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Prevalence of Parasitic Infections in Livestock in Slaughterhouses of Kermanshah Province during 2013-2017

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ABSTRACT

Background: Many parasitic diseases cause parasitic complications in humans, in addition to causing significant damage to the livestock industry. This study intended to determine the prevalence pattern of some parasitic infections observed in livestock slaughtered in Kermanshah province.

Methods: Data were obtained through the examination of livestock carcasses in Kermanshah province during 2013-2017 (4367 cows, 29809 sheep, and 8995 goats) and further evaluated descriptively-analytically.

Findings: The highest prevalence rate of a parasitic disease referred to as hepatic hydatid was observed in cows with 166 cases (3.8%), followed by goats with 116 cases (1.28%), and sheep with 320 cases (1.07%), while the highest prevalence rate of Hydatid cyst was observed in cows with 252 cases (5.77%), followed by goats with 304 cases (3.37%), and sheep with 708 cases (2.37%), respectively. Fasciola infection was recognized in 115 cases of cows (2.63%), followed by 37 cases (0.41%) of goats, and 73 cases (0.24%) of sheep, and the disparity between the rates was deemed significant. In terms of the prevalence rate of Dicrocoelium infection, a considerable disparity was observed between cows with 85 cases (1.94%) and sheep with 464 cases (1.55%), while 247 cases (2.74%) were recognized in goats.

Conclusion: Moreover, a significant disparity was observed in the seasonal prevalence of infections between different livestock breeds. Ultimately, the results of this study provided essential information for the implementation of developmental and prevention programs in the monitored area.

Keywords: **Prevalence, Parasitic infection, Livestock, Slaughterhouse, Kermanshah**

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Introduction

Population growth and the ever-increasing human need for protein sources are deemed crucial issues in densely populated developing countries. Animal proteins render a higher nutritional quality in comparison to plant proteins largely due to their remarkable balance of amino acids. Red meat (beef, mutton, and goat meat, also referred to as chevon) is one of the primary sources of animal protein. Statistics indicate that the total weight of carcasses pertaining to light and heavyweight livestock slaughtered nationwide in the course of 2016 amounted to 361 thousand tons. This quantity of production, if contaminated with various diseases, will have a disastrous impact on public health [1]. Slaughterhouses serve as one of the most relevant places to monitor and inspect livestock and meat health prior to presenting the product to the consumer. Therefore, valuable information concerning the product health status could be obtained by examining livestock products while still in slaughterhouses. The parasitic infections diagnosis has a particular place among the health quality assessments of livestock to the extent that, according to some reports, a considerable part of livestock contaminations due to parasitic diseases are either altered or eliminated annually [2]. Liver and heart are regarded among the livestock contaminations that are parasitically assessed in slaughterhouses due to their high nutritional value. In parallel, *Hydatid* cyst, *Fasciola*, *Dicrocoelium,* and *Cysticercus* are regarded as the major parasitic diseases of the liver-biliary system in cows, sheep, and goats, which eventually provoke total or localized seizure of the liver in slaughterhouses [3]. Hydatidosis is a severe disease targeting humans and causing irreparable damage, its diagnosis and treatment in humans is challenging given the nature of the disease. Thus, the prevention is the most convenient approach to control the disease worldwide [4]. In terms of commercial ends generated by the parasitic infections in the livestock industry, financial damage involves reduced production and reproductive performance of livestock, as well as the extermination of infected products (organs) in the course of post-mortem inspection. In sheep, approximately 70% of cysts are observed in the lung, 25% in the liver, and the rest in other organs. Conversly, in cows, over 90% of cysts are observed particularly in the liver [5]. Various studies have detailed the prevalence of *Hydatid* cysts in different regions, to the extent that liver assessments in slaughterhouses indicated the prevalence of this infection as 11% in Urmia cows [6], 6.2% in Gachsaran sheep and goats, as well as 16.38 and 3.4% in Isfahan sheep and cows, respectively [7], and finally, 7.26% in Urmia sheep [8]. Additionally, lung assessments in slaughterhouses registered *Hydatid* cyst infection rate as 2.17% in Kermanshah cows [9], 3.7% in Kashan cows, and 4.96% in Gachsaran sheep and goats [10].

Dicrocoelium and *Fasciola* are the other liver parasites that dwell in the bile ducts and gallbladder. The World Health Organization statistics in 2014 designated that approximately 2.4-17 million individuals worldwide were contaminated by fasciolosis [11]. Humans could often acquire fasciolosis through the use of metacercariae contaminated water and plant. Also, domestic animals increase the incidence of *Fasciola* infection in humans through the spread of metacercariae in the enviroment [12]. Furthermore, in terms of livestock husbandry, the damage caused by livestock infection with *Fasciola* is estimated to be equal to 2 billion dollars annually, which is due to the extermination of infected livers as well as further *financial* losses due to reduced production and treatment costs

[13]. Fasciolosis may appear chronic in cows as well as acute and fatal in sheep. *Fasciola* and *Dicrocoelium*-infected animals are often asymptomatic and could be conclusively diagnosed only at post-mortem inspection. The prevalence of fasciolosis in ruminants in the southern regions of Iran is higher than in the northern regions [11]. Several reports have discussed details of parasite infections in slaughtered livestock in the country; accordingly, the prevalence of parasitic diseases varies depending on the study area, season, and year [14]. Oskooi et al. (2009-2010) surveyed the prevalence of fasciolosis in slaughtered cows in six Iranian provinces, namely Markazi, Mazandaran, Khorasan Razavi, East Azerbaijan, Khuzestan, and Fars. The results revealed that the highest and lowest prevalence rates of infection were related to Khuzestan (4.5%) and Fars (0.4%), respectively [15].

Cysticercosis is another prevalent parasitic disease common between humans and livestock. *Cysticercus* is generally observed in muscles that sustain high blood flow, such as the heart and triceps, as well as the liver. The most practical diagnostic method for identifying this parasite is an observe-touch-cut method. However, this method merely serves to place a maximum of 38.3% of the contamination [16]. Numerous studies have investigated the prevalence of this particular parasitic disease in slaughterhouses, the results of which were similar to other parasitic diseases, depending on the region, season, and year of sampling [17].

Obtaining basic information on the prevalence of parasitic diseases in livestock populations is deemed necessary given the health and economic consequences of parasitic diseases common between humans and animals. Slaughterhouses inspection is the most reliable means to obtain fundamental information about the prevalence of parasitic infections and to decipher their contagion pattern, given that the diagnosis of these diseases is feasible only with post-mortem health inspections in slaughterhouses.

The obtained information could be employed to raise awareness regarding human health and veterinary activism to improve health policies and ultimately adopt the best treatment option for combatting parasitic diseases. Furthermore, it appears necessary to exclusively survey the prevalence of each parasite in each region since the prevalence of these diseases differs depending on the geographical circumstances as well as upbringing and health principles of each area.

Objectives: The present study was conducted in accordance with these concerns and with the aim of surveying the number of parasitic infections, namely *F. hepatica, Dicrocoelium, Hydatid cyst*, and *Cysticercus*, in livestock (cows, sheep, and goats) slaughtered in slaughterhouses of Kermanshah province.

Materials and methods

Data collection: The present study was conducted based on a descriptive-analytical research method. Data on the number of slaughtered livestock (4367 cows, 29809 sheep, and 8995 goats) and their infected organs (liver, heart, and lungs) by *F. hepatica, Dicrocoelium, Hydatid cyst,* and *Cysticercus* per month during 2013-2017 were obtained from the slaughterhouses of Kermanshah province, Iran. Veterinary health inspectors in charge of the slaughterhouses conducted the parasite diagnosis based on the observe-touch-cut method.

Statistical analysis: SAS.9.1 software was employed for descriptive and statistical analysis of the collected data. Chi-square test with a significance level of 5% was used to examine the interrelation between the prevalence of infections and years,

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Table 1) Prevalence of parasitic infections in cows, sheep, and goats in different years (%)

Parasite / Involved Organ	Livestock	2013	2014	2015	2016	2017
Fasciola / liver	Cows	1.51^{a}	1.3^{a}	3.4^{b}	3.12^{b}	4.4^{d}
	Sheep	0.08^{a}	0.11^{ab}	0.34^{cd}	0.24^{bc}	0.55^{d}
	Goats	0.09^{ad}	0.57^{bad}	1.3^{cb}	0.28^{de}	0.5^{eb}
Hydatid cyst / liver	Cows	3.67^{abc}	2.38^{ac}	4.15^{b}	2.79^{bc}	7.28^{d}
	Sheep	0.54^{a}	0.6^{a}	1.32^{b}	1.11^{b}	2.02^{b}
	Goats	0.55^{a}	1^{a}	3.1^{c}	1.79^{c}	2.1^{c}
Hydatid cyst / lung	Cows	3.88^{ab}	3.5^{ab}	6.6^{c}	4.01^{b}	13.65^{d}
	Sheep	0.8^{a}	1.23^{b}	2.2^{c}	2.92^{d}	6.53^{e}
	Goats	1.58^{a}	3.15^{a}	6.16^{b}	6.37^{a}	5.11^{b}
Hydatid cyst / other organs	Cows	0^{ab}	0^{ab}	4.71^{ab}	1.78^{a}	3.72^{b}
	Sheep	0^{ab}	0^{ab}	1.44^{a}	1.85^{ab}	2.21^{b}
	Goats	0^{a}	0^{a}	5.23^{a}	3.65^{a}	2.4^{a}
Dicrocoelium / liver	Cows	2.15^{a}	1.51^{a}	2.07^{a}	1.45^{a}	2.84^{a}
	Sheep	1.51^{ab}	1.06^{ac}	2.03^{d}	1.14^{bc}	2.78^{e}
	Goats	2.7^{ab}	3.3^{a}	5.02^{b}	3.22^{ab}	2.8^{ab}
Cysticercus / liver	Cows	0^{a}	0^{a}	0.28^{a}	0^{a}	0^{a}
	Sheep	0.05^{a}	0.16^{a}	0.6^{b}	0.9^{c}	1.4^{d}
	Goats	0^{abcd}	0.21^{a}	1^{bc}	1.14^{c}	0.8^{dc}
Cysticercus / heart	Cows	0^{a}	0^{a}	0^{a}	0.44^{a}	0^{a}
	Sheep	0^{a}	0^{a}	0.56^{a}	0.6^{a}	0.79^{a}
	Goats	0^{a}	0^{a}	0.93^{a}	0.71^{a}	1.1^{a}

Please note that the common letters in each row imply no significant difference between the prevalence rates (significance level 0.05).

seasons, and infected organs, and the results were displayed in the form of appropriate statistical tables.

$\mathbf{Y_{ij} = \mu + T_i + e_{ij}}$

Y_{ij}: Characteristic Mean
μ: Population Mean
T_i: Treatment Impact
e_{ij}: Experimental Error Impact

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Table 2) Comparison of the infection prevalence rates in different livestock breeds from 2013 to 2017 (%)

Parasite / Involved organ	Sheep	Goats	Cows
Fasciola / liver	0.24[a]	0.41[b]	2.63[c]
Hydatid cyst / liver	1.07[a]	1.28[b]	3.8[c]
Hydatid cyst / lung	2.37[a]	3.37[b]	5.77[c]
Hydatid cyst / other organs	0.98[a]	1.64[b]	1.49[b]
Dicrocoelium / liver	1.55[a]	2.74[b]	1.94[c]
Cysticercus / liver	0.55[a]	0.45[a]	0.06[b]
Cysticercus / heart	0.35[a]	0.37[a]	0.09[b]

Please note that the common letters in each row imply no significant difference between the prevalence rates (significance level 0.05).

Findings

A total of 4367 cows, 29809 sheep, and 8995 goats were subjected to post-mortem inspection to diagnose parasitic diseases by veterinary health inspectors of the slaughterhouses from 2013 to 2017. The epidemiological results of the studied infections in each livestock breed by year are shown in Table 1. The results gathered for this component designated that the prevalence of infections in sheep during 2016-2017 was higher compared to the other years, and in general, a significant disparity exists between the data. Due to the insignificance of the infections prevalence between 2013 and 2014 (except for pulmonary hydatid), the lowest prevalence rare of infections was related to these years. Moreover, the infections prevalence from 2013 to 2015 varied depending on the infection type and the year, and a significant disparity was seldom remarked between the data. The obtained results on the prevalence of infections in goats determined that the highest prevalence was related to 2013 and 2014, which rendered significant disparities compared to the other years. Nevertheless, except for *Fasciola*, no significant disparities were observed amongst data. Although some infections prevalence denoted no significant difference between 2013 statistics and other years, the lowest prevalence was observed in this year. The prevalence of *Cysticercus* was observed to be zero from 2013 to 2017 while surveying the prevalence statistics of infections in cows. The highest prevalence of infections was observed in 2015, to the extent that the infections prevalence in this year was significantly divergent from the prevalence recorded in other years. Furthermore, a significant disparity was seldom observed in the prevalence rates from 2013 to 2017 depending on the type of infection, but in general, no particular trend was observed, and it was determined that the infection type and the year shaped the prevalence rates.

The comparison of the prevalence rates of different infections among livestock from 2013 to 2017 is displayed in Table 2. Significant differences were observed between livestock in terms of *Fasciola*, hepatitis, and pulmonary infections, among which the highest and lowest prevalence rates belonged to cows and sheep, respectively. In terms of hepatic and

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cardiac cysticercosis, the lowest prevalence was observed in cows, which rendered a considerable disparity with infection rates in sheep and goat, while no significant difference was observed between sheep and goat regarding the infection rates. The results of surveying hepatic *Dicrocoelium* prevalence designated that there was a substantial difference between the livestock breeds, while the lowest prevalence rate was related to sheep, the highest rate belonged to goats.

The results concerning the seasonal prevalence pattern of infections in each livestock breed from 2013 to 2017 are displayed in Figure 1. The highest prevalence of *Fasciola* in sheep was observed in winter, and no significant difference was observed amongst other seasons. No significant difference was observed between goats and cows despite statistical differences between the infection prevalence rates in different seasons. The highest prevalence of hepatic hydatid in sheep was observed in winter, and no further disparity was found in terms of seasonal prevalence rates of infection in goats and cows. The prevalence of hepatic liver Dicrocoelium in the second six months of the year was significantly higher compared to the first six months of the year. In goats, the infection prevalence was higher in autumn and considerably different from other seasons. In cows, the highest prevalence was observed in autumn and summer, and the lowest prevalence was observed in spring and winter. In sheep and goats, the highest prevalence of hepatic cysticercosis was observed in spring, whereas no significant difference was observed between seasons in case of cows. The results of pulmonary hydatid showed that there was no significant difference between the infection rates in cows through different seasons. Goats had the minimum prevalence rates in summer, and no significant difference was observed between the prevalence rates in other seasons. Additionally, the lowest and highest prevalence rates of infection in sheep were observed in summer and winter, respectively. Regarding the infection rate of cardiac cysticercosis in sheep and goats, the results showed that the prevalence in the first six months of the year was significantly higher than in the second six months of the year. There was no significant difference between the seasonal prevalence of infection rates in cows.

The comparison between different organs in terms of infections prevalence could be viewed in Table 2. In all the three livestock breeds, the prevalence rate of hepatic hydatid infection was significantly higher than that of pulmonary hydatid. In sheep, the prevalence of hepatic cysticercosis was considerably higher than that of cardiac cysticercosis, whereas, in cows, the prevalence of cardiac cysticercosis was substantially higher than that of hepatic type. No significant difference was observed between the hepatic and cardiac cysticercosis prevalence rates in goats.

Discussion

Parasitic diseases are regarded as chronic diseases in the livestock industry, and resulting health and economic issues exist in most countries worldwide (12). Adequate control, prevention, and treatment of these diseases require valid fundamental information on the infection development timing and prevalence. Surveying slaughterhouses is the best way to accurately estimate the time and extent of infections prevalences since the definitive diagnosis of these diseases is primarily conducted through post-mortem veterinary health inspections (9). Numerous studies have been administered in Iran and other countries on the spatial and temporal prevalence of infections. Nevertheless, a spatial and temporal case study of infections

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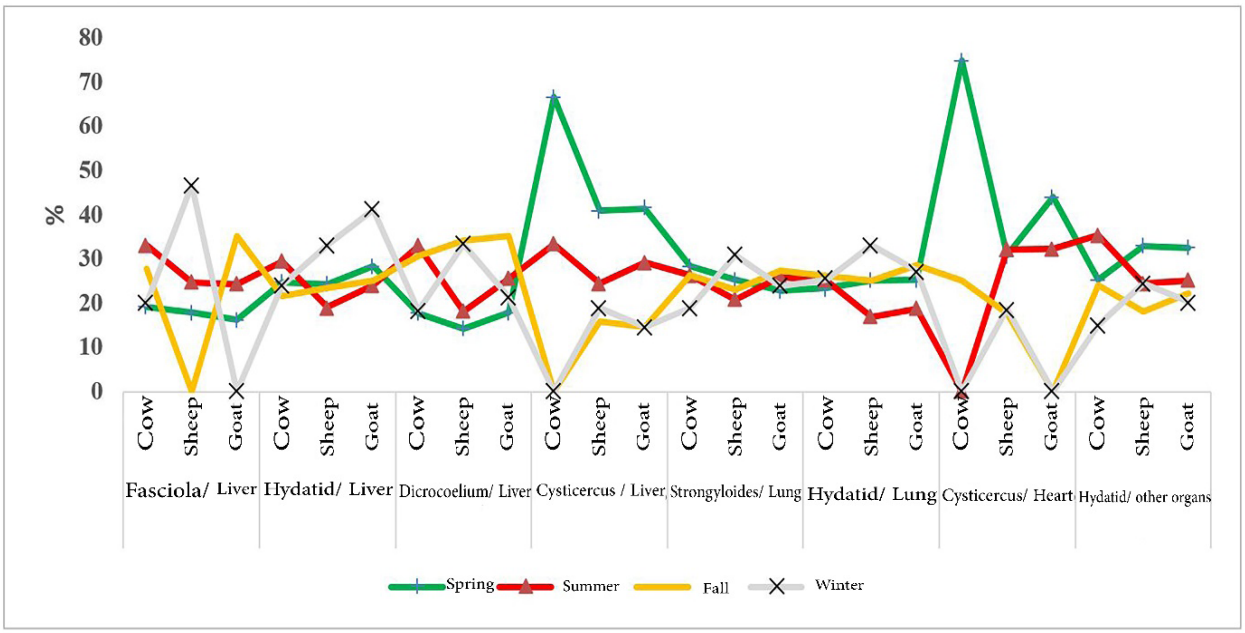

Figure 1) Comparison of infection prevalence rates in cattle, sheep, and goats in different seasons (2013 – 2017).

prevalences in each area is essential, given the local status of prevalence in each region. This study determined the prevalence pattern of some parasitic infections observed in the livestock (cows, sheep, and goats) slaughtered in slaughterhouses of Kermanshah province, namely *F. hepatica, Dicrocoelium*, *Hydatid cyst,* and *Cysticercus* from 2013 to 2017.

Hydatid cyst: In this study conducted from 2013 to 2017, the highest hepatic hydatid infection prevalence rate was reported in cows (3.8%), followed by goats (1.28%), and sheep (1.07%), respectively. In parallel, the highest pulmonary hydatid infection prevalence rate was observed in cows (5.77%), followed by goats (3.37%), and sheep (2.37%), and the difference between the prevalence rates was significant. Climatic diversity and dispersion of parasite hosts have been suggested as the leading causes for this relatively high range [14]. For example, we can further elaborate on some reports in this regard. Yakhchali et al. (2009) reported the prevalence rate of *Hydatid cyst* in Sanandaj to be 6.1% in sheep, 9.7% in cows, and 20.6% in goats (18). The prevalence of hepatic hydatidosis in Sistan and Baluchestan was estimated to be 5.3% in domestic cows and 15.1% in foreign cows breeds, respectively [19]. Ghahvei et al. (2019) in Kermanshah reported the rate of bovine infection with hepatic and pulmonary hydatids as 8.8 and 20.17%, respectively [9]. In Gachsaran, hepatic hydatid infection in sheep and goats was listed to be 6.2 and 9.6%, respectively, and pulmonary hydatid infection was similarly pronounced to be 4.96 and 4.76%, respectively [10]. In a study by Alizadeh et al. (2018) in Urmia, the prevalence rate of hepatic hydatid infection in cows was estimated to be 10.9% [6]. In Torbat-e-Heydarieh, Mokhber-Dezfouli et al. (2016) reported a hepatic hydatid prevalence of 7.95% in sheep and 8.05% in cows between 2009 to 2015 [20].

Fallah et al. (2010) reported the highest prevalence rate of hepatic *Hydatid cyst* in cows, sheep, and goats in a study concerning the prevalence of parasitic

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infections observed in slaughterhouses of Hamadan province in 2010 [14]. There are various reports on the hydatidosis prevalence in other countries. In Libya, Ekhnefer et al. (2012) reported 20.38% hepatic and pulmonary hydatid infection in sheep [21]. Al-Qureshi et al. (2012) estimated the prevalence of hydatidosis in Saudi sheep and goats as 6 and 2.5%, respectively [22]. Comparing the results of the present study with previous studies conducted in other regions signify that *Hydatid cyst* prevalence in Kermanshah province is low despite the active parasite cycle. In line with the preceding analysis, the hydatic cyst prevalence in cows was observed to be significantly higher than in sheep and goats, which is consistent with the results of a study by Yakhchali et al. (2009). Similarly, the prevalence of hydatic cysts in sheep was more moderate than in goats in the previous review, which is further consistent with the results of Yakhchali et al. (2009) (18). Dependence of the infection prevalence on the region, year, and season is suggested as the potential reason for this discrepancy [14].

Furthermore, by assessing the infection prevalence in different seasons, it was determined that the highest prevalence of hepatic hydatid in sheep occurred in winter, while no significant difference was observed concerning the seasonal infection prevalence rates in goats and cows. In sheep, the lowest and highest prevalence rates were observed in summer and winter, respectively. In the study of Ghahvei et al. (2019) in Kermanshah, the highest prevalence rate of hepatic and pulmonary hydatid was observed in cows during summer, while the lowest prevalence occurred in autumn, and the disparity between the seasonal prevalence rates was significant, which appeares to be inconsistent with the results of the preceding study by Gahvei et al., 2019 [9]. In a study by Ibrahim et al. (2010), the highest infection prevalence was remarked in cows and sheep during spring [23], which is not consistent with the results of the present study. In their six-year-long study administered in Ilam province, Mokhber-Dezfouli reported the highest prevalence rate of hepatic hydatid in sheep in winter. While in cows, there was no significant difference between the seasonal prevalence rates [20]. These results are consistent with the results of the present paper. In another study conducted by Pezeshki et al. (2018) in Tehran province from 2015 to 2016, the highest prevalence rate of hepatic hydatid infection in cows and sheep occurred during winter and summer, respectively, while the highest rates pertaining to pulmonary hydatid was observed in summer [24]. It seems that the sample size method is one of the influential determinants in rendering consistency between the results of different studies, to the extent that the highest degree of consistency was observed in the results of studies in which the prevalence rates have been surveyed over an extended period of several years. Additionally, the geographical conditions and location of the region are deemed as the potential causes of inconsistency between the results of different studies [9].

Evidently, the infection prevalence rates through these years lacked a particular pattern. Accordingly, increase, decrease, and sometimes stability were marked in prevalence rates in the course of the study period. The results of this section are consistent with the results obtained by Mokhber-Dezfoli et al. (2016) as well as Pezeshki et al. (2018) [20, 24]).

In all the studied livestock breeds, the prevalence of pulmonary hydatid was significantly higher than the hepatic type. In the study of Fallah et al. (2010) in

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Hamedan, the prevalence of pulmonary hydatid in cows, sheep, and goats was considerably higher than that of haptic hydatid [14]. The findings of their study are consistent with the results of another study by Ghasemian et al. (2018) [25]. The higher prevalence rate of the hydatid infection in the lung compared to the liver could be justified by considering that the lung has a soft and flexible tissue; therefore, it is more practical to catch smaller cysts in the depth of the tissue than the liver [14].

Fasciola: In this survey, the highest prevalence rate of *Fasciola* parasitic infection was observed in cows (2.63%), followed by goats (0.41%), and sheep (0.24%), and the disparity between the rates was significant. Reports detailing the *Fasciola* infection prevalence in other areas were briefly discussed below. In Kermanshah, Fasciola infection prevalence rate in cows was estimated as 5.47% [9]. In Hamedan, the infection prevalence rate amounted to 4.2% in sheep, 4.5% in goats, and 9.5% in cows [14], which are consistent with the results of the present study in terms of the prevalence pattern discerned in the livestock. In Gachsaran, the infection prevalence in sheep and goats was 9.99 and 9.27%, respectively, and there was no significant difference between the rates [10]. Alizadeh et al. (2019) reported a prevalence rate of 25.5% in Urmia [6]. In another study conducted by Piri et al. [14] in Hamedan, the infection prevalence rates in cows, sheep, and goats were 1.5, 0.5, and 4%, respectively, all of which are consistent with the results of the present study.

The average prevalence of infection was reported as 4.2% in sheep, 9% in cows, and 3.1% in goats [26] in a meta-analysis study conducted by Khadem Vatan et al. (2020). Accordingly, the prevalence of Fasciola infection in Kermanshah province is lower than the national average.

In this study, the highest *Fasciola* infection prevalence rate was observed in sheep during winter. Generally, no significant difference was observed between seasonal prevalence rates in goats and cows, despite the seasonal differences between the infection prevalence rates. Ghahvei et al. (2019) reported the highest and lowest infection prevalence rates in cows in winter and autumn, respectively, which are not consistent with the results of the present study [9]. Furthermore, Mokhber-Dezfoui et al. [20] in their study administered in Torbat-e Heydarieh indicated that the highest prevalence of *Fasciola* infection in sheep and cows occurred in winter and autumn, respectively, which is consistent with the results of this study. Similarly, Pezeshki et al. (2018) reported the highest infection prevalence rate in sheep in autumn and winter and in cows in winter, which were significantly different in comparsion to the other seasons [24]. In sum, the above findings are consistent with the findings of the present study. Similar to the results obtained for annual hydatid prevalence pattern, the pattern obtained for Fasciola infection did not display a significant trend, which is consistent with the respective reports of Mokhber-Dezfouli and Pezeshki studies [20, 24].

Cysticercosis: In the present study, the lowest prevalence rate of hepatic (0.06%) and cardiac (0.09%) *Cysticercus* was observed in cows, and no significant difference was observed between sheep and goats. Furthermore, in terms of seasonal prevalence rate, the highest prevalence rate was observed in sheep and goats during spring, while no significant difference was observed in infection prevalence rate in cows between seasons. The comparative survey directed on the infection prevalence in different tissues in cows indicated that the highest infection prevalence rate

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was related to the cardiac tissue. In the study conducted in Kermanshah, the prevalence of *Cysticercus* infetion in cows was estimated as 0.68%, and the highest prevalence occurred in autumn [9]. In another study by Mirzaei et al. (2016) in Tabriz, the infection prevalence in cows was determined to be 1.73% [27]. Faraji et al. (2015) similarly marked the highest prevalence of bovine infection in Bisotun, Kermanshah, as 0.06 and 0.03% in 2010 and 2011, respectively, with the highest prevalence rates in heart and tongue tissues [28]. In a study conducted in Croatia from 2005 to 2011, the infection prevalence in cows was reported to be 0.11% [29]. Additionally, the infection prevalence in cows was reported to be 0.011% in a four-year study overseen in Romania [30]. Moreover, the highest infection prevalence was observed in the tongue, followed by the shoulder and heart muscles in a study by Amiro et al. [31] concerning the infection prevalence in cows. Comparing the results of the present and other studies shows the favorable situation and low prevalence of infection in Kermanshah province. In sum, comparing the results of the present and other studies on the infection prevalence designated that the results render more consistency with the results of studies conducted over an extended period of several years.

Dicrocoelium: The results obtaind in this study concerning *Dicrocoelium* parasitic infection registered a significant disparity in the infection prevalence between cows (1.94%), sheep (1.55%), and goats (2.74%). The highest and lowest prevalence rates were observed in sheep and goats, respectively. Furthermore, the infection prevalence rate was higher in all the three livestock breeds in autumn, and no particular pattern was found in the annual prevalence rates of infection in any of the livestock breeds. The infection prevalence rates in some provinces of the country were briefly discussed below. In Hamedan, the highest infection prevalence was recognised in sheep, while the lowest occurred in cows [14] Ghahvei et al. (2019) showed that the highest infection prevalence in cows was in autumn and spring, which is consistent with the results of the present study [9]. Mokhber-Dezfouli et al. (2016) reported the infection prevalence (over six years) in sheep and cows as 1.97 and 2.16%, respectively; also, the highest seasonal infection prevalence was observed in sheep and cows in the second half of the year and autumn, respectively, which is highly consistent with the results of the present study [20]. In Pezeshki et al. (2018)'s study in Tehran, which lasted from 2016-2018, the infection prevalence in sheep (2.86%) was higher than in cows (0.79%). Also, the highest seasonal infection prevalence in sheep and cows was observed in the second and first six months of the year, respectively; the results concerning infection prevalence in sheep are more consistent with the results of the present study [24]. The geographical situation of the region and the study year are deemed the main potential causes of inconsistency between the results of different studies, all of which are due to the increasing awareness of livestock activists and the extension of veterinary services [9].

Conclusion

The present study resolved the infection prevalence of *F. Hepatica, Dicrocoelium, Hydatidosis, Cysticercosis,* and Strongylus in cattle, sheep, and goats in Kermanshah province, Iran. Furthermore, the results indicated that the infection prevalences seen in this province is lower compared to the other regions. The results of this study revealed that the annual prevalence of parasitic infections in the assessed livestock breeds does not

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adhere to a particular pattern and is primarily determined by environmental and managerial conditions. Contrary to the annual prevalence pattern, the seasonal prevalence in livestock followed a particular pattern, one that can be adopted as a management tool to improve the efficiency of veterinary development and prevention programs.

Issues and limitations

One of the problems and limitations that the present study faced is the limited access to the decade data concerning the number of parasitic infections in Kermanshah province, which further delays the comparison of available data and results with neighbouring regions.

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Ethical Permision: This study was also confirmed and permitted by the Ethics Committee of Islamic Azad University, Shahrekord, Iran (Code: 183; 1399/1/27).

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