



PREVALENCE OF TAENIA SOLIUM TAENIASIS AMONG INHABITANTS OF TWO RURAL COMMUNITIES OF JOS SOUTH LOCAL GOVERNMENT AREA, PLATEAU STATE, NIGERIA

Kum, Folakemi O¹., Adeiyongo, Celine M². and Yohanna, Jael A².

¹Department of Food Science Technology, Plateau State Polytechnic, Barkin Ladi

²Department of Zoology, University of Jos, Jos, Nigeria

Corresponding Author's email: oluwafolakemikum@gmail.com; 08036058724

Abstract

Taenia solium taeniasis is an intestinal parasitic infection that is caused by the cestode Taenia solium, also known as the pork tapeworm. The infection causes serious public health and socioeconomic problems in endemic regions of the world. The prevalence of Taenia solium was investigated in Gyel and K Vom, two rural communities in Jos South Local Government Area, Plateau State, Nigeria, in 2024. A total of one hundred and forty one (141) stool samples were collected and analyzed for taeniasis using the Copro Antigen Enzyme Linked Immunosorbent Assay (Copro Antigen ELISA) technique and a prevalence of 4.96% (7 out of 141) was observed. The age group with the highest prevalence of infection (8.82%) was 51 years and above, and the lowest prevalence of 3.26% was observed in the 21 to 30 year old group where 1 person out of 31 individuals was positive. Females had a higher prevalence (7.58%) of infection than males (2.67%), but neither age nor gender had a significant association with infection in the study area. In addition, there was no other risk factor that was significantly associated with infection. In order to reduce the prevalence of this infection in the study area, preventive measures such as proper sewage disposal, intensive method of pig rearing, thorough cooking of pork before consumption and mass enlightenment campaigns are suggested.

Key words: Human taeniasis, Prevalence, Pork tapeworm, Plateau State

Introduction

Taeniasis is a parasitic disease of the human intestinal tract caused by the adult stage of the closely related tapeworms *Taenia solium*, *T. saginata* and *T. asiatica*. *Taenia solium* is a cestode parasite infecting both humans and pigs, and prevailing mostly in developing countries (Scuitto et al., 2000). Gweba et al. (2010) stated that *Taenia solium* is an important parasite that causes serious public health and socioeconomic problems in endemic regions of the world. Mogaji et al. (2016) also stated that taeniasis is a neglected zoonotic disease caused by segmented parasitic tapeworms belonging to the family Taeniidae and subclass Cestoda. According to the World Health Organization (WHO, 2018), taeniasis is an intestinal infection caused by adult tapeworms, however only *Taenia solium* causes major health problems. According to Lightowers, et al. (2023), human taeniasis is caused by 3 *Taenia spp.*, including *T. solium*, *T. saginata* and *T. asiatica*, however, only *T. solium* causes neurocysticercosis and warrants a public health intervention. They also explained that *Taenia saginata* in particular is widely distributed in areas where *T. solium* is prevalent, hence diagnostic tests for *T. solium* taeniasis must differentiate *T. solium* from infection with other *Taenia* species.

Poor sanitary conditions, free roaming of domestic pigs and lack of awareness of the disease play an important role in the perpetuation of *T. solium* taeniasis and cysticercosis in Africa (Assana et al., 2013). Humans contract Taeniasis after ingesting viable Cysticerci in raw or undercooked pork, beef or dog meat. *Taenia solium* infection is related to poverty, absence of latrines as well as free access, by roaming pigs, to human faeces deposited indiscriminately on



heaps and farmlands (Adesokan & Adesoye, 2019). The spread of infection could also be enhanced by poor hygiene, inadequate sanitation and the use of untreated or partially treated waste water in agriculture.

Adult tapeworms live in the human small intestine and usually produce no symptoms (Arora & Arora, 2012) but at times they may cause vague abdominal discomfort, indigestion, persistent diarrhoea or diarrhoea alternating with constipation and loss of appetite. *Taenia solium* is endemic in Africa, Central and South America, Southeast Asia, India, The Philippines, Eastern Europe and China. It is cosmopolitan and has a worldwide distribution and infection rates are high in areas with large faecal human contamination and free grazing of pigs (Edia – Asuke, 2015). Human cases of taeniasis and cysticercosis are often linked to various factors including consuming undercooked or raw pork infested with *T. solium* cysticerci, open defaecation, having free foraging pigs at home, use of sewage sludge as fertilizer on pastures and use of open water sources such as rivers, streams, wells and lakes without proper boiling or decontamination (Phumrattanapapri *et al.*, 2024).

Zulu *et al.* (2023) further emphasized that *T. solium* is common in Africa, Asia and Latin America especially in areas where pigs are reared under free-ranging conditions, where pork is eaten and where hygiene is limited. Acosta Soto *et al.* (2021) in a cross sectional study conducted among 680 children from a rural primary school in Gakenke district in Northern Province of Rwanda, obtained a total of 0.3% (2 out of 680) positivity of taeniasis. They also obtained a seroprevalence of human cysticercosis of 13.3% (76 out of 572) among the children. The risk factors that were significantly associated with the prevalence of *Taenia solium* taeniasis in the study by Acosta Solo *et al.* (2021) included sex, where infection was significantly higher in females (16.6%) than in males (9.9%) with a p value of 0.019. Vaidya *et al.* (2018) conducted a study on the scenario of human taeniasis in Maharashtra State, India over a period of 7 years, from 2010 to 2017 and got a prevalence of 3.15% by ELISA and 2.04% by PCR techniques.

Li *et al.* (2021) carried out a study to determine the prevalence of *T. solium* taeniasis in a village in Liangshan prefecture, Sichuan province in China. Out of the 389 study subjects, 194 (49.9%) were positive for taeniasis. Children less than 16 years of age had a higher prevalence (8.8%) than older individuals (2.5%).

Materials and Methods

Jos-South Local Government Area has its headquarters located in Bukuru town at 9°48'00"N 8°52'00"E. It occupies a total area of 510.4km² (1,971 sqm). (ACRESAL) as at the 2006 Census, the total population was 506, 716. Jos South LGA has an average temperature of 28^o C and a total area of 510 square kilometers. The region experiences two distinct seasons, which are the dry and the wet seasons with an annual total of 1750mm of precipitation. The primary occupations of the inhabitants are agriculture and mining.

Advocacy Visits

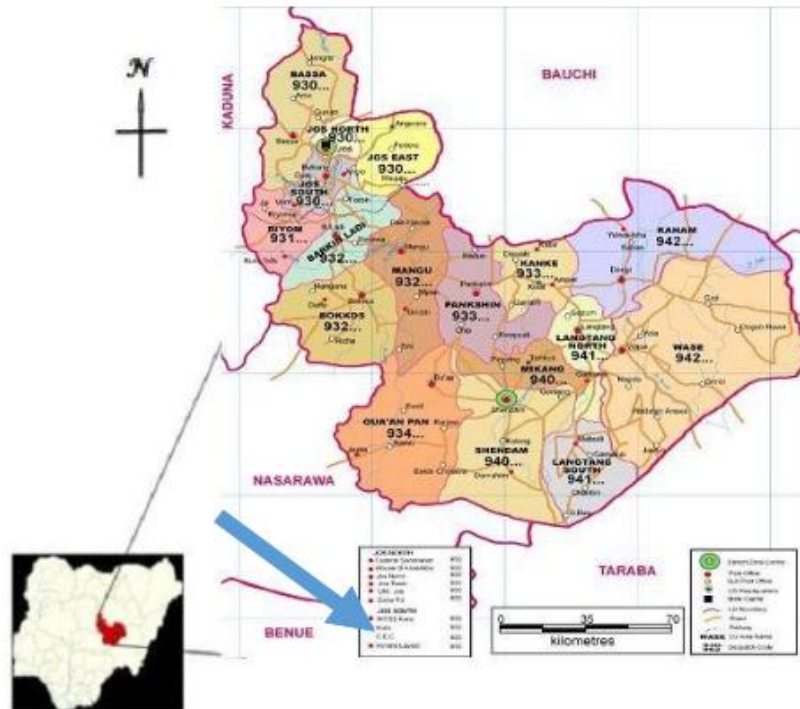
Pre-sampling advocacy visits were made to the study areas and the district/village heads were met to enlighten them on the proposed study including benefits to their communities.



Figure 1: Map of Plateau State showing the study area

Source: (<https://openi.nlm.nih.gov>)

Date of Retrieval: 7/3/2025



Ethical Clearance

Ethical clearance was obtained from the Plateau State Ministry of Health (Clearance number: MOH/MIS/202/VOL.T/X) and this was presented at the Health Department of Jos South Local Government Council. Permission was sought and obtained from the local authorities, which included district heads or ward heads. Informed consent of willing individuals was sought to collect their faecal samples.

Collection of Faecal Samples

Each consenting individual was given a clean, wide screw – capped container and instructed to pass a small quantity of stool (about 5 g) into the container. All specimen containers were properly labelled and then transported in cool insulated boxes to the Parasitology Laboratory of College of Veterinary and Medical Laboratory Technology of the National Veterinary Research Institute (NVRI), Vom for further analysis.

Detection of *Taenia solium* Taeniasis from faecal samples using Coproantigen enzyme linked immunosorbent assay (ELISA) technique

The Coproantigen ELISA technique is a more sensitive procedure than microscopy. Faecal samples that were preserved in 10% formalin were used for this technique using a commercially prepared Kit produced by the Institute of Tropical Medicine Antwerp, Belgium. It is a polyclonal-monoclonal based coproantigen ELISA for the diagnosis of taeniasis.

Pre-treatment of stool samples was done by mixing equal volumes of Phosphate Buffered Saline (PBS) and faecal sample. One (1)g of stool was picked with a Pasteur pipette and put into a falcon tube then 1ml of PBS was added. Soaking was done for 1hour with intermittent shaking. The stool and PBS were spanned for 30 minutes at 2000g after which 100µl of supernatant was drawn with Pasteur pipette and put in the appropriate well in the plate. The plates were then coated following this procedure. Capturing antibody (Hyper Immune Rabbit Anti-*Taenia* Immunoglobulin G Polyclonal Anti-body) in coating buffer at concentration of 2.5 µg/ml. One hundred(100) µl were



put in all wells except that of substrate control. Incubation was done at 31°C for 1 hour while shaking the plates. Washing was done once using washing buffer (PBS and Tween 20 0.05 %). Blocking was the next step, this was done by using washing buffer and 2% New Born Calf Serum (NBCS). One hundred and fifty (150) µl was dispensed in each well. Then incubation was done at 37°C for 1 hour while shaking. The plates were then emptied but not washed, then 100 µl of pre-treated faecal samples were dispensed into each designated well while blocking buffer was dispensed into the substrate control and conjugate control wells. Plates were incubated at 37°C for 1 hour while shaking. Washing was done 5 times using the washing buffer.

The next step was the detection step, in which the detecting antibody (Hyper Immune Rabbit Anti-Taenia 1g G Polyclonal Antibody) in blocking buffer was dispensed (100 µl) into each well, except the substrate control well. Only the blocking buffer was dispensed into the substrate control well. The plates were again incubated at 37°C for 1 hour while shaking. Washing was done 5 times using the washing buffer.

100µl of dilute peroxidase labelled streptavidin (1 in 10,000) in blocking buffer was dispensed into each well except the substrate control well. Only the blocking buffer was dispensed into the substrate control well. The plates were again incubated at 37°C for 1 hour while shaking. Washing was done 5 times using washing buffer.

The substrate made up of Orthophenylenediamine (OPD) in Phosphate Citrate Buffer was used for the next step. One tablet of OPD was dissolved in 10ml of phosphate citrate buffer in a dark recipient. Just before putting the substrate on the plate, 10µl of Hydrogen Peroxide was added, then 100µl of the substrate was dispensed into each well, incubation was done at 30°C in the dark for 15 minutes without shaking. To stop the reaction, 50µl of 4N Sulphuric Acid (H₂S₀₄) was dispensed in all wells. Reading was done at wavelength 492 and 655nm

Data collection

Demographic data of participants was collected using a structured questionnaire.

Statistical Analysis

Statistical analysis was done using SPSS version 25, significance was determined at $p < 0.05$.

Results

The prevalence of *Taenia. solium* Taeniasis in relation to age in Jos South Local Government Area is shown on Table 1. A total of 141 individuals were sampled and there were 5 different age groups.

The prevalence of infection was 4.96% as 7 individuals were infected out of 141 individuals. The age group of 51 years and above had the highest prevalence of 8.82% because 3 individuals out of 34 were positive for *T. solium* infection. This was followed by the 11 to 20 years old group where 2 (5.26%) out of 38 individuals were infected. Next, a prevalence of 4.00% was observed among individuals aged 31 to 40 years where 1 person out of 25 was positive, and the lowest prevalence of 3.26% was observed in the 21 to 30 year old group where 1 person out of 31 individuals was positive. There was zero (0) prevalence in the 41 to 50 year old group. P value was 0.734 thus, the difference was statistically not significant at $p < 0.05$.



Table 1 : Prevalence of *Taenia solium* Taeniasis Detected using Coproantigen ELISA Technique in Relation to Age in Jos South Local Government Area, Plateau State.

AGE (Years)	Number Examined	Number/ (%) Positive
11–20	38	2(5.26)
21–30	31	1(3.26)
31–40	25	1(4.00)
41–50	13	0(0.00)
51 and above	34	3(8.82)
Total	141	7(4.96)

$\chi^2 = 2.007$; df =4; P= 0.734;

The prevalence of *T. solium* Taeniasis in relation to gender in Jos South Local Government Area is presented on Table 2. Out of the 75 males sampled, 2 (2.76%) were positive for *T. solium* Taeniasis, while 5 (7.58%) out of 66 females were positive. The p value was 0.181 and difference was not significant statistically at p <0.05.

Table 2 : Prevalence of *Taenia solium* Taeniasis Detected using Coproantigen ELISA Technique in Relation to Gender in Jos South Local Government Area of Plateau State.

Gender	Number Examined	Number/ (%) Positive
Male	75	2(2.67)
Female	66	5(7.58)
Total	141	7(4.96)

$\chi^2 = 1.793$; P = 0.181; df =1

Table 3 shows the risk factors that are associated with *Taenia solium* Taeniasis in Jos South Local Government Area. Of all the risk factors, none of them was significantly associated with infection at p < 0.05, all the p values were greater than 0.05



Table 3: Risk Factors Associated with Prevalence of *Taenia solium* Taeniasis Detected Using Coproantigen ELISA Technique in Jos South Local Government Area of Plateau State.

Variable	Number Examined	Number/ (%) Positive	p-value
Occupation			0.728
Farmers	12	1(8.33)	
Civil Servants	7	0(0.00)	
Housewives	8	1(12.5)	
Students	17	2(11.76)	
Others	97	3(3.09)	
Total	141	7(4.96)	
Presence of Toilet in the Home			0.774
Yes	117	5(4.27)	
No	24	2(8.33)	
Total	141	7(4.96)	
Type of Toilet System			0.784
Pit Latrine	21	2(9.52)	
Water system	94	3(3.19)	
Other	4	0(0.00)	
No response	24	2(8.33)	
Total	141	7(4.96)	
Rearing of Pigs in/around home			0.703
Yes	25	3(12.00)	
No	116	4(3.45)	
Total	141	7(4.96)	
Method of Pig Rearing			0.318
Extensive (roaming)	4	1(25.00)	
Intensive (penned/tied)	24	2(8.33)	



No response	113	4(3.54)	
Total	141	7(4.96)	
Presence of Vegetable Farm near Pigsty			0.428
Yes	25	1(4.00)	
No	103	2(1.94)	
No Response	13	4(30.77)	
Total	141	7(4.96)	
Consumption of Pork			0.135
Yes	77	3(3.90)	
No	64	4(6.25)	
Total	141	7(4.96)	
How is Pork Prepared?			0.287
Boiled only	7	0(0.00)	
Boiled and Fried	74	3(4.05)	
Roasted	1	0(0.00)	
Other	3	0(0.00)	
No response	56	4(7.14)	
Total	141	7(4.96)	
Regular Deworming			0.957
Yes	96	5(5.21)	
No	44	2(4.55)	
No response	1	0(0.00)	
Total	141	7(4.96)	
When last were you Dewormed?			0.620
0–6 months ago	48	3(6.25)	
7–12 months ago	11	0(0.00)	
More than 1 year ago	11	0(0.00)	
Cannot remember	78	2(2.56)	



No response	43	2(4.65)	
Total	141	7(4.96)	
Knowledge of Taeniasis			0.171
Yes	3	1(33.33)	
No	138	6(4.35)	
Total	141	7(4.96)	
Do you know how it is contracted?			0.739
Yes	1	0(0.00)	
No	140	7(5.00)	
Total	141	7(4.96)	
Do you know how to prevent it?		-	
Yes	0	0(0.00)	
No	141	7(4.96)	
Total	141	7(4.96)	

Discussion

In this study, the prevalence of human *Taenia solium* taeniasis was 4.96% (7 out of 141 individuals). This is much lower than what was recorded by Li *et al.* (2021) who observed a prevalence of 49.9% in a village in Liangshan prefecture, Sichuan province in China, 40.9% reported by Mogaji *et al.* (2016) in Odeda in Ogun State, Nigeria and 14.3% recorded by Edia-Asuke *et al.* (2015) in Kaduna, Nigeria. The prevalence of 1.4% recorded by Acosta Soto *et al.* (2021) in a rural area of North Rwanda and 1.38% reported by Anyin *et al.* (2017) in Jos South LGA, Plateau State were lower than what was recorded in the present study. Prevalence of infection in relation to age was not statistically significant in the study area even though the oldest age group of 51 years and above had the highest prevalence of 8.82%. This implies that any individual of any age can be infected so long as infected pork is consumed. Mogaji *et al.* (2016), also stated that age was not significantly associated with infection.



Conclusion

Taenia solium taeniasis is a parasitic infection that is easily preventable. When inhabitants of rural communities are enlightened on the means or route of infection, they are able to avoid infection, therefore, it is important to carry out mass enlightenment campaigns regularly on the dangers of *Taenia solium* taeniasis. Meat inspection by veterinary officers for cysticerci should be enforced. Pork should be thoroughly cooked in order to kill cysticerci which may be present, before consuming the pork. The intensive method of pig rearing, where pigs are penned rather than being allowed to roam should be encouraged in order to prevent uptake of *Taenia solium* eggs by pigs.

Acknowledgements

The authors wish to acknowledge and appreciate TETFUND for the funding provided for this study, which was a part of an Institution Based Research (IBR). The Health Department of Jos South Local Government Area, Plateau State, the Staff of The Parasitology Division of the National Veterinary Research Institute, Vom and all participants in the study are all acknowledged.

References

- Acosta Soto,L., Parker,L.A., Iri Sarri–Gutierrez, M. J., Bustos, J.A., Castillo,Y., Perez,E., Munoz – Antolli, C., Esteban, J. G., Garcia, H. H. & Bornay – Lilinares, F. J. (2021). Evidence for transmission of *Taenia solium* Taeniasis/cysticercosis in a Rural Area of Northern Rwanda. *Frontiers in Veterinary Science* 8:645076..
- Adesokan, H. K. & Adeoye, F. A. (2019). Porcine Cysticercosis in slaughtered pigs and factors related to *Taenia solium* transmission amongst abattoir workers in Ibadan, Nigeria. *The Pan African Medical Journal*, 32, 145.
- Anyin, J. Umar, Y.A., Dikwa, K.B., Musa, M.A., Ogundeji, E.B., Ojemudia, E.I., & Ogundeji, A.O., (2019). Prevalence of Human Taeniasis in Jos South Local Government Area of Plateau State. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR – JESTFT)* 13 (7), 52 – 27.
- Arora D.R & Arora B.B. (2012). *Medical Parasitology* 3rd Edition, CBS Publishers & Distributors Pvt Ltd, India. Pp. 129 – 130
- Assana, E., Lightowers, M. W., Zoli, A. D. & Geerts, S. (2013) *Taenia solium* taeniosis/cysticercosis in Africa: Risk factors, epidemiology and prospects for control using vaccination. *Veterinary Parasitology*, 195, (1-2), 14-23.
- Edia-Asuke, U.A. (2015). Prevalence and Molecular Studies of *Taenia solium* and Assessment of Sanitary Conditions of some pig slaughter slabs in Kaduna Metropolis, Nigeria. A Ph.D. thesis submitted to the School of Post Graduate Studies, Ahmadu Bello University, Zaria. Pp 8 to 57
- Gweba, M., Faleke, O. O., Junaidu, A. U., Fabiyi, J. D. & Fajinmi, A. O. (2010) Some risk factors for *Taenia solium* cysticercosis in semi-intensively raised pigs in Zuru, Nigeria. *Veterinaria Italiana*, 46 (1), 57-67.
- Li, T., Chen, X., Budke, C. M., Zhou, Y., Duan, M., Wang, C., Zhong, B., Liu, Y., Luo, J., He, W., Shang, J., & Ito, A. (2021). New insights on the *Taenia solium* tapeworm using molecular tools: age-based human definitive host prevalence and deliberation on parasite life span. *Pathogens and Global Health*, 116 (2), 99-106.
- Lightowers, M. W., Mananjara, D. E. A., Rakotoarinoro, M., Rakotoarison, V. C., Raliniaina, M., Rasamoelina – Andriamanivo, H., Gauci, C. G., Jabbar, A., Mwape, K. E.,Donadeu, M.,



- Ramiandrasoa, N. S. & Nelly, J. A. (2023) Comparison of Kato-katz, PCR and coproantigen for the diagnosis of *Taenia solium* taeniasis *Parasitology* 150, 894-900.
- Mogaji, H. O., Adeniran, A. A., Fagbenro, M. T., Olabinke, D. B., Abe, E. M. & Ekpo, U. F. (2016). Prevalence of Human taeniasis in Odeda area of Ogun State, Nigeria. *International Journal of Tropical Disease and Health*, 17, (4) 1-8.
- Phumrattanaprapin, W., Tatiya – apiradee, N., Jantaban, P. & Mahikul, W. (2024). Assessment of knowledge and practices regarding Taeniasis and Cysticercosis in Pak Chong, Nakhon Ratchasima, Thailand: A cross – sectional study. *PLoS ONE* 19 (7): e0307240.
- Scuitto, E., Fragoso, G., Fleury, A., Laclette, J.P., Soletto, J., Aluja, A., Vargas, L. & Larralde, C. (2000). *Taenia solium* disease in humans and pigs, an ancient parasitosis disease rooted in developing countries and emerging as a major health problem of global dimensions. *Microbes and Infection*, 2(15), 1875 – 1890.
- Vaidya, V., Paturkar, A., Zende, R., Gatne, M., Dighe, D., Waghmare, R., Moon, S., Bhawe, S., Jadhav, P. & Wahval, N. (2018). Scenario of Porcine cysticercosis and human taeniasis Maharashtra State, India. *Turkish Journal of Veterinary and Animal Sciences*, 42, 353 -358 - 1707- 23
- World Health Organization (2018) Taeniasis/Cysticercosis Fact Sheets.
- Zulu, G., Stelzle, D., Mwape, K. E., Welte, T. M., Stromm, H., Mubang, C., Mutale, W., Abraham, A., Hachangu, A., Schmidt, V., Sikasunge, C. S., Phiri, I. K. & Winkler, A. S. (2023). The epidemiology of human *Taenia solium* infections in Eastern and Southern Africa. *PLoS Neglected Tropical Diseases* 17(3): e0011042