping exercise. *Eur J Public Health*. 2018;28(4):773-778.
2. Enserink R, Ypma R, Donker G, Smit H, van Pelt W. Infectious Disease Burden Related to Child Day Care in the Netherlands. *Pediatr Infect Dis J*. 2013;32(8):e334-e340.
3. Muleviciene A, Sestel N, Stankeviciene S, Sniukaite-Adner D, Bartkeviciute R, Rascon J, et al. Assessment of Risk Factors for Iron Deficiency Anemia in Infants and Young Children: A Case-Control Study. *Breastfeed Med*. 2018;13(7):493-499.
4. Awasthi S, Das R, Verma T, Vir S. Anemia and under nutrition among preschool children in Uttar Pradesh, India. *Ind Pediatr*. 2003;40(10):985-990.
5. Zho YP, Liao QK. Collaborative Study Group for "The Epidemiological Survey of Iron Deficiency in Children in China." *Zhonghua Er Ke Za Zhi*. 2004;42(12):886-891.
6. Fançony C, Ânia Soares<sup>1</sup>, João Lavinha, Henrique Barros, Miguel Brito. Iron deficiency anaemia among 6-to-36- month children from northern Angola. *BMC Pediatr*. 2020;20:298.
7. John JJ, Mohan G, Ajitha K, David A. Iron deficiency anemia among preschool children belonging to affluent families in Kerala, India. *J Curr Res Sci Med*. 2019;5:23-7.
8. Alqahtani SM, Dalbough MM, Asiri SA, Albishri A, Asiri MA, Alajam M. Prevalence of Anemia among Preschool Age Children. *Bahr Med Bulletin*. 2019;41(2).
9. Chomchoei C, Apidechkul T, Wongnuch P, Tamornpark R, Upala P, Nongkhai MP. Perceived factors influencing the initiation of methamphetamine use among Akha and Lahu youths: a qualitative approach. *BMC public health*. 2019;19(1):1-1.
10. da Silva LL, Fawzi WW, Cardoso MA, ENFAC Working Group. Factors associated with anemia in young children in Brazil. *PloS one*. 2018;13(9):e0204504.
11. Hussein MD, Mohamed S. Prevalence of anaemia in preschool children in Karma Albalad area, Northern State, Sudan. *East Mediterr Health J*. 2014;20(1):33-38.

12. Sudhagandhi B, Sundaresan S, William WE, Prema A. Prevalence of anemia in the school children of Kattankulathur, Tamil Nadu, India. *Int J Nutr Pharmacol Neurolog Dis.* 2011;1(2):184.
13. Faysal W, Zaidi AR, Al-Abdi S, Alhumaid S, AlShehery MZ, Al Mutair A. Hospital-Based Prevalence of Iron Deficiency Anemia among Pre-School Children in Dubai. *Cureus.* 2020;12(10).
14. Kounnavong S, Sunahara T, Hashizume M, Okumura J, Moji K, Boupha B, et al. Anemia and related factors in preschool children in the southern rural Lao People's Democratic Republic. *Tropic med health.* 2011;39(4):95-103.
15. Berglund, Staffan et al. "Iron supplements reduce the risk of iron deficiency anemia in marginally low birth weight infants." *Pediatrics* vol. 126,4 (2010): e874-83. doi:10.1542/peds.2009-3624

UNDER PEER REVIEW