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Hematology

Previously Undiagnosed Anemia and Iron Deficiency Anemia among Preschool Children at Taif City

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Abstract **Original Research Article**

Introduction: In the Arab Gulf countries, anemia, including iron deficiency anemia (IDA), considered one of the main public health problems. Although, the World Health Organization reported that IDA as the most common type of anemia, which made up half of all anemic cases all over the world, there were limited research performed among preschool children about anemia in Saudi Arabia. Thus, the aim of this study was to investigate the prevalence of previously undiagnosed anemia and IDA among children between 2 to 6 years old. In this study, several risk factors that might contribute to the high prevalence of anemia were assessed. ***Methods:*** The study was carried out in Taif city during the period from January 2023 to April 2023. Blood samples were collected from 200 preschool children and analyzed for hematological parameters as well as related biochemistry tests to investigate the prevalence of previously undiagnosed anemia and IDA. ***Results:*** The majority of the study participants were Saudi 99% and aged 4 to 6 years 72.5%. Most of children participants, 92.5% had normal haemoglobin (Hb) concentration and normal levels of red blood cells (RBCs) and normal hematocrit indicating their non-anemia health status. In this study, previously undiagnosed anemia were reported within 6% of children indicated by low Hb concentration, low RBC count and abnormal low hematocrit level. Out of these undiagnosed anemic children, there were 25% diagnosed with IDA. ***Conclusions:*** Since, anemia and IDA are still a public health problem among preschool children in Saudi Arabia this study suggested that the hematological blood examination should be done to students as a requirement before school which may reveal the presence of previously undiagnosed anemia and might associated with low mantle and functional performance among children. Moreover, further studies are recommended at all regions of the Kingdome to investigate the underlying related risk factors, which will provide more insight to the nature and types of policies can be involved to prevent or minimize anaemia among children.

Key words: Undiagnosed, Anemia, IDA, Preschool, Children, Taif, Saudi Arabia.

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INTRODUCTION

Anemia is a serious public health problem all over the world in particular developing countries [1]. A global data was reported high prevalence rate of iron deficiency anemia (IDA) among infants and children between the age of 6 - 59 months as the most prevalent cause of anemia globally [2]. The Middle East and North Africa have the greatest number of preschool children with IDA, as reported by WHO, moreover, IDA was more prevalent in preschool children (20 - 67%) than in school-age children (12.6 - 50%) [3]. A variety of health disorders were reported with anemia and IDA, including increase cognitive impairment, delay children mental and motor development, effect on immunity and susceptibility to infection, weakness, pica or pagophagia and headache. Some of these symptoms may lead to long-term consequences as well as decrease

delivery of oxygen to body tissues [4-6]. Diagnosis of anemia and iron deficiency anemia (IDA) starts with detailed history and physical examination then laboratory investigations. Hematological blood tests are essential as a primary action to assess for any abnormalities in a complete blood count (CBC) as well as biochemistry tests to determine the type of anemia by investigating serum iron level [7].

In 2020 a study by Faisal and colleagues, performed at a tertiary care hospital in Dubai, found that 1,136 confirmed cases were diagnosed with iron deficiency anemia in preschool children (age ranged from one to five years) with a prevalence of 71%. Within the same study they also found that male children were more affected by IDA than females [8]. In Saudi Arabia a study conducted on infants attending a well-baby clinic in the northwestern region has been found that the prevalence of iron deficiency anemia was 49% for infants aged 6 - 24 months with no significant difference between genders [9]. Another research study performed in the Kingdom of Saudi Arabia showed that 26.9% of children who attended emergency room (ER) at hospitals in Abha and Khamis Mushait suffer from iron deficiency anemia when haematology lab tests investigated [10]. However, there are limited research studies about the prevalence of iron deficiency anemia in Saudi Arabia among preschool children at Western region of the Kingdome. Thus, the aim of this study was to investigate the prevalence of previously undiagnosed anemia and IDA among children between 2 to 6 years old. In this study, several factors that might contribute to the high prevalence of anemia and IDA were assessed.

METHODS

This is a cross-sectional study intended to investigate the prevalence of previously undiagnosed anemia among preschool children aged between 2 to 6 years at Taif city in the Westren region of Saudi Arabia. Samples were collected from the participating children after explaining the details and objectives of the research to their parents and obtaining their consent. Before blood samples collection, questionnaire was answered by child's parent. Questionnaire was related to some factors associated with high risk of anemia including; mothers' age, education level, vitamin supplement intake and children milk feeding during the first two years of child's life. The inclusion criteria include all healthy children not previously diagnosed with any type of anemia. The exclusion criteria comprised; age less than 2 years or more than 6 years, previously diagnosed with anemia, children with a history of chronic disease that affect the level of erythropoietin, RBC and Hb concentration such as chronic kidney and liver disease.

Venous blood samples were collected from each child into EDTA (ethylenediamine tetra-acetic acid) tube. Blood samples were used to analyse complete blood count (CBC) by using Sysmex XN-1000 device (Beckman coulter DxH 900 in some cases) in the hematology laboratory where the results of the complete blood count including; RBC, hemoglobin, hematocrit, MCV and MCH were determined automatically. The results of the hematology parameters, which proved the diagnosis with anemia were sent to the biochemistry laboratory to measure the serum iron level and total iron binding capacity (TIBC) by using Beckman coulter DxC 700 AU device, as the samples were drawn in a plain tube.

Ethical approval: The study was approved by the research ethical committee of the Applied Medical Science College at Taif University as well as the research ethical committee of the Maternity and Children Hospital.

Statistical Analysis: Demographic data, blood results were entered manually and analyzed using Microsoft Excel. Moreover, SPSS version 25 (IBM Cooperation, Armonk. NY) test was used to measure any significant differences regarding; mother's age, mother's education level, mother's intake of vitamins during pregnancy and breastfeeding or formula lactation.

RESULTS AND DISCUSSION

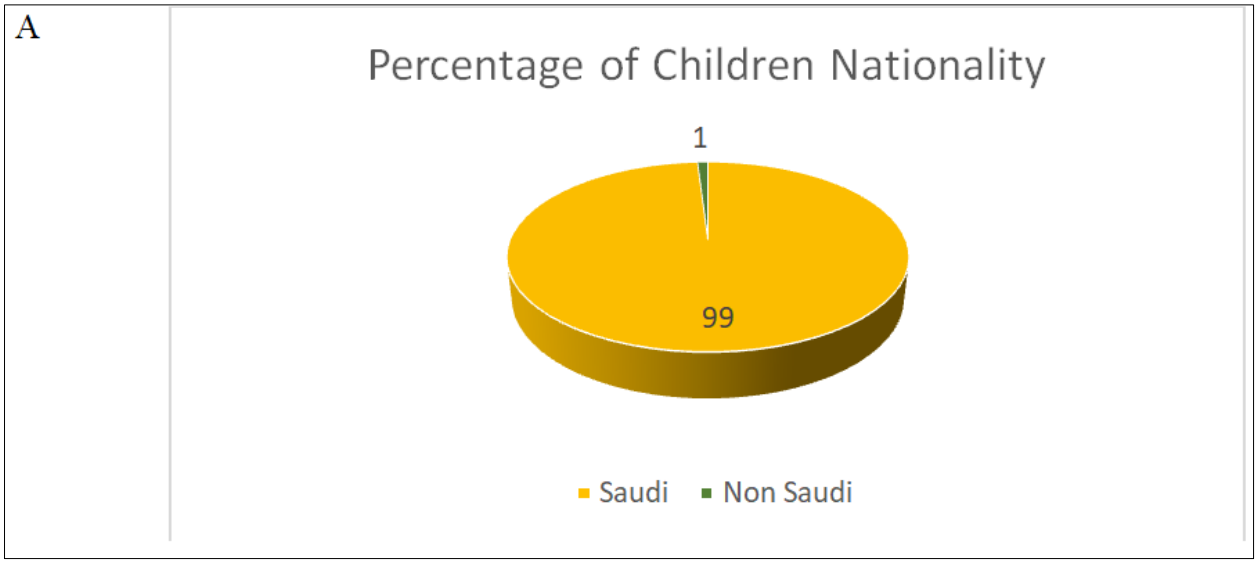
Blood samples from 200 preschool children participates in this study were aged 2 to 6 investigated to detect any abnormality within haematological parameters as well as related biochemistry tests to find previously undiagnosed anemia and iron deficiency anemia (IDA). A questionnaire with four questions related to factors associated with anemia was answered by children's parents after their permission. This study was performed between the period from February to April 2023, at a government hospital in Taif city at the western region of Saudi Arabia.

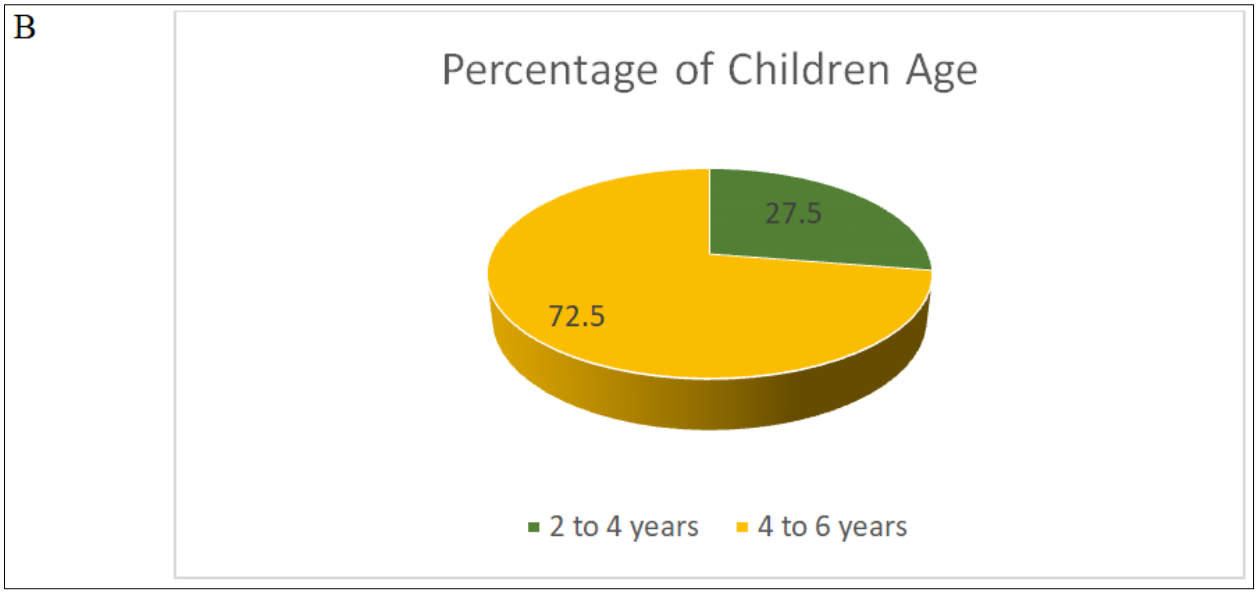
The majority of children participants in this study were Saudi 99% (n=198/200) (Figure 1a) and between 4 to 6 years 72.5% (145/200) (Figure 1b). In addition, male and female children participants in this study were 58% (116/200) and 42% (84/200) respectively (Figure 1c). Four risk factors might associated with the high risk of anemia development were assessed in this study including; mothers' age, education level, vitamin supplement intake and children milk feeding during the first two years of child's life.

The result of this study showed that the majority of children participants 92.5% (188/200) were found with normal CBC results as defined by WHO [11]; normal haemoglobin concentration (11 - 18 g/dl) and normal level of red blood cells (RBCs) (4 - 5.5 x 10*6/µL), haematocrit (33 - 40%), MCV (75 - 95 fl) and MCH (27 - 32 pg) which indicates their non anemic health status (Figure 2). However, 6% (12/200) of preschool children in this study were presented with

previously undiagnosed anemia indicated by their low Hb concentration defined as haemoglobin <11 g/dl and low red blood cell count reported below than 4 x 10*6/µL and low hematocrit level (Table 1). Out of those anemic children there were 25% (3/12) diagnosed with IDA, which were undiagnosed previously (Table 2). They presented with low Hb concentration, abnormal low RBCs count and low hematocrit. Also, their MCV and MCH were reported at lower level than the normal, which indicate the microcytic and hypochromic characteristic of RBCs. Samples of all anemic children participants were investigated further for serum iron and TIBC to confirm the diagnosis with IDA. Each specimen was run in duplicate. The result of this study also showed non- significant difference between Childs 'gender and age in term of anemia status.

In this study, different parameters might related to anemia among children were assessed including; mother's age, mother's education level, mother's intake of vitamins during pregnancy and breastfeeding or formula lactation. However, there is no significant differences between children with non-anemia and anemic condition regarding mother's age, education level and vitamin intake, or the approach of feeding.





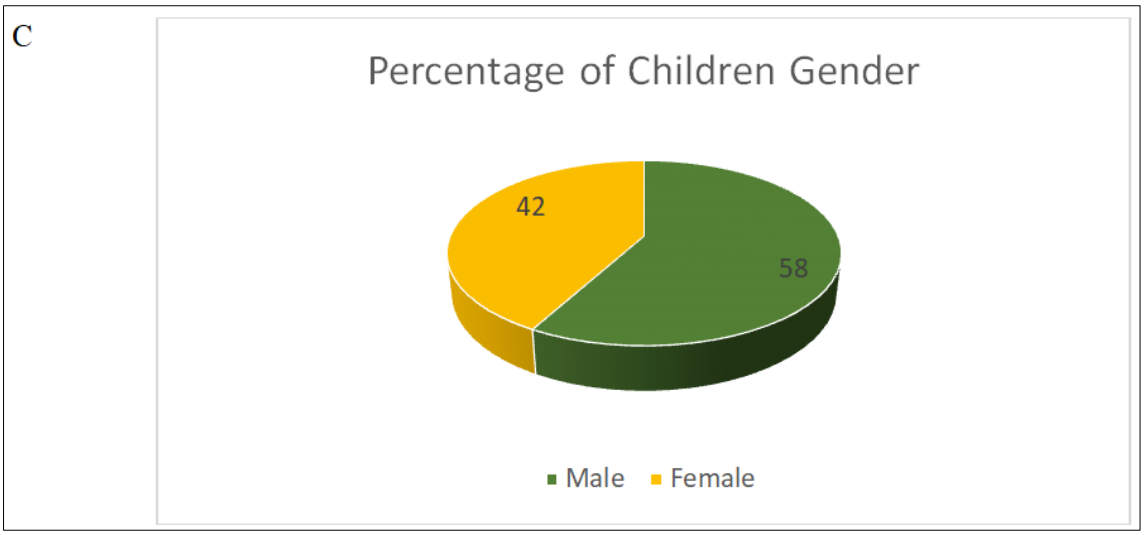


Figure1. Demographics data of children participants

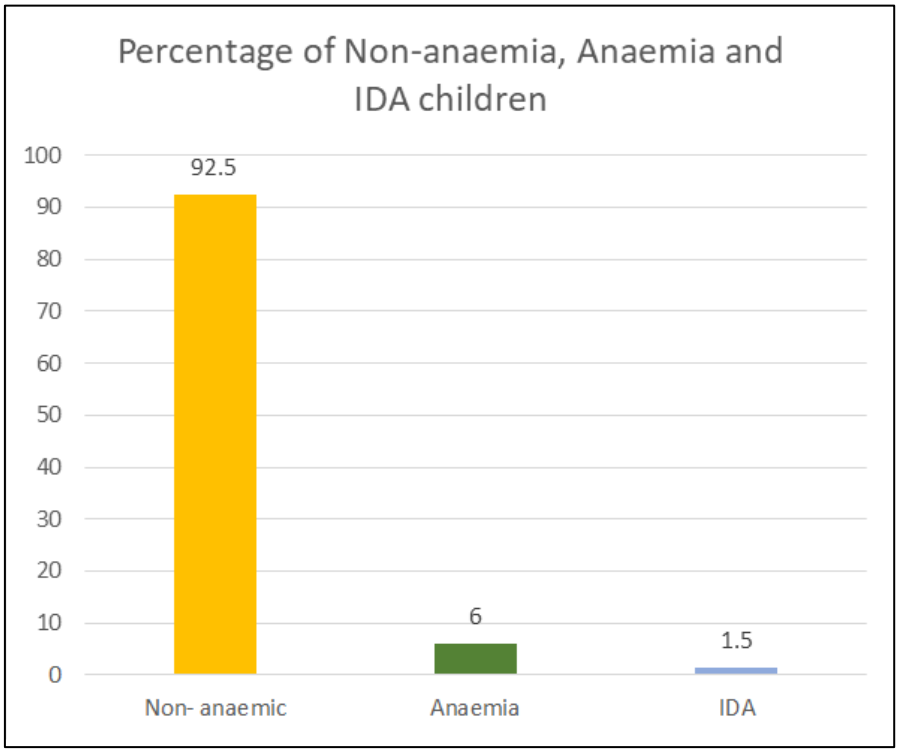


Figure 2: Percentages of children participants without anemia, with anemia and IDA

Table 1: Laboratory results for patients with anemia.

Patient No.	HB (11 – 18 g/dl)	RBC (4 – 5.5 x 10*6/µL)	HCT (33 - 40%)
1	9.5	4	32
2	9.20	4. 2	29.50
3	6.70	3.56	25.10
4	10.20	3.92	32
5	10.0	4	31.80
6	10.40	4.27	32.80
7	10	4.04	31.60
8	9.40	4.36	29

Table 2: Laboratory results for patients with IDA

Patient No.	HB (11 – 18 g/dl)	RBC (4 – 5.5 x 10*6/µL)	MCV (75 – 95 fl)	MCH (27 – 32 pg)	Serum iron (5.83 – 34.5 umol/l)	TIBC (24.2 – 70 umol/l)
1	10	3.97	70.70	25.30	2.73	73
2	8.40	4.03	55.10	17	2.85	81
3	9.30	4	63	17.30	1.99	75

In the Arab Gulf countries, anemia, including IDA, considered a serious and main public health problems [1, 12]. Anemia and iron deficiency anemia among preschool children may cause impaired psychomotor and mental development and many other possible health disorders and effects. However, some children may be asymptomatic [13].

Although, the World Health Organization reported that iron deficiency anemia (IDA) as the most common type of anemia, which made up half of all anemic cases all over the world [11], there were limited research studies about anemia and IDA among preschool children in the Western region of Saudi Arabia. Thus, the aim of this study was to investigate the prevalence of previously undiagnosed anemia among children between 2 to 6 years old. In this study, several factors that might contribute to the high prevalence of anemia and IDA were measured.

In the present study, the prevalence of previously undiagnosed anemia among preschool children was 6%. Out of those anemic children, there were 25% presented with microcytic hypochromic IDA. Similar finding to the result of this study was shown a prevalence with 26.4% microcytic hypochromic anemia among preschool children aged 6 to 59 months who attended ER in three government and two private hospitals at Abha and Khamis Mushait [10]. However, Tawfik *et al.*, reported higher prevalence with 64% of studied children had IDA in a research study performed in Al-Fayoum University Hospital at Egypt [14]. Another study from Gaza, found that the prevalence of anemia was 59.7%, as it was associated with location, age, gender, family income, and malnutrition. The study stated that the high prevalence rate is due to crowded living conditions and poverty, which led to an increase in the prevalence of malnutrition [15]. In Sudan, the prevalence of anemia was high (80.4%) in the rural community, where the high prevalence is due to the association of anemia with poverty, and Sudan, in turn, is considered one of the poorest countries in the world [16]. Such variation in the prevalence of anemia and IDA between regions within the same country or between different countries among preschool children might be related to the differences in the characteristics of the study participants age and overall health. In addition, it has been found that variation in the socio-economic status such as poverty was highly associated with increasing the prevalence of anemia [17]. The result of this study showed no significant difference between genders in term of anemia status, while another study reported that male children were more affected by IDA than females [8].

This study also focused on different parameters might related to anemia among children including; mother's age, mother's education level, mother's intake of vitamins during pregnancy and breastfeeding or formula lactation. However, there is no significant differences among children regarding mother education level and vitamin intake, or the approach of feeding. On the other hand, in Kenya, mother's education level was found to be significantly associated with anemia [18]. This study found no association between maternal age and anemia while, Azher *et al.*, found that mother's age was significantly associated with anemia [19].

In conclusion, since, anemia and IDA are still a public health problem among preschool children in Saudi Arabia this study suggested that the hematological blood examination should be done to students as a requirement before school which may reveal the presence of previously undiagnosed anemia and might associated with low mantle and functional performance among children. Moreover, further studies are recommended to cover all regions of the Kingdome to investigate more underlying related risk factors that provide more insight to the nature and types of policies can be involved to prevent or minimize anaemia development.

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