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RESEARCH ARTICLE

IRON DEFICIENCY ANEMIA AND MALNUTRITION IN PEDIATRICS IN SAUDI ARABIA: A REVIEW ARTICLE

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Abstract

Anemia remains a global health problem in the 21st century. Iron deficiency anemia is the most common type. Childrenare especially vulnerable to the detrimental health consequences of anemia including fatigability, predisposition to repeated infections, and cognitive impairment. Iron deficiency anemia is considered the most prevalent type of nutritional anemia. Insufficient dietary iron intake, decreased iron absorption, and excess iron loss can cause iron deficiency.Accordingly, malnutrition plays a role in the prevalence of iron deficiency anemia. Saudi Arabia is now in advanced nutrition transition, which means the rates of obesity are high together with malnutrition. In this review, we shed light on the prevalence of iron deficiency anemia among the pediatric population of the Kingdom of Saudi Arabia. We also focus on the burden of malnutrition and its association with anemia, and evaluate the strategies needed to combat these health problems. Further research all over the Kingdom is needed to expose the full magnitude of anemia. Monitoring of the implementation of the previously existing health programs is needed.

Introduction:-

Anemia as a global health burden

Anemia is a clinical condition with reduction of the hemoglobinlevel below normal limits. It is listed as a global health burden by the world health organization (WHO). In 2019, approximately 1.8 billion people had anemia. South Asia, Western, Eastern and Central Sub-Saharan Africa regions have the highest prevalence (1). Children - especially those under five-year-old-are recognized by WHO as a susceptible population for contracting anemia. Anemic children are at increasedrisk for cognitive impairment and abnormal physical development(2). It has a recognized effect on school performance (3). Itis also a burden on healthcare costs. Reduction of anemia is one of the World Health Assembly Global Nutrition Targets for 2025(4).

Regarding the East Mediterranean Region (EMR), Al-Jawaldeh et al. (5) conducted a systematicreview reporting varyingprevalence of anemia ranging between 23.8% and 83.5% among children under five-year-old.There is a limited number of studies on the extent of prevalence of anemia and its impact as a national health problem in the Kingdom of Saudi Arabia. Bakry and Elhefny(6) reported high prevalence of anemiain both school

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anduniversitystudents.Specifically, severalstudies reported the prevalence of anemiaamong the pediatric population (3, 7-10).There are older reports of anemia prevalence in Saudi Arabia. El-Hazmi and Warsy(11) reported an overall prevalence of 24.8% among Saudi children all over Saudi Arabia. Rasheed et al. (12) reported a prevalence of 26.4% in El-Khobar.

Iron deficiency anemia prevalence among pediatric population in Saudi Arabia

Iron is required for hemoglobin synthesis. Its deficiency is generally either due to insufficient intake, decreased absorption, or excess iron loss as in parasitic infestation. On a global level, iron deficiency anemia (IDA)is the most common cause of anemia according to the WHO (2). It is also the main cause of microcytic hypochromic anemia among Saudi population (13).The reported health consequences of IDA are numerous, including developmental delay, learning disabilities, general weakness, and compromised immune system (14). Lead poisoning has been associated with IDA as it is reported to increase the absorption of toxic metals (15).The effects of IDA may be long lasting and irreversible even if anemia was corrected (1, 16).

In Saudi Arabia, there are reports of high prevalence of IDA among infants (17, 18), preschool children (19), and school children(20, 21). Iron-deficiency anemia is common in infants because of the rapid growth and development in this stage, especially when the served complementary foods are low in iron content (2). Babiker et al. conducted a historical cross-sectional study concluding prevalence of IDA by age was 3.3%, 9.3%, 12.7%, and 14.5% in children aged 5–6, 7–8, 9–10, and 12–15 months of age, respectively (22). The prevalence of IDA amongschoolgirls in Riyadh reported by al-Othaimeen et al. (20) was high (55.4%).

Anothercross-sectional survey was conducted on Saudi school children from Riyadh revealed that about fifth of the children were anemic. Although the subjects were studied for risk factors of IDA, this percentage is not representative of IDA alone since they did not measure serum ferritin level, or differentiate different types of anemiaas pointed out by the authors (8). Likewise, a 26.9% prevalence of microcytic hypochromic anemia among preschool children in Abha was considered by the authors to represent IDA prevalencebecause of the importance of IDA in the differential diagnosis of microcytic hypochromic anemia (9).Belali et al. (23) studied 683 residents of different ages in Asir Region. Although generally IDA was mildly prevalent, children under the age of 10 along with females were the most affected groups.

Nutritional status of children inSaudi Arabia and its impact on iron deficiency anemia

To highlight the importance of the role of nutrition in the etiology of anemia, the WHO has classified the causes of anemia as nutritional vs. non-nutritional(2). Another model classified anemia contributing factors to fundamental, intermediate, and immediate determinants. Nutritional factors lie within the category of the immediate determinants (24). Iron deficiency anemia is the most prominent example of nutritional anemias.

Rapid growth in childhood years requiresseveral specific nutritional requirements (25). Nutrients are classified into two major groups: macronutrients and micronutrients. Malnutrition can result from either deficiency, excess, or imbalances in nutrient intake. Accordingly, three major groups of malnutrition exist: undernutrition (wasting, stunting, and underweight), micronutrient deficiency, and obesity (26).

There is an observed decline in malnutrition in children of Saudi Arabia(10). Gohal et al. (27) revealed that in Jazan, malnutrition in children under five years old was lower compared to some other areas in the EMR. This is further supported by an older study reporting low prevalence of severe underweight and severe wasting (1.3% and 2.9%, respectively) among Saudi children of the same age group reported by El Mouzan et al. (28). However, a comprehensive literature review was conducted, on dietary intakes in children and adolescents in countries of the EMR. The results of this review emphasized the low intake of fruits, vegetables, water, milk, and dairy products. At the same time, there was an observed high consumption of sweetened beverages and snacks.

To sum up, there is an increase in the consumption of nutrient poor foods (29). Dietary habits of the Saudi population witnessed fundamental changes in the past 20 years as a part of the multidimensional phenomenon called (the nutrition transition). The traditional Saudi diet used to contain dates, fresh vegetables, and fish. Nowadays, fast food is popular among all population with more fat and sugar intake (3).The nutrition transitionis a condition where undernutrition and non-communicable diseases associated with other forms of malnutrition (including obesity) coexist. The Kingdom of Saudi Arabiais considered to have an advancedtransition with high rates of obesity and moderate malnutrition and undernutrition(2). The change of body mass index distribution in Saudi Arabiatowards a

high prevalence of overweight and obesity in Riyadh and Hail is shifting closer to developed countries (10, 30, 31). The consequences of this transition can lead to slower growth rates, delayed sexual maturation, micronutrients deficiency, lowered immunity, and obesity related diseases.There are reports that obesity and iron deficiency can be associated, although it can be without anemia (2).

In addition to the change of quality of diet, a dietary habit that can contribute to malnutrition is missing breakfast. A study pointed out the prevalence of that habit among school children who depend on canteen foods in Arar region. Only about one fifth of the sample reported they always had breakfast. Conveniently, more than half of them were underweight (32). An older study pointed outthat habit as well (20). In fact, that study also revealed high prevalence of IDA among the subjects especially between (7-14) years old.

Micronutrients include different minerals and vitamins essential for good health.They are divided into type I, composed of iodine, iron, and vitamins A and C. Their deficiency does not affect growth but can affect the body functions and cause a spectrum of disorders including anemia. Type II micronutrients are essential for growth (26). Micronutrient deficiency among Saudi children has been reported. Nasreddine et al. (10) reported that children of the region had inadequate intake of micronutrients in general, including iron. Al-Hussaini et al. (31) conducted a large studyin Riyadh city on 7,931 students (children and adolescents). The second most common micronutrient deficiency among them was iron following vitamin D. Interestingly, no correlation was found between undernutrition and micronutrient deficiencies. Owaidah et al. (33) reported a high prevalence of iron deficiency in all the studied regions of Saudi Arabia in their study.

In addition to the dietary habits in Saudi population mentioned before, there are certain habits that contribute to iron deficiency specifically. As mentioned before, iron-rich food as red meat, liver, legumes, spinach, and fish is no longer common food staples for Saudis. In addition, some dietary habits might impair iron absorption. Consumption of Laban (Sour milk) during or just after lunch was considered a risk factor for anemia in school children. This is probably attributed to its high contents of calcium inhibiting the absorption of iron. Likewise, drinking carbonated beverages and high phytate-containing items (grains, beans, nuts) while or immediately after eating iron-containing food decreases iron absorption (31).

Therefore, the association between IDA and malnutrition is understandable. A Syrian study revealed an association between IDA and malnutrition. In their study, underweight was significantly higher in children with IDA as opposed to nonanemic children (14). Serum iron level was positively correlated with children anthropometric measures according to Shalaby et al. (34).Belali et al. (23) identified inadequate iron intake as a main risk factor in developing IDA among Asir population. Gad et al. (8) concluded that meat (an iron-rich food) was a protective factor against IDA.Anemia was more prevalent among students who skipped breakfast and those who did not eat iron-rich food; however, the difference was not statistically significant according to Abalkhalil and Shawky (3).

Prolonged exclusive breast feeding was recognized as a risk factor for IDA. Although iron bioavailability of breast milk is very high (50%), its iron content is low. Till six months, this does not represent a problem, because infants have their iron stores from the last trimester of pregnancy and physiological hemolysis during the first weeks of life. After that, the process of growingdepletes the iron stores necessitating increasediron intake (35). Other risk factors for contracting anemia includelow income and lack of parental education (2, 3, 23) as well as maternal malnutrition (36, 37). The prevalence of anemia was significantly higher in children infected with parasites than those without infection (12). Iron was among other micronutrient that were significantly lower in children with parasitic infections compared to others in a Saudi study (34)

Measuring hemoglobin level is the most common investigation used to detect anemia. There are other hematological indices; hematocrit, mean corpuscular volume, and reticulocyte count. To detect the cause of anemia, other investigations are needed.In case of IDA, serum ferritin is frequently used. In the presence of infection, serum ferritin level can be affected(2).An Indonesian study suggested using the reticulocyte hemoglobin equivalent as an early indicator of iron deficiency. It is a direct measurement of iron level in reticulocytes recently formed in the bone marrow. They found a significant positive relationship between hemoglobin and Ret-He in children. Reduced reticulocyte hemoglobin equivalent level was associated with a greater risk of IDA (38). A Saudi study also reported that reticulocyte hemoglobin content together with complete blood count may can be an alternative for the diagnosis of iron deficiency and IDA in young children (39).

Efforts to reduce the burden of IDA and iron deficiency

Overcoming pediatric malnutrition in all of its forms necessitates the development of evidence-based solutions and the construction of policies to secure the availability of healthy diets (10).Unfortunately, according to a recent review by Al-Jawaldeh et al. (5), the EMR is not on the right path towards meeting the world health assembly target. Although most countries started fortification programs, this did not achieve the desired progress in anemia reduction.

Food based strategies of combating anemia are directed towards providing and increasing the consumption of foods rich in the deficient micronutrient (iron in the case of IDA) and avoiding foods that decrease its absorption. Red meat, vegetables, liver, legumes are recommended. School time is a good opportunity to monitor dietary habits of children and implement plans to combat malnutrition and associated nutritional anemia. Implementing strict school health programs focused on the correcting the dietary habits is a necessity. The National Strategy for Diet and Physical Activity for the Years 2014-2025 provided recommendations regarding educating schoolchildren on healthy diet, along with improvement of canteen served food (40). Abalkhalil and Shawky in 2002 reported that the food served in school canteens witnessed great improvements because of the continued efforts of the Ministry of Education. Carbonated beverages are no longer allowed among other unhealthy diets (3). Food rich in Vit C should be provided since it increases iron absorption by turning ferric iron into ferrous form(35).

For infants, exclusive breast feeding for six months must be encouraged followed by balanced complementary diets.Foodfortification with iron is a very cost-effective method. Biscuits and wheat flour are the most commonly fortified diets. Enriching diet with iron was proved to reducethe incidence of IDA (41, 42). Sallou and Ashry(32) suggested adding molasses to biscuits for its high iron content.However, fortification programs in EMR are unfortunately on a narrow scale, and not well-monitored (43).The majority of countries fortify foods with iron compounds with poor bioavailability(5). Another fortification tactic aimed to combat the inhibition of iron absorption is the use of NaFeEDTA (ferric sodium ethylenediaminetetraacetate) which was proved to increase iron absorption by a factor of two to three in the presence of phytic acid (42, 44). Morocco adopted NaFeEDTA fortification (5). Another recommended food-based strategy is biofortification of crops.Nutritional supplementation according to WHO recommendations for age, gender and special populations is essential in curing iron deficiency(2, 35).

Another strategy of anemia reduction is education for social and behavior changing. Again, school health and nutrition programs can have a great impact in teaching students and their parents the healthy nutritional habits. In additions, governmental programs must be planned and implemented for treating parasitic infections and ensuring water sanitation(2).

More research is needed to further assess the prevalence of anemia, its different etiologies, and risk factors in Saudi Arabia.Asystematic review suggested that preventing iron deficiency is more beneficial in preventing neurodevelopmental complications than treatment of existing iron deficiency. They also suggested thatstructural brain damage resulting from iron deficiency in the first three years of life may be irreversible (16). There should be continuous monitoring and evaluation of the existing implemented programs to assess their efficacy. There should be more control over marketing unhealthy diets during children's programs and viewing time(29).

Conclusion:-

Despite the limited evidence, anemia in general and iron deficiency anemia is still a health problem in Saudi Arabiaespecially among the pediatric population. The Saudi dietary habits are contributing to iron deficiency either by decreasedconsumption of iron-rich food or by eating foods that limit the absorption of it. More research is needed to highlight the role of malnutrition in the etiology of IDA. Food based Strategies and health education must be monitored, evaluated and improved accordingly to overcome that national problem.

Author Contributions:-

All authors contributed to the study conception and design. Literature search and data collection were performed by AsmaaGhmaird, Abeer Mohammed M. Alanazi, Dina Ahmed Aljohani, and Amal Abutaleb M. Qaysi. The first draft of the manuscript was written by Laila Abdullah S. Alanazi, Jomanah Khalid M. Aljohani, and Asma Hussain A. Hamdi. The final draft of the manuscript was reviewed by AsmaaGhmaird and Dina Ahmed Aljohani.

Conflicts of interest:-

The authors have no conflicts of interest.

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