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Prevalence and Associated Risk Factors of Major Gastrointestinal Parasites of Pig Slaughtered at Addis Ababa Abattoirs Enterprise, Ethiopia

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Abstract

A cross-sectional study was conducted to determine prevalence and associated risk factors of gastrointestinal tract (GIT) parasites of pigs slaughtered at Addis Ababa Abattoirs Enterprise (AAAE) from October, 2009 to May, 2010 using systematic random sampling technique. A total of 390 pigs were sampled to assess and identify different genera of GIT parasites of pig. For this study, faecal samples were collected from a total of 390 pigs' slaughtered in the abattoir while post mortem adult parasite recovery was done by incision of liver, removing intestinal content, opening of the cecum and colon. The collected faecal samples were examined by zinc sulphate floatation and sedimentation techniques for isolation of parasitic eggs and/or oocysts. Out of 390 samples tested in the present study, an overall prevalence of 61.8% GIT parasite was identified. Among the examined samples, 16.2% (63/390), 12.6% (49/390), 6.9% (27/390), 3.9% (15/390), 11.8% (46/390), 10.5% (41/390) were identified as *Strongyloides* spp., *Ascaris suum (A. suum), Trichuris suis (T. suis), Oesophagostomum* spp., *Coccidia* spp. and *Fasciola hepatica (F. hepatica)* ova/oocyst, respectively. The study had also revealed that about 11.28% and 37.69% pigs had harbored mixed and single infection, respectively. A Chi-square computed statistical analysis indicated that origin (χ^2=3.5408; P>0.05), age (χ^2=1.8628; P>0.05) and sex (χ^2=0.0636; P>0.05) were insignificantly associated with the infection of GIT parasites in the study area. However, the prevalence of individual GIT parasite infections analysis revealed that both sex and age were significantly associated with the prevalence of *Coccidia* spp. (p<0.05) while origin was significantly associated with the prevalence of the nematode *A. suum* (p<0.05). An overall prevalence of 28.2% GIT parasites were identified upon postmortem adult parasite inspection. Our study revealed that pig GIT parasites were the major biological constraints contributing to the low productivity of pig and hampered the economic benefit obtained from the sector. Therefore, further detailed investigations are needed to formulate appropriate and cost-effective strategies for the control of gastrointestinal parasites in pig farms in Ethiopia.

Keywords: Gastrointestinal parasites; Pig; Prevalence; Risk Factors; Ethiopia

Abbreviations

AAAE: Addis Ababa Abattoirs Enterprise; CI: Confidence Interval; GIT: Gastro Intestinal Tract; MASL: Meters Above Sea Level; NaCl: Sodium Chloride; RPM: Revolution per Minute; χ^2: Pearson's Chi-square

Background

Pigs, also called hogs or swine, are ungulates which have been domesticated as a source of food, leather and similar products since ancient times. More recently, they have been involved in biochemical research and treatment [1]. Pig farming is an important task which provides opportunity as an income generating activity for small-scale farmers, especially in developing countries. This activity is most popular in Africa, Latin America, and South East Asia [2]. In most cases, the reasons for keeping pigs include provision of protein/meat, dowry, and manure for fertilizing the soil, particularly for farmers that practice mixed farming. However, swine could carry many intestinal pathogens which would hinder the growth of pigs, leading to significant economic losses to the livestock industries and farming communities [3,4].

Infection of pigs with GIT parasites is widely reported from all corners of the world and shown to be influenced by the type of pig management practiced [5]. Pig infected with GIT parasites had poor feed conversion rate and delays in achievement of market weight. Some of the GIT parasites of pigs result in condemnation of organs or entire carcasses causing economic losses in pork industry [6,7]. In addition, pigs infected with GIT parasites may act as source of zoonoses through contaminating the environment with infective stages of intestinal parasites present in their excreta [7,8]. The prevalence of pig born GIT parasites may further be complicated when some of the parasites of pigs infect man and vice versa [7].

Among GIT parasites, helminthes are major health problem to those swine grazing on pasture. Helminthes importance on swine is chiefly economical with its sub-clinical infection delay's the achievement of market weight by being responsible for poor feed conversion rates [9]. The common *helminth* parasites of swine are

Ascaris, Trichuris, Oesophagostomum, Trichinella and Strongyles species[10] while Fasciolosis caused by *F. hepatica* and *F. gigantica*, is also one of the most prevalent helminthes infection of ruminants(also pseudoruminants, pig) in different parts of the world. It causes significant morbidity and mortality [11]. Among protozoan diseases, *Eimeria* and *Isospora* spp. are very common [12]. The most known external parasite of swine is *Sarcoptic* mange, although in some condition swine may be infested by *Demodex* mange and lice [13,14].

Prevalence studies on intestinal parasites affecting pigs have been undertaken worldwide. In a study in Eastern Ghana,Permin et al. [15] reported a prevalence of 91% with the highest prevalence of eggs of *Oesophagostomum* spp. (60.6%) while Nsoso et al. [16] reported a prevalence of 82% of gastrointestinal parasite ova in pigs infected with *A. suum* (54.6%), *Trichostrongylus* spp. (20.4%) and *T. suis (*6.8%) in Botswana. In the Guadong province of China, [4] reported four gastrointestinal parasite infecting pig among which *Coccidia* spp. (*Eimeria* spp. and/or *I. suis*) (47.2%) was the most prevalent. Contrary to the aforementioned higher prevalence of gastrointestinal parasites ova/oocyst infection in pig, Adesiyun AA reported no evidence of nematode parasites in pigs in Trinidad and Tobago [17].

In Ethiopia, where domestic pig has been neglected by the scientific community, very few publications are available focusing on gastrointestinal parasites. In a study investigated among 714 pigs by Tomass et al. [7] for gastrointestinal parasites in extensively managed pigs in Mekelle and urban areas of southern zone of Tigray region, Northern Ethiopia, four species of parasites were implicated including *A. suum*, *F. hepatica*, Eimeria spp. and *T. suis*. Study conducted by Abdu et al. among 388 pigs for parasitic interaction in and around Holetta, reported three gastrointestinal parasites infection with *A. suum* the most prevalent (13.9%) [14]. Recently, Kumsa et al. reported 13.2% of pigs were infected with one or more types of parasite in Burayu District, Oromia Regional State while Jufare et al. reported four gastrointestinal parasites in two farms with poor husbandry practices in Bishoftu with the highest prevalence of *Coccidia* spp [18,19]. Parasites of pigs and their potential to infect humans have recently become major issues among the public [20]. To our knowledge, there is no published information detailing prevalence of gastrointestinal parasites ova/oocyst and adult parasites identification of pigs slaughtered in abattoir in the country. Therefore, this study was intended to investigate the prevalence of gastrointestinal parasites in pigs slaughtered at AAAE, Addis Ababa, Ethiopia.

Materials and Methods

Description of the study area

The study was conducted in pigs slaughtered at AAAE originated from the two purposively selected sites in Central Ethiopia namely, Addis Ababa and Bishoftu areas. Addis Ababa is the capital city of Ethiopia located at longitude 38° 44′-24″E and latitude 9°1′ 48″N. The altitude is from 2,200 to 3,300 meters above sea level (masl). The annual rainfall is 800-1,100 mm and the mean annual maximum and minimum temperature is about 21°C and 27°C, respectively [21]. Bishoftu is found in Adea district of East Shewa Zone of Oromia Regional State at a distance of 45 kms from Addis Ababa. Bishoftu town is situated at a longitude of 38°59′ E to 38.983°E and latitude of 08° 45′N to 8.750°N at an elevation of 1920 masl. The average rainfall is about 839 mm, while the mean minimum and maximum temperatures recorded for 27 years ranged from 7.9°C to 28°C with an overall average of 18.5°C [22].

Study populations

The study population was pig's slaughtered at AAAE originating from Addis Ababa and Bishoftu areas. The majorities of the pig populations studied were from the Bishoftu area, where many large and small scale commercial pig farms are concentrated. In the Bishoftu area, pigs are mainly kept under an intensive production system. In the Addis Ababa area, both intensive and extensive pig management systems are common. All pigs including those less than three months of age belonging to both sexes (male and female) were considered for the purpose of this study. Age was determined using tooth eruption patterns [23].

Study designs and sample size determination

A cross-sectional study design was conducted to determine the prevalence of major gastrointestinal parasites of pig slaughtered at AAAE from October, 2009 to May, 2010 using systematic random sampling technique. The sample size was calculated according to Thrusfield [24] by considering 50% expected prevalence (P), 95% confidence interval (CI) (Z=1.96) with 5% desired absolute precision (d), using the formula $N=(Z)\ 2\ P\ (1-P)/d^2$. The calculated required sample size (N) was 384. However, the total number of sampled animals was increased to 390 to maintain the proportionality of the sample size.

Feacal sample collection and transportation

Fecal samples were collected directly from the rectum of pigs with strict sanitation in the abattoir, when the pigs are slaughtered (after stunning). About 5 gram of the collected fecal sample was put in sterile plastic containers and transported to AAAE general purpose laboratory. All faecal samples were kept in 10% buffered formalin as recommended by William and Anne [25,26] and stored at -20°C until processed and examined for eggs and oocysts of gastrointestinal helminths and protozoan's, respectively.

Coproscopical examination

Zinc sulphate flotation: Three grams of feacal samples were mixed with 50 ml of 0.4g/ml zinc sulphate (flotation fluid) using mortar and pistil. The resulting fecal suspension was poured through a tea strainer into a centrifuge tube and centrifuged at 1500 revolution per minute (rpm) for 10 minutes. The centrifuge tube was then filled to the brim with more zinc sulphate and a cover slip placed on top of the tube and let to stand for 20 minutes. The cover slip was then removed from the centrifuge tube and placed on a glass slide for microscopic examination. Identification of parasitic eggs and oocysts was carried out as described by Kassai T and Charles [27,28].

Sedimentation: Sedimentation technique was used to recover eggs of intestinal helminths such as *F. hepatica* which do not float well in sodium chloride solution/zinc sulphate. For this purpose(for sedimentation), 3 gm of feacal sample was put in a conical flask and mixed with 30 ml of water; the mixture was then sieved through a tea strainer into a beaker and transferred into a centrifuge tube for centrifuging at 1500 rpm for 3 minutes. The supernatant was then discarded and sediment was mixed with 1% of methylene blue and examined under the microscope using 40 objective lens [29].

Postmortem examination

Liver, small intestine, cecum and colon were examined thoroughly to identify (recover) adult parasites during postmortem examination. Bile duct enlargement and irregularity in the morphology of the liver was inspected visually, and then palpation and multiple incisions of all visible bile ducts and their branches were conducted to search for adult *Fasciola* logged inside. Small intestine, colon and cecum were opened and examined for the presence of adult helminthes.

Data analysis

Data generated from laboratory investigations were recorded and coded using Microsoft Excel spreadsheet (Microsoft Corporation) and analyzed using STATA version 11.0 for Windows (Stata Corp. College Station, TX, USA). The prevalence of pig gastrointestinal parasite was calculated as the number of positive (egg/oocytes present) samples divided by the total number of samples tested. To identify association of prevalence with the risk factors (origin, age and sex) were computed by percentages and Pearson's Chi-square (χ^2) test. In all cases P<0.05 was considered as statistically significant.

Results

Overall prevalence of pig GIT parasites ova/oocyst identified in this study

Parasitological analytical data indicated that 241 of 390 total pig herd examined harbored either single infection or mixed infection. Based on egg/ova identification, the study had established 4 genera of nematode, a genus of protozoa and trematode (Table 1).

Parasite identified (ova/oocysts)	Number of positive sample	Prevalence (%)
Strongyloides spp.	63	16.2
A. suum	49	12.6
T. suis	27	6.9
Oesophagostomum spp.	15	3.9
F. hepatica	46	11.8
Coccidia spp.	41	10.5
Total	**241**	**61.8**

Table 1: Overall prevalence of GIT parasites ova/oocyst of pig slaughtered at AAAE

Overall prevalence of pig GIT parasite ova/oocyst in relation to origin, age and sex

The overall prevalence of gastrointestinal parasites for those pigs originated from Addis Ababa area was 54.97% whereas those from Bishoftu was 45.19%. Moreover, it was shown that the overall prevalence of pig GIT parasites in piglet, grower and adult was 33.33%, 65.85% and 49.17%, respectively. The overall prevalence of pig GIT parasites ova/oocyst was also found to be 49.54% and 48.26% in females and males, respectively (Table 2).

Variables		Number examined	Number of positive sample	Prevalence (%)	χ^2	P-value
Origin					3.5408	0.060
	Addis Ababa	151	83	54.97		
	Bishoftu	239	108	45.19		
Age					1.8628	0.394
	Piglet	48	16	33.33		
	Grower	41	27	65.85		
	Adult	301	148	49.17		
Sex					0.0636	0.801
	Female	218	108	49.54		
	Male	172	83	48.26		

Table 2: Overall prevalence of pig GIT parasites ova/ oocyst in relation to origin, age and sex, NB: For origin, df=1, age, df=2, sex, df=1; df=degree of freedom

Prevalence of Pig GIT parasites ova/oocyst in relation to origin

From the parasite identified (ova/oocyst) in the present study, *Strongyloides* spp. was highly prevalent in pigs originated from Bishoftu (17.2%) while *A. suum* was the highly prevalent intestinal parasite in pig originated from Addis Ababa and its surroundings (Table 3)

Parasites identified (ova/oocysts)	**Addis Ababa (n=151)**	**Bishoftu (n=239)**	**χ^2**	**P-value**
	Positive (%)	**Positive (%)**		
Strongyloides spp	14.6	17.2	0.4566	0.499
A. suum	18.5	8.8	8.0181	0.005
T. suis	4.6	8.4	2.0006	0.157
Oesophagostomum spp	4.6	3.3	0.4154	0.519
F. hepatica	15.2	9.6	2.7977	0.094
Coccidia spp	13.9	8.4	3.0179	0.082

Table 3: Prevalence of Pig GIT parasites ova/oocyst in relation to origin, NB: n=number of animals examined; df =1, df=degree of freedom

Prevalence of pig GIT parasites ova/oocyst in relation to age group

High prevalence of *Coccidia* spp. (22.9%) oocyst was found in piglet slaughtered in the abattoir when compared to *A. suum* (8.3%), *Strongyloides* spp. (6.3%), *T. suis* (6.3%) while no Oesophagostomum spp. and *F. hepatica* ova were identified in this age group. Adult pigs were highly infected by *Stronglyoides* spp. (17.6%) while *Oesophagostomum* spp. (3.7%) was the least among the parasite ova identified as depicted in Table 4.

Parasite identified (ova/oocyst)	**Age group**			**χ^2**	**P-value**
	Piglet(n=48)	Grower(n=41)	Adult(n=301)		
	Positive (%)	Positive (%)	Positive (%)		
Strongyloides spp.	6.3	17.1	17.6	3.9716	0.137
A. suum	8.3	19.5	12.3	2.6041	0.272
T. suis	6.3	7.3	6.9	0.0450	0.978
Oesophagostomum spp.	0	9.8	3.7	5.8221	0.054
F. hepatica	0	14.6	13.3	3.0842	0.214
Coccidia spp.	22.9	14.6	7.9	10.6536	0.005

Table 4: Prevalence of pig GIT parasites ova/oocyst in realtion to age group, NB: n=number of pigs examined; df=1, df=degree of freedom

Prevalence of pig GIT parasites ova/oocyst in relation to sex group

Female pigs were highly infected by GIT parasites ova/oocysts identified in this study when compared to male, except the *Coccidia* spp. which was highly prevalent in male pigs than in females (Table 5).

Parasite identified (ova/oocyst)	**Sex**		**χ^2**	**P-value**
	Female(n=218) (%)	Male(n=172) (%)		
Strongyloides spp.	17.4	14.5	0.5955	0.440
A. suum	14.2	10.5	1.2341	0.267
T. suis	8.3	5.2	1.3647	0.243

Oesophagostomum spp.	4.6	2.9	0.7339	0.392
F. hepatica	11.9	11.6	0.0082	0.928
Coccidia spp.	6.9	15.1	6.9315	0.008

Table 5: Prevalence of pig GIT parasites ova/oocyst in relation to sex, NB: n=number of pigs examined; df =1, df=degree of freedom

Infection types

Out of 390 pigs examined, 44(11.28%) and 147(37.69%) pigs were found to harbor mixed and single infections, respectively (Table 6).

Variables		Number of animals examined	Infection type		χ^2	P-value
			Mixed (polyparasitic) (%)	Single (monoparasitic) (%)		
Origin					3.6371	0.162
	Addis Ababa	151	20(13.25)	63(41.72)		
	Bishoftu	239	24(10.04)	84(35.15)		
	Total	390	44(11.28%)	147(37.69)		
Sex					0.2139	0.899
	Female	218	26(11.93)	82(37.61)		
	Male	172	18(10.47)	65(37.79)		
	Total	390	44(11.28)	147(37.69)		
Age					2.8104	0.590
	Piglet	48	4(8.33)	16(33.33)		
	Young	41	7(17.07)	16(39.02)		
	Adult	301	33(10.96)	115(38.21)		
	Total	390	44(11.28)	147(37.69)		

Table 6: Infection type in relation to origin, age and sex, NB: For origin, df =2; age, df=4; sex, df=2, df=degree of freedom

Recovery of adult GIT parasites by postmortem examination

The overall prevalence of adult GIT parasites in pig slaughtered at AAAE based on post mortem examination was 28.2%. The recovered adult parasites in the decreasing order of prevalence were *F. hepatica* (22.1%), *A. suum* (4.6%), *T. suis* (1.03%) and *Oesophagostomum* spp. (0.5%) (Table 7).

Adult parasite identified	Predilection site	Number of positive animals	Prevalence (%)
F. hepatica	Liver	86	22.1
T. suis	Ceacum	4	1.03
Oesophagostomum spp	Colon	2	0.5
Strongyloides spp	Small intestine	0	0
A. suum	Small intestine	18	4.6

Total		**110**	**28.2**

Table 7: The prevalence of adult GIT parasites identified in pigs slaughtered at AAAE based on the recovery by post mortem examination.
NB: In all cases, a total numbers of animals examined were 390.

Discussion

The present study established six GIT parasites ova/oocysts namely, *Strongyloides* spp, *A. suum*, *T. suis, Oesophagostomum* spp, *F. hepatica* and *Coccidia* spp. The coproscopical examinations employed for identification of ova/oocyst include zinc sulphate flotation and sedimentation techniques which revealed the existence of parasitosis with overall prevalence of 61.8% of pigs slaughtered in the abattoir. This finding is consistent with the earlier reports of Fasil [30] in Ethiopia and Ismail HAHA [31] in Korea. However, our result is higher than the prevalence reported by Tomass [7,19,32] in Ethiopia, [33] in China and [34] in Nigeria. The differences in the prevalence observed between the present study and aforementioned studies could be due to poor management system and lack of veterinary care. Traditional system of management in which pigs are allowed to roam freely or are kept under poor hygienic conditions such as those obtainable in dirty isolated lots or pens encourages helminthosis [35].

This study revealed that *Strongyloides* spp. was the most prevalent parasite followed by *A. suum*. This is in contrast with the findings of past studies where *A. suum* was reported as the most prevalent parasite in scavenging pigs [36-38] and also in semi-intensively managed pigs [16]. The high prevalence of *Strongyloides* spp. (16.2%) could be due to the differences in climatic conditions, management systems and local circulating parasites in the locality. The survival of *Strongyloides* larvae depends on the environmental temperature and moisture. The larvae of these species are susceptible to desiccation with the dry areas providing unfavourable environment for survival of *Strongyloides* larvae [39,40].

The prevalence of 12.6% recorded for *A. suum* in this study was higher than 4.9% reported from Bishoftu, Ethiopia [19], 3.7% from Turkey [41] but lower than 54.6% reported from Bostwana [16], 17.6% from Korea [31] and 18.5% from Plateau state of Nigeria [42]. The moderately high prevalence of *A. suum* in the present study might be associated with farm management systems and access of free roaming of pig in the environment which facilitates ingestion of thick-shelled eggs of *A. suum*. These thick-shelled eggs are resistant to adverse environmental factors as well as chemicals and can maintain infectivity for long periods of time [43].

Previous studies by Tomass et al. and Jufare et al. [7,19] from Ethiopia, [40] from Zimbabwe, [15] from Ghana and [4] from China reported *T. suis* prevalence of 0.3%, 2.9%, 4.7%, 4.6% and 5.2% respectively which is lower than the report of the present study (6.9%). Contrary to this, [44] from West Indies and [45] from Uganda reported a prevalence of 38% and 17%, respectively which is higher than the result of this study. The aforementioned differences in the prevalence of *T. suis* could be due to the ability of the eggs to survive for long in the environment [46,47].

Oesophagostomum spp. is one of the intestinal parasites of pigs identified in this study, having the lowest prevalence of 3.9% which is consistent with the report of Weng et al. [4] from China (2.5%). However, lower than the report of Abdu and Gashaw [14] from Ethiopia and [10,48] from Kenya with the prevalence of 6.7%, 39.1% and 40%, respectively. *Coccidia* spp. is the only protozoan observed in this study with a prevalence of 10.5%, lower than 12% reported from Bishoftu, Ethiopia [19], 88% from West Indies [44] and 47.2% from China [4]. The aforementioned differences in the prevalence could be due to difference in the ecological factors between the origin of pigs, differences in management system and the ability of the cysts/oocysts to survive for long in the environment [48].

Fasciola hepatica is the only trematode observed in this study with a prevalence of 11.8%, which is in agreement with findings of Bernard AN et al. [42] in Plateau state of Nigeria (9.3%) while higher than the report of Tomass [7] (2.81%) in Tigray Region of Ethiopia. Factors such as presence of reservoir hosts, presence of snail intermediate hosts and ability of *F. hepatica* to colonise and adapt new hosts contribute for its spread in livestock in an area [49]. The transmission ecology of our present study areas are not far away from fulfilling the aforementioned epidemiological determinants of fasciolosis in pigs.

The present study revealed higher prevalence of GIT parasites in pigs originated from Addis Ababa and its surroundings (54.97%) when compared to Bishoftu (45.19%). The reasons for the variations in GIT parasite prevalence among the origin of the pigs might be related to difference in management practice performed or, could be attributed to differences in climate as a result of geographical location. The highest prevalence recorded in grower pigs (65.85%) than in piglet (33.33%) and adult (49.17%) pigs could be attributed to immune status, pre-exposure and probably nutritional status [39]. Induced immunity against parasites re-infection post-exposure is possible in pigs [50].

Adult pigs are more likely to have accumulated the infection over time which enhances them to develop resistance against re-infections [35,51]. Though there was no significant association between infection rate of GIT parasite and age of the pig, there was higher prevalence in grower pigs than adult and piglet which corroborates the findings of Nosal et al. [52] who also reported higher helminthosis in fatteners, gilts and young sows. A report of Esrony [39] had indicated a significantly lower infection rate in piglets than weaners, growers and adult pigs. The lower infection rates recorded in piglet could be linked to acquired immunity through suckling of milk from their dams or sows [35,53].

The higher prevalence recorded in females than in male pigs can be attributed to more females been sampled, though there was no significant difference between the infection rate of GIT parasites and sex of the host. Our finding is inconsistent with the findings of Shima FK et al. and Tamboura [35,38], who reported that female pigs excreted significantly more numbers of worm eggs in their faeces than male pigs. This area needs an indebt study to unveil the factors responsible for this difference.

The absence of statistically significant association in infection rate between sex, age or origin groups, and the prevalence of pig GIT parasite, except for *A. suum* ova (in case of origin) ($p<0.05$) and *Coccidia* (oocyst) (in case of age and sex) ($P<0.05$), is an indication that pigs can become infected and develop clinical disease under similar conditions of helminth infections exposure [35]. This could be due to equal exposure of both sex and all age groups [54]. The significant association (P<0.05) that was observed between infection rates of *A. suum* and source(origin)of pigs could be attributed to differences in management practices i.e., pig populations originating from Bishoftu areas are mainly kept under an intensive production system whereas those from Addis Ababa areas are from both intensive and extensive management system. The association in this study could also be ascribed to dissimilarities in adoption of veterinary care by the pig farmers from their respective areas. Pig farmers in Bishoftu seemed to adopt more to regular deworming and improved nutrition probably due to the presence of a veterinary school in the town and enlightenment received.

The present study also revealed as there was higher monoparasitic infection (37.9%) compared to polyparasitic (mixed) (11.28%) infection. Higher monoparasitic infection in grower pig than in piglet and adult pigs could be attributed to immune status, pre-exposure and probably nutritional status [39]. Higher prevalence of both mixed (polyparasitic) and monoparasitic infection was observed in females compared to male pigs. This could be explained by the fact that males are slaughtered at early age while females are kept for breeding purpose and will have greater chance to acquire infection before they are eventually slaughtered especially for chronic infection like fasciolosis [55].

This study also presented postmortem examination findings by recovering adult parasites from liver, small intestine, colon and ceacum. The adult parasite identified overall prevalence was 28.2%. Among the adult parasites identified, *F. hepatica* was higher in prevalence (22.1%) when compared to the overall prevalence of the rest parasites and this is higher than the prevalence reported by Fikiremariam [55] (18.5%) at AAAE, Ethiopia while Egypt(8%),South America(15%) and our neighbour Kenya reported zero prevalence in contrary to this findings [56]. The higher prevalence of this parasite compared to the above mentioned reports have indicated that , the pigs might be grazing around a lot of rivers and swampy area for a long period of time and poor control strategies employed in the origin of the pigs. Commonly water lodged areas favour the existence of snail, intermediate host [57].

Conclusion

This study has revealed the existence of six GIT parasites ova (oocysts) namely, *Strongyloides* spp., *A. suum*, *T. suis, Oesophagostomum* spp., *F. hepatica* and *Coccidia* spp. in pigs slaughtered at AAAE. *Strongyloides* spp. was the most prevalent parasite followed by *A. suum* among the parasites ova (oocyst) identified in this study. The study also established that A. suum is significantly associated with origin (source) of pigs while age and sex were significantly associated with the prevalence of *Coccidia* spp. infection rates among the related risk factors. This has exposed the poor quality of husbandry practices and/or inadequate veterinary care given to pigs by their rearers. This study also presented postmortem examination findings by recovering adult parasites from liver, small intestine, colon and ceacum in which *F. hepatica* was the highly prevalent parasite identified when compared to the overall prevalence of the rest parasites. Our investigation here provided basic data on the prevalence of GIT parasites and associated risk factors in and around Addis Ababa and Bishoftu areas. The prevalence of intestinal parasites in pigs in these two areas was severe and the infection of intestinal parasites is still an important factor that hinders the development of the pig farming industry. Therefore, the findings here would have important implications to control and prevent intestinal parasite infection in pigs in Addis Ababa and Bishoftu areas.

References

1. Pam VA, Daniel LN, Bata SI, Udokaninyene AD, Hassan AA, et al. (2013) An investigation of haemo and gastrointestinal parasites of pigs in some parts of Langtang, North Local Government Area of Plateau State. J Vet Adv 3: 79-86.
2. Huynh T, Aarnik AJA, Drucker A, Verstegen MWA (2007) Swine production in Cambodia, Laos, Philippines, and Vietnam: A review. Asian J Agri Develop 4: 323-339.
3. Joachim A, Dülmer N, Daugschies A, Roepstorff A (2001) Occurrence of helminths in pig fattening units with different management systems in Northern Germany. Vet Parasitol 96: 135-146.
4. Weng YB, Hu YJ, Li Y, Li BS, Lin RQ, et al. (2005) Survey of intestinal parasites in pigs from intensive farms in Guangdong Province, People's Republic of China. Vet Parasitol 127: 333-336.
5. Nansen P, Roepstorff A (1999) Parasitic helminths of the pig: factors influencing transmission and infection levels. Int J Parasitol 29: 877-891.
6. Stewart TB, Hale OM (1988) Losses to internal parasites in swine production. J Anim Sci 66: 1548-1554.
7. Tomass Z, Imam E, Kifleyohannes T, Tekle Y, Weldu K (2013) Prevalence of gastrointestinal parasites and Cryptosporidium spp. in extensively managed pigs in Mekelle and urban areas of southern zone of Tigray region, Northern Ethiopia. Vet World 6: 433-439.
8. Morgan UM, Buddle JR, Armson A, Elliot A, Thompson RC (1999) Molecular and biological characterisation of Cryptosporidium in pigs. Aust Vet J 77: 44-47.
9. Borthakur SK, Rahmani S, Sama K (2007) Prevalence of gastrointestinal helminthes in pigs in Aizawl. J Vet Parasitol 21: 71-78.
10. Nganga CJ, Karanja DN, Mutune MN (2008) The prevalence of gastrointestinal helminth infections in pigs in Kenya. Trop Anim Health Prod 40: 331-334.
11. Okewole EA, Ogundipe GAT, Adenjinmi JO, Olaniyan AO (2000) Clinical evaluation of three chemoprophylactic regimes against ovine helminthosis in Fasciola endemic farm in Ibadan, Nigeria. Israel J Vet Med 56:15-28.
12. Nosal P, Eckert R (2005) Gastrointestinal parasites of swine in relation to the age group and management system. Med Wet 61: 435-438.
13. Davis DP, Moon RD (1990) Density, location, and sampling of Sarcoptes scabiei (Acari: Sarcoptidae) on experimentally infested pigs. J Med Entomol 27: 391-398.
14. Abdu S, Gashaw A (2010) Production system dynamism and parasitic interaction of swine in and around Holetta, Ethiopia. Ethiop Vet J 14: 71-81.
15. Permin A, Yelifari L, Bloch P, Steenhard N, Hansen NP, et al. (1999) Parasites in cross-bred pigs in the Upper East region of Ghana. Vet Parasitol 87: 63-71.
16. Nsoso S, Mosala KP, Ndebele RT, Ramabu SS (2000) The prevalence of internal and external parasites in pigs of different ages and sexes in Southeast District, Botswana. Onderstepoort J Vet Res 67: 217-220.
17. Adesiyun AA, Kaminjolo JS, Ngeleka M, Mutani A, Borde G, et al. (2001) A longitudinal study on enteropathogenic infections of livestock in Trinidad. Rev Soc Bras Med Trop 34: 29-35.
18. Kumsa B, Kifle E (2014) Internal parasites and health management of pigs in Burayu District, Oromia Regional State, Ethiopia. J S Afr Vet Assoc 85: 913.
19. Jufare A, Awol N, Tadesse F, Tsegaye Y, Hadush B (2015) Parasites of pigs in two farms with poor husbandry practices in Bishoftu, Ethiopia. Onderstepoort J Vet Res 82:839-844.
20. Olso ME, Guselle N (2000) Are pig parasites a human health risk? Adv Pork Prod 11: 153-162.

21. Fikire Z, Tolosa T, Nigussie Z, Macias C, Kebede N (2012) Prevalence and characterization of hydatidosis in animals slaughtered at Addis Ababa abattoir, Ethiopia. J Parasitol Vector Biol 4: 1-6.
22. Improving Productivity and Market Success (IPMS) (2004) Ada'a-Liben Woreda Pilot Learning Site Diagnosis and Program Design. Addis Ababa, Ethiopia, International Livestock Research Institute, pp. 24-32.
23. Xiaolin MA (2004) Pig husbandry strategies in a complex society, Central China. BIPP 2: 91-102.
24. Thrusfield M (2007) Sample size determination. In Veterinary Epidemiology (3rd Edn) Oxford, UK, Blackwell Science Limited pp. 185-189.
25. William JF (2001) Veterinary Parasitology Reference Manual (5th Edn), Washington State University, Pullman, WA, pp. 126-139.
26. Anne MZ, Gary AC (2006) Veterinary Clinical Parasitology (7th Edn) Blackwell Publishing pp. 3.
27. Kassai T (1999) Veterinary Helminthology (1st Edn) Butterworth-Heinemann, Oxford, and pp. 113-114.
28. Charles M, Hendrix (2006) Diagnostic Veterinary Parasitology (2nd Edn) Mosby Inc. USA 11:153-157.
29. Bayou K (2005) Standard Veterinary Laboratory Diagnostic Manual. Ministry of Agriculture and Rural Development, Animal Health Department. Addis Ababa, Ethiopia.
30. Fasil L (2009) Prevalence of pig internal parasites in Haramaya University pig Farm. DVM Thesis. Haramaya University, Haramaya, Ethiopia.
31. Ismail HA, Jeon HK, Yu YM, Do C, Lee YH (2010) Intestinal parasite infections in pigs and beef cattle in rural areas of Chungcheongnam-do, Korea. Korean J Parasitol 48: 347-349.
32. Kumsa B, Kifle E (2014) Internal parasites and health management of pigs in Burayu District, Oromia Regional State, Ethiopia. J S Afr Vet Assoc 85: 913.
33. Lin Q, Wang XY, Cong MM, Ren WX, Hu B, et al. (2013) Epidemiological investigation on swine intestinal parasites in Shaanxi province, China. Int J Agri Res Natural Resources 1: 34-38.
34. Okorafor UP, Unigwe CR, Okorafor JC, Isegbe EI, Ogbu UM (2014) A survey of gastrointestinal parasites of pigs that arrived for slaughter at Bodija Abattoir, Ibadan, Oyo State, Nigeria. Int J Pure Appl Sci Technol 20: 53-57.
35. Shima FK, Garba HS, Nongo NN (2014) Prevalence of verminous pneumonia of pigs and associated helminth observed at slaughter in Makurdi, Benue state, Nigeria. Afri J Sci Res 3: 03-07.
36. Kumar S, Prasad KD, Singh SK, Kumar S (2002) Prevalence of common gastrointestinal parasites in pigs at and around Ranchi, Jharhand. Indian J Anim Sci 72: 35-37.
37. Ngowi HA, Kassuku AA, Maeda GE, Boa ME, Willingham AL (2004) A slaughter slab survey for extra-intestinal porcine helminth infections in northern Tanzania. Trop Anim Health Prod 36: 335-340.
38. Tamboura HH, Banga-Mboko H, Maes D, Youssao I, Traore A, et al. (2006) Prevalence of common gastrointestinal nematode parasites in scavenging pigs of different ages and sexes in eastern centre province, Burkina Faso. Onderstepoort J Vet Res 73: 53-60.
39. Esrony K, Kambarage DM, Mtambo MM, Muhairwa AP, Kusiluka LJ (1997) Helminthosis in local and cross-bred pigs in the Morogoro region of Tanzania. Prev Vet Med 32: 41-46.
40. Marufu MC, Chanayiwa P, Chimonyo M, Bhebhe E (2008) Prevalence of gastrointestinal nematodes in Mukota pigs in a communal area of Zimbabwe. Afri J Agri Res 3: 91-95.
41. Uysal HK, Boral O, Metiner K, Ilgaz A (2009) Investigation of intestinal parasites in pig feces that are also human pathogens. Turkiye Parazitol Derg 33: 218-221.
42. Bernard AN, Daminabo V, Ekam E, Okonkwo EC, Nwuzo AC, et al. (2015) Prevalence of intestinal parasites in faecal droppings of swine in Pankshin urban, Pankshin local government area, Plateau state, Nigeria. Amer J Life Sci 3: 119-122.
43. Roepstorff A, Nansen P (1998) The epidemiology, diagnosis and control of helminth parasites of swine. FAO Animal Health Manual No. 3, Food and Agriculture Organization of the United Nations, Rome.
44. Keshaw PT, Alfred C, Guillaume B, Guillaume V, Claude D, et al. (2009) Prevalence of intestinal parasites in pigs in Grenada, West Indies. West Indian Vet J 9: 22-27.
45. Nissen S, Poulsen IH, Nejsum P, Olsen A, Roepstorff A, et al. (2011) Prevalence of gastrointestinal nematodes in growing pigs in Kabale District in Uganda. Trop Anim Health Prod 43: 567-572.
46. Roepstorff A, Murrell KD (1997) Transmission dynamics of helminth parasites of pigs on continuous pasture: *Ascaris suum* and Trichuris suis. Int J Parasitol 27: 563-572.
47. Pittman JS, Shepherd G, Thacker BJ, Myers GH (2010) Trichuris suis in finishing pigs: Case report and review. J Swine Health Prod 18: 306-313.
48. Kagira JC, Kanyart NP, Waruiru RM (2002) The prevalence of gastrointestinal parasites in commercial pig farms in Thika district, Kenya. Bull Anim Health Prod Afri 50: 1-11.
49. Mas-Coma S, Bargues MD, Valero MA (2005) Fascioliasis and other plant-borne trematode zoonoses. Int J Parasitol 35: 1255-1278.
50. Radostits OM, Gay CC, Hinchcliff KW, Constable PD (2006) Textbook of the diseases of cattle, sheep, pigs, goats and horses: Veterinary Medicine (10thEdn.) WB Saunders Company Ltd, New York, pp. 1569-1570.
51. Murrell KD (1981) Induction of protective immunity to Strongyloides ransomi in pigs. Am J Vet Res 42: 1915-1919.
52. Nosal P, Petryszak A, Nowosad B (2008) Some aspects of nematode infection in pigs from small herds. Pol J Vet Sci 11: 219-223.
53. Kelley GW, Nayak DP (1965) Passive immunity to Ascaris suum transferred in colostrum from sows to their offspring. Am J Vet Res 26: 948-950.
54. Armour J (1980) The epidemiology of helminth disease in farm animals. Vet Parasitol 6: 7-46.
55. Fikiremariam H (2008) Study on the prevalence and economic importance of Fasciolosis in pigs slaughtered at Addis Ababa Abattoir Enterprise. DVM Thesis. Haramaya University, Haramaya, Ethiopia.
56. FAO (2002) Liver flukes infection in distribution and impact of helminthes disease of livestock.
57. Ephrem E, Ademe Z, Trunch Z (2006) Fasciolosis: In Standard Treatment Guidelines for Veterinary Practices. Drug Administration and Control Authority of Ethiopia pp. 121-122.