The prevalence of anemia, its association with dietary patterns and nutrient intakes among children aged 6 to 24 months: a systematic review.

Rhoda Ama Koranteng[1], Dery Bede[2], Dr Charles Apprey[1]

[1] Department of Nutrition and Dietetics, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.
[2.] Dietetics and Nutrition Unit, Effia Nkwanta Regional Hospital, Takorad, Ghana.

DOI: 10.29322/IJSRP.12.09.2022.p12950
http://dx.doi.org/10.29322/IJSRP.12.09.2022.p12950

Paper Received Date: 15th August 2022
Paper Acceptance Date: 15th September 2022
Paper Publication Date: 26th September 2022

***Abstract*- Purpose:** Anemia threatens healthcare system worldwide with enormously high prevalence among the vulnerable groups in society posing a huge economic burden. The purpose of this paper is to investigate the prevalence of anemia and it association to dietary patterns and nutrient intake among children.

Method: A systematic review was done on published studies that looked at prevalence of anemia and its association with dietary patterns and nutrient intakes among children aged 6 to 24 months. PubMed, Doaj, Google scholar and Google advanced search databases were searched from a period sof 8th July 2021 to 29th July 2021. Quality assessment was done for all papers based on their methodology.

Findings: Online search yielded a total of 365 papers of which 79 were appropriately titled but 21 remained after removing duplicates. 11 of the studies could not be included because they were anemia treatment protocols and reviews. 10 studies that met inclusion criteria in terms of abstracts and methodology were included in the study. Majority of the studies associated anemia prevalence with nutrient intakes; vitamin A or serum retinol levels (4 out of 10) articles and c-reactive protein deficiency was associated with anaemia (2 out of 10) articles. Also inadequate consumption of iron-rich foods as a dietary pattern was associated with high prevalence of anemia among children 6 to 24months.

Practical implications: Most of the studies were conducted in developed countries and this implies that there is a rarity of data in developing countries where prevalence of anemia is high. There is the need for more studies to be steered in this area among developing countries.

***Index Terms*-** Anemia, dietary patterns, nutrient intakes

I. INTRODUCTION

Anemia denotes red blood cell mass and hemoglobin concentrations of less than the fifth percentile for age. It is categorized into microcytic, macrocytic, and normocytic, based on the mean corpuscular volume. The condition is further classified as mild anemia with a Hb concentration of 10.0-10.9g/dL, moderate anemia with a Hb concentration of 7.0-9.9g/dL, and severe Anemia with a Hb concentration of less than 7.0g/dL. Anemia is also one of the leading micronutrient deficiencies, currently being recognized as the most prevalent nutritional deficiencies and the second leading cause of disability nutritionally (Woldie, Kebede, and Tariku, 2015). According to the World Health Organization, Anemia affects about 273 million preschool children, thus affecting about 42.6% of such children. The organization again, in 2011, further indicated that the prevalence of Anemia across the globe was highest in Africa, at about 64.6%. In 2008, data from the Ghana Demographic and Health Survey indicated that about 78% of children aged 6–59 months were estimated to be anemic (Ewusie *et al.*, 2014). A study conducted by Stevens *et al. (*2013) showed that the prevalence of Anemia in the country had dropped to 67%, which was still higher than the global prevalence. Due to the complex interactive nature of Anemia with many factors such as health and nutrition, it has major consequences on the socio-economic development of the population. Other causes of Anemia include viral infections, malaria, hemolysis, chronic disease, folate, and vitamin B12 deficiencies. These other causes are significantly associated with dietary patterns and nutrient intake. Crucial for life-long health and well-being, nutrition and nurturing are essential during the first years of life, especially when new foods are introduced to children. Nutrient requirements are considerably elevated and deemed vital for developing children below two years. Nutrients usually evaluated include iron, as breast milk alone is not rich in iron to supply the growing child's needs during the complementary feeding stage, thus 6 to 24months. Iron as a micronutrient is needed to synthesize hemoglobin, an indicator of Anemia, and its deficiency is also seen as the major cause of Anemia. Nutrient intake, especially micronutrients and dietary diversity, provides adequate iron, folate, and Cobalamin in producing Red blood cells.

A systematic review of all studies published in this field is necessitated to assess anemia risk among young children and also report on it trends and associations with nutrient intake and dietary patterns. This will enable preventive and reductive actions to be taken to reduce this menace drastically. This writes up compiled published studies done on prevalence of anemia and one or more

nutrients consumption or dietary patterns among children below two years.

II. METHODOLOGY

SEARCH STRATEGY

A systematic review was done and all published data from 2000 to 2021 to search for all data on the dietary patterns, nutrient intakes and their associations with anemia of children below two years. In veracity, the severity of the anemia suffered by various children and the sexes of the children were of little consideration, indicating that all studies involving the target population were included. The main search engines included Google Scholar, Pubmed, Doaj and Google advanced search. The search was conducted systematically to find the association between nutrient consumption, dietary patterns and the outcome of anemia.

INCLUSION AND EXCLUSION CRITERIA

Below was the inclusion criterion

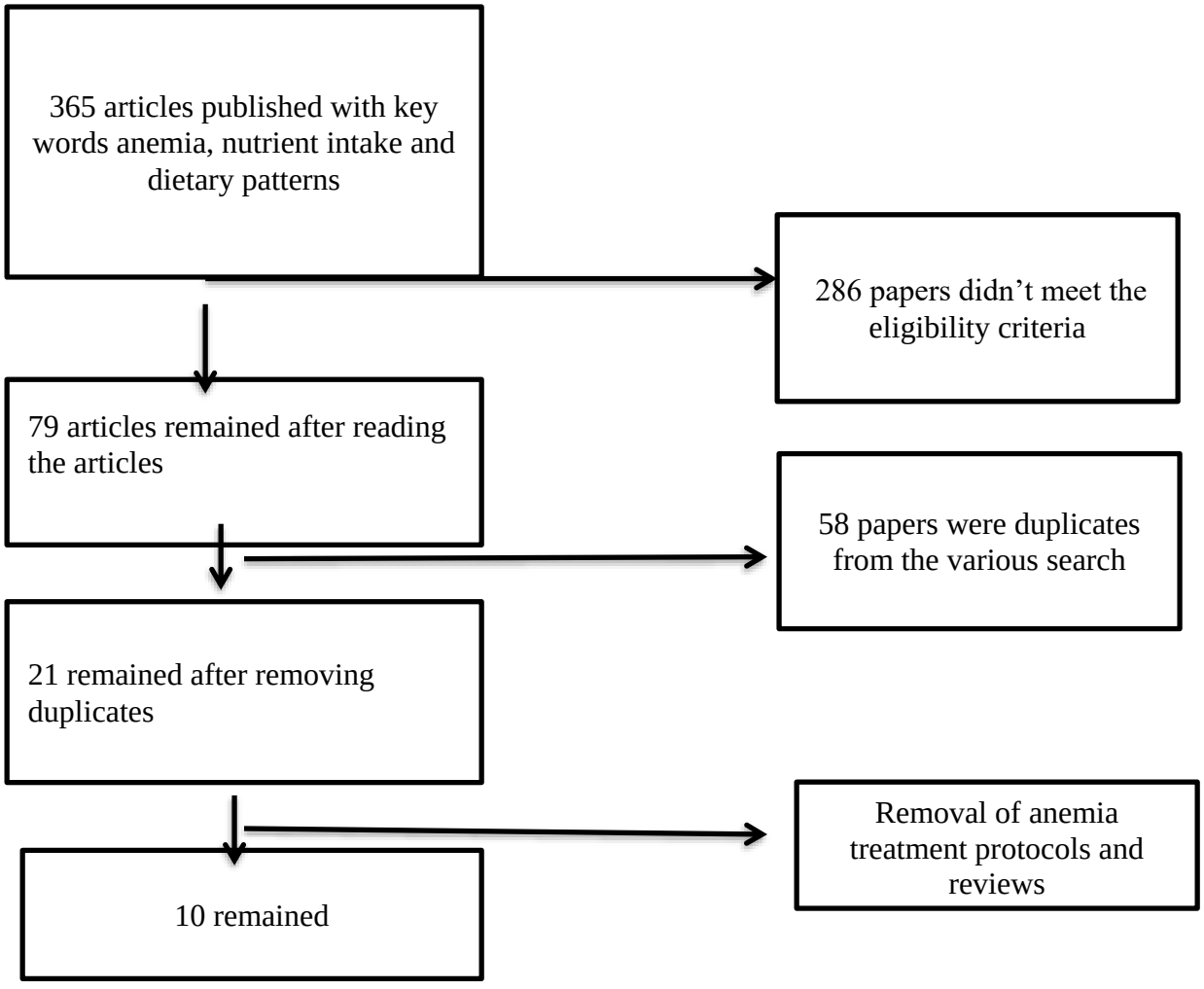
- Population: Human population (Children below 2 years)
- Study designs: Experimental and Observational studies
- Outcome: Anemia
- Exposures: Dietary pattern, nutrient intake

The following search results were excluded

- Reviews
- Reports on various protocols used in treating anemia patients were excluded
- Various case studies that did not meet the inclusion criteria

SEARCH RESULT

With the repeated articles eliminated and articles that did not meet the criteria also excluded the total number of 365 journal articles was obtained from the various search engines. Unluckily some of the full texts of the articles could not be accessed. At the end of the systematic search, only ten remained.



THE FINDINGS ON THE STUDIES INVOLVING DIETARY PATTERNS AND NUTRIENT INTAKE ASSOCIATIONS WITH ANEMIA

A summary of the results based on the various searches is presented below.

STUDY DESIGN

The prevailing study designs used in the various studies were observational studies where dietary patterns or nutrient intakes were associated with anemia simultaneously or individually.

EXTRACTION OF DATA

Data was extracted based on study source (Author, year of publication), country in which study was conducted, study design, data collection procedures, prevalence of anemia, nutrient intake or dietary pattern involved, age of participants and major findings.

STUDY POPULATION, SETTING AND COUNTRY

The populations of the various studies were similar. The subjects were health male and female children mostly between the age 6 months and 24 months. The exclusion criteria were mainly non breastfed children and children who suffered from various chronic conditions or diseases.

DIETARY PATTERNS AND NUTRIENTS CONSIDERED IN THE STUDY

Nutrients considered are Carbohydrates, Proteins, Fats, vitamins A, C, B12, B9, Iron, Calcium and Selenium. Dietary diversity and the consumption of iron-rich foods were dietary patterns of consideration. In one study, non-vegetable based dietary pattern and vegan diets among various children concerning the anemia status were considered (Fajolu *et al.*, 2007).

III. MAIN FINDINGS

One remarkable associate of the prevalence of anaemia is inadequate vitamin A intake or serum retinol levels time as reported by most the journals (Morasso *et al.*, 2003; Gamble *et al.*, 2004; Nabakwe *et al.*, 2005; Mahfuz *et al.*, 2019). Apart from that, the inclusion of vegetables and animal protein less than three times a week in the diet was significantly associated with anemia (Fajolu *et al.*, 2007). In addition, decreases in the consumption of iron-rich foods and inadequate intake of foods rich in heme iron compared to high non-heme iron intake were associated with anaemia (Reboso Perez *et al.*, 2005; Akalu *et al.*, 2021). As reported by (Soh *et al.*, 2004), a significant outcome from the study revealed that c-reactive protein deficiency was associated with iron deficiency anaemia. Moreover, the prevalence of anaemia is dependent on multi-sectoral factors, with nutrition and nurturing being major determinants.

IV. RESEARCH GAPS

Table 1 Summary of the main findings of the research

AUTHOR	STUDY DESIGNS	NUTRIENTS OR DIETARY PATTERN INVOLVED	PREVALENCE OF ANEMIA	AGE OF CHILDREN	OUTCOME
(Morasso *et al.*, 2003)	Not stated in abstract	Vitamin A Iron	66.4%	6 to 24months	Anemia prevalence was significantly higher in children who had never taken iron supplements.
(Nabakwe *et al.*, 2005)	Cross-sectional	Vitamin A	92%		There was no difference in hemoglobin level of children with normal serum retinol and those with low serum retinol
(Gamble *et al.*, 2004)	Community-based survey	Iron and Vitamin A	42.5%	Preschool	Both iron deficiency and severe vitamin A deficiency were significantly associated with anemia
(Mahfuz *et al.*, 2019)	Birth cohort study	Iron and Vitamin A	Not stated in abstract	7 to 24months	low retinol levels were associated with increased anemia prevalence

(Soh *et al.*, 2004)	Cross-sectional	Iron (serum ferritin) and C-reactive protein	29%	6 to 24months	C-reactive protein deficiency was associated with iron deficiency anaemia
(Fajolu *et al.*, 2007)	Cross-sectional	Non vegetable based dietary pattern Vegan dietary pattern	79.1%	6 to 24 months	Inclusion of vegetables and animal protein less than three times a week in the diet were both significantly associated with IDA
(Appiah *et al.*, 2021)	Cross-sectional	Dietary diversity		6 to 24months	Dietary diversity does not significantly contribute to anemia among the children.
(Reboso Perez *et al.*, 2005)	Cross-sectional	Vitamin A, Iron	29.1%	6 to 24months	Serum vitamin A values were associated to anemia in children 6 to 24months. Intake of foods rich in heme iron was infrequent; conversely, intake of non heme iron was much higher.
(Zou *et al.*, 2021)	Cross-sectional studies	Dietary pattern	20.6%	6 to 23months	Four dietary patterns identified were associated with anemia status of children.
(Akalu *et al.*, 2021)	Cross-sectional studies	Consumption of iron rich foods		6 to 23months	Iron-rich foods consumption has a determinant role on anemia status.

Table 2 Study designs, main findings and research gaps

AUTHOR AND COUNTRY	AIM OF STUDY	MAIN FINDING	GAPS
(Morasso *et al.*, 2003) Argentina	Determining the prevalence of vitamin, A and iron (ID) anemia	a) Anemia prevalence was significantly higher in males, in children with low birth weight, in those who had never taken iron supplements and among the poor, both structural and by income. b) Low iron and vitamin A deficiencies.	A large sample size would have been beneficial
(Nabakwe *et al.*, 2005) Kenya	Determining and correlating the prevalence of vitamin A deficiency, anaemia and malaria parasitaemia to hemoglobin, ferritin, and acute phase response.	a) Hemoglobin levels in children with normal serum retinol and children with low serum retinol did not differ. b) Ferritin was not substantially different between children with	• Smaller sample size. • Much work should be done on all serum micronutrient

		normal hemoglobin and children with low hemoglobin	levels in relation to the prevalence of anemia.
(Gamble *et al.*, 2004) Republic of the Marshall Islands	Characterizes contributions to anemia in pre-school children from vitamin A and iron deficits	Both iron and vitamin A deficiencies were independent risk factors for anemia, but inflammation was not a significant risk factor for anemia among these preschool children.	Cumulative impact of macronutrients and micronutrients deficiencies on anemia rates also needs to be probed.
(Mahfuz *et al.*, 2019) Bangladesh	To identify the factors associated with micronutrient deficiencies and association of plasma micronutrient concentration trajectories from 7 to 24 months	Deficiencies in iron and vitamin A were independent anemia risk variables but inflammation was not a major anemia risk factor in these prechool children. Low concentrations of ferritin and retinol are connected with higher anemia prevalence.	
(Soh *et al.*, 2004) New Zealand	Determining biochemical iron deficit and identifying ferritin-related factors	The presence of suboptimal iron status Very low proportions of children with inadequate C-reactive protein being anemic.	
(Fajolu *et al.*, 2007)	To determine the prevalence of IDA and some factors associated with it	High prevalence of anemia. Poor consumption rate of iron rich foods was significantly associated with IDA.	The study population was smaller
(Appiah *et al.*, 2021) Ghana	To identify the predictors of child undernutrition and anemia	child's past morbidity and exclusive breast-feeding rate ominously contributed to anemia among the children Dietary diversity does not significantly contribute to anemia among the children	• Study design could not establish causality. • Small sample size
(Reboso Perez *et al.*, 2005) Cuba	Prevalence of iron deficiency anemia in children	High prevalence of anemia Serum vitamin A values were associated to anemia Inadequate intake of foods rich in heme iron compared to high intake of non heme iron	
(Zou *et al.*, 2021) China	The association between dietary patterns and anaemia among children	Anemia status and dietary patterns are significantly associated	
(Akalu *et al.*, 2021) South Africa	To determine the prevalence of good consumption of iron-rich foods and its associated factors among children	Low prevalence of good consumption of iron-rich foods among children. The consumption of iron rich foods was associated with anemia. Child, family and community-level factors are significantly associated	

		with consumption of iron rich foods	

V. DISCUSSION

Numerous researches show that the effects of certain micronutrients and dietary patterns on the anemia rate are remarkable. The study shows that the prevalence of anaemia is related to iron and vitamin A deficits (Morasso et al., 2003). However, sex, birth weight, supplementation of micronutrients, and economic status were key factors. Studies by (Gamble et al. 2004; Soh et al. 2004; Mahfuz et al., 2019) showed that the different intakes of micronutrients were substantially related to childhood anaemia. The individual roles of the different micronutrients in anaemia prevalence were clear, but it is tough to know the impact of synergistic micronutrients on anaemia status. The influence of micronutrients and their role in hematological components cannot be over emphasized. Some studies that measure deficiency rates have shown that nutrients can affect an individual's hemoglobin level. The search revealed that low consumption of iron-rich meals by children impacts the prevalence of anemia (Fajolu et al., 2007). Akalu *et al.* (2021) also reports that iron-rich food consumption is, therefore, an important area of research associated with anemia. A correlation with anemia in dietary patterns such as dietary diversity among young children has been described by (Appiah et al., 2021; Zou et al., 2021). In addition to the high incidence of anaemia in serum retinol content, inadequate consumption of foods rich in heme iron is also linked to the high intake of non-heme iron (Reboso Perez et al., 2005). An anaemia child is likely to have poor dietary and nutrient intake. Most nutrient intakes were lower, hence considered deficient, than the recommended daily allowance. Cross-sectional studies have dominated the results of this study, so create a study that provides specific information on the current situation while providing insight for large-scale Bosomtwe and Ghana studies as a whole. Neither study revealed either dietary patterns or anaemia-related nutrient intakes. The link between dietary patterns, nutrient intake, and anemia is essential.

VI. LIMITATIONS

There are some limitations to this research work. Majority of the studies reviewed were done in developed countries therefore results of the study may not be applicable to low-income countries. Also, most of the studies were cross sectional and did not assess cause and effect relationship but only looked at prevalence of anemia, dietary patterns and nutrient intakes. The inaccessibility to full articles of some papers that met the inclusion criteria by title and abstract is also a limitation to the study.

VII. CONCLUSION

The impact of dietary patterns and nutrient intake on the general wellbeing of children below 2years cannot be overemphasized. Their roles in various systemic and physiological processes in the human body attribute them to the likelihood of developing anemia in children. It is evident that most studies done so far on determinants and causative factors of anemia do not focus on the association dietary patterns and specific nutrient intakes and the condition.

REFERENCES

[1] Akalu, Y. et al. (2021) 'Iron-rich food consumption and associated factors among children aged 6-23 months in sub-Saharan Africa: A multilevel analysis of Demographic and Health Surveys', PLoS ONE, 16(6 June). doi: 10.1371/journal.pone.0253221.

[2] Appiah, C. A. et al. (2021) 'Predictors of undernutrition and anemia among children aged 6–24 months in a low-resourced setting of Ghana: a baseline survey', Journal of Health Research, 35(1), pp. 27–37. doi: 10.1108/JHR-05-2019-0095.

[3] Fajolu, I. B. et al. (2007) 'Prevalence of iron deficiency in children 6-24 months in Lagos.', Nigerian quarterly journal of hospital medicine, 17(3), pp. 97–100.

[4] Gamble, M. V. et al. (2004) 'Relationship of vitamin A deficiency, iron deficiency, and inflammation to anemia among preschool children in the Republic of the Marshall Islands', European Journal of Clinical Nutrition, 58(10), pp. 1396–1401. doi: 10.1038/sj.ejcn.1601982.

[5] Mahfuz, M. et al. (2019) 'Why do children in slums suffer from anemia, iron, zinc, and vitamin a deficiency? Results from a birth cohort study in Dhaka', Nutrients, 11(12). doi: 10.3390/nu11123025.

[6] Morasso, M. D. C. et al. (2003) 'Prevalence of anemia, iron and vitamin A deficiencies in children between 6 to 24 months of age in Chaco, Argentina | Deficiencias de hierro y de vitamina A y prevalencia de anemia en niños y niñas de 6 a 24 meses de edad en Chaco, Argentina', Archivos Latinoamericanos de Nutricion, 53(1), pp. 21–27.

[7] Nabakwe, E. C. et al. (2005) 'Vitamin A deficiency and anaemia in young children living in a malaria endemic district of western Kenya', East African Medical Journal, 82(6), pp. 300–306. doi: 10.4314/eamj.v82i6.9301.

[8] Reboso Perez, J. et al. (2005) 'Iron deficiency anemia in children from 6 to 24 months and 6 to 12 years of age in eastern Cuba | Diagnóstico de la anemia por deficiencia de hierro en niños de 6 a 24 meses y de 6 a 12 años de edad de las provincias orientales de Cuba', Revista Espanola de Nutricion Comunitaria, 11(2), pp. 60–68.

[9] Soh, P. et al. (2004) 'Iron deficiency and risk factors for lower iron stores in 6-24-month-old New Zealanders', European Journal of Clinical Nutrition, 58(1), pp. 71–79. doi: 10.1038/sj.ejcn.1601751.

[10] Zou, S.-H. et al. (2021) 'Associations between dietary patterns and anaemia in 6- to 23-month-old infants in central South China', BMC Public Health, 21(1). doi: 10.1186/s12889-021-10699-8.

AUTHORS

First Author – Rhoda Ama Koranteng, Department of Nutrition and Dietetics, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.
Second Author – Dery Bede, Dietetics and Nutrition Unit, Effia Nkwanta Regional Hospital, Takorad, Ghana.
Third Author – Dr Charles Apprey, Department of Nutrition and Dietetics, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.