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Prevalence of Intestinal Parasites Among Patients Attending A Tertiary Referral Hospital in Mogadishu, Somalia: A 6-year Retrospective Study

Somali, Mogadişu'daki Üçüncü Basamak Bir Hastaneye Başvuran Hastalarda İntestinal Parazitlerinin Prevalansı: 6 Yıllık Retrospektif Bir Çalışma

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ABSTRACT

Background: Parasitic intestinal infection is a neglected public health problem in developing countries, including Somalia. This study examined the prevalence of parasitic intestinal infections among patients who requested stool examination at University of Health Sciences Türkiye, Mogadishu Somalia Türkiye Recep Tayyip Erdoğan Training and Research Hospital.

Materials and Methods: We retrospectively reviewed the electronic medical records of patients who requested stool examination between January 2015 and December 2020. Stool samples were examined for the presence of parasites by direct wet smear using light microscopy.

Results: Seven percent (2738 of 37398) of patients tested for parasitic intestinal infections were positive for at least one species of intestinal parasite. *Giardia duodenalis* was the most prevalent parasite (3.85%), followed by *Entamoeba histolytica/dispar* (2.77%). Female patients had more episodes of parasitic intestinal infections than their male counterparts; however, no differences were found (p=0.31) between sex and parasitic infections. Compared with adults, children had significantly higher infection rates (p<0.001). Parasitic intestinal infections were significantly higher during the dry season than during the rainy season (p<0.001). Of the stool samples, double parasitic infections were detected in 2.26%.

Conclusions: A low prevalence of parasitic intestinal infections was observed among patients who attended a tertiary referral hospital in Mogadishu, Somalia. *Giardia duodenalis* was the most common intestinal parasite, followed by *Entamoeba histolytica/dispar*, while double parasite infections were also present. The introduction of effective community-based parasite control programs may help combat parasitic intestinal infections in the country.

Keywords: Parasitic intestinal infections, *Entamoeba histolytica/dispar*, *Giardia duodenalis*, seasonal variation, Somalia

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ÖZ

Amaç: Paraziter intestinal enfeksiyonları, Somali'nin de içinde bulunduğu gelişmekte olan ülkelerde ihmal edilen halk sağlığı sorunlarından biridir. Bu çalışma, Sağlık Bilimleri Üniversitesi, Mogadişu Somali Türkiye Recep Tayyip Erdoğan Eğitim ve Araştırma Hastanesi'nde dışkı muayenesi istenen hastalarda parazitik bağırsak enfeksiyonlarının prevalansını değerlendirmeyi amaçladı.

Gereç ve Yöntemler: Ocak 2015 ile Aralık 2020 arasında dışkı muayenesi talep edilen hastaların elektronik tıbbi kayıtları retrospektif olarak incelenmiştir. Dışkı örnekleri ışık mikroskobu kullanılarak doğrudan ıslak yayma ile parazit varlığı açısından incelendi.

Bulgular: Paraziter intestinal enfeksiyonları için test edilen hastaların %7'si (37398'in 2738'i) bağırsak parazitinin en az bir türü için pozitifti. *Giardia duodenalis* en yaygın parazitti (%3,85), ardından *Entamoeba histolytica/dispar* (%2,77) idi. Kadın hastalarda erkeklere göre daha fazla parazit intestinal enfeksiyon epizodu vardı, ancak cinsiyet ve paraziter enfeksiyonlar arasında fark bulunmamıştır (p=0,31). Yetişkinlerle karşılaştırıldığında, çocuklarda enfeksiyon oranları anlamlı olarak daha yüksekti (p<0,001). Paraziter bağırsak enfeksiyonları kurak mevsimde yağışlı mevsime göre önemli ölçüde daha yüksekti (p<0,001). Dışkı örneklerinin %2,26'sında çift parazit enfeksiyonu tespit edildi.

Sonuç: Somali, Mogadişu'daki bir üçüncü basamak hastaneye başvuran hastalar arasında düşük paraziter intestinal enfeksiyon prevalansı gözlenmiştir. *Giardia duodenalis* en sık görülen bağırsak parazitiydi, bunu *Entamoeba histolytica/dispar* izlemektedir ve ikili parazit enfeksiyonları da mevcuttu. Etkili toplum temelli parazit kontrol programlarının tanıtılması, ülkedeki parazitik intestinal enfeksiyonları ile mücadeleye yardımcı olabilir.

Anahtar Kelimeler: Parazitik barsak enfeksiyonları, *Entamoeba histolytica/dispar*, *Giardia duodenalis*, mevsimsel değişim, Somali

Introduction

Intestinal parasites are organisms that live in or feed on other organisms and reside in the human and animal gastrointestinal tract. Protozoa and/or helminths are the most prevalent parasites that cause intestinal illness (1). Intestinal parasites are common human parasitic infections, posing a global health threat that results in clinical morbidity and mortality (2). Enteric parasites infect 60% of the world's population, according to estimates, and this remains a major public health concern in both industrialized and developing nations (3).

According to the World Health Organization, over 3.5 billion individuals are infected with parasitic infections, and approximately 450 million individuals develop clinical illnesses (4). According to estimates, 895 million individuals are infected with soil-transmitted helminths, with *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms infecting 447 million, 290 million, and 229 million people, respectively (5). Furthermore, 200-500 million people in sub-Saharan African countries were infected with one or more of these intestinal parasite (6).

Parasitic infections mostly affect developing countries, including Somalia, because of their spreading through ingestion or skin penetration by infective forms. Previous studies have reported that it is linked to low socioeconomic status, low education level, lack of awareness of simple health promotion practices, poor hygiene, insufficient toilet facilities, contaminated food and water, hot and humid climate, and environmental and sociocultural factors (5,6,7).Intestinal parasites are one of the major causes of gastrointestinal disorders such as diarrhea, dysentery, and symptoms of vomiting, loss of appetite, hematuria, and abdominal distension, as well as other critical public health issues such as malnutrition, anemia, growth retardation, and physical and mental health issues (7).

In Somalia, epidemiological data on the spread and frequency of intestinal parasites with cutting-edge public health solutions among cases attended in tertiary hospitals, population groups, and the general community are lacking. Only a few studies were carried out in the country, especially before the civil war, which reported that the most common intestinal parasite was *Trichuris trichiura* (8,9,10,11). The country has gone through a devastated civil war, in which nearly the entire healthcare facilities as well as the basic water, sanitation, and hygiene facilities have been non-functioning. Under these conditions, intestinal parasite transmission is likely to thrive. However, limited data on the current status of parasitic infections are available among Somali people. Therefore, we evaluated the prevalence of parasitic intestinal infections among patients attending a tertiary referral hospital in Mogadishu, Somalia.

Materials and Methods

The research was conducted at the University of Health Sciences Türkiye, Mogadishu Somalia Türkiye Recep Tayyip Erdoğan Training and Research Hospital located in Mogadishu, Somalia, which encompasses an altitudinal range of 900 to 2100 meters and has coordinates of 10° 00' N, 49°00' E. Mogadishu is the most populous city in Somalia, with a population of 2,587,183 individuals, 46.8% of whom are urban residents. The city is characterized by an arid to semi-arid climate, with an average annual

minimum temperature of 27 °C (81 °F) and a maximum of 30 °C (86 °F) and an average precipitation of 430 mm per year. Located just north of the Equator on the Indian Ocean, a hot and dry climate prevails throughout the year, along with periodic monsoon winds, erratic rainfalls, droughts, and floods caused by the Shebelle River crossing the region. The population suffers from poor access to safe drinking water, basic sanitation, and hygiene and lives in poverty.

The current study was conducted at the University of Health Sciences Türkiye, Mogadishu Somalia Türkiye Recep Tayyip Erdoğan Training and Research Hospital, which is a tertiary referral center with a 200-bed capacity that caters to approximately 327,000 patients annually and covers all areas of medicine and surgery. The research was conducted in accordance with the ethical principles of the Declaration of Helsinki. The Research Ethics Committee of the University of Health Sciences Türkiye, Mogadishu Somalia Türkiye Recep Tayyip Erdoğan Training and Research Hospital approved the study on April 19, 2021, under the reference number MSTH/6089. Because of the retrospective study design, informed consent was waived, as per the ethics committee that authorized the study.

Demographic and laboratory data were obtained from the electronic medical records of the hospital. Data were subsequently double extracted using Microsoft Excel 365 to ensure consistency and minimize errors in the extracted information. Records completeness and adequacy were checked, and insufficient records were excluded. All patients who were examined for the presence of parasitic infections during a 6-year period from January 2015 to December 2020 were included in this study. All stool samples were collected in labeled, disposable, clean, dry, leak-proof, plastic containers. Each stool sample was processed by direct wet smear and examined under light microscopy (Olympus CX23, Olympus Corporation, Japan) in the parasitology department for the presence or absence of intestinal parasites. Examination of single stool specimen per person was requested by physicians. *G. duodenalis*, *G. intestinalis,* and *G. lamblia* are used interchangeably in referring to the *Giardia species*; therefore, for the purpose of consistency, *G. duodenalis* is used in this study.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test or Mann-Whitney U test after normality test using a one-sample Kolmogorov-Smirnov test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square (χ^2) test to verify the possible association between the prevalence of parasitic intestinal infections and variables such as age, sex, and season. Odds ratio, 95% confidence intervals (95% CI), and p-values were calculated, and the results were considered significant when $p<0.05$. The age of patients was stratified into groups of under-five (<5), 5-14, 15-40, 41-65, and >65 years for statistical analysis. The age range was also categorized into children (≤14 years old) and adults (>14 years). Somalia recognizes two rainy (Gu' and Deyr) and two dry (Jiilaal and Hagaa) seasons. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA).

Results

From 2015 to 2020, 46994 stool samples were requested for the diagnosis of intestinal parasites at the involved hospital. After removing 3764 duplicates and 5832 records with incomplete information, the remaining 37398 records were used for the subsequent results. The mean age of the patients was 23.42±21.17 with a statistical difference (U=46134073, Z=-2.42, p=0.02) between the mean age of patients with parasitic intestinal infections (21.98) and patients without parasitic intestinal infections (23.53).

Overall, 2738/37398 (7.32%, 95% CI=7.06-7.59%) patients were infected with at least one intestinal parasite. Among them, 1407/19569 (7.19%, 95% CI=6.83-7.56%) were males and 1331/17829 (7.47%, 95% CI=7.08-7.86%) were females, but the difference was not statistically significant (p=0.31). A total of 604/8755 (6.89%, 95% CI=6.38-7.45%) children under five years of age were positive for parasitic intestinal infections. Table 1 shows that the highest prevalence was among those aged 5-14 years (9.22%, 95% CI=8.6-9.88) while those age over 65 years had the lowest prevalence (5.54% 95% CI=4.53-6.71), the difference was statistically significant (χ^2=25.32, p<0.001).The prevalence of parasitic intestinal infections was significantly higher during the dry (1893/22976, 8.24%, 95% CI=7.89-8.6%) than during the rainy (845/14422, 5.86%, 95% CI=5.48-6.26%) season (χ^2=73.96, p<0.001) (Table 1).

A total of 2676/37398 (7.16%, 95% CI=6.89-7.42%) patients had a single infection (Table 1). In other words, 97.74% (2676/2738) of the parasitic intestinal infections were single infections, whereas 2.26% (64/2738) were co-infections. Infections with *G. duodenalis* and *E. histolytica/dispar* comprised 92.29% of all positive cases.

Fourteen intestinal parasites were identified in this study. Among these parasites, *G. duodenalis* (1438/37398, 3.85%, 95% CI=3.65-4.05) and *E. histolytica/dispar* (1036/37398, 2.77%, 95% CI=2.61-2.94) were the most prevalent, whereas a low prevalence was recorded for hookworms (1/37398, 0.003%, 95% CI=0.0003-0.02) (Table 2).

Table 1. Prevalence of parasitic intestinal infections for each variable studied

Variable		+/n	Prevalence (%) (95% CI)	p-value
Sex	Female	1331/17829	7.47 (7.08-7.86)	0.31 (χ^2=1.04)
	Male*	1407/19569	7.19 (6.83-7.56)	
Age group-A	<5 years	604/8755	6.89 (6.38-7.45)	0.04 (χ^2=4.38)
	5-14 years	743/8055	9.22 (8.6-9.88)	<0.001 (χ^2=25.32)
	15-40 years	880/12849	6.85 (6.42-7.29)	0.04 (χ^2=4.28)
	41-65 years	412/5953	6.92 (6.29-7.59)	0.04 (χ^2=4.23)
	>65 years*	99/1786	5.54 (4.53-6.71)	
Age group-B	Children (≤14 years)	1347/16810	8.01 (7.61-8.43)	<0.001 (χ^2=21.54)
	Adult* (>14 years)	1391/20588	6.76 (6.42-7.11)	
Season	Rainy	845/14422	5.86 (5.48-6.26)	<0.001 (χ^2=73.96)
	Dry*	1893/22976	8.24 (7.89-8.6)	

*: Reference, +: Number of positive patients, n: Number of samples, CI: Confidence interval, χ^2: Chi-square

Table 2. Prevalence and distribution of intestinal parasites among patients who requested stool examination at a tertiary referral hospital in Mogadishu, Somalia, 2015-2020 (n=37398)

Parasites identified	Number of infected	Prevalence (%) (95% CI)
Overall prevalence	2738	7.32 (7.06-7.59)
Single infection	**2676**	**7.16 (6.89-7.42)**
Giardia duodenalis	1438	3.85 (3.65-4.05)
Entamoeba histolytica/dispar	1036	2.77 (2.61-2.94)
Ascaris lumbricoides	49	0.13 (0.09-0.18)
Enteromonas hominis	33	0.09 (0.06-0.12)
Trichomonas hominis	33	0.09 (0.06-0.12)
Hymenolepis nana	30	0.08 (0.05-0.11)
Trichuris trichiura	28	0.07 (0.05-0.11)
Enterobius vermicularis	10	0.03 (0.01-0.05)
Blastocystis hominis	6	0.02 (0.01-0.03)
Chilomastix mesnili	4	0.01 (0.003-0.03)
Entamoeba coli	3	0.01 (0.002-0.02)
Strongyloides stercoralis	3	0.01 (0.002-0.02)
Retortamonas intestinalis	2	0.005 (0.0003-0.02)
Hookworm	1	0.003 (0.0003-0.02)
Co-infection	**62**	**0.17 (0.13-0.21)**
G. duodenalis + E. histolytica/dispar	31	0.08 (0.06-0.12)
A. lumbricides + G. duodenalis	9	0.02 (0.01-0.05)
A. lumbricides + T. trichuria	5	0.01 (0.004-0.03)
A. lumbricoides + E. histolytica/dispar	4	0.01 (0.003-0.03)
G. duodenalis + H. nanoa	3	0.01 (0.002-0.02)
A. lumbricoides + E. coli	2	0.005 (0.0003-0.02)
G. duodenalis + E. coli	2	0.005 (0.0003-0.02)
G. duodenalis + T. hominis	2	0.005 (0.0003-0.02)
E. histolytica/dispar + E. vermicularis	1	0.003 (0.0003-0.02)
E. histolytica/dispar + T. trichuris	1	0.003 (0.0003-0.02)
E. hominis + H. nana	1	0.003 (0.0003-0.02)
A. lumbricides + H. nana	1	0.003 (0.0003-0.02)

CI: Confidence interval

Discussion

Intestinal parasitic infections are highly prevalent in developing countries, 40% of which are in the African continent, leading to a high burden of morbidity and mortality (12). Few studies have been reported on neglected parasitic intestinal infections in Somalia (8,9,10,11,13). To the best of our knowledge, this is the first comprehensive assessment of the prevalence of intestinal parasite infections in Somalia.

The overall prevalence of parasitic infections in the present study was lower (7.32%) than that in previous studies performed in Somalia (85%) (10), Ethiopia (52.9%) (14), Northeast Nigeria (17.5%) (15), North-Western Nigeria (11.8%) (16), Northwestern Saudi Arabia (45.38%) (17), Iran (31.2%) (18), Nepal (30.1%) (19), and India (6.63%) (20). Differences in the prevalence of parasitic intestinal infections may be explained by the diagnostic test used, different population densities, health status and habits of the people, seasonal fluctuations, the status of open space defecation, and the presence of control and prevention programs.

Fourteen different intestinal parasites were identified in the present study, and the most common parasitic infection was *G. duodenalis* (3.85%). This finding is higher than that of a previous study conducted in Somalia (11), but lower than that reported in a previous study in Ethiopia (14) and Kenya (7). This might be attributed to the differences in geographical regions, the characteristics of soil, altitude, climatic conditions, including temperature, rainfall, humidity, proper sanitary infrastructure, and socioeconomic factors. Provision of community-based low-cost interventions and introduction of control and elimination programs to combat preventable and treatable parasitic intestinal infections can be achieved by regular surveillance of the trending distribution of intestinal parasite species.

This study also revealed that parasitic intestinal infections were significantly higher in the dry season than in the rainy season, and this difference might be attributed to differences in water quality, access to clean water, and sample size between the two seasons.

Although the prevalence of parasitic intestinal infections was slightly higher in females than in male counterparts, the difference was not significant between genders. This finding is in agreement with studies in Ethiopia (7) and Kenya (15). This might be due to the differences in occupational exposure, such as females taking care of children and sick patients and performing chores in the house.

Intestinal parasitic infections can occur during the early stages of life and may lead to undernutrition and growth retardation. This study indicated that the prevalence of parasitic intestinal infections was significantly higher in children than in adults, and this finding is consistent with other studies in Ethiopia (7). This might be due to factors such as playing with soil and water, poor personal and environmental hygiene conditions, being in overcrowded classrooms, and being in close contact with each other, which makes the spread of parasitic intestinal infections easier.

Study Limitations

We are aware that our research may have several limitations. The first is a single direct wet smear method used for the detection of intestinal parasites at the hospital, which underestimates the true prevalence and intensity of parasitic intestinal infections in the country because of the low sensitivity of this method and inability to determine the infection intensity (21). Further studies should use more sensitive laboratory diagnostic methods to confirm and distinguish morphologically identical parasites. Moreover, the parasites were determined by examination of a single stool specimen from each patient, which may impede the diagnostic performance of the method used in this study. Furthermore, the findings presented here were collected from a single-centre health facility database, and thus cannot be generalized for the entire Somalia population. The strengths of the study were that it constitutes the six-year experience of the largest tertiary referral hospital in the region and represents the first comprehensive examination of the prevalence of parasitic intestinal infections in Somalia. However, we are confident that our research provides considerable insight into the burden of parasitic intestinal infections in Somalia and will serve as a basis for future studies. In addition, the descriptive epidemiological data generated in this study may assist health authorities in producing effective national intervention programs.

Conclusion

A low prevalence of parasitic intestinal infections was observed among patients who attended a tertiary referral hospital in Mogadishu, Somalia. Significantly higher parasitic intestinal infections were found in children than in adults. Further epidemiological studies should be conducted to halt the spread of parasitic intestinal infections in Somalia. The introduction of effective community-based parasite control programs may help combat parasitic intestinal infections in the country.

Ethics

Ethics Committee Approval: The Research Ethics Committee of the University of Health Sciences Türkiye, Mogadishu Somalia Türkiye Recep Tayyip Erdoğan Training

and Research Hospital approved the study on April 19, 2021, under the reference number MSTH/6089.

Informed Consent: Retrospective study.

Authorship Contributions

Concept: H.H.E., E.K., M.A.H.K., Design: H.H.E., E.K., M.A.H.K., Data Collection or Processing: H.H.E., M.M.O., Ş.K., A.M.O., A.A.H.K., Analysis or Interpretation: Ş.K., A.M.O., A.A.H.K., Literature Search: H.H.E., E.K., M.M.O., M.A.H.K., Ş.K., A.M.O., A.A.H.K., Writing: H.H.E., E.K., M.M.O., M.A.H.K., Ş.K., A.M.O., A.A.H.K.

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