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Study on small ruminant lungworms and associated risk factors in northeastern Iran

Hassan Borji[1*], Mohammad Azizzadeh[2], Mansour Ebrahimi[1], Mohammad Asadpour[1]

[1]*Department of Pathobiology, School of Veterinary Medicine, Ferdowsi University of Mashhad, Mashhad, Iran*
[2]*Department of clinical science, School of Veterinary Medicine, Ferdowsi University of Mashhad, Mashhad, Iran*

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ABSTRACT

Objective: To determine the prevalence, identify the species involved and assess possible risk factors of lungworm infection in small ruminant slaughtered in abattoir of Mashhad in the northeast of Iran from October 2010 −August 2011. **Methods:** Faecal and post mortem examination were conducted on 350 and 2 500 animals, respectively. **Results:** The overall prevalence of lungworm infection was 10.85% and 3.80% in coproscopic and post mortem examination respectively, and this difference was found to be significant. Higher prevalence of lungworm infection was recorded in post mortem examination in sheep (4.1%) than in goats (0.5%) ($P< 0.05$). The proportion of infection with *Dictyocaulus filaria*, *Protostrongylus rufescens* and mixed infection were 3.7%, 0.1% and 0.2% in sheep while in goats, the infection was reported with *Dictyocaulus filaria* (0.5%) only. The seasonal dynamics of lungworm infection showed that prevalence was highest in winter (7.8%) with a remarkable decline during the dry time (summer) (0.8%) which the difference was significant ($P<0.001$). The animals of less than one year old showed greater infection in post mortem examination than older animals significantly ($P<0.001$). Also, the infection rate between male and female animals showed significant difference ($P<0.05$) with prevalence rate of 4.6% and 2.0%, respectively. **Conclusions:** Due to its impact on production, emphasis should be given for the control and prevention of lungworm infection in this area.

1. Introduction

Small ruminants are considered as one of the most important sources of milk and meat production in Iran. Moreover, these animals play important role in the rural economy and enable the country to earn substantial amount of foreign currency through export of skins and other by-products[1]. Helminth parasites of ruminants are ubiquitous, and many tropical and sub-tropical environments in the world provide nearly perfect conditions for their survival and development. Although these parasites are widely prevalent, the clinical signs of infected animals can be less obvious than signs of other livestock diseases[2].

Lungworms can result in infection of the lower respiratory tract, usually resulting in verminous bronchitis or verminous pneumonia. Now, bronchopneumonia is one of the most important ovine diseases in Iran which is due to bacteria, viruses and parasites. In the ruminants, pulmonary worms are the most prevalent cause of this disease. Pulmonary parasites of small ruminants cause significantly economical losses with mortality and production reduction.

Control of these parasites is therefore essential for increasing small ruminant production. For proper implementation of control measures, knowledge of parasitic diseases and their dynamics must be studied. The available information about pulmonary worms in Iran is just of the investigation based on slaughterhouse observation with limited numbers of small ruminant[3,4]. The incidence of parasitic diseases, including respiratory helminthosis varies greatly from place to place depending on the relative importance of factors involved. The present study was to estimate the prevalence of lung worm infection and to assess the associated risk factors in Mashhad, northeast of Iran.

*Corresponding author: Hassan Borji, Department of Pathobiology, School of Veterinary Medicine, Ferdowsi University of Mashhad, Mashhad 9177948974, Iran.
Tel: 0098-511-8788944
E-mail: hborji@um.ac.ir
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2. Materials and methods

2.1. Study area

Mashhad is located in the northeast of Iran at the center of the Razavi Khorasan Province. In this province, there are about 5.8 million sheep and 1.1 million goats. This area is located at 36.20 latitude and 59.35 east longitude, in the valley of the Kashaf River near Turkmenistan, between the two mountain ranges of Binalood and Hezar-masjed. The city benefits from the proximity of the mountains, with cool winters, pleasant springs, mild summers, and beautiful autumns. The rainfall is about 250 mm per year, some of which occasionally falls in the form of snow. Annual precipitation falling usually occurs between December and May. The altitude of the area is 985 meter above sea level.

2.2. Study animals

During one year (Oct. 2010 to Aug. 2011), post mortem examination was performed on 2 500 aniamls (2 300 sheep and 200 goats). Similarly, 350 animals (320 sheep and 30 goats) were sampled for coprological examination. The species of the animals, sex, age and the season of sampling were recorded

2.3. Postmortem examination

The lungs were touched for the presence of nodules induced by lungworms, which are usually grayish white in color. Also the air passages were opened starting from the trachea down to the small bronchi with fine blunt pointed scissors to detect parasites. The isolated worms were kept in alcohol 70% then were transferred to lactophenol for fluoresce. In the last, their genus and species were diagnosed by the key diagnostic analysis.

2.4. Faecal examination

Faecal samples of randomly selected 350 animals were collected directly from the rectum and transported to laboratory in icebox. In the laboratory, for the extraction of larvae we used modified Baermann technique. The faeces were enclosed in gauze fixed on to string rod and submerged in clean glass tube filled with warm water. The whole apparatus was left for 6 h. The larva leaves the faeces, migrates through the gauze and settles at the bottom of the glass. After removing the supernatant, the sediment was examined under the microscope[5,6].

2.5. Data analysis

Prevalence and 95% confidence interval for lung and fecal infection were calculated as the number of parasitologically positive animals divided by the total number of animals observed at that particular time[7]. Association of independent variables (species, sex, season of sampling and age) and prevalence of lungworm infection was evaluated using *Chi*-square test and Fischer exact test. All statistical analyses were performed by SPSS version 16 and *P*-value less than 0.05 was considered as significant.

3. Result

3.1. Postmortem examinations

Of 2 500 (2 300 sheep and 200 goats) small ruminants studied, 95 (3.8%) were positive for lungworm infection, and the prevalence was 4.1% and 0.5% for sheep and goats, respectively, with significant difference between sheep and goats ($P< 0.05$).

The proportion of infection with *Dictyocaulus filaria (D. filaria)*, *Protostrongylus rufescens (P. rufescens)* and mixed infection were 91.5% (86/94), 3.2% (3/94) and 5.3% (5/94) in sheep (Table 1). In goats, the infection was reported with *D. filaria* (0.5%) only.

The relationship between risk factors of age, sex and season with the infection in post mortem examination of sheep is shown in Table 2. The animal of less than one year showed significantly higher infection rate than older animals ($P<0.001$). The highest and least rate of infection in sheep was in winter (7.8%) and summer (0.8%), respectively.

There was a significant difference between the prevalence of *D. filaria* (96.8%) and *P. rufescens* (8.5%).

3.2. Coprology

Faecal examination revealed the prevalence of lungworm infection to be 10.9% (38/350). The specific prevalence of lungworm was 11.6% (37 of 320) in sheep and 3.3% (1 of 30) in goats. This difference was not significant ($P=0.227$).

The rate of infection by larvae of *D. filaria*, *P. rufescens* and mixed infection were 6.9% (22/320), 4.4% (14/320) and 0.3% (1/320) In sheep. In goats, the only species which isolated was *D. filaria*.

There was no significant difference($P>0.05$) between sex and age with infection in faecal examination (Table 3). Similary to postmortem examination, the most infection to larvae of lungworms was reported in winter (22.5%) while 1.2% in summer was minimum (Table 3).

Prevalence of lungworm infection tested by faecal examination (11.5%) in sheep was significantly higher than the record of postmortem examination (4.1%) ($P<0.001$). In goats, infection prevalence in faecal examination (3.3%) was higher than postmortem examination (0.5%), but this difference was not significant ($P=0.244$). There was no significant relationship between infection and risk factors in faecal and postmortem examinations of goats.

Table 1
Prevalence of lungworm infection in sheep.

Animals examined	No. of examined	No. of positive	Prevalence (95% *CI*)	Infection proportions [*n*(%)]		
				D. filarial	*P. rufescens*	*D. filaria*+ *P. rufescens*
Postmortem examination	2 300	94	4.1(3.3–4.9)	86 (91.5)	3(3.2)	5(5.3)
Coprology	320	37	11.5(8.0–15.0)	22(59.5)	14(37.8)	1(2.7)

Table 2
Risk factors association with occurrence of lungworms infection.

Risk factors		No tested	No (%) positive	Crude OR (95% CI)	*P* value
Sex	Female	450	9 (2.0)	1	0.013
	Male	1 850	85 (4.6)	2.36 (1.2–4.7)	
Age (years old)	<1	1 450	85 (5.9)	7.2 (5.2–9.9)	<0.001
	1–3	600	7 (1.2)	1	
	>3	250	2 (0.8)	1.5 (0.3–7.2)	
Season	Spring	600	12 (2.0)	2.5 (0.8–7.9)	<0.001
	Summer	500	4 (0.8)	1	
	Fall	600	31 (5.2)	6.7 (1.5–29.4)	
	winter	600	47 (7.8)	10.5(3.7–29.8)	

Table 3
Risk factors association with occurrence of lungworms infection in faecal examination.

Risk factors		No tested	No (%) positive	Crude *OR* (95% CI)	*P* value
Sex	Female	75	4 (5.3)	1	0.054
	Male	245	33 (13.5)	2.7 (0.7–7.9)	
Age (years old)	<1	190	25 (13.2)	5.1 (0.1–7.6)	0.216
	1–3	95	11 (11.6)	4.4 (0.1–8)	
	>3	35	1 (2.9)	1	
Season	Spring	80	5 (6.2)	5.3(0.5–51.4)	<0.001
	Summer	80	1 (1.2)	1	
	Fall	80	13 (16.2)	15.3 (1.9–119.9)	
	winter	80	18 (22.5)	22.9 (3–176)	

4. Discussion

The study of lungworm infection in small ruminants by faecal and postmortem examination in the study area revealed prevalence of 10.85% and 3.8%, respectively. In this regard, higher prevalence of 42.7% around West-Azarbaijan[4], 56.9% from East-Azarbaijan in the northwest of Iran was reported[3]. The differences in the prevalence of lungworms of small ruminants between this study and the above studies might be associated with nutritional status, level of immunity, management practice of the animal, rain fall, humidity, temperature and altitude differences in the respective study area. Also, the difference in these studied areas which favors the survival of the larvae of the lung worm or the snail intermediate in case of *P. rufescens* bring in difference of results[8]. The cause of low prevalence in this study could be attributed to the development of open aired clinic, and awareness of farmers to deworm their sheep. Although lungworms are widely distributed throughout the world, the rate of infection is particularly common in countries with temperate climates and in the highlands of tropical and sub-tropical countries[2,8–10]. The higher infection rate (3.9%) due to *D. filaria* in small ruminants than *P. rufescens* agrees with the previous reports[3,4–11] from different parts of Iran and also other regions of the world[8,12,13]. However, in some regions of world it appeared that *Dictyocaulus* infection in small ruminants is not a serious problem[9,10]. The higher prevalence of *D. filaria* than *P. rufescens* could partly be attributed to difference in the life cycles. *D. filaria* has a direct life cycle and takes less time to reach the infective stage and after ingestion, larvae can appear in the faeces within 5 weeks[14]. Compared with *D. filaria*, transmission of *P. rufescens* is epidemiologically complex event involving host, parasite and intermediate host. *P. rufescens* whose intermediate host range is restricted to certain species of snail has lower prevalence because its geographic range is just wide like. Higher prevalence of *P. rufescens* infection was recorded in sheep than in goat which could be related to the difference in their feeding system[14–15]. It has been argued that goats are browsers while sheep graze closer to ground and as a result, for sheep, there is high chance of acquiring infective stage of the parasite (L3 larvae) which is normally found in intermediate hosts.

Lungworm infection prevalence recorded by faecal (11.5%) examination in sheep was significantly higher than the record of postmortem (4.1%) examination. This finding is in agreement with Nematollahi *et al*[3]. It is unusual as

it is impossible to detect parasites in the prepatent (L1) or post patent phases (L5) or during hypobiosis by faecal examination while this could be possible during post mortem inspection[5]. The probable reasons for this difference could be attriuted to lower number of animals in the faecal examination.

The result of current study revealed that infection rate in less than one year was higher than older animals ($P<0.001$). Similarly, several studies reported that young animals were more susceptible in comparison with adult animals[8,9,12]. This might be associated with the apparent ability of the host to develop acquired immunity so that adult animals have lower infection and the lower prevalence[6].

The present study indicated that male animals are more susceptible to lungworm infection than females ($P<0.05$). This might be associated to difference in the number of samples in both sexes. As samples of male was quadruple of samples female. The nutrition of males and females may also cause such differences. It should be noted that this differences could be confounded by age as young male animals for meat may be presented at abattoirs at age under one year. Therefore, sex differences in prevalence may be the reason for sex differences in the age profile of animals presented for slaughter, rather than any differences in transmission patterns. Therefore, it is difficult to detect any real sex effects tend. Also comparison of lungworm infection between male and female in faecal examination showed that male animals are more sensitive, but this difference was not significant ($P=0.054$).

The seasonal dynamics of lungworm infection showed that prevalence was highest in winter with a remarkable decline during the dry time (summer) which the difference was significant ($P<0.001$). This result is in agreement with the previous reports by other researchers[9,10,16]. The epidemiology of lungworms indicated that a damp and cool environment is very suitable for the development of *D. filaria* and third stage larva (L3) is resistant to cold[16]. The sporangia of the fungus *Pilobolus* and dung beetles facilitate the spread of *D. filaria* larvae under favorable situations but under adverse (dry) conditions the larvae may be inhibited in lungs. As *P. rufescens* depends on intermediate host, factors which influence epidemiology of the intermediate host indirectly determine epidemiology of the parasite as well. Moisture is considered to be an important factor in determining the survival and availability of land snails[17]. Thus, the relatively higher record of lungworm infection during the cold time could also be due to the fact that the survival and development of larvae is favored by low moisture and high humidity[18]. In conclusion, this study revealed the importance of lungworm infection in the study area and strategic deworming of small ruminants using broad-spectrum anthelmintics is necessary to increase productivity of these animals.

Conflict of interest statement

We declare that we have no conflict of interest.

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