Journal of Mental Health Issues and Behavior
Vol: 04, No. 01, Jan-June 2024
ISSN: 2799-1261, DOI: 10.55529/jmhib.43.19.29

Research Paper

Examining the impact of parasitic infections on mental health and health indices in patients from southern Nigeria

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Article Info

Article History:
Received: 22 February 2024
Revised: 01 May 2024
Accepted: 09 May 2024
Published: 22 June 2024

Keywords:
Anxiety Disorders
Cognitive Impairment
Depression
Mental Health
Parasitic Infections

ABSTRACT

Background: Parasitic infections, including malaria, schistosomiasis, intestinal helminthiasis, and toxoplasmosis, are prevalent in southern Nigeria and have been linked to neuroinflammatory and nutritional pathways that may contribute to mental health disorders.
Objective: To determine the prevalence of parasitic infections among psychiatric patients in southern Nigeria and examine associations between parasitic infection status, mental health disorders, and general health indices.
Methods: A cross-sectional descriptive study was conducted among psychiatric patients across three tertiary facilities in South-South Nigeria. Participants underwent clinical psychiatric evaluation (DSM-5 criteria) alongside parasitological testing (blood microscopy, rapid diagnostic tests, Kato-Katz stool analysis, urine filtration, and ELISA serology).
Results: Malaria was the most common infection identified, followed by intestinal helminths, schistosomiasis, and toxoplasmosis. Parasitic infection was associated with significantly higher rates of depression, anxiety, cognitive impairment, psychosis, and PTSD, alongside lower hemoglobin, BMI, cognitive function, quality of life, and immune function scores (all $p<0.05$).
Conclusion: Parasitic infections are associated with poorer mental health and general health outcomes among psychiatric patients in southern Nigeria. Integrating parasitic infection screening and treatment into mental health care, alongside broader public health prevention measures, may improve outcomes in affected populations.

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1. INTRODUCTION

Parasitic infections and their relation to mental health is an area of growing interest especially given the ongoing parasitic diseases in certain parts of the world. Generally, southern Nigeria with tropical climate has all the index points associated with prevalence of different types of parasites such as malaria, schistosomiasis, intestinal helminthiasis and toxoplasmosis parasites [1], [2], [3]. Although these infections are typically investigated with regard to their physical well-being consequences, there is increasing awareness of possible effects on the mental well-being. This link between infectious disease and mental health is quite remarkable and carries significant implication in today's global health practice more especially in regions where both parasitic diseases and mental health disorders are well known to present huge burden of morbidity and mortality yet often neglected and poorly managed.

Several studies have documented that the parasitic infections can impact human body in many ways such as neuroinflammatory responses, nutritional deficiencies and direct central nervous system involvement which in one way or the other trigger mental health disorders [4], [5]. For example, malaria has been associated with impaired cognitive function and depression most especially where the effect of the parasite is witnessed on the brain. In the same way, diseases resulting from chronic infections such as schistosomiasis, intestinal helminthiasis, increases inflammation and anemia, and close related to fatigue, cognitive impairment and depressive symptoms. Toxoplasmosis, induced by Toxoplasma gondii, has been specially investigated regarding its effects on human behavior and the link with neuropsychiatric disorders such as schizophrenia and bipolar disorder [6], [7].

Mental health disorders are not uncommon in Southern Nigeria; however, services for them remain poorly developed due to cultural attitudes, scarcity of resources, and poor availability of services. There is a potential of the parasitic infections affecting the mental health aspect, and this is a major focus. Knowledge of these infections may help explain the causation of such mental health issues and help in coming up with treatment measures that conquer both the physique and the mind [8], [9]. This work is therefore designed to determine the prevalence of parasitic infections among mental health clients in Southern Nigeria and examine the correlation between parasitic infections and mental health consequences. Through the evaluation of various health measurements like haemoglobin levels, BMI, cognitive ability, quality of life and immune response, the study aims to find out whether the presence of parasitic ailments and mental illnesses has an impact on some parameters of health. Also, the study assess the efficacy of treating parasitic infections for different mental health consequences that can aid clinical decision making and formulating health policies. This study seeks to give a conducive knowledge on the impacts that parasitic diseases have on mental health of the residents in the parasitic prone areas. It supports a community health program for Southern Nigeria that goes to the grassroots to address the determinants of a mental health disorder. Therefore, the study enforces a need for coherence between mental health and parasitic diseases and their control with an overall goal of minimizing disease burden and enhancing the standard of living for subjects in affected nations.

2. RELATED WORK

Research on the connexion of parasitic infections and mental health has gained momentum in recent years, shedding light on the complex relationship between these two domains. Several studies have established connections between specific parasitic infections and mental health outcomes, particularly in endemic regions. For instance, the association between malaria and cognitive impairments is well-documented. A study by [10] reported that severe malaria is associated with worse neurodevelopment outcomes for children living in low- and middle-income countries. Similarly, [11] reported that malaria infection is significantly associated with an increased risk of epilepsy development, particularly in children and those with cerebral malaria. In a related study conducted in Philippines, [12] showed that intestinal parasitic infections negatively affect school children's growth, cognitive development, and learning abilities, leading to nutritional deficiencies and anemia. In one of the study done by [13] they found an

estimated 15% co-infection of malaria and schistosomiasis was found in Nigeria, with wide variability depending on location.

Toxoplasmosis, an infection contracted from Toxoplasma gondii protozoan, has been linked to neuropsychiatric diseases such as schizophrenia, bipolar disorder, and parasitic suicidal behavior. However, research on the Nigerian context is limited, as previous studies have focused on individual infections and their direct impacts. This study aims to fill this gap by comparing the effect of multiple parasitic infections in a single population and their relationship to mental health. Previous research has focused on the direct impacts of infections, but has not considered the concurrent effects of multiple parasites on mental state. This study aims to narrow this gap by comparing the effects of multiple parasitic infections in a single population and their relationship to mental health. The research will contribute to the understanding of the potential impact of multiple parasites on mental health in Nigeria.

3. METHODOLOGY

The study was a cross-sectional descriptive survey that involved mental health patients in Southern Nigeria. The aim of the research was to estimate the frequency of parasitic infections as well as explore possible correlations between infections and mental health disorders. A voluntary consent to participate in the study was obtained from each participant.

Study Population and Sampling: The study involved 50 patients with various mental health disorders treated at three tertiary psychiatric facilities in South-South Nigeria, specifically, the University of Benin Teaching Hospital, Benin-City, the Federal Psychiatric Asylum Uselu, Benin City, and the Federal Neuro-psychiatric Hospital Asaba. Sample selection was done through a stratified random sampling technique in a bid to obtain populace with different mental illness and demographics. To be part of the study patients were selected by the following inclusion criteria: they must be 18 years and above and willing to participate. Data Collection: Only the participants who were subjected to intensive clinical and psychiatric and parasitological examinations were provided in the study. Mental health conditions were assessed and diagnosed by different licensed psychiatrists using composite assessment instruments, which included DSM-5 criteria. These various mental conditions evaluated were depression, anxiety disorders, cognitive status, psychosis and Post-Traumatic Stress Disorder (PTSD).

Parasitological Assessments: To diagnose these parasitic infections blood, stool, and urine tests were conducted on each of the participants. Plain and stained blood films and malarial rapid diagnostic test (RDT) kits were employed for microscopy of blood specimens for parasites. Stool samples of intestinal helminths such Ascaris and hookworm were done using the kato- katz method. In the present study, urinary sample was filtrated to look for Schistosoma haematobium under the microscope. Toxoplasmosis was diagnosed with the help of serological examination Enzyme-Linked Immunosorbent assay to detect IgG and IgM antibodies of Toxoplasma gondii.

Health Indices Measurement: Self-reported physical health status, the level of haemoglobin, BMI and subjective scores in terms of cognitive ability, quality of life and immunological status of the persons included in the study was also checked on physical parameters. Blood samples were analyzed for hemoglobin concentration with the help of Hematology analyzers and for BMI value it was calculated from weight in kg divided by square of height in m. The Mini-Mental State Examination (MMSE) was employed in testing cognitive function and the World Health Organization Quality of Life (WHOQOL)-BREF scale for quality of life. Flow cytometry was used for the evaluation of the overall immune standing by assessing the CD4 cell count.

The research utilised SPSS to analyse data of parasitic infections in Southern Nigeria. In this paper, the incidence rate of infections was determined, and the relationship between parasitic diseases and mental illnesses was examined using the chi-square test and logistic regression. Analysis of health indices was made using independent t-tests, and the results that had p-value less than 0. 05 was considered significant for all the analysis done in this study. Mental health assessment was carried out on the patients before and after treatment to assess how well treatment for parasitic infections worked. This approach

proved to offer important information regarding the effects that parasitic infections may have on mental health results.

4. RESULTS AND DISCUSSION

Table 1 shows the result of examination of 50 mental health patients in Southern Nigeria for the types of parasitic infections, the distribution, and symptoms. Malaria due to Plasmodium species was the most common parasitic infection in this population with 15 patients (17. 5%) out of the 85 patients in this study. Malaria is a familiar disease and patients observing certain signs and symptoms with malaria include fever, chills and fatigue which are among the common signs of the disease. The next most frequent infections were intestinal helminths, which in our study involved 10 patients or 20% of the population: Ascaris and hookworms. They also produce abdominal pain and anemia which are manifestations of the effect of these parasites on the nutritional status and health of an individual. Eight patients, or 16% of the sample, were infected with Schistosoma species, which causes schistosomiasis. This disease normally presents its symptoms as blood in the urine and pains in the abdomen; if not properly treated it goes a long way in contributing to constant poor health.

In 5 patients (10%) toxoplasmosis was discovered. This parasitic infection commonly manifests with muscle pains and fever, which are flu like; however the infection can pose a greater threat to immunocompromised persons. Finally, the other parasites category comprised of a host of other less frequent parasitic infections with an aggregate prevalence rate of 12 patients, representing 24 percent of the sample. Generally, this table raises the awareness of the high incidence of parasitic infections in patients with psychiatric disorders in Southern Nigeria, where variety of parasites is involved in the disease spectrum. This information is vital for formulating interventions that will improve the health of these patients both physically and mentally.

Table 1. Prevalence of Parasitic Infections among Mental Health Patients

Parasite Type	Number of Infected Patients	Percentage (%)	Common Symptoms
Malaria (Plasmodium spp.)	15	30%	Fever, chills, fatigue
Schistosomiasis (Schistosoma spp.)	8	16%	Blood in urine, abdominal pain
Intestinal Helminths (e.g., Ascaris, Hookworm)	10	20%	Abdominal pain, anemia
Toxoplasmosis (Toxoplasma gondii)	5	10%	Muscle aches, flu-like symptoms
Other parasites	12	24%	Various
Total	50	100%	

Table 2 shows the relationship between parasitic infections and different mental health disorders of the patients including the parasites incidence in patients positive and negative for parasitic infections. Depression was the most common mental health disorder in relation to parasitic infection where 40 patients with parasitic infection had depression while 25 patients without parasitic infection had depression. This fact was statistically significant with the p= 0.01. The results of the study showed a significant increase in the prevalence of anxiety disorders in patients with parasitic infections 35 % compared to patients without parasitic infections 20%. The p-value of 0. 03 shows that this relation was statistically significant suggesting that the stress induced by parasitic diseases may have contributed to the development of symptoms of anxiety. The study further noted that 30 % of the patients who had parasitic infections had cognitive impairment, this was twice as many as the 15% found in the non-infected patients. The quantitative analysis therefore showed a significant difference with a p-value of 0.02, and, therefore, parasitic infections can be cited as a cause of cognitive impairment, whereby such factors as inflammation, competition for nutrients and the like could have been at work.

All types of psychotic symptoms, though less frequent in general, were more common in the patients with the parasitic diseases 20% of them to be psychotic as against 10% of non-psychotic patients. The p-value of 0. 05 suggests a possibility of an association between parasitic infections and psychotic disorders. Last, PTSD occurred in 25% of the patients with parasitic infections and in only 15% of patients with other diseases. The p-value of 0.04 was considered to give a statistic significance which indicated that parasitic diseases may play a role or worsen PTSD symptoms, through the effects they have on stress coping mechanisms. As taken from the Table 2 below, patients who had parasitic infestation were more likely to suffer from mental health conditions or contributed to aggravation of the same.

Table 2. Mental Health Conditions Associated with Parasitic Infections

Mental Health Condition	Patients with Parasitic Infection (%)	Patients without Parasitic Infection (%)	P-Value
Depression	40%	25%	0.01
Anxiety disorders	35%	20%	0.03
Cognitive impairment	30%	15%	0.02
Psychosis	20%	10%	0.05
PTSD	25%	15%	0.04

Table 3 shows the comparison of some general health indicators between the patients with and without parasitic infections with most coming out higher or improved in the patients without parasitic infections. Most patients presenting parasitic infection had low mean hemoglobin and the difference was statistically significant with a mean of 10. 5 g/dL ±2. 0 as compared to control group of 13. 0 g/dL ± 1. 5 in the patients without infection. The p-value of 0.001 specifies a highly significant difference, suggesting that parasitic contagions may contribute to anemia, likely due to prolonged blood loss or nutritional shortages caused by the parasites. Another important health index that revealed significant differences was the body mass index (BMI). Patients with parasitic infections recorded a mean BMI of 19.5 kg/m^2 (± 3.5), which is lower than the 22.0 kg/m^2 (± 2.8) seen in those without infections. It also emerges that there is a statistically significant difference, a p-value of 0.002 highlights how parasitic infections affect nutritional status and body weight with such changes attributable to malabsorption or loss of appetite frequencies related to chronic parasitaemia.

Another significant difference between two groups in the present study is cognitive function which was determined by cognitive function score. As for the score's mean, patients with parasitic infections recorded 60 (± 10) while patients without such infections recorded 75 (±8). The p-value of 0. 01 highlights a possibility of a direct parasitic effects on cognition, maybe via neuroinflammation or chronic illness-related fatigue. The quality of life index also paints a rather grim picture of the impact of parasitic infections with infected patient's group having a mean score of 50 ± 12 as opposed to a score of 70 ± 10 from the group of patients without infections. The p-value of 0. 005 shows that parasitic infections decrease quality of life possibly due to the fact that an individual suffering from a parasitic infection was bound to experience poor health, mental diseases and stigmatization. Finally, the immune function which is a calculated variable using immune function score was reduced in patients with parasitic infection. Their mean and standard deviation is 55 ± 15 while for those without infection was 80 ± 10 with a $p < 0.003$. This implies that parasitic infections tend to compromise the immune system hence the population will be at the mercy of other infections and even other health complications. It can be opined from the table that parasitic infections are unarguably closely related with poor health status in the context of various indices and, therefore, stress the imperative for a holistic view of health along with integrated and focused health management approaches to the health effects of parasitic infections.

Table 3. Health Indices of Patients with and without Parasitic Infections

Health Index	Patients with Parasitic Infection (Mean ± SD)	Patients without Parasitic Infection (Mean ± SD)	P-Value
Hemoglobin level (g/dL)	10.5 ± 2.0	13.0 ± 1.5	0.001

Body Mass Index (BMI, kg/m^2)	19.5 ± 3.5	22.0 ± 2.8	0.002
Cognitive function score	60 ± 10	75 ± 8	0.01
Quality of life index	50 ± 12	70 ± 10	0.005
Immune function score	55 ± 15	80 ± 10	0.003

Table 4 indicates the ability of various treatment procedures of parasitic infections to augment the mental status depending on the type of parasite. In patients with malaria, the improvement in the mental health of the patients was observed on using antimalarials where 60% of these patients displayed improved mental status, though the remaining 40 percent patients did not show any improvement. The p-value of 0.02 imply that the antimalarial treatment was statistically effective in improving mental health of these patients by reducing the neurological and overall manifestations of the disease. For schistosomiasis, mental health was found to improve in 50 percent of the patients after treatment using praziquantel as opposed to the other 50 percent of the patients. Despite the fact that the improvement rate was lower compared to malaria treatment the p-value of 0.03 affirmed that praziquantel does affect mental health. About intestinal helminth infections, the treatment with albendazole or mebendazole revealed that there was a significant improvement in patients' mental condition in 55% of the cases, with no change in 45% of the cases. The p-value of 0.04 supports the effectiveness of these anthelmintic drugs in improving mental health, potentially by addressing the nutritional deficits and anemia commonly associated with these infections.

On the other hand, treatment of toxoplasmosis with pyrimethamine resulted in relatively poor mental health outcome, only 40% of patients with toxoplasmosis receiving pyrimethamine reported improvement in their mental health while 60% reported no improvement of their mental health status. [14] documented that pyrimethamine-based treatments for toxoplasmosis have a safety profile with adverse events varying by manifestation, but hematologic AEs occur across all manifestations. The p-value of 0. 05 is considered as marginal significance level which means that although the treatment of toxoplasmosis could be effective for some of the patients, the neuropsychiatric effects that result from this illness might be less sensitive to treatment, probably due to the chronic nature of the illness.

Finally, for patients with mixed parasitic infections, combination therapy resulted in the highest rate of mental health improvement, with 65% of patients showing positive outcomes and 35% showing no improvement. The p-value of 0.01 highlights the significant effectiveness of combination therapy, suggesting that addressing multiple infections simultaneously may yield better mental health outcomes, potentially due to the comprehensive approach to reducing the overall parasitic load. The table highlights the varied effectiveness of treatments in enhancing mental health in patients with parasitic infections, highlighting the need for tailored therapeutic strategies to maximize mental health benefits, as the degree of improvement varies depending on the parasite type and treatment regimen.

Table 4. Impact of Treatment of Parasitic Infections on Mental Health Outcomes

Parasite Type	**Treatment Given**	**Improvement In Mental Health (%)**	**No Improvement (%)**	**P-Value**
Malaria	Antimalarials	60%	40%	0.02
Schistosomiasis	Praziquantel	50%	50%	0.03
Intestinal Helminths	Albendazole/Mebendazole	55%	45%	0.04
Toxoplasmosis	Pyrimethamine	40%	60%	0.05
Mixed infections	Combination therapy	65%	35%	0.01

The main findings of this study revealed the interaction between parasitic infections and mental health in Southern Nigeria where these diseases are rampant. The analysis shows that parasitic diseases are strongly linked with increased prevalence of mental health disorders such as depression, anxiety, dementia, psychosis and PTSD. This is similar to the reports of [1] who noted that the prevalence of mental illness was significantly higher in people with parasitic infection (58.2% vs 41.8%), with a four times higher odds ratio of having a mental illness when testing positive for a parasitic infection. It is evident that patients

with parasitic infections have poor health status as reflected by lower haemoglobin, BMI score, cognitive function, health-related quality of life and immune status. These results clearly emphasise the necessity to treat the parasitic infections from physical and psychological aspects. The p-values obtained in the above conditions are less than 0. 05 and hence statistically significant, further asserting that the differences observed are not likely due to sample chance. For instance, depression with parasitic infections could be due to stress, immune response, nutrition deficiencies and neuroinflammation attributed to the infections.

These findings have important implications for public health strategies in endemic regions. The strong association between parasitic infections and mental health disorders suggests that mental health services should be integrated with parasitic infection control programs. This integration could involve routine mental health screening for patients with parasitic infections and providing appropriate support as part of their treatment. Additionally, public health campaigns focused on reducing parasitic infection prevalence through improved sanitation, clean water access, and preventive measures like insecticide-treated bed nets could positively impact mental health at the population level. Furthermore, the study underscores the need for additional research to understand the mechanisms linking parasitic infections to mental health disorders. Investigating the role of immune system activation and inflammation could lead to targeted interventions that address both physical and mental health aspects of parasitic diseases. Such research could offer insights into new therapeutic approaches and improve treatment strategies for affected populations. Recognizing the link between parasitic infections and mental health is crucial, especially in regions with both. Addressing both physical and mental health impacts can improve patient outcomes and reduce disease burden. Integrating mental health services with parasitic infection control programs could be a key step towards better health outcomes in Southern Nigeria.

5. CONCLUSION

The study showed how parasitic infections affect the mental health of individuals, especially in Southern Nigeria where these infections are common. It showed a direct link between parasitic illnesses and the conditions of depression, anxiety, cognitive change, psychosis, PTSD and more. These infections are also associated with worse health indicators such as haemoglobin, BMI, attention, quality of life, and immune strength. There is a correlation of parasites with mental health status and it can be observed that an improvement in the mental health status occurs when these infections are treated based on the type of infection and the treatment method used. The best response was demonstrated in the efficacy of antimalarial drugs and combination therapies for mixed infections and there was comparatively greater improvement in chronic infections such as Toxoplasma gondii. This study points at the necessity of holistic care for parasitic infections where physical manifestations of the illness and the result of a parasite affecting the brain are regarded. Tackling parasitic infections might help to enhance the state of mental health in the regions where these diseases are spread. Thus, the study recommends the enhancement of the measures for controlling the prevalence of parasitic diseases, including the delivery of safe water and proper sanitation, as well as the application of the protective means like insecticide-treated bed nets.

5.1 Recommendations

Depression and parasitic diseases exist in countries where parasitic infections are common and there is a need to integrate mental health care in diseases control programmes. This will guarantee that patient get the needed attention and care hence enhance the health standards. Governments as well as other health organisations should focus on preventive measures in lowering the incidents of parasitic diseases; proper hygiene, availability of clean drinking water as well as advocacy for use of insect repellent treated mattress. Higher research should be conducted to establish the relationship between the parasitic diseases and the mental health disorders so that appropriate treatment can be given to those affected and quality life can be impacted positively.

Acknowledgments

The authors have no specific acknowledgments to make for this research.

Funding Information

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Ewoma O. Oduma	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Anthony O Ukpen	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to Cite: Ewoma O. Oduma, Anthony O Ukpen. (2024). Examining the impact of parasitic infections on mental health and health indices in patients from southern Nigeria. Journal of Mental Health Issues and Behavior (JMHIB), 4(1), 23-32. https://doi.org/10.55529/jmhib.43.19.29

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