MULTIDISCIPLINARY SCIENCE JOURNAL

RESEARCH ARTICLE
Published Online: March 7, 2023
https://doi.org/10.31893/multiscience.2023012

The prevalence and determinants of gastrointestinal parasites of pigs in Roma, Lesotho

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Abstract The small-scale pig keeping in Lesotho has emerged as one of the common ways of subsistence for the vast majority of Basotho. Infection by gastrointestinal parasites is a common and persistent health threat that limits the extent to which the pig industry can potentially perform. Knowledge about the risk factors influencing parasitic infection is essential in order to make relevant interventions aimed at mitigating the occurrence and spread of parasites. A cross-sectional study was undertaken on 90 healthy pigs to determine the prevalence of gastrointestinal parasites. The floatation technique was utilized for laboratory analysis, and parasite eggs were identified based on the morphology. SPSS version 20.00 was used for analysis, from which Binary logistic regression was utilized. The overall prevalence of gastrointestinal parasites was 69%, the predominant specie was nematodes with 63% and the least was recorded for coccidian with 28%. Sows (79.6%, 32.7%) were more highly parasitized than boars (43.9%, 22.0%) in terms of nematodes and coccidian, respectively. Higher parasitic prevalence was recorded in young (76.5%, 35.3%) pigs than in older (46.2%, 17.9%) pigs both for nematodes and coccidian, respectively. It is therefore concluded that sex and age are the major determinants of parasitic infection in pigs.

Keywords: nematodes, coccidia, age, sex

1. Introduction

In recent years farming in Lesotho has taken a notable shift from subsistence to commercial and this shift might partly be explained by the escalating rate of unemployment in the country. Pig production in Lesotho has taken the lead as one of the income-generating farming activities, and this coincides with Onunkwo et al (2011) in Nigeria, who articulated that pig farming is practiced mainly as a family business. Regarding other livestock species, pigs are naturally highly prolific. Kyriazakis and Whittemore (2006) indicated that low prolific breeds could produce an average of eight live piglets per litter, while high prolific breeds can produce 13 piglets or more per litter.

Weka et al (2020) indicated that pig production contributes to poverty alleviation in different ways, including an increase in the food supply, source of income and a means for capital accumulation, employment opportunities, and supply inputs and services for crop production. Similarly, Akanni et al (2017) stated that pig farming remains a reliable component of the rural economy which mitigates and curbs the frustration of a higher unemployment rate. Despite the unfolding importance of the pig industry in the country, they are constantly confronted with several constraints, which include but are not limited to parasitic infection, which ultimately affect their production efficiency.

According to Atawalna et al (2016), parasitic infection accounts for a significant economic thread for pig production. Tumusiime et al (2020) articulated that the parasites for swine can be found in different body parts, including the lungs (*Metastrongylus* spp.), kidney (*Stephanurus dentatus*), muscle (*Cysticercus cellulosae*, *Toxoplasma gondii*), and gastrointestinal tract. Protozoa such as coccidia (*Cystoisospora* spp. and *Eimeria* spp.) and *Entamoeba* spp., as well as helminths, represent the common gastrointestinal track parasites (Tumusiime et al 2020). Retarded growth rate is one of the eminent signs of parasitic infection, particularly in piglets (Nonga and Paulo 2015). Abonyi and Njoga (2020) stated that at the advanced stage of parasite infection, the worms usually out-compete their hosts for nutrition and consequently affect the body condition score of an animal. Similarly, Geresu et al (2015) attested that parasites can potentially irritate intestinal mucosa, which has a detrimental impact on the digestion and absorption of nutrients.

Murthy *et al* (2016) further confirmed that a slight infection by *Ascaris suum* can result in reduced daily body weight gain as a result of decreased food intake. According to Agustina et al (2017) the prevalence of gastrointestinal parasites is influenced by the system of management (intensive, semi-intensive, and extensive), farm hygiene, geographical location, and antiparasitic prophylactic treatment such as deworming. Currently, there are no studies to elucidate the magnitude of parasitic

 Received: December 16, 2022 | Accepted: March 3, 2023

infection in swine in Lesotho, hence why the current study was undertaken to explore the major determinants of infection in swine.

2. Materials and Methods

2.1. Description of the study site

The study was conducted in Roma Valley, which is in the foothills of the Maseru district, Lesotho. According to Olaleye et al (2022), foothills have an estimated area of about 4588 km^2 that lies between 1,800 and 2,000m above sea level and forms 15% of the total land area. Roma is a settlement under the Manonyane Community Council, some 34 kilometers southeast of Maseru, the capital of Lesotho.

2.2. Study animals

The study animals were pigs of different ages and sex groups managed intensively. The breed that was used in this study was Duroc. All sampled pigs were in good health states and were housed in pens. They were all from the foothills of Maseru District, which are known to have a mean annual rainfall of 900–1000mm and mean annual temperature of −8 to 30ºC

2.3. Study design and sampling

A cross-sectional study was undertaken on 90 pigs of different age and sex groups. The age of the pigs was obtained from the farmers' records, and accordingly, pigs were classified as old (>6 months) and young (<6 months). With the help of the extension officer from the Ministry of Agriculture and Food Security, a list of households keeping pigs within the selected villages was established. Households to participate in the study were randomly selected from the list.

2.4. Collection and processing of samples

Prior to sample collection, farmers from selected villages were sensitized on the purpose of the study and how it will be undertaken and samples were only taken from farms whose owners have consented. Faecal samples were taken directly from the rectum using disposable cloves and were packed in sample bottles that were clearly labeled. The labeling included the sex of the pig, its age, and the village. The samples were packed in a cooler box containing ice packs and were transported to the National University of Lesotho laboratory for analysis. The samples were processed within 48 hours of collection and were processed using the flotation method. In order to prepare the flotation solution, 400g of sodium chloride was dissolved in 1 liter of distilled water. From each sample, 3g was mixed with 50ml of the flotation solution to make a slurry, and the mixture was blended (Hansen and Perry 1990). After blending, the mixture was then sieved into the beaker, and four drops of amyl alcohol were added to the sieved mixture to treat bubbles which can be mistakenly counted as parasite eggs. Using the disposable pipettes, a few milliliters were drawn from the sample and the two chambers of the McMaster slides were filled. Eggs were examined microscopically (10× and 40×). The parasitic eggs were identified based on morphology (Adeppa et al 2014).

2.5. Data analysis

The data were analyzed using SPSS software (version 20.00). The prevalence of gastrointestinal parasites was calculated as the ratio between the number of infected animals and the total number of animals sampled. Binary logistic regression was used to assess the relationship between predictor variables (age, sex) and the prevalence of different gastrointestinal parasites. The confidence level was tested at 95%.

3. Results and discussion

The results presented in Table 1 summarize the prevalence rate of gastrointestinal parasites in the study area, the obtained overall prevalence rate for gastrointestinal parasites was 69% and the predominant parasites were nematodes at 63% and the least was recorded for coccidian at 28%. The level of mixed infection recorded in the current study was found to be 22%.

Table 1 The overall prevalence rate of gastrointestinal parasites.

Description	Examined	Infected	Prevalence (%)
Faecal samples	90	62	69
Nematodes	90	57	63
Coccidian	90	25	28

The overall prevalence rate of the current study is far different from 79%, which was reported by Nwafor et al (2019) in central Free State Province, South Africa. In the same way, the recorded prevalence rate of the current study differs enormously from 97%, 82%, 91%, and 93% reported from investigations undertaken in China, Botswana, Ghana, and Burkina Faso,

respectively (Tamboura et al 2006: Nsoso et al 2000: Boes et al 2000: Permin et al 1999). The 69% recorded in the current study is, however, higher than 61.4%, reported in Uganda by Roesel et al (2017). The discrepancies reported in different studies might be due to different timing of the sampling, the geography of the site, and the age of the stud animals (Roesel et al 2017). Apart from that, the variation between different studies might partly be explained by the difference in the management practices per individual farm, as Pettersson et al (2021) articulated that effective parasitic control does not only rely on the use of antiparasitic drugs but also requires various management practices performed at farm level.

The results of the current study, which show an overall prevalence of 63% for nematodes, are in close proximity with the findings of Boes et al (2000) in China, who reported 58% of nematodes. The current results are however below 72%, which was reported by Tumusiime et al (2020) in Rwanda.

The prevalence of coccidian (28%) recorded in the current study is almost equal to 27.8%, which was obtained from the study of Karamon et al (2007) in Poland. This rate of prevalence is, however, lower than the 40.7% and 47.2% reported by Roesel et al (2017) and Weng et al (2005) in Uganda and China, respectively. According to Tumusiime et al (2020), the disparities between different studies can be explained by variations in production systems. The current results provide ample evidence that nematodes represent the major health threat in the study area and this call for the attention of pig producers to revive their de-worming programs in such a way that it targets the nematodes.

The results of the current study showed the level of mixed infection as 22% is far below the findings of Dey et al (2014) in Bangladesh and Kagira et al (2012) in Kenya, who reported 96.4% and 84.2%, respectively. The current findings are, however, in close proximity to those of Nganga et al (2008) in Kenya, who reported a 31.3% level of mixed infection. The level of mixed infection obtained in the current is study contradicts the findings in Ghana by Atawalna et al (2016), who reported 7%. According to Nonga and Paulo (2015), co-infections affect the production and performance of pigs considerably. Due to subclinical infections, farmers are most likely to be unaware of the infections; however, the damage caused by endoparasites cannot be underestimated (Agustina et al 2017).

Table 2 summarizes the results on the prevalence of gastrointestinal parasites in different villages. It was observed that pigs in village 5 were significantly more infected than the other four villages both in terms of nematodes and coccidian. For comparison purposes, village 1 was regarded as the reference point both for nematodes and coccidian. In terms of nematodes, the odds of getting infected moving from village 1 to villages 2, 3, and 4 decreased significantly ($P<0.05$) by 0.48, 0.61, and 0.48 times, respectively. On the other hand, the chances of getting nematode eggs moving from village 1 to village 5 increased significantly ($p<0.05$) by 8.81 times. The chances of getting coccidian eggs moving from village 1 to villages 2, 3, and 4 decreased significantly ($p<0.05$) by 0.15, 0.64, and 0.51 times, respectively.

Table 2 The prevalence rate of GIPs in different villages.

Village	Examined	Prevalence (%)	S.E	Exp(B)
		Nematodes		
1	17	64.7[a]	0.11	1
2	17	47.1[b]	0.12	0.48
3	19	52.6[c]	0.11	0.61
4	17	47.1[b]	0.12	0.48
5	20	100[d]	0.00	8.81
		Coccidian		
1	17	29.4[a]	0.11	1
2	17	5.9[b]	0.05	0.15
3	19	21.1[c]	0.09	0.64
4	17	17.6[c]	0.09	0.51
5	20	60.0[d]	0.11	3.60

Percentages within the same column with different superscripts [(ab)] differ significantly, S.E= Standard error.

The obtained results in Table 2 indicate that all the pigs in village 5 tested positive for nematodes. This 100% prevalence rate can be attributed to several reasons, including poor management systems. Previous conducted studies have confirmed that animals reared under a good management system tend to possess strong immunity and demonstrate resistance to infectious diseases (Atawalna et al 2015; Sow et al 2012; Ahmed et al 2008). Similarly, Madke et al (2010) suggested that animal housing must be well-ventilated to maintain required humidity and air circulation since the growth of the parasites population is accelerated in high humidity and low light. Moreover, Roepstorff et al (2011) articulated that the conditions and the environment in which an animal is kept can potentially influence the level of infestation.

The results on how sex affects the prevalence of gastrointestinal parasites are presented in Table 3. The findings revealed that females were significantly ($p<0.05$) more infected than males both in terms of nematodes and coccidian. The chances of having nematodes and coccidian infection significantly decrease by 0.2 and 0.58 times, respectively, moving from females to males.

Table 3 Prevalence rate of GIPs in different sex groups.

Sex	Examined	Prevalence (%)	S.E	Exp(B)
		Nematodes		
Male	41	43.9[a]	0.07	0.20
Female	49	79.6[b]	0.05	1
		Coccidian		
Male	41	22.0[a]	0.06	0.58
Female	49	32.7[b]	0.06	1

Percentages within the same column with different superscripts [(ab)] differ significantly, S.E= Standard error.

The results of the current study, which show a higher infestation rate in females, are in line with the findings of Maganga et al (2019) in Southeast Gabon, who reported that females were mostly infected. Similar trend of infection has also been reported in Burkina Faso by Tamboura et al (2006). In accordance with the current findings, previous studies have also confirmed higher infestation rates in females (Nwafor et al 2019: Swai et al 2010).

According to Sangioni et al (2017), higher parasitic infestation in females could be the result of changes in some parameters, such as physiological status or reproductive function (pregnancy, parturition, and lactation), which can potentially weaken activities of the immune system thereby exposing animals to parasitic infection. Maganga et al (2019) further explained that female animals, particularly during late pregnancy and lactation, are highly susceptible to parasitic infection due to hormonal alterations that lower the resistance to nematodes which results in higher infections.

The current results contradict the findings of Dadas et al (2016) and Sowemimo et al (2012), who reported higher parasitic burden in males (28.15 % and 18.0 %) than in females (22.96 % and 7.0 %), respectively. Moreover, the findings of the current work disagree with the results of Adhikari et al (2021) in South Central Nepal, who reported higher parasitic infection in males (97.5%) than in females (87%). According to Li et al (2020), variations in the prevalence rate obtained from different studies could be explained by factors including detection procedures utilized, sample size, farm management, climatic variations, and the immune status of an animal.

The results on how age influences parasitic infection are presented in Table 4. The results revealed that young (76.5%) pigs were significantly more infected than young (46.2%) pigs. The likelihood of pigs getting nematodes and coccidian infection decreased significantly by 3.79 and 2.49 times, respectively, moving from old to young pigs.

Table 4 Prevalence rate of GIPs in different age groups.

Age	Examined	Prevalence (%)	S.E	Exp(B)
		Nematodes		
Young	51	76.5[a]	0.06	3.79
Old	39	46.2[b]	0.08	1
		Coccidian		
Young	51	35.3[a]	0.06	2.49
Old	39	17.9[b]	0.06	1

Percentages within the same column with different superscripts [(ab)] differ significantly, S.E= Standard error.

The results of this study, which revealed a higher infection rate in young pigs than older pigs, are in consonance with previous investigations of Maganga et al (2019), who reiterated that gastrointestinal parasites were highly prevalent in young pigs. Similar findings have been reported by several researchers (Roesel et al 2017: Dey et al 2014: Kagira et al 2012: Nsoso et al 2000). According to Tamboura et al (2006), a lower infestation rate in adult pigs can be as a result of established immunity after the first infection. Similarly, Corwin (1997) confirmed that adult pigs had acquired a more effective immune memory over time hence why they are lowlily infected.

The current findings are, however, in disagreement with the results of Sarker et al (2016), who reported similar infection rates across different age groups.

4. Conclusions

Based on the findings of this study, it is concluded that infection by gastrointestinal parasites is a common health thread in the study area, and nematodes represent the major challenge. Moreover, sex and age have been confirmed as the major determinants of infection by gastrointestinal parasites. With this knowledge, it would be easy for small-scale pig keepers to establish effective and relevant deworming programs.

Ethical considerations

The Research and Ethics Committee in the Department of Animal Science at the National University of Lesotho approved this study based on international animal welfare standards for the use of animals in conducting research.

Conflict of Interest

The authors declare no conflict of interest.

Funding

This research did not receive any financial support.

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