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Intestinal Parasitic Infections among Prison Inmates in Kathmandu Nepal

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ABSTRACT

Background: Prison inmates are at high risk of intestinal parasitic infections. Thus, we studied intestinal parasitic infections among inmates of the Central Jail, Kathmandu, Nepal.

Methods: Morning stool samples from 400 inmates (M=282 and F=118), were collected in a clean, dry and wide-mouthed plastic container. The samples were transported to the research laboratory of Shi-Gan International College of Science and Technology, and were fixed using 10% formal saline. Then, samples were processed by formal ether sedimentation concentration technique and were observed microscopically by direct-smear technique.

Results: Six percent (24/400) samples were positive for intestinal parasites, with a gender ratio (M:F) 1.7:1. But, co-parasitism was not observed. Intestinal parasitic infections were higher among 21-40 years age-group, 3.5% (14/262). Similarly, intestinal parasitic infections were higher among '*Dalits*' ethnic group, 21.1% (4/19). As compared to helminths, more protozoans, 62.5% (15/24), were observed. *Giardia lamblia,* 41.67% (10/24), was the most common protozoans while *Trichuris trichiura*, 25.0% (6/24), was the most common helminths.

Conclusions: Intestinal parasitic infections were lower among the inmates of Central jail, but such conditions cannot be presumed in other peripheral settings. Pure and safe drinking water supply and the effective deworming campaign can further reduce this figure at this setting and peripheral jails across the country.

Keywords: Intestinal parasitic infections; IPIs; Nepal; prison inmates.

INTRODUCTION

Intestinal parasitic infections (IPIs) are common infections in developing countries.[1,2] More than 1.5 billion people are infected with soil-transmitted helminthes worldwide.[3] Closed-contact communities like prisons are a high-risk zone for IPIs.[4] Limited healthcare, high-risk behaviors, lower immunity due to stress and poor nutrition adds the risks.[4-6] Most inmates represent the marginalized communities[7] and overall living standards of inmates are low.[6] Thus, illness is higher in inmates than in general population.[5] In prison settings, IPIs of 9-73% have been reported. It was reported 26.5% in Asia[4] and 9.2-72.7% in Africa.[5,8-14] Inmates in developing countries are at higher risk of IPIs.[10]

Varying IPIs are reported among Nepalese individuals.[15-22] Yet, there are no reports on IPIs among Nepalese inmates. This study aimed to insight IPIs among prison inmates of the Central Jail, Kathmandu. The findings will be relevant to health care providers and concerned authorities to embark appropriate intervention through resource mobilization and control strategies.

METHODS

A cross-sectional study was conducted at the Central Jail in Kathmandu, Nepal from July to September 2014. Kathmandu is the capital city with a total area of 50.67 sq. km and a population density of 4,416 per sq. km. The prison is a pool type, housing several inmates in a room. The prison has a capacity of 1,000 inmates, but 2,642 inmates were imprisoned during the study period. These inmates were from diverse ethnic backgrounds and locations. The random sampling technique was adopted to select 400 inmates (M=282 and F=118). The selection criteria were the inmates' stay of 6 months or more in prison. The sample size was determined using Fisher's formula i.e. $n = Z\alpha^2pq/d^2$ [where, n = required sample size, Z = z-score at 1.96 at 95% confidence level,

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p = estimated proportion in the population having an intestinal parasitic infection. Since the intestinal parasitic infection among different communities in Nepal ranges from 9.3% to 93.0% (average= 51.5%); p-value was estimated at 0.515, q = 1-p, d= marginal error for the desired result i.e. ±5% (0.05)]. The minimum required sample size was calculated to be 384.

Prior to sample collection, a questionnaire on various demographic and socioeconomic variables was filled for each selected inmates. About 50g fresh morning stool samples, containing mucus or blood if present, were collected in a clean, dry and wide-mouthed plastic container. The samples were transported in an ice pack to the microbiology laboratory of Shi-Gan International College of Science and Technology and were fixed using 10% formal saline after the macroscopic examination. Samples were processed by formal-ether sedimentation concentration technique.[23] The processed samples were observed microscopically by direct-smear technique, in both normal saline solution and 1% iodine solution for the presence of ova, larvae or cysts of intestinal parasites. A positive control slide was used to confirm the parasites.[24]

Data were entered and curated in MS Excel (v 10). SPSS (v 17) for Windows was used for data analysis. Descriptive statistics (frequency and percentage) were used to summarize the socio-demographic factors of the inmates. Univariate logistic regression and relative risks were used to assess the association of the outcome parasitic infection with independent variables. The independent variables included in the model include sex, age, ethnicity, seasons, educational status, duration of stay in the prison, residence before imprisonment, occupation before imprisonment and administration of the anti-parasitic drug. Differences in the proportions and significance of study variables were tested using the Chi-square test, with Yates correction when required. The differences were considered significant when the p-value was less than 0.05.

This study was approved by the ethical review committee of Shi-Gan International College of Science and Technology. Permission for sample collection was obtained from the prison authority. Oral informed consent was obtained from each participant.

RESULTS

Among the 400 inmates, intestinal parasites were detected in 6% (n=24) stool samples with a gender ratio (M:F) 1.67:1. IPIs were higher among 21-40 years age-group, 3.5% (14/262). IPIs were higher among '*Dalits*' ethnic group, 21.1% (4/19) (Table 1 and Table 2).

Table 1. Distribution of intestinal parasitic infection (demographic variables).

	Total Number	Frequency	Percent*
Sex			
Male	282	15	5.3
Female	118	9	7.6
Age groups (years)			
≤20	8	2	0.5
21-40	262	14	3.5
>40	130	8	2.0
Seasons			
Early rainy season	250	17	6.0
Late rainy season	150	7	5.9
Duration in prison (months)			
6-8	151	13	8.6
8-10	52	4	7.7
10-12	89	4	4.5
>12	108	3	2.8
Anti-parasitic drug treatment in the past 6 months			
Yes	347	14	3.5
No	53	10	2.5
Total	400	24	6

*Percentage calculated on row total.

Table 2. Distribution of intestinal parasitic infection (socioeconomic variables).

	Total Number	Frequency	Percent*
Ethnicity			
Tibeto-Burman	286	16	8.6
Indo-Aryan	95	4	4.2
Dalit	19	4	21.1
Education			
No formal education	182	13	7.1
Primary level	77	5	6.5
Secondary level	89	4	4.5
Higher Secondary level	52	2	3.9
Residence before imprisonment			
Urban	256	7	2.7
Rural	144	17	11.8

Occupation before imprisonment			
Farmer	128	14	10.9
Merchant	42	3	7.1
Students	171	2	1.2
Others	59	5	8.5
Total	400	24	6

*Percentage calculated on row total.

The burden of protozoans was found to be higher, 62.5% (15/24). *Giardia lamblia* 41.67% (10/24) was the most common protozoans while *Trichuris trichiura* 25.0% (6/24) was the most common helminths. Co-parasitism was not observed (Table 3).

Table 3. Distribution of parasites.

Parasites	Frequency (%)
Protozoans	
Giardia lamblia	10 (41.7)
Entamoeba histolytica	2 (8.3)
Entamoeba coli	2 (8.3)
Endolimax nana	1 (4.2)
Helminths	
Trichuris trichiura	6 (25.0)
Hookworm	2 (8.3)
Ascaris lumbricoides	1 (4.2)
Total	24 (100)

After adjusting for other variables, no single predictor of intestinal parasitic infection was found in this study. Yet, the administration of the anti-parasitic drug in the past 6 months was significantly associated with IPIs (COR 0.181, 95% CI 0.076-0.432) (RR 0.214, 95% CI 0.100-0.457). *'Dalits'* ethnicity was also significantly associated with IPIs (COR 0.015, 95% CI 0.005-0.049) (RR 0.222, 95% CI 0.093-0.531). Residence before imprisonment was also significantly associated with IPIs (COR 0.210, 95% CI 0.085-0.520) (RR 0.232, 95% CI 0.098-0.545). Farming before imprisonment was significantly associated with IPIs (COR 3.218, 95% CI 1.388-7.459) (RR 2.975, 95% CI 1.359-6.515). Also, being students before imprisonment was significantly associated with IPIs (COR 0.111, 95% CI 0.026-0.480) (RR 0.122, 95% CI 0.029-0.511) (Table 4 and Table 5).

Table 4. Univariate analysis of demographic variables and associations with IPIs.

Demographic variables	IPI Positive	IPI Negative	COR (95% CI)	RR (95% CI)	Chi-square (χ^2)	p-value
Sex						
Male	15	267	1	1	0.786	0.375
Female	9	109	0.680 (0.289-1.600	0.697 (0.314-1.549)		
Age groups (years)						
≤20	2	6	5.606 (1.069-29.399)	4.455 (1.255-15.815)	2.353	0.125
21-40	14	248	0.004 (0.002-0.010)	0.058 (0.035-0.096)	0.580	0.446
>40	8	122	0.004 (0.002-0.010)	0.065 (0.033-0.128)	0.008	0.928
Seasons						
Early rainy season	17	233	1	1	0.757	0.384
Late rainy season	7	143	1.491 (0.603-3.683)	1.457 (0.619-3.432)		
Anti-parasitic drug treatment in the past 6 months						
Yes	14	333	1	1	17.937	p<0.05*
No	10	43	0.181 (0.076-0.432)	0.214 (0.100-0.457)		
Duration in prison (month)						
6-8	13	138	2.038 (0.889-4.674)	1.949 (0.896-4.239	2.928	0.087
8-10	4	48	1.367 (0.448-4.170	1.339 (0.476-3.761)	0.057	0.812
10-12	4	85	0.685 (0.228-2.058)	0.699 (0.245-1.992)	0.181	0.671
>12	3	105	0.369 (0.108-1.262)	0.386 (0.118-1.269)	1.997	0.158
Total	24	6				

**Significant at p<0.05.COR=Crude Odds Ratio, RR=Relative Risk*

Table 5. Univariate analysis of socioeconomic variables and associations with IPIs.

Socioeconomic variable	IPI Positive	IPI Negative	COR (95% CI)	RR (95% CI)	Chi-square (χ^2)	p- value
Ethnicity						
Tibeto-Burman	16	270	0.785 (0.326-1.889)	0.797 (0.351-1.811)	0.293	0.588
Indo-Aryan	4	91	0.003 (0.001-0.009)	0.045 (0.017-0.118)	0.353	0.553
Dalit	4	15	0.015 (0.005-0.049)	0.222 (0.093-0.531)	5.457	p<0.05*
Education						
No formal education	13	169	1.448 (0.632-3.314	1.415 (0.650-3.083	0.773	0.379
Primary level	5	72	1.111 (0.401-3.075)	1.104 (0.426-2.864)	0.041	0.839
Secondary level	4	85	0.685(0.2278-2.058)	0.699 (0.245-1.992)	0.181	0.671
Higher secondary level	2	50	0.593 (0.135-2.598)	0.608 (0.1474-2.512	0.151	0.698
Residence before imprisonment						
Urban	7	249	1	1	13.446	p<0.05*
Rural	17	127	0.210 (0.085-0.520)	0.232 (0.098-0.545)		
Occupation before imprisonment						
Farmer	14	114	3.218 (1.388-7.459)	2.975 (1.359-6.515)	8.137	p<0.05*
Merchant	3	39	1.234(0.3521-4.327)	1.218 (0.379-3.911	0.0002	0.989
Students	2	169	0.111 (0.026-0.480)	0.122 (0.029-0.511)	10.906	p<0.05*
Others	5	54	1.569 (0.562-4.380)	1.521 (0.5908-3.915)	0.751	0.386
Total	24	6				

**Significant at p<0.05.COR=Crude Odds Ratio, RR=Relative Risk*

DISCUSSION

In this study, the IPIs among inmates was found to be 6% which is lower than other counties as the study site is located in the capital city, Kathmandu of Nepal. A comparison with other studies was not possible owing to the lack of reports from Nepal. But, in prison settings, IPIs of 9% to 73% have been reported in different countries. It was reported 26.5% in Asia (Malaysia)[4] and 9.2-72.7% in Africa (Burkina Faso,[8] Ethiopia,[9,10] Kenya,[11] Nigeria[5,12,13] and Sudan.[14] Factors predisposing to parasitic infections include poor sanitation, inadequate water supply, unhealthy cultural practice and lack of education. Consuming raw or under-cooked vegetables or unwashed fruits might also be regarded as a probable source of parasitic infection.[15] In Nepal, IPIs is decreasing in recent years due to improved health education, improved standard of living, access to health services, public awareness towards the prevention and control of disease as well as the regular deworming program.

The IPIs were significantly higher in the '*Dalit*' ethnic group, 21.0%. This accords with reports in other communities in Nepal.[16-19] The lower socioeconomic, poor health, sanitation, and illiteracy could have resulted in this difference.

The study was done during the rainy season. The rainy season is considered as the peak season for IPIs especially in developing countries like Nepal, where outbreaks of waterborne and foodborne epidemics are the common phenomenon during the wet season. However, IPIs were similar throughout the rainy season. The controlled closed environment within prison could have accounted to this uniformity.

The IPIs were similar among anti-helminthic drug taking and non-taking inmates. But, this was statistically significant. The prison authority was concerned about the deworming program. However, some inmates denied taking anti-parasitic drugs. This may be because of the ineffective deworming schedule and some new inmates might have missed the deworming schedule. Deworming of new inmates and sustaining the therapy can cut the propagation of the parasite inside the prison.

Inmates with a lower level of education were found to have higher IPIs. Lack of proper health knowledge and personal cleanliness could have accounted for a higher prevalence. This was similar to the findings in other prison settings.[4,11] However, the findings contrast with findings in other prison settings, which was confined to helminthes only.[10]

Inmates with lower duration were found to have higher IPIs. Increase in deworming drug dose could have accounted for lower IPI with time. This was similar to the findings in other prison settings.[4] Inmates residing in a rural setting were found to have higher IPIs compared to those residing in an urban setting before imprisonment. However, the findings contrast with the findings in some prison settings which was confined to helminthes only.[10] Inmates' residence before imprisonment was significantly associated with IPIs.

Inmates involved in farming before imprisonment were found to have higher IPIs. Similarly, inmates who were students before imprisonment were found to have lower IPIs. This was similar to the findings in other prison settings.[10-12] Farmers and students before imprisonment were significantly associated with IPIs.

The burden of protozoans was higher i.e. 62.5% than that of helminths. This was similar to earlier reports.[16,18,19] The higher rate of protozoan infection might be due to contaminated drinking water. The climatic cause might be another reason for the high prevalence of protozoa compared to helminths as the study was conducted during the rainy season when the number of insect vectors increases and due to active protozoal infection during the rainy season. On the contrary, other studies in Nepal in the general population have reported a higher burden of helminth infection.[20] However, these reports showing the higher burden of helminth parasites are relatively outdated. Similarly, in prison settings, higher helminths than protozoa were reported by different studies.[9] However, it contrasts with the findings in some prison settings.[4,8,11,12] This inconsistency could be attributed to the geographic difference.

The prevalence of parasites in IPIs is influenced by eco-climates, geography, socioeconomic factors, environments, behaviors, cultures and demographic factors (particularly age).[25-29] In this study, *G. lamblia* was the most common parasite (41.6%).This was in agreement with various earlier studies in the general population.[18,21,22] *G. lamblia* is one of the common protozoan detected in prison settings.[14] The resistance of the cyst of *Giardia* to the osmotic lysis and normal chlorination of drinking water can account higher detection.

Among helminths, *T. trichiura* (25%) was the most common parasite. It could be due to ineffective deworming with a single dose of anti-helminthic drugs particularly in case of heavy infections. Besides this, special modes of attachment to cecal mucosa, longer life span and refractory reaction to most anti-helminthic drugs result in chronic infection in the intestine which further accounts for higher trichuriasis. The helminth infection can be prevented only by regular anti-helminthic treatment, health education, sanitation,and personal hygiene.

The risk of acquiring infectious diseases and the activation or aggravation of existing diseases usually increases in prisons.[9] Hence, inmates demand higher healthcare attention than the general population.

CONCLUSIONS

The findings showed the lower IPIs among the inmates. IPIs in other peripheral prisons can be presumed higher, as regional prison still lacks the infrastructures and facilities of the Central Jail. Also, the purity of drinking water should be improved and the periodic deworming program should be effective.

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