

The Prevalence of *Fasciola* (Digenea: Fasciolidae) Species in Livestock and Humans in Iran, A Systematic Review

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ABSTRACT

Fasciolosis, a foodborne parasitic disease, is caused by the trematodes *Fasciola hepatica* and *Fasciola gigantica*. This disease is of significant concern, having been reported in various vertebrate hosts across more than 80 countries. A comparison of the geographical distribution of the two species reveals that *Fasciola hepatica* affects a wider range of animals and is often reported from high altitudes and hot and humid areas. The present study endeavors to provide an update on fascioliasis in animal and human hosts in Iran during the years 2019 to 2024. A systematic search of published articles in English was conducted using electronic databases including Google Scholar, PubMed, Iran Science Direct, SID and Magiran. Following a thorough review of the literature, a total of 18 articles were identified that satisfied the predetermined inclusion criteria for the evaluation of the prevalence of fascioliasis in humans and animals within the Iranian context. Of the 18 articles that were subjected to analysis, only five documented the presence of the *Fasciola hepatica* species. In four articles, researchers encountered difficulties in identifying the specific species of *Fasciola*. Notably, the remaining articles reported the presence of both *F. hepatica* and *F. gigantica* species. The molecular analysis was employed in 61.1% of the cases, which is noteworthy. The prevalence of human fascioliasis exhibited variability, ranging from 1.7% to 2.4% across diverse regions of Iran. The present systematic review revealed that there has been a paucity of studies conducted in the field of fasciolosis in Iran during the last five years. Consequently, the authors of the present study recommend the implementation of further research focusing on the prevalence of fasciolosis in all provinces. The authors further recommend the formulation and dissemination of effective prevention and control strategies for this disease, contingent on the prevalence of fasciolosis in different provinces.

Keywords: Human Livestock, Fasciolosis, Prevalence.

1. Context

Fasciolosis, a foodborne parasitic disease, is caused by the trematodes *Fasciola hepatica* and *Fasciola gigantica* (1). This disease is of significant concern, having been reported in various vertebrate hosts across more than 80 countries (2). A comparative analysis reveals that *F. hepatica* exhibits a broader spectrum of host range, with a propensity to be reported from high altitudes and hot and humid regions, in contrast to the distribution patterns of *F. gigantica*. The prevalence of human fasciolosis remains uncertain, necessitating further investigation and the collection of additional epidemiological data. Approximately two decades ago, estimations placed the global burden of fasciolosis at approximately 17 million individuals (3-4). It is possible that these figures underrepresent the actual numbers due to a limited understanding of the impact of the disease in numerous African and Asian nations. The life cycle of *Fasciola* comprises two hosts: gastropods, which function as intermediate hosts, and mammals, which act as final hosts. Following the excretion of eggs by the final host, the miracidium is immediately released into the water. The miracidium, upon entering the skin of a snail from the family Lymnidae, undergoes a transformation into a cercaria. Free-floating cercariae can subsequently metamorphose into metacercariae, which attach to aquatic vegetation. Humans and livestock become infected through the ingestion of metacercariae from contaminated water or vegetables. Ingestion of these metacercariae leads to their migration through the intestinal wall and liver tissue, reaching the bile ducts and undergoing maturation (5). In Asia, fasciolosis has been reported principally from Iran and Vietnam. Notably, Iran is among the six countries with the highest annual reports of fasciolosis worldwide (6). In order to develop effective disease control strategies, it is essential to understand the transmission method and the epidemiological characteristics of the disease (2). A recent study was conducted to comprehensively assess the prevalence of human and animal fasciolosis in Iran and globally (7-9). However, a comprehensive report on the prevalence of fasciolosis in different hosts during the last five years in Iran is currently not available. The objective of this study is to provide an update on the prevalence of *Fasciola* in human and animal hosts in Iran from 2019 to 2024.

2. Evidence Acquisition

In this study, the PRISMA method was employed to systematically review and report on standard systematic review studies. A comprehensive search strategy was employed, encompassing English and Persian databases, namely Google Scholar, Science Direct, and PubMed, as well as IranDoc, Magiran, and SID. The search terms included the operators "or" and "and," along with the keywords "fasciola," "fasciolosis," "human," "domestic animals," "diagnosis," "prevalence," and "Iran." The search was limited to articles published between 2019 and 2024. Initially, the titles and abstracts of the selected articles that

investigated the prevalence of *Fasciola* in arthropod hosts in Iran were reviewed. The full texts of the documents were entered into a reference and note management software program, and duplicate studies were removed. The selection of articles meeting the study criteria was conducted by two of the authors separately and according to a predetermined checklist. The extraction and evaluation of studies was conducted using two forms: one form for human studies and one form for animal studies. The two authors then meticulously reviewed the selected studies, and those that met the inclusion criteria were incorporated into the study. Conversely, studies were excluded if they lacked essential information, failed to align their methods with their results and conclusions, centered on treatment, or reported the presence of other trematodes (Figure 1). The required information was elicited from the selected articles by two independent authors. In the event of inconsistency, the difference between the two was resolved by the other author.

3. Results

A total of 408 studies were initially identified through database searching, and an additional five articles were appended to this list by examining their reference lists. Subsequent to the removal of duplicate articles (n=40), an initial search of the titles and abstracts of the remaining articles (373 articles) was conducted. The full texts of 68 articles were then evaluated for validation. Following this, 50 articles were excluded from the review due to non-relevance to the subject, the study area being outside of Iran, the presence of parasites other than *Fasciola*, duplicate results, and lack of full text. Following these exclusions, 18 articles were selected according to the established entry criteria (10-25). Of these, only *F. hepatica* was reported in five articles, the species of *Fasciola* was not specified in four articles, and the simultaneous infection of *F. hepatica* and *F. gigantica* was reported in other articles. Of the 18 studies conducted on fasciolosis, 11 articles employed molecular tests such as the melting point curve of high-quality genomic material (HRM), standard polymerase chain reaction (PCR), loop-mediated amplification (LAMP), restriction fragment length polymorphism (RFLP), and multiplex PCR. Conversely, serological tests were utilized in only two studies, while morphology tests were employed in five studies. The serological studies that employed commercial kits and natural cathepsin L utilized the aforementioned methods to detect *Fasciola* (Table 1). A total of seven articles were identified as pertaining to the prevalence of fasciolosis. The prevalence of fasciolosis was most frequently reported in goats, followed by sheep, cattle, and humans (Table 1). This study revealed that fasciolosis has been documented in sheep, cattle, goats, buffalo, and humans in the provinces of Tehran, Ardabil, Fars, Gilan, Khuzestan, Sistan and Baluchestan, Bushehr, Mazandaran, Golestan, Alborz (Karaj), Lorestan, Ilam, West Azerbaijan, East Azerbaijan, Qom, Qazvin, Yazd, Isfahan, Kermanshah, and Razavi Khorasan. The prevalence of

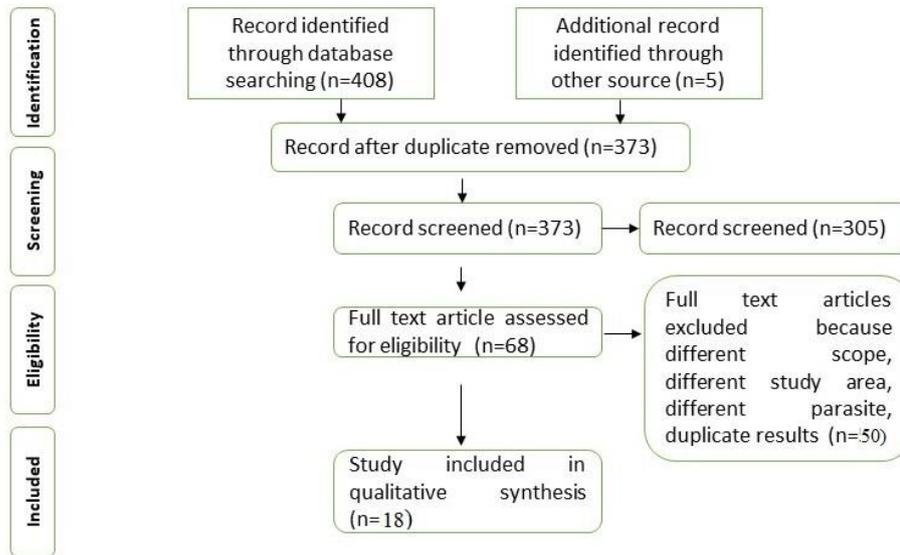


Figure 1. Flowchart of searching and selecting the desired final studies between the years 2019 and 2024.

fasciolosis in humans has exhibited geographical variation, ranging from 1.7% in Golestan to 2.4% in Sistan and Baluchistan.

4. Conclusion

The present study was conducted with the objective of investigating the various types of human and animal fasciolosis in Iran. Until the conclusion of the 20th century, fasciolosis was acknowledged as a significant veterinary problem due to substantial economic losses. However, with the emergence of human cases worldwide, the World Health Organization (WHO) recognized the need to re-evaluate the significance of this disease. Human fasciolosis has been reported on all five continents, with a surge in cases documented in 51 countries. In some of the reviewed studies, fasciolosis was identified to the genus level due to the use of morphological and serological techniques. However, the challenges associated with accurately identifying parasite species using morphological methods, such as the presence of multiple variations in morphological characteristics, have led to a shift toward the utilization of molecular tests (28). According to the studies of Khademvatan et al. (7), the epidemiology of fasciolosis in animals and humans in Iran is still unknown. A review of the literature reveals that only nine studies examined the prevalence of fasciolosis in humans, goats, sheep, and cattle between 2019 and 2024 (27-23, 17, 12, 11, 2). Of these, only two seroprevalence studies were conducted on human fasciolosis. Consequently, it is not feasible to accurately estimate the status of human fasciolosis in recent years in Iran. The prevalence of fasciolosis in various hosts across different time periods ranged from 0.8% to 10%, suggesting a low prevalence of *Fasciola* in Iran. In a review study by Khadem Vatan et al. (7), the overall prevalence of

fasciolosis in Iran between 1999 and 2019 was reported to be approximately 6%. Recent research suggests a significant drop in prevalence rates of veterinary fascioliasis in Iran, largely attributed to improved collaboration among veterinary organizations in treating livestock and heightened awareness among local farmers (29). Numerous studies have demonstrated that fasciolosis imposes substantial economic burdens on dairy cattle. The economic repercussions of fasciolosis encompass diminished milk, meat, and wool production; a retarded growth rate; and elevated expenses associated with liver destruction during meat inspection (31). Notably, a paucity of research addressing the economic ramifications of fasciolosis in Iran has been observed (35). The present study revealed that human and animal fasciolosis cases have been documented in twenty Iranian provinces over the past five years. However, when the general population of Iran is taken into consideration, the number of individuals examined for the prevalence of the *F. hepatica* parasite is minimal. Consequently, in order to obtain a precise estimate of the prevalence of this parasite in Iran, further studies are required throughout the country. Despite the numerous research studies conducted on fascioliasis in regions where the disease is prevalent, many aspects of the condition still require further elucidation (36). The present systematic review revealed that there has been a paucity of studies conducted in the field of fasciolosis in Iran during the last five years. Consequently, the authors of the present study recommend the implementation of further research focusing on the prevalence of fasciolosis in all provinces. Given the prevalence of fasciolosis in different provinces, it is recommended that effective prevention and control strategies for this disease be designed and disseminated.

Table 1. The list of studies that the infection of *Fasciola* spp. have reported in animals and humans in different provinces of Iran (2019-2024).

aim	Provinces	Host	Diagnostic test	Fasciola sp.	Finding	References
Comparison between molecular and morphological test in identification of <i>Fasciola hepatica</i> in sheep	Lorestan	Sheep	Morphological and molecular	<i>F. hepatica</i>	The higher sensitivity of molecular tests in the diagnosis of fasciola compared to morphological tests. The prevalence rate was reported as 1.2%.	10
Serological study of fasciolosis	Golestan	Human	Serology	<i>Fasciola sp.</i>	The prevalence rate was 1.7%	11
Genetic diversity and evaluations of different <i>Fasciola hepatica</i> haplotypes in different provinces	Elam, West Azerbaijan, East Azerbaijan, Khuzestan, Bushehr, Yazd, Alborz (Karaj), Sistan and Balochistan and Qom.	Sheep, goat and cow	PCR	<i>F. hepatica</i>	Among 130 different samples of <i>Fasciola hepatica</i> , 37 different haplotypes were identified based on nad gene	12
Rapid identification of different <i>Fasciola</i> species using HRM test	Gazvin	Sheep and Cow	HRM	<i>F. hepatica</i> and <i>F. gigantica</i>	The HRM technique in the present study was found to be a reliable technique for the identification and genetic diversity of liver flukes	13
Morphological study of <i>Fasciola sp.</i>	Golestan	Cow and Sheep and Goat	ITS1, RFLP and Multiplex PCR	<i>F. hepatica</i> and <i>F. gigantica</i>	Observation of the first case of <i>Fasciola</i> hybrid in Golestan province	14
Morphological characterization of <i>Fasciola sp.</i>	Ardabil, Khuzestan, Isfahan, Tehran, Mazandaran	cows, sheep, goats, buffalo	PCR	<i>F. hepatica</i> and <i>F. gigantica</i>	Significant genetic differences between populations of <i>f. gigantica</i> was shown in Asia and Africa, while isolates of <i>f. hepatica</i> from different regions of the world share high similarities.	15
Molecular characterization of <i>Fasciola sp.</i>	Lorestan	Cow, sheep, goat	PCR	<i>F. hepatica</i> and <i>F. gigantica</i>	Among the mitochondrial genes, the nd1 gene is able to examine the differences and similarities better than the co1 gene.	16
Serological study of fasciolosis	Sistan and Baluchestan	Human	Serology	<i>Fasciola sp.</i>	The prevalence of fasciolosis in the samples was 2.4% and a significant relationship between the use of raw vegetables and fasciolosis was reported.	17
Phylogenetic analysis of fasciolosis from endemic regions	Ilam, Lorestan and Khuzestan	Cows, Sheep, Goats	Multiplex PCR	<i>F. hepatica</i>	similarity in ITS gene among samples isolated from different hosts is almost similar. The genetic variation in the Cox gene is much higher than that of ITS and NAD	18

Molecular phylogeny and genetic diversity among <i>Fasciola gigantica</i>	Kermanshah	cows, sheep, goats.	PCR	<i>Fasciola gigantica</i>	<i>Fasciola gigantica</i> was isolated among 20 samples of 5 different haplotypes based on Nad gene. A statistically significant difference was reported between the genotypes of the present study and other genotypes in the world	19
Molecular identification of <i>Fasciola</i>	Fars	cows, sheep, goats	PCR	<i>F. hepatica</i> and <i>F. gigantica</i>	<i>Fasciola gigantica</i> was the dominant species in these areas	20
Identification and phylogenetic analysis of the isolated species	Sistan and Baluchistan,	Cow, sheep	PCR	<i>F. hepatica</i> and <i>F. gigantica</i>	<i>Fasciola gigantica</i> was the dominant species in these areas	21
Prevalence of fasciolosis among	Alborz	cow	morphology	<i>Fasciola sp.</i>	The prevalence of fasciolosis was reported as 2%. A significant relationship between humidity and fasciolosis was reported.	22
Investigating the prevalence of fasciolosis in slaughtered animals in Tabriz	Tabriz	Cows, sheep, goats	Morphology	<i>Fasciola</i> species	The prevalence of <i>Fasciola hepatica</i> in cows, goats and sheep was 3.3, 3.8 and 10% respectively. The prevalence of <i>Fasciola gigantica</i> in cows, goats and sheep was 1.9, 1.8 and 4 percent, respectively.	23
Investigating the prevalence of fasciolosis in slaughtered cattle	Qazvin	Cows, sheep, goats	Morphology	<i>Fasciola</i> species	The prevalence of <i>Fasciola</i> in cows, sheep and goats was 1.2, 0.8 and 0.9 percent respectively.	24
Comparison of molecular methods for the diagnosis of <i>Fasciola hepatica</i> in sheep	Lorestan	the sheep	molecular	<i>Fasciola hepatica</i>	The prevalence rate of <i>Fasciola</i> was 5.6%. Lamp technique was more efficient than PCR	25
Investigating the prevalence of fasciolosis in slaughtered animals <i>Fasciola</i>	Sabzevar	Sheep and cattle	morphology	<i>Fasciola</i>	The prevalence of <i>Fasciola</i> in cattle and sheep was 8.3% and 2.5% respectively.	26
Investigating the prevalence of fasciolosis in	Gilan	sheep	Morphology	<i>Fasciola hepatica</i>	The prevalence of <i>Fasciola hepatica</i> in sheep was 3.4 percent.	27

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Authors' Contribution

Study concept and design: B H A, N T

Acquisition of data: B H A, Y P, S S Sh

Analysis and interpretation of data: B H A, Y P, S S Sh, NT

Drafting of the manuscript: B H A, Y P, S S Sh, NT

Critical revision of the manuscript for important intellectual content: B H A, Y P, S S Sh, NT

Ethics

We hereby declare all ethical standards have been respected in preparation of the submitted article.

Conflict of Interest

It has been demonstrated that there is an absence of competition of interest.

Data Availability

The data that support the findings of this study are available upon request from the corresponding author.

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