Original Research Article

PREVALENCE OF INTESTINAL PARASITOSIS AMONG MENTALLY ILL PERSONS IN NEUROPSYCHIATRIC HOSPITAL, CALABAR, NIGERIA

ABSTRACT

Aim: The prevalence of intestinal parasitosis in relation to mental illness among inpatients of Federal Neuropsychiatric Hospital, Calabar was investigated with a view to improving the quality of their medical care.

Study design: This was cross sectional study. Ethical approval and patients' informed consent were sought and obtained before collection and processing of samples.

Place and Duration of Study: Federal Neuropsychiatric Hospital, Calabar, between February and August, 2016.

Methodology: We included 246 (126 patients, 120 apparently healthy) subjects. Intestinal parasites were detected by direct stool microscopy and formol ether concentration technique and the cellophane anal swab method for *Enterobius vermicularis.* Chi square analysis was used to compare percentages.

Results: The prevalence of intestinal parasitosis among the 126 studied patients was 49.2% compared to 11.7% recorded among the 120 apparently healthy (control) subjects examined (P < 0.0001). There was no significant association between intestinal parasites prevalence and gender in test as well as control subjects 60.0% v. 45.1%, respectively, p = 0.2022) and 14.3% v. 8.8%, respectively, P = 0.3113). Subjects with chronic mental cases insignificantly harbored more intestinal parasites than those with acute cases (53.8% v. 47.1%, respectively; P = 0.5699). Parasites detected in the study were Hookworm 34.6%, *Entamoeba histolytica/dispar* 25%, *Ascaris lumbricoides* 17.3%, *Trichuris trichiura* 9.6%, *Enterobius vermicularis* 5.8%, *Giardia intestinalis* 3.8%, *Taenia* species and *Schistosoma mansoni* 1.9% each. Hookworm ranked highest 34.6% among the parasites encountered in the test subjects while *Ascaris lumbricoides* 33.3% took the lead in the control group. People diagnosed with Variance Psychosis disorder recorded highest infection rate (68.4%) while those with substance abuse had the least (28.0%).

Conclusion: Intestinal parasitosis may possibly play aetiologic or enhancement role in mental ill health. For effective management of the mental challenge, periodic parasitic investigations and appropriate therapy before and after admittance should be effected in all psychiatric institutions.

Keywords: Mental Illness, Psychiatric disorder, Intestinal parasitosis, Prevalence, Calabar.

1. INTRODUCTION

Intestinal parasites are associated with significant morbidity and mortality worldwide, particularly in developing countries [1] where an estimated 3.5 billion people are affected, the majority being children [2], the aged, people with low nutritional and immune status, and institutionalized persons [3]. Socioeconomic and environmental factors including poor personal and food hygiene, sanitation, poverty, and overcrowding have been documented to promote intestinal parasitic infections [4]. Transmission of

intestinal infection occurs through ingestion of mature cyst of protozoa, egg or larva of helminthes or larval skin penetration of certain helminthes. Common symptoms of intestinal parasitic infections include diarrhoea, nausea or vomiting, gas or bloating, dysentery, rash or itching around the anus or vulva, abdominal discomfort, fatigue, weight loss and passing a worm in stool [5]. These infections may lead to low nutritional and immune status, impaired growth, and poor cognitive performance which complicate and contribute to other illnesses [6, 7, 8, 9].

Mental illness refers collectively to all of the diagnosable mental and emotional conditions and are characterized by abnormalities in cognition, emotion or mood, or the highest integrative aspects of behavior, such as social interactions or planning of future activities [10, 11]. When the mental illness significantly interferes with the performance of major life activities such as learning, working and communicating, among others, the term “psychiatric disability” is applied [11]. It is a core tenet of modern science that behavior and our subjective mental lives reflect the overall workings of the brain as the mental functions are all mediated by the brain [10].

Mental illnesses are disabling and common globally but underestimated and under-treated in many developed and developing countries with estimated global burden between 21.2% - 32.4% of years lived with disability (YLDs) [12] and around 450 million people currently suffering from such conditions worldwide [13].

An estimated 20%–30% of the Nigerian population are believed to suffer from mental disorders [14]; unfortunately, inadequate attention is given to this health problem as only about three percent of the government's budget on health, according to the World Health Organization estimates, goes to mental health [15]. This, coupled with misconceptions and poor level of awareness of the Nigerian public on mental health issues [16], has compounded this problem. Despite several previous reports of high prevalence of intestinal parasitosis in many mental facilities elsewhere, very limited studies have been documented in Nigeria.

The cause of mental illness and psychiatric disorders is controversial but a combination of factors, including biological, psychological, environmental, social and spiritual factors have been incriminated [17, 18]. Genetic and biological factors have been associated with schizophrenia, depression, and alcoholism [17]. There are records of accumulated evidence showing Schizophrenia and Bipolar Disorder as complex diseases in which many predisposing genes interact with one or more environmental agents to cause symptoms, *Toxoplasma gondii* being an example of infectious agent that has been linked to schizophrenia and in which genes an infectious agent interact. Such infections may occur early in life and are thus consistent with neurodevelopmental as well as genetic theories of psychosis [19].

Risk factors of mental disorders include traumatic brain injury [20], substance abuse, viral infections [21], and general physical health. Researches show that a number of mental disorders occur in people suffering from other diseases more often than would be expected by chance as in infection, Coeliac disease, etc and this is often never investigated. Currently, science believes that mental illness is linked to genetic flaws. However, recent medical research also points to immune system dysregulation, most likely originating from gastrointestinal dysfunction as another factor. Psychiatrist Dr C.M. Reading, after over 30 years of practice believed that a significant percentage of those with mental illness suffer due to gastrointestinal & physical problems manifesting as Coeliac or latent Coeliac disease, food allergies, infections, auto-immune disease and malabsorbtion [22]. The role of the gastrointestinal system in the development of many illnesses, especially mental illness and neurological disorders has often been overlooked. Recent research findings have linked mental disorders to microbiota – brain- gut interaction (Brain-Gut Axis) through adjustment in the gut microbiota and activation of certain immune system cells in response to an infection, or on an ongoing basis (chronic inflammation) and studies are under way to evaluate the use of anti-inflammatories in treating depression and schizophrenia [23].

Repeated immune response due to infection or allergy may result in inflammation, particularly in the area of the small bowel and over time this may lead to damage of the mucosal villi and in turn increase mucosal permeability. Recurrent gastrointestinal infection, gastritis, post antibiotic infection (colonization

of bad bacteria), tropical sprue and inherited gastro-immunological disorders such as coeliac sprue, non-coeliac sprue and food intolerances may lead to the development of mental illness and disease [22]. Inflammation plays a key role in mood disorders and mental illness. When inflammatory antibodies cross the blood-brain barrier, it interferes with the brain's ability to function. The immune system secretes antibodies that are distributed in the blood to help fight the infection or repair the problem. The blood-brain barrier is supposed to protect the brain from those antibodies. But for yet unknown reasons, when inflammation reaches the brain, the cytokines wreak havoc on the neurotransmitters, interfering with the brain function [24]. Auto-immune response can lead to symptoms like anxiety, depression, and hallucinations [25] and some studies have even found higher levels of inflammation in patients with depression and suicidal thoughts, PTSD, and chronic fatigue [26, 27].

The relationship between mental and medical illnesses further emphasizes the need for continued mental health research for proper diagnosis of psychiatric illness [28].

The impact of mental illness is grave on the victims, their family members and the communities [29-31]. In addition to the health and social costs, those suffering from mental illnesses are also victims of human rights violations, stigmatization and discrimination, both inside and outside psychiatric institutions. Many psychiatric institutions have inadequate, degrading and even harmful care and treatment practices, as well as unhygienic and inhuman living conditions [32]. With memory loss, poor reasoning, low education, poverty, and low hygiene level, mentally ill persons are likely to acquire and spread infectious agents which in turn promotes the already underlying health problem.

Although a relationship between infectious diseases and psychiatric disorders has been suggested, this relationship is yet to be well demonstrated and be considered important by many health care providers [8, 17]. A better understanding of the role of infection may speed treatment and prevention efforts and reduce the degree of disability and stigma associated with mental illness. This study therefore, aimed to investigate the prevalence of intestinal parasites among hospitalized psychiatric patients in the Federal Neuropsychiatric Hospital, Calabar and its relationship with demographic variables of interest.

Related risk factors and consequences of intestinal parasitic infections among the study subjects were also assessed and action initiated for treatment of the infected persons.

2. MATERIALS AND METHODS

This study was carried out at the Federal Neuropsychiatric Hospital, Calabar situated in the tropical rain forest of Southern Nigeria between February and August, 2016. It is the only psychiatric institution in the state and serves as a home as well as hospital for people with mental illnesses from across the state and neighboring states. At the time of the study, the institution had a 235 bed capacity with 181 inmates/inpatients, mostly adults. With ethical approval from the hospital research ethics committee and informed consent of participants, a total of 126 (91 males/35 females) patients of the hospital who complied and 120 (57 males/64 females) apparently healthy subjects from the general population without any history of anti-parasitic medication in last preceding month were recruited for the study. Demographic data and health status of each studied subjects were obtained through the instrument of interviewer- administered questionnaire, with the help of the hospital/faculty workers, based on medical records. Subjects were also questioned for recent abdominal discomforts, diarrhoea, anal itching or emergence of nematodes from the anus, and anti-parasitic medication.

All studied subjects were screened for intestinal parasites based on stool and anal swab examination. The subjects or their informants were each given a sterile screw-capped wide mouth universal container for collection of stool sample and cellophane anal swab for collection of anal swab. Anal swabs of the subjects were obtained early in the morning (before defecating/bathing) using the cellophane anal swab (8 by 2- cm of transparent adhesive tape), held sticky side out, over the end of a glass microscope slide [33]. Samples were processed and examined in the University of Calabar Teaching Hospital laboratory. The stool samples were macroscopically examined for appearance, consistency, presence of blood, mucus, worm segments and worms. Stool samples were further processed by direct smear microscopy and formol ether concentration technique. The preparations and the anal swabs were examined microscopically using the 10x and 40x objectives for the presence of larva, cysts, and eggs of parasites [6]. Percentages were compared using

Chi square analysis. All parasites infected subjects were recommended to their health care providers for appropriate antiparasitc treatment.

3. RESULTS

The results of this study are as shown in Figures 1-4 and Tables 1-2.

Fig. I displays the prevalence of intestinal parasites among patients and apparently healthy subjects in Calabar. Sixty two (49.2%) of the 126 test versus 14 (11.7%) of 120 control subjects examined significantly tested positive for parasites ($P < 0.0001$).

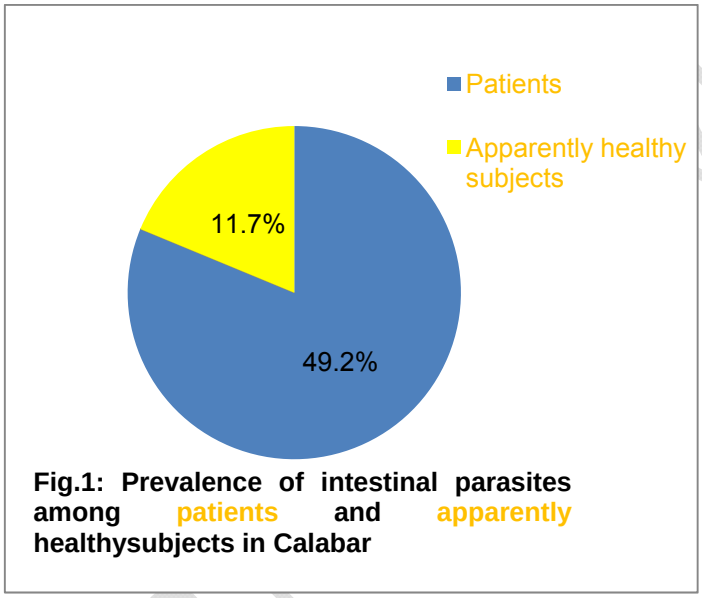
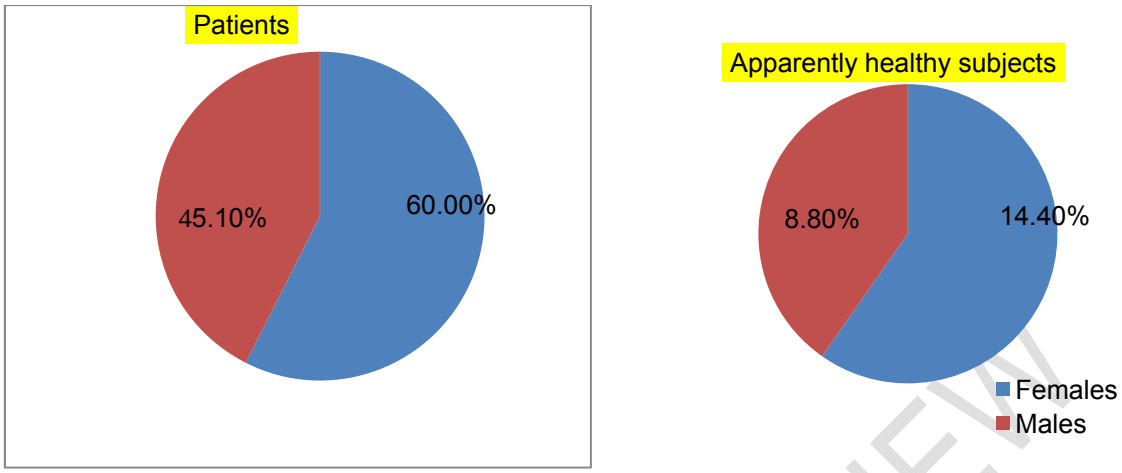


Fig.1: Prevalence of intestinal parasites among patients and apparently healthysubjects in Calabar

Patients as well as apparently healthy female subjects were insignificantly more infected than their male counterpart (21/35) 60.0% v. (41/91) 45.1%, respectively, p = 0.2022 and (9/64) 14.4% v. (5/57) 8.8%,



respectively, p = 0.3113 (Fig. 2).

Fig. 2: Prevalence of intestinal parasites among mental and healthy subjects in Calabar by gender

Persons with chronic cases of mental problem were insignificantly more infected with intestinal parasites than those having acute cases 53.8% v. 47.1%, respectively, P = 0.5699) (Table1).

Table 1: Distribution of Intestinal Parasites among Patients by Duration of Case

Case	No. Examined	No. (%) Positive for Parasites
Acute	87	41 (47.1)
Chronic	39	21 (53.8)
Total	126	62 (49.2)

Key: Acute - Newly admitted patients with sudden onset, high degree but short-term condition (who spent less than 4 weeks at the care center).
Chronic - Patients with long-lasting condition (who spent more than 4 weeks at the care center), who sometimes acted normally, but at other times suffered from periods of rage, hallucination, delusions and the like.

The most frequently detected parasite among the patients was hookworm 34.6% followed by *Entamoeba histolytica/dispar* 25.0%. Other parasites detected in descending order of frequency were *Ascaris lumbricoides* 17.3%, *Trichuris trichiura* 9.6%, *Enterobuis vermicularis* 5.8% (in one sampling), *Giardia intestinalis* 3.8%, *Taenia species* and *Schistosoma mansoni* 1.9% each, whereas among the controls, *Ascaris* ranked highest 33.3% followed by hookworm and *E. histolytica/dispar* 22.2% each,

Enterobius and *Giardia* 11.1% each (Fig. 3).

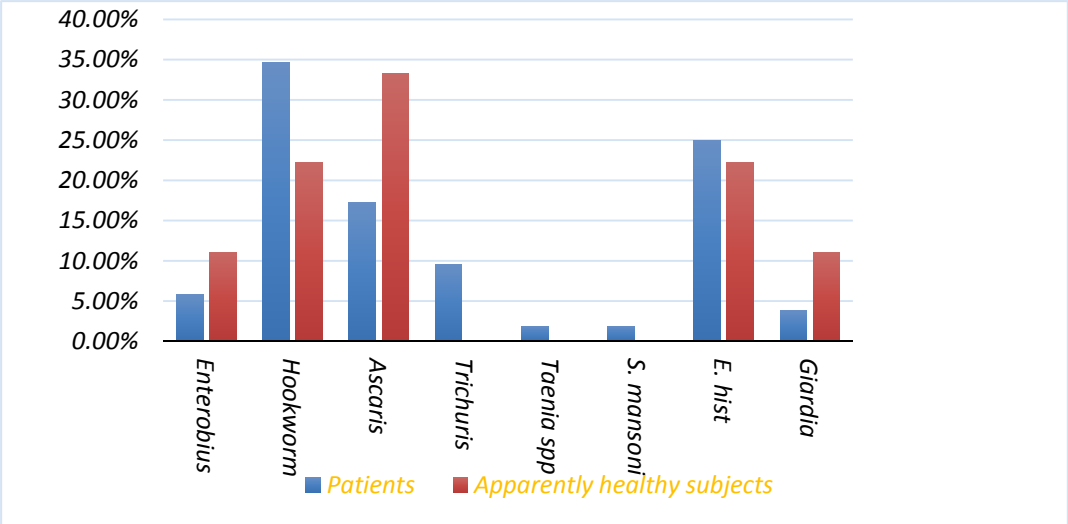


Fig. 3: Frequency of intestinal parasites among patients and healthy subjects

Table 2 shows occurrence of mixed parasitic infections among patients. The rate of single infection was higher than that of mixed infection 68.1% and 31.9%, respectively. Mixed infections with 2 parasites were more often encountered 86.4% than those with 3 parasites 13.6%.

Table 2: Occurrence of Mixed parasitic infections among patients

Parasites grouping/No.	Occurrence	Frequency (%)
Mixed Infections		
2 Parasites	19	(27.5)
3 Parasites	3	(4.3)
Subtotal	22	(31.9
Single Infection		
1 Parasite	47	(68.1)
Total	69	(100.0)

The highest prevalence of infection was recorded among persons diagnosed with Variance Psychosis 68.4%, closely followed by those with Mania Disorder 63.6%, Acute Schizophrenia 56.2%, Chronic Schizophrenia 48.2%, Depression 46.7%, Organic Source 45.4%, while those with Substance Abuse recorded the least prevalence 28.0% (Fig. 4).

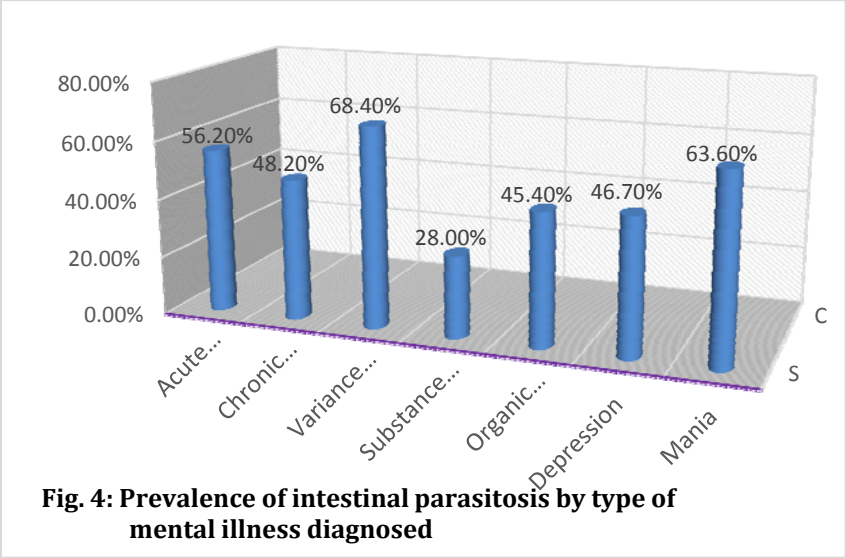


Fig. 4: Prevalence of intestinal parasitosis by type of mental illness diagnosed

4. DISCUSSION

The prevalence of intestinal parasitosis among mentally ill subjects in this study was 49.4% as against 11.4% recorded among the controls ($P < 0.0001$). These findings are similar to those of Sirivichayakul *et al*. [34] in Thailand where a higher prevalence was also observed among institutionalized mentally handicapped than non-institutionalized healthy individuals (57.6% v. 7.5 %, respectively, $p < 0.05$). The 49.4% prevalence recorded in this study is high compared to 8.4% recorded in mental hospitals in North Taiwan [35], 7.3% in New York [36] , 20.5% in Urmia, Iran [37], 35.7% in Korea [38] but is related to 52.3% reported in Puerto Rico [39], 53.8% in Italy [8], and 76.7% in Egypt [40]. The higher prevalence observed among our studied subjects compared to controls may be attributed to the poor state of hygiene usually observed among this (institutionalized) group of persons, coupled with their abnormal behavior, limited access to anti-parasitic therapy poor environmental conditions and poor sanitary practices within the facility.

The prevalence rate observed in the study area, being hospital environment, may not necessarily reflect the endemicity level of intestinal parasitoses in the general population of Calabar as Calabar wide prevalence data on intestinal parasitoses is lacking and most of the mentally ill persons are victims of displaced homes (may not be Calabar residents), poverty, low levels of education, poor hygiene and

feeding problems which are known risk factors of parasitoses. It is believed that those persons might have been harboring these infectious agents before admittance into the hospital, since no routine medical examination was done on their admission. However, the possibilities of hospital-acquired infection and inter-hospital transfer are inevitable.

The higher prevalence of parasites (49.4%) noted among the test subjects in this study may not necessarily attribute their mental illnesses to intestinal parasitoses but our results being consistent with those reported elsewhere, Puerto Rico 52.3% [39], Italy 53.7% [8], and Egypt 76.7% [40] is suggestive that intestinal parasitosis may possibly play etiologic or enhancement role in mental disorders.

Test as well as the control females were insignificantly more infected with intestinal parasites than their males counterpart (60.0% v. 45.1%, respectively, P = 0.2021) and (14.4% v. 8.8%, respectively, P = 0.3113). This differs from the findings in Iran [36] where infection rates among males and females were similar (20.3% v. 20.5%, respectively).

The prevalence of intestinal parasites among the patients insignificantly increased with duration of cases as subjects with chronic (long-lasting) condition showed a higher parasites prevalence (53.8%) than those with acute (short-term) mental problems (47.4%) (P = 0.5699). This may be attributed to difference in the degrees of chronic stresses and immune system deficiency (which might be higher in the chronic cases) usually associated with mental disorders which are also known risk factors of parasitosis [41].

Hookworm ranked highest among the parasites encountered in the test subjects 34.6% followed by *Entamoeba histolytica/dispar* 25%, *Ascaris lumbricoides* 17.3%, *Trichuris trichiura* 9.6%, *Enterobius vermicularis* 5.8% (in one sampling), and *Giardia intestinalis* 3.8%, *Taenia* species and *Schistosoma mansoni* 1.9% each whereas, among the controls, *Ascaris* ranked highest 33.3% followed by hookworm and *E. histolytica/dispar* 22.2% each, *Enterobius* and *Giardia* 11.1% each. It is possible that infection with these parasites may have come from institutional food or water in the psychiatric hospital and/or may be the result of poverty, a condition intimately linked with mental illness. The high prevalence of hookworm here may be attributed to the habit of walking bare foot, observed among some of the test subjects, and poor hygiene related to faeces. *Taenia* species and *Schistosoma mansoni* encountered here probably represent imported infection and have been related to organic sources of mental disorder and their associated

220 symptoms [8, 9]. According to various authorities, taeniasis is thought to be the cause of psychiatric
221 symptoms due to its neural and psychological effects. These claims have been confirmed in a taeniasis
222 case study of a 36 year-old woman whose psychiatric symptoms (obsessive and compulsive neurosis and
223 depression) decreased after the taeniasis treatment [11].

224 *Entamoeba histolytica/dispar* was the leading protozoan infection (25%) in this study. Although this
225 study was limited to stool examination, this organism has been previously reported to be capable of causing
226 extra intestinal infection in other parts of the body including the brain [42]. Amoebic brain abscesses which
227 have been rarely reported [43], result when trophozoites invade the central nervous system [44] leading to
228 headache, altered mental confusion, focal neurologic signs and seizures.

229 Extra intestinal migration of *Enterobius vermicularis* has been documented to result in severe health
230 disorders, including nervousness or even death, especially in population dense areas and institutionalized
231 persons [45, 46]. Among the parasite positive persons, single infections recorded 65.9%, mixed infections
232 34.1% (31.7% double and 2.4% triple) prevalence.

233 The highest prevalence of parasites was noted among subjects diagnosed of Variance Psychosis
234 68.4% closely followed by those having Mania 63.6%, Acute Schizophrenia 56.2% while those with
235 Substance Abuse had the least prevalence 28.0%. Poor mental health in association with parasitic
236 infections may produce extreme anxiety with recurrent attacks of Mania and Depression [10]. The least
237 parasites prevalence, 28.0% observed among Substance Abuse subjects suggests the need to investigate
238 hard substances (cocaine, cannabis, etc.) and their lethal effect on intestinal parasites.

239 A number of mental disorders have often been tentatively linked with microbial pathogens [47],
240 particularly viruses and parasites [48]. *Taenia solium, Naegleria fowleri, and Toxoplasma gondii* are all
241 parasites that have been documented to infect the human brain resulting in symptoms such as headaches,
242 fever, confusion, nausea, seizures, loss of balance, and hallucinations with *Toxoplasma* being the cause of
243 most cases of schizophrenia and bipolar disorder [21]. Acute infection with *Toxoplasma gondii* has been
244 shown to produce personality changes and psychosis; incidence of infection in schizophrenic patients being
245 twice that of control subjects (42 % versus 11 %, respectively). *T. gondii* is usually spread to humans
246 through cat's faeces contact; exposure to cats in childhood revealed in two studies as a risk factor for the

development of schizophrenia [8]. The parasite has been documented might play a role in the development of these disorders by affecting the production of dopamine -- the chemical that relays messages in the brain controlling aspects of movement, cognition and behavior [49]. *The Toxoplasma gondii parasite has been linked, in another study, to the brain cells damage leading to* suicide attempts [50] while meningitis or encephalitis was found in 24 % of 1300 cases of trichinosis reported from Germany [8].

Psychiatric Disorders are illnesses of the brain and parasitic infections have been documented, could alter normal functions by depleting the host's essential nutrients, interfering with enzyme and neuroimmune functions, and releasing massive amounts of waste products, enteric poisons, and toxins which may disable brain metabolism [8]. Previous reports show that tape worms have been associated with direct brain invasion (as in neurocysticerccosis) leading to depression and psychosis [8]. These tapeworms could produce cysts, swelling, and encephalitis in brains of patients. Pittella [51] linked neurocysticercosis with seizures, increased intracranial pressure, ischemic cerebrovascular disease, dementia, and signs of compression of the spinal roots/cord. Tapeworm eggs are **spread** through food, water, or surfaces contaminated with feces. Humans get the tapeworm infection after eating raw or undercooked pork contaminated with cysts of *T. solium* [51] while *Naegleria fowleri* is acquired when water containing *Naegleria fowleri* enters the nose and the ameba migrates to the brain along the olfactory nerve.[52]

There are several reports [51, 53, 54] on neuroschistosomiasis caused by *Schistosoma mansoni* infection. These worms can evoke granulomatous inflammatory reaction when eggs are being transmitted to the spinal cord or brain via the vascular system, or by inadvertent adult worms' migration to these organs resulting in psychiatric symptoms, including seizures and increased intracranial pressure [51].

Other parasitic infections (giardiasis, ascariasis, etc.) may produce mental symptoms indirectly through brain – gut - axis (BGA) which may clear after effective therapy [8].

The relationship between mental health problems and parasitic infections, although yet to be well demonstrated, is real and needs to be given concrete consideration by health care providers. The results obtained here further stresses the need for continued investigation on intestinal parasitosis and mental health.

5. CONCLUSION

This study has revealed a high prevalence of intestinal parasitic infections among institutionalized mentally ill patients in the Federal Neuropsychiatric Hospital compared to apparently healthy persons in the general population in Calabar, Nigeria. There is no prevalence data on intestinal parasitoses among mentally ill people in Calabar and in Nigeria, such information is sparsely documented. The study strongly suggests that intestinal parasites may play aetiologic or enhancement role in mental health problems. Periodic parasitic investigations and appropriate therapy before and after admittance should be effected in all psychiatric institutions.

6. SIGNIFICANCE OF THE STUDY

The findings of this study will improve the quality of medical care of patients treated at Federal Neuro-Psychiatric Hospital, Calabar as intestinal parasitosis would be considered during clinical and laboratory diagnosis.

CONSENT

All authors declare that written informed consent was obtained from the patients/guardians after details of the study was explained to them, before recruitment into the study.

INCLUSION AND EXCLUSION CRITERIA

Participation in the study was strictly voluntary. Only those subjects who gave their consent with compliance and were not on any antiparasitic medication were included in the study. On the other hand, those who refused to give their consent and those on antiparasitic medication were left out of the study.

ETHICAL ISSUE

Ethical approval for the study was obtained from Committee on Research Ethics, Federal Neuro-Psychiatric Hospital, Calabar.

CONFLICT OF INTERESTS: None declare

AUTHORS' CONTRIBUTIONS

Author IBOB designed the study and wrote the protocol. Author DII wrote the first draft of the manuscript. Authors IBOB and OMO managed the analyses of the study. Author IBOB performed the statistical analysis. Authors DII and OMO managed the literature searches. Author MFU critically revised the manuscript for intellectual content. All authors read and approved the final manuscript.

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REFERENCES

1. Hotez PJ. Reducing the global burden of human parasitic diseases. *Comp Parasitol* 2002; 69: 140-5.

2. Ngonjo TW, Kihara JH, Gicheru M, Wanzala P, Njenga SM, Mwandawiro CS. Prevalence and Intensity of Intestinal Parasites in School age Children in Thika District, Kenya. *Afri J Health Sci 2012*; 21 (3-4): 153-60.

3. Chan MS. The global burden of intestinal nematodes infections- fifty years on. *Parasitol Today* 1997; 13: 436-43.

4. Al-Mohammed HI, Amin TT, Aboulmagd E, Hablus HR, Zaza BO. Prevalence of intestinal parasitic infections and its relationship with socio-demographics and hygienic habits among male primary school children in Al-Ahsa, Saudi Arabia. Asian Pac J Trop Med. 2010; 3:906–12.

5. de Silva NR, Guyatt HL, Bundy DAP. "Morbidity and mortality due to Ascaris-induced intestinal obstruction," *Transactions of the Royal Society of Tropical Medicine and Hygiene*. 1997; vol. 91, no. 1, pp. 31–36.

6. Arora DR, Arora B. Medical Parasitology. 2nd Ed. New Delhi, Bangalore, India: CBS Publishers and Distributors; 2005; p. 213-6.

7. Read CP. The vertebrate small intestine as an environment for parasitic helminthes. *The Rice Institute Pamphlet* 1990; 37: 1-94.

8. Howenstine Dr. J. The overlooked relationship between infectious diseases and mental symptoms. *http://www.newswithviews.com/Howenstine/james16.htm#_ftn1.*2004 [accessed 6 May 2015].

9. Inceboz T, Yalçin G, Aksoy U. Case report: taeniasis, is it a cause of psychiatric and neural symptoms? *Turkiye Parazitol Derg* 2006; 30(3): 187-9.

10. Mental Health: A Report of the Surgeon General, Chpt 2. The Fundam- entals of Mental Health and Mental Illness. *http://www.Surgeongeneral. gov/library/mentalhealth/chapter8/sec1.html.* [accessed 15 May 2015].

11. Zuckerman D, Debenham K, Moore K. The ADA and People with Mental Illness. A Resource Manual for Employers. Available from the National Mental Health Association, 1021 Prince Street, Alexandria, VA22314-2971: 1993; (703): 684-722.

12. Vigo D, Thornicroft G, Atun R. Estimating the True Global Burden of Mental Illness. Lancet Psychiatry. 2016; 3 (2): 171-78 Vigo D, Thornicroft G, Atun R. Estimating the True Global Burden of Mental Illness. Lancet Psychiatry. 2016; 3 (2): 171-78.

13. WHO, 2001: The world health report 2001 - Mental Health: New Understanding, New Hope WHO, 2001: The world health report 2001 - Mental Health: New Understanding, New Hope.

14. Onyemelukwe C. Stigma and mental health in Nigeria: Some suggestions for law reform. J Law Policy Glob 2016; 55:63-8

15. *WHO-AIMS Report on Mental Health System in Nigeria, WHO and Ministry of Health, Ibadan, Nigeria,* [*2006*]*. https://www.who.int/mental_health/evidence/nigeria_who_aims_report.pdf.* Retrieved 7 January 2016*.*

16. Suleiman DE. Mental health disorders in Nigeria: A highly neglected disease. Ann Nigerian Med 2016; 10:47-8.

17. Torrey EF*,* Miller J. The Invisible Plague: The Rise of Mental Illness from 1750 to the Present. Piscataway, NJ 08854- n8099: Rutgers University Press, 2002; 314.

18. Study Finds Serious Mental Illness Often Dismissed by Local Church. *http://newswise.com/articles/view/545316/.* [accessed 15 May 2015].

19. Yolken RH and Torrey EF. Are some cases of psychosis caused by microbial agents? A review of the evidence. *Molecular Psychiatry* 2008; 13, 470–479; doi:10.1038/mp.2008.5

20. Jesse R. Fann, MD, MPH; Bart Burington, MS; Alexandra Leonetti, MS; Kenneth Jaffe, MD; Wayne J. Katon, MD; Robert S. Thompson, MD. Psychiatric illness following brain injury in an adult health maintenance organization population. *Arch Gen Psychiatry* 2004; 61(1): 53-61.

21. Yolken RH, Torrey EF. Viruses, schizophrenia, and bipolar disorder. *Clin Microbiol Rev* 1995; 8(1): 131-45.

22. www.GutandMentalillness.com**.** The Gastrointestinal origin of mental Illness and complimentary treatment strategies. *Based on the writings of Psychiatrist Dr C.M. Reading and Jordan Rubin* [accessed 17 February 2016].

23. Haapakoski R, Mathieu J, Ebmeier KP, Alenius H, Kivimäki M. Cumulative meta-analysis of interleukins 6 and 1β, tumour necrosis factor α and C-reactive protein in patients with major depressive disorder. Brain Behav Immun. 2015; 49:206-15. doi: 10.1016/j.bbi.2015.06.001.Rege, S. (2016). Autoimmune Diseases Masquerading as Psychiatric Disorders – A Paradigm Shift. https://psychscenehub.com/psychinsights/autoimmune-diseases-masquerading. Accessed 28/1/2017

24. Souhel Najjar, Daniel M Pearlman, Kenneth Alper, Amanda Najjar, and Orrin Devinsky. Neuroinflammation and psychiatric illness. J Neuroinflammation. 2013, 10: 43. doi: 10.1186/1742-2094-10-43.

25. Holmes SE, Hinz R, Conen S, Gregory CJ, Matthews JC, Anton-Rodriguez JM, *et al*. Elevated Translocator Protein in Anterior Cingulate in Major Depression and a Role for Inflammation in Suicidal Thinking: A Positron Emission Tomography Study. Biological Psychiatry Journal, 2018, Volume 83, Issue 1, Pages 61–69. DOI: https://doi.org/10.1016/j.biopsych.2017.08.005

26. Montoya JG, Holmes TH, Anderson JN, Maecker HT, Rosenberg-Hasson Y, Valencia IJ, *et al*.. Cytokine signature associated with disease severity in chronic fatigue syndrome patients. PNAS. 2017; Volume 114 (34) E7150-E7158. https://doi.org/10.1073/pnas.1710519114

27. Linda C. Mental Disorders Secondary to General Medical Condition –overview. *http://emedicine.medscape.com\article/294131-overview.*[accessed 1 March 2016].

28. Veggeberg SK. The big story in depression: What isn't happening? *Brainwork-The Neuroscience Newsletter, Vol. 7*. http://www.dana.org/articles/bwn_1997. cfm. [accessed 28 August 2017].

29. National Institute of Mental Health. The impact of mental illness on society. *http://www.nimh.nih.gov/publicat/2001b/burden.cfm.* [accessed 27 June 2015].

30. U.S. Department of Health and Human Services. Mental health: A report of the surgeon general. http://www.surgeongeneral.gov/library/*2000/*mentalhealth/home.html. [accessed 27 December 2016].

31. World Health Organization. Investing in Mental Health. *http://www.who. int/mental_health/en/investing_in_mnh_fin-al. Pdf. 2003.* [accessed 30 June 2016].

32. Faust EC, Russel PF, Jung RC. Craig and Faust's Clinical parasitology, 8th Ed. Philandelphia PA: Lea & Febiger 1970; 525-7.

33. Sirivichayakul C, Pojjaroen-anant C, Wisetsing P, Siripanth C, Chanthavanich P and Pengsaa K. Prevalence of intestinal parasitic infection among Thai people with mental handicaps. *Southeast Asian J Trop Med Public Health* 2003; 34(2):259-63.

34. Cheng HS, Wang LC. Intestinal parasites may not cause nosocomial infections in psychiatric hospitals. *Parasitol Res.* 2005; 95(5): 358-62.

35. Schupf N, Ortiz M, Kapell D, Kiely M, Rudelli RD. Prevalence of intestinal parasitic infections among individuals with mental retardation in New York State. *Ment Retard.* 1995; 33(2):84–9.

36. Hazrati Tappeh Kh , Mohammadzadeh H, Nejad Rahim R. Prevalence of Intestinal Parasitic Infections among Mentally Disabled Children and Adults of Urmia, Iran. *Iran J Parasitol..* 2010; 5(2): 60–4.

37. Lee J, Park GM, Lee DH, Park SJ, Yong TS. Intestinal parasite infections at an institution for the handicapped in Korea. *Korean J Parasitol.* 2000; 38(3):179– 81.

38. Ferrer-Rodríguez I and Kozek W J. Prevalence of intestinal parasitoses among patients and staff of an institution for the mentally retarded. *J Parasitol and Vector Biol* 2011; 3(5): 69-74.

39. Mohamed NH, Salem SA, Azab ME, Bebars MA, Khattab HM, Kamal AM. Parasitic infections associated with mental retardation in Egypt. *J Egypt Soc Parasitol* 1991; 21(2): 319–31.

40. Beaton DB. Effects of Stress and Psychological Disorders on the Immune System. Rochester Institute of Technology at http://www.personalityresearch.org/papers/beaton.html. [accessed 9 October 2017] .

41. Entamoeba and Amebiasis at *http://www.garlandscience.com/res/pdf/9780815365006ch03. pdf.* [accessed 18 July 2016].

42. Banerjee AK, Bhatnagar RK, Bhusnurmath SR. Secondary cerebral amebiasis. *Trop Geogr Med* 1983; 35(4): 333-6.

43. Maldonado-Barrera CA, Campos-Esparza Mdel R, Muñoz-Fernández L, Victoria-Hernández JA, Campos-Rodríguez R, Talamás-Rohana P, *et al*. Clinical case of cerebral amebiasis caused by *E. histolytica*. *Parasitol Res* 2012; 110(3): 1291-6.

44. Markell EK, John DT, Krotoski WA. *Markell and Voge's Medical Parasitology.* Philadelphia: W.B. Saunders Company; 2006.

45. Schmunis GA, Lopez-Antunano FJ. In: Cox FEG, Wakelin D, Gillespie SH, Despommier DD, Editor (s). *Toply and Wilson Microbiology and Microbial infections, Parasitology.* p. London: Edward Arnold. 2005; 24.

46. Pearce BD. Modeling the role of infections in the aetiology of mental illness. *Clinical Neuroscience Research* 2003; 3 (4-5): 271-82.

47. Thomas HV, Thomas DR, Salmon RL, Lewis G and Smith AP. Toxoplasma and Coxiella infection and psychiatric morbidity: a retrospective cohort analysis. *BMC Psychiatry* 2004; 4: 32. DOI: 10.1186/1471-244X-4-32

48. University of Leeds (2009, March 11). Toxoplasmosis Parasite May Trigger Schizophrenia and Bipolar Disorders. *Science Daily*. Retrieved August 26, 2013, from *http://www.sciencedaily.com/releases/2009/03/090311085151.htm.*

49. Michigan State University (2012, August 16). Common parasite may trigger suicide attempts: Inflammation from T. gondii produces brain-damaging metabolites. *Science Daily*. Retrieved August 26, 2013, from *http://www.sciencedaily.com /releases/2012/08/120816170400.htm.*

50. Pittella, José EH. Neurocysticercosis. *Brain Pathology* 1997; 7: 681-93.

51. Yoder JS, Eddy BA, Visvesvara GS, Capewell L, Beach MJ. The epidemiology of primary amoebic meningoencephalitis in the USA, 1962-2008. *Epidemiol Infect.* 2010; 138:968-75.

52. Nascimento-Carvalho CM, Moreno-Carvalho OA. Neuroschistosomiasis due to *Schistosoma mansoni*: a review of pathogenesis, clinical syndromes and diagnostic approaches. Rev Inst Med Trop Sao Paulo 2005; 47(4):179-84.

53. Houdon L, Flodrops H, Rocaboy M, Bintner *M*, Fériot JP, Tournebize P *et al*. Two Patients with Imported Acute Neuroschistosomiasis Due to *Schistosoma mansoni. J Travel Med* 2010; 17(4): 274–7.