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Original Paper

Assessment of Malaria, Anemia and Nutrition status of school-going children in the rural area of Charsadda, Pakistan

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***Abstract*— Malaria, anemia, and malnutrition are global health challenges with significant morbidity and mortality, and higher rates among children particularly in Africa. This study evaluated the prevalence and risk factors of malaria infection, anemia, and malnutrition among school-going children of Charsadda (a city of Khyber, Pakistan). A total of 400 children of aged 5-10 years were included in the study in 2023. Malaria infection was confirmed by rapid diagnostic tests. Hematocrit level was obtained using a centrifuge microhematocrit and converted to hemoglobin using standard conversion. Nutritional status was determined by the anthropometric measurements, and demographic characteristics were obtained by questionnaire. Anemia and malnutrition were defined according to the World Health Organization standards. Logistic regression analysis was used to determine association between the predictor variables and primary outcomes. In current research work 400 children were selected for the assessment of malaria and nutritional status, malaria infection was found more frequent among the students 120(12%). In addition, high prevalence of anemia 105(10.5%), malnutrition 90(9%), and stunting 70(7%) was observed, while wasting 2(0.2%) and underweight 20(2%0 had very low frequency. Malaria infection, anemia, and malnutrition were observed in12%, 10.5% and 9% of the children population, respectively. To the best of our knowledge, this is the first study showing the current health problems among the school-going children of district Charsadda the prevalence of malaria, anemia and malnutrition and their co-existence in children 5-10 years.**

Keywords*— *Anemia, Malaria, Malnutrition, Stunting, Underweight

I. INTRODUCTION

Rate of malaria infection declined from 22% (146 million individuals) in 2005 to 13% (114 million individuals) in 2015 in sub-Saharan Africa [1]. In Cameroon, malaria burden and transmission intensity are heterogeneous with spatial and temporal variations between altitudes and geographical areas, with varied prevalence rates from one area to another [2]. Like many sub-Saharan countries, prevalence of malaria has dropped in Cameroon by using insecticide-treated nets (ITN) in 2007 [3-6]. According to the follow-up study of Sumbele et al. [3], prevalence of malaria parasitemia dropped from 85.4% in 2006 to 36.6% in 2013 with a relative risk reduction of 57.2% in the Mount Cameroon area. Nevertheless, malaria still remains a major killer of children in this country and is estimated to take the life of a child every two minutes [1].

Malaria, anemia, and undernutrition are associated with morbidity and mortality, with higher rates among children, particularly in sub-Saharan Africa [7-9]. Anemia is defined as a condition in which the oxygen-carrying capacity of red blood cells is insufficient to meet the body's physiologic needs due to low blood hemoglobin concentration [7]. This condition affects individuals and has significant adverse health consequences, as well as adverse impacts on social and economic development [10].

Childhood anemia is considered a severe public health problem in Sub-Saharan Africa (62.5%) and in particular Cameroon, where a prevalence of 63.2% was reported in 2011 [1]. Malaria causes a substantial proportion of anemia in malaria-endemic settings [11-13]. Notwithstanding, updating the role of malaria parasitemia in anemia prevalence when

coverage of insecticide-treated nets is above 75% in Cameroon [14], will help the National Malaria Control Programs to plan proper management strategies by considering the heterogeneities in different localities. However, association of anemia burden with malaria, relative to other causes such as malnutrition, and its variation across different altitudes of Cameroon has not been established. On the other hand, nutritional status is closely associated with immune response to the infections, is an important determinant of risk and prognosis of infectious diseases and is directly influenced by the infections [15]. Nonetheless, association of malnutrition with malaria has been contradictory. Sumbele et al. [16] reported that malnutrition is associated with a higher risk of Plasmodium infection, and infectious episodes contribute to deterioration of nutritional status. In contrast, some studies found no association between nutrition and subsequent mortality from malaria [9,17]. In agreement, malnutrition and Plasmodium falciparum malaria frequently co-exist in Sahelian countries and are accounted for a large part of under-five morbidity and mortality during their concomitant peak seasons [18]. Based on the report of the United Nations Children's Fund in 2013, 38% of children below the age of 5 years suffer from chronic malnutrition or stunting in sub-Saharan Africa. Unfortunately, malaria and undernutrition are two major causes of childhood mortality in the region [19]. Anemia has also been reported as a significant determinant of stunting [20], which is the main type of malnutrition in young children [21]. Stunting is associated with impaired cognitive development, reduced academic achievement, and decreased physical work capacity in adulthood, with a financial burden on societies [22]. While the global stunting prevalence fell from 39.6 to 23.8% between 1990 and 2014, scenario is quite different in Africa, where an increasing trend is observed [23]. Nevertheless, prevalence of stunting fell from 49.9% [24] to 17.1% [21] in some localities in the Mount Cameroon area.

Impact of nutritional status on malaria may differ due to the heterogeneity of populations, species of the parasite, and other factors involved in the host and parasite relationship. This study aimed at determining the prevalence and intensity of malaria parasitemia, anemia, and malnutrition as well as identifying the risk factors for these public health concerns among children living in Charsadda (a city of Khyber, Pakistan). Anemia and malnutrition were defined according to the World Health Organization standards. Logistic regression analysis was used to determine associations between the predictor variables and primary outcomes.

II. Materials And Methods

This observational cross-sectional study was conducted in Charsadda city from April to September 2023. It was approved by ethical committee of the Takht Bhai Institute of Health and Management Sciences and the Takht Bhai THQ Hospital (Pakistan). Informed consent was obtained from the teachers and participants. Verbal consent was obtained from the parent/caregivers after explaining the purpose, risks, and benefits of the study. Sample size was determined by a single population formula. Accordingly, 400 students of aged 5-10 years were selected from the Govt schools. Demographic information together with weight and height of the children were obtained by a questionnaire (Table 1), and plotted to gender specific, growth charts. School Health Program was carried out on a systematic basis in the Rural Block. Ages of the children were determined using school records. For nutritional status assessment, weight was measured by a floor type weighing scale, height was taken using a measuring tape applied to the wall from their back of heels to the head touching the wall. Malaria infection was confirmed by rapid diagnostic tests. The hematocrit level was obtained using a centrifuge microhematocrit and converted to hemoglobin using standard conversion. Nutritional status was determined from the anthropometric measurements collected. Anemia and malnutrition were defined according to the World Health Organization standards.

TABLE 1. INDICATORS AND CUTOFFS FOR ASSESSMENT OF MALNUTRITION IN THE SCHOOL-GOING CHILDREN

Demographic information	**General information**	**Dietary Habits**
Name: Age: Gender: Grade/Class: School Name: **Anthropometric Measurements** Height (cm): Weight (kg): BMI (Body Mass Index):	Do you have breakfast every day before going to school? (Yes/No) How many meals do you typically eat a day? Do you eat fruits and vegetables daily? (Yes/No) How often do you consume fast food? (Yes/No)	What is your favorite healthy food? How often do you drink water a day? o Less than 3 glasses o 3-5 glasses o 6-8 glasses o More than 8 glasses Are you aware of the importance of a balanced diet? (Yes/No) Do you receive any nutrition education at school? (Yes/No)

III. Results And Discussion

In current research work 400 children were selected for the assessment of malaria and nutritional status, malaria infection was found more frequent among the students 120(12%). In addition, high prevalence of anemia 105(10.5%), malnutrition 90(9%), and stunting 70(7%) was observed, while wasting 2(0.2%) and underweight 20(2%0 had very low frequency. Malaria infection, anemia, and malnutrition were observed in12%, 10.5% and 9% of the school aged children correspondingly (Figure 1).

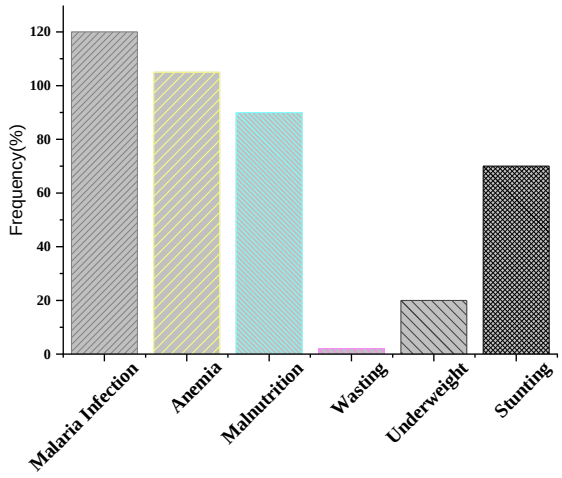

Fig. 1. Clinical characteristics of the study population

In age wise incidence of Malaria the lower age group were more infect by Malaria as compare to higher age group students 6.5% and 5.5% respectively (Table.1). While gender wise incidence of Malaria shows that the more boys were infected by Malaria as compare to girls. Boys 70(7%) and girls 50(5%) Table.3.

TABLE 2. Malaria infection prevalence with respect to sex and age

Parameter	Number	Prevalence (%)
Age		
0-5	65	6.5%
6-10	55	5.5%
Sex		
Girls	50	5%
Boys	70	7%

Overall assessment of nutritional status was found more frequent, malnutrition 90(9%), and stunting 70(7%) was observed, while wasting 2(0.2%) and underweight 20(2%) had very low frequency. malnutrition were observed in 12%, 10.5% and 9% of the school-going children respectively (Figure 2).

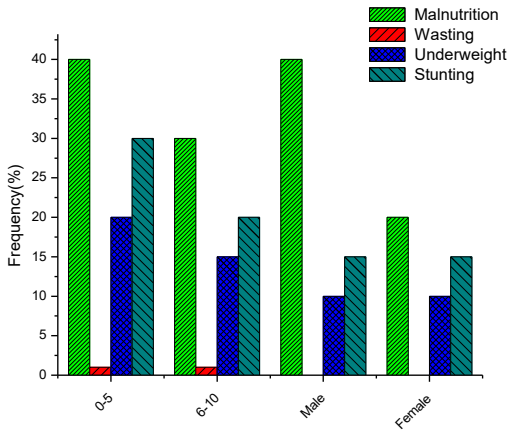

Fig. 2. over all frequency of Malnutrition, wasting, underweight and stunting

TABLE 3. Food frequency questionnaires for assessment of nutrition status of school going children

Food frequency questionnaire for Nutrition status of school-going children in the rural area of Charsadda, Pakistan				
food frequency questionnaire (ffq)				
MEAL TIMINGS				
Do You Take	Always	Sometimes	Rarely	Never
Pre-Breakfast	50	50	140	160
Breakfast	30	70	100	200
Brunch	10	30	60	300
Lunch	200	160	30	10
Tea time	150	100	110	40
Dinner	220	80	60	40
Post Dinner	50	100	150	100
FOOD RESPONSE AND REACTIONS				
Cravings		Aversions		Unsuitability
300		60		40
WATER INTAKE (1Glass=250ml)				

In the current research work a total of 400 samples were isolated from school-going children The samples collected from male and females students of age 5-10 years. Among the all samples malarial infection were found more frequent (120), leading by Anemia (105), similarly malnutrition also with high prevalence rate(90) while wasting and underweight with very low frequency of (2) and (20) respectively, stunting were also having frequency of (70). Out of 1000 children the number of male was slightly higher than females.

More males were malnourished (43.6%), underweight (18.1%) and stunted (42.6%) when compared with females (39.7%), (7.1%) and (37.2%) respectively though the difference was not significant in malnutrition and stunting. The difference in prevalence of underweight among the sexes was significant (P = 0.025) with the males having a higher prevalence. Bivariate analysis revealed children of the 0–5 years age group (P b 0.001) were significantly at odds of being malnourished "Table 6". Anaemia has also been reported as a significant determinant of stunting [20], which is the main type of malnutrition in young children [21].Stunting is associated with impaired cognitive development, reduced academic achievement, and decreased physical work capacity in adulthood, with a negative cost on the economic development of societies [22]. While the global stunting prevalence fell from 39.6 to 23.8% between 1990 and 2014, the scenario is quite different in Africa, with an increase [23]. Nevertheless, in some localities in the Mount Cameroon area, the prevalence of stunting fell from 49.9% [24] to 17.1% [21]. The impact of nutritional status on malaria may differ due to the heterogeneity of the population under study, species of the parasite, and other factors involved in the host and parasite relationship.The study aimed at determining the prevalence and intensity of malaria parasitaemia, anaemia and malnutrition as well as identifying the risk factors for these public health concerns among children living in low versus high altitude settings in the Mount Cameroon area.

IV. Conclusions

The available data show that malnutrition is a public health problem among the school-going children of the local area of District Charsadda, Pakistan. However, the available data, on micronutrient status, are limited. These findings highlight the need for nutrition involvements in school-going children and more high-quality research to assess nutritional status in this age group.The findings of the study revealed that slightly above one third (30%) school going of the local area of Charsadda were thin, underweight and malnutrated. Being male, were more effected than female students. Based on the finding; there must be collaboration among health sectors and education sectors of the city to address under nutrition problems of the City. The basic surveillance is that there is a limited study on the health problems of this population in District Charsadda. This research work however provides data for further studies and advance on public health among school-going children.

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Declaration of Competing Interest

The authors declare that they have no competing interests.

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