Prevalence of Parasitic Infections in a Tertiary Hospital in China: A 12-Year Retrospective Study

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Research Article

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Abstract

Background

Parasitic infections represent a worldwide public health issue in many developing countries. Few epidemiological studies regarding parasitic infections and the evolution of infection spectrum in China have been reported up to date. It is necessary to investigate the epidemiological feature of parasitic infection during recent years.

Methods

Three hundred and thirty-six cases of parasitic infections were retrospectively enrolled and analyzed. Electronic medical records of the enrolled parasitic patients from January 1, 2010 to May 31, 2021 were retrieved from the Electronic Medical Record System of a tertiary hospital in China. Demographic characteristics and data of laboratory tests were exported in Excel and analysis were performed using Graphpad Prism 5.

Results

Overall, seventeen species of parasites were detected in 336 admissions with a total number of infected individuals reached the peak in 2018. Moreover, the regions of patients distributed mainly included: Shanghai (40.48%), Zhejiang (18.45%), Anhui (6.85%), Jiangsu (6.25%) and Jiangxi (4.76%). Two hundred and eighty-eight cases were diagnosed with single species of parasitic infection and 47 cases were found mixed species infection. Foodborne parasites (FBPs) were the primary species of parasites and the top 4 were *clonorchis sinensis* (24.70%), *sparganum mansoni* (16.07%), *paragonimus westermani* (20.83%) and *cysticercus* (17.86%). Obvious eosinophil elevation was found in 56.54% enrolled patients. Patients with periods of infection before the time of diagnosis lasted longer than 6 months includes four parasites: *sparganum mansoni* (28.30%, 15/53), *paragonimus westermani* (38.57%, 27/70), *cysticercus* (25.00%, 15/60).

Conclusions

Our study demonstrated the prevalence of parasitic infection over the latest 12 years in a single center of China. The trend of parasitic infection rate reached the peak in 2018 with the dominating parasitic species changed from soil origin to foodborne. Furthermore, with the emergence of various dietary habits and the development of living conditions, unclean diets especially eating raw meat had become the main route of transmission for parasites, which alarmed that food safety education for public should be strengthened and enlarged. Although eosinophil elevation and IgE is reliable indicators for initiating screening of parasitic infection but enough for diagnosis, novel diagnostic kits for parasites should be deveopled.

Background

In the early 1960s, there were many parasitic diseases that seriously affected the health of people worldwide, especially in China and poor countries. Parasitic infection was used to be a troublesome problem that hindered social and economic development [1, 2]. Though exceptional achievements have been accomplished in fighting parasites in the past 60 years, parasitic infections in China still account for a large percentage of the global burden [3]. Soil-transmitted parasites and foodborne parasites (FBPs) are the two dominant species of parasites. FBPs exist in animal meat or aquatic products, and these parasites would be transmitted to human body by eating raw or uncooked food containing eggs or larvae [4]. Soil-transmitted parasites (also named soil-transmitted nematodes) do not require an intermediate host, and its eggs or larvae in the outside world (mainly refers to the soil) could directly infect human [5]. Altered routes of transmission can reflect the current situation of economic development of a country to a certain extent. For the rapid advance of economy and sanitary conditions, the species spectrum of parasites has been changed for years.

It had been reported that the number of patients showed a growing trend and the diversity of parasites altered during the period from 1991 to 2001 among admissions for parasitic infection of hospitals in Shanghai [6]. However, there is no investigation in the evolution of the spectrum of parasitic infection in recent years in Shanghai. Changes in the parasitic spectrum could provide valuable information for diagnosis and prevention of parasitic diseases for clinicians. Our study is a single-center retrospective survey to reveal the prevalence of parasitic infections at the Department of Infectious Diseases of Shanghai Ruijin hospital, Shanghai Jiaotong University School of Medicine in China in the recent twelve years from 2010 to 2021.

Methods

Study design and subjects

This single-center retrospective study was performed in the *Department of Infectious Diseases of Ruijin hospital, Shanghai Jiao Tong University School of Medicine* in China from January 1, 2010 to May 31, 2021. Three hundred and thirty-six patients infected with parasites consisting of 139 females and 197 males were enrolled and analyzed.

Data Collection And Analyzed

Electronic medical records of patients with parasitic infection from January 1, 2010 to May 31, 2021 were retrieved from the Electronic Medical Record System of *Ruijin hospital*. Blood or stool samples were sent to *National Institute of Parasitic Disease, Chinese Center for Disease Control and Prevention (CDC)* for testing the serum antibody of parasites. The results of laboratory tests were collected at the time of the first visit. Diagnosis was made by parasitic serum antibody or tissue biopsy or stool parasite eggs. Data and basic information of patients was collected by Excel 2010 and analyzed by GraphPad Prism 5.00 (GraphPad Software, San Diego CA, USA).

Results

Epidemiological characteristics of parasitic diseases

Three hundred and thirty-six patients according to the medical records were included. For the prevalence of parasitic infection during the years from 2010 to 2021, it showed an upward trend with a peak in 2018 and descent in the last three years: 2010 (20, 5.95%), 2011 (19, 5.65%), 2012 (21, 6.25%), 2013 (23, 6.85%), 2014 (31, 9.23%), 2015 (22, 6.55%), 2016 (41, 12.20%), 2017 (31, 9.23%), 2018 (53, 15.77%), 2019 (36, 10.71%), 2020 (21, 6.25%), 2021 (18, 5.36%) (Figure 1a) (Table 1). Patients were mainly from five regions: 136 from Shanghai (40.48%, 136/336), 62 from Zhejiang (18.45%, 62/336), 23 from Anhui (6.85%, 23/336), 21 from Jiangsu (6.25%, 21/336), 16 from Jiangxi (4.76%, 16/336), accounting for 77% of total cases (Figure 1b). Cases from other regions were less than 10: 9 from Guizhou, 8 from Henan, 8 from Heilongjiang, 5 from Jilin, 5 from Sichuan, 4 from Fujian, 4 from Hubei, 4 from Chongqing, 3 cases from Guangdong, 3 from Hunan, 3 from Liaoning, 3 from Shanxi, 2 from Guangxi, 2 from Inner Mongolia, 2 from Shandong, 2 from Xinjiang, 1 from Beijing, 1 from Hainan, 1 from Qinghai, 1 from Shanxi, 1 from Xizang, 1 from Yunnan and 2 from America.

Table 1
Parasitic infections over recent 12 years in a tertiary hospital in Shanghai.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Parasites entities												
Amoeba	1						1		1		1	
Hydatid					1	1		1	1			
Tapeworm	1	1			1	1	2	1	2	1	1	2
Paragonimus westermani	3	7	6	7	2	1	15	11	7	8	3	
Toxoplasmosis	2				3		1			1	2	1
Hookworm				1					1			
Clonorchis sinensis	1	2	2	3	4	1	7	7	22	12	8	14
Borrelia burgdoferi				1		1						
Giardia lamblia									1			
Sparganum mansoni	4	4	3	2	3	4	10	4	11	7	2	
Cysticercus	6	5	5	7	13	8	4	3	2	4	3	
Leishmania spp			1									
Plasmodium				1		1	1	3	1			
Blastocystis hominis	1		1					1	1			
Trichinella spiralis					2							
Schistosoma			2	1	1	4			3	3	1	1
Tsutsugamushi	1		1		1							
Total	20	19	21	23	31	22	41	31	53	36	21	18
Note: Seventeen species of parasites were found in our study with the highest number of infections occurring in the year of 2018.												

Demographic characteristics of parasitic patients and the main routes of transmissions

As shown in Figure 2a, patients were categorized into nine different age groups. Male-to-female ratio was 1.42:1 with the age of majority ranged from 21 to 70. Parasitic infections can be acquired in several ways. There were four major routes of transmission (Figure 2b): unclean diets (47.62%, 160/336); traveling abroad (8.33%, 28/336); contacting infected water (2.60%, 9/336); raising animals (1.19%, 4/336), additionally, there were nearly half of the patients with unknown routes of transmission (47.62%, 135/336).

Parasitic Species And Epidemic Trend Of Parasites Over Years

A total of seventeen types of parasites were detected in patients (Figure 3a). Among these parasites, *clonorchis sinensis* (24.11%, 81/336) was the most prevalent one, followed by *paragonimus westermani* (20.83%, 70/336), *cysticercus* (17.86%, 60/336), *sparganum mansoni* (16.07%, 54/336), *schistosoma* (4.76%, 16/336), tapeworm (3.87%, 13/336), toxoplasmosis (2.98%, 10/336), *plasmodium* (2.08%, 7/336), *hydatid* (1.49%, 5/336), *amoeba* (1.49%, 5/336), *blastocystis hominis* (1.19%, 4/336), *tsutsugamushi* (0.89%, 3/336), *trichinella spiralis* (0.60%, 2/336), *borrelia burgdoferi* (0.60%, 2/336), hookworm (0.60%, 2/336), *leishmania spp* (0.30%, 1/336), *giardia lamblia* (0.30%, 1/336). The patients of superinfection with 2 parasites, 3 parasites and 4 parasites were 39 cases, 6 cases and 2 cases respectively, accounting for 14% of the whole patients.

The profile of every-year parasitic infections was displayed in Figure 3b, showing that the FBP (clonorchis sinensis, paragonimus westermani, cysticercus, sparganum mansoni) became the dominated parasitic species. *Cysticercus* showed high infection rate in the early 5 years: 2010 (30.00%), 2011 (26.32%), 2012 (23.81%), 2013 (30.43%), 2014 (41.94%), 2015 (36.36%). Moreover, the infection rate of *clonorchis sinensis* presented with an upward trend in recent six years: 2016 (17.07%), 2017 (22.58%), 2018 (41.51%), 2019 (33.33%), 2020 (38.10%), 2021 (77.78%). Notably, *paragonimus westermani* showed high infection rate in 2011 (36.84%), 2012 (28.57%), 2013 (30.43%), 2016 (36.59%), 2017 (35.48%). The infection rate of *cysticercus* was persistent high from 2010 to 2015, while other parasites species were sporadic over the years from 2012 to 2020.

Evidence Of Parasitic Infection For Diagnosis

Definite evidence of parasitic infection for diagnosis had been found in 275 cases. Serum parasitic antibodies of 260 cases were detected. Proglottids were detected in 13 cases with tapeworm infection. Two cases with *cysticercus* infection were diagnosed by detection of worm body in pathological tissue. There were 61 patients diagnosed without definite evidence but based on their epidemiological investigations (Figure 4a). Patients with parasitic infection always have early signs of abnormal blood cytometry which are prone to be misdiagnosed as hematological diseases. It's worth noting that 169 (56.54%) patients with elevated eosinophil counts were found positive antibody associated with parasites (Figure 4b). Immunoglobulin E (IgE) detection was conducted in 173 patients with nearly half of them (50.3%) showing positive parasitic antibody (87 cases) (Figure 4c).

The Periods Of Parasitic Infections Before Diagnosis

The periods of infection before the time of diagnosis of the top four parasites (*clonorchis sinensis*, *paragonimus westermani*, *cysticercus* and *sparganum mansoni*) were summarized in Table 2. Surprisingly, 38.57% patients infected with *paragonimus westermani* were diagnosed after more than 6 months' infection. Similarly, patients with *cysticercus* and *sparganum mansoni* diagnosed after more than 6 months' infection accounted for 25.00% and 28.30% respectively (Table 2). Moreover, symptoms of 6 cases infected with *sparganum mansoni* had appeared over 10 years since they were children. Of the 6 cases, 3 cases were diagnosed owing to epileptic seizure, but other patients were unfortunately wrongly diagnosed as rheumatoid arthritis. Therefore, etiological treatments for many parasitic patients were delayed because of delayed diagnosis of parasites infection.

Table 2

Infection period before diagnosis among clonorchis sinensis, clonorchis sinensis, cysticercus and sparganum mansonii

Parasites enties	Clonorchis sinensis	Paragonimus westermani	Cysticercus	Sparganum mansonii
Time of diagnosis				
~ 2 weeks	33 (40.74%)	9 (12.86%)	26(43.33%)	15(28.30%)
~ 1 month	26 (32.10%)	1 (1.43%)	12(20.00%)	12(22.64%)
~ 6 month	18 (22.22%)	33 (47.14%)	7(11.67%)	11(20.75%)
~ 1 year	1 (1.23%)	7 (10.00%)	6(10.00%)	4(7.55%)
> 1 year	3 (3.70%)	20 (28.57%)	9(15.00%)	11(20.75%)
Total	81	70	60	53
Note: The periods of infection at the time of diagnosis of the top four parasites (clonorchis sinensis, paragonimus westermani, cysticercus and sparganum mansonii) were summarized above.				

Discussion

Parasitic infection as a burdensome public health issue has harmed people's health and depressed economic growth globally especially in developing countries. Although great advances have been achieved in fighting parasitic diseases in the past 60 years [3], transmission of parasites still exists worldwide.

The present study demonstrated the prevalence of parasitic infection over the latest 12 years in a tertiary hospital of China. Challenges remain and strategies aimed to eliminate parasitic diseases need to be adapted to dynamic changes. Recently, imported parasitic diseases have increased for years with close and frequent international communication and cooperation in China and other western countries. Foodborne parasites (FBPs) are still challenging for successfully controlling the prevalence of parasitic diseases. This study only showed the parasitic infection of a single center in east China, however, there is a non-negligible fact that in some areas of the parasite endemic areas in the west, south and northeast of China are still enlarging [7]. Therefore, consolidation of the achievements for parasitic prevention and control remains challenging worldwide especially in this period of coronavirus diseases (COVID-19) pandemic[8]. Based on the present survey, three points could be recommended for future control and prevention of parasitic diseases.

First of all, parasitic infection can't be ignored in clinical work. The present investigation recorded period of infection before diagnosis for foodborne parasitic diseases demonstrating an important actual situation that many cases were not diagnosed timely at the first visit in local hospitals. Three possible reasons are displayed here. Firstly, lack of specific diagnostic kits for parasites in some areas may be the dominant reason, as the diagnostic kits for parasites are only available in CDC. Secondly, specialized disease outpatient departments for parasitic diseases have not been set or closed in many hospitals for the declined prevalence of parasitic infection. Moreover, most foodborne parasitic diseases with non-specific clinical symptoms are easily confused with other medical diseases, and the epidemiological history collection is incomplete or lacks specificity, enhancing the difficulty of diagnosis [9]. All these possible reasons alert us that though the prevalence of parasites has declined or even disappeared for years, parasitic infection remains. With the profile of parasitic diseases changed with the improvements of economic and living conditions, diagnosis of parasitic diseases should be taken into consideration for many clinicians as an optional choice accordingly. Setting up specialized disease outpatient departments for parasitic diseases in some regions is necessary and urgent.

In addition, system of therapeutic effect evaluation and specific indicators for the outcome should be developed. Praziquantel as a broad-spectrum antiparasitic agent specific for parasitic infection has been widely applied for about forty years since it was found in 1970s [10]. Patients with parasitic infection were usually administered praziquantel

according to the course. However, medical history of many patients in our study manifested that the lack of sensitive and specific prognostic biomarkers results in a fact that it is impossible to accurately evaluate the therapeutic effects and the outcome of antiparasitic treatment. Consequently, some patients had been repeatedly admitted to the hospitals because of relapse and becoming worse or chronic. Thus, standardized system for evaluation of therapeutic effect should be set and biomarkers for accurately monitoring the outcome need to be developed for delicacy management.

Finally, novel and effective diagnostic kits for parasites need to be explored. Currently available specific diagnostic kits for parasites in China can only identify nine types of serum antibody of parasites: schistosoma, clonorchis sinensis, toxoplasmosis, paragonimus westermani, blastocystis hominis, sparganum mansonii, tubular nematode, fasciola and hydatid. Whereas traditional parasites related to poverty had been eliminated gradually, novel and rare parasites have arisen and became a severe public health issue, highlighting that novel kits need to be developed for identifying the new rare parasitic diseases. Elevated peripheral eosinophil count [11] and positive IgE [12] can only indicate parasitic infection to some extent for half of the patients in the present study. Therefore, it is urgent to develop novel parasite kits for early, rapid, and accurate diagnosis to cope with the current situation with constantly emerging parasites.

Conclusions

In our study, foodborne parasite was the main type over the past 12 years. The whole patients' number of parasitic infection firstly presented with an increasing tendency from 2010 to 2018 and then with a decreasing tendency during the recent three years. Worth noting that clonorchis sinensis has become the main species for recent years. Although great achievements have been accomplished in the past decades, parasitic infection can't be ignored in clinical work because many patients were misdiagnosed or delayed diagnosed. Elevated eosinophil count and positive IgE are still significant indicators for screening parasitic infection but not enough for diagnosing parasitic diseases. It is strongly suggested that novel, effective and convenient diagnostic kits for parasites should be developed to face the challenges of prevention and control of emerging parasites. Additionally, in the course of treatment and posttreatment, system for assessment of therapeutic effects and specific biomarkers for evaluating prognosis should be developed for the patients to promote precise treatment.

Abbreviations

Chinese Center for Disease Control and Prevention CDC

Foodborn parasites FBPs

Immunoglobulin E IgE

Declarations

Ethics approval and consent to participate

The study is approved by the Ethics Committee of Shanghai Ruijin Hospital, School of Medicine, Shanghai Jiao Tong University in accordance with the Helsinki Declaration.

Consent for publication

All participants enrolled in this study consent to submission.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

X.G.X. and Q.X. and D.M.S. conceived, designed and directed the overall project; J.M.Z. and J.X. and W.L.T. recorded and analyzed the data. J.M.Z. and X.G.X. wrote the manuscript. D.B.S. and J.L. and Z.Q.L. and X.L.W. reviewed the manuscript and approved final version. All authors had access to the study data and have reviewed and approved the final manuscript.

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Footnotes

Not applicable

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Figures

Figure 1

Epidemiological characteristics of parasitic diseases. (a) **Parasitic infection in a tertiary hospital of China during recent 12 years.** The prevalence of parasitic infection showed an upward trend of waves with the peak in 2018 and was descent in the last three years. (b) **Geographical distribution of the parasitic patients.** Parasitic patients admitted to Shanghai Ruijin Hospital were mainly from Shanghai, Zhejiang, Anhui, Jiangsu, Jiangxi.

Figure 2

Demographic characteristics of parasitic patients and the main routes of transmissions. (a) Gender and age distribution of parasitic patients. Three hundred and thirty-six parasitic patients were categorized into nine different age groups. Male-to-female ratio was 1.42:1 with the age ranged from 21 to 70. **(b) Main routes of transmission among parasitic patients.** Four major infective ways were concluded here: unclean diet (47.62%, 160/336); traveling abroad (8.33%, 28/336); contacting infected water (2.60%, 9/336); raising animals (1.19%, 4/336) and unknown infective ways (40.19%, 135/336).

Figure 3

Parasitic species and epidemic trend of parasites. (a) **Constituent ratio of parasitic species.** A total of 17 types of parasites were detected in patients. (b) **Profile of every-year parasitic infections.** Foodbore parasites (clonorchis sinensis, paragonimus westermani, cysticercus, sparganum mansonii) became the dominated parasitic species with rare infection of soil-transmitted parasites.

Figure 4

The periods of parasitic infection before diagnosis. (a) **Evidence of parasitic infection for diagnosis.** Definite evidence of diagnosis had been found in 275 cases, accounting for 81.25%. (b) **Eosinophils and parasitic infection.** One hundred and sixty-nine (56.54%) patients with elevated eosinophil count were detected positive antibody associated with parasites. (c) **Immunoglobulin E (IgE) and parasitic infections.** IgE detection was conducted in 173 patients with nearly half of them (50.3%) showing positive parasitic antibody (87 cases).