Research Article

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Relationship between Malnutrition and Anemia among In-Patient Children at Rahmah Teaching Hospital, Irbid-Northern Jordan

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1. Abstract

1.1. Introduction: Anemia and malnutrition are common health problems in developing countries with children being the most vulnerable. They have negative impacts on human performance, growth, and development, in children, both as causes and consequences of the disease, no study has been carried out to determine the prevalence of anemia and malnutrition among inpatients children. The aim of this study was therefore designed to determine the prevalence of anemia and malnutrition among an inpatient aged 3-14 years admitted to Rahmeh Pediatric Teaching Hospital – Irbid – Jordan.

1.2. Methods: A cross-sectional study on malnutrition and anemia prevalence among inpatient pediatric children aged 3-14 years old admitted to Rahmeh Pediatric Teaching Hospital – Irbid - Jordan. A sample of 117 children was included in this study. All patients were free of serious diseases (including serious diseases of the heart and brain, digestive system and urinary system, and serious infective diseases) or congenital malformations. any child who has any type of disabilities, congenital abnormality, twins, inherited blood disorders (such as thalassemia and sickle cell anemia), and unknown birth weight or received micronutrient supplement therapy in the last 2 months was excluded. Body weight and height were measured using an electronic weighing scale and stadiometer respectively.

1.3. Anthropometric indices: Height-for-Age Z scores (HAZ), Weight-for-Age Z scores (WAZ), and Body Mass Index-for-Age Z scores (BMIAZ) were analyzed and compared with WHO Growth Reference Standards using WHO Anthroplus software. Hemoglobin levels were determined using Urit-12 Haemoglobinometer and anemia was defined as Hemoglobin (Hb) < 11.5g/dl. Data analysis was done using the SPSS software.

1.4. Results: The overall prevalence of acute malnutrition was 24.7% distributed as mild and moderate acute malnutrition at 16.2% and 8.5 % respectively with mean ± SD of WAZ (- 0.50 ± 1.04), while the overall prevalence of chronic malnutrition compared with the WHO reference values, based on Height-for-age Z-score (HAZ) was 25.7%, distributed as mild and severe chronic malnutrition at 23.1%, and 2.6% respectively with mean± SD of HAZ -0.11 ± 0.78). The overall prevalence of anemia (Hb < 11.5g/dl) was (43.6%) and Hb levels were analyzed by gender, it was observed that females had a significantly higher prevalence of anemia (55.8%) than male children (33.8%), (P=0.01) figure 1. Out of the 51 anemic children, the prevalence of severe anemia (Hb ≤ 7 g/dl) was found to be 1.7% (95% CI = 0 - 0.74), mild anemia (Hb 7.0 - 9.9 g/dl) was 11.9% (95% CI = 0.63 - 3.37) and moderate anemia (Hb 10.0 - 10.9g/dl) was 13.7% (95% CI = 1.15 - 4.35). Hemoglobin levels were analyzed by birth weight, exclusive breastfeeding, and mother education level. It was observed that low birth weight children had a higher prevalence of anemia (44.6%) than normal birth weight children (42.6%) as well as exclusively breastfeeding and mother education level. These observations were statistically not significant (P > 0.05) Table 1. Children aged between 3-9 years of age had a significantly higher prevalence of anemia (41.9%) than those aged > 9 years (3.4%), P <0.05).

1.5. Conclusion: Based on the findings of this study, the prevalence of anemia in the studied patients was (43.6%), the prevalence of malnutrition was 24.7%, and 25.7% for acute and chronic malnutrition respectively. The risk factors associated with the development of anemia were parents' birth weight, breastfeeding practices, occupation, and family income. Risk factors for malnutrition were age, BMI, and family income.

2. Key words:
Malnutrition, Anemia, Hemoglobin, Acute, Chronic

3. Introduction

Malnutrition refers to imbalances, deficiencies, or excess in a person's intake of energy and/or nutrients according to theWorld Health Organization (WHO) [1], which may take the form of either undernutrition or obesity and it is measured by indicators of such effects, stunting, being underweight, or obesity [2]. Several side effects of malnutrition were documented including clinical side effects such as impaired muscle function, decreased bone mass, anemia, decrease cognitive function, immune dysfunction, poor and delayed wound healing, delay of post-surgery recovery, and non-clinical side effect such as increased hospital length of stay, increased hospital readmission rate, and increase mortality rate [3]. Dying from common infections increases the frequency and severity of such infections, delays recovery [4], and impaired child development [5] may be caused by undernutrition. Among children as reported by United Nations Children's Fund (UNICEF) in 2022. Anemia is characterized by a low level of hemoglobin in the blood. is one of the major public health problems affecting people in both developed and developing countries, particularly young children and pregnant women (6-8), and contributing to about one million deaths each year worldwide [9]. Anemia may occur at all stages of life; however, young children and women of childbearing age are the most vulnerable [10,11]. In 2019, global anemia prevalence was estimated to be 39.8% (95% UI 36.0%, 43.8%) in children aged 6-59 months, and about 269 million children with anemia.

The prevalence of anemia in children under five years was the highest in Africa and was estimated to be 60.2% (95% UI 56.6%, 63.7%) [12]. Negative impacts on human performance, impaired growth, and development, especially in children were reported as a result of malnutrition. mortality in children in developing countries, especially during the first five years of life mainly caused by malnutrition [13]. about 9 million children below 5 years old die annually [14] and 50% of deaths in children are caused by malnutrition [15]. infants and young children are the most vulnerable because of their high nutritional requirements for growth and development [16]. in rural populations, anemia and malnutrition are caused by several factors including epidemiologic socioeconomic, and parasite infections [17]. anemia and nutritional deficiency have been shown to be associated with Poor personal hygiene [18].

The most common causes of low school enrolment, early dropout, high absenteeism, and unsatisfactory classroom performance in primary school-age children are their miserable nutritional status [19]. slow cognitive development with serious health impairments later in life that reduces the quality of life of individuals happened because of chronic undernutrition in childhood, so Nutritional status is an important index of this quality through assessing health and nutritional condition in children [15]. underweight, stunting, and wasting are the most classifications of malnutrition in children [19, 20]. Chronic malnutrition in children is defined as low Height-for-Age (Stunting), which is usually associated with poor sanitation, and interactive effects of poor energy, nutrient intake, and infection it reflects inadequate nutrition over a long period of time and is affected by recurrent and chronic illness [21]. Acute malnutrition is defined as low Weight-for-Height or low BMI for age for children (Wasting). Generally, it is associated with recent illness, weight loss, or a failure to gain weight [13]. overweight or obese children can be classified by using the weight-for-height indicator [6].

It indicates a history of poor health or nutritional deficiencies, including recurrent illness and/or starvation. A child can be under-weight for his/her age because the child is stunted, wasted, or both [21]. is not recommended to use the weight-for-age for assessment of growth beyond childhood (> 10 years of age) because of its inability to differentiate between relative height and body mass [22]. The nutritional status of children does not only reflect the socioeconomic status of the family and social well-being of the community but also the efficiency of the health care system and the influence of the surrounding environment. The nutritional status of school-age children is very important since the foundation of lifetime health and intellectual vitality is laid during that period [15]. Nutritional deficiencies particularly iron, folate, and vitamin B12 are the most common causes of anemia [23].

The risk for infant anemia is significantly increased with less low family income, crowded living conditions, and inappropriate complementary food introduction maternal education, particularly with low birth weight. anemic infants were reported to have significantly lower Serum concentrations of iron, zinc, and retinol (vitamin A) [24]. Iron deficiency shares 50% of all causes of anemia, and it is basically linked with poor dietary intake [25], serious implications for individuals and societies may result because of anemia and malnutrition among Children who have both short- and long-term malnutrition. SOME studies identified stunting and low body mass index (BMI) as one the risk factors for anemia in under-five children. According to recent evidence from national surveys and studies [26, 27], about 36% of under-five children are stunted (low height-for-age), 33% are underweight (low weight-for-age) and 14% are wasted (low weight-for-height). The high prevalence of anemia and malnutrition hints at a possible link between these two conditions. Thus, an intensive investigation is required to determine how and to what extent the nutritional status of children is associated with their anemia levels and whether the association is modified by other risk factors.

The findings of the study will be useful in providing new insights that may help design effective policies for reducing the burden of anemia as well as malnutrition in children. Additionally, the impact of COVID-19 has likely exacerbated these figures and could mean that 15% or 1.15 times more children were affected by the waste in 2020 than estimated before due to deteriorations in household wealth and disruptions to the availability and affordability of nutritious [28]. Early nutritional assessment and early intervention by healthcare providers may reduce malnutrition effects and implications decrease morbidity and mortality, as well as decrease healthcare costs [29]. Health education focusing on feeding practices and nutrition education could be a practical strategy for preventing anemia

and malnutrition in young children [8]. Despite making some progress, key drivers of malnutrition have been shown to persist especially among infants, young children, adolescents, and women [13]. In 2016 about 20% of child deaths are still related to malnutrition [30], especially in low-to-middle-income (LMIC) countries [14]. More than 232 million children around the world suffered from malnutrition last year. In 2021 203,400 admissions of malnourished children were to outpatient feeding programs and 82,000 severely malnourished children were admitted to inpatient feeding programs [31]. On other hand, the prevalence of anemia has gradually declined in high-income countries, but it is still a major public health problem in many low- and middle-income countries [32].

In 2010, The latest micronutrient survey in Jordan (a middle-income country in The Eastern Mediterranean Region (EMR)) found that 13.7% of preschool children were iron deficiency compared to 26.1% in 2002. In addition, the prevalence of anemia increased from 20% in 2002 to 32% in 2012 [33]. However, no recent studies were done about this subject, especially in Jordan and we will discuss it in the article. We conducted a cross-sectional study as the baseline survey to provide data to develop a policy-based approach for controlling children's anemia and malnutrition in the north of Jordan. The objectives of the study included: (1) Measuring the prevalence of anemia and malnutrition among children aged 3- 14 years old in Irbid city – north of Jordan (2) Detecting the socio-demographic, feeding practice risk factors and nutritional factors for these problems.

4. Method

4.1. Study Population And Design

A cross-sectional study on malnutrition and anemia prevalence among inpatient pediatric children aged 3-14 years old admitted to Rahmeh Pediatric Teaching Hospital – Irbid - Jordan. A sample of 117 children was included in this study. All patients were free of serious diseases (including serious diseases of the heart and brain, digestive system and urinary system, and serious infective diseases) or congenital malformations. any child who has any type of disabilities, congenital abnormality, twins, inherited blood disorders (such as thalassemia and sickle cell anemia), and unknown birth weight or received micronutrient supplement therapy in the last 2 months was excluded. The study protocol and informed consent procedure were approved by the ministry of health- Jordan (MOH/REC/2022/95). written Informed consent was obtained from each child's parents.

4.2. Data Collection And Blood Sampling

Data was collected by well-trained researchers through face-to-face interviews over 3 months period of 1st April – 14th July 2022, using a structured questionnaire that includes socio-demographic data: age, sex, place of residence, parent's education level, and socioeconomic state. Furthermore, data about birth weight, admission weight, hemoglobin (Hgb) at admission, and last Hgb level were collected from the patient's medical record, using standardized methods described by the World Health Organization (WHO, 1995). The height and weight of each child were measured to determine their anthropometric indices. Weight was measured without shoes and with minimum clothing, using an electronic weighing scale to the nearest 0.1 kilograms (kg). Height was measured to the nearest 0.1 centimeters (cm) in bare feet with participants standing upright against a mounted stadiometer. Both measurements were recorded in the individual's questionnaire. [34]. Weight-for-age Z-score (WAZ), height-for-age Z-score (HAZ), and weight-for-height Z-score (WHZ) were calculated with the 2006 WHO Anthro and WHO Child Growth Standards (WHO, 2006). Malnutrition including underweight, stunting, and wasting was defined from WAZ, HAZ, and WHZ, respectively, as <2 standard deviations from the mean [35].

According to Waterlow JC, (1977) [36]. acute malnutrition is defined by % of ideal body weight as actual body weight/ideal body weight *100 and classified as 90-110 normal, 80-89 mild, 70-79 moderate, and < 70 severe malnutrition, while chronic malnutrition is defined by % of ideal body height as actual body height/ideal body Hight for age *100 and classified as>95 normal, 90-94 mild, 85-89 moderate and < 85 severe malnutrition. Weight-for-height (WFH) and body mass index (BMI) was calculated and evaluated according to age and gender data published in 2000 by the Centre for Disease Control (CDC) [37]. Percentages of weight-for-age (WFA), height-for-age (HFA), WFH, and BMI, were calculated. All the cases were evaluated according to the Waterlow and Gomez classification [38,39]. Anemia was defined as a Hb level < 11.5g/dl (Pasricha et al., 2014) [40]. and Hb concentrations < 7g/dl, 7.0 - 9.9g/dl, and 10.0 - 10.9g/dl are classified as severe anemia, moderate anemia, and mild anemia respectively [41].

5. Statistical Analyses

The statistical analyses of the study were made using Statistical Package for the Social Science for Windows (SPSS) v. 15.0 statistics program (SPSS Inc, Chicago, IL, USA, 2006). By calculating the mean and standard deviation values for the distribution of measurable variables, a comparison of the grouped data with defined numbers was made with the Chi-square test and a comparison of the mean values of the measurements of the independent two groups was made using the Mann–Whitney U test. A value of $p < 0.05$ was considered statistically significant.

6. Results

6.1. Socio-Demographic Characteristics Of The Study Participants

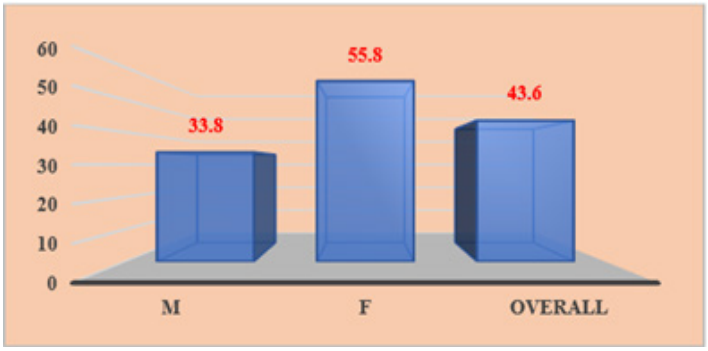
One hundred and seventeen children aged between 3 and 14 years, admitted as inpatients at Rahma teaching hospital – Irbid – Jordan were included in this study. Most of the study participants, 50.7% were aged between 3-9 years and 11.9% > 9 years. The median age of the study population was 7 years, with an age range between 3-14 years. 65 (55.6%) and 52(44.4%) were males and females respectively. The majority (83.7%) of the mothers

were educated, (secondary or graduate level). Two-thirds (62.4%) of them have no history of anemia and (60.7%) were exclusively breastfed for at least 6 months. (94%) were with normal birth weight and only (6%) were low birth weight LBW (table 1).

6.2. Prevalence Of Anemia

The median hemoglobin Hb level in the study was 11.4g/dl, while the minimum and maximum Hb levels recorded were 7.0 g/dl and 14.9g/dl respectively. The overall prevalence of anemia (Hb < 11.5g/dl) was (43.6%) and Hb levels were analyzed by gender, it was observed that female had significantly higher prevalence of anemia (55.8%) than male children (33.8%), (P=0.01) figure 1.

Figure 1: Overall prevalence of anemia and by gender

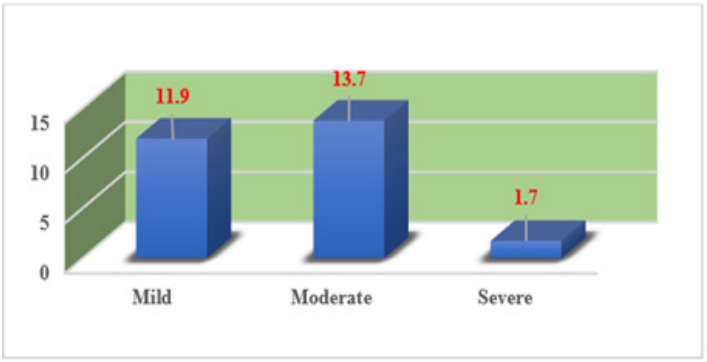


Out of the 51 anemic children, the prevalence's of severe anemia (Hb ≤ 7 g/dl) was found to be 1.7% (95% CI = 0 - 0.74), mild anemia (Hb 7.0 - 9.9 g/dl) was 11.9% (95% CI = 0.63 - 3.37) and moderate anemia (Hb 10.0 - 10.9g/dl) was 13.7% (95% CI = 1.15 - 4.35) figure2 . Hemoglobin level were analyzed by birth weight, exclusive breast feeding and mother education level. It was observed that low birth weight children had a higher prevalence of anemia (44.6%) than normal birth weight children (42.6%) as well exclusively breast feeding and mother education level. These observations were statistically not significant (P > 0.05) Table 1. Children aged between 3-9 years of age had a significantly higher prevalence of anemia (41.9%) than those aged > 9 years (3.4%), P <0.05).

Table 1: Socio-demographic characteristics of participants

variable	(n)	(%)
Sex		
M	65	55.6
F	52	44.4
Mother education		
Illiterate	3	2.6
< secondary	16	13.7
Secondary	50	42.7
Graduate	48	41.0
History of anemia		
Yes	44	37.6
No	73	62.4
Exclusive breast milk		
Yes	71	60.7
No	46	39.3
Birth weight		
LBW	7	6.0
Normal	110	94.0
Anemic status		
Anemic	51	43.6
Non- anemic	66	56.4

Figure 2: Categories of anemia



6.3. Prevalence of Malnutrition

The overall prevalence of acute malnutrition in the study population compared with the WHO reference values, based on Weight-for-age Z-score (WAZ) was 24.7%, distributed as mild and moderate acute malnutrition at 16.2% and 8.5 % respectively with mean ± SD of WAZ (- 0.50 ± 1.04), while the overall prevalence of chronic malnutrition compared with the WHO reference values, based on Height-for-age Z-score (HAZ) was 25.7%, distributed as mild and severe chronic malnutrition at 23.1%, and 2.6% respectively with mean± SD of HAZ -0.11 ± 0.78),. figure 3a&3b.

Figure 3a: overall Prevalence of acute and chronic malnutrition

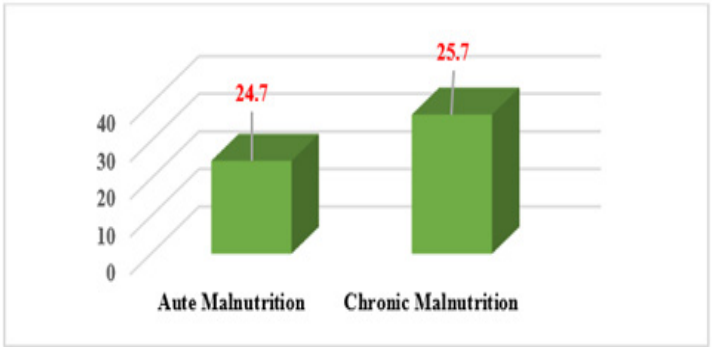


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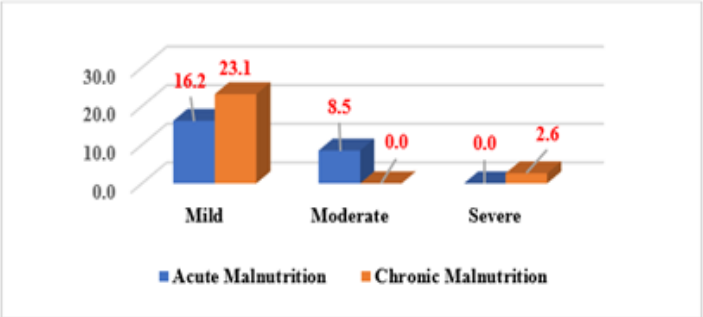
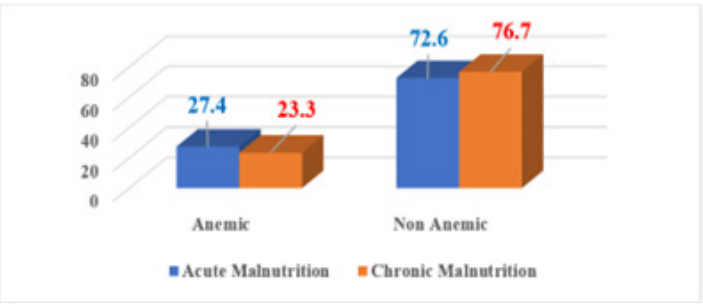
Figure 3b: Prevalence and severity of acute and chronic malnutrition



The overall acute malnutrition status was analyzed with respect to gender and it found that acute and chronic malnutrition was more but not significant among males 14.5% and 13.7% than among females 10.2% and 11.9% respectively. It was observed that most of the malnourished children were amongst the age group 3- 9 years (86.6%) with just (13.4%) of malnourished children in the age group >9 years. A statistically significant difference was observed in the prevalence of malnutrition between the age groups ($\chi 2 = 19.45$, $P = 0.00$).

Fourteen patients among 51 infants with anemia, were suffered from acute malnutrition with prevalence rates 27.5%, while twelve patients among the anemics were suffered from chronic malnutrition with prevalence rates 23.5%

Figure 4: Relationship between anemia and malnutrition



7. Discussion

Our study indicated an anemia prevalence of (43.6%) which is similar to the prevalence obtained in Muyuka, Cameroon 44.8% in children aged 10 years and below [42] and in South West Cameroon. 44.2% [43], however, several studies have reported high prevalence rates of anemia such as: 71.5% at a baseline study in children 6 months to 10 years living in Mutengene, South West Region of Cameroon [44], It is known that females tend to be more anemic than males as a result of physiological differences and this was observed in this study. Our study indicated there was significant difference in the prevalence of anemia between males (33.8%) and females (55.8%) $p< 0.05$ and this is consistent with the findings of Anticona and San Sebastian (2014) (45), 45.5% –56.3% in males and females aged 0-17 years respectively, and with Monge-Rojas et al.46 (2005) findings 46.5% in males and 67.2% in females aged 10- 16 years. The overall prevalence of acute malnutrition was 24.7%, % and chronic malnutrition 25.7%, which is almost similar to the findings of Sumbele and colleagues, who found a prevalence of 22.8% in children in Muea [47]. Stunting was the most common type of malnutrition found in this study which is consistent with the findings of Sumbele et al. [47] and Nkuo Akenji et al. who found stunting to be more common than underweight and wasting, likely reflecting the low socio-economic status of the patients [48]. The overall acute malnutrition status was analyzed with respect to gender and it found that acute and chronic malnutrition was more but not significant among males 14.5% and 13.7% than among females 10.2% and 11.9% respectively, these results which are consistent with previous report by Munisi and colleagues [49].

8. Conclusion

Based on the findings of this study, we therefore conclude as follows; the prevalence of anemia in the studied patients was (43.6%), prevalence of acute and chronic malnutrition was 24.7%, and 25.7% respectively. The risk factors associated with the development of anemia were birth weight, breastfeeding practices, and family income. Risk factors for malnutrition were age, BMI, and family income. The strengths of the study: this study had a representation of the Health Areas Northern district of Jordan with a large sample size; all the 117 study participants had complete anthropometric measurements. The weaknesses of the study: other factors associated with the occurrence of anemia such as iron deficiency, micronutrient deficiencies, and hemoglobinopathy were not measured and taken into consideration. Despite limitations, the study provides data on the current prevalence of anemia and malnutrition which forms a basis for the evaluation of the control program and highlights the need for further research and interventions to improve the studied indicators; this study establishes the fact that there is need for evaluations of micronutrient supplementation strategies.

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