Available online on 15.05.2023 at *http://ujpr.org*
Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)
Open access to Pharmaceutical Research

Volume 8, Issue 2, 2023

RESEARCH ARTICLE

PREVALENCE OF INTESTINAL PARASITES, MALNUTRITION, ANEMIA AND THEIR RISK FACTORS AMONG ORPHANED CHILDREN IN SANA'A CITY, YEMEN

Ali Ahmed Al-Halani[1], Wadhah Hassan Edrees[2,3,4,5], Lutf Mohammed Alrahabi[6], Jameela Mohemmed Thabit[4], Sawsan Muktar Al-Bahlouli[4], Fatima Ali Alwashali[4], Raghda Mohammed Al-Qhali[4], Maria Mohammed Morshed[4], Anood Sultan Al-Hossainy[4], Eman Abdulnaser Al-Maflhi[4], Nahed Hussein Al-Sufi[4]

[1]*Department of Biology, Faculty of Education and Applied Sciences, Hajjah University, Yemen*
[2]*Medical Microbiology Department, Faculty of Applied Sciences, Hajjah University, Yemen.*
[3]*Medical Laboratory Department, Faculty of Medical Sciences, Al-Razi University, Yemen.*
[4]*Medical Laboratory Department, Faculty of Medical Sciences, Queen Arwa University, Yemen.*
[5]*Yemen Foundation for Research and Health Development, Food and Drug Researches & Studies Center, Yemen.*
[6]*Dental Department, Faculty of Medical Sciences, Queen Arwa University, Yemen.*

ABSTRACT

Background: Intestinal parasites infection, malnutrition, and anemia are endemic among children living inpoor and developing low-income countries, particularly Yemen.

Aims: The current study aims to determine the prevalence of intestinal parasites, malnutrition, and anemia and their risk factors among orphaned children in Sana'a city, Yemen.

Methods: A cross-sectional study was conducted in the orphanage between September 2022 and February 2023. One hundred and ninety-five (195) stool and blood samples were collected from orphan children aged 7-15 years. Intestinal parasites were examined using the formal ether concentration technique and hemoglobin was assessed using a Sysmex hematology analyzer.

Result: Out of 195 specimens, 77(39.49%) were positive for parasite infection. The high rate of infections was among subjects aged between 10-12 years (43.9%), at primary schools (42.9%), didn't have a history of parasite infection (48.9%), between 102-118 cms in height (48.6%), 11-30 kg in weight (49.4%), and underweight (40.1%) non-statistical differences ($p>0.05$). The most predominant parasite was *Entamoeba histolytica* (17.4%), followed by *Giardia lamblia* (10.3%), *Hymenolepis nana* (6.2%), *Ascaris lumbricoides* (3.6%), and *Enterobius vermicularis* (3.6%). The prevalence of anemia was 19% and statistically significant with parasitic infection ($p=0.000$) but not significantly to risk factors ($p>0.05$).

Conclusion: There is a high prevalence of intestinal parasites, anemia and malnutrition among the participating children, and this affects their health and life. Therefore, the implementation of control and prevention programs including improvement of health status, regular deworming practices with medication, health education, provision of appropriate food, and iron supplementation is required to reduce the incidence of malnutrition and anemia associated with intestinal parasitic infection.

Keywords: Anemia, Children, Intestinal parasites, Malnutrition, Prevalence, Orphanage Sana'a, Yemen.

Article Info: Received 20 February 2023; Revised 16 March; Accepted 18 April 2023, Available online 15 May 2023

Cite this article-
Al-Halani AA, Edrees WH, Alrahabi LM, Thabit JM, Al-Bahlouli SM, Alwashali FA, Al-Qhali RM, Morshed MM, Al-Hossainy AS, Al-Maflhi EA, Al-Sufi NH. Prevalence of Intestinal Parasites, Malnutrition, Anemia and their Risk Factors among Orphaned Children in Sana'a City, Yemen. Universal Journal of Pharmaceutical Research 2022; 8(2):32-39.
DOI: *https://doi.org/10.22270/ujpr.v8i2.923*

Address for Correspondence:
Dr. Wadhah Hassan Edrees, Medical Microbiology Department, Faculty of Applied Sciences, Hajjah University, Yemen. Medical Laboratory Department, Faculty of Medical Sciences, Al-Razi University, Yemen. Medical Laboratory Department, Faculty of Medical Sciences, Queen Arwa University, Yemen.; Tel: +967-778555695; E-mail: *wadah.edrees@alraziuni.edu.ye, edress2020@gmail.com*

INTRODUCTION

Intestinal parasites are the commonest health concern in poor and limited resources countries and cause considerable morbidity and mortality internationally, particularly in children[1]. Parasite infections are endemic in developing nations due to limited economic resources, inadequate sanitation, living in overcrowded

conditions, lack-hygienic practices, low latrine availability, lack of safe water and food, low health awareness, and malnutrition as a consequence of poverty[2]. Internationally, approximately 1.5 billion people are infected by intestinal parasitic infections with a prevalence rate between 30– 60% in low-income countries and 2% in developed countries[3]. The commonest signs and symptoms associated with parasite infection are abdominal pain, nausea and vomiting, diarrhea, and loss of weight. The persistent infections among children can progress to serious complications such as malabsorption, indigestion, Iron-deficiency anemia, vitamin A deficiency, retardation of growth, loss of weight, deprived school performance, and other mental consequences[4].

Anemia is a serious health problem with highly prevails in poor and low-income countries. Nearly 50% of all types of anemia resulting from a deficiency of Iron and is almost responsible for a million deaths each year worldwide. Iron-deficiency anemia is ranked one of the top ten risk factors in the "top ten" risk factors causal the disease incidence globally. The prevalence rate of anemia was 43% in underdeveloped nations and 9% in industrialized countries. According to the World Health Organization estimation in 2019, it was reported that about 40% of younger children (aged 6–59 months) around the world were suffering from anemia, contrary to 48% in 2000. Also, the prevalence of anemia in the year 2019 among children aged 6–59 months exceeded 70% in 11 countries[5].

The consequences of anemia in children result in weakened immunity, increased vulnerability to diseases, intellectual disability, delay of physical development, poor eruditeness, and rising social disability and economic development of the country[6].

Yemen is ranked as one of the poorest low-income nations in the world and more than 79% of the population living below the national poverty line according to the UNDP report in 2019[7]. In addition, poor socioeconomic status, inadequate toilet facilities, poor personal hygiene, inadequate sanitation conditions, nutritional deficiency, and limited access to drinking water may be the commonest factors that contribute to the transmission of communicable diseases among the population, particularly children suffering from malnutrition that develop anemia diseases[8-13].

Also, the prevalence rates of anemia were ranging between 31.7-49% among children[14]. Therefore, the presented data are not enough. So, the present study is intended to determine the prevalence of intestinal parasites, malnutrition, and anemia and their risk factors among orphaned children in Sana'a city, Yemen.

MATERIALS AND METHODS

Study area and period

A cross-section study carried out an orphanage at Taiz Street which administratively belongs to Sana'a capital of Yemen. The present study was performed between September 2020 and February 2023.

Sample size

A total of hundred and ninety-five (195) stool and blood specimens were collected from orphans' children. The laboratory analysis was performed in the Department of Medical Laboratory, Queen Arwa University (QAU).

Data collection

A structured questionnaire was subjected to gather the needed data that includes socio-demographic (i.e., age, study level, number of children in the room, meal frequency/day, and history of parasite infection), and clinical signs and symptoms (i.e., fever, cough, muscles pain, diarrhea, and abdominal pain) were obtained.

Inclusion and exclusion criteria

The children who were residents in orphanage aged between 7-15 years, signed the informed consent, delivered specimens, and non-received any anti-parasitic drugs in the days before sampling were included. Conversely, children who refuse to sign the informed consent, sample collection, or had taken anti-parasitic drugs during the collection of data were excluded from this study.

Blood collection and hemoglobin assessment

About 5 mL of venous blood was sampled from each subject under aseptic procedures by vein puncture and transferred into a sterile tube. Hemoglobin concentration was measured by using a fully automated Hematology analyzer Sysmex KX (Sysmex Corporation, South Korea) at the hematology laboratory in the QAU. Anemia was classified according to WHO[15] parameters. The level of hemoglobin was set at <11 g/dL for children (aged <12 years), <12 g/dL for children (12-14 years), and <13 g/dL for male children (15 or 16 years).

Fecal collection and parasite detection

The fecal specimens were collected by using clean, dry, wide-mouthed, labeled, and screw-capped containers that were distributed to each participant after carefully describing the way of collection. The collected specimens were immediately transported to the parasitology lab. at QAU and processed by using the formol-ether concentration method. The parasite detection was screened under a compound microscope with 10× and 40× objectives[16].

Anthropometry measurement.

The anthropometric data including age, height in centimeters (cms) and weight of the participants in kilograms (Kg) enrolled in this study were obtained during the period of blood and stool specimens collection. Anthropometric measurements were converted into body mass index (BMI) using the growth reference according to WHO[17].

Nutritional status

The assessment of nutritional status of study subjects was assessed by counting their BMI. Calculation of BMI is done by dividing an individual weight (kg) by the square of his height (cms). The nutritional status is classified as underweight, normal weight, and overweight[17].

Ethical statement

Ethical clearance was permitted by the Ethics Committee of Queen Arwa University, Yemen, and an

agreement was also obtained from the administration of the orphanage through an official letter from the university. Before collecting the sample, the objectives and importance of this work were elucidated briefly to all orphaned children and administrative staff working in the orphanage building. Further, the study subjects were knowledgeable well that all gathered data will be only used for the study purpose.

Statistical analysis

The results were analyzed by using the SPSS version 22 (IBM Corp., USA). A descriptive analysis of obtained data was performed and the variables were presented in tables with frequencies and percentages. The association between intestinal parasitic infections and anemia and nutrition status was evaluated by using reporting odds ratio (OR) and its corresponding 95% confidence interval (CI). A *p*-value ($p<0.05$) was considered to be statistically significant.

Table 1: Socio-demographic characterizations of study subjected.

Variables	Categories	Examined	Rate (%)
Study level	7-11	83	42.6
	12-15	112	57.4
	Primary	126	64.6
	Preparatory	69	35.4
Number of children in the room	3-5	52	26.7
	6-8	40	20.5
	9-12	103	52.8
Meal frequency/day	≤3 times	189	96.9
	>3 times	6	3.1
History of parasite infection	Yes	150	76.9
	No	45	23.1

RESULTS

Socio-demographic characteristics

About 195 orphan children participated in the present study aged between 7-15 years with a mean age of 11.8 years. The majority of specimens were sampled from participants aged 12-15 years (57.4%), attending primary schools (64.6%), living in a room with a number of children between 9-12 individuals (52.8%), eating meals ≤3 times per day, and had a history of parasite infection as illustrated in Table 1.

Prevalence of intestinal parasites

Out of 195 orphan children samples, it was found that 77(39.49%) were infected by intestinal parasites while 118(60.51%) individuals were non-infected with intestinal parasites as shown in Figure 1.

Table 2: Prevalence of parasite infection concerning risk factors.

Variables	Categories	Examined No. (%)	Infected No. (%)	Non-infected No. (%)	*p*-value
Age (in years)	7-11	83(42.6)	34(40.9)	49(59.1)	0.718
	12-15	112(57.4)	43(38.4)	69(61.6)	
Study level	Primary	126 (64.6)	54 (42.9)	72 (57.1)	0.195
	Preparatory	69 (35.4)	23 (33.3)	46 (66.7)	
Number of children in the room	3-5	52 (26.7)	22 (42.3)	30 (57.7)	0.883
	6-8	40 (20.5)	12 (30.0)	28 (70.0)	
	9-12	103 (52.8)	43 (41.7)	60 (58.3)	
Meal frequency/day	≤3 times	189 (96.9)	74 (39.2)	115 (60.8)	0.595
	>3 times	6 (3.1)	3 (50.0)	3 (50.0)	
History of parasite infection	Yes	150 (76.9)	55 (36.7)	95 (63.3)	0.143
	No	45 (23.1)	22 (48.9)	23 (51.1)	
Anemia	Yes	37(19)	24(64.9)	13(35.1)	0.000
	No	185(81)	53(33.6)	105(66.5)	
Anthropometric measurements					
Height (cm)	102-118	37 (19)	18 (48.6)	19 (51.4)	0.187
	119-135	33 (16.9)	13 (39.4)	20 (60.6)	
	136-152	75 (38.5)	29 (38.7)	46 (61.3)	
	153-170	50 (25.6)	17 (34.0)	33 (66.0)	
Weight (kg)	21-30	85 (43.6)	42 (49.4)	43 (50.6)	0.143
	31-40	70 (35.9)	21 (30.0)	49 (70.0)	
	41-50	28 (14.4)	8 (28.6)	20 (71.4)	
	51-60	12 (6.2)	5 (33.3)	7 (72.7)	
Nutrition status	Underweight	142 (72.8)	57 (40.1)	85 (59.9)	0.587
	Normal weight	48 (24.6)	19 (39.6)	29 (60.4)	
	Overweight	5 (2.6)	1 (20.0)	4 (80.0)	

*Significant association ($p<0.05$)

Risk factors associated with intestinal parasitic infections

The highest rate of intestinal parasitic infections in this result was detected among orphaned children aged between 7-11 years old (42.9%) %), children who study at primary schools (42.9%), lived in room content between 3-5 individuals (42.3%), eat meals more than 3 times per day (50%), and didn't have a history of parasite infection (48.9%) with non-significant differences (p>0.05). Furthermore, the existing result found that the prevalence rate of anemia was 19% recorded among the participants and there were statistical differences between anemia and intestinal parasitic infection (p=0.000).

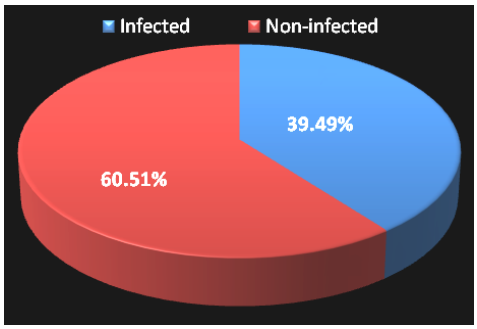

Figure 1: Prevalence rate of intestinal parasites among orphan children.

Additionally, the rate of parasite infections was significantly higher detected among participants between 102-118 cm in height at 48.6%, between 11-30 kg in weight (49.4%), and underweight (40.1%) non-statistical differences (p>0.05) as shown in the Table 2. In the present finding, the most predominant parasite was *E. histolytica* (17.4%) among study subjects followed by *G. lamblia* (10.3%), *H. nana* (6.2%), *A. lumbricoides* (3.6%), and *E. vermicularis* (3.6%) (Figure 2). In current result, it was showed that the study subjects who suffered from fever, cough, muscles pain, diarrhea, and abdominal pain had a higher rate of parasite infection with non-statistical differences (p>0.05) as summarized in Table 4.

Associations of risk factors with intestinal parasitic infections and anemia

This result revealed that the high risk of anemia was associated with meal frequency a day (OR=1.143; 95% CI=0.186-7.006) followed by study level (OR=0.803; 95% CI=0.447-1445). Also, anemia prevalence was not statistically associated with all risk factors (p>0.05) (Table 5).

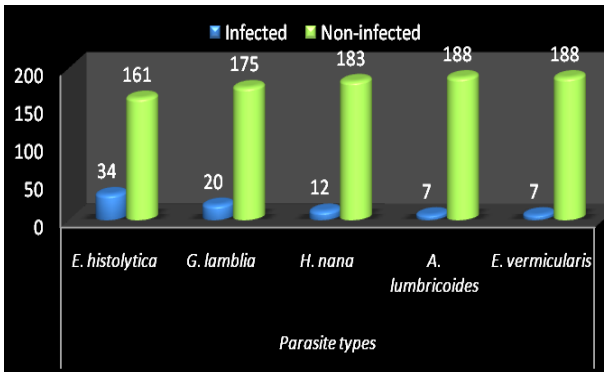

Figure 2: Type of intestinal parasitic infection among orphan children.

Table 3: Distribution of parasite infections concerning sociodemographic characterizations.

Variables	Categories	*E. histolytica*	*G. lamblia*	*H. nana*	*A. lumbricoides*	*E. vermicularis*	Total No. (%)
Age (in years)	7-11	16(19.3)	9(10.8)	3(3.6)	4(4.8)	3(3.6)	35(43.75)
	12-15	18(16.1)	11(9.8)	9(8)	3(2.7)	4(3.6)	45(56.25)
Study level	Primary	24(42.9)	15(26.8)	9(16.1)	4(7.1)	4(7.1)	56(70)
	Preparatory	10(21.7)	5(20.8)	3(12.5)	3(12.5)	3(12.5)	24(30)
Number of children in the room	3-5	10(23.5)	9(39.1)	1(4.3)	2(8.7)	1(4.3)	23(28.7)
	6-8	4(30.8)	1(7.7)	3(23)	4(30.8)	1(7.7)	13(16.3)
	9-12	20(45.5)	10(22.7)	8(18.2)	1(2.2)	5(11.4)	44(55)
Meal frequency/day	≤3 times	31(40.3)	20(25.9)	12(15.6)	7(9.1)	7(9.1)	77(96.3)
	>3 times	3(100)	0(0)	0(0)	0(0)	0(0)	3(3.7)
History of parasite infection	Yes	24(45.3)	14(26.4)	10(18.85)	6(11.3)	3(5.7)	54(71.3)
	No	10(23.5)	6(26.1)	2(8.7)	1(4.3)	4(17.4)	23(28.7)

Association between intestinal parasitic infections and anemia

Table 6 displays the association between parasite infections and anemia that infected by *H. nana*, *A. lumbricoides* and *E. histolytica* were associated with an increased risk of anemia with (OR=4.902, 95% CI=3.057-7.860), (OR=4.196, 95% CI=3.057-7.860), and (OR=3.229, 95% CI=1.878-5.552), respectively. Also, it was found that the associations between parasite infections with anemia were significant (p<0.05) except *E. vermicularis* (p>0.05).

DISCUSSION

The overall rate of parasite infection was 39.49% reported among orphan children. Current finding was in disagreement with the reports of an earlier investigation carried out in Yemen that reported the frequency rate of parasites infection was 61.85% in Sana'a[18], 51.26% in Taiz[19], 61.85% in Amran[20], 62.7% in Ibb[21], 73.25% in Hajjah[22], and 61.25% in Amran[11].

The variance in frequency rate may be attributed to variations in geographical locations, study population, sample size, hygienic conditions, socioeconomic status, food consumption behavioral differences, and

diagnostic methods employed by the participants. However, the orphanage center may be contributing to reducing prevalence of the parasitic infections by proved safe foods and water and resident adhering to strong policies in behavior. Regarding the age group, parasite infections were significantly detected among those aged between 7-11 years old (42.9%) compared to the age group of 12-15 years (38.4%) with non-significant differences (p=0.718). These results are reliable to findings conducted in Yemen[19,23-25].

It could be explained that younger children are more vulnerable to infectious disease sources as a result of their behaviors related to activities outdoors throughout the day. Poor environmental sanitation and lack of hygienic practices are often revealed as the main factors contributing to the increased prevalence of parasite infection among the study group. However, the children who study at primary schools had a higher rate of parasite infections compared to children who study at preparatory schools. Correspondingly, another local investigation conducted among children showed that the students who attended primary schools had a higher rate of pathogenic organisms[21,26]. Educational levels are crucial a significant factor that has been noticed in influencing parasitic infection[27].

Table 4: Prevalence of parasite infection concerning signs and symptoms.

Variables	Categories	Examined No. (%)	Infected No. (%)	Non-infected No. (%)	*p*-value
Fever	Yes	122 (62.6)	51 (41.8)	71 (58.2)	0.395
	No	73 (36.9)	26 (35.6)	47 (64.4)	
Cough	Yes	104 (53.3)	44 (42.3)	60 (57.7)	0.392
	No	91 (46.7)	33 (36.3)	58 (63.7)	
Muscles pain	Yes	107 (54.9)	44 (41.1)	63 (58.9)	0.609
	No	88 (45.1)	33 (37.5)	55 (62.5)	
Diarrhea	Yes	10.3 (52.8)	46 (44.7)	57 (55.3)	0.119
	No	92 (47.2)	31 (33.7)	61 (66.3)	
Abdominal pain	Yes	137 (70.3)	60 (43.8)	77 (56.2)	0.059
	No	58 (29.7)	17 (29.3)	41 (70.7)	

*Significant association (P<0.05)

In the present result, it was observed that participants who eat meals more than 3 times a day had a higher rate of parasite infections (50%). The report by Hailegebriel[28] revealed that the meal frequency (>3 times/day) was associated with parasite infection (OR=1.77; 95% CI: 1.03–3.05). The existing resultnoticed that a high rate of parasite infections prevailed among participants who didn't have a history of parasite infection (48.9%) with a non-significant difference (p>0.05).

Table 5: Associations of intestinal parasitic infections and anemia with risk factors.

Variables	Categories	Infected No. (%)	*p*-value	Anemia No n (%)	OR (95% CI)	*p*- value
Age (in years)	7-11	34(40.9)	0.718	71(85.5)	0.648 (0.346-1.213)	0.168
	12-15	43(38.4)		87(77.7)		
Study level	Primary	54 (42.9)	0.195	104(82.5)	0.803 (0.447-1445)	0.240
	Preparatory	23 (33.3)		54(78.3)		
Number of children in the room	3-5	22 (42.3)	0.883	39(75)	NA	0.226
	6-8	12 (30.0)		33(82.5)		
	9-12	43 (41.7)		86(83.5)		
Meal frequency/day	≤3 times	74 (39.2)	0.595	153(81)	1.143 (0.186-7.006)	0.884
	>3 times	3 (50.0)		5(83.3)		
History of parasite infection	Yes	55 (36.7)	0.143	126(84)	0.554 (0.308-0.996)	0.053
	No	22 (48.9)		32(71.1)		
Height (cm)	102-118	18 (48.6)	0.187	30(81.1)	NA	0.975
	119-135	13 (39.4)		25(75.8)		
	136-152	29 (38.7)		64(85.3)		
	153-170	17 (34.0)		39(78)		
Weight (kg)	21-30	42 (49.4)	0.143	65(76.5)	NA	0.335
	31-40	21 (30.0)		60(85.7)		
	41-50	8 (28.6)		23(82.1)		
	51-60	5 (33.3)		10(83.3)		
Nutrition status	Underweight	57 (40.1)	0.587	113(79.6)	NA	0.475
	Normal weight	19 (39.6)		41(85.4)		
	Overweight	1 (20.0)		4(80)		

*Significant association (p<0.05), OR =odds ratio, CI =confidence interval, NA = not applicable

Table 6: Association between intestinal parasitic infections and anemia among study subjects.

Parasite types	Result	Anemia		OR (95% CI)	*p*-value
		Yes n (%)	No n (%)		
E. histolytica	Positive	15 (44.1)	19 (22.9)	3.229 (1.878-5.552)	0.000
	Negative	22 (13.7)	139 (86.3)		
G. lamblia	Positive	8 (40)	12 (60)	2.414 (1.284-4.538)	0.011
	Negative	29 (16.6)	146 (83.4)		
H. nana	Positive	9 (75)	3 (25)	4.902 (3.057-7.860)	0.000
	Negative	28 (15.3)	155 (84.7)		
A. lumbricoides	Positive	5 (71.4)	2 (28.6)	4.196 (2.385-7.383)	0.000
	Negative	32 (17)	156 (83)		
E. vermicularis	Positive	0 (0)	7 (100)	1.245 (1.160-1.336)	0.194
	Negative	37 (19.7)	151 (80.3)		

*Significant association ($p<0.05$), OR=odds ratio, CI=confidence interval

Moreover, the prevalence rate of parasites infection was significantly more detected among participants between 102-118 cms in height at 48.6%, between 11-30 kg in weight (49.4%), and underweight (40.1%) non-statistical differences ($p>0.05$). In this study, the anthropometric result showed that the highest rate of parasite infection was observed between 102-118 cms in height and between 21-30 kg in weight with non-statistical difference ($p>0.05$). In relation to nutrition status, the underweight participants were found to be had the highest rate of parasite infections (40.1%) and non-statistical differences ($p=0.587$).

A similar result by Al-Haidari *et al.*,[14] showed that the frequency rate of wasting, stunting, and being underweight among children was 25%, 45.8%, and 27.3%, respectively. Another study by Degarege *et al*.,[29] revealed that among the 532 subjects infected with parasites, 15.5% were stunted, 26.8% were underweight, and 35.8% were undernourished. The increased risk of anemia and undernutrition in children infected with intestinal parasitic infection was well documented in some studies[29,31]. The present finding revealed that the most predominant parasite was *E. histolytica* (17.4%) among study subjects followed by *G. lamblia* (10.3%), *H. nana* (6.2%), *A. lumbricoides* (3.6%), and *E. vermicularis* (3.6%). This result is in agreement with several recently published studies. Recently, *E. histolytica*, *G. lamblia*, *H. nana*, *Taenia* species, and *A. lumbricoides* were reported among participating children in Sana'a[18]. Also, in Amran City, the highest rate among children was *E. histolytica* followed by *G. lamblia*, *H. nana*, *S. mansoni*, and *E. vermicularis*[21]. However, Qasem *et al.*,[21] found that the most intestinal parasites were *E. histolytica*, *G. lamblia*, *A. lumbricoides*, *H. nana*, and *E. vermicularis* reported among children in Ibb City. Furthermore, the majority of infected participants with intestinal parasites in this result were found to be suffered from fever, cough, muscle pain, diarrhea, and abdominal pain ($p>0.05$). This data is in accord with Al-Haddad and Baswaid[32] and Qasem *et al.*,[21] reported that abdominal pain, diarrhea, fever, cough, myalgia, vomiting, and loss of weight were the most signs and symptoms noticed among those infected by parasites. Conversely, the association between some clinical symptoms and intestinal parasitic infections was documented by Al-Fakih *et al.*,[25].

The existing study showed that 19% (37/195) of the participants had anemia and there were statistical differences between anemia and intestinal parasitic infection ($p=0.000$). This result is lower than recent reports that presented anemia among children was 37.8% in Hodeida[33], and 31.7% in Sana'a[14]. The prevalence of anemia in some centuries was 12.4% in Eritrea[34], 48.8% in Ethiopia[35], and 14% in Tanzania[36]. The prevalence rate of anemia was found to be at two times higher risk among age group of 11-15 years of subjects the aged 11–15 years compared to the younger age group[14]. The reason behind the high rate of anemia in Yemen may be accredited to some factors such as economic marginalization, poverty, household food insecurity, access to social protection, household-level environmental factors, and access to health care[37]. Also, there were significant associations of intestinal parasitic infections with anemia ($p<0.05$) except *E. vermicularis* ($p>0.0$ In this finding, the association between parasitic infections and anemia showed that the risk of anemia was increased among infected participants with *H. nana* (OR=4.902, 95% CI=3.057-7.860), *A. lumbricoides* (OR=4.196, 95% CI=3.057-7.860), and *E. histolytica* (OR=3.229, 95% CI=1.878-5.552). This result is inconsistent with some reports conducted in some countries[14,33].

Limitation of the study

The limitation of this work was examined of a single specimen of each subject. In addition, the long distance between the study area and the experimental lab, it was screened for cyst stag only and these are the factors that may be reducing the accuracy and validity of the results.

CONCLUSION

In conclusion, the prevalence of intestinal parasitic infection, anemia, and malnutrition is high among orphaned children and is a major concern for their health. Therefore, effective control and prevention strategies such as health education, nutritional education, environmental hygiene practices, pediatric treatment, regular deworming, iron supplementation, and wholesome food provision are important to reduce these problems.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

ACKNOWLEDGEMENTS

The authors would like to thank the general Manger of the Orphanage and all workers there for their invaluable help and coordination. Also, they would like to thank Dr. Gader, Dr. Tamaam Alsqaf, Dr. Ahmed Al-Muraisiand all members of staff of the medical laboratories at Queen Arwa University for their help in specimen analysis.

REFERENCES

1. Gholipoor Z, Khazan H, Azargashb E, *et al*. Prevalence and risk factors of intestinal parasite infections in Mazandaran Province, North of Iran. Clin Epidemiol Glob Health 2020; 8(1):17–20. *https://doi.org/10.1016/j.cegh.2019.03.010*
2. Sitotaw B, Mekuriaw H, Damtie D. Prevalence of intestinal parasitic infections and associated risk factors among Jawi primary school children, Jawi town, north-west Ethiopia. BMC Infect Dis 2019; 19(1):341. *https://doi.org/10.1186/s12879-019-3971-x*
3. World Health Organization WHO, Fact sheet, soil-transmitted helimnth infections, WHO, Geneva, Switzerland, 2019.
4. Paniker CKJ. Paniker's Textbook of medical parasitology. 8th ed. New Delhi: Jaypee Brothers Medical Publishers; 2018.
5. Stevens GA, Paciorek CJ, Flores-Urrutia MC, *et al*. National, regional, and global estimates of anaemia by severity in women and children for 2000–19: A pooled analysis of population-representative data. Lancet Glob Health 2022; 10: e627–39. *https://doi.org/10.1016/S2214-109X(22)00084-5*
6. Grantham-McGregor S, Ani C. A review of studies on the effect of iron deficiency on cognitive development in children. J Nutr 2001; 131(2):649–666. *https://doi.org/10.1093/jn/131.2.649S*
7. The United Nations Development Programme (UNDP). Prolonged conflict would make Yemen the poorest country in the world, UNDP study says. The United Nations Development Programme. September 26, 2019. *https://www.undp.org/press-releases/prolonged-conflict-would-make-yemen-poorest-country-world-undp-study-says*
8. Alhlale MF, Humaid A, Saleh AH, Alsweedi KS, Edrees WH. Effect of most common antibiotics against bacteria isolated from surgical wounds in Aden governorate hospitals, Yemen. Universal J Pharm Res 2020; 5(1): 21-24. *https://doi.org/10.22270/ujpr.v5i1.358*
9. Abdullah QY, Al-Helali MF, Al-Mahbashi A, Qaaed ST, Edrees WH. Seroprevalence of dengue fever virus among suspected patients in Taiz Governorate-Yemen. Universal J Pharm Res 2020; 5(5):21-26. *https://doi.org/10.22270/ujpr.v5i5.482*
10. Al-Mekhlafi AM, Abdul-Ghani R, Al-Eryani SM, Saif-Ali R, Mahdy MA. School-based prevalence of intestinal parasitic infections and associated risk factors in rural communities of Sana'a, Yemen. Acta Trop 2016; 163: 135-141. *https://doi.org/10.1016/j.actatropica.2016.08.009*
11. Alshahethi MA, Edrees WH, Mogalli NM, Al-Halani AA. Prevalence of *Entamoeba histolytica* among children attending healthcare centres at Amran governorate, Yemen. PSM Biol Res 2020; 5(3): 98-105.
12. Alshahethi MA, Edrees WH, Mogalli NM, Al-Halani AA, Al-Shehari WA, Reem A. Distribution and risk factors for *Giardia lamblia* among children at Amran governorate, Yemen. Universal J Pharm Res 2020; 5(3):34-37. *https://doi.org/10.22270/ujpr.v5i3.413*
13. Qasem EA, Al-Shehari WA, Al-Shamahy AH, *et al*. Occurrence and risk factors of Cryptosporidiumparvum among immunocompromised patients in Ibbcity-Yemen. J Med Pharm Sci 2022;6 (3):66-78. *https://doi.org/10.26389/AJSRP.S011121*
14. Al-Haidari SA, Mahdy MAK, Al-Mekhlafi AM, *et al*. Intestinal schistosomiasis among schoolchildren in Sana'a Governorate, Yemen: Prevalence, associated factors and its effect on nutritional status and anemia. PLoS Negl Trop Dis 2021; 15(9): e0009757. https://doi.org/10.1371/journal.pntd.0009757
15. World Health Organization WHO. Iron deficiency anaemia: Assessment, prevention and control, a guide for programme managers 2001; World Health Organization: Geneva, Switzerland, 2001.
16. Cheesbrough M. District laboratory practice in tropical countries part 1. Cambridge University Press, Cambridge. 2009.
17. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007; 85(9):660–667. *https://doi.org/10.2471/blt.07.043497*
18. Edrees WH, Al-Ofairi BA, Alsaifi AG, *et al*. Prevalence of intestinal parasitic infections among asymptomatic primary schoolchildren at Al-Sabeen district in Sana'a city, Yemen. PSM Biol Res 2022; 7(1): 34-45.
19. Alharazi T. Intestinal parasitic infection among rural schoolchildren in Taiz, Yemen: School-based Assessment of the prevalence and associated risk factors. Helminthologia. 2022; 17; 59(3):233-245. *https://doi.org/10.2478/helm-2022-0032*
20. Edrees WH, Alshahethi MA, Al-Awar MS. Factors associated with prevalence of intestinal parasitic infection among schoolchildren in Amran city, Yemen. Al-Razi Univ J Med Sci 2022; 6(2):1-10. *https://doi.org/10.51610/rujms6.2.2022.135*
21. Qasem EA, Edrees WH, Al-Shehari WA, Alshahethi MA. Frequency of intestinal parasitic infections among schoolchildren in Ibbcity-Yemen. Universal J Pharm Res 2020; 5(2):42-46. *https://doi.org/10.22270/ujpr.v5i2.388*
22. Mogalli NM, Edrees WH, Al-Awar MS, Alshahethi MA, Al-Shehari WA. Prevalence of intestinal parasitic infections among primary schoolchildren in Kohlan district at Hajjah governorate, Yemen. Al-RaziUniv J Med Sci 2020; 4 (2):34-39. *https://doi.org/10.51610/rujms4.2.2020.75*
23. Alsaifi AG, Alhadhri EG, Alansi ST, *et al*. Distribution and risk factors for intestinal parasitic infections among primary schoolchildren in Sana'a city, Yemen. Bachelor Thesis, Medical Laboratory, Queen Arwa University 2021:20-40.
24. Alharazi TH, Al-Mekhlafi HM, Al-Abd, N *et al*. A cross-sectional survey of the knowledge, attitudes and practices regarding schistosomiasis among rural schoolchildren in Taiz governorate, southwestern Yemen. Trans R Soc Trop Med Hyg 2021;115(6):687–698. *https://doi.org/10.3934/publichealth.2020059*
25. Al-Fakih AA, Al-Wrafi EA, Al-Motawkil AA, *et al*., Prevalence of Intestinal Parasitic Infections and Associated Risk Factors Among Schoolchildren in Ibb Governorate, Southwest Yemen: A Cross-Sectional Study. Pediatric Health Med Ther 2022; 19;13: 325-333. *https://doi.org/10.2147/PHMT.S374475*
26. Edrees WH, Alshahethi MA, Alariqi RR, *et al*. Detection of intestinal parasites of some fresh vegetables and their consumers in Sana'a City, Yemen. Al-Razi Univ J Med Sci 2021; 5 (2):19-25. *https://doi.org/10.51610/rujms5.2.2021.112*
27. Raghupathi V, Raghupathi W. The influence of education on health: An empirical assessment of OECD countries for the period 1995–2015. Arch Public Health 78, 20 (2020). *https://doi.org/10.1186/s13690-020-00402-5*
28. Hailegebriel, T. Undernutrition, intestinal parasitic infection and associated risk factors among selected primary school children in Bahir Dar, Ethiopia. BMC Infect Dis 2018; 18: 394. *https://doi.org/10.1186/s12879-018-3306-3*
29. Degarege A, Erko B, Negash Y, Animut A. Intestinal helminth infection, anemia, undernutrition and academic

performance among school children in Northwestern Ethiopia. Microorganisms 2022; 5;10(7):1353. *https://doi.org/10.3390/microorganisms10071353*

30. Alelign T, Degarege A, Erko B. Prevalence and factors associated with undernutrition and anaemia among school children in Durbete Town, northwest Ethiopia. Arch Public Health 2015, 73(1): 34. *https://doi.org/10.1186/s13690-015-0084-x*
31. Moncayo AL, Lovato R, Cooper PJ. Soil-transmitted helminth infections and nutritional status in Ecuador: Findings from anational survey and implications for control strategies. BMJ Open 2018; 8:e021319. *http://dx.doi.org/10.1136/bmjopen-2017-021319*
32. Baswaid S, AL-Haddad A. Parasitic infections among restaurant workers in Mukalla (Hadhramout/Yemen). Iranian J Parasitol 2008; 3(3): 37–41.
33. Al-Jermmy ASM, Idris SM, Coulibaly-Zerbo F, Nasreddine L, Al-Jawaldeh A. prevalence and correlates of anemia among adolescents living in Hodeida, Yemen. Children 2022; 9(7):977. *https://doi.org/10.3390/children9070977*
34. Kesete Y, Tesfahiwet H, Fessehaye G, *et al*., Assessment of prevalence and risk factors for intestinal parasitosis, malnutrition, and anemia among school children in Ghindae area, Eritrea. J Tropical Med 2020; Article ID 4230260. *https://doi.org/10.1155/2020/4230260*
35. Gujo AB, Kare AP. Prevalence of intestinal parasite infection and its association with anemia among children aged 6 to 59 months in Sidama national regional state, southern Ethiopia. Clin Med Insights Pediatr 2021; 2; 15. *https://doi.org/10.1177/11795565211029259*
36. Mrimi EC, Palmeirim MS, Minja EG, Long KZ, Keiser J. Malnutrition, anemia, micronutrient deficiency and parasitic infections among schoolchildren in rural Tanzania. PLoS Negl Trop Dis 2022; 16(3): e0010261. *https://doi.org/10.1371/journal.pntd.0010261*
37. World Health Organization. Global anaemia reduction efforts among women of reproductive age: impact, achievement of targets and the way forward for optimizing efforts; 9240012206; World Health Organization: Geneva, Switzerland, 2020.