

The Evolution of the prevalence of intestinal parasitosis between 01/01/ 2015 and 31/03/ 2020 in the city of Ouezzane in Morocco

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Abstract- This retrospective study was conducted to establish the prevalence and epidemiological assessment of intestinal parasitosis in Al Hayat private laboratory for Medical Analysis of Ouezzane between 01/01/2015 and 31/03/2020. The careful analysis of 1607 EPS found that 345 were positive, an IPS of 21.47%. The thirteen intestinal parasites encountered, of which 53.33% produce protozooses and 46.67% produce helminthiases, ranked in descending order of frequency are: *Entamoeba histolytica* (26,96%), *Ascaris lumbricoides* (24,35%), *Giardia intestinalis* (15,94%), *Ankylostoma sp.* (15,07%), *Entamoeba coli* (8,99%), *Trichostrongylus sp.* (3,19%), *Strongyloides stercoralis* (2,32%), *Endolimax nana* (1,45%), *Trichuris trichiura* (0,58). *Enterobius vermicularis*, *Taenia saginata*, *Fasciola hepatica* and *Schistosoma sp.* are each represented by 0.29%. Parasitic infestation appears from the seventh month to the eighty-ninth year with a peak in the age group between 31 and 40 years (27.25%) followed by children under or equal to 10 years (26.09%). The average age of parasitic parasites is 30.37 years, while the sex ratio (M/F) is 0.94. Males are slightly more exposed to intestinal parasitism (21.79%) than females (21.16%). Parasites with oral transmission are dominant with 82.32% of which those related to fecal peril represent 81.74%. In contrast those with transcutaneous transmission are the least frequent (17.68%). Although several identified parasitic species are low pathogenic, their epidemiology requires the elaboration and development of programs to prevent and control all the diseases they cause.

Index Terms- Prevalence, intestinal parasitosis, Ouezzane.

I. INTRODUCTION

Intestinal parasitosis is widespread, almost worldwide and has a high prevalence in many regions [1]. In many countries, they represent a real public health problem, especially in third world countries where promiscuity, lack of drinking water and sanitary facilities are felt [2]. According to the World Health Organization (WHO), intestinal worm infestations affect at least two billion people worldwide and pose a significant threat to public health in areas with poor sanitation and hygiene [3]. Two groups of parasites can colonize the digestive tract: protozoa and helminths. Amoebiasis, caused by *Entamoeba histolytica*, is the

third most deadly parasitic disease in the world [4]. They colonize the different parts of the digestive tract with a very variable pathogenicity ranging from a simple attack to fatal cases. Since intestinal parasites are cosmopolitan, they are found in most parts of Africa. Moreover, Morocco is not an exception. Numerous studies carried out in different parasitology departments in several cities have confirmed the endemic nature of intestinal parasitosis. Considering that no epidemiological study on intestinal parasites of the population of the city of Ouezzane has been carried out, it seems essential to us to carry out a retrospective survey to draw up an assessment within the private laboratory Al Hayat for Medical Analyses. This study consists of processing the database where 1607 EPS were recorded over a period of 63 months and has assigned as objectives the evaluation of the frequency of intestinal parasitosis and the identification of the different parasitic species causing these diseases. Certainly, it would be an authentic and reliable bibliographic reference that could, on the one hand, be used to launch a program to control these diseases and on the other hand to make comparisons with other regions of Morocco or elsewhere.

II. MATERIALS AND METHODS

• Location of study

Our work focused on the analysis of the results of the parasitological examinations of the stools (EPS) of the patients having carried out the analysis of their stools in the laboratory Al Hayat for Medical Analyses of the city of Ouezzane. The latter is the capital of the province of the same name since it was created in 2009 and is part of the Tangier-Tetouan-Al Hoceima region. It is located in the northwest of Morocco, 183 km from Rabat, south of the Loukkous wadi. Its climate is subhumid Mediterranean, dry in summer, with temperatures varying between 26°C and 44°C and cold to mild in winter, with temperatures varying between 8°C and 1°C and precipitation varying between 700mm and 900mm/year. According to the 2014 general population and housing census, the city of Ouezzane has 70239 inhabitants [5]. From the point of view of health

infrastructure dedicated to parasitic analysis, the city of Ouezzane is equipped with two laboratories, one public under the Provincial Hospital Center Abi Kacem Zahraoui and one private in which this study was done.

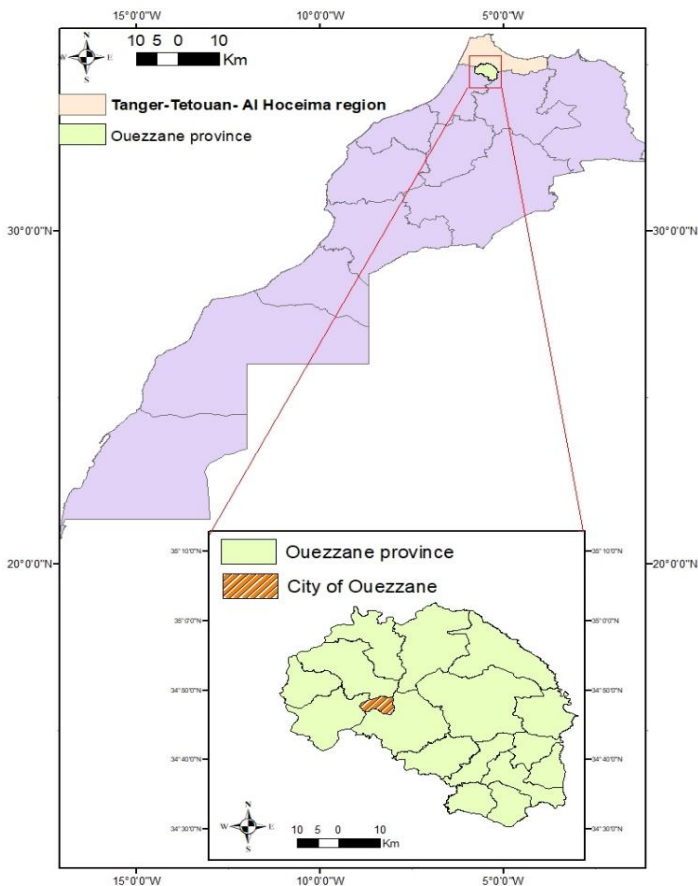


Figure 1: Location of Ouezzane city

Methodology

Our descriptive analytical and retrospective study took place from March to June 2020 and consisted in processing the database of the management software EASYLAB. The analysis of the results of 1607 parasitological examinations of stools (EPS) of patients coming from urban and rural territory communes of the province of Ouezzane and belonging to different social classes, was carried out. The examination is done on freshly passed feces and each stool is examined macroscopically with the naked eye, microscopically directly and microscopically after concentration. A subject is considered parasitized when stool examination reveals the existence of one or more parasites in the form of cysts, vegetative forms, eggs and/or adults. The data sheet of each patient registered in the database was carefully read to bring out all the information related to the date of analysis, sex, age and in case positive the infesting parasite. Data collected over a 63-month period from January 2015 to March 2020 were entered and analyzed on a Windows 2010 Excel file.

III. RESULTS

- Simple Parasite Index (IPS) is the percentage of parasitized subjects out of the total number of PSEs performed.

$$IPS = \frac{\text{Number of Positives EPS}}{\text{Numero of total EPS}} \times 100$$

- Specific Parasite Index (SPI) is the percentage of subjects parasitized by a species in relation to the total number of positive EPS.
- IPS Global
Of the 1607 EPS analyzed over a period of 63 months, 345 subjects were found to be parasite carriers, i.e., an SPI of about 21.47%.
- Evolution of EPS performed according to the years
The annual distribution of EPS is shown in Figure 2.

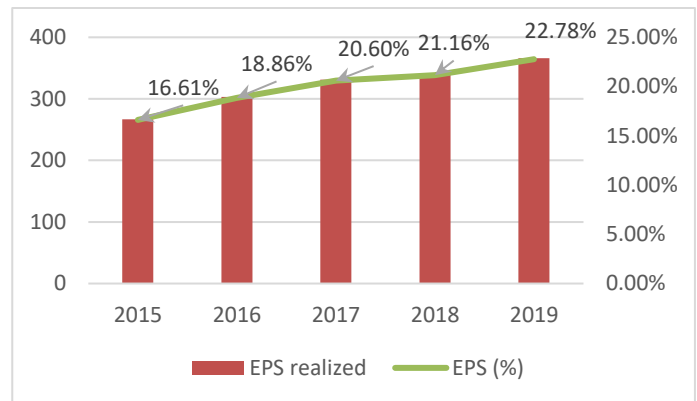


Figure 2: Annual distribution of EPS

The distribution of parasitological examinations of stool EPS according to the years reveals that EPS, in general, are increasing. They increased from 297 (16.61%) in 2015 to 366 (22.78%) in 2019.

- Evolution of IPS according to the years
Figure 3 summarizes the annual evolution of the IPS.

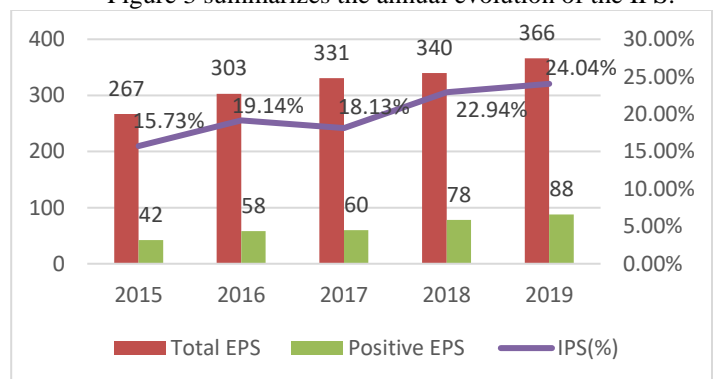


Figure 3: Annual evolution of the IPS.

From Figure 3, we can see that the IPS changes from year to year. The percentage of parasitized cases increases from 17.57% in 2015 to 22.13% in 2019. There is a regression in the

parasitism rate in 2017 (19.80%) compared to the year it preceded. During the five years, the average IPS is 20.18% this means that one in five people is affected by intestinal parasitosis.

- IPS by the gender

Table 1: Distribution of EPS and IPS by gender

	Effectif EPS	EPS effectués%	EPS Positifs	EPS positifs%	IPS %
Féminin	827	51,46%	175	50,72%	21,16%
Masculin	780	48,54%	170	49,28%	21,79%
Total	1607	100,00%	345	100,00%	42,96%

The gender distribution of the subjects showed a female superiority: 827 female (51.46%) and 780 male (49.28%) with a sex ratio equal to 0.94. Among the 345 positive cases, 175 were female and 170 males. An increase in prevalence of 0.63% was observed in favor of males (21.79%).

- IPS by age

The distribution of IPS by age is shown in Figure 4.

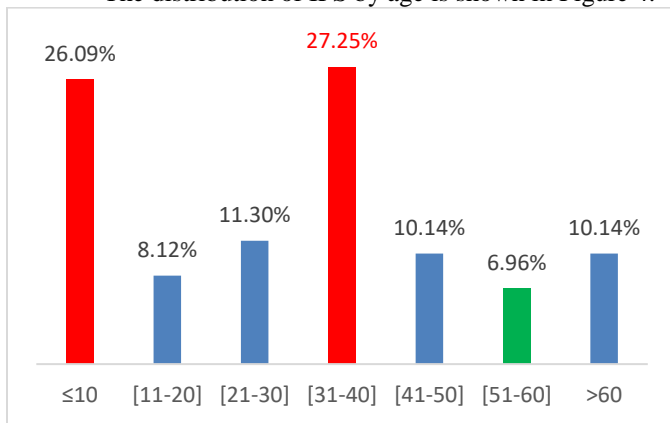


Figure 4: Distribution of IPS by age

To establish the age distribution of the subjects, we opted for a 10-year age range. Among the 345 parasitized EPS subjects, the parasitic infestation occurs from the seventh month until the eightieth year, with an average age of 30.37 years. According to the above figure, the IPS varies according to age groups. The rate of parasitism is remarkably higher in subjects with age between 31 and 40 years (27.25%), followed by subjects whose age is less than or equal to 10 (26.09%). The range [51- 60] is the one where the parasite infestation does not exceed 6.69%.

- EPS according to the seasons

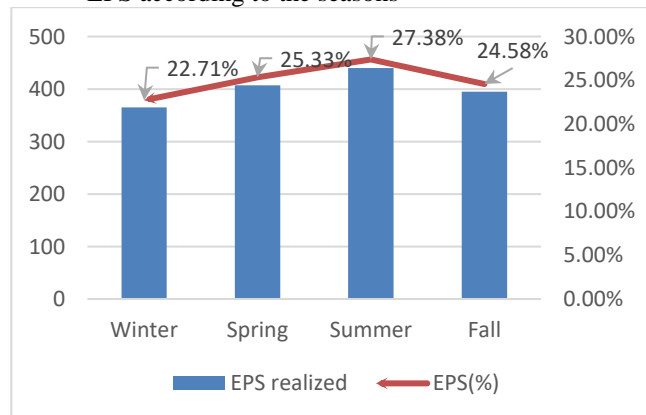


Figure 5: Seasonal distribution of EPS

The number of EPS varies from season to season. Out of 1607 EPS analyzed, 27.38% are performed in summer, 25.58% in spring, 24.58% in winter. Autumn is the season with the lowest rate of parasitological examinations of stools with 22.71%.

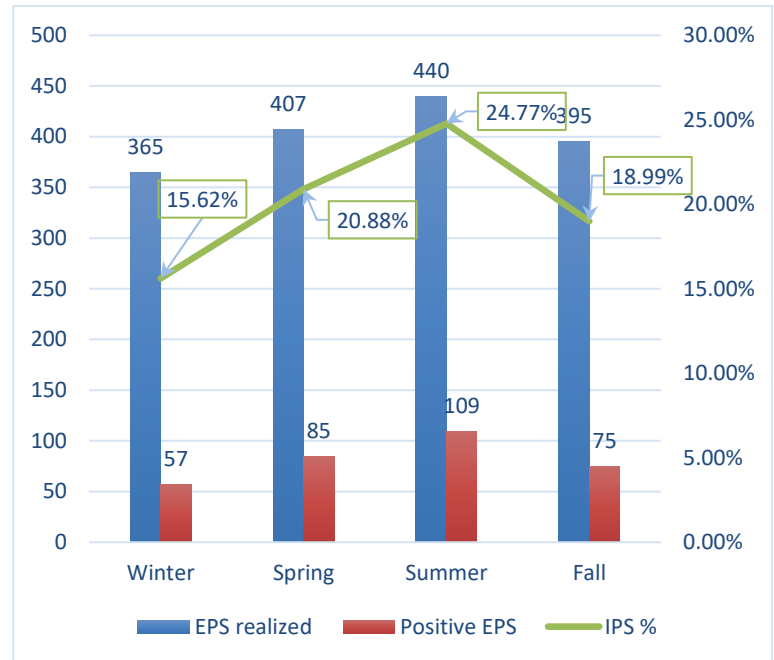


Figure 6: Seasonal evolution of IPS

The rate of seasonal digestive parasitism varies with the seasons. This can be seen in the variation of SPI. The figure above shows that summer has the highest number of parasite infestation with a rate of 24.77% followed by spring with 20.88%. The intestinal parasitosis of winter and autumn record the lowest SPI with 18.88% and 15.62% respectively.

- Distribution of parasitic groups

Table 2: Distribution of parasitic groups

Groups	Effectif	Pourcentage
Protozoa	184	53,33%
Helminths	161	46,67%
Total	345	100,00%

The identification of parasites infesting the positive subjects allowed us to identify species belonging to the groups of protozoa and helminths. Among the 345 parasites diagnosed, protozoa represented 53.33% while helminths were identified in only 46.67% of cases.

Parasitic species found

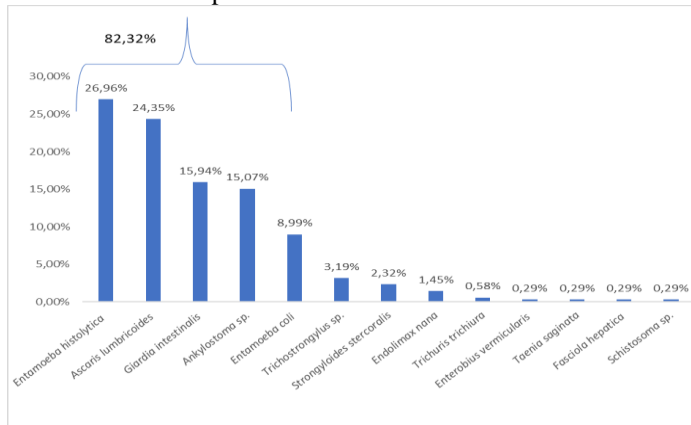


Figure 7: Prevalence of parasitic species

The results of our study reveal that 4 parasites infest 82.32% of patients or 284 individuals: *Entamoeba histolytica* (93 patients or 26.96%), *Ascaris lumbricoides* (84 patients or 24.35%), *Giardia intestinalis* (55 patients or 15.94%) and *Akylostoma sp.* (52 patients or 15.07%). For the other parasites: *Entamoeba coli* (31 patients or 8.99%), *Trichostrongylus sp.* (11 patients or 3.19%), *Endolimax nana* (8 positive cases or 1.45%), *Trichuris trichiura* (2 positive cases or 0.58%). Finally, *Enterobius vermicularis*, *Taenia saginata*, *Fasciola hepatica* and *Schistosoma sp.* with the same percentage of infestation which is 0.29% or one patient each.

Protozoa

Table 3: The distribution of protozoa

	Espèces parasitaires	Effectif	IPS / cas positifs (n=345)	IPS/ cas effectués (n=1607)
Amibes	<i>Entamoeba histolytica</i>	93	50,54%	26,96%
	<i>Entamoeba coli</i>	31	16,85%	8,99%
	<i>Endolimax nana</i>	5	2,72%	1,45%
	Total	129	70,11%	37,39%
Flagellés	<i>Giardia intestinalis</i>	55	29,89%	15,94%
	Total	184	100%	53,33%

Among the protozoa diagnosed, four taxa belonging to two classes (Amoebae and Flagellates) were identified. Amoebae are the most dominant, 129 parasitized subjects, that is 70.11% were infested by one of its three parasitic species. Flagellates are represented by only one taxon: *Giardia intestinalis* which infests 55 of the positive cases or 15.94%.

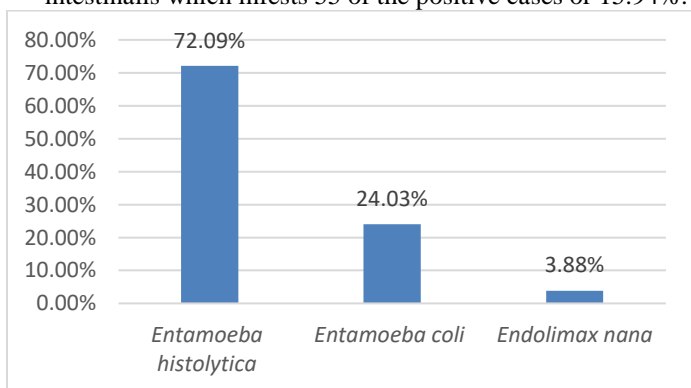


Figure 8: Specific parasitic index of amoebae

The amoeba class is represented by three taxa, *Entamoeba histolytica* comes first (SPI = 72.09%), then *Entamoeba coli* (SPI =24.03%) and finally *Endolimax nana* (SPI =3.88%).

Helminthes

Table 4: Distribution of helminths

Groupes	Espèce parasites	Effectif	IPsp helminthes (n=161)	IPS/ cas positifs (345)	IPS/ examens effectués(n=160)
Nématodes	<i>Ascaris lumbricoides</i>	84	52,17%	24,35%	5,23%
	<i>Ankylostoma sp.</i>	52	32,30%	15,07%	3,24%
	<i>Trichostrongylus sp.</i>	11	6,83%	3,19%	0,68%
	<i>Strongyloides stercoralis</i>	8	4,97%	2,32%	0,50%
	<i>Trichuris trichiura</i>	2	1,24%	0,58%	0,12%
	<i>Enterobius vermicularis</i>	1	0,62%	0,29%	0,06%
	Total	158	98,14%	45,80%	9,83%
	Trématode	<i>Fasciola hepatica</i>	1	0,62%	0,29%
<i>Schistosoma sp.</i>		1	0,62%	0,29%	0,06%
Total		2	1,24%	0,58%	0,12%
Céstodes	<i>Taenia saginata</i>	1	0,62%	0,29%	0,06%
Total global	161	100,00%	46,67%	10,02%	

Nine taxa belonging to three classes (Trematodes, Nematodes and Cestodes) have been inventoried in helminths. The class of Nematodes is the most diversified with 6 taxa that infest almost all helminthiasis (SPI =98.14%). It is represented by: *Ascaris lumbricoides*, *Ankylostoma sp.*, *Trichostrongylus sp.*, *Strongyloides stercoralis*, *Trichuris trichiura* and *Enterobius vermicularis*. Then comes the class of Trematodes with two taxa (IPsp = 1.24%): *Fasciola hepatica* and *Schistosoma sp.* As for the class of Cestodes, only *Taenia saginata* is found (SPI = 0.62%).

Modes of transmission

The figure above shows the distribution of parasites according to the mode of transmission.

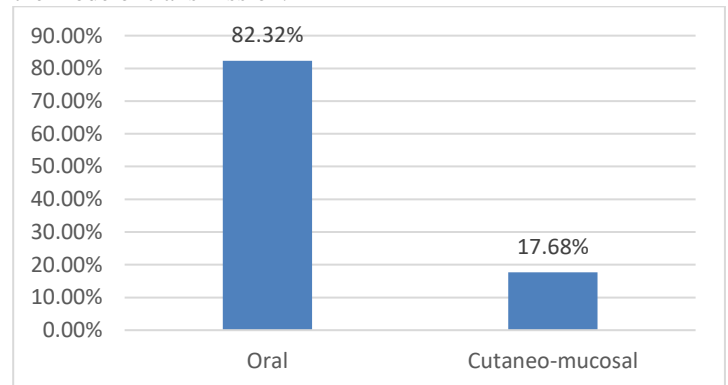


Figure 9: Distribution of parasites by mode of transmission The figure above reveals that the intestinal parasites of oral transmission are dominant with 82.32% compared to those of cutaneous-mucosal transmission (17.68%). In addition, parasites

related to fecal peril present 81.74% while skin-transmitted Nematodes (*Strongyloides stercoralis* and *Ankylostoma* sp.) are less frequent and infest 17.39% of parasitized patients.

VI. DISCUSSION

During the period from 01/01/ 2015 to 31/12/2019, out of 1607 EPS diagnosed in the private laboratory Al Hayat for Medical Analysis in Ouezzane, 345 were positive, that is to say an IPS of 21.47%. The comparison of the IPS found during this study with those found elsewhere allowed us to situate the rate of intestinal parasitism at the level of the city of Ouezzane compared to other cities at the national and regional level. On a national scale, the rate of parasitism (21.47%) remains high compared to that observed in Kenitra which is 14.15% [6], lower than those found at the University Hospital of Rabat (25%) [7], and Mohammed V Military Instruction Hospital of the same city (48.21%) [8]. According to the study done by [9] At the Hassan II University Hospital in Fez, the IPS is 38.14%. Regionally, the prevalence is 26.6% in the region of Sfax in Tunisia [10], 12.55% in the Tunis region [11], and 19,96% [12] observed at the C.H.U. of Oran in Algeria. In Outside Africa, the rate of parasitism is so disparate, 13.7% in Catalonia (Spain) [13], 44% in North Jordan [14], 32.2% in Nahavand (Iran) [15], and 55,6% in Santa Rita (Venezuela) [16]. Continuously, from 2015 to 2019 the number of stool parasite examinations EPS is growing. Thus, the EPS increased from 16.61% in 2015 to 22.78%. The awareness of sanitary danger that parasites present as well as their propagations could be the reasons for this increase. The analysis of the annual variation of the IPS allows us to see that the rate of parasitism tends to increase over time. In only five years, this rate has increased by 8.31%. This increase is attributed to the demographic growth and to the accentuation of the risk factors to which the population is exposed. These risks would be strongly linked to the hygienic conditions and the presence of parasites in water (stagnant water, river water), on soiled food (by dejecta, by the use of wastewater in irrigation, soil, badly washed hands or washed with unsuitable water) and in poorly or undercooked meat. Of the 1607 PEs performed, 827 PEs, or 51.46%, were performed by women, compared to 780 PEs performed by men, or 48.54%. Our situation is consistent with that of [17]. The results of gender prevalence in this study are consistent with those of the epidemiological study of intestinal parasites in the region of Ouarzazate where the GPI of male patients (18.55%) is slightly higher than that of female patients (17.73%) [18]. This could be explained by the fact that in general men are less careful about what they ingest, do not apply the rules of hygiene correctly, do not seek medical attention quickly and early. On the contrary, women are more concerned about their health condition, respect the rules of hygiene better and in case of detection of any abnormality, seek medical assistance quickly. The appearance of intestinal parasitosis in the seven age groups indicates the exposure of the province's inhabitants to parasitic attacks at different stages of their lives. In fact, there are no specific parasitoses for each age, intestinal parasites infest all age groups without exception. Among the 345 positive cases, the extreme ages are 7 months and 89 years with an average age of 30.76 years. The subjects most frequently affected are aged 31 to 40 years (27.25%). followed by those whose age is less than or equal to 10 years. In the latter, the lack of knowledge of sanitary

hygiene measures, collective games, the ingestion of soiled food are intertwined to maintain this high rate of parasitism. Several authors have found that infestation occurs at a young age [19] (33%) and [20] (36,25%). People between the ages of 51 and 60 are the least infested. At this age, people pay a lot of attention to their health condition, therefore to what they ingest and have an awareness of diseases related to fecal peril. One of the reasonable justifications for the increase in parasite prevalence, especially in the summer period, is the increase in the consumption of raw food (fresh vegetables, salads, fruits...). Indeed, the use of wastewater discharged by the population of the city of Ouezzane in the irrigation of crops can not be without consequences. Certainly, the crops, especially the contaminated edible parts, are vectors of intestinal parasitosis and therefore constitute a potential risk to the local population. The explanation for the lower prevalence in winter could be due to a decrease in the supply of raw food to households. Parasitological characterization of the positive PSEs revealed a significant diversity of parasitic species, their prevalence and the IPsp of each of them. A total of 13 different taxa of parasites were identified in the parasitized subjects, divided between helminths (46.67%) and protozoa (53.33%). The parasites of this last group are transmitted in cystic form through raw food that has not been properly washed (fruits, vegetables, salad) [21]. Different results have been found by some authors: In 2020, in the region of Ouarzazate [18] reported that protozoa have a parasitism rate of 79.65%, while helminths infest only 20.35% of subjects. In 2018, in the city of Agadir, [2] confirmed that protozoa (92.53%) largely dominate helminths (7.46%). These intestinal parasitoses, closely related to the fecal peril, indicate that the bad application of the hygienic rules and the contamination of the food would be the main causes of the perpetuation and the transmission of these diseases. Our results indicate that Nematodes are the most frequent class with a prevalence of 45.80%, followed by amoebae (37.39%) and flagellates (15.94%) in third place. [2] reported a similar finding to ours where amoebae have a prevalence of 40.71% of total parasites. According to epidemiological findings in Morocco on the prevalence of flagellates, there are 5.85% in Marrakech [22], 9.66% in Agadir [2] and 25.40% in Ouarzazate [18]. Quantitatively, the parasites found are encountered in different proportions. The analysis reveals that *Entamoeba histolytica* is the most infesting parasite (26.96%). We note the very low prevalence of parasites belonging to the trematode and cestode groups. Only two subjects were found to be infested with trematodes: one with *Fasciola hepatica* and the other with *Schistosoma* sp. Due to the total absence of pig meat, the only cestode parasite identified in the stool was *Taenia saginata*. Ascariasis is the most frequent helminthiasis with an SPI of *Ascaris lumbricoides* of 52.17%. A difference in the number and type of parasites between our study and other studies is noted. Seven of our taxa were also identified in the work of [6] 43.75% (7/16), 38.88% (7/18) and 46.66% (7/15) respectively of common parasites. These differences could be explained by the fact that the applications of hygienic rules, cauline habits, socio-economic levels, climatic conditions, geographical positions are not the same in the different study areas. The prevalence of fecal-oral transmitted parasites is 81.74% while the prevalence of skin transmitted parasites (*Strongyloides stercoralis* and *Ankylostoma* sp.) is 17.39%. As

long as the conditions are favorable for the direct or indirect transmission of parasites related to the fecal perimeter, the health risks inherent to them are frequent and diverse. On the other hand, the respect of the general rules of hygiene, a supply of drinking water and uncontaminated food and the fight against fecal peril remain the keys to reduce the rate of parasitism. It should be noted from the outset that this study only characterizes the parasites identified in the Al Hayat laboratory. Therefore, it would be very useful, on the one hand, to process the data of the database recorded during the last two years. On the other hand, it would be useful to broaden the scope of the study by conducting an epidemiological survey on intestinal parasites diagnosed in public laboratories.

A comparison of the two results would be very interesting for a better establishment of parasite assessment in the province of Ouezzane.

V. CONCLUSION

This retrospective study conducted over a period of 63 months, from January 2015 to March 2020, at the private laboratory Al Hayat for Medical Analysis on 1607 parasitological examinations of stools (EPS) found that more than one subject out of five suffers from an intestinal parasitosis (IPS= 21.47%) and 13 intestinal parasites colonize the digestive tract. Particular attention should be paid by health authorities to the health risks of intestinal parasites to the local population. In order to lower the prevalence rate of intestinal parasitosis, several actions should be carried out such as the acceleration of the construction of the wastewater treatment plant of the city of Ouezzane, the prohibition of the irrigation of market garden crops by polluted water, the organization of mass awareness campaigns for the benefit of the population and the popularization of the measures of respect of the individual and collective hygiene rules. The results obtained are partial and do not allow a precise estimation of the extent of the parasitic infestation. This study must be deepened and completed by other studies spread out in time and space. The headings: Parasitism/age group, parasitism/sex, monthly distribution of parasites, annual evolution of each parasite, polyparasitism and origin of patients (urban or rural) should be taken into account in future surveys.

REFERENCES

- [1] OMS, 1987, Lutte contre les parasitoses intestinales : Rapport d'un comité OMS d'experts.
- [2] Afriad, Y., 2018. Epidémiologie des parasitoses intestinales chez la population de la ville d'Agadir. thèse du Doctorat en Médecine, Faculté de Médecine et de Pharmacie, Marrakech, p.114
- [3] Adedayo, O., and Nasiiro, R., 2004. Intestinal parasitoses. J Natl Med Assoc. Jan:96(1):93
- [4] Majera, S., and Neumayrb, A., 2015. Article de revue. Parasites de l'appareil gastrointestinal. Swiss Medical Forum-Forum Médical Suisse :15(11). p242-250.

- [5] Haut-commissariat au plan, 2004. Monographie de la région Tanger-Tetouan- Al Hoceima
- [6] El Guamri, Y., Belghyti, D., Achicha, A., Tiabi, M., Aujjar, N., Barkia, A., El Kharrim, K., Barkia, H., El-Fellaki, E., Mousahel, R., Bouachra, H., and Lakhal, A., 2009. Enquête épidémiologique rétrospective sur les parasitoses intestinales au Centre hospitalier provincial El Idrissi (Kénitra, Maroc) : bilan de 10 ans (1996-2005). Ann Biol. Clin, Vol.67 N°2 p. 191-202191
- [7] Choukri, M., Aoufi, S., Douabi, I., and Agoumi, A., 2007. Les parasitoses intestinales au CHU de Rabat, Espérance Médicale 2007 ; 14 : 287-90.
- [8] El houdaibi, S., 2013. Épidémiologie et prévalence des parasitoses intestinales à l'Hôpital militaire d'instruction Mohammed V- Rabat (Janvier 2008-Décembre 2012).p.123.
- [9] Amhaouch, Z., 2017. Les parasitoses digestives au service de parasitologie –mycologie du CHU Hassan II fès, Mémoire, p.46.
- [10] Cheikhrouhou, F., Trabelsi, H., Sellami, H., Makni, F., and Ayadi, A., 2009. Parasitoses intestinales dans la région de Sfax (sud tunisien) : étude rétrospective, Rev Tun Infectiol, avril 09, Vol 3, N°2, 14 – 18.
- [11] Siala, E., Toumi, I., Béttaieb, J., Zallega, N., Aoun, K., and Bouratbine, A., 2015. Evolution de la prévalence des parasitoses digestives dans la région de Tunis de 1996 à 2012, La Tunisie Médicale- ; vol 93 (11).
- [12] Benouis, A., Bekkouche, Z., and Benmansour, Z., 2013. Etude épidémiologique des parasitoses intestinales humaines au niveau du C.H.U. d'Oran (Algérie). International Journal of Innovation and Applied Studies. ISSN 2028-9324 Vol. 2 No. 4 Apr. 2013, pp. 613-620.
- [13] Gonzalez-Moreno, O., Domingo, L., Teixidor, J., and Gracenea, M., 2011. Prevalence and associated factors of intestinal parasitisation: A cross-sectional study among outpatients with gastrointestinal symptoms in Catalonia, Spain, Parasitology Research 108(1):87-93.
- [14] Jaran, A.S., 2016. Prevalence and seasonal variation of human intestinal parasites in patients attending hospital with abdominal symptoms in northern Jordan. Eastern Mediterranean Health Journal. Vol. 22 No. 10.
- [15] Kiani, H., Haghghi, A., Rostami, A., Azargashb, E., Seyyed Tabae, S.J., Solgi, A., and Zebardas, A., 2016. Prevalence, risk factors and symptoms associated to intestinal parasite infections among patients with gastrointestinal disorders in nahavand, western Iran, Rev. Inst. Med. Trop. Sao Paulo, 58:42
- [16] Marcano, Y., Suárez, B., González, M., Gallego, L., Hernández, T., and Naranjo, M., 2013. Caracterización epidemiológica de parasitosis intestinales en la comunidad 18 de Mayo, Santa Rita, estado Aragua, Venezuela, Agosto-Diciembre, Vol. LIII (2): 135-145.
- [17] Lango-Yaya, E., Ngalema, T., Agboko, F.M., Bondom, R.L., Namzeka, M., Rafai, D.C., 2021. Prevalence Des Infections Parasitaires Dues Aux Protozoaires Identifies Au Laboratoire National De Biologie Clinique Et De Sante Publique, Bangui Republique Centrafricaine. European Scientific Journal, ESJ, 17(21), 115.
- [18] Baraha, N., 2020. Epidémiologie des parasites intestinaux dans la région d'Ouarzazate, thèse du Doctorat en Médecine, Faculté de Médecine et de Pharmacie, Marrakech, p.161.
- [19] Soumana, A., Kamaye, M., Saidou, D., Dima, H., Daouda, B., and Guéro, T., 2016. Les parasitoses intestinales chez les enfants de moins de cinq ans à Niamey au Niger, Mali Medical, Tome XXXI N°4.
- [20] Eddehbi, F.E., 2020. Les parasitoses digestives chez l'enfant à l'Hôpital IBN ZOHR de Marrakech, Thèse Doctorat en Médecine, Faculté de Médecine et de Pharmacie, Marrakech p.145.
- [21] El Kattani, S., Azzouzi, E.M., and Maata, A., 2006. Prévalence de Giardia intestinalis chez une population rurale utilisant les eaux usées à des fins agricoles à Settat (Maroc, Médecine et maladies infectieuses, 36, pp.322-328.
- [22] Belhamri, N., 2015. Profil épidémiologique des parasitoses intestinales au service de Parasitologie Mycologie à l'Hôpital Militaire Avicenne de Marrakech. thèse du Doctorat en Médecine.p.115.