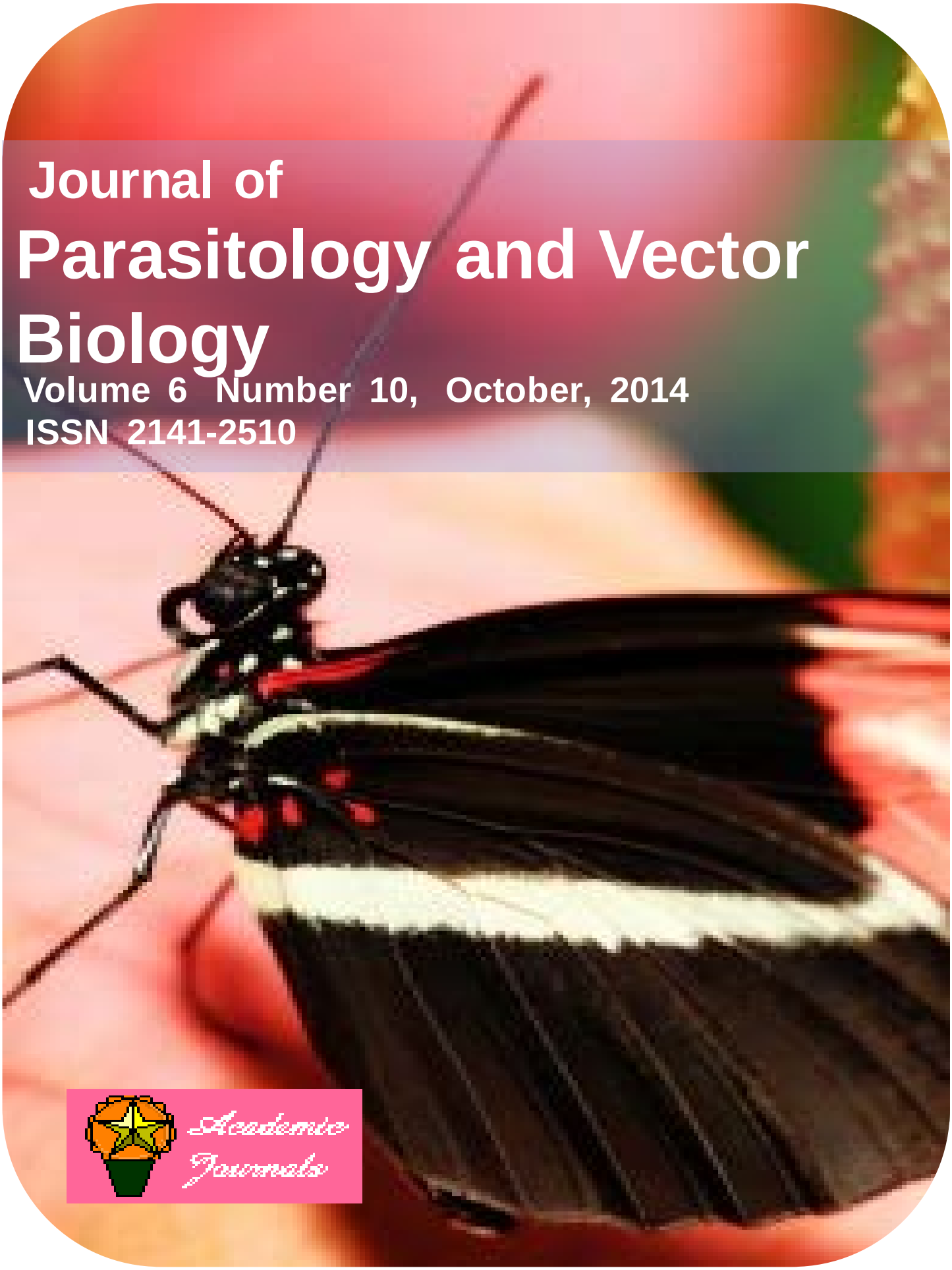

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Full Length Research Paper

Hard Ticks of Camel in Southern Zone of Tigray, Northern Ethiopia

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This cross-sectional study was carried out in Raya Azebo district with the objective of determining the prevalence and species diversity of hard ticks encountered in camels. During the study period, a total of 384 camels were examined and 96.6% of them were found infested with ticks. A total of 15,723 ticks were collected from half body regions of infected camels during the study period. The average tick burden from half body region of camels was 42.4 ± 19.63. In this study four genera and ten species of hard ticks were identified. The genera identified were *Amblyomma* (11.11%), *Boophilus* (1.8%), *Hyalomma* (23.32%) and *Rhipicephalus* (61.77%). The tick species identified during the study period were *Amblyomma variegatum*, *Boophilus decolaratus*, *Amblyomma cohaerence*, *Rhipicephalus evertsi evertsi*, *Rhipicephalus pulchelis*, *Amblyomma gemma*, *Amblyomma lepidum*, *Hyalomma rufipes*, *Hyalomma dromedarii and Hyalomma truncatum* at a prevalence of 22.9, 16.7, 23.2, 41.5, 92.7, 7.8, 3.4, 47.4, 42.7 and 8.9%, respectively. Further study and appropriate control measures are recommended to improve the health and productivity of camel.

Key words: *Amblyomma, Boophilus,* camel, ectoparasite, *Hyalomma*, Raya Azebo, *Rhipicephalus*, tick.

INTRODUCTION

The camel plays an important role in the culture and agriculture of many countries. It is an important working animal of the arid and semi-arid ecosystem because of its unique adaptive physiological characteristics (Rabana et al., 2011). However, camel production is conversely affectted by the occurrence of various diseases, in-adequate veterinary services and feed shortage (Bekele, 2010). Of all, various internal and external parasitic diseases have been reported to be the major problems affecting the health, productivity and performance of camels. Ticks are one of the most important parasites among the factors affecting the health, productivity and performance camels (Anwar and Khan, 1998; Parsani et al., 2008; Bekele, 2010); by transmitting various diseases causing agents, and causing blood loss, irritation, inflammation, hypersensitivity and damage to hide and udder (Wall and Shearer, 2001; Walker et al., 2003). In Ethiopia, ticks are common in all agro-ecological zones of

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the country (Pegram et al., 1981). The most important tick species reported to infest camel in Ethiopia include *Hyalomma* species, *Amblyomma* species, *Boophilus* species and *Rhiciphalus* species (Richard, 1979; Melaku and Fisseha, 2001; Lawal et al., 2007; Parsani et al., 2008; Dinka et al., 2010).

Knowing the prevalence and geographical distribution of tick species is important for the control of tick and tick born diseases. Studies conducted in Ethiopia are limited to the Eastern part of the country (Zelalem, 1994; Abebe, 2001; Melaku and Fisseha, 2001; Woldemeskel, 2001; Dinka et al., 2010) and there is limited information in other part of the country. Therefore, this study was conducted to estimate the prevalence and species diversity of ticks in camels in Raya-Azebo district, northern part of Ethiopia.

MATERIALS AND METHODS

Study area

The study was conducted in Raya Azebo district, Southern Zone of Tigray Region. Raya Azebo is located at latitude of 12° to 180° North and longitude of 38° to 39°. The average elevation of the district is 1470 to 2370 m above sea level. The mean annual rain fall is 610.5 (351 to 870) mm. The mean minimum and maximum annual temperature for the area are 15 and 30°C, respectively (RAWAO, 2010).

Study type, study animals and sample size determination

A cross-sectional study was undertaken to estimate the prevalence and to identify the species composition of tick in camel. The sample size was determined following the formula described by Thrusfield (1995). By considering the expected prevalence of 50 and 5% absolute precision with 95% confidence level, the sample size was calculated as follows:

$$n = \frac{1.96^2 \times Pexp\ (1\text{-}Pexp)}{d^2}$$

Where, n = required sample size, Pexp = expected prevalence (50%), d= desired absolute precision (5%), 1.96 = Z-value for the 95% confidence interval. Based on this formula the minimum sample size for the present study was 384 camels. The study camels were selected by simple random sampling method.

Sample collection and identification of tick

First, general physical examination was conducted on each camel. All data regarding the age, sex, body condition and other related information of the animals were recorded appropriately. The age and body condition of camels were determined based on their dentition and hump structure as described previously (Schwartz and Dioli, 1992; CACIA, 1995). After proper restraining, all visible adult ticks were collected from half-body regions of camels (on right side of the study animal) by hand and using good quality steel forceps. The collected adult ticks were kept in a properly labeled plastic containers containing 70% ethanol for further identification. The collected ticks were identified to their species level at Raya Azebo veterinary clinic and parasitology laboratory of college of Veterinary Medicine in Mekelle University, using stereomicroscope. Sampling and identification of ticks were carried out according to the standard technique recommended by Hoogstraal (1956), Okello-Onen et al. (1999) and Walker et al. (2003).

Data analysis

The data was entered into Microsoft excel spread sheet and coded appropriately. For data analysis, SPSS version 17 was used. In this data analysis, descriptive statistics was used to determine the prevalence of tick infestation in camels. The chi-square test was used to determine the existence of any association between tick distribution and the risk factors like age, body condition score and sex. In all cases, 95% confidence intervals and $p < 0.05$ were set for significance.

RESULTS

Out of the 384 camels examined, 371 (96.6%) of them were found infested with tick. A total of 15,723 hard ticks were collected from half body regions of all infested camels during the study period. The average tick burden from half body region of camels was 42.4 ± 19.63 (range 23 to 62). In general, four genera and ten species of hard ticks were identified. The genera identified were *Rhipicephalus* (61.77%), *Hyalomma* (23.32%), *Amblyomma* (11.11%) and *Boophilus* (1.8%). The tick species identified during the study period were *Rhipicephalus pulchelis*, *Hyalomma rufipes*, *Hyalomma dromedarii, Rhipicephalus evertsi evertsi*, *Amblyomma cohaerence*, *Amblyomma variegatum*, *Boophilus decolaratus*, *Hyalomma truncatum, Amblyomma gemma* and *Amblyomma lepidum* at aprevalence of 92.7, 47.4, 42.7, 41.5, 23.2, 22.9, 16.7, 8.9, 7.8 and 3.4%, respectively (Table 1). *R. pulchelis* was the predominate tick species identified in our study; with a proportion of 53.7%. The proportion of each tick species identified is indicated in Table 2.

Except for *A. variegatum* the age of animal had no effect ($p > 0.05$) on the prevalence of tick species. *B. decolaratus*, *A. cohaerence*, *A. gemma*, *H. dromedarii* and *R. pulchelis* infestation had showed statistically significant variation ($p < 0.05$) between male and female camels. In addition, the body condition of camel had no effect ($p > 0.05$) on the prevalence of tick species except for *H. truncatum* (Table 3).

DISCUSSION

The present study assesses the prevalence and species of hard tick infestation encountered on camel in northern

Table 1. The prevalence of tick species of camels in Raya Azebo district.

Tick species	No. of camels infested	Prevalence (%)
Rhipicephalus pulchelis	356	92.7
Hyalomma rufipes	182	47.4
Hyalomma dromedarii	164	42.7
Rhipicephalus evertsi-evertsi	159	41.5
Amblyomma cohaerence	89	23.2
Amblyomma variegatum	88	22.9
Boophilus decolaratus	64	16.7
Hyalomma truncatum	34	8.9
Amblyomma gemma	30	7.8
Amblyomma lepidum	13	3.4

Table 2. The proportion of tick species in Raya Azebo district.

Tick species	No. of ticks collected	Proportion (%)
Rhipicephalus pulchelis	8443	53.7
Hyalomma dromedarii	2011	12.8
Hyalomma rufipes	1756	11.2
Rhipicephalus evertsi-evertsi	1269	8.1
Amblyomma cohaerence	1102	7.0
Amblyomma variegatum	376	2.4
Boophilus decolaratus	283	1.8
Hyalomma truncatum	214	1.4
Amblyomma gemma	176	1.1
Amblyomma lepidum	93	0.6
Total	15723	100

part of Ethiopia. Out of the 384 camels examined, 371 (96.6%) were found infested with tick. This result was higher than Dinka et al. (2010) who reported a prevalence of 61.46% tick infestation on camel in eastern Ethiopia. Similarly, the finding of Lawal et al. (2007) revealed that 92.7% of the total camel in Nigeria was infested by ectoparasites. The average tick burden from half body region of camels in this study was 42.4 ± 19.63. This was in accordance with the previous investigators who reported high tick load per camel (Zeleke and Bekele, 2004; Bekele, 2010; Nazifi et al., 2011). These results showed that tick infestations in camel are highly prevalent.

R. pulchelis was the most abundant tick species found on 92.7% of the examined camels and constituted 53.7% of the total ticks collected. Zelalem (1994), Abebe (2001), Zeleke and Bekele (2004) and Dinka et al. (2010) also reported this tick species from camel with a prevalence of 52.63, 70.47, 85.2 and 27.86%, respectively. The high prevalence of this tick in this study might be due to the fact that *R. pulchellus* is a tick of savanna, steppe and desert climatic regions. It is also among the commonest tick species present in North East Africa and the Rift Valley areas (Walker et al., 2003). *H. rufipes* was the second ranked tick species on camel with a prevalence of 47.4% and constituted 11.2% of the total ticks collected. This result was lower than the finding of Lawal et al. (2007) who reported a prevalence of 22.9% in Nigeria. *H. rufipes* is widely distributed in the most arid parts of tropical Africa, receiving 250 to 650 mm annual rainfall (Hoogstraal, 1956). In addition, *Rhipicephalus evertsi evertsi* was also identified at a prevalence of 41.5%. *R. evertsi evertsi* constituted 8.1% of the total ticks collected. This tick species shows no apparent preference for particular altitude, rainfall zones and seasons (Pegram et al., 1981).

The prevalence of *H. dromedarii* in this study was 42.7% and constituted 12.8% of the total ticks collected. This result was in agreement with the result of Lawal et al. (2007) who reported a prevalence of 46.9% but higher

Table 3. The distribution of tick species among/between the different sexes, ages and body condition score of camels.

Risk factor	Category level	No. of animal infested (%)									
		Tick species									
		AV	BD	AC	HMf	REE	AL	HT	AG	HD	RP
Age (year)	1-4	20 (5.2)	15 (3.9)	19 (4.9)	32 (8.3)	26 (6.8)	2 (0.5)	5 (1.3)	5 1.3)	3 (8.3)	67 (17.4)
	4-8	14 (3.6)	11(2.9)	63 (16.4)	36 (9.4)	35 (9.1)	1 (0.3)	9 (2.3)	3 (0.8)	28 (7.3)	75 (19.5)
	8-12	27 (7.0)	15 (3.9)	15 (3.9)	43 (11.2)	30 (7.8)	3 (0.8)	7 (1.8)	8 (2.1)	33 (8.6)	81 (21.1)
	12-16	9 (2.3)	14 (3.6)	17 (4.4)	38 (9.9)	39 (10.2)	1 (0.3)	9 (2.3)	7 (1.8)	38 (9.9)	67 (17.4)
	≥16	18 (4.7)	9 (2.3)	21 (5.5)	33 (8.6)	29 (7.6)	6 (1.6)	4 (1.0)	1 (1.8)	33 (8.6)	66 (17.2)
	P-value	0.019	0.583	0.470	0.916	0.275	0.117	0.602	0.608	0.335	0.308
Sex	Female	19 (4.9)	6 (1.6)	15 (3.9)	43 (11.2)	31 (8.1)	3 (0.8)	13 (3.4)	17 (4.4)	56 (14.6)	94 (24.5)
	Male	69 (18.0)	58 (15.1)	74 (19.3)	139 (36.2)	128 (80.5)	10 (2.6)	21 (5.5)	13 (3.4)	108 (28.1)	262 (68.2)
	P-value	0.436	0.002	0.049	0.631	0.053	0.888	0.056	0.000	0.000	0.007
BCS	Thin	0 (0.0)	0 (0.0)	0 (0.0)	1(0.3)	1 (0.3)	0 (0.0)	1(0.3)	0 (0.0)	1 (0.3)	1 (0.3)
	Moderate	53 (13.8)	32(8.3)	53 (13.8)	103 (28.8)	93 (24.3)	10 (2.6)	24 (6.2)	22 (5.7)	110 (28.6)	217 (0.3)
	Good	35 (9.1)	32 (8.3)	36 (9.4)	78 (20.3)	65 (17.9)	3 (0.8)	9 (2.3)	8 (2.1)	53 (13.8)	138 (35.9)
	P-value	0.846	0.123	0.811	0.161	0.381	0.483	0.002	0.343	0.045	0.960

(AV) *Amblyomma variegatum*, (BD) *Boophilus decolaratus*, (AC) *Amblyomma cohaerence,* (REE) *Rhipicephalus evertsi evertsi*, (RP) *Rhipicephalus pulchelis*, (AG) *Amblyomma gemma*, (AL) *Amblyomma lepidum*, (HMR) *Hyalomma rufipes* , (HD) *Hyalomma dromedarii*, (HT) *Hyalomma truncatum* and (BCS) body condition score.

higher than the findings of Abebe (2001) and Dinka et al. (2010) studies who reported a prevalence of 20.44 and 15.36%, respectively. Because of its adaptation to extreme dryness and camel hosts, *H. dromedarii* is commonly found in desert climates and in areas where camels are present (Hoogstraal, 1956; Walker et al., 2003).

In this study, the prevalence of *Amblyomma variegatum* was 22.9% and constituted 2.4% of the total ticks collected. Zeleke and Bekele (2004) reported *A. variegatum* from camel at a prevalence of 1.8%. This tick species was also reported by Banaja and Ghandour (1994) and Lawal et al. (2007) in camel from Saudi Arabia and Nigeria, respectivly. *Amblyomma gemma* was also found at a prevalence of 22.9% in this study. This result was higher than the finding of Zeleke and Bekele (2004) and Dinka et al. (2010) who reported a prevalence of 4.0 and 15.10% in camels, respectively. Additionally, *Amblyomma cohaerence* and *Boophilus decolaratus* were encountered on 23.2 and 16.7% of the examined camels, respectively. *A. variegatum, A. gemma, A. cohaerence* and *B. decolaratus* were identified from different domestic animals and from different parts of Ethiopia. These tick species are common and widely distributed on livestock in Africa within a wide variety of climates (Morel, 1980; Pegram and Higgins, 1992; Okello-Onen et al., 1999; Walker et al., 2003). Even though their proportions were very low, *Hyalomma truncatum* and *A. lepidum* were also detected at a prevalence of 8.9 and 3.4%, respectively. Both *H. truncatum* and *A. lepidum* are adapted to dry habitats and occur in arid and semi-arid areas (Walker et al., 2003).

In general, this and other studies showed that ticks are still among the most commonly found ectoparasites of camels worldwide. Further studies should be undertaken in order to understand the distribution pattern of ticks, to estimate the impact of tick infestation on camel

production, and to design effective control and prevention strategies.

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Full Length Research Paper

The prevalence of intestinal helminthic infections and associated risk factors among school Children in Lumame town, Northwest, Ethiopia

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This study was conducted on prevalence of intestinal helminthes infection and their associated risk factors among school children from a rural and a semi urban setting in Lumame town, Northwest, Ethiopia. A cross-sectional parasitological study was conducted to determine the prevalence and associated risk factors of intestinal helminthes infection. A total of 402 students' stool samples were taken and processed with direct wet mount and formalin ether concentration techniques from December to January 2011/2012. A structured questionnaire was prepared to assess the association of intestinal helminthes infection with socio-demographic and socioeconomic variables. The data collected was analyzed using χ^2 test and logistic regression ($p < 0.05$ was considered as statistically significant). The overall prevalence rate for at least one intestinal helminthes infection was 54.5%. Of which *Ascaris lumbricoides* (32.6%) was the dominant followed by hookworm (12.2%); the others were minor cases. High rate infection (*A. lumbricoides*) was recorded among students who had dirty finger nails, large family, habit of eating undercooked vegetable, walking barefoot, and had no latrine than their respective counterpart. Such relatively high prevalence rate of helminthes infection in the study area could be used as a baseline for the concerned bodies to launch de-worming intervention.

Key words: Intestinal helminthes, prevalence, school children, Lumame town.

INTRODUCTION

Intestinal helminthes infections are among the most common and neglected public health problems in many developing countries including Ethiopia. Worldwide, more than 3.5 billion people are infected with intestinal worms (Luong, 2003), and an estimated 4.5 billion individuals are at risk of soil-transmitted helminths infection (Uneke, 2010). Majority of infected people live in resource-poor settings, 80% of these in sub-Saharan Africa (Jamison et al., 2006). Epidemiological surveys have revealed that poor sanitary conditions such as open field defecation and faecal contamination of water bodies are the most important factors leading to intestinal worm infestation, while the spread is due to lack of personal hygiene (Okyay et al., 2004; Hung et al., 2005; Abebe et al., 2001).

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In Ethiopia, the prevalence and distribution of intestinal helminth infection among school children varies from place to place (Mengistu and Birhanu, 2004; Girum, 2005). Likewise, Yared et al. (2001) reported that the low economic standard, poor sanitation, ignorance of simple health promotion factors favor the wide distribution of intestinal helminth infections. Of all types of disease in the country, helminthiasis is the second most common cause of outpatient morbidity next to malaria (Yared et al., 2001).

Although several studies have been conducted on the distribution and prevalence of intestinal parasite in Ethiopia, there are still several localities for which epidemiological information is not available. One of such localities is Lumamae town. Thus, the present investigation was undertaken to determine the prevalence and associated risk factors of intestinal helminth infection, to provide recent and valuable information and to set baseline data for those who are working in the prevention and control of intestinal helminth infection among school children in the area.

MATERIALS AND METHODS

Study area

Lumame is located 260 km away from the capital city, Addis Ababa with an altitude of 1850 m above sea level and an average temperature of 16.25°C. The area is predominantly rural about 89% and most residents live in villages as agriculturalists (AFEO, 2011).

Study design and period

Institution based cross-sectional study was conducted among Lumame primary school children (grade 1 to 8) from December to January 2011/2012.

Study population

The study population was students attending Lumame elementary school in 2011/2012 academic year. The total population enrolled by that academic year was 2865.

Sample size determination and sampling techniques

The sample size was determined using single population proportion formula by considering the prevalence of intestinal parasites in primary school children 95% confidence interval (CI), and design effect that give a final sample size of 422. Proportional allocation for each grade was determined and the desired sample was obtained by systematic sampling technique using the class roster formula (Daniel et al., 1999):

$n= z^2_{\alpha/2}\, p\, (1-P)/d^2$

where n = total number of sample size required, Z = Z statistics for a level of confidence ($Z_{\alpha/2}$ = 1.96), d = marginal error for 95% confidence level, p = expected prevalence of intestinal helminthes in the study area. Since, there was no previous study in the area; P value of 0.5 was taken.

Data collection and laboratory procedures

Data about the socio demographic characteristics and other associated factors were collected using a semi structured based questionnaire. Onsite training was given for interviewers. The interviewers also inspected whether they wore shoe or not. Approximately 2 g of stool specimen was collected using clean, tightly corked, leak proof containers. Small amount of the sample was analyzed using wet mount technique and the remaining portion was concentrated using formal-ether concentration technique and examined microscopically (Adefioye et al., 2011).

Statistical analysis

All statistical analysis was performed using Statistical Package for Social Sciences (SPSS) for window version 16 statistical package. Descriptive statistics was used to present prevalence of intestinal helminth infection as percentage and proportion. The association between student's socio-demographic or socioeconomic variables and prevalence of parasitism was analyzed using Chi-square test. Logistic regression analysis was used to determine the independent effect of the variables by calculating the strength of the association between infection and risk factors using odds ratio (OR) and 95% confidence interval (CI). P-value < 0.05 was considered as statistically significant.

RESULTS

Socio-demographic and other characteristics of study subjects

A total of 422 students were sampled from grade 1 to 8 in this study. Of these, 402 (95.3%) of them positively responded for intestinal helminthes examination by providing fresh stool. The age of study subjects range from 6 to 19 with mean age of 11.67 years.

Students were grouped into three age groups (6 to 10, 11 to14, and 15 to 19 years old). Age group 6 to 10 year accounts for 39.5%, while the remaining group was 40.8 and 19.7%, respectively. Students were further grouped into two grade levels (grades 1 to 4 and 5 to 8) and grade 5 to 8 group accounts for 51.2% of the study subjects. From a total of 402 study participants, 121 (30%) were from nearby rural area and 281 (70%) were urban settings. The proportion of male and female participants was nearly equal 206 (51.2%) and 196 (48.8%), respectively.

Half of student's mothers were illiterate and concerning the occupation, 42.3% students mother were housewives; the remaining, 31.3, 23.2 and 3.2% earn their living as government employees, merchants and daily laborers, respectively.

More than half of the study participants (52.7%) used pipe water, while 39.6 and 7.7% used rivers/streams and well water as source of drinking, respectively. Regarding latrine availability and defecation habit, 61.4% of the study participant had latrine, and 60.7% defecate in latrine only while the rest 39.3% in open field.

Regarding shoe wearing habit, 43.5% wore shoe always, 40.1% sometimes and 16.4% not at all. On assessment about family size, 42.3% of the study subjects

Table 1. Single, double and triple intestinal helimnth infections.

Types of intestinal helminth infections	Frequency (n = 402)	Percentage
A. lumbricoides	107	26.6
Hookworm species	31	7.7
Trichuristrichuria	7	1.7
Hymnolepis nana	18	4.5
S. stercoralis	9	2.2
Taenia species	8	2
E. vermicularis	12	3
A. lumbricoides plus Hookworm species	14	3.5
A. lumbricoides plus *T. trichuria*	4	1
T. trichuria plus *S. stercoralis*	3	0.75
A. lumbricoides plus *E. vermicularis*	2	0.5
A. lumbricoides plus Hookworm plus *T. trichuria*	4	1
Single	192	47.8
Double	23	5.7
Triple	4	1
Total	219	54.5

subjects had family size range from 1 to 3, 26.6% had 4 to 6 member and 31.1% above 6.

Concerning food habit, 37.1% of the study subjects eat raw or under cooked meat and 38.1% study subjects eat unwashed or under cooked vegetables while the remaining 62.9 and 61.9% did not such a habit, respectively. About 96% of the study subjects washed their hands before eating a meal. However, observation of the students hand cleanliness at the time of interview revealed that 32.8% of the total had dirty material in their finger nails. Furthermore, 74.1% of the study subjects did not have a habit of swimming.

Prevalence of intestinal helminth infections

Based on stool sample diagnosis, the prevalence intestinal helminth infections in the study area were identified. Generally, seven types of intestinal helminth species were encountered: *Ascaris lumbricoides*, Hookworm (*Necator americanus* or *Ankylostoma duodenale*), *Trichuris trichuria, Sterongloides stercoralis, Enterobius vermicularis*, *Taenia* species and *Hymenolepis nana* (Figure 1). Out of 402 stool specimen examined, 219 (54.5%) were positive for one or more intestinal helminth infections (Table 1).

Variation was observed in prevalence rate of each intestinal helminth species. The prevalence of *Taenia* spp. was the lowest as compared with other intestinal helminthes encountered. *A. lumbricoides* (32.6%) was the most predominant helminth infection followed by Hookworm (12.2%), *T. trichuria* (4.5%), *H. nana* (4.5%), *E. vermicularis* (3.3%), and *S. stercoralis* (3%).

Nearly half (47.8%) of the study subjects had a single helminth infections, while 5.7 and 1% had double and triple helminth infections, respectively (Table 1). The most frequent combination of helminth infection identified was co-infection of *A. lumbricoides* and Hook worm (3.5%), followed by *A. lumbricoides* and *T. trichuria* (1.0%) and the least being *E. vermicularis* and *A. lumbricoides* (0.5%).

There was a statistical significant association between age group, mother's occupation, family size, educational status of mothers, and availability of latrine, shoe wearing habit, defecation habit, presence or absence of dirty matter on finger nails, eating raw/unwashed vegetable with overall intestinal helminth infection ($p < 0.05$) (Table 2).

Helminth infection varied significantly with grade level of study subjects (χ^2=9.305, df=1, p=0.002). Grade level 1 to 4 students harbor more helminth infection, 55.7% of the total infected students than grade level 5 to 8. The overall prevalence of intestinal helminth infection with respect to age group was statistically significant (χ^2=14.827, df=2, p=0.001). Children between the age group 6 to 10 years old were more affected by helminth infection than the other age groups. Prevalence decreased in age group 11 to 14 years old and the least being 15 to 19 age groups (Table 2).

Risk factors associated with intestinal helminth infections

Risk factor analysis was performed for all variables that were significantly associated with any of the intestinal helminth infection from Chi-square test analysis. Multivariate logistic regression analysis on intestinal helminth infection showed that there was no significant difference in infection rate between grade levels, age groups, mother's education, mother's occupation, defecation

Table 2. Association of socio-demographic and other characteristics with intestinal helminth infection.

Variable	Intestinal helminth infection		χ^2	P- value
	Positive n (%)	Negative n (%)		
Age group				
6 – 10	105 (66)	54 (34)		
11 – 14	74 (45.1)	90 (45.9)	14.827	0.001
15 -19	40 (50.6)	39 (49.4)		
Grade level				
1 – 4	122 (62.2)	74 (37.8)	9.305	0.002
5 – 8	97 (47.1)	109 (52.9)		
Gender				
Male	115 (52.8)	91 (44.2)	0.309	0.578
Female	104 (53.1)	92 (46.9)		
Residence				
Urban	145 (51.6)	136 (48.4)	3.114	0.082
Rural	74 (61.2)	47 (38.8)		
Source of drinking water				
Stream/rivers	110 (69.2)	49 (30.8)		
Pipe water	88 (41.5)	124 (58.5)	30.43	0
Well water	21 (67.7)	10 (32.3)		
Latrine availability				
Present	97 (39.3)	150 (60.7)	59.73	0
Absent	122 (78.7)	33 (21.3)		
Defection habit				
Latrine	98 (40.2)	146 (59.8)	51.288	0
Open field	121 (76.6)	33 (23.4		
Shoe wearing habit				
Always	67 (38.3)	108 (61.7)		
Sometimes	98 (60.9)	63 (39.1)	41.047	0
Not at all	54 (81.8)	12 (18.2)		
Hand washing				
Yes	208 (53.9)	178 (46.1)	1.369	0.242
No	11 (68.8)	5 (31.2)		
Eating raw meat				
Yes	83 (57.7)	66 (44.3)	0.144	0.705
No	136 (53.8)	117 (46.2)		
Eating unwashed vegetables				
Yes	117 (76.5)	36 (23.5)	48.177	0
No	102 (41.0)	147 (59.0)		
Swimming				
Yes	59 (56.7)	45 (43.3)	0.287	0.648
No	160 (53.7)	138 (46.3)		

Table 2. Cont'd.

Dirty finger nails				
Present	114 (86.4)	18 (13.6)	80.574	0
Absent	105 (38.9)	165 (61.1)		
Mothers education				
Illiterate	138 (68.7)	63 (31.3)	32.59	0
Literate	81 (40.3)	120 (59.7)		
Family size				
1 – 3	42 (24.7)	128 (75.3)		
4 – 6	74(69.2)	33 (30.8)	109.357	0
> 6	103 (82.4)	22 (17.6)		
Mothers occupation				
House wife	109 (64.5)	60 (35.5)		
Merchant	57 (60.0)	38 (40)	36.969	0
Daily laborer	10 (76.9)	3 (23.1)		
Government employed	43(34.4)	82(65.6)		

habit and source of drinking water ($p > 0.05$). None of these were risk factors for helminth infection in this study (Table 3). On the other hand, presence of dirty material in the finger nails was the potential risk factor (OR = 7.925 for dirty versus clean finger nails; 95% CI 3.983 – 15.766). Study subjects with dirty material in finger nails were 7.925 times more likely to be infected. Similarly, the model showed that having large family was a risk factor for helminth infection (OR = 6.949 for family member >6 versus 1 to 3, $P < 0.000$ and OR = 4.784 for family member 4 to 6 versus 1 to 3, $p < 0.000$).

Regarding feeding habit, study subjects who eat unwashed or undercooked vegetables and fruit were more likely exposed to helminth infection than those who did not eat. The difference was significant (OR = 4.095 for eating versus not eating; 95% CI: 2.176 – 7.704).

The model also showed that shoe wearing habit was a risk factor for helminth infection. Students who did not wear shoe were at higher risk (OR = 0.36 for those who did not wear shoe versus those who wear always; 95% CI: 0.147 - 0.884).

Furthermore, the model identified the lack of latrine as a risk factor for helminth infection. The difference was significant (OR = 0.307 for none latrine versus latrine; 95% CI: 0.097 – 0.973). Students who did not have latrine were 0.307 times more likely to be infected than those that had latrine.

Relationship between intestinal helminth species and some selected variables

Although, age groups, grade levels, source of drinking water and defecation habit and mother's occupation were not identified as risk factor for helminth infection. They were significantly associated with intestinal helminth infection. Except *E. vermicularis* and *T. trichuria* each helminth species identified in this study revealed significant difference with respect to age group (χ^2). Prevalence of hookworm and *Taenia* spp. were significantly increased with age, whereas *A. lumbricoides*, *H. nana* and *S. stercoralis* significantly decreased (Table 4).

The two predominant helminth infections in this study, *A. lumbricoides* and Hookworm, were significantly associated with source of drinking water while the rest of the helminthes did not. Source of drinking water significantly associated with *A. lumbricoides* and Hookworm infection among students (χ^2= 15.928, df = 2, p = 0.000) and (χ^2= 7.81, df = 2, p = 0.02), respectively.

Study subjects who defecated in open field harbor more helminth infections than those that defecated in latrine (76.6% versus 40.2% from the total helminth infection). Defecation habit was significantly associated with *A. lumbricoides* and Hookworm infections among study subjects (χ^2= 16.267, df = 1, p = 0.000) and (χ^2= 9.245, df = 1, p = 0.002), respectively (Figure 2).

Logistic regression analysis revealed shoe wearing as risk factors for hookworm infection. Study subjects who did not wear shoe were 3.28 times at risk of infection thanthose who wore shoe always and the difference were statistically significant. Although, the overall helminth prevalence did not differ significantly with respect to residence (Rural versus Urban), hookworm infection was significantly different between urban and rural students and being rural was a risk factor. Rural student were 3.070 times more exposed to hookworm infection than urban students (Table 5).

Table 3. Multivariate logistic regression analysis showing the impact of selected risk factors on intestinal helminth infections.

Risk factor	Helminth infection		Adjusted OR	95% CI	P-value
	Positive	Negative			
Age group					
6 -10	105	54	2.238	0.687 - 7.292	0.181
11 - 14	74	90	0.814	0.366 – 1.808	0.613
15 - 19	40	39	1	-	-
Grade level					
1 – 4	122	74	0.68	0.26 – 1.777	0.680
5 – 8	97	109	1		
Latrine availability					
Present	97	150	1	0.097 – 0.973	0.045
Absent	122	33	0.307		
Defecation habit					
Open field	121	33	1.131	0.377 – 3.395	0.826
Latrine	98	146	1		
Shoe wearing habit					
Always	67	108	1	-	-
Sometimes	98	63	0.236	0.088 – 0.628	0.004
Not at all	54	12	0.36	0.147 – 0.884	0.026
Source of drinking water					
Stream/rivers	110	49	1.259	0.607 – 2.612	0.536
Well water	21	10	1.288	0.416 – 3.984	0.66
Pipe water	88	124	1	-	-
Eating undercooked vegetable					
Yes	117	36	4.095	2.176 – 7.704	0.000
No	102	147	1		
Dirty material in finger nails					
Present	114	18	7.925	3.983 – 15.766	0.000
Absent	105	165	1		
Mothers education					
Illiterate	138	63	0.88	0.446 – 1.736	0.713
Literate	81	120	1		
Family size					
1 – 3	92	128	1	-	-
4 – 6	74	33	4.784	2.373 – 9.646	0.000
>6	103	22	6.949	3.272 – 14.756	0.000
Mothers occupation					
House wives	109	60	0.383	0.067 – 2.184	0.258
Merchants	57	38	0.358	0.06 – 2.127	0.280
Daily laborers	10	3	0.247	0.04 – 1.513	0.130
Government employees	43	82	1	-	-

OR stands for Odds Ratio, 95% CI for the 95 percent confidence interval.

Table 4. The relationship between intestinal helminth infections and age groups.

Age group (years)	Al [n (%)]	Hk [n (%)]	Tt [n (%)]	Tsp [n (%)]	St [n (%)]	Hn [n (%)]	Ev [n (%)]
6-10	67 (42.1)	14 (8.8)	4 (2.5)	0 (0)	10 (6.3)	13 (8.2)	7 (4.4)
11-14	49 (29.9)	16 (9.8)	12 (7.3)	3 (1.8)	1 (0.8)	3 (1.8)	7 (4.3)
15-19	15 (19)	19 (24.1)	2 (2.5)	5 (6.3)	1 (1.3)	2 (2.5)	0 (0)
Total	131 (32.6)	49 (12.2)	18 (4.5)	8 (2)	12 (3)	18 (4.5)	14 (2.6)
Chi-square	12.896	12.993	5.222	10.876	9.996	8.474	3.55
P- value	0.002	0.002	0.073	0.004	0.007	0.014	0.169

Table 5. The risk factors of Hookworm infection with respect to shoe wearing habit and residence.

Risk factor		Hookworm		OR	95% CI	P- value
		Positive [n (%)]	Negative [n (%)]			
Shoe wearing habit	Always	4 (8.2)	171 (48.4)	1	-	-
	Sometimes	15 (30.6)	146 (41.4)	1.12	0.527- 2.377	0.769
	Not at all	30 (61.2)	36 (10.2)	3.28	1.545 – 6.964	0.002
Residence	Urban	23 (46.9)	258 (73.1)	1	1.671 – 5.641	0.000
	Rural	26 (53.1)	95 (26.9)	3.070		

DISCUSSION

Studying the infection prevalence of intestinal helminthes and associated risk factors in different localities is a primary objective to identify high risk communities and select appropriate intervention mechanisms. In line with this view, the present study attempted to assess the prevalence of intestinal helminth infections and risk factors among Lumame elementary school children.

This study identified seven types of intestinal helminth species. The overall prevalence of any helminth infection was 54.5% among students. This result was in line with prevalence rates reported by Teklemariam and Teklemariam (1983) and Olusegum et al. (2011). On the other hand, the present finding was higher than that reported by Girum (2005) and Anosike et al. (2006). The differences in findings among the studies might be due to variations in socio-economic conditions, individual behavioral habits of selected children, the methods employed for stool examination, the sample size taken and the time of study (Mengistu and Berhanu , 2004; Yared et al., 2001).

A. lumbricoides was the most dominant helminth infection followed by hookworm. The result was higher than school children reported by Ihesiulor et al. (2006) and Abebe et al. (2011). However, it was comparable to the reports by Lapiso et al. (2002) and Olusegun et al. (2011). Hookworm species was lower in the study conducted by Mengistu and Birhanu (2004) and Fekadu et al. (2008). But it was in line with studies Mani et al. (2002) and Anosike et al. (2006). The difference in prevalence rate of hookworm could be climate and behavior of study subjects. The relatively low prevalence of *T. trichuria*, *H. nana*, *S. stercoralis*, *Taenia* spp. and *E. vermicularis,* in this study was in agreement with other studies (Yared et al., 2001; Fekadu et al., 2008; Asrat et al., 2011).

In this study, the presence of dirty material in finger nails, having large family and availability of latrine were the main risk factor of *A. lumbricoides* infection. The result is in line with other studies (Dongre et al., 2008; Asrat et al., 2011; Olusegun et al., 2011). This is probably due to insufficient water supplies, poor hygienic practice, poor socio-economic status of the study subjects, and contamination of vegetables with fecal materials in the farm.

A. lumbricoides significantly affected the age group and grade level in the study. Similar findings were reported by Awasthi et al. (2003), Fleming et al. (2006), Inabo and John (2010) and Abebe et al. (2011). This high infection rate of *A. lumbricoides* could be linked to the route of infection being faeco-oral, since children within this age are easily susceptible due to poor level of hygiene and indiscriminately play on fecal contaminated grounds and have a common habit of placing soiled fingers in the mouth. On the other hand, low prevalence rate among older age group and grade level 5 to 8 in this study, was possibly due to the change in attitude, habits, and more awareness regarding to personal hygiene among the older school children.

In addition, children who defecated in open field and used rivers/streams as source of drinking water harbored more *A. lumbricoides* infection than their respective counterparts. This result was consistent with other studies Yared et al. (2001) and Asrat et al. (2011). This is

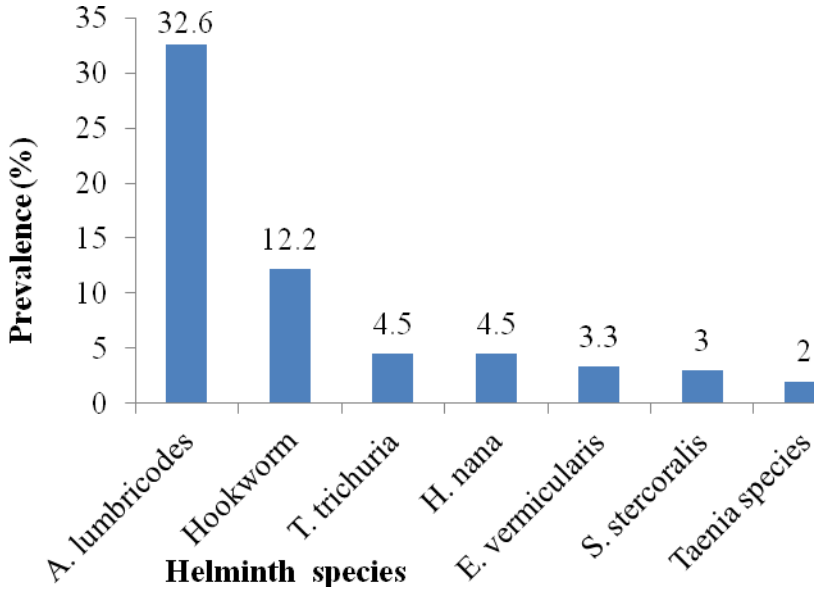

Figure 1. Prevalence of intestinal helminth infection in the study subjects.

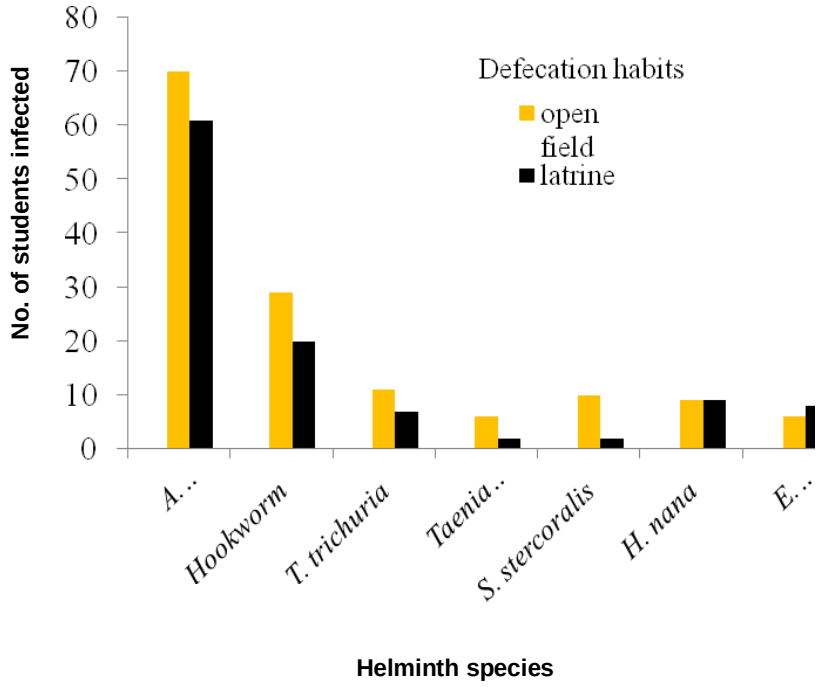

Figure 2. Prevalence of intestinal helminth infections with respect to defecation habits.

the environment and hence favor the transmission.

Similarly, literacy rate of mother and mothers' occupation are found to be important helminth transmission factors. The result was in agreement with findings reported by Okyay et al. (2004) and Hung et al. (2005). This is more likely that parents of children at high level of education provide better sanitation condition for their children than low educational level parents and low level of hygiene and high exposure potentials of daily laborer mothers, respectively.

Hookworm infection, in this study significantly varied with age. This is in agreement with other studies (Anosike et al., 2006; Fleming et al., 2006). High rate of hookworm infection in older aged group probably linked to having

high outdoor activities such as helping in farming, playing at the back yard in moist soil, etc., resulting in higher exposure to infective egg and filariform larvae in the soil.

In this study, students who did not wear shoe were more likely to be infected by hookworm infection than who wore shoe always. Similarly, being rural was the risk factor for hookworm infection than urban. This finding was in agreement with Lapiso et al. (2002).

CONCLUSION AND RECOMMENDATION

Intestinal helminth infections were prevalent in varying magnitude among Lumame elementary school children and were important health problem with relatively high overall rate of prevalence (54.5%). The predominant helminth was *A. lumbricoides* followed by Hookworm and the rest were minor cases. The relatively high prevalence rate of intestinal helminth infection in the study area might be the reflection of poor sanitation of the environment, poor personal hygiene, relatively unhygienic water supply, and others.

The presence of dirty material in finger nails was the main risk factor for intestinal helminth infection followed by having large family size, consumption of unwashed or raw vegetable, walking bare foot and lack of toilet in the study area. Therefore, personal sanitary education, having small family size, proper cooking or washing of vegetables before eating, using toilet for defecation, and always wearing shoe were important measures that greatly reduced the predominant intestinal helminth infections prevalent in the study area.

In order to reduce the impact of helminth infection among children, adequate intervention strategies should be designed and implemented. Therefore, the authors recommended that local health sector should collaborate with school health program for delivering health education to enhance the knowledge and attitude of the children against transmission of intestinal helminthes. The local government should improve pipe water supply, latrine facilities and health education to the society since *A. lumbricoides* infection can be significantly reduced by improving these services. Furthermore, the current study did not address the intensity of helminth infection. Hence, further research focusing on intensity infection should be conducted for further status of helminth infection in the study area.

Conflict Interests

The authors declare that there is no conflict of interests.

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APPENDIX

I. A questionnaire prepared to assess prevalence and risk of intestinal helminth infection on the study subjects (students) among Lumame elementary school.

Part I: Student's school record and Socio-demographic data
1. Name of student_____
2. Student code_____
3. Grade level _____
4. Age_____
5. Sex: 1. Male 2. Female
6. Residence: 1. Urban 2. Rural

Part II: socioeconomic data
1. From where do you get water for drinking? From:
1. Streams or rivers 2. Pipe water 3. Well water
2. Do your parents have latrine? 1. Yes 2.No
3. Where do you defecate your feces? 1. Open field 2. Latrine only
4. How often do you wear shoes? 1. Always 2. Sometimes 3. Not at all (no shoe)
5. Do you wash your hands before eating meal? 1. Yes 2. No
6. Do you eat raw meat? 1. Yes 2. No
7. Do you eat unwashed or raw vegetables or fruits? 1. Yes 2. No
8. Do you swim in the nearby river? 1. Yes 2. No
9. Is there dirty materials in the finger nails (if not trimmed off)? (Inspected by Interviewer) 1. Yes 2. No
10. What is your mother education level?
a) Unable to read/write (Illiterate) b) Able to read /write (Literate)
11. What is the number of your family? a) 1 - 3 b) 4 –6 c) >6
12. What is four mother's occupation? A. house wife b. merchant c. daily laborer
d. government employees

2. Parasitological investigation of the study subjects at the study site health center
Laboratory data

Code of study subject_____
Date of examination_____
1. Microscopic Examinations
1.1 Direct wet mount microscopic observation
A. Intestinal helminthes egg or larva observed_____, _____, _____
B. other parasites (protozoa)_____,_____
1.2. Formalin-ether concentration method
A) Ova of helminthes parasite observed_____, _____
B) Other parasites
_____, _____
Name of laboratory investigator:_____
Signature: _____
Date:_____

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