Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/15623
DOI URL: http://dx.doi.org/10.21474/IJAR01/15623

RESEARCH ARTICLE

DISTRIBUTION OF SCHISTOSOMIASIS IN THE DEPARTMENT OF AGBOVILLE IN SOUTH-EASTERN COTE D IVOIRE

N'Guessan Aya Nicaise Sp. Okoubo, Yoboué Konan Claude Sylvain, Diakite Nana Rose Sp. N'Goran and Orsot Niangoran Mathieu

Biology and Health Laboratory, Parasitology & Parasitic Ecology Specialty, Félix Houphouet-Boigny University, Abidjan, Côte d'Ivoire, 22 BP 582 Abidjan, Côte d'Ivoire.

Manuscript Info

Manuscript History
Received: 31 August 2022
Final Accepted: 30 September 2022
Published: October 2022

Key words:-
Schistosomiasis, Distribution, Agboville, Ivory Coast

Abstract

Bilharzia and intestinal worms are public health problems in Côte d'Ivoire. The health authorities are trying to control these diseases. However, it is difficult to identify outbreaks. This study was therefore initiated for this purpose. The objective was to assess the prevalence of these parasites, to map outbreaks of bilharzia and to determine the nature of the biotopes in which these diseases develop. The study was carried out in the department of Agboville. It consisted of researching high-risk households by means of a questionnaire. Parasitological examinations of urine by filtration and of stools by Kato-katz were carried out on 50 pupils per school per locality in 30 localities to find out the real prevalence of the outbreaks. A questionnaire was used to detect the nature of potential transmission sites.A total of 16.740 pupils were interviewed. Of these, 4.377 reported having urinary bilharzia and 5.542 reported blood in the urine. The urine of 1.503 pupils were examined, 26.2% of pupils had *Schistosoma haematobium* and 40% of the schools were hyperendemic. Schools with moderate or low prevalence were less than 10. 3.084 reported intestinal bilharzia compared to 4.361 cases of blood in the stool. A total of 693 pupils had at least one parasite. The pupils were infected with five different intestinal parasites. Both urinary (26.16%) and intestinal (15.01%) bilharziasis were very important in the department, rivers and marigots were the most at risk environments as they were present in 61.5% of the localities with hyperendemic foci.

Introduction:-

Schistosomiasis is a public health problem in Africa (Bourre, 1994; Chippaux *et al*., 2000; Doumenge *et al*., 1987; Lengeler *et al*., 2002; WHO, 2022). In Côte d'Ivoire, the results of parasitological surveys have shown that urinary and intestinal schistosomiasis are endemic (Assaré *et al*., 2014). They are even said to be on the increase. In 1998, this condition was recognised as a public health problem in this country (Anonymous, 1998) and the health authorities have developed a national control program. The lack of regional or even national epidemiological data, which is essential for planning coherent and efficient control approaches, led to a questionnaire survey in almost all primary schools in five regions of Côte d'Ivoire (N'Guessan *et al*., 2007). This study made it possible to draw up distribution maps of communities reporting blood in urine and stools at the regional, departmental and local levels.

Corresponding Author:- N'Guessan Aya Nicaise Sp. Okoubo
Address:- Biology and Health Laboratory, Parasitology & Parasitic Ecology Specialty, Félix Houphouet-Boigny University, Abidjan, Côte d'Ivoire, 22 BP 582 Abidjan, Côte d'Ivoire.

Of the 13 departments surveyed, Agboville was the most affected by blood in urine, with 64.6% of schools at high risk. In order to implement the WHO resolution WHA 54.19 which consists in regularly treating all school children exposed to the risk of schistosomiasis (WHO, 2013), it is necessary to determine the real foci of schistosomiasis and the environment in which this disease develops. Hence the interest in undertaking parasitological surveys and determining the distribution factors of this endemic. These data will enable effective control to be undertaken, the impact of treatment to be assessed and, if possible, control of the molluscs to be planned if necessary.

Material And Method:-

Criteria for choosing the target population

The department of Agboville is located in the south of Côte d'Ivoire between 05°55'N and 04°13'W. It covers an area of 6.094 km2. Administratively, the department is made up of three communes divided into six sub-prefectures: Agboville, Azaguié, Rubino, Céchi, Oress-Krobou and Grand-Morié. Epidemiological surveys were carried out in these six sub-prefectures, covering 103 villages and a population of 244.868 (Anonymous, 1998). The choice of this department was motivated by the high prevalence of blood in the urine and blood in the stool (N'Guessan *et al*., 2007).

The epidemiological surveys were conducted in two phases. The first phase consisted of a rapid identification of blood-in-urine and blood-in-faeces outbreaks and the nature of the transmission sites by means of a questionnaire. The second phase consisted of determining the actual prevalence of outbreaks by parasitological examination. These surveys concerned schoolchildren aged 8 to 14 years, who represent the age group of children who are most vulnerable and suffer the most from parasitosis because of their permanent contact with waterways, which exposes them to the risks of transmission. They also contribute to environmental contamination (WHO, 2003). In addition, they are accessible, available and easy to monitor (N'Goran *et al.*, 1998).

Questionnaire survey

The questionnaire used consists of a list of 12 different diseases and symptoms. It was distributed in almost all primary schools in Agboville with classes above the second preparatory class (CP2) because it was shown that pupils in the preparatory classes had great difficulty answering the questions (N'Goran *et al*., 1998). A total of 171 envelopes containing questionnaire forms were deposited in the three primary inspectorates of Agboville, which were responsible for distributing them to the schools and collecting the responses. The envelope sent to each of the schools contains three sheets: an instruction sheet for the teachers of the selected classes, a questionnaire sheet for the pupils of each selected class and another questionnaire sheet to be filled in by the headmaster of the school on the nature of the sources of water supply and human-water contact.

Parasitological survey

Thirty (30) schools randomly selected among the schools that returned the questionnaire were selected for coprological and urinary examinations. They were distributed as follows: Seven (7) schools in urban areas and twenty three (23) schools in rural areas. In each primary school, about 50 pupils from the first grade class (CE1) each gave stool and urine samples preferably taken between 10:00 and 14:00 on the day of analysis. The presence of S. haematobium in urine is detected by the WHO urine filtration technique (2022). Stools are examined by the Kato-Katz technique (WHO, 2022) to search for, identify and count S. mansoni eggs. At the end of the microscopic examinations, a quality control check is carried out to verify the consistency of the results. For this purpose, the team leader reads 10% of the slides handled by each technician each day, without prior knowledge of the result.

Data analysis

In the case of the questionnaire survey, responses to the following four key questions are analysed: "Do you have blood in your urine?", "Do you have blood in your stool?", "Do you have urinary bilharzia?" and "Do you have intestinal bilharzia? The schoolchildren responded with: "yes", "no" or "I don't know". Positive responses were used to calculate school prevalences. These were classified according to the moderate and high thresholds of positivity of the questionnaire established at 19.8% and 33.3% by N'Goran *et al* (1998) according to WHO standards (WHO, 1993). Indeed, the prevalences of 19.8% and 33.3% correspond respectively to the parasitological prevalences of 25% and 50% considered at the time as thresholds for moderate and high infestation (WHO, 1993). The analyses were essentially based on symptoms, as blood in urine and blood in stool have been shown to be the most reliable for detecting *Schistosoma haematobium* and *S. mansoni* infestations (N'Goran *et al*., 1998; Lengeler *et al*., 2000; N'Guessan *et al*., 2007).

The calculated parasitological prevalences are classified according to the parasitological thresholds defined by WHO 2004b and WHO 2004. Thus, high prevalences are above 30% for urinary schistosomiasis and above 50% for intestinal schistosomiasis. Following the same order, moderate prevalences are below 30% and between 10% and 50%. Low prevalences are less than 10% in both cases. The calculated prevalences are compared by Chi-square tests. The results of the questionnaire survey are compared with those of the parasitological survey by correlation tests. In addition, they were used to draw up the schistosomiasis distribution map using MapInfo professional (French version 5.5), Arcview (version 3.2) and Paint software. All statistical analyses are done in Stastica 6.0 software. In relation to the sources of water supply and or human-water contact, our analyses focus on the use of natural water sources.

Results:-

Distribution of *Schistosoma haematobium* urinary tract infection

The questionnaire was sent to 171 selected schools and 158 schools correctly completed and returned them. A total of 16.740 pupils aged 8-12 years were surveyed. Of these, 4.377 (26.2%) reported having urinary bilharzia and 5.542 (33.1%) reported blood in the urine (table). The prevalence of blood in urine varied from 13.9% in Mafou to 90.8% in Kedjempo. In the department of Agboville, 62 households are at high risk of blood in urine, 40 and 56 households are at moderate and low risk respectively. Concerning the 30 schools, they include 3.207 pupils surveyed, i.e. 19.2% of those surveyed in the department. The prevalence of blood in the urine varied from 4.6% in Plateau 3 school in the town of Agboville to 78.3% in Ehouéguié in the sub-prefecture of Agboville. The symptom blood in urine is strongly correlated with urinary bilharzia disease ($r = 0.92$; $t = 12.24$; $ddl = 28$; $p = 0.00$) and with the presence of *Schistosoma haematobium* eggs in urine ($r = 0.65$; $t = 4.58$; $ddl = 28$; $p = 0.00$). Therefore, schools with a high prevalence of blood in urine are predominantly identified with a high prevalence of *Schistosoma haematobium*-positive students (Figure 1). Therefore, our analyses focus on *Schistosoma haematobium* egg carriers. The excreta of 1.503 pupils were examined. Three hundred and ninety-three (393) or 26.2% of the pupils were carriers of *Schistosoma haematobium*. Cases of urinary schistosomiasis are almost present in all localities with prevalences ranging from 2% in the Methodist and Soukouradjan schools in the town of Agboville to 82% in Grand Moutcho in the sub-prefecture (Table 1). Of the 30 schools selected, 12 (40%) are hyperendemic. They are all located in rural areas. They are Grand Moutcho (82%), Guessiguié (64%), Oress-Krobou (60%), Poyokro (54%), Yadio (54%), Odoguié (52%), Babiahan (50%), Ehouéguié (48%), Aboudé (40%), Séguié (34%), Gbessé (34%) and Allany (32%) (Table 1). The moderate and low prevalence schools are less than 10. Dioulakro 3 is the only school in the town where no case of urinary schistosomiasis was recorded.

Comparing the prevalences of the questionnaire with the parasitological prevalences at the sub-prefecture level, Oress-Krobou, Grand Morié and Azaguié did not change their level of endemicity, whereas it varied significantly in Cechi and Agboville. The prevalence of *Schistosoma haematobium* varies from 9.17% in Azaguié to 50% in Oress-Krobou. Three sub-prefectures, Oress Krobou (50%), Cechi (32%) and Grand Morié (31.5%) are identified as having a high prevalence of urinary bilharzia and two others, Agboville (25.59%) and Rubino (13.2%) have a moderate prevalence. Azaguié is the only one with low prevalence (9.2%).

Five different natural water sources, namely rivers, marigots, ponds, streams and lakes are used by the population of Agboville department. Rivers and marigots are the most widespread, as they are present in 66.67% of localities. This river-marigot binomial seems to be the most at risk environment because 8 localities out of 13, i.e. 61.5% of localities where this binomial exists are hyperendemic foci. The presence of ponds, rivers and lakes does not have a major influence on the prevalence of *Schistosoma haematobium* bilharzia in this department. It should also be noted that cases of urinary bilharziasis are rare in communities that do not use natural water sources. This is the case for the 7 schools in the town where prevalences of less than 10 were recorded.

Distribution of *Schistosoma mansoni* intestinal bilharzia

Of the 16.740 pupils interviewed, 3.084 or 18.6% reported intestinal bilharzia, compared to 4.361 or 26.3% reported blood in the stool. The prevalence of blood in the stool varied from 7.4% in Boka-Oho to 61.5% in Irfa Azaguié. Cases of blood in the stool are recorded in all schools in the department, most of which have low or moderate prevalences. Blood in the stool correlated with the presence of *Schistosoma mansoni* eggs in the stool ($r = 0.72$; $t = 5.42$; $p < 0.0000$; $ddl = 28$). However, all outbreaks of *Schistosoma mansoni* intestinal bilharzia are identified by questionnaire regardless of the level of endemicity of the condition. For this reason, we chose to focus our analysis on *Schistosoma mansoni* carriers. Five different intestinal parasites (*Ankylostomasp*. *Schistosoma mansoni*, *Ascarislumbricoides*, *Trichuristrichiura*, *hymenolepis nana*) are at the origin of infestations in schoolchildren in the

department of Agboville (Figure 2). A total of 693 out of 1503 pupils have at least one parasite. This corresponds to an overall prevalence of parasitic infestation equal to 46.11%. Figure 2 summarising the prevalence of the different intestinal parasite infestations among the students shows a major infestation, Hookworm sp. (28.53%). The least prevalent parasite was Hymenolepis nana observed in 3 individuals. Intestinal bilharzia, the subject of this study, with a prevalence of 15.4%, is not widespread in the study area (Figure 1). The four hyperendemic foci, Odoguié (78%), Gbessé (64%), Azaguié gare (61.5%) and Irfa Azaguié (56%), are mainly concentrated in the southern half of the department. As for the moderate prevalence foci, which are Dioulakro 3 (40%), Seguié (28%), Azaguié gare (23.1%), Gantois (18%), Yadio (18%), Sokouradjan (16%) and Méthodiste (13.7%), they are spread throughout the department. Intestinal bilharzia is non-existent in 7 schools located in the northern half. These are Allany, Poyokro, Badiahan, Ery-Makouguié, Boka-Oho, Kouadjakro and Plateau 3.

As regards the sub-prefectures, Azaguié with a moderate prevalence of 46.87% is the only sub-prefecture where intestinal bilharzia is a real problem. With the exception of Cechi, where no cases have been detected, the other sub-prefectures have prevalences of around 10%. Intestinal bilharzia is present in all types of environment (Table 1). It is even possible to find cases in localities where the population does not draw on natural water sources.

Discussion:-

Our results, together with those of previous studies, confirm that the department of Agboville is an established focus of bilharzia in Côte d'Ivoire (N'Guessan *et al.*, 2007; Adoubryn *et al*., 2006; Doumenge *et al.*, 1987). Both species of schistosomes *Schistosoma haematobium* and *S. mansoni* are present with a predominance of *S. haematobium* over *S. mansoni*. The parasitological survey of the sample of 30 schools was sufficient to confirm that urinary bilharziasis is a public health problem in this department because it is widely distributed both geographically and demographically. Our results also show that the rivers that are the preferred habitats of *Bulinus globosus* in the Ivorian forest zone exist in almost all localities. The high prevalence of urinary bilharzia recorded as well as its wide distribution in the department can be explained by the abundance of freshwater collections, intermediate host molluscs that are certainly compatible with the *Schistosoma haematobium* strain, and the intensity of river and marsh frequentation. Massive infestations resulting in visible haematuria are thought to be the cause of schoolchildren's knowledge of the disease and its symptoms in most localities. Counting 12 hyperendemic foci of urinary bilharzia in the 30 schools surveyed by parasitology, we can infer 64 hyperendemic foci in the 158 schools surveyed by questionnaire. Combining the 40 moderate prevalence foci, urinary bilharzia should be treated in 104 localities in the department of Agboville.

From the results of the stool examinations, it appears that 46.10% of the subjects examined harbour at least one intestinal helminth. This overall prevalence rate appears to be significantly lower than that found by N'Guessan *et al*., in 2007, which was 58.7%. This lower rate compared to that of N'Guessan *et al.,* (2007) is explained by improved sanitary conditions, the creation of latrines and mass deworming. The existence of other parasitoses implies that abendazole or mebendazole should be combined with praziquantel as recommended by WHO (2003). The high transmission of *Schistosoma mansoni* in 4 of the 30 localities can be explained by parasite strains from Gbessé, Irfa Azaguié, Odoguié and Ores-Krobou compatible with *Biomphalaria pfeifferi*. We retain this hypothesis because it is highly probable that *Biomphalaria pfeifferi*, being ubiquitous, is also present in all rivers. In rural areas, the rare cases of intestinal bilharzia would be imported cases. In Oress-Krobou, Azaguié gare, Yadio, Loviguié and Babiahan, schoolchildren answered massively that they had blood in their stools, which was not confirmed by stool examination. The presence of blood in the stool would therefore be due to another parasite which could be *Entamoeba histolytica*.

In the town of Agboville, both species of schistosomes were also found with a lower prevalence for *Schistosoma haematobium* as observed by Aboudryn *et al*. The rarity of *S. haematobium* in urban areas (Azaguié and Agboville) is mainly explained by the absence or low presence of intermediate mollusc hosts. Indeed, in the city, the modification of the habitat of *Bulinus globosus* is accentuated by the deforestation inducing the sunshine of the Agnéby in the city of Agboville. *Biomphalaria*, a ubiquitous species, would therefore develop to the benefit of *Bulinus globosus* in the city, hence the higher prevalence of *Schistosoma mansoni* in the urban environment.

Bilharziasis and other parasites are widespread in the department of Agboville. These facts are observed in the 30 localities that were the subject of our study.
The use of the questionnaire as a tool for identifying high-risk areas allowed us to identify the department of Agboville as a high-risk area for bilharzia and blood in the stool. This study confirms that the questionnaire approach

is an efficient method that can be implemented in a short time. Parasitological examinations carried out following the questionnaire showed that both urinary and intestinal bilharziasis are very important in the department. Urinary bilharziasis is more prevalent with a prevalence of 26.16% than intestinal bilharziasis reported by 15.01% of the 1503 school children examined.

This study shows that the distribution of parasitosis is favoured by the typology of biotopes and the distribution of mollusc populations for bilharziasis and all activities related to water.

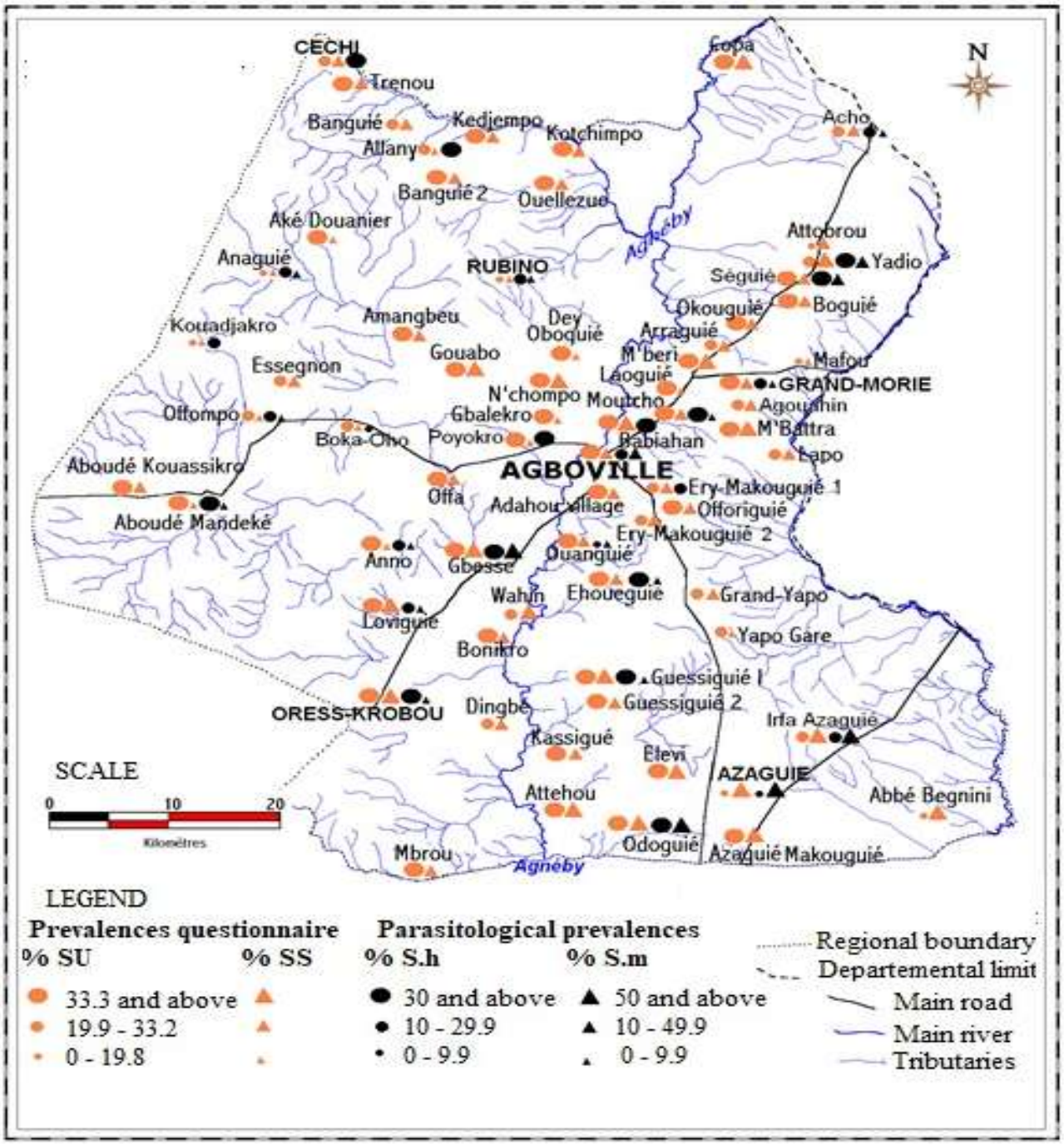

Figure 1:- Distribution of prevalences of *Schistosoma haematobium (S. h), S. mansoni (S. m),* blood in urine (SU) and stool (SS) in the department of Agboville.

Table 1:- Results of questionnaire and parasitological surveys in the 6 sub-prefectures of the department of Agboville: SU: blood in the urine, SS: blood in the stool, BU: urinary schistosomiasis, BI: intestinal schistosomiasis, Riv: river, Mar: backwater, Eta: pond, Flv: river, S. h: *Schistosoma haematobium*, *S. m*: *Schistosoma mansoni*

	Results Questionnaires										**Results parasitological**		
School	Total Inter	SU	SS	BU	BI	Water sources					Total exam	Bilharzias	
Sub-prefecture						Riv	Mar	Eta	Flv	Lac		S. h	S.m
Allany	80	27.5	13.8	12.5	8.8						50	32	0
Cechi	**80**	**27.5**	**13.8**	**12.5**	**8.8**						**50**	**32**	**0**
Aboudé	120	45.8	19.2	40	13.3						50	40	2
Oress-Krobou	94	39.4	39.9	40.4	30.9	1	1				50	60	4
Oress-Krobou	**214**	**42.6**	**29.5**	**40.2**	**22.1**	**1**	**1**				**100**	**50**	**3**
Azaguié Ahoua	141	8.5	58.9	10.6	40.4	1	1				52	1.9	61.5
Azaguié Gare	118	22	34.8	14.4	18.6						52	9.6	23.1
Irfa Azaguié	109	12.8	61.5	11	56	1				1	50	16	56
Azaguié	**368**	**14.5**	**51.7**	**12**	**38.3**	**1**				**1**	**154**	**9.2**	**46.9**
Anaguié	141	14.9	8.5	6.4	4.3	1	1	1			53	13.2	1.9
Rubino	**141**	**14.9**	**8.5**	**6.4**	**4.3**	**1**	**1**	**1**			**53**	**13.2**	**1.9**
Acho	27	27	24.3	27	27		1				50	28	2
Grand-Morié	192	51	31.5	48.9	16.3	1	1				50	10	2
Séguié	141	64.5	20.3	54.6	38.3	1	1	1			50	34	28
Yadio	111	24.3	34.2	13.5	14.4	1	1		1		50	54	18
Grand-morié	**471**	**41.7**	**27.6**	**36**	**24**	**1**	**1**	**1**	**1**		**200**	**31.5**	**12.5**
Anno	123	58.5	16.3	59.4	12.2	1		1	1		50	20	2
Badiahan	101	37.6	34.7	15.8	13.9	1	1	1			50	50	0
Boka-Oho	65	21.3	7.4	12.5	4.5						50	4	0
Dioulakro	103	7.8	27.2	5.8	8.7						50	0	40
Ehouéguié	129	78.3	27.1	61.2	20.9	1	1				50	48	4
EPV Méthodiste	91	13.2	19.8	8.8	6.6						51	2	13.7
Ery-Makouguié	126	26.2	20.6	22.2	14.3						50	82	4
Gantois	115	22.6	30.4	20.9	10.4	1					50	4	18
Gbessé	105	47.6	50.5	41.9	45.7	1	1	1	1		50	34	64
Grand-Moutcho	99	62.6	27.3	47.5	11.1	1	1				50	82	4
Guessiguié	93	55.9	27.9	55.9	33.3	1					50	64	2
Kouadjakro	80	19	8.9	14	4.7						50	12	0
Loviguié	86	54.7	44.2	48.8	44.2	1	1				50	18	2
Odoguié	90	47.8	47.8	34.4	28.9	1	1				50	52	78
Offompo	130	21.5	10.8	12.3	7.7	1	1	1			50	20	4
Ouanguié	94	36.2	23.4	34.0	19.2						50	6	4
Plateau 3	87	4.6	25.3	10.3	4.6		1				45	2.2	0
Poyokro	93	53.8	10.8	38.7	9.7	1		1			50	54	0
Sokouradjan	123	25.2	17.9	26.0	17.9				1	1	50	2	16

Agboville	**1933**	**36.5**	**25.2**	**29.1**	**16.8**	**1**	**1**	**1**	**1**	**1**	**946**	**25.6**	**13.3**
Grand total	**16740**	**33.1**	**26.3**	**26.2**	**18.6**	**1**	**1**	**1**	**1**	**1**	**1503**	**26.2**	**15.4**

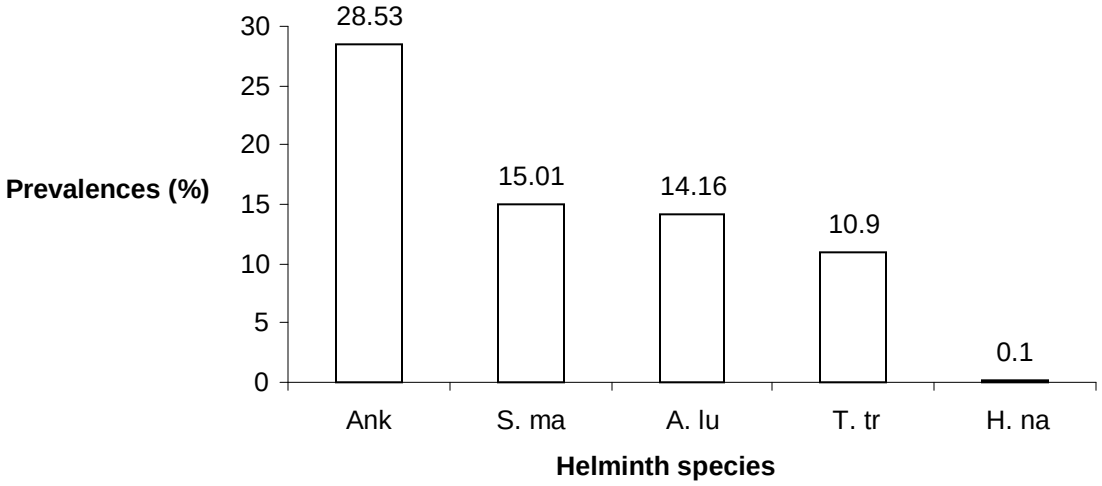

Figure 2:- Prevalence of helminth species identified in the department of Agboville
Ank: *Hookworm sp*; S.ha: *Schistosoma haematobium*; S.ma: *Schistosoma mansoni*; A.lu: *Ascaris lumbricoides*; T.tr: *Trichuris trichiura* ; H.na: *Hymenolepis nana*

Bibliographic References :-

1. Adoubryn K. D. J., Ouhon C. G., Yapo E. Y., Assoumou, K. M. L., & Assoumou A. (2006). Profil épidémiologique des schistosomoses chez les enfants d'âge scolaire dans la région de l'Agnéby (sud-est de la Côte-d'Ivoire) Bull Soc Pathol Exot, 2006, 99, 1, 28-31.
2. Anonymous (1998). Séminaire de formation et de sensibilisation à la lutte contre les bilharzioses. INFAS Bouaké du 13 au 17 juillet 1998. Rapport final, Direction exécutive du programme national de lutte contre l'onchocercose, la trypanosomiase humaine africaine, les bilharzioses et le ver de Guinée, Bouaké, 1998.
3. Assaré R. K., Knopp S., N'Guessan N. A. *et al*. (2014). Sustaining control of *schistosomiasis mansoni* in moderate endemicity areas in western Côte d'Ivoire: a SCORE study protocol. BMC Public Health 14 (décembre). doi:10.1186/1471-2458-14-1290.
4. Bourre P. (1994). Trématodes–Bilharzioses ou schistosomiases. In : Aide-mémoire de parasitologie et de pathologie tropicale. Flam Méd Sc, 1994, 2, 39-101.
5. Chippaux J. P., Garba A., Boulanger D., Ernould J. C., Engels D. et les participants de l'atelier de Niamey. (2000). Réduire la morbidité des schistosomoses : compte-rendu d'un atelier d'experts sur le contrôle des schistosomoses réunis au CERMES (15-18 février 2000, Niamey, Niger). Bull Soc Pathol Exot, 2000, 93, 356-360.
6. Doumenge J. P., Mott K. E., Cheung C., Villenave D., Chapuis O. *et al*.(1978). - Atlas of the global distribution of schistosomiasis. World Health Org, Geneva, 1987.
7. N'Goran K. E, Utzinger J., Traore M., Lengeler C. & Tanner M. (1998). Identification rapide par questionnaire des principaux foyers de bilharziose urinaire au centre de la Côte d'Ivoire. Méd Trop, 1998, 58, 253-260.
8. N'Guessan N. A., Acka C. A., Utzinger J. & N'Goran E. K., (2007). Identification des régions à haut risque de schistosomoses en Côte d'Ivoire. Bulletin de la Société de Pathologie Exotique, 100 (2) : 119 – 123.
9. Lengeler C., Utzinger J. & Tanner M. (2002). Questionnaires for rapid screening of schistosomiasis in sub-Saharan Africa. Bull World Health Org, 2002, 80, 235-242.
10. WHO (1993). The control of schistosomiasis. WHO Technical Report Series n° 830, Geneva, 1993.
11. WHO (2003). Schistosomiasis and soil- transmitted helminth infections - preliminary estimates of the number of children treated with albendazole or mebendazole
https://apps.who.int/iris/bitstream/handle/10665/233075/WER8116_145-163. PDF
12. WHO (2004a). Schistosomiases et géohelminthiases, prévention et lutte. Rapport d'un comité d'experts de l'OMS, Genève. 68p.
13. WHO (2004b). Agir contre les vers. Bull PPC, World Health Org, 2004, 4, 1-10.

14. WHO (2013). Schistosomiase : rapport de situation 2001-2012 : plan stratégique 2012-2020 https://apps.who.int/iris/bitstream/handle/10665/129941/9789242503173_fre.pdf?sequence=1&isAllowed=y. consulté le 30 juillet 2022.
15. WHO(2022). Centre des Médias / Principaux repères / Détail Schistosomiase. https://www.who.int/fr/news-room/fact-sheets/detail/schistosomiasis.Consulté le 23 octobre 2022.
16. Utzinger J, N'goran KE, Ossey YA, Booth M, Traoré M et al.(2000). Rapid screening for *Schistosoma mansoni* in western Côte d'Ivoire using a simple school questionnaire. Bull World Health Org, 2000, 78, 389-398.