УДК 616.99

https://doi.org/10.47526/YJoHS-2025.1-07

ГРНТИ 76.03.45

PREVALENCE OF GASTROINTESTINAL PARASITES AMONG PRIMARY SCHOOL STUDENTS AS A PUBLIC HEALTH ISSUE: A COMPARATIVE STUDY BETWEEN RURAL AND URBAN AREAS

Shoibek A.[1], Kuandikova R.[1], Kuandikova A.[1]

Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkistan, Kazakhstan[1]

ABSTRACT The main purpose of the research work is to study the diversity of the etiological structure of gastrointestinal parasites among primary school students in rural and urban settlements of the Turkestan region by identifying and comparing the frequency of their occurrence and spread.

Gastrointestinal parasitic infections pose a serious public health problem worldwide, especially in rural areas of developing countries. There is evidence that about 3.5 billion people worldwide have been infected with parasitic infections, of which about 450 million (about 30%) children have been infected with gastrointestinal parasites. It is known that primary school students are in a vulnerable group at risk of contracting gastrointestinal parasitic infections due to immaturity of the immune system, non-compliance with hygiene measures, oral activity. According to the World Health Organization (WHO), 870 million children live in an endemic zone with gastrointestinal worms and annually lead to the death of 15 million young children, most of whom are widespread in developing countries, mainly on the Asian and African continents.

The scientific novelty of the study is that for the first time the etiological structure of gastrointestinal parasites occurring among primary school students of rural and urban settlements of Turkestan region will be revealed, the frequency of their occurrence and distribution will be studied. The influence of various levels of the economic and social factor of rural and urban settlements on the frequency of gastrointestinal parasites is also investigated. To contribute to the World Health Organization on behalf of the Republic of Kazakhstan. As a result of the study, the occurrence of gastrointestinal parasites in children in our state, which is among the developing countries, will be revealed or not revealed, compared with each other in socio-economic conditions with other developed and underdeveloped states.

Keywords: Turkestan region, gastrointestinal parasites, protozoa, helminths, urban and rural areas, primary school students, microscopic method, prevalence.

Қоғамдық денсаулық сақтау мәселесі ретінде бастауыш сынып оқушылары арасында асқазан-ішек паразиттерінің таралуы: ауылдық және қалалық аймақтар арасындағы салыстырмалы зерттеу

Шойбек А.[1], Куандыкова Р.[1], Куандыкова А.[1]

Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті, Түркістан қ., Қазақстан[1]

АҢДАТПА. Бұл ғылыми-зерттеу жұмысының басты мақсаты – Түркістан облысының ауылдық және қалалық елді мекендеріндегі бастауыш сынып оқушылары арасында асқорыту жүйесі паразиттерінің этиологиялық құрылымының әртүрлілігін зерттеу, олардың кездесу жиілігі мен таралуын анықтап, салыстыру болып табылады. Асқорыту жүйесінің паразитарлық инфекциялары әлем бойынша, әсіресе дамушы елдердің ауылдық

аймақтарында, қоғамдық денсаулық сақтау үшін елеулі мәселе болып табылады. Деректерге сәйкес, әлемде шамамен 3,5 миллиард адам паразитарлық инфекциялармен жұқтырылған, олардың ішінде шамамен 450 миллионы (яғни 30%-ға жуығы) балалар болып табылады және олар асқорыту жүйесінің паразиттерімен зақымданған. Бастауыш сынып оқушылары иммундық жүйесінің толық жетілмеуі, гигиеналық талаптарды сақтамауы және заттарды ауыз арқылы қабылдау әдеттеріне байланысты қауіп тобындағы балалар қатарына жатады. Дүниежүзілік денсаулық сақтау ұйымының (ДДҰ) мәліметтері бойынша, әлемде 870 миллион бала ішек құрттарымен эндемиялық аймақтарда өмір сүреді және жыл сайын 15 миллионнан астам жас баланың өліміне себеп болады, олардың көпшілігі Азия және Африка құрлықтарындағы дамушы елдерде тіркеледі.

Зерттеудің ғылыми жаңалығы – алғаш рет Түркістан облысының ауылдық және қалалық мектептеріндегі бастауыш сынып оқушылары арасында кездесетін асқорыту жүйесінің паразиттерінің этиологиялық құрылымы анықталып, олардың таралу жиілігі мен кездесу жиілігі зерттелетін болады. Сонымен қатар, ауылдық және қалалық елді мекендердің әртүрлі әлеуметтік-экономикалық деңгейлерінің асқорыту жүйесі паразиттерінің таралу жиілігіне әсері талданады. Бұл зерттеу нәтижелері арқылы Қазақстан Республикасы атынан Дүниежүзілік денсаулық сақтау ұйымына өз үлесін қосу мүмкіндігі қарастырылады. Зерттеу нәтижесінде елімізде, дамушы елдердің қатарына жататын мемлекет ретінде, балалар арасында асқорыту паразиттерінің бар-жоғы анықталып, әлеуметтік-экономикалық жағдайлары әртүрлі дамыған және даму деңгейі төмен елдермен салыстырмалы талдау жасалады.

Түйін сөздер: Түркістан облысы, асқазан-ішек паразиттері, қарапайымдылар, гельминттер, қалалық және ауылдық аймақтар, бастауыш сынып оқушылары, микроскопиялық әдіс, таралу жиілігі.

Распространённость паразитов желудочно-кишечного тракта среди учащихся начальных классов как проблема общественного здравоохранения: сравнительное исследование между сельскими и городскими районами

Шойбек А.[1], Куандыкова Р.[1], Куандыкова А.[1]
Международный казахско-турецкий университет имени Ходжа Ахмеда Ясави, г.Туркестан, Казахстан[1]

АННОТАЦИЯ. Основной целью научно-исследовательской работы является изучение многообразия этиологической структуры желудочно-кишечных паразитов среди учащихся начальных классов школ сельских и городских поселений Туркестанской области путем выявления и сравнения между собой частоты их встречаемости и распространения.

Желудочно-кишечные паразитарные инфекции представляют серьезную проблему для общественного здравоохранения во всем мире, особенно в сельской местности развивающихся государств. Есть данные о том, что во всем мире паразитарными инфекциями заразились около 3,5 миллиарда человек, из которых около 450 миллионов (около 30%) детей были заражены желудочно-кишечными паразитами. Известно, что учащиеся начальных классов входят в уязвимую группу по риску заражения желудочно-кишечными паразитарными инфекциями из-за незрелости иммунной системы, несоблюдения гигиенических мер, пероральной активности. По данным Всемирной организации здравоохранения (ВОЗ), 870 миллионов детей живут в эндемичной зоне с желудочно-кишечными гельминтами и ежегодно приводят к гибели 15 миллионов детей раннего возраста, большая часть которых широко распространена в развивающихся странах, в основном на Азиатском и Африканском континентах.

Научная новизна исследования состоит в том, что впервые будет выявлена этиологическая структура желудочно-кишечных паразитов, встречающихся среди учащихся начальных классов школ сельских и городских поселений Туркестанской области, будет изучена частота их встречаемости и распространения. Исследуется также влияние различных уровней экономико-социального фактора сельских и городских поселений на частоту распространения желудочно-кишечных паразитов. Внести свой вклад во Всемирную организацию здравоохранения от имени Республики Казахстан. В результате исследования будут выявлено или не выявлено встречаемости желудочно-кишечных паразитов у детей в нашем государстве, относящемся к числу развивающихся стран, сравнивается между собой в социально-экономических условиях с другими развитыми и отстающими в развитии государствами.

Ключевые слова: Туркестанская область, паразиты желудочно-кишечного тракта, простейшие, гельминты, городские и сельские районы, учащиеся начальных классов, микроскопический метод, распространённость.

Introduction: Gastrointestinal parasitic infections are a major public health issue in many developing countries, particularly among preschool and school-age children. Helminths and protozoa are among the most common infections in people living in developing countries. Currently, approximately 2 billion people worldwide are infected with gastrointestinal parasitic infections. According to the World Health Organization (WHO), more than 568 million school-age children live in areas where helminths are widespread [1] [2][3] [4].

Gastrointestinal parasitic infections are a group of diseases caused by one or more types of protozoa, cestodes, trematodes, or nematodes, and are widespread in many regions of the world. Amoebiasis, ascariasis, hookworm infection, and trichuriasis are among the most common parasitic infections. Over 550 million schoolchildren live in areas where gastrointestinal parasitic infections are endemic, with approximately 450 million cases recorded in countries south of the Sahara in Africa. [5] [6].

Gastrointestinal helminth and protozoan infections are among the most common infections in developing countries, contributing to high rates of morbidity and mortality. Children, particularly in tropical and subtropical regions with limited or no access to safe drinking water, poor sanitation, substandard housing, and weak economic conditions, are the most affected. According to epidemiological data, more than 1 billion people worldwide, primarily children, are infected with parasitic infections caused by helminths and protozoa. The majority of these infections are associated with helminths such as *Ascaris lumbricoides, hookworms,* and *Trichuris trichiura* [2] [7].

Gastrointestinal parasitic infections can affect individuals of any age, but children are the most severely affected by their consequences. The primary causative agents of these infections are protozoa (*Entamoeba histolytica, Giardia intestinalis*) and helminths. Among them, soil-transmitted helminths, specifically *Strongyloides stercoralis, Ascaris lumbricoides, Trichuris trichiura,* and *hookworms*, are the most frequently encountered types. According to the World Health Organization (WHO), these gastrointestinal parasites are included in the list of neglected tropical diseases. The prevalence of gastrointestinal parasitic infections in the community is reported differently in various studies, depending on factors such as the socio-economic status of the population, sanitation and environmental conditions, access to water, as well as lifestyle changes due to environmental degradation and intercultural shifts [8] [9].

In general, gastrointestinal parasitic infections are widespread worldwide, particularly in low-income regions. Approximately 3.5 billion people globally suffer from parasitosis, with 450 million, mostly children, suffering from various diseases caused by these infections. According to data from the WHO and UNICEF Joint Monitoring Program, in 2015, 663 million people lacked access to improved water sources, while 2.4 billion people, due to poor sanitation and inadequate hygiene, contributed to 7% of global morbidity and 19% of child mortality worldwide [10].

In Europe, 32 million people are infected with ascariasis, 34 million with whipworm, and 62 million with pinworm. In the Commonwealth of Independent States (CIS) countries, approximately 65 species of helminths have been registered, among which 18-20 species are most commonly found and are of significant medical importance due to their widespread distribution and considerable harm to public health.

In the Republic of Uzbekistan, the following helminth species are primarily registered: ascariasis, fascioliasis, pinworms, and beef and pork tapeworms [11].

In the Republic of Belarus, the most commonly encountered gastrointestinal parasitic infections are ascariasis and enterobiasis [12].

In the Russian Federation, approximately 2 million people with gastrointestinal parasites are officially registered each year. However, according to expert estimates, the number of infected individuals reaches 20-22 million [12].

In the Republic of Kazakhstan and the Kyrgyz Republic, the most widespread gastrointestinal parasitic infection is ascariasis [12].

Research questions:

1. How does the diversity of the etiological structure of gastrointestinal parasites among primary school students affect their health?

2. What is the prevalence rate of gastrointestinal parasites among primary school students in rural and urban areas?

3. Based on a comparative study of the prevalence of gastrointestinal parasites among primary school students in rural and urban areas, in which region are these parasites more frequently encountered?

Materials and methods: This cross-sectional study was conducted from November 2022 to April 2023 in the city of Turkestan, Republic of Kazakhstan. Using a simple random sampling method, a total of four schools (two urban and two rural) were selected from two districts. As a result, 200 stool samples were collected from boys and girls studying in primary schools. Prior to the study, approval was obtained from the local ethics committee. School principals were provided with an official letter and gave their consent. School nurses, class teachers, and the parents of participating students were informed about the study process. Parents signed an informed consent form for their children's participation. All students were fully provided with the necessary tools and equipment. The age range of the participants was 6–11 years. In total, 200 children participated in the study, including 100 primary school students from rural areas and 100 from urban areas.

Standard procedures were followed for sample collection for laboratory analysis. Appropriate precautionary measures were taken to prevent contamination and ensure adequate sample collection. Fresh stool samples were stored in a refrigerator and transported to the laboratory as quickly as possible in sealed containers. Each sample was labeled with the student's name, unique identification number, sample type, collection date and location, and the name of the collector. In addition to laboratory research, a questionnaire-based method was used.

The collected samples were delivered to the laboratory of Khoja Akhmet Yassawi International Kazakh-Turkish University in Turkestan for microscopic examination. The following laboratory methods were applied: macroscopic method, direct microscopic method, a special adhesive tape method for detecting Enterobius vermicularis, and the sedimentation method.

Macroscopic Method: Stool types were assessed using the Bristol Stool Chart.

Direct Microscopic Method:

A drop of isotonic sodium chloride solution was placed on one side of a clean glass slide, and a drop of Lugol’s iodine solution was placed on the other side. A small portion of the stool sample was collected using a sterile stick and first homogenized in the isotonic solution, then in the Lugol’s iodine solution. The preparations were covered with a cover slip. Before drying, the entire glass area was scanned under a light microscope, first using a 10× objective and then a 40× objective to examine at least one-third of the area.

Adhesive Tape Method:

Since Enterobius vermicularis cannot be detected in stool samples, the adhesive tape method was used. Parents were instructed on the collection technique: in the morning, before washing, adhesive tape was applied several times to the perianal area, then transferred onto a glass slide and examined under a microscope.

Sedimentation Method:

A 1–1.5 g sample of fresh stool was completely homogenized in 10 ml of 10% formalin in a 15-ml tube. The sample was left to fix for at least 30 minutes. The solution was then filtered through two layers of gauze into another 15-ml conical tube. Next, 3 ml of ethyl acetate was added, the tube was sealed, and the solution was vigorously shaken for 30 seconds. The mixture was centrifuged at 1680 rpm for 10 minutes. After centrifugation, four layers were observed:

a) the top layer – ethyl acetate;

b) a layer of fecal debris adhering to the tube walls;

c) the formalin layer;

d) the sediment.

Fecal debris was removed with a sterile stick, the top three layers were discarded, and the sediment was mixed with a few drops of 10% formalin. The direct microscopic examination slides were prepared using the Native-Lugol's method.

Statistical analysis: Pearson's χ^2 test was used for comparative analysis of the obtained results. The level of statistical significance was set at a 95% confidence interval. Statistical analysis was performed using the OpenEpi statistical software (version 3.01, dated 06/04/2013).

Results: In this study, stool samples from 200 primary school students were analyzed. The sample included 100 students from rural areas and 100 students from urban areas. Among primary school students in rural areas, 53 (53%) were female, and 47 (47%) were male. In urban areas, 62 (62%) were female, and 38 (38%) were male. The age of the participants ranged from 6 to 11 years, with a mean age ± standard deviation of 7.7±1.6 years. The mean age ± standard deviation for rural school students was 7.7±1.5 years, while for urban school students, it was 7.7±1.6 years. No statistically significant differences were found between the groups in terms of gender and age (p=0.2; p=0.1). (Tables 1, 2), (Figures 1, 2, 3).

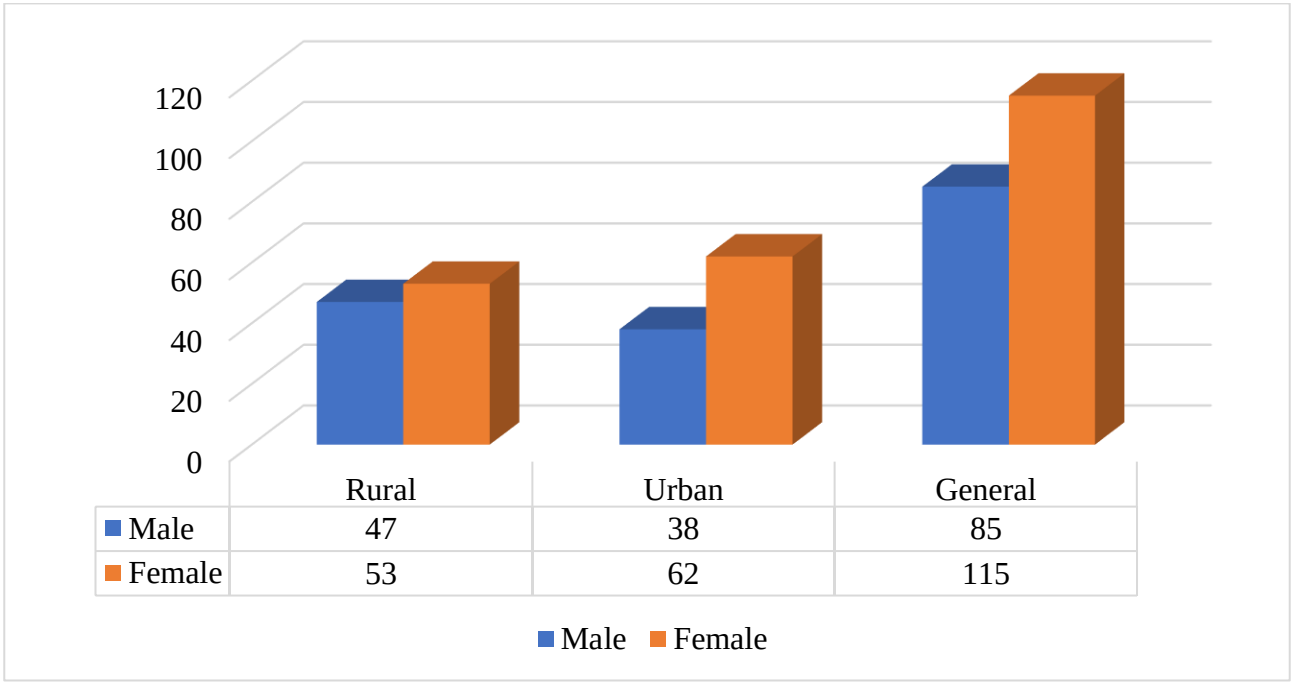
Table 1. Distribution of Study Participants by Gender

Study Group	Number of Participants	Gender (Male/Female), n (%)	p
Rural	100	47 (47%) / 53 (53%)	0.2
Urban	100	38 (38%) / 62 (62%)	

Table 2. Distribution of Study Participants by Age

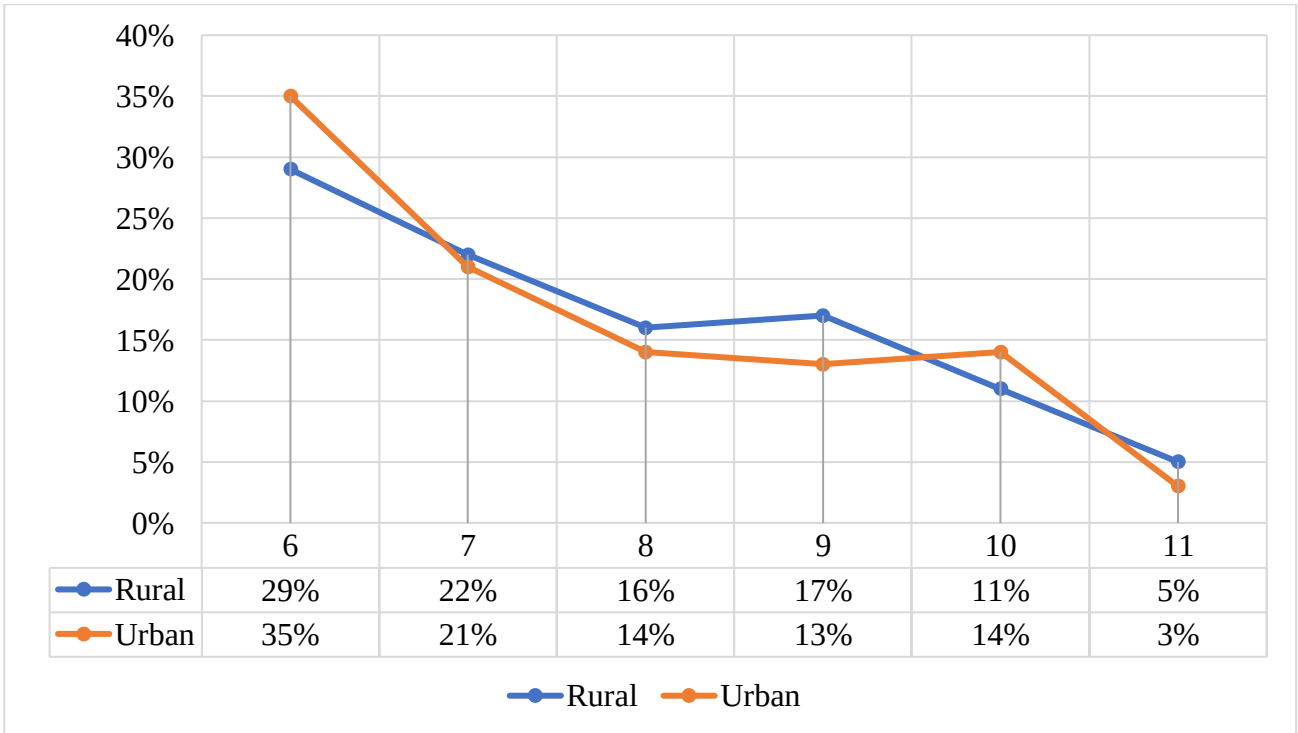
Study Group	Mean Age	Standard Deviation	Age Range	p
Rural	7.7	1.5	6-11	0.1
Urban	7.6	1.6	6-11	

Figure 1. Distribution of Study Participants by Gender



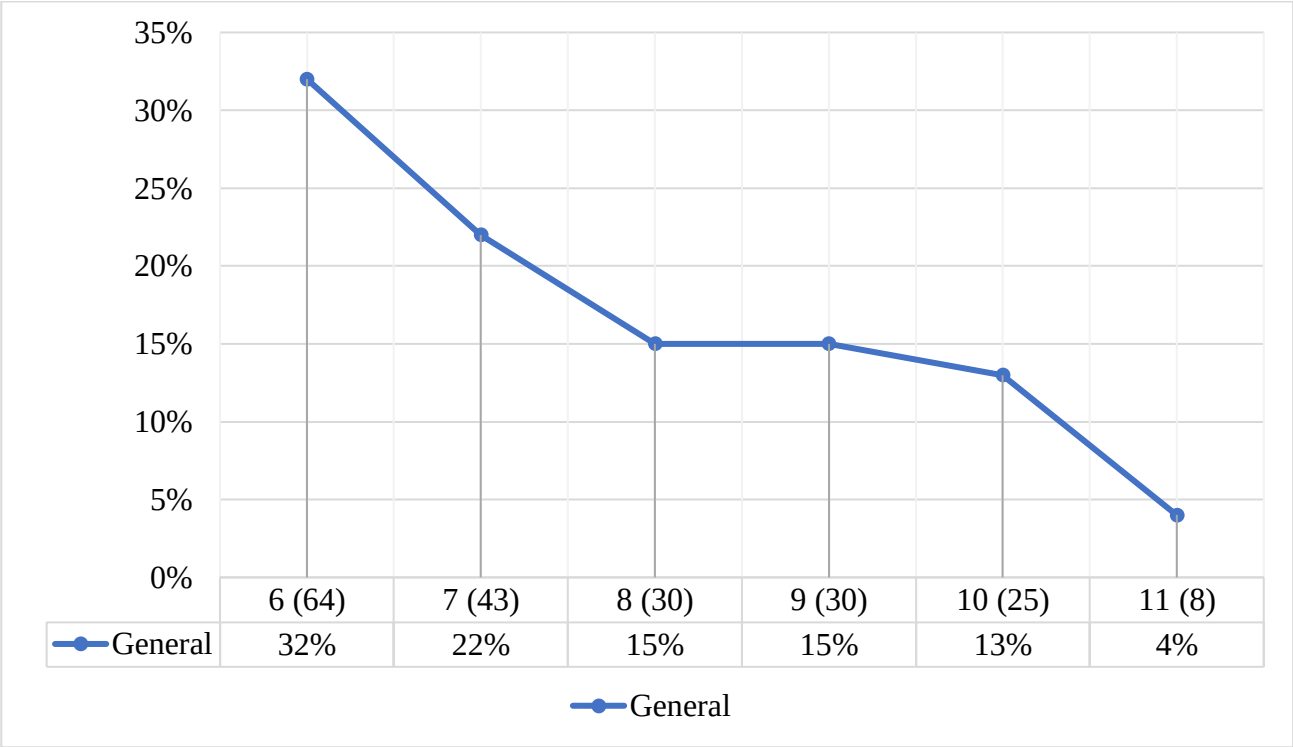
	Rural	Urban	General
Male	47	38	85
Female	53	62	115

Figure 2. Distribution of Study Participants by Age



	6	7	8	9	10	11
Rural	29%	22%	16%	17%	11%	5%
Urban	35%	21%	14%	13%	14%	3%

Figure 3. Overall Age Distribution of Study Participants



Survey Results

Table 3. Distribution of Gastrointestinal Parasites by Socio-Demographic Characteristics

Category	Group	Urban				Rural			
		Count	Positive	%	p	Count	Positive	%	p
Gender	Male	38	1	2,63	0,72	47	3	6,38	0,27
	Female	62	1	1,61		53	1	1,88	
Age	6-8	70	1	1,42	0,54	67	3	4,47	0,73
	9-11	30	1	3,33		33	1	3,03	

Table 4. Statistical Significance Between Gastrointestinal Parasites and Socioeconomic Status

Description	Urban				Rural			
	Count	Positive	%	p	Count	Positive	%	p
Socioeconomic Status								
High	18	0	0	0,50	6	0	0	0,61
Medium	82	2	2,43		94	4	4,2	
Low	-	-	-		-	-	-	
Number of children in the family								
1-2	23	1	4,34	0,60	12	0	0	0,76
3-4	58	1	1,72		67	3	4,47	
5-6+	19	0	0		21	1	4,76	
Parents' employment in public catering establishments								
Yes	20	1	5,0	0,30	28	1	3,57	0,89
No	80	1	1,25		72	3	4,16	

Description	Urban				Rural			
	Count	Positive	%	p	Count	Positive	%	p
Location of their homes								
Private house	82	2	2,43	0,50	100	4	4,0	-
Apartment building	18	0	0		0	0	0	
Toilet type								
Flush toilet	18	0	0	0,50	0	0	0	-
Pit latrine	82	2	2,43		100	4	4,0	
Use of public catering facilities								
Yes	100	2	2	-	58	4	6,89	0,09
No	0	0	0		42	0	0	
Habit of handwashing hygiene								
Yes	92	1	1,08	0,03	81	3	3,70	0,76
No	8	1	12,5		19	1	5,26	
Presence of pets at home								
Yes	32	0	0	0,33	73	4	5,47	0,22
No	68	2	2,94		27	0	0	

Table 5. General Indicators

Socioeconomic Status			**Number of children in the family**			**Parents' employment in public catering establishments**			**Location of their homes**		
Indicator	Count	%	Indicator	Count	%	Indicator	Count	%	Indicator	Count	%
High	0	0	1-2	35	17,5	Yes	48	24	Private house	182	91
Medium	176	88	3-4	125	62,5	No	152	76	Apartment building	18	9
Low	24	12	5-6+	40	20						
General	200		200			200			200		

Toilet type			**Use of public catering facilities**			**Habit of handwashing hygiene**			**Presence of pets at home**		
Indicator	Count	%	Indicator	Count	%	Indicator	Count	%	Indicator	Count	%
Flush toilet	18	9	Yes	158	79	Yes	173	86,5	Yes	105	52,5
Pit latrine	182	91	No	42	21	No	27	13,5	No	95	47.5
General	200		200			200			200		

Manifestations of Gastrointestinal Parasites Identified by Different Methods in Study Groups

Diagnostic methods used in the study: direct microscopic method (physiological solution/Lugol's solution), adhesive tape method for Enterobius vermicularis, and sedimentation method.

Images of gastrointestinal parasites detected during microscopic examination:

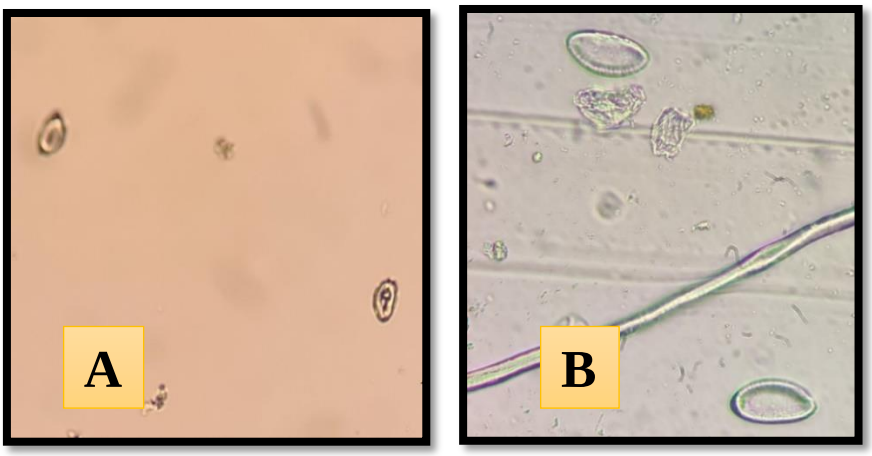


Figure 1. Adhesive Tape Method

Enterobius vermicularis (A – 10× objective, B – 40× objective)

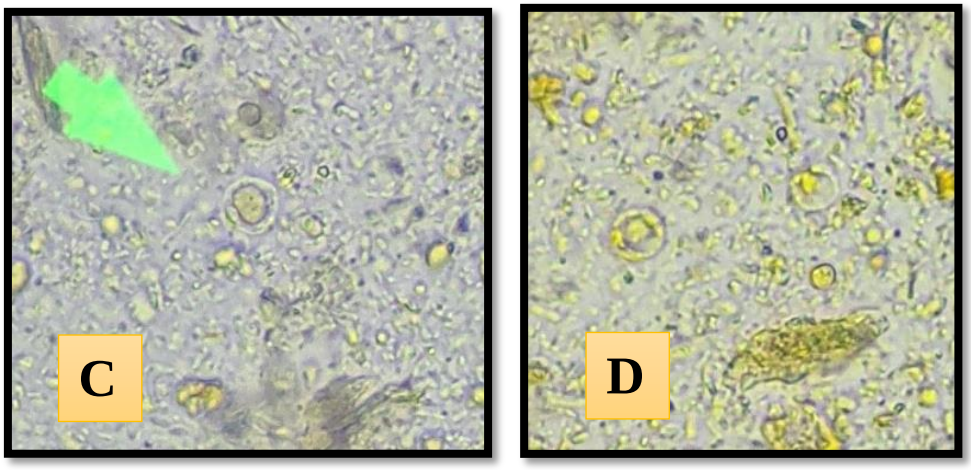


Figure 2. Direct Microscopic Method

C, D – Blastocystis (C – PS 10× objective, D – LI 10× objective)

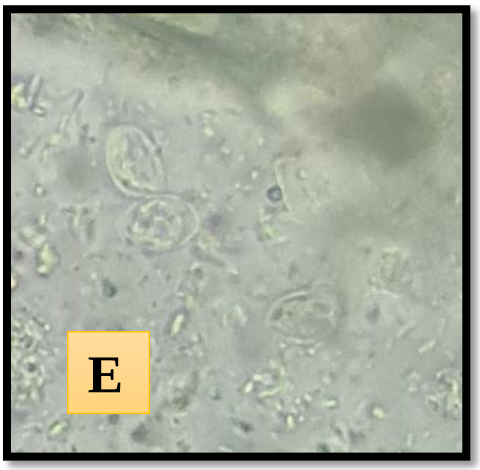


Figure 3. Sedimentation Method

E – Giardia lamblia (10× objective)

Discussion: Gastrointestinal parasites were identified in 3.5% of the 200 examined participants. The prevalence among primary school students in rural areas was 4%, while in urban primary schools, it was 3%. The statistical difference in the frequency of gastrointestinal parasites between the two groups was $X^2=0.6$, p=0.4. Therefore, no statistically significant difference was found in the prevalence of gastrointestinal parasites among primary school students in urban and rural areas. The most frequently detected parasite in both groups was *Giardia lamblia.*

Table 6. Identified Gastrointestinal Parasites

Gastrointestinal parasites	**Rural (n=100)**		**Urban (n=100)**			**General (n=200)**	
	N	**95%**	**N**	**95%**	**p**	**N**	**95%**
Blastocystis	-	-	2	2 (0,3-6,4)	0,1	2	1 (0,1-3,2)
Enterobius vermicularis	2	2 (0,3-6,4)	-	-	0,1	2	1 (0,1-3,2)
Giardia lamblia	2	2 (0,3-6,4)	1	1 (0,05-4,8)	0,2	3	1,5 (0,3-4,0)
General	4	4 (1,2-9,3)	3	3 (0,7-7,9)	0,3	7	3,5 (1,5-6,7)

Table 7. Information on Participants with Identified Gastrointestinal Parasites

	Age	**Gender**	**Socio-economic status**	**Number of children in the family**	**Parents' employment in public catering establishments**	**Habit of handwashing hygiene**	**Use of public catering facilities**	**Presence of pets at home**	**Identified Gastrointestinal Parasites**
Urban	8	Female	Medium	1-2	No	No	Yes	No	*Blastocystis*
	9	Male	Medium	3-4	No	Yes	Yes	No	*Blastocystis/ G.lamblia coinfection*
Rural	**Age**	**Gender**	**Socio-economic status**	**Number of children in the family**	**Parents' employment in public catering establishments**	**Habit of handwashing hygiene**	**Use of public catering facilities**	**Presence of pets at home**	**Identified Gastrointestinal Parasites**
	8	Male	Medium	3-4	No	No	Yes	Yes	*G.lamblia*
	10	Female	Medium	3-4	No	Yes	Yes	Yes	*G.lamblia*
	6	Male	Medium	5-6+	Yes	Yes	Yes	Yes	*E.vermicularis*
	7	Male	Medium	3-4	No	Yes	Yes	Yes	*E.vermicularis*

Conclusion: In families with three or more children, gastrointestinal parasites are detected more frequently. Therefore, it is necessary to examine all children in the household for gastrointestinal parasites, as they are primarily transmitted through contact, facilitating their rapid spread. Additionally, all children utilize public catering facilities, which serve as one of the main transmission routes for gastrointestinal parasites. Compared to primary school students in urban areas, those in rural schools are more likely to have domestic animals, which represent a key source of gastrointestinal parasite transmission. The presence of coinfection (mixed infection) in an urban primary school student, whose parents work in the public catering sector and who has not developed a habit of hand hygiene, highlights the lack of compliance with sanitary and hygienic standards. Given these findings, we recommend strengthening hygiene practices among primary school students, educating their parents, and conducting regular health screenings of domestic animals.

Acknowledgments: Parts of the manuscript were translated from kazakh language to English using artificial intelligence (ChatGPT, OpenAI, GPT-4). The translation was subsequently reviewed and edited for accuracy by the authors.

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Authors' Contributions: All authors participated equally in the writing of this article.

No conflicts of interest have been declared.

This material has not been previously submitted for publication in other publications and is not under consideration by other publishers. There was no third-party funding or medical representation in the conduct of this work. Funding - no funding was provided.

Information about authors:

Shoibek Azamat Maratuly – Khoja Akhmet Yassawi International Kazakh-Turkish University, Faculty of Medicine, Coordinator for 5th-6th Year Medical Students, Master's and Doctoral Programs; Master's Lecturer at the Department of Public Health and Scientific Research. Turkestan, Kazakhstan. azamat.shoibek@ayu.edu.kz, https://orcid.org/0009-0008-0879-1640, +7775-054-53-73.

Kuandikova Raushan Kenesbayevna – Khoja Akhmet Yassawi International Kazakh-Turkish University, Faculty of Medicine, Acting Head of the Department of Public Health and Scientific Research, Candidate of Biological Sciences, Associate Professor. Turkestan, Kazakhstan. raushan.kuandykova@ayu.edu.kz, https://orcid.org/0009-0003-7482-4651, +7777-548-48-83.

Kuandikova Ainash Kenesbayevna – Khoja Akhmet Yassawi International Kazakh-Turkish University, Faculty of Medicine, Doctor of Medical Sciences at the Department of Public Health and Scientific Research. Turkestan, Kazakhstan. ainash.kuandikova@ayu.edu.kz, https://orcid.org/0009-0008-7277-8301, +7702-365-30-99.

Shoibek Azamat Maratuly – Khoja Akhmet Yassawi International Kazakh-Turkish University, Faculty of Medicine, Coordinator for 5^{th}-6^{th} Year Medical Students, Master's and Doctoral Programs; Master's Lecturer at the Department of Public Health and Scientific Research. Turkestan, Kazakhstan. azamat.shoibek@ayu.edu.kz, https://orcid.org/0009-0008-0879-1640.

Kuandikova Raushan Kenesbayevna – Khoja Akhmet Yassawi International Kazakh-Turkish University, Faculty of Medicine, Acting Head of the Department of Public Health and Scientific Research, Candidate of Biological Sciences, Associate Professor. Turkestan, Kazakhstan. raushan.kuandykova@ayu.edu.kz, https://orcid.org/0009-0003-7482-4651.

Kuandikova Ainash Kenesbayevna – Khoja Akhmet Yassawi International Kazakh-Turkish University, Faculty of Medicine, Doctor of Medical Sciences at the Department of Public Health and Scientific Research. Turkestan, Kazakhstan. ainash.kuandikova@ayu.edu.kz, https://orcid.org/0009-0008-7277-8301.

Corresponding author: Shoibek Azamat Maratuly, Khoja Akhmet Yassawi International Kazakh-Turkish University, Faculty of Medicine, Coordinator for 5^{th}-6^{th} Year Medical Students,

Master’s and Doctoral Programs; Master’s Lecturer at the Department of Public Health and Scientific Research. Turkestan, Kazakhstan.
Postal code: 161200
Address: Bekzat Sattarhanov street, №29
Phone: +7775-054-53-73
E-mail: azamat.shoibek@ayu.edu.kz