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Research Article

Current Status of *Schistosoma mansoni* Infections and Associated Risk Factors among Students in Gorgora Town, Northwest Ethiopia

Tarko Essa,[1] Yemane Birhane,[2] Mengistu Endris,[3] Asmeret Moges,[2] and Feleke Moges[3]

[1] *Pathfinder International, Addis Ababa, Ethiopia*
[2] *Addis Continental Institute of Public Health, Addis Ababa, Ethiopia*
[3] *Department of Medical Microbiology, School of Biomedical and Laboratory Sciences, College of Medicine and Health Sciences, University of Gondar, P.O. Box 196, Gondar, Ethiopia*

Correspondence should be addressed to Mengistu Endris; mengistu06@gmail.com

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Background and Objective. Schistosomiasis is highly prevalent in tropics and causes morbidity and mortality in developing countries including Ethiopia. This study is aimed to assess the current status of *S. mansoni* infections and associated risk factors among students in Gorgora town, Northwest Ethiopia. *Method*. A cross-sectional study was conducted from October 2010 to November 2010 at Gorgora, Northwest Ethiopia. All students (579) present during the study period were enrolled. Pretested questionnaires were used to collect sociodemographic data and predisposing factors. Stool examination was performed using wet mount and Kato-Katz techniques. Data were entered and analysed using SPSS version 20.0 statistical software. *Result*. Among 579 students enrolled, 291 (50.3%) were positive for one or more intestinal parasites. Prevalence of *S. mansoni* was found to be 20.6% with mean intensity of infection (125 eggs per gram of feces). Lack of awareness and water contact habits such as frequent swimming in the open water source, agricultural activities on bare foot, and washing clothes were also associated with high risk of *S. mansoni* infection. *Conclusion*. Even though there seems to be a decline in the prevalence of *S. mansoni* infections in the study area, the problem still persists and affects students significantly. Therefore, therapeutic intervention and health education are needed.

1. Background

Schistosomiasis is a parasitic disease that leads to chronic infection. The disease is prevalent in 75 countries of the world [1]. Globally 500–600 million people are at risk of infection and 200 million peoples are infected with schistosomiasis; 85% of the cases are found in 41 countries of Africa [2]. In Ethiopia and Eritrea the population living under the risk of infection with *Schistosoma mansoni* (*S. mansoni*) was estimated to be 19 million [3].

Human infection is initiated during water exposure (planting, fishing, washing, and swimming) that contains the free-living infective stage of the parasite, cercaria. Different strategies have been used to prevent this debilitating disease. The primary health care approach has been used by a number of countries in Africa and other endemic regions of the world. It was based on the fact that development of irrigation schemes, dam construction for hydroelectric power, water conservation for different purposes, human behaviours such as swimming habits and improper waste disposal, poverty like use of river water for different purposes, and wide distribution of intermediate host were identified as the major contributing factors for the increased prevalence and wide distribution of schistosomiasis [4].

Patients infected with *S. mansoni* develop granuloma around the egg and the Schistosoma antigens in the intestine and liver. The granuloma is followed by fibrosis, and chronic inflammation in the liver, leading to portal hypertension, causing liver disease, ascites, and oesophagogastric haemorrhage [5]. Renal failures due to antigen antibody complex and exposure to secondary bacterial or viral infection were observed in some chronically infected individuals [6].

Schistosomiasis like other neglected diseases is a disease of poverty [7]. It is mostly prevalent in sub-Sahara Africa, where not only it overlaps with other few low priority diseases but also high priority diseases such as HIV, malaria, and tuberculosis [8]. Schistosomiasis has low mortality but high morbidity rates and because of prioritization, the high mortality diseases are treated first [7, 8]. Praziquantel is primarily used for treating people with *S. mansoni* infections [4]. It is helpful not only to recognize the prevalence of schistosomiasis but also identify the risk factors of schistosomiasis. A review of literatures on prevalence of *S. mansoni* documented rates that range from less than 1% up to more than 90% in Ethiopia [9]. This study is aimed to provide the current epidemiological information on *S. mansoni* and associated risk factors among students in Gorgora town, Northwest Ethiopia.

2. Methods

2.1. Study Design. A cross-sectional study was conducted among students in Gorgora town, Northwest Ethiopia from October 2010 to November 2010.

2.2. Study Area. Gorgora is a small road side town on the shore of Lake Tana with elevation (altitude) 1800 meters, 65 km south of Gondar town, 2.89 km square area, with annual rain fall 1038 mm and population size 2500 (Dembia district). Their economy depends primarily on trading, farming, fishing, gathering the fuel wood, and others are retired soldiers.

2.3. Study Population. All 579 students who attended in Gorgora Elementary school were included in the study.

2.4. Data Collection. Sociodemographic data which include sex, age, parental occupation, and educational status and other necessary information were gathered using pretested structured questionnaires. Risk factors of *S. mansoni* infection like swimming habit, washing clothes and utensil in open water source, water contact during agricultural activities on bare foot, and source of water for drinking were assessed. Eight teachers (home room teachers for each class room) were selected and trained how to conduct interviews. Students were interviewed for the presence or absence of signs and symptoms of *S. mansoni* infection like bloody stool, bloody diarrhoea, abdominal discomfort, and whether treated for the previous infection or not.

2.5. Stool Collection and Parasitic Examination. Each student was provided with labeled, clean, dry, and leak proof stool cup to bring about 5 gm of fresh stool. About 20 mg of stool sample was processed at Gorgora Clinic laboratory using direct saline preparation for microscopic examination of *S. mansoni* and other intestinal parasites. To determine intensity of infections for *S. mansoni* and other common helminthes, 41.7 mg of stool sample was processed using Kato thick smear [2]. The parasite load was defined as light, moderate, and heavy based on the number of eggs per gram of stool (EPG) for *S. mansoni* and other common helminthes according to WHO guideline [2].

2.6. Quality Control. All the necessary reagents were checked by known positive and negative samples before sample preparation and examination. The smears were examined independently with two experienced laboratory technologists and 10% of the total slides were randomly selected and read by a third experienced laboratory technologist working at the University of Gondar.

2.7. Data Analysis. For data entry and analysis SPSS version 20.0 statistical software was used. Overall and sex-specific prevalence were calculated using descriptive statistics of the sample through frequencies and cross tabulations. Strength of association between *S. mansoni* infection and various risk factors was calculated by bivariate analysis. Association was analyzed by multivariate logistic regression to show the cofounding effect and calculating the odds ratios (OR) with 95% confidence intervals (CI).

2.8. Ethical Consideration. Ethical clearance was obtained from ethical clearance committee of University of Gondar and permission from Amhara Regional Health Bureau and local education authority of the schools to conduct the study. Informed verbal consent was obtained from each study participant and their parent/guardian. The students who were found positive for *S. mansoni* and other intestinal parasites were treated with the standard regimen.

3. Results

A total of 579 students with age ranged from 7 to 24 (median age of 12) were enrolled in the study. Of the total subjects 293 (50.6%) were males and 286 (49.4%) were females. Out of this 293 (50.6%) were from Gorgora town and 286 (49.4%) from rural areas around Gorgora (Table 1).

The overall prevalence rate for all intestinal parasites was 291/579 (50.3%). The most frequent parasites encountered in the present study were *S. mansoni* and *Ascaris lumbricoides* followed by *Hymenolepis nana* and *Giardia lamblia* and others less than 5% (Table 2). The highest prevalence of intestinal parasite was observed in the age range of 5–9 years (54%), followed by 10–14 years (52%). Among study subjects, 53.3% of males and 47.2% females were found to be positive for one or more intestinal parasites (Table 2).

The prevalence of *S. mansoni* in this study was found to be 20.6%. The highest prevalence of *S. mansoni* was obtained from urban areas 23.9% (70/293). Twenty two percent of females and 18.4% of males were found to be positive for *S. mansoni*. The distribution of *S. mansoni* infection with age groups showed that 15–19 (22%) of ages were more affected, followed by age group 10–14 (20%). *S. mansoni* infection was statistically associated with high prevalence in rural areas and school grade level (5–8). However, sex, age, parent educational status, and parent occupation were not statistically significant (Table 1).

Table 1: Distribution and association of *S. mansoni* by sociodemographic data among students ($n = 579$) of Gorgora Elementary School, Northwest Ethiopia, October 2010-November 2010.

Sociodemographic data	Total (n = 579)	Positive (*S. mansoni*)	P value	COR [95% CI]	AOR [95% CI]
Residence					
Urban	293 (50.6)	70 (23.9)*	0.047	1.51 [1.00, 2.28]	1.89 [1.00, 3.33]
Rural	286 (49.4)	49 (17.1)		1.00	
Sex					
Male	293 (50.6)	54 (18.4)	0.217	1.00	
Female	286 (49.4)	65 (22.7)		1.30 [0.87, 1.95]	131 [0.86, 1.99]
Age					
5–9	100 (17.3)	15 (15.0)	0.087	3.09 [0.99, 9.63]	2.73 [1.95, 14.0]
10–14	330 (57.0)	69 (20.9)		2.06 [0.73, 5.77]	2.70 [2.20, 5.07]
15–19	132 (22.8)	29 (22.0)		1.94 [0.66, 5.66]	2.51 [2.01, 3.37]
20+	17 (2.9)	6 (35.3)		1.00	
Educational status of respondents (grade)					
1–4	209 (36.1)	32 (15.3)	0.03	1.00	
5–8	370 (63.9)	87 (23.5)		1.70 [1.09, 2.66]	2.64 [1.49, 4.66]
Father education					
Unable to write and read	150 (25.9)	25 (16.7)	0.208	0.71 [0.44, 1.16]	0.82 [0.47, 1.45]
Able to write and read	429 (74.1)	94 (21.9)		1.00	
Mother education					
Unable to write and read	290 (50.1)	55 (19.0)	0.358	1.00	
Able to write and read	289 (49.9)	64 (22.1)		0.82 [0.55, 1.23]	0.93 [0.56, 1.50]
Father job					
Government employee	370 (63.9)	81 (21.9)	0.288	1.29 [0.82, 2.03]	1.01 [0.85, 2.50]
Farmer, fisher, daily laborer	209 (36.1)	38 (18.1)		1.00	
Mother job					
House wife	442 (76.3)	86 (19.5)	0.281	0.76 [0.48, 1.48]	0.60 [0.30, 7.53]
Daily laborer	137 (23.7)	33 (24.1)		1.00	

*Figures in parenthesis indicate percentages.

Risk factors assessment for *S. mansoni* infection showed that open water contact habits such as swimming, washing clothes and utensil in open water sources, frequent swimming, bare foot during agricultural activities, and low awareness of bilharziasis were associated with high risk of schistosomiasis infection (Table 3).

Multiple logistic models were performed for variables that were significantly associated with *S. mansoni* from bivariate analysis. In urban areas *S. mansoni* infection was 1.89 times (95% CI: 1.07, 3.3) more likely than rural students. After adjusting for urban areas, in grade 5–8 students, open water contact practice such as swimming, washing clothes and utensil in open water sources, frequent swimming, bare foot during agricultural activities, and low awareness of bilharziasis remained significant association with *S. mansoni* (Table 3).

Students from grades 1–4 and 5–8 were compared for *S. mansoni* infection. Students with a habit of washing clothes were 15.9 times (95% CI: 3.86, 65.40) more likely to acquire *S. mansoni* infection. Students washing utensils were 2.076 times (95% CI: 1.19, 3.62) more likely to acquired *S. mansoni* infection. Students with bare foot during agricultural activities were 7.08 times 95% CI: 3.82, 13.12) more likely to acquire *S. mansoni* infection. Students swimming in open water were 4.51 times (95% CI: 1.38, 14.73) more likely to acquire *S. mansoni* infection. Students with no knowledge of bilharziasis were 20.36 times (95% CI: 8.16, 50.78) more likely to acquire *S. mansoni* infection. Generally, students who have more access to open water contact habits (i.e., grade 5–8) were 2.64 times (95% CI: 1.49, 4.66) more likely to acquire *S. mansoni* infection (Table 3).

The intensity of *S. mansoni* infection showed that predominantly light infection 76 (13.1%) with the egg count ranged from 1–99 eggs per gram of feces, the rest (41 (7.1%) and 2 (0.3%)) was considered as moderate (100–399 EPG) and heavy infections (>399 EPG), respectively, (Table 4). The mean intensity of infection was 125.8 EPG. Analysis of the intensity of infection in the age groups showed the peak of light infections to be in the age group 15–19. The intensity decreased in the age group 10–14 and the least affected were 5–9-year-old children.

4. Discussion

Schistosomiasis is the most prevalent helminthic infection in tropics and subtropics mainly in sub-Saharan countries

Table 2: Prevalence of intestinal parasites among male and female students ($n = 579$) of Gorgora Elementary School, Northwest Ethiopia, October 2010-November 2010.

Intestinal parasites	Male $n = 239$	Female $n = 286$	Total ($n = 579$)	P value (95% CI)
Schistosoma mansoni	54 (18.4)*	65 (22.7)	119 (20.6)	0.20 (0.18, 0.24)
Ascaris lumbricoides	55 (18.8)	54 (18.9)	109 (18.8)	1.00 (0.99, 1.0)
Hymenolepis nana	20 (6.8)	19 (6.6)	39 (6.7)	1.00 (0.99, 1.0)
Giardia lamblia	21 (7.2)	12 (4.2)	33 (5.7)	0.15 (0.12, 0.18)
Trichuris trichiura	14 (4.8)	7 (2.4)	21 (3.6)	0.18 (0.15, 0.21)
Hook worm	5 (1.7)	8 (2.8)	13 (2.2)	0.41 (0.38, 0.45)
Taenia species	2 (0.7)	3 (1.0)	5 (0.9)	0.68 (0.64, 0.71)
Entamoeba histolytica/dispar	5 (1.7)	3 (1.0)	8 (1.4)	0.71 (0.67, 0.75)
Enterobius vermicularis	1 (0.3)	4 (1.4)	5 0.9)	0.21 (0.17, 0.24)
Strongyloides stercoralis	2 (0.7)	6 (2.1)	8 (1.4)	0.16 (0.13, 0.19)
Overall	**156 (53.2)**	**135 (47.2)**	**291 (50.9)**	

*Figures in parenthesis indicate percentages.

Table 3: Association of *S. mansoni* infection with open water sources contact habit of students ($n = 579$) of Gorgora Elementary School, Northwest Ethiopia, October 2010-November 2010.

Risk factors	Positive for *S. mansoni* no. (%)	P value	COR (95% CI)	AOR (95% CI)
Swimming in open water				
Yes	116 (20.03)	0.00	4.51 (1.38, 14.73)	4.51 (1.38, 14.73)
No	3 (0.52)		1.00	1.00
Washing clothes in open water				
Yes	117 (20.20)	0.00	15.89 (3.86, 65.40)	15.89 (3.86, 65.40)
No	2 (0.35)		1.00	1.00
Washing utensil in open water				
Unprotected	79 (13.64)	0.95	1.88 (1.23, 2.86)	2.076 (1.19, 3.62)
Protected	40 (6.91)		1.00	1.00
Bare foot on agricultural activities				
Yes	100 (17.27)	0.04	4.7 (2.78, 7.93)	7.08 (3.82, 13.12)
No	19 (3.28)		1.00	1.00
Awareness of bilharzia				
No	114 (19.69)	0.00	20.36 (8.16, 0.78)	20.36 (8.16, 50.78)
Yes	5 (0.86)		1.00	1.00
Frequency of swimming/open water, contact habits				
Daily	103 (17.79)	0.03	2.02 (1.15, 3.57)	2.02 (1.15, 3.57)
Weekly	16 (2.76)		1.00	1.00
Overall	**119 (20.55)**			

including Ethiopia. Depending on various reasons, the prevalence of *S. mansoni* is ranging from less than 1% up to more than 90% in Ethiopia [3, 9].

In the present study the overall prevalence of *S. mansoni* among Gorgora Elementary school students was 20.6%. This is comparable with the study conducted among students in rural area close to the South East of Lake Langano (21.2%) [10] and South Wollo (24.9%) [11]. However, the present study showed lower rate (20.6%) of prevalence of *S. mansoni* compared to earlier reports from the same area at different years to be 67% [12] and 29% [13]. The reason why *S. mansoni* infection was higher in Gorgora before when compared to the present finding might be due to lower student age groups (little school ages) which were not exposed frequently with the Lake or other water bodies and deworming exercise prior to this study [14]. Changing of Lake water level and creating dry lands devoid of vegetation which limit the breeding ground of the Mollusca also contribute to the low prevalence of the current study. This justification was also supported by the Boelee and Madsen study of the fluctuation of water level causing removal of aquatic vegetation and silt intermediate host snail. Thus, removal of aquatic plants would affect snails directly and under certain circumstance expose them to predators [15].

Table 4: Intensity of *S. mansoni* and other common intestinal helminthes using Kato-thick smear technique among students of Gorgora Elementary School, Northwest Ethiopia, October 2010-November 2010.

Species of parasites	Intensity of infection (EPG)		
	Light	Moderate	Heavy
Schistosoma mansoni	76 (13.1)*	41 (7.1)	2 (0.3)
Ascaris lumbricoides	97 (16.8)	12 (2.1)	0 (0)
Trichuris trichiura	21 (3.6)	0 (0)	0 (0)
Hook worm	13 (2.2)	0 (0)	0 (0)
Total	**207 (35.8)**	**53 (9.2)**	**2 (0.3)**

*Figures in parenthesis indicate percentages.

This study has shown higher prevalence rate compared to earlier surveys conducted in students in Ethiopia, Babile 4.3% [16], Gondar 16.4% [17], and Abaya 4% [18]. This difference might be due to the focal distribution of *S. mansoni* [19] and close proximity of schools in Gorgora town to Lake Tana. The present study showed lower *S. mansoni* infection compared to other studies conducted in different localities in Ethiopia such as: Zeghie (69.7%) [20], Azezo 43.5% [21], Dembia plains 35.8% [22], Methehara 71% [23], Zarima (37.9%) [24], and Dek (69%) [12]. This variation can be explained by the fact that environmental factors that influence snail distribution should not be overlooked, despite the fact that these can vary considerably from site to site and area to area, even within short distances [25].

Age specific prevalence of *S. mansoni* in the present study showed that students whose age groups ranged from 15–19 and 10–14 were highly affected and the prevalence in these age groups was 22% and 20%, respectively, but in some studies the age range was 10–14 [26, 27]. *S. mansoni* infections in female and male students was 22% and 18.4%, respectively. This result was in line with the study conducted from primary school children near Lake Victoria of Kenya in which the prevalence was slightly higher in females [28]. The observed variation in the present study might be due to high tendency of open water source exposure among females because mostly they are doing the household activities such as fetching water and washing clothes. However, this remains to be further elucidated.

Site specific prevalence of *S. mansoni* revealed the higher prevalence from urban (23.9%) and followed by rural areas (17%). Students living in urban areas were 1.89 times (95% CI: 1.07, 3.3) more likely to get *S. mansoni* infection than there in rural areas. The reason might be due to high tendency of urban exposure to open water access which is found near the shore of Lake Tana and more contaminated water due to poor sanitation in urban area. This reason supported by the relationship between intensity of schistosomiasis infection and proximity of the location to water bodies has been reported from other locations in Ethiopia [29].

In grade 5–8 students, they were 2.64 times (95% CI: 1.49, 4.66) more likely to acquire *S. mansoni* infection. The reason might be that students at this age had higher exposure to keep their personal hygiene in unsafe open water sources.

Water contact habits of the study subjects confirmed that swimming and washing clothes and utensil in open water source are the risk factors for *S. mansoni* infection. Children who practice swimming are particularly at high risk maybe because of their prolonged and complete body exposure. This is similar to a study done in western Uganda's children (36%) who depend on carter water unknowingly becoming infected while swimming, fishing, and fetching water for domestic use [30]. Those students who had frequency of swimming daily were 2.02 times (95% CI: 1.15, 3.57) more likely to acquire *S. mansoni* infection than those swimming weekly. Longer periods and frequent exposure to inshore areas increase the probability of being infected by cercariae. This finding agreed with the study conducted in Brazil where a daily contact of open water source results in higher rate of infection by *S. mansoni* [31]. Students with bare foot during agricultural activities were 7.08 times (95% CI: 3.82, 13.12) more likely to acquire infection. This might be due to the involvement of students in urban agricultural activities near Lake Tana. Similar finding was reported in Tigray where *S. mansoni* infection was higher in people living in the irrigation site [32].

Among 579 students interviewed 62% of them were without any knowledge of schistosomiasis. Students who had no awareness were 20.36 times (95% CI: 8.16, 50.78) more likely to acquire infection. The reason might be that the students were not conscious about the epidemiology of this disease either informally or formally through their school curriculum. This in turn may cause not only increased infection but also decreased interest of people from seeking medical treatment. Even though sex was not statistically significant, females are more likely infected and not knowledgeable of schistosomiasis compared to males. Similar studies showed that low awareness about schistosomiasis increases the risk of infection [33].

5. Conclusions and Recommendations

This study showed that *S. mansoni* was still an important health problem among school children at Gorgora Elementary School. Factors such as urban residence, grade, and open water contact practice: swimming and washing clothes in open water, frequent swimming, washing utensil by open water, bare foot during agricultural activities, and low awareness of schistosomiasis were associated risk factors for *S. mansoni* infection. Therefore, the well being of school age children must be made a matter of utmost priority by the health planner and decision maker and continuous effort must be geared towards the strengthening of health systems by advocating health education, strengthening of basic infrastructure and sanitation, and community involvement which are important components of successful disease control programmes.

Conflict of Interests

All authors declare that they have no conflict of interests in relation to their work.

Authors' Contributions

T. Essa conceived the study, undertook statistical analysis, and drafted the initial and final draft paper. Y. Berhane and A. Moges reviewed the initial and final drafts of the paper. M. Endris participated in sample collection, performed laboratory diagnosis, conducted data analysis, and drafted the initial and final draft paper. F. Moges performed statistical analysis and drafted the initial and final draft paper. All authors contributed to the writing of the paper and approved the submitted version of the paper.

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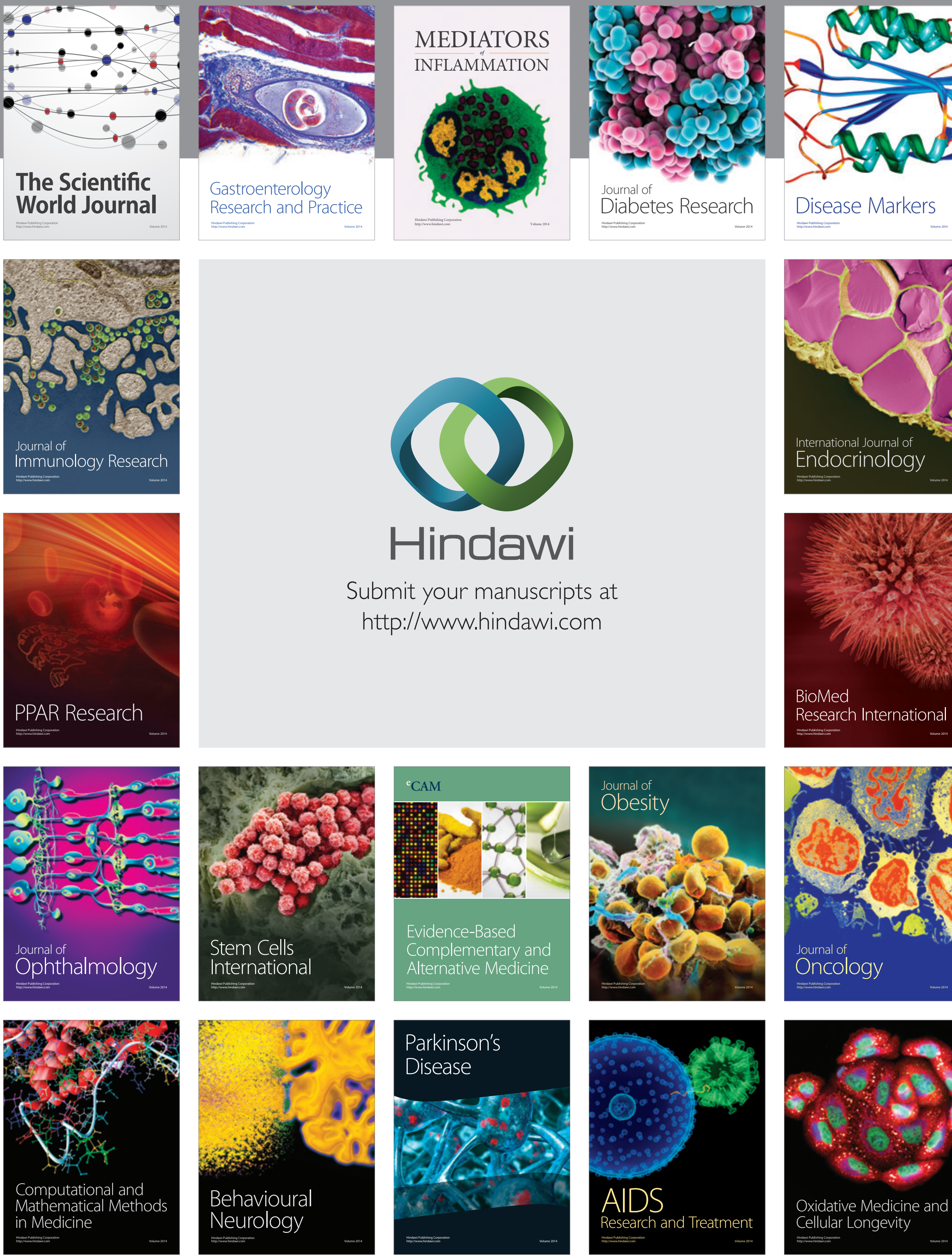

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