Annals of Medicine and Medical Sciences (AMMS)
Volume 04, 2025, *Page No.: 50 to 54*
Available at: *http://ammspub.com*

Original Article

OPEN ACCESS

Epidemiological and Clinical Profile of Acute Diarrhea, Among Young Patients Consulting at the Sino-Gabonese Friendship Hospital in Franceville

Hilaire Kenguele Moundounga [1], Thiéry Ndong Mba *[1,2], Brice Arnaud Pambo-Pambo [4], Gracy Kanute Mapagou [3], Nancy Dorothée Mambandy Opassi [1], Simon Mapasu [3], Assane Ndiaye [1]

[1]Laboratory of Molecular and Cellular Biology, University of Sciences and Techniques of Masuku, BP 943, Franceville, Gabon.
[2]Research Laboratory in Biochemistry, University of Sciences and Techniques of Masuku, BP 943, Franceville, Gabon.
[3]Sino-Gabonese Friendship Hospital in Franceville, Gabon.
[4]Animal Physiology Laboratory, University of Sciences and Techniques of Masuku, BP 943, Franceville, Gabon.

*Corresponding author: Thiéry Ndong Mba; *hkenguele@gmail.com*

Abstract

Background: Despite recent improvements, acute diarrhea remains a public health issue. This study investigated the epidemiological and clinical characteristics of acute diarrhea in young patients at the Sino-Gabonese Friendship Hospital in Franceville, Gabon (2021-2023). ***Methods:*** This retrospective study analyzed data from patients diagnosed with acute diarrhea. Statistical analysis explored links between diarrhea prevalence and factors like age, sex, residence, and seasonality. ***Results:*** The prevalence of acute diarrhea was 14.75% (IC à 95 %: [0,14-016]). Significant associations were found with ages 1-5 (Odds Ratio = 1,18; 95% IC [1,02;1,35] p=0,023), and 6-10 years Odds Ratio = 0,27; 95% IC [0,23;0,32] p≤ 0,001),, rural residence(Odds Ratio = 1,01; 95% IC [3,8;4,99] p≤0,001*), une p-value ≤ 0,001),, and rainy seasons (Odds Ratio = 0,81; 95% IC [0,7;0,91] p=0,001*) and (Odds Ratio = 0,80; 95% IC [0,7;0,94] p=0,007*). Sex was not a significant factor. ***Conclusion:*** Prevention and management efforts should target children aged 1-10 years, especially those in rural areas and during rainy seasons.

Keywords: ***Prevalence; Acute diarrhea; Sino-Gabonese Friendship Hospital; Franceville; Gabon.***

Introduction

Numerous infections, whether bacterial, viral, or parasitic, affect the health of populations around the world. Among these infections, diarrheal diseases represent a major public health problem [1]. These are not only the second leading cause of death in children under five years of age, with approximately 525,000 deaths each year [2], but also in another proportion of the vulnerable population, the elderly [3]. Despite the serious consequences of this burden, many lives can be saved through access to safe drinking water, good hygiene conditions, and appropriate treatment [4]. Also, the situation can be improved through basic interventions [5]. For example, in recent years, the total number of deaths per year due to diarrhea in children under 5 years of age has decreased by 60% [6]. This disease kills more than AIDS, malaria, and measles combined [7]. Although most deaths from diarrhea most often occur in children living in South Asia [8]. In low- or middle-income countries in sub-Saharan Africa, the lack of safe drinking water, hygiene, good sanitary conditions, malnutrition, and health problems promote the spread of diarrheal diseases [4]. As water is an essential component of the body's body weight, people with diarrhea are more susceptible to dehydration than those in good health [9]. In Gabon, despite efforts to fight acute diarrhea, this disease remains a major cause of infant mortality, after malaria, measles, and respiratory infections [10]. Current management, based solely on clinical arguments, has limitations, with the development of drug resistance, unjustified treatments, delay or errors in management [11]. Faced with this observation, this study aims to establish the epidemiological and clinical profile of acute diarrhea in young patients who consulted at the Sino-Gabonese Friendship Hospital in Franceville (Haut-Ogooué province, Gabon) between 2021 and 2023.

II. Materials and Methods

II.1 Study Design

This retrospective cross-sectional study was based on patient records from the Sino-Gabonese Friendship Hospital in Franceville between January 2021 and December 2023. By collecting data at a specific point in time, it aimed to describe the prevalence of acute diarrhea in Franceville and compare its incidence over a two-year period. The objective was to build a structured dataset for a systematic analysis of the situation.

Received: January 11, 2025; **Revised:** February 19, 2025; **Accepted:** February 24, 2025

II.2 Study Setting

The study was conducted at the medical analysis laboratory of the Sino-Gabonese Friendship Hospital in Franceville, a major city in Gabon. This public hospital receives patients from the entire region. Franceville, like other Gabonese cities, experiences four seasons: a long dry season, a long rainy season, a short dry season, and a short rainy season. These seasonal variations, sometimes unpredictable, favor the spread of many diseases, especially during the rainy seasons. Unfortunately, access to safe drinking water and a good sanitation system is uneven in Franceville. Some disadvantaged neighborhoods have no choice but to use contaminated water from the river or the "Mpassa" river for their daily needs. This situation increases the risk of water- and food-related diseases for the most vulnerable populations.

II.3 Study Population

The study population included all patients who consulted at the Sino-Gabonese Friendship Hospital in Franceville and received a diagnosis of acute diarrhea between January 2021 and December 2023. The study was based on the total number of acute diarrhea cases recorded during this period.

II.3.1 Exclusion and Inclusion Criteria

Only patients aged 0 to 20 years who consulted at the Sino-Gabonese Friendship Hospital in Franceville between January 2021 and December 2023 were included. A healthcare professional diagnosed them with acute diarrhea based on stool analysis, and the results were recorded in the patient's medical file. Patients were excluded from the study if they had No confirmed diagnosis of acute diarrhea (including cases of chronic diarrhea, irritable bowel syndrome, or other gastrointestinal conditions not related to an acute infection). Suspected acute diarrhea without laboratory confirmation, Incomplete or unusable data. Nosocomial diarrhea (contracted during the hospital stay).

II.3.2 Sampling Method

To focus specifically on laboratory-confirmed cases of acute diarrhea, a purposive sampling method was adopted. The sample size was determined based on the number of cases recorded in the database of the Regional Health Directorate of Southeast Franceville, thus ensuring the representativeness of the study.

II.4 Data Collection Procedure

The data used for the study came from the database of the Regional Health Directorate of Southeast Franceville. Access to this data was made possible through collaboration between the University of Sciences and Techniques of Masuku and the health facilities of Haut-Ogooué. All cases of acute diarrhea recorded from January 2021 to December 2023 were extracted from this database and analyzed in digital form for the purposes of the study.

II.5 Statistical Analysis of Data

After being entered into a Microsoft Excel 2016 spreadsheet, the data were analyzed using the R statistical software (version 3.6.1). This software was used to calculate the prevalence rates of acute diarrhea and to identify the factors associated with these infections. Fisher's exact test was used to determine the statistical significance of the associations, with a 95% confidence interval and a significance threshold set at $p \leq 0.05$.

II.6 Ethical Considerations

Before beginning the study, the research protocol was submitted to the ethics committee of the Sino-Gabonese Friendship Hospital in Franceville for approval. To protect patient privacy, all data were anonymized and stored securely, with access restricted to authorized personnel.

III. Results

III.1.1 Prevalence of Acute Diarrhea Cases in the Study Population

Between January 2021 and December 2023, 7343 children consulted for acute diarrhea at the Sino-Gabonese Friendship Hospital in Franceville. Among them, 1083 cases were confirmed, representing a prevalence of 14.75% (95% CI: [0.14 - 0.16]). The remaining 6260 consultations (85.25%) were for other reasons.

III.1.2 Distribution of the Prevalence of Acute Diarrhea Cases According to the Sex of the Study Population

To determine whether sex influenced the prevalence of acute diarrhea, a statistical test (Fisher's exact test) was used with a 95% confidence interval. The results showed no significant difference between males and females (p-value = 0.95), indicating that sex is not a risk factor for acute diarrhea in this study (**see Table 1**).

Table 1: Statistical analysis of the distribution of the prevalence of acute diarrhea cases according to the gender of the study population

Gender	Total number of patients diagnosed N (%)	Prevalence of acute diarrhea		Univariate analysis	
		Positif (%)	Négatif (%)	Crude OR 95% CI	p-value
Male	2488 (47.5)	513 (20.62)	2975 (78.38)	Reference	-
Female	3855 (52.5)	570 (14.79)	3285 (85.21)	1.01 [0.88;1.15]	0.95

*OR: Odds ratio, *: Significant test*

III.1.3 Distribution of the Prevalence of Acute Diarrhea Cases According to the Age of the Study Population

Statistical analysis revealed that age was a significant factor in the occurrence of acute diarrhea. Specifically, children aged 1 to 5 years (Odds Ratio = 1.18; 95% CI [1.02; 1.35], p=0.023) and those aged 6 to 10 years (Odds Ratio = 0.27; 95% CI [0.23; 0.32], $p \leq 0.001$) showed a statistically significant association with acute diarrhea (**see Table 2**).

Table 2: Statistical analysis of the distribution of the prevalence of acute diarrhea cases according to the age of the study population.

Age groups	Total number of patients diagnosed N (%)	Prevalence of acute diarrhea		Univariate analysis	
		Positive (%)	Negative (%)	Crude OR 95% CI	p-value
0 – 11 months	715 (9,74)	315 (44.06)	400 (55.94)	Référence	-
1– 5 years	2158 (29,39)	350 (16.02)	1808 (83.98)	1.18 [1.02;1.35]	**0.023***
6 - 10 years	2677 (36.46)	167 (6.24)	2510 (93.76)	0.27 [0.23;0.32]	**≤0.001***
11 – 15 years	952 (12.98)	135 (14.18)	817 (88.2)	0.95 [0.77;1.16]	0.62
15– 20 years	841 (11.43)	116 (13.79)	725 (86.21)	0.91 [0.73;1.13]	0.44

*OR: Odds ratio, *: Significant test*

III.1.4 Distribution of the Prevalence of Acute Diarrhea Cases According to the Place of Residence of the Study Population

Table 3 shows that patients living in rural areas were more likely to contract acute diarrhea. This association was statistically significant (Odds Ratio = 1.01; 95% CI [3.8; 4.99], p ≤ 0.001).

Table 3: Statistical analysis of the distribution of the prevalence of acute diarrhea cases according to the place of residence of the study population

Residence	Total number of patients diagnosed N (%)	Prevalence of acute diarrhea		Univariate analysis	
		Positive (%)	Negative (%)	Crude OR 95% CI	P-value
Urban (Franceville)	5198 (70,79)	453 (8,71)	4745 (91,29)	Référence	-
Rural (surrounding departments)	2145 (29,21)	630 (29,37)	1515 (70,63)	1,01 [3,8;4,99]	≤0,001*

*OR: Odds ratio, *: Significant test*

III.1.4 Seasonal Distribution of the Prevalence of Acute Diarrhea Cases in the Study Population

Statistical analysis demonstrated a significant link between rainy seasons and the frequency of acute diarrhea. Indeed, the risk of acute diarrhea was higher during the short rainy season (Odds Ratio = 0.81; 95% CI [0.7; 0.91], p=0.001) and the long rainy season (Odds Ratio = 0.80; 95% CI [0.7; 0.94], p=0.007) (**see Table 4**).

Table 4: Statistical analysis of the seasonal distribution of the prevalence of acute diarrhea cases in the study population.

Seasonal periods	Prevalence of acute diarrhea		Univariate analysis	
	Positive (%)	Negative (%)	Crude OR 95% IC	P-value
Short rainy season (March to May)	395 (13.23)	2591 (86.77)	0.81 [0,7; 0,91]	**0,001***
Long rainy season (September to December)	257 (12,91)	1733 (87,09)	0.80 [0,7;0,94	**0,007***
Short dry season (January to February)	138 (13.46)	887 (86.54)	1.91 [1.62;2.24]	0.22
Long dry season (june to August)	290 (21.66)	1049 (78.98)	Reference	-

*OR: Odds ratio, *: Significant test*

Discussion

This study aimed to establish the epidemiological and clinical profile of acute diarrhea among young patients at the Sino-Gabonese Friendship Hospital in Franceville. It included 7343 consultations for this condition between January 2021 and December 2023. Of these, 1083 cases were positive, representing an overall prevalence of 14.75% (95% CI: [0.14-0.15]). This figure is practically similar to the combined prevalence of acute diarrhea in East African countries, reported at 14.28% [12]. Our result is lower than the 29% found in a previous study [13], but higher than the 12.0% reported by the Ethiopian DHS [14]. and the 12.7% found in Nigeria [15]. This variability in prevalence could be explained, on the one hand, by the difference in the sociodemographic characteristics of the populations of the different studies, the geographical location of the studies, the climatic conditions, the stool disposal culture, access to water and a handwashing culture [16] and on the other hand, the discrepancy between the results could be the consequence of the neglect of the execution of health outreach programs in certain regions, and considering that water facilities, sanitation and hygiene are not often adequate [13]. Unlike a study conducted among children under 5 years of age in the United States between 1997 and 2000, in which a higher incidence rate of diarrhea was revealed in male children [17], the present study did not find any association between gender and the prevalence of acute diarrhea. This result is similar to that of a study which found no evidence of differences in the severity of diarrhea between the sexes in children under 5 years of age [18]. This would find an explanation in the fact that in endemic areas such as Gabon, acute diarrhea infects both men and women, despite disparities in their daily behavior, hygiene, diet, environmental sanitation and characteristics of habitats [19]. Similar to two studies that indicated a higher prevalence in children under 5 years old suffering from acute diarrhea [20,21]., this study revealed a significant link between the prevalence of acute diarrhea and age. Children aged 1 to 5 years and 6 to 10 years represented 47.74% of the cases. Several factors could explain this observation, including malnutrition, low parental education level, poor socioeconomic conditions, and lack of rotavirus vaccination [22]. Patients residing in rural areas were 1.01 times more likely to contract acute diarrhea than those residing in urban areas. This result corroborates the findings of numerous studies, such as one conducted in India, which made the same observation [3]. This aligns with the fact that in sub-Saharan Africa, only capital cities often benefit from a certain level of development, to the detriment of rural areas where populations are often forced to consume unimproved drinking water, use unimproved sanitation facilities, and have limited access to healthcare facilities [23]. This study indicated that rainy seasons were significantly associated with cases of acute diarrhea. This result corroborates a study that observed cases of acute diarrhea almost all year round, with a peak during the rainy season [24]. Being perfectly in line with the rainfall pattern each year in Gabon, this observation confirms the role played by water in the dissemination of parasites, bacteria, and viruses responsible for acute diarrhea and the resulting contamination [25].

Strengths of the study

The study addresses an important public health problem, acute diarrhea, which still affects many people, especially children. It uses a retrospective and cross-sectional methodology with appropriate statistical analysis (R software, statistical tests, confidence intervals) and focuses on young patients, a group particularly vulnerable to acute diarrhea. By identifying important risk factors associated with acute diarrhea, such as age (age groups 1 to 5 years and 6 to 10 years), rural residence, and rainy seasons, the results of the study have direct implications for public health, highlighting the need to target prevention and management efforts on the most at-risk populations.

Limitations of the study

Like any study, this work has limitations. Based on the data collected, we were not able to specify which types of parasites, viruses, or bacteria were responsible for each case of acute diarrhea, since all recorded cases were labeled as cases of acute diarrhea. However, this does not affect the quality of our study. Another limitation is that in Gabon, as soon as the first symptoms of a disease

appear, people tend to first resort to traditional medicine, using so-called medicinal plants. Therefore, it is certain that not all people infected with acute diarrhea went to the Sino-Gabonese Friendship Hospital in Franceville between January 2021 and December 2023 for treatment. This could affect the actual prevalence values of this disease in Franceville. It is in this spirit that the results of our study can therefore be interpreted.

Conclusion

In this study, cases of acute diarrhea were more frequently recorded in children aged one to five years. This shows that this age group should receive special attention in terms of nutrition, hygiene, and adequate medical monitoring, both in rural and urban areas. As diarrheal diseases are silent killers, it is advisable to develop a system for early detection and surveillance in both children and adults. In addition, preventive measures for acute diarrhea should include a healthy diet and the promotion of fruit and/or vegetable consumption after proper washing.

Acknowledgements

The authors express their sincere gratitude to all the participants at the Sino-Gabonese Friendship Hospital in Franceville (SGFHF) for their invaluable contributions to this study. The authors also thank the dedicated medical and administrative staff of the SGFHF for their unwavering support. Finally, the authors appreciate the insightful feedback provided by the anonymous reviewers, which greatly improved the quality of this manuscript

Data Availability Statement

Data supporting this study's findings are available from the corresponding author upon reasonable request.

Author’s contributions

HKM conceived this study, which was led by TNM. The study design and data analysis were a collaborative effort by TNM, GKM, NDMO, and SM, who also co-wrote the materials and methods section. HKM and BAPP prepared the initial manuscript draft. HKM, TNM, and AD then critically reviewed and revised the manuscript. All authors contributed to and approved the final submitted manuscript.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Ugboko HU, Nwinyi OC, Oranusi SU, Oyewale JO. Maladies diarrhéiques infantiles dans les pays en développement. Héliyon. 2020 avril 13;6(4):e03690. doi: 10.1016/j.heliyon.2020.e03690. Erratum dans: Heliyon. 2020 Jun 10;6(6): e04040. PMID: 32322707; Numéro PMCID: PMC7160433.

[2] Shine S, Muhamud S, Adanew S, Demelash A, Abate M. Prévalence et facteurs associés de diarrhée chez les enfants de moins de cinq ans dans la ville de Debre Berhan, Éthiopie 2018: une étude transversale. 2020 févr. 24;20(1):174. doi: 10.1186/s12879-020-4905-3. PMID: 32093615; PMCID: PMC7041267

[3] Srivastava S, Banerjee S, Debbarma S, Kumar P, Sinha D. Rural-urban differentials in the prevalence of diarrhoea among older adults in India: Evidence from Longitudinal Ageing Study in India, 2017-18. PLoS One. 2022 Mar 16;17(3): e0265040. doi: 10.1371/journal.pone.0265040. PMID: 35294455; PMCID: PMC8926275.

[4] Mebrahtom, S., Worku, A. et Gage, D.J. Le risque de l’eau, de l’assainissement et de l’hygiène sur la mortalité infantile liée à la diarrhée dans l’est de l’Éthiopie: un cas-témoins niché basé sur la population. BMC Public Health 22, 343 (2022). https://doi.org/10.1186/s12889-022-12735-7

[5] Mokomane M, Kasvosve I, de Melo E, Pernica JM, Goldfarb DM. Le problème mondial des maladies diarrhéiques infantiles: nouvelles stratégies de prévention et de prise en charge. Ther Adv Infect Dis. 2018 Jan;5(1):29-43. doi: 10.1177/2049936117744429. EPUB 2017 Déc 7. PMID: 29344358; Numéro PMCID: PMC5761924.

[6] Santosham M, Duggan CP, Glass R. Élimination de la mortalité diarrhéique chez les enfants - le dernier demi-million. J Glob Santé. 2019 Déc;9(2):020102. doi: 10.7189/jogh.09.020102. PMID: 31656597; PMCID: PMC6812939.

[7] Hou, G., & Ding, S. (2024). Decoding mechanisms of diarrhea induction by enteric viruses. Plos Pathogens, 20(8), e1012414.

[8] Sadiq K, Mir F, Jiwani U, Chanar S, Nathwani A, Jawwad M, Hussain A, Rizvi A, Muhammad S, Habib MA, Soofi SB, Ariff S, Bhutta ZA. Facteurs de risque de diarrhée aiguë chez les enfants âgés de 0 à 23 mois dans un district périurbain du Pakistan: une étude cas-témoins appariée. Int Santé. 2023 mai 2;15(3):281-288. doi: 10.1093/inthealth/ihac022. PMID: 35567792; PMCID: PMC10153564

[9] Shrestha, A., Six, J., Dahal, D. et coll. Association des pratiques de nutrition, d’eau, d’assainissement et d’hygiène avec l’état nutritionnel des enfants, les infections parasitaires intestinales et la diarrhée dans les zones rurales du Népal: étude transversale. BMC Public Health 20, 1241 (2020). https://doi.org/10.1186/s12889-020-09302-3.

[10] Imboumy-Limoukou, R.K., Lendongo-Wombo, J.B., Nguimbyangue-Apangome, A.F. et al. Paludisme sévère au Gabon: caractéristiques épidémiologiques, cliniques et de laboratoire à l’hôpital Amissa Bongo de Franceville. Malar J 22, 88 (2023). https://doi.org/10.1186/s12936-023-04512-7

[11] Carvajal-Vélez L, Amouzou A, Perin J, Maïga A, Tarekegn H, Akinyemi A, Shiferaw S, Young M, Bryce J, Newby H. Prise en charge de la diarrhée chez les enfants de moins de cinq ans en Afrique subsaharienne: la source de soins importe-t-elle? Une analyse du compte à rebours. BMC Santé publique. 2016 Aug 19; 16:830. doi: 10.1186/s12889-016-3475-1. PMID: 27538438; PMCID: PMC4991040.

[12] Areke AA, Enyew EB, Takele BA. Prévalence regroupée et facteurs associés de diarrhée chez les enfants de moins de cinq ans en Afrique de l’Est: une analyse de régression logistique à plusieurs niveaux. PLoS One. 2022 avril 14;17(4): e0264559. doi: 10.1371/journal.pone.0264559. PMID

[13] Birhan TA, Bitew BD, Dagne H, Amare DE, Azanaw J, Genet M, Engdaw GT, Tesfaye AH, Yirdaw G, Maru T. Prevalence of diarrheal disease and associated factors among under-five children in flood-prone settlements of Northwest Ethiopia: A cross-sectional community-based study. Front Pediatr. 2023 janv. 23; 11:1056129. doi: 10.3389/fped.2023.1056129. PMID: 36756237; PMCID: PMC9899848

[14] Central statistical agency [Ethiopia] et ICF International: Ethiopia demographic and health survey. In: Central Statistical Agency [Éthiopie] et ICF International. Addis-Abeba, Éthiopie et Calverton, Maryland, États-Unis (2016)

[15] Hussein H. Prévalence de la diarrhée et facteurs de risque associés chez les enfants de moins de cinq ans dans le nord du Nigéria: une analyse des données secondaires de l'enquête démographique et sanitaire du Nigéria 2013. Projet de diplôme non publié, Uppsala Universitet. 2017

[16] Melese M, Birhan TA, Simegn W, Adugna DG, Diress M, Getawa S, Azanaw J. Prevalence of Diarrhea, Intestinal Parasites, and Associated Factors Among Under-Five Children in Dabat District, Northwest Ethiopia: Multicenter Cross-sectional Study. Environ Health Insights. 2023 May 9; 17:11786302231174744. doi: 10.1177/11786302231174744. PMID: 37187706; PMCID: PMC10176582.

[17] Malek MA, Curns AT, Holman RC et coll. Hospitalisations associées à la diarrhée et au rotavirus chez les enfants de moins de 5 ans: États-Unis, 1997 et 2000. Pédiatrie 2006; 117:1887-92. 10.1542/peds.2005-2351

[18] Mahmud I, Das S, Khan SH, Faruque ASG, Ahmed T. Gender disparity in care-seeking behaviours and treatment outcomes for dehydrating diarrhoea among under-5 children admis to a diarrhoeal disease hospital in Bangladesh: an analysis of hospital-based surveillance data. BMJ Ouvert. 2020 septembre 3;10(9): e038730. doi: 10.1136/bmjopen-2020-038730. PMID: 32883737; PMCID: PMC7473626.

[19] Getahun, W., Adane, M. Prévalence de la diarrhée aiguë et des facteurs associés à l'eau, à l'assainissement et à l'hygiène (WASH) chez les enfants de moins de cinq ans dans la ville de Woldia, région d'Amhara, nord-est de l'Éthiopie. BMC Pediatr 21, 227 (2021). https://doi.org/10.1186/s12887-021-02668-2

[20] Heylen E, Batoko Likele B, Zeller M, Stevens S, De Coster S, Conceição-Neto N, et coll. Rotavirus surveillance in Kisangani, the Democratic Republic of the Congo, reveal a high number of unusual genotypes and gene segments of animal origin in non-vaccinated symptomatic children. PLoS One. 2014; 9(6):E100953. doi: 10.1371/journal.pone.0100953.

[21] Sangaji MK, Mukuku O, Mutombo AM, Mawaw PM, Swana EK, Kabulo BK, et coll. Epidemiological and clinical study of rotavirus acute diarrhea in infants at the Jason Sendwe hospital Lubumbashi, Democratic Republic of Congo. Pan Afr Med J. 2015; 21:113.

[22] Saha J, Mondal S, Chouhan P, Hussain M, Yang J, Bibi A. Occurrence of Diarrheal Disease among Under-Five Children and Associated Sociodemographic and Household Environmental Factors: An Investigation Based on National Family Health Survey-4 in Rural India. Enfants (Bâle). 2022 mai 3;9(5):658. doi: 10.3390/enfants9050658. PMID: 35626835; PMCID: PMC9139802.

[23] Terefe B, Jembere MM, Assimamaw NT. Access to drinking safe water and its associated factors among households in East Africa: a mixed effect analysis using 12 East African countries recent national health survey. J Health Popul Nutr. 2024 May 24;43(1):72. doi: 10.1186/s41043-024-00562-y. PMID: 38790067; PMCID: PMC11127454.

[24] Nengminza Sangma, Risa Vernette [1], Rasania, Saskatchewan [2]; Prasuna, JG [3]; Das, Ranjan [3]; Jaïs, Manoj [4]. Variation saisonnière des maladies diarrhéiques et de la qualité de l'eau potable dans une colonie de réinstallation à Delhi, en Inde: Une étude transversale communautaire. Revue indienne de santé publique 65(4): p. 387-390, octobre-décembre 2021. | DOI: 10.4103/ijph.IJPH_1214_20

[25] Hikal, W. M. (2020). Contamination parasitaire de l'eau potable et normes égyptiennes pour les parasites dans l'eau potable. Open Journal of Ecology, 10(1), 1-21.