Medical Research Archives

European Society of Medicine

OPEN ACCESS

Published: August 31, 2023

Citation: Sánchez Vega JT, Hernández López R, et al., 2023. Prevalence of Intestinal Parasites and Anthropometric Assessments in Preschool Children in a Region of the Istmo de Tehuantepec, Oaxaca, Mexico, Medical Research Archives, [online] 11(8).

https://doi.org/10.18103/mra.v11i8.4354

DOI
https://doi.org/10.18103/mra.v11i8.4354

ISSN: 2375-1924

RESEARCH ARTICLE

Prevalence of Intestinal Parasites and Anthropometric Assessments in Preschool Children in a Region of the Istmo de Tehuantepec, Oaxaca, Mexico.

José Trinidad Sánchez Vega, Doctor, Ricardo Hernández López*, Arnulfo Eduardo Morales Galicia, Hector Alejandro Cabrera-Fuentes, Doctor, Rodrigo Ildefonso Hernandez Covarrubias, Diego Ivan Sanchez Aguilar, Ana Citlali Tapia Castor, Eunice Galilea Morales Reyes, Brenda Coquis Tellez, Alondra Navez Valle.

***Corresponding author:** ricardohdezlpz@gmail.com

ABSTRACT:

Introduction: Intestinal parasites are infections that affect the digestive system, and can also affect other organs and tissues, they are transmitted by the fecal-oral route through the ingestion of cysts or eggs, present in contaminated food and beverages. In Mexico they are one of the main causes of morbidity and mortality in pediatric ages.

Objective: To determine the prevalence of intestinal parasites, their socioeconomic impact and their effect on growth and development in children from a population of the Isthmus of Tehuantepec, Oaxaca.

Material and Methods: An observational, descriptive and cross-sectional study was carried out in 589 children between 0-5 years of age, for 8 months, through medical examination, coproparasitoscopic studies and Méndez-Graffar questionnaire to their guardians. The EPI-INFO™ program, SPSS version 27.0 and EPIDAT 4.2 were used to perform the Chi^2 and Student's t statistical tests, with a 95% confidence interval.

Results: Of all the children studied, 81.49% had at least one parasitic agent, Blastocystis spp. (79%) the most prevalent. No significant difference was found between both sexes, but it was found in the age group, being the ages of 4-6 years the most parasitized in 100%. According to statistical tests, there is a direct relationship with parasitic load, development of nutritional alterations and socioeconomic conditions in which they grow.

Conclusion: The community studied presented a high prevalence of these diseases associated with socioeconomic factors, which is why the implementation of prevention programs for these infections is insisted on.

Keywords: Intestinal diseases, Preschool, Malnutrition, Mexico.

Introduction

Intestinal parasites are infections that deteriorate the digestive system and in some cases can spread, weaken other organs or tissues, their main transmission mechanism is fecal-oral by ingesting cysts or eggs present in contaminated soil and food (1). They can cause gastrointestinal symptoms such as diarrhoea, abdominal pain, nausea and vomiting, which can lead to malnutrition and anemia in the long term, as well as increasing susceptibility to other diseases (2).

Intestinal parasites are a significant public health problem in Latin America and Mexico due to their high prevalence, impact on the health of the population, and their socioeconomic implications. In Latin America, intestinal parasites are endemic and affect a large proportion of the population, especially in rural areas and marginalized communities; It is estimated that one in three people is infected and about 46 million children between 1 and 14 years of age are at risk of being infected by these agents, affecting their growth and cognitive development, causing the loss of the productive capacity of their up to 40% and the loss of approximately 39 million years of healthy life (3). The prevalence and incidence of parasitosis develops in areas with cultural disadvantages, difficult access to medical care, insufficient health education and conditions of poverty (4, 5).

The socioeconomic conditions in which pediatric patients develop play an integral role in the presence and repercussion of intestinal parasitosis (6). The interaction between the lack of resources, the lack of access to basic services and the lack of education can increase the vulnerability of children to these infections. The chronic presence of intestinal parasitosis in children relies on the long-term negative impact on their physical and cognitive development (7, 8). Malnutrition and anemia resulting from these infections can affect growth and school performance, perpetuating the cycle of poverty and inequality. Intestinal parasites impose a significant economic burden on health systems and labor productivity (2). The costs associated with the diagnosis, treatment and care of those affected, as well as the loss of work days due to the disease, can negatively affect the economy of families and communities (9, 10).

Among the main causes of morbidity and mortality in the Mexican Republic are intestinal infections, which predominate in the pediatric age, with a 50% possibility that a child dies before the age of 5. According to data from the National Health Information System (SINAIS), between 2011 and 2018 there were 6,031 deaths due to intestinal infectious diseases (11, 12). In 2018 alone, the percentage of deaths from these diseases was 502, of which 62.75% were boys or girls under one year of age and 37.25% from one to four years of age (11). In low-income Mexican families, a higher prevalence of parasitosis has been observed due to environmental (temperature, humidity, soil characteristics, etc.) and social factors, which determine the viability and maturity of the eggs, larvae, and cysts of the parasites. pathogens (12, 13).

The area of the Isthmus of Tehuantepec is located in the state of Oaxaca, in the south of the country. It is a rural area with limited access to public and health services, conditions of extreme poverty, where various factors (climatic, physical, biological, and social) determine the distribution, abundance, and persistence of certain parasitic agents (2, 14). Based on the above, and considering the little information related to the prevalence of these diseases and their association with socioeconomic and anthropometric variables, this study aims to find relevant information for the creation of preventive and health care programs, in addition to encouraging to carry out similar studies in different areas.

Material and Methods

TYPE AND STUDY POPULATION

An observational, descriptive and cross-sectional study was carried out in 589 children between 0-5 years of age, originally from Ixtepec, Oaxaca, for a period of 8 months from February to September 2021. Initially, the community authorities (mayor health and educational) of the objectives of this work, later informative talks were held with parents about the social and economic repercussions produced by these diseases, inviting them to participate with their children by filling out informed consent and socioeconomic questionnaire. where the data was collected for analysis. Initially, 622 children were considered; however, the sample size corresponds to the total number of records obtained on the days that the researchers applied the clinical questionnaire and sample collection.

Study area: Ixtepec, located southeast of the state of Oaxaca, in the region of the Isthmus of Tehuantepec, Mexico; north latitude of 16°34' and west longitude of 95°06'; Territorial extension of 229.6 km2, altitude 500 to 0 meters above sea level (asl), average north wind of 25 km/h, humidity 49% and with a population of 29,143 inhabitants (14).

INFORMATION SOURCES

Stratification was performed according to age

groups used in the health sector based on motor, cognitive, language/ communication, and social/emotional development:

- Group I: 0 to 6 months
- Group II: 6 to 12 months
- Group III: 12 to 24 months
- Group IV: 2 to 4 years
- Group V: 4 to 6 years

Socioeconomic clinical questionnaire: this questionnaire was applied to the guardians of minors, to record sex and age, housing conditions (floor material, access to drinking water, body hygiene, excreta disposal, garbage disposal and living with animals).

Determination of the socioeconomic stratum: the Graffar-Méndez Castellano method was used, which establishes the socioeconomic stratum of the families, considers four variables (profession of the head of the family, educational level of the mother, source of income of the family and living conditions). the House). All these variables correspond to a decreasing weight from one to five. The stratum is obtained with the weighted sum of the four variables, whose results place households in five unequal strata (15, 16):
Stratum I: households that have the best social conditions, that is, a high quality of life (upper class).

- Stratum II: has a good living condition, but not luxurious (upper middle class).
- Stratum III: demonstrates a much greater loss of quality of life than stratum I to II (middle class or lower middle class).
- Stratum IV: the families located here have critical problems (relative poverty), however, they do not show absolute needs, but they do show low quality of life conditions.
- Stratum V: families that are in a state of critical poverty.

Fecal matter test: fecal matter samples were requested from each of the children for 3 consecutive days, collecting the first stool of the day in sterile vials, in addition to being labeled with full name and date, to be processed by coproparasitoscopic examination (CPS) with the flotation centrifugal concentration method (FAUST) in order to be observed microscopically at 10x and 40x (17).

Anthropometric measurements: using calibrated scales and stadiometers (Seca®), the nutritional status of the minors was evaluated, considering indicators of weight, height and head circumference in relation to age, weight in relation to height and body mass index (BMI) in relation to age, taking as a reference the International Child Growth Standards of the World Health Organization (WHO) (18, 19).

STATISTIC ANALYSIS
The data obtained were recorded in a database in the EPI-INFO™ program, they were established in tables for their analysis, and using the SPSS version 27.0 and EPIDAT 4.2 program, percentages and proportions, Chi^2 and student's t were calculated, with an interval 95% confidence ($p<0.05$).

INCLUSION AND EXCLUSION CRITERIA
All minors between 0 and 5 years of age were included, whose parents will provide informed consent, a complete questionnaire and three properly labeled stool samples. Anyone who did not meet any of the previous criteria was excluded.

ETHICAL ASPECTS
The local committee approved that the study was carried out, and all the data is kept anonymous, in addition to taking into account the principles of the Declaration of Helsinki of the World Medical Association (20).

Results

Of the total population of children studied, 480 (81.49%) of these were positive with at least one parasitic agent in the CPS, the most prevalent being Blastocystis spp. (79%), followed by *Endolimax nana* (77.5%), *Cryptosporidium spp* (68%), *Retortamonas intestinalis* (67%), *Entamoeba coli* (59%), in descending order. Similarly, the presence of other agents was observed, although in a lower percentage, among which appear in decreasing order: *Chilomastix mesnilli*, *Iodamoeba butschlii*, *Giardia lamblia*, *Ascaris lumbricoides*, *Hymenolepis nana*, *Entamoeba histolytica/dispar*, *Trichuris trichiura* and *Enterobius vermicularis*. (**TABLE 1**)

TABLE 1. AGENTS PRESENT IN THE STUDY POPULATION			
PARASITIC AGENT	**PARASITIZED PATIENTS**		**TOTAL**
	No. of cases	**Percentage (%)**	
Blastocystis hominis	380	79	480 (100%)
*Endolimax nana**	372	77.5	
Cryptosporidium spp.	335	68	
*Retortamonas intestinalis**	320	67	
*Entamoeba coli**	285	59	
*Chilomastix mesnili**	262	54.5	
*Iodamoeba butschlii**	216	45	
Giardia lamblia	177	37	
Ascaris lumbricoides	157	33	
Hymenolepis nana	141	29.3	
Entamoeba histolytica/dispar	65	13.5	
Trichuris trichiura	44	9	
Enterobius vermicularis	33	7	

Table 1. Presents the agents found in decreasing order, including parasites and those of doubtful pathogenicity (commensals).
There was no significant statistical difference between both sexes (boys 82.49% - girls 80.15%) (**TABLE 2**).

TABLE 2. FREQUENCY OF INTESTINAL PARASITES BY SEX							
GENDER	**TOTALS**		**PARASITIZED PATIENTS**				**STATISTICAL CALCULATION**
			YES		**NO**		
	No. of cases	Percentage (%)	No. of cases	%	No. of cases	%	
Male	337	100	278	82.49	59	17.51	p-valor= 0.475
Female	252	100	202	80.15	50	19.85	
TOTAL	589		480		109		

The presence of intestinal agents was analyzed by age groups, observing that group 5 was 100% parasitized, followed later by the other groups with different percentages (**TABLE 3**).

TABLE 3. FREQUENCY OF INTESTINAL PARASITES BY AGE GROUP							
AGE GROUP	**TOTALS**		**PARASITIZED PATIENTS**				**STATISTICAL CALCULATION**
	No. of cases	**Percentage (%)**	**No. of cases**	**%**	**No. of cases**	**%**	
GROUP 1	92	100	41	44.5	51	55.5	Chi^2= 118.17 p-valor= 1.356
GROUP 2	112	100	86	76.7	26	23.3	
GROUP 3	117	100	102	87.1	15	12.9	
GROUP 4	164	100	147	89.6	17	10.4	
GROUP 5	104	100	104	100	0	0	
TOTAL	589		480		109		

According to the nutritional status of the 589 children studied, most (48.04%) were in a normal range for their age, and as for the group that presented the highest weighting between the relationship between their nutritional status and the presence of parasites. intestinal was in those with risk of malnutrition (88.88%). (**TABLE 4**)

In the weighting of the Graffar-Méndez Castellano method in the 480 children who were positive, none was found within groups I and II, with the majority being located in group IV (76.29%). Of the total

number of minors studied, it was evidenced that the majority have inadequate conditions in terms of infrastructure and hygienic habits, obtaining high figures related to the presence of enteric parasites. (**TABLE 5**)

TABLE 4. FREQUENCY OF INTESTINAL PARASITES BY NUTRITIONAL STATUS

NUTRITIONAL CONDITION	TOTALS		PARASITIZED PATIENTS				STATISTICAL CALCULATION
			YES		NO		
	No. of cases	Percentage (%)	No. of cases	%	No. of cases	%	
Obesity	47	100	37	78.72	10	21.28	Chi²= 9.668 p-valor =0.843
Overweight	106	100	94	88.67	12	11.33	
Normal	283	100	219	77.38	64	22.62	
Under weight	135	100	114	84.44	21	15.56	
Malnutrition risk	18	100	16	88.88	2	11.12	
TOTAL	589		480		109		

TABLE 5. RESULTS OF THE SOCIOECONOMIC QUESTIONNAIRE

EVALUATED PARAMETER	TOTALS		PARASITIZED PATIENTS				STATISTICAL CALCULATION
			YES		NO		
	No. of cases	Percentage (%)	No. of cases	%	No. of cases	%	
Socioeconomic stratum according to the Graffar-Méndez Castellano method							
Group I upper class	0	0	0	0	0	0	Chi2=cannot be performed*p-= 0.890
Group II upper middle class	0	0	0	0	0	0	
Group III middle class	121	100	107	88.42	14	11.58	
Group IV relative poverty	308	100	235	76.29	73	23.71	
Group V critical poverty	160	100	138	86.25	22	13.75	
Floor material conditions							
Appropriate	218	100	178	81.65	40	18.35	p-= 0.940
Inappropriate	371	100	302	81.40	69	18.6	
Access to drinking water							
Appropriate	501	100	408	81.43	93	18.57	p-= 0.932
Inappropriate	88	100	72	81.81	16	18.19	
Corporal hygiene							
Appropriate	165	100	134	81.21	31	18.79	p-= 0.913
Inappropriate	424	100	346	81.60	78	18.4	
Excreta disposal							
Appropriate	242	100	197	81.40	45	18.6	p-= 0.963
Inappropriate	347	100	283	81.55	64	18.45	
Garbage disposal							
Appropriate	194	100	158	81.44	36	18.56	p-= 0.982
Inappropriate	395	100	322	81.51	73	18.49	
Living with animals							
Positive	448	100	365	81.47	83	18.58	p-= 0.981
Negative	141	100	115	81.56	26	18.44	
TOTALS							
	589		480		109		

*If there is more than one value of 0

According to the results of the statistical tests, an association was reflected between the presence of parasitism and alteration of nutritional status, parasitism and socioeconomic stratum, parasitism and conditions in which the child develops (conditions of floor material, access to drinking water, body hygiene, elimination of excreta, coexistence with animals) obtaining a range of acceptance between variables with a degree of confidence of 95% ($p<0.05$).

Discussion

In this work it is observed that the deficiency of habits and resources such as: low socioeconomic stratum, bad hygienic habits, inadequate housing conditions, poor access to drinking water (21), poor disposal of excreta and garbage, as well as living with animals , influence the presence of parasitic agents in the general population, mainly in pediatric ages, in addition to a poor hygienic practice of breastfeeding and/or in the preparation of their food (2, 22), a fact for which we could explain the presence of parasitic agents in the early ages of life (23, 24).

The presence of intestinal parasites in children can be significantly influenced by socioeconomic factors (25), such as access to basic resources, level of education, quality of housing, and availability of medical care services, the same parameters that were evaluated in this study (26). The socioeconomic conditions in which a pediatric patient develops can affect the incidence, prevalence and consequences of intestinal parasitosis:

- ***Access to safe drinking water and sanitation***: Lack of access to safe drinking water and adequate sanitation is a common problem in rural and disadvantaged communities. Lack of safe drinking water contributes to the spread of intestinal parasites through consumption of contaminated water and lack of personal hygiene. Also, the lack of adequate sanitation facilities can increase exposure to parasites present in human faeces, further spreading the infection (21).
- ***Overcrowding and housing conditions***: Overcrowded conditions, common in unfavorable socioeconomic environments, can favor the transmission of enteroparasites due to close contact between individuals and the difficulty in maintaining personal and environmental hygiene (27). The lack of adequate ventilation and the accumulation of debris can create an environment conducive to its proliferation and persistence (23).
- ***Inadequate food and nutrition***: Families with low economic resources, a situation that is also predominant in rural areas, may face difficulties in accessing an adequate diet (28). Malnutrition and lack of adequate consumption make them more susceptible to parasitic infections and other etiologies such as bacterial and viral (29, 30, 31).
- ***Limited access to medical care***: Economic barriers can limit access to quality medical services, including the diagnosis and timely treatment of intestinal parasitosis. Lack of proper medical care can prolong the duration of the infection and increase the risk of complications (2, 5).

The increase in the number of parasitized cases as age increases, observed in the results, can be related to the psychomotor activities that the child develops, such as crawling and being in close and direct contact with the ground (32, 33). Likewise, an impact on the growth and development of the minors studied is observed, observing more than 20% with low weight and height, a situation also reported by other authors in similar populations (34).

One piece of data that is powerfully striking is the disproportion that exists in terms of the large number of agents found, in relation to the absence of clinical data; as well as the parasitic transition that has already been mentioned in other reports by other researchers, regarding the weighting of Blastocystis spp. on other agents such as Giardia lamblia (35, 36), Ascaris lumbricoides and Entamoeba histolytica/dispar. Without omitting that in this study, commensal agents or agents of doubtful pathogenicity predominated (37, 38).

Conclusion

This work is relevant because it reveals not only the prevalence of intestinal parasitosis in pediatric ages and the various factors that influence its presentation, generating important social and economic repercussions in their families, affecting the physical, nutritional and cognitive development of infants, which affects their growth and development. It should be considered that in the Mexican Republic there is a great diversity of climates and soils, so it is not possible to extrapolate the general frequency data to any other region of the country; however, the figures reported here serve as a frame of reference. Intestinal parasites tend to disproportionately affect the most vulnerable populations, exacerbating existing inequalities in society. According to our results, people with low income and limited access to health services have a higher risk of contracting and suffering the consequences of these infections. In

addition, affected pediatricians may have difficulty reaching their full educational and future employment potential.

The importance of addressing intestinal parasitosis in Latin America and Mexico lies in the need to implement comprehensive interventions that address both medical and socioeconomic aspects. This implies improving access to health services and being truly considered as emerging and re-emerging infectious causes, promoting education on hygiene practices, guaranteeing the supply of drinking water and improving housing conditions in vulnerable communities. Addressing this problem requires a multidisciplinary approach and collaboration between the health, education and social development sectors to reduce the burden of these infections and improve the quality of life of affected communities.

The common underdiagnosis of enteroparasitosis in pediatric patients is a topic of great importance in public health and in clinical medicine for several reasons demonstrated in this study, children are especially susceptible to parasitic infections due to their lower personal hygiene. The lack of diagnosis and adequate treatment can lead to serious complications, in addition to the fact that they can be asymptomatic carriers and contribute to the spread of the parasites through their environment, including other children and members of the family and community. Discussing and addressing the issue of underdiagnosis of enteroparasitosis in pediatric patients is essential to protect the health and well-being of children, prevent the spread of infections, reduce the economic burden, and promote effective prevention strategies.

It is essential to address the socioeconomic dimensions together with medical and preventive measures to reduce the burden of intestinal parasitosis in rural and disadvantaged communities. Public health strategies must take these complex interactions into account in order to achieve a comprehensive and effective approach to the prevention and control of intestinal parasitosis in the pediatric population.

Declaration of conflicts of interest

It should be noted that there is no conflict of interest between the authors for the publication, no financial compensation is sought, it has not been proposed in another journal and it has been authorized and read by all the authors.

Financing Statement

This manuscript has been financed by the Faculty of Medicine of the National Autonomous University of Mexico (UNAM).

Acknowledgements

To Mr. Margarito Meza Salazar and Ms. Maricela Espinosa, for their support in preparing the laboratory material used in this study.

References

1. Navone GT, Zonta ML, Cociancic P, Garza M, Gamboa MI, Giabelluca LA. Cross-sectional study of intestinal parasitism in Argentinean child populations. *Rev Panam Salud Publica*. 2017: 41:e24. https://doi.org/10.26633/RPSP.2017.24
2. Sánchez JT. Medical Parasitology. Mendez Editores; 2023.
3. Organización Panamericana de la Salud. Operational Guidelines for the Implementation of Deworming Activities: A Contribution to the Control of Soil-Transmitted Helminth Infections in Latin America and the Caribbean. Disponible en: https://iris.paho.org/handle/10665.2/31345 . Accessed verified on July 21, 2023.
4. Organización Panamericana de la Salud. Geohelminthiasis in the Americas for public health workers. Disponible en:https://www3.paho.org/hq/index.php?option=com_content&view=article&id=14747:soil-transmitted-helminthiasis-americas&Itemid=0&lang=es#gsc.tab=0 Accessed verified on July 21, 2023.
5. Becerril M. Medical Parasitology. 6th ed. Mcgraw Hill. 2023
6. Alvarado B, Vásquez L. Social determinants, feeding practices and nutritional consequences of intestinal parasitism in children from 7 to 18 months of age in Guapi, Cauca. *Biomédica*, 2006 *26*(1); 81-87. https://pubmed.ncbi.nlm.nih.gov/16929906/
7. Espinoza D, Cristóbal I, Odalis G, Henry Cabrera Medina. Prevalencia de enteroparasitosis y factores asociados en niños escolares de la unidad educativa "Eudófilo Álvarez" cantón Sucúa, comunidad de Cumbatza. *Panorama Médico*. 2014 8(4): 04-11. https://dspace.ucacue.edu.ec/handle/ucacue/833
8. Arrieta S, Brito V, Chavez E, Iñiguez L. Parasitosis intestinal en una población de 5 a 14 años que acuden a unidades educativas escuelas colegios públicos de la ciudad de Riobamba. *European Scientific Journal, ESJ*, 2017 *13*(30); 11-11. https://eujournal.org/index.php/esj/article/view/10073
9. Navone G, Gamboa M, Oyhenart E, Cesani M, Zonta M, Castro L, Sicre. Estado nutricional y parasitosis intestinales en niños residentes en zonas urbana, periurbana y rural del partido de Brandsen (Buenos Aires, Argentina). *Revista Argentina de Antropología Biológica*, 2007 9(2), 105-121. http://sedici.unlp.edu.ar/handle/10915/6008
10. Cruces Y. Prevalencia y factores de riesgo asociados a desnutrición infantil, distrito Túpac Amaru Inca-Pisco. *Revista de la Facultad de Medicina Humana*, 2014 *14*(1); 28-34. https://revistas.urp.edu.pe/index.php/RFMH/article/view/965
11. Sistema de Información de la Secretaría de Salud. Datos de Salud. Disponible en:http://sinaiscap.salud.gob.mx:8080/DGIS/ . Accessed verified on July 21, 2023.
12. Ávila E, Ávila A, Araujo JM, Villarreal A, Douglas T. Factors Associated with intestinal parasitosis in children from the outpatient clinic of a care hospital. *Revista Mexicana de Pediatría*. 2007 74(1):5-8. https://www.medigraphic.com/pdfs/pediat/sp-2007/sp071b.pdf.
13. Organización Mundial de la Salud. WHO's first ever global estimates of foodborne diseases find children under 5 account for almost one third of deaths. Disponible en:https://www.who.int/news/item/03-12-2015-who-s-first-ever-global-estimates-of-foodborne-diseases-find-children-under-5-account-for-almost-one-third-of-deaths Accessed verified on July 21, 2023.
14. Instituto Nacional de Estadística y Geografía (INEGI). Disponible en: https://www.inegi.org.mx/. Accessed verified on July 21, 2023.
15. Méndez Castellano, H. Society and Stratification. Graffar-Méndez Castellano method. Caracas: Fundacredesa; 1994.
16. Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL). Disponible en:https://www.coneval.org.mx/Medicion/Paginas/Pobrezalnicio.aspx . Accessed verified on July 21, 2023.
17. Faust EC, D'Antoni JS, Odom V, Miller M, Peres C, Sawitz W. A critical study of clinical laboratory techniques for the diagnosis of protozoan cysts and helminth eggs in feces. *American Journal of Tropical and Hygiene*. 1938 (2): 1-18, 669-683.https://doi.org/10.4269/ajtmh.1938.s1-18.169.
18. Organización Mundial de la Salud. Who International Child Growth Standards.Disponible en:https://www.who.int/tools/child-growth-standards. Accessed verified on July 21, 2023.
19. Organización Mundial de la Salud. WHO child growth standards: growth velocity based on weight, length and head circumference: methods and development. Disponible

en:https://apps.who.int/iris/handle/10665/44026. Accessed verified on July 21, 2023.
20. World, A.M. Declaration of Helsinki of the World Medical Association. Ethical principles for medical research in human beings. (2008) In Anales del Sistema Sanitario de Navarra (Vol. 24, No. 2, pp. 209-212).
21. Sanchez JT, Tay J, Robert L, Romero R, Ruiz, Rivas C. Frequency of intestinal parasites in irregular human settlements.*Revista Facultad de Medicina UNAM*. 2000 43(3):80-83. https://www.medigraphic.com/pdfs/facmed/un-2000/un003c.pdf
22. Solano L, Acuña I, Barón MA, Morón De Salim A, Sánchez A. Intestinal parasitic infestation and others infectious backgrounds influence in the anthropometric nutritional status of children in poverty. *Parasitología latinoamericana*. 2008 63(1-2-3-4): 12-19. https://dx.doi.org/10.4067/S0717-77122008000100003
23. Soriano SV, Manacorda AM, Pierangeli NB, Navarro MC, Giayetto AL, Barbieri LM. Intestinal parasites and their relationship with socioeconomic factors and habitat conditions in children from Neuquén, Patagonia, Argentina. *Parasitología Latinoamericana*. 2005 60(3-4):154-161. https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0717-77122005000200009.
24. Rodríguez E, Mateos B, González JC, Aguilar YM, Alarcón E, Mendoza AA. Parasitic transition to Blastocystis hominis in children from the Central Zone of the State of Guerrero, Mexico. *Parasitología Latinoamericana*. 2008 63(1-2-3-4): 20-28. https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0717-77122008000100004.
25. Oyhenart E, Garraza M, Bergel M, Torres M, Castro E, Luis M, Navone T. Caracterización del estado nutricional, enteroparasitosis y condiciones socio-ambientales de la población infanto-juvenil del partido de La Plata. *Revista argentina de antropología biológica*, 2013 *15*(1); 47-60. https://revistas.unlp.edu.ar/raab/article/view/691
26. Cardona J, Rivera Y, Carmona J. Salud indígena en el siglo XXI: parásitos intestinales, desnutrición, anemia y condiciones de vida en niños del resguardo indígena Cañamomo-Lomaprieta, Caldas-Colombia. *Medicas UIS*, 2014 *27*(2), 29-39. https://revistas.uis.edu.co/index.php/revistamedicasuis/article/view/4322
27. Villa A, Kelly S. Determinación de la prevalencia de parásitos intestinales en niños de 3 a 5 años y los factores sociosanitarios asociados, en el distrito de Jacobo Hunter-Arequipa. Doctoral dissertation, Universidad Nacional de San Agustín. *2017*.
28. Bonilla C. Asociación entre estado nutricional y la presencia de parasitosis intestinales en niños preescolares del Colegio San Francisco de Asís, Barrio el Codito y Bella Vista, Bogotá DC. 2009 58-79. http://hdl.handle.net/10554/8330
29. Manrique A, Fred G, Suescún S. "Prevalencia de parasitismo intestinal y situación nutricional en escolares y adolescentes de Tunja." *CES Medicina*, (2011 25(1): 20-30. Prevalencia de parasitismo intestinal y situación nutricional ...SciELO (Colombia)http://www.scielo.org.co › scielo
30. Acuña A, Álvarez R. "Parasitosis intestinales y estado nutricional en una escuela de Montevideo." *Montevideo: UdelaR, Espacio Interdisciplinario* (2012). https://www.colibri.udelar.edu.uy/jspui/bitstream/20.500.12008/7582/1/parasitosis_final.pdf
31. Salas K, Barrios A, Zapata C, Galofre M, Gonzales C, Macías J. Prevalencia De Parasitismo Intestinal Y Su Asociacion Con El Estado Nutricional En Niños Del Municipio De Galapa, Atlántico-Colombia 2018 14(36); 12-24. https://eujournal.org/index.php/esj/article/view/11595
32. Romero R, Tay J, Gutierrez M, Gonzalez A, Sanchez JT. Repercussion of Geohelminthiasis in Individual Development and Growth Rate. XI International Congress of Clinical Chemistry: Proceedings. Vienna, Austria. August 30-September 5, 1982: 371-382.
33. Zonta ML, Navone GT, Oyhenart EE. Intestinal parasites in preschool and school age children: Current situation in urban, periurban and rural populations in Brandsen, Buenos Aires, Argentina. *Parasitología latinoamericana*.2007 62(1-2):54-60. http://dx.doi.org/10.4067/S0717-77122007000100009.
34. Zuta N, Rojas AO, Mori MA, Cajas UV. Impact of school health education, overcrowding and intestinal parasites in preschool children. *Comunic@ción*. 2019 10(1): 47-56. http://www.scielo.org.pe/scielo.php?script=sci_arttext&pid=S2219-71682019000100004
35. Giraldo JM, Lora F, Hena LH, Mejia S, Gonzalez JE. Prevalence of giardiasis and intestinal parasites in preschool children from homes attended in a state program in Armenia, Colombia. *Revista de Salud Pública*. 2005 *7*(3):327-338.

http://www.scielo.org.co/pdf/rsap/v7n3/v7n3a08.pdf.

36. Morales A, Restrepo L, Ramírez L, Villa A. . Giardiasis y desnutrición infantil. *Investigar y Aprender*, 2016 (1); 61-71. https://doi.org/10.22209/ia.n1a06 http://fer.uniremington.edu.co/ojs/index.php/IA/article/view/205/210
37. Mazariego AMÄ, Alejandro GMR, Ramirez ASJ, Trujillo MG.Prevalence of intestinal parasites in children from rural day care centers in Chiapas. *Enfermedad Infecciosas y Microbiología Clínica*. 2020 40(2):43-46. https://www.medigraphic.com/pdfs/micro/ei-2020/ei202b.pdf.
38. Arias J, Guzmán G, Lora F, Torres E, Gómez E. Prevalencia de protozoos intestinales en 79 niños de 2 a 5 años de edad de un hogar infantil estatal en Circasia, Quindío. *Infectio*, 2010 *14*(1), 31-38. https://www.sciencedirect.com/science/article/pii/S0123939210700904