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Epidemiology of intestinal parasitosis in the population of Agadir City, Morocco

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Abstract

Intestinal parasitosis in Morocco represents a real public health problem given the promiscuity and sanitary facilities that prevail in some regions, Agadir city is not spared. To determine the epidemiological profile of intestinal parasitosis in this population, a retrospective study was conducted over a period of five years in the medical biology laboratories. 6201 subjects have benefited from at least one parasitological stool examination (PSE) including an analysis in the fresh state, after staining with Lugol and finally after concentration by the technique of Willis and Ritchie; 933 examinations were positive with a simple parasitic index (SPI) at 15.04%. Our study also included 1105 children of whom 238 were positive with a higher SPI at 21.53%. The average age of our patients was 28 years old. Among the parasites encountered, protozoa were present in 92.53% of cases. *Blastocystis hominis* were the most common with 43.2%, followed by amoebae (40.7%), flagellates (8%), helminths (7.46%) and lastly coccidia (0.62%). *Giardia intestinalis* appeared to be the most dominant pathogenic parasite in children and was responsible in 20% of stature-weight growth delay cases. The different results recorded are roughly comparable to the data reported by similar studies. Despite the urban origin of our population, the prevalence of intestinal parasitism is not negligible. It is still necessary to insist on the rigorous respect of hygiene rules against orofaecal contamination, as well as the realization of similar studies in the rural environment to establish more precise epidemiological profile of intestinal parasitosis in this region.

Keywords: Intestinal parasitosis; Parasite; Prevalence; Morocco

1. Introduction

Intestinal parasitosis is caused by parasites that develop in the digestive tract. According to the WHO, they are widespread all over the world, and present a high prevalence in many regions. They represent a real public health problem especially in developing countries where promiscuity, lack of clean water and sanitary facilities are felt. They are, for most of them, a direct reflection of the level of individual and collective hygiene. These parasitosis raise serious medical and social problems by causing malabsorption, diarrhea, blood spoliation, slowed growth, impaired work capacity, and reduced resistance to infection which led to hospitalization [1]. Morocco remains very concerned by these parasitic diseases which constitute until today a public health problem. The present study aims to contribute to study the epidemiology of this pathology in Morocco.

2. Patients and Methods

Patients: This is a retrospective descriptive and analytical study, focusing on the results of parasitological stool examinations (PSE) performed in adults and children, hospitalized or consulting for stool analysis within the biology laboratories in Agadir city, over a 5-year period from January 2012 to December 2016. The collection of information is made from the registers and the digital database of biology laboratories. The exploitation forms included: the identity

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of the patients (name, sex, age, origin), the reason for examination, the date of the analysis and the macroscopic and microscopic results of the PSE.

Method: At the laboratory, PSE is done on freshly passed feces. Each stool is examined macroscopically, microscopically directly and after concentration. The macroscopic examination assesses the appearance, consistency, color and the presence of parasites visible with the naked eye, especially helminth worms. Microscopic examination begins with a direct examination in fresh physiological water and Lugol solution. The concentration of the stool is done by Ritchie technique or other equivalent method. The reading is done with a x10 and x40 dry objective.

Statistical analysis: Data were entered into Microsoft Office Excel 2013 and exported to SPSS (Statistical Package for Social Sciences) version 22.0 for the analytical study.

Ethics, Authorization and Approval: The study includes children. Hence, the anonymity of each patient was considered according to recommendations of the Declaration of Helsinki.

3. Results

3.1. Descriptive Analysis of the Study Population

Our study population included 6201 patients of different ages, ranging from 6 months to 88 years. Most of subjects examined are between 21 and 30 years-old with a percentage of 42% of the overall population examined. The sex ratio (M/F) of our adult sample was 1.71 and 1.53 in our pediatric sample. During the study period between January 2012 and December 2016, the annual screened population increased significantly from 891 cases screened in 2012 to 1667 screened in 2016. Most of the examined subjects came from outpatient consultations and periodic screening in hotels and restaurants of Agadir city.

3.2. Descriptive analysis of the parasitized population

The simple parasitic index (SPI) in the overall population, relating subjects with parasitized stools to all subjects examined, is 15.01%. It varies by year, 12.23 in 2016 and 20.75 in 2013

Table 1 Simple parasitic index (SPI) according to the years

	2012	2013	2014	2015	2016	Total
subjects examined	891	1089	1209	1345	1667	6201
parasitized subjects	129	226	180	194	204	933
Annual parasitic index	14.47%	20.75%	14.88%	12.42%	12.23%	15.01% (SPI)

During the period of study, the number of parasitized patients was 933, of which 538 were male (58.62%) and 395 female (41.31%), with a sex ratio (M/F) of 1.36. There were 238 parasitized children, of which 131 were boys and 107 were girls, with sex ratio (M/F) of 1.42. The SPI of male patients (8.67%) was higher than that of female patients (6.33%). The most affected age group in our study population was between 20 and 35 years and represented 33% of the overall parasitized population with a clear male predominance. In children, the simple parasitic index (SPI) is 21.5% and the most parasitized age group is between 0 and 4 years with 10%. Most parasitized patients are from outpatient consultations. The most frequent symptom in our patients was diarrhea. We have noted that 27 children included in our study have benefited from PSE following a stature-weight growth delay (SWGd), 14 of whom have Giardiasis.

3.3. Study of collected parasites

In our study, intestinal parasitism was dominated by protozoa which represented 92.53% of total parasites isolated, divided between amoebae, flagellates, coccidia and Blastocystis hominis. Blastocystis hominis and amoebae had a prevalence of 43.2% and 40.71% of total parasites collected respectively. Giardia intestinalis is by far the most frequently involved flagellate parasite in 70 cases of the 90 flagellate parasites. We isolated 3 cases of Cryptosporidium sp and 4 of Isospora belli, the percentage of coccidia was 0.62%. The helminths isolated in our study represent 7.46% of the parasites isolated, they are dominated by Enterobius vermicularis (81 cases), followed by Taenia saginata (3 cases). In children, protozoa represent 86.75% of the parasites isolated. Amoebae are the most frequently found parasite group, with a prevalence of 54.63%. Flagellate parasites had a prevalence of 7.28%, of which the leader is

Giardia intestinalis. 14 children with *Giardia intestinalis* had a stature–weight growth delay (SWGD). 3 cases of *Isosporbelli* were found, which corresponds to 0.99% of the parasites isolated. *Blastocystis hominis* was found in 72 cases and represents 23.84% of the isolated parasites. All 41 helminths isolated from children were *Enterobius vermicularis*. In the adult population, protozoa represented 89.79% of the parasites collected. Amoebae representing 35.60%, Flagellates 8.26%. The coccidia found in adults were 3 cases of *Cryptosporidium* sp and one case of *Isospora belli* which corresponds to 0.84% of the parasites isolated. *Blastocystis hominis* is the most frequent parasite in our adult patients. It was found in 50.30% of the parasites isolated. The 43 helminths isolated in our adults, divided between 40 cases of *Enterobius vermicuaris* and 3 cases of *Taenia saginata*. Polyparasitism concerns 16.51% of parasitized subjects. It is clearly higher in adults (17.4%) compared to children (13.8%).

Table 2 Epidemiological profile of collected parasites (n=1125)

Collected parasites	Adults (n=822)	Children (n=303)	Total (n=1125)
Protozoa	779 cases 94.77%	262 cases 86.46%	1041 cases 92.53%
Amoebae (IPSp = 7.38)	293 cases 35.60%	165 cases 54.45 %	458 cases 40.71%
<i>Entamoeba histolytica histolytica</i>	25 cases 3.03%	31 cases 10.23 %	56 cases 4.97%
<i>E. histolytica/dispar</i>	147 cases 17.86%	70 cases 23.10%	217 cases 19.28%
<i>E. minuta</i>	9 cases 1.09%	1 cases 0.33 %	10 cases 0.88%
<i>E. coli</i>	27 cases 3.28%	41 cases 13.53 %	68 cases 6.04%
<i>E. hartmani</i>	23 cases 2.79%	-	23 cases 2.04%
<i>Endolimax nana</i>	53 cases 6.46%	22 cases 7.26 %	75 cases 6.66%
<i>Pseudolimax butshlii</i>	9 cases 1.09%	-	9 cases 0.8%
Flagellates (IPSp = 1.30)	68 cases 8.26%	22 cases 7.26 %	90 cases 8%
<i>Giardia intestinalis</i>	55 cases 6.68%	15 cases 4.95 %	70 cases 6.22%
<i>Trichomonas intestinalis</i>	6 cases 0.72%	5 cases 1.65 %	11 cases 0.98%
<i>Chilomastix mesnili</i>	7 cases 0.85%	2 cases 0.66 %	9 cases 0.80%
Coccidia (IPSp = 0.065)	4 cases 0.48%	3 cases 0.99 %	7 cases 0.62%
<i>cryptosporidium</i>	3 cases 0.36%	-	3 cases 0.27%
<i>Isospora belli</i>	1 cases	3 cases	4 cases

	0.12%	0.99 %	0.35%
Blastocystis hominis (IPSp = 7.38)	414 cases 50.30%	72 cases 23.76 %	486 cases 43.2%
Helminths (IPSp = 1.40)	43 cases 5.23%	41 cases 13.54%	84 cases 7.46%
Enterobius vermicularis	40 cases 4.87%	41 cases 13.54%	81 cases 7.20%
Tenia saginata	3 cases 0.36%	-	3 cases 0.26%

SpPI: specific parasite index; It is the percentage of the subjects parasitized by a parasite or a group of parasites compared to the total number of the examined subjects, the parasitized subjects and the percentage of each parasite or group of parasites compared to the total number of parasites counted

4. Discussion

4.1. Discussion of the overall sample results

Intestinal parasitism remains a major health problem in developing countries. Population growth, immigration, ethnic diversity, climatic conditions, low socioeconomic level, agricultural activities, poor hygiene and contact of the population with animals are favorable factors for the spread of parasitism in a population [1,2]. During the five years of the study, we examined 6201 subjects. The results show a high percentage of adults that represent 82% of the total sample examined; and this may be due to the periodic screening done regularly among hotel and restaurant staff. Our study population ranged in age from six months to 88 years, with the most affected age range being 21 to 30 years. This age range is common because of the screening of active people in society. A clear male predominance is observed, the hypothesis may be that most of the screened subjects are male. During the study period, we note an increase in the number of subjects screened which may be due to population growth and immigration from rural to urban areas. Most of the subjects screened are from outpatient consultations and periodic screening of hotel and restaurant staff in Agadir city. Inpatients represent only 6% of the subjects screened. This is probably due to the nature of digestive parasitic pathologies which do not often require hospitalization. Of the 6201 PSE performed, 933 were positive, with a SPI at 15.01%. This calculated rate is lower than those found in different hospitals in Morocco: 25.06% in Mohammedia [3], 24.98% and 26.68% in Casablanca [3], 24.11% in Oujda [4], 27.54% in Marrakech [5] and 26.06% in Rabat [6]. This difference is probably related to geographical variations and the complexity of socio-economic factors between the different cities mentioned. The prevalence of intestinal parasitosis in our study was lower than in Tunisia and the Senegal River with a prevalence of 26.6% and 26.5% respectively [7,8]; and much lower than in Gaza (46%) [9]. This prevalence is close to that reported in Algeria (19%) [10]. Our situation is intermediate between Europe, where the prevalence of digestive parasitism is low (9.2% in Italy) [11] and the tropical zone where it is much higher (Burkina-Faso 54.7%) [12,13]. The rate of parasitism decreases over time: we note 20.75% in 2013 and 12.23% in 2016. This decrease could be due in addition to awareness campaigns, an improvement in the standard of living and hygiene of our population. The SPI of male patients (8.67%) is higher than that of female patients (6.33%). This can be explained by the predominance of male subjects in our study population (62.65%). However, gender does not significantly influence the prevalence of intestinal parasitosis ($P > 0.05$). The same result is found in southern Togo [14] and in Senegal [15]. Similarly, no significant association was determined for the distribution of parasite species according to the sex of the patients, which could be explained by the equality of exposure and undergo the same risks of infestation whatever their sex. Intestinal parasitism affects all age groups without exception, but 33% of the parasitized subjects have an age between 20 and 34 years. This could be explained by the fact that those, belonging to this age group, have a more active community life. The rates of parasitism in our study are higher in children (21.94%) than in adults (13.64%). This finding could be explained by the fact that this age group has a more active community life and observes less hygiene rules. It should also be noted that children are infested from an early age. The peak of parasitism (0-9 years) occurs at the age when children are sent to nursery and elementary school, a period during which promiscuity, collective play and contact with soil favor contamination. The effect of the age of the patients on the prevalence of intestinal parasitosis is different from one study to another. In children, our results are close to those reported in Algeria (28%) [10] and Tunisia (25%) [16], slightly lower than those obtained in Salé (39%) [17], largely different from those of Kenitra (80%) [18] and in the Senegal river basin (73.5%) [8]. A study conducted in Kenitra shows that age is the best predictor of intestinal parasitosis; as the age of patients decreases, the risk of parasitic infestation increases [19]. Symptoms justifying a search for intestinal parasites in our patients were absent in 14% of our parasitized subjects, which raises the question of asymptomatic carriage of parasites [20]. Protozoa are much more frequent than helminths since the

latter constitute only 7.46% of the parasites found. This is consistent with similar studies in Morocco (protozoa 76.38% versus helminths 23.61%) [19], in Tunisia (protozoa 96.5% versus 3.5% helminths) [16] and Algeria (protozoa 95.7% versus helminths 4.3%) [10]. On the other hand, in Martinique [21], nematodes with transcutaneous transmission (anguilliosis and ankylostomiasis) were in the majority (52.6%) and this is closely linked to the tropical climate. This high rate of intestinal protozooses, indicates the high level of contamination of water and food by faeces and the lack of hygiene measures [2] and sanitation of Agadir city and regions. These parasites are transmitted in cystic forms mainly through poorly washed raw food (fruits, vegetables, salads...) and water drawn mostly from rivers polluted by human excreta or tap water without prior treatment [21]. *Blastocystis hominis*, considered as occasionally or non-pathogenic but as a true reflection of the level of hygiene, is the most frequently isolated parasite with a CPI of 43.2%, closely followed by amoebae with a CPI of 40.7%. Despite this high frequency of amoebae, the highly pathogenic forms are less frequent than the relatively or non-pathogenic forms. This would be in favor of the low aggressiveness of the amoeba strains frequent in Morocco, despite a large reservoir and an intense level of transmission [22, 23]. *Giardia intestinalis* appeared as the most dominant pathogenic parasite in the examined stools with a CPI of 6.22%. In second position was *Entamoeba histolytica* with a CPI of 4.72%. As for helminthiasis, *Enterobius vermicularis* is the main helminth found. The other helminthiasis are relatively rare, since only three cases of *Taenia saginata* were found, or they were not sought out at all. The typical counterexample is that of anguilliosis, which must be systematically sought out using a special technique called Baermann, before any immunosuppressant-based medication or any prolonged or high-dose corticosteroid therapy. Protozoa most often cause diarrhea. Intestinal helminths, when symptomatic, often manifest as non-specific digestive disorders. 27 of our parasitized patients, 14 of whom had *Giardia intestinalis*, presented with stature–weight growth delay, which is a serious complication of certain parasitoses, especially giardiasis. According to a study done in Rabat, *Giardia intestinalis* can aggravate or even cause weight loss in children, probably through malabsorption [24]. Concerning the degree of polyparasitism, it concerns 16.51% of parasitized subjects. It is clearly higher in adults (17.4%) than in children (13.8%). It should be noted that the presence of parasitic association shows the very low level of sanitary, food and faecal hygiene as well as the unfavourable living conditions of these polyparasitic subjects. Protozoa are the species most frequently found in polyparasitic patients. This can be explained by the presence of several non-pathogenic species. They are also the witness of a defective hygiene which makes those who carry them represent subjects at risk. In fact, because of a mode of infestation that is probably identical, these subjects have probably other pathogenic parasitic species, either simultaneously or subsequently [25]. Some authors believe that parasitic associations are governed only by the law of chance, while others find explanations for these associations based on the modes of contamination of the parasites. The latter explain associations between protozoa and helminths with directly infesting eggs and associations with pure protozooses by a probability of concomitant direct contamination from an infected person. On the other hand, delayed fecal-oral infestations are most likely in the case of associations between parasites eliminated in immature form requiring a stay in the external environment before becoming infesting and parasites with directly infesting forms [24].

4.2. Discussion of the results for adults

The prevalence of intestinal parasitism in adults was about 13.64%. This rate is higher than the prevalence recorded in adults in Kenitra (9.14%) and significantly lower than 26.5% in Senegal [26,8]. We note that the SPI in men (8.67%) is higher than that in women (6.33%), however, this difference is not statistically significant ($p>0.05$). In our adult sample, *Blastocystis hominis* is the most common parasite, with a CPI at 50.30% of total parasites isolated. Amoebae occupy the 2nd position with 35.60% of isolated parasites. The relatively pathogenic amoebae were dominated by the E.h/dispar complex with an infestation rate of 17.86% of which 3.03% for *E. histolytica* responsible for amoebiasis disease. Intestinal polyparasitism was found in 12.66% of adults.

4.3. Discussion of the results for the child

The results obtained show that one child out of five, of the urban population and average socio-economic level, have one or more intestinal parasites. Our prevalence is close to that reported in Marrakech (23.78%) [27] and is less important when compared with other local studies, especially those in rural areas [16, 10, 8, 28, 29, 30, 31]. In fact, rural areas are characterized by the lack of cleanliness, drinking water and food hygiene and the insalubrity of the habitat [32]. The intestinal parasitism in children is essentially due to protozoa with a CPI of 86.75% versus 13.25% for helminths. This observation is consistent with those made by other authors at the national level and in neighboring countries [33,27, 16, 29, 31, 30, 28]. In our pediatric sample, non-pathogenic amoebae are the most common parasitic and more than 20% of the children parasitized by *Giardia intestinalis* had stunted growth, which is a serious complication with a heavy impact on schooling and consequently poor social integration. The relationship between giardiasis and stature–weight growth delay, as illustrated in the literature [34, 35, 36, 37, 38], is explained by the phenomenon of malabsorption due to *Giardia intestinalis*. Helminths represent 13.24% of the parasites collected in our children and are largely less found than protozoa and this is probably because helminthiasis is often treated on clinical

grounds in favor. Polyparasitism affected 13.86% of all children examined. This frequency is lower than those reported by other local studies [33,30,31].

5. Conclusion

Intestinal parasitosis is a public health problem due to the high prevalence. This problem is favored by environmental conditions and defective hygiene. Our study reveals that both sexes are infested equally, the highest prevalence was observed in the youngest age groups living in communities and having an active community life. Protozoa were the most diagnosed parasitic group while helminths were less isolated. *Giardia intestinalis* was the most frequently isolated pathogenic parasite. This parasite is quite aggressive especially in children causing severe complications such as stature–weight growth delay which also concern their schooling and their social integration. The frequency of amoebiasis disease is quite high, which imposes the necessary measures to watch out for serious complications. The prevalence of intestinal parasitosis in Agadir city is quite high even if the study was done in the urban environment where the living conditions are better than in the rural environment, complementary studies in the rural environment is necessary to have a global idea on intestinal parasitism in this region.

Recommendations

To reduce the morbidity of intestinal parasitosis we suggest that adequate personal and collective hygiene measures be reinforced. These include health education, environmental sanitation, screening and treatment of diagnosed cases, strengthening systematic deworming and improving screening, treatment and prevention services. In addition to the above, we recommend to the Ministry of Public Health to promote concrete actions in terms of hygiene and environmental sanitation to fight against certain vectors, to the health personnel to organize and intensify mass health education for an effective fight against the fecal peril and to the population to respect a rigorous hygiene, in particular the washing of the hands before eating, after going to the toilets, the washing of fruits and other raw foods before consumption, the wearing of shoes...etc.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

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