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Prevalence of Geohelminths and its Risk Factors among Secondary School Students in Emohua Local Government Area, Rivers State, Nigeria

Amadi, Mollycent Chiburoma (B.Sc)., Dr. M. N. Wogu (PhD)

Department of Animal and Environmental Biology, University of Port Harcourt

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ABSTRACT

Geohelminths are parasitic organisms that pose a very important public health concern globally. They cause anemia, diarrhoea, stunted growth, and school absenteeism, especially in children. This study was carried out to establish the occurrence of geohelminths among school-aged children in three randomly selected Community Secondary Schools in Emohua Local Government Area, Rivers State, Nigeria. Data were collected through structured questionnaires to obtain socio-demographic information. The stool samples of 325 students were collected after prior consent was obtained from the parents or guardians, and the samples were analyzed using the formol ether concentration technique. The data derived were statistically analyzed, assuming significance at ($p<0.05$). An overall prevalence of parasites was recorded as 69.85%. The identified geohelminths included *Ascaris lumbricoides*, which was 40.53%; hookworm, 21.14%; *Trichuris trichiura*, 9.25%; and *Strongyloides stercoralis*, 4.40%. Gender-based analysis revealed a higher prevalence among females (77.05%) compared to males (60.56%). Age-wise, children aged 10–12 years showed the highest prevalence (75.25%), followed by those aged 13–15 years (67.50%), while the 15–17-year age group had the lowest prevalence (51.06%). A significant association between age and helminthiasis prevalence was observed ($p<0.05$). Similarly, there was a significant association of the type of toilet facility used with helminth infections ($p<0.05$). Accordingly, open defecation practitioners demonstrated the highest prevalence, 81.58%, followed by pit latrine users, 71.86%, while those having water cisterns showed the lowest, 29.17%. The findings call for awareness, raising campaigns to enlighten students on the health risks associated with geohelminth infections and the adoption of preventive practices.

Keywords: Helminth, geohelminth, prevalence, parasites, infection.

INTRODUCTION

Geohelminths which are also known as Soil-transmitted helminths (STHs) are a group of intestinal parasites causing human infection through contact with parasite eggs or larvae by ingestion, penetration by skin or ingestion of stages in the meat of intermediate host.When unwashed, uncooked, contaminated food is ingested by mouth, then parasite travels into intestine and reproduces itself causing symptoms by their toxicity like abdominal pain, diarrhea, vomiting, fatigue, dysentery, weight loss, muscle pain, skin irritation, sleep problem and passing of worms in stool (Strunz et al., 2014).Soil-transmitted helminths belong to the class Nematoda, which includes *Ascaris lumbricoides* (roundworms), *Trichuris trichiura* (whipworms) and hookworms (*Ancylostoma duodenale* and *Necator americanus*).

Intestinal worms occur throughout the developing world, but are most commonly seen in poorest communities. They are primarily seen in areas with poor sanitation and hygiene, and poor water supply. Of the current estimate of 3.5 billion people infected with these worms, about 450 million suffer severe and permanent impairment and majority of these are children (Ukpai et al., 2003). Nigeria is endemic for helminthic infections withPre-school and School-aged children being at greater risk of getting infected due to their poor hygiene practices and play habits which bring them in close contact with contaminated soil (Savioli et al., 2024). The effects of these infections are always detrimental to children.

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The problem of parasitic diseases is compounded by socio-economic factors like illiteracy, poverty, poor sanitation, overcrowding, proximity with animals and lack of clean drinking water as well as socio-cultural practices in food sourcing and consumption (Chharba & Singla, 2009). Infections caused by geohelminths are associated with poor hygienic habits; these include the indiscriminate disposal of human and animal faeces. In Nigeria, intestinal helminth infections continue to prevail because of low living standards, poor environmental sanitation, and ignorance of simple health-promoting behaviours (Sufiyan et al., 2011). Over 260 million preschool-age children. 654 million school-age children, 108 million adolescent girls and 138.8 million pregnant and lactating women live in areas where these parasites are intensively transmitted, and are in need of treatment and preventive interventions (WHO, 2002).

Emohua region in Rivers State, Nigeria, is no exception in contributing to the global burden of soil-transmitted helminth infections. Several studies have been conducted in different parts of Rivers State to educate on, principally, the epidemiological profile of intestinal helminths. However, not much is known

MATERIALS AND METHODS

Study Area

The study was conducted among students in Community Secondary School Obelle, Ibaa Comprehensive High School and Community Secondary School Omudioga, all in Emohua Local Government Area, Rivers State, Nigeria.

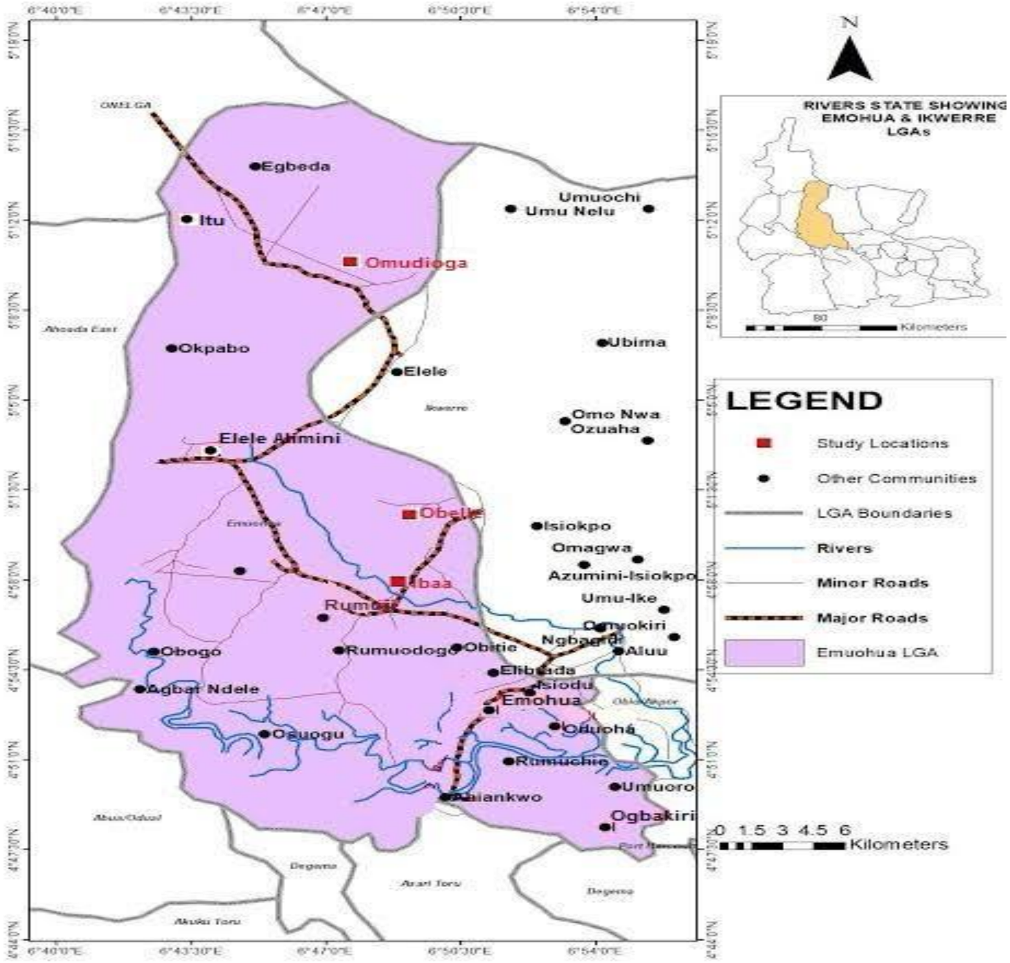

Figure 1 Map of Study Area

Study Design

This study employed a cross-sectional design to assess the prevalence of geohelminths within public secondary school children in Obelle, Ibaa and Omudioga communities in Emohua Local Government Area. This approach allows for the collection of data at a single time and provides an estimate of the prevalence of geohelminths in the targeted population.

Sample Size

A total of three hundred and twenty five (325) consented secondary school students made up of 142 males and 183 females (their age ranged from 10-17 years) from each state secondary school in each of the selected communities in Emohua Local Government Area, Rivers State.

Exclusion Criteria

Children who had previously been dewormed close to the study period and whose parents/guardians refused to give their consent were immediately excluded.

Ethical Approval/Informed Consent

Before commencement of this study, ethical approval was obtained from Uniport Research Ethics Committee and from Rivers State Ministry of Health with ethical number RSHMB/RSHREC/2024/019. The consent of school administrators, parents/guardians of students was gotten before the collection of samples.

Demographic Data Collection

An oral briefing explaining the objectives of the study was given to the participants and were administered a structured questionnaire developed to elicit information on the demographic data (i.e., gender, age, socio-economic status of parents), knowledge and perception (i.e., whether the participant knows about soil transmitted helminths and its mode of transmission), behavioural (i.e., personal hygiene such as wearing of foot wears, washing of hands and food consumption), medical treatment (i.e., whether the participant has taken anthelminthic drugs), environmental sanitation and living conditions (i.e., type of water supply, latrine system and garbage disposal) which was used to assess the potential risk factors for soil-transmitted helminths.

Stool Specimen Collection

Students were given sterile sample bottles with their sex and age boldly written on them and numbered. They were instructed on how to collect the sample (i.e. put a small portion of morning stool in the bottle using the spatula attached to the sterile bottle). Majority of the students co-operated and returned their stool samples the following morning. Stool samples were transported to the Laboratory for diagnosis.

Parasitological Examination

Formol ether technique was employed to examine stool samples for the presence of *A. lumbricoides, T. trichiura* and hookworm eggs. The prepared slides were examined under the microscope with X10 and X40 magnifications. All eggs detected were counted and identified allowing for the quantification of parasite eggs per gram (EPG) of faeces.

Data Analysis

Data was analyzed using SPSS version 23. Results are presented in frequencies, percentages and tables. Chi-square was used to test for association between variables. Result was considered statistically significant at $p<0.05$.

RESULTS

Prevalence of Geohelminths based on Location

This study recorded a 69.85% overall prevalence of soil-transmitted helminth infection among students examined. The prevalence of STH infection was 76.33% in CSS Obelle, 70.09% in Ibaa Comprehensive High School, and 46.94% in CSS Omudioga. Students in CSS Obelle had the highest infection rate (76.33%).

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Table 1Prevalence of Geohelminths based on Location

Schools	No. Examined	No. Uninfected	No. Infected (%)	x^2	p-value
CSS Obelle	169	40(23.67)	129 (76.33)	15.586	0.000
Ibaa CHS	107	32(29.91)	75 (70.09)		
CSS Omudioga	49	26(53.06)	23(46.94)		
Total	325	98(30.15)	227(69.85)		

Prevalence of Geohelminths based on Sex

Table 2 shows the prevalence of STH infection according to gender. Result showed that females (77.05%) were more infected than males (60.56%) and there was a statistically significant difference between both sexes (x^2=10.318, df=1, p=0.001).

Table 2 Prevalence of Geohelminths based on Sex

Sex	No. Examined	No. Uninfected (%)	No. Infected (%)	x^2	p-value
Male	142	56(39.44)	86 (60.56)	10.318	0.001
Female	183	42(22.95)	141(77.05)		
Total	325	98(30.15)	227(69.85)		

Prevalence of Geohelminths based on Age

This study shows that students between the ages of 10-12 years had the highest prevalence of infection (75.25%), those between 13-15 years recorded a prevalence of 67.50%, while age group, 15-17 years had the least prevalence of 51.06%. Chi-square analysis showed a significant association between soil-transmitted helminth infection and age (x^2=10.829, df=2, p=0.004).

Table 3 Prevalence of Geohelminths based on Age

Age (yrs)	No. Examined	No. Uninfected (%)	No. Infected (%)	x^2	p-value
10-12	198	49(24.75)	149 (75.25)	10.829	0.004
13-15	80	26(32.50)	54(67.50)		
15-17	47	23(48.94)	24(51.06)		
Total	325	98(30.15)	227(69.85)		

Prevalence of Geohelminths based on Toilet System Used

The prevalence of geohelminths based on toilet type used revealed pit latrine had the highest number of individuals examined, totaling 263, with 189 (71.86%) individuals testing positive for geohelminth parasites. Open defecation, although involving a smaller sample size of 38, 31(81.58%) were infected; while 7(29.17%) of those who used water closet were infected (x^2=21.849, df=2, p=0.000).

Table 4 Prevalence of Geohelminths based on Toilet System Used

Toilet types	No. Examined	No. Uninfected (%)	No. Infected (%)	x^2	p-value
Pit latrine	263	74(28.14)	189 (71.86)	21.849	0.000
Open defecation	38	7(18.42)	31(81.58)		
Water closet	24	17(70.83)	7(29.17)		
Total	325	98(30.15)	227(69.85)		

Nematode Abundance and Distribution in the Study Area

This study recorded the occurrence of 4 species of soil-transmitted helminths in the students examined in the 3 selected schools, which included *Ascaris lumbricoides*, Hookworms, *Trichuris trichiura*and *Strongyloides stercoralis.*

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Table 5 Nematode Abundance and Distribution in the Study Area

Schools	**No. Positive**	***A. lumbricoides***	**Hookworm**	***T. trichiura***	***S. stercoralis***	**Multiple infection**
CSS Obelle	129	52(40.31)	23(17.83)	9(6.98)	7(5.43)	38(29.46)
Ibaa CHS	75	30(40)	18(24)	8(10.67)	3(4)	16(21.33)
CSS Omudioga	23	10(43.48)	7(30.43)	4(17.39)	0(0)	2(8.70)
Total	227	92(40.53)	48(21.14)	21(9.25)	10(4.40)	56(24.67)

DISCUSSION

The prevalence of helminthiasis in the current study was 69.85%. This is higher than the 55.4% and 40% reported by Akaet al. (2017) and Okolieet al. (2016) who carried out research in southern and northern Nigeria respectively but similar to the work of Olufotebi et al., (2017) who recorded a prevalence rate of 62% in Ibadan, Oyo State in Nigeria. Also, Adamu et al. (2023) recorded a prevalence of 60.4% among school age children in Kano, Northern Nigeria. Also, Oyewole*et* al. (2007) recorded a high prevalence of intestinal helminths of 77% in parts of Delta State likewise Awi-Waadu et aI. (2005) recorded overall prevalence rate of 84.6% in part of Port Harcourt. The higher prevalence can be attributed to poor environmental and personal hygiene, shortage of portable water and indiscriminate defecation. The unacceptable state of environmental hygiene and inadequate supply of portable water prevalent in the study area is to a great extent responsible for the high prevalence reported in this study. The inhabitants practice open defecation and get their water from sources that are not good and are susceptible to contamination by wastes including human and animal faeces containing cysts, ova and/or larva or spread by vectors such as flies. The chances of ingesting parasites ova or cysts are thereby greatly enhanced. One of the primary factors contributing to the differences in STH prevalence is environmental conditions, particularly climate and sanitation. Warm, humid climates provide ideal conditions for the survival and transmission of many parasitic species, such as *Ascaris lumbricoides* and *Trichuris trichiura* (Hotez et al., 2014). Regions with poor sanitation, such as inadequate waste disposal systems and limited access to clean water, also exhibit higher prevalence rates. These conditions facilitate the contamination of soil and water with parasitic eggs and larvae, increasing the risk of transmission to humans (WHO, 2020). Socioeconomic status is another critical factor influencing the prevalence of STH. Populations living in poverty often lack access to proper healthcare, education, and sanitation, all of which are crucial for preventing and controlling parasitic infections (Pullan et al., 2014). Poor nutrition, which is more common in low-income communities, can weaken the immune system, making individuals more susceptible to infections. Furthermore, overcrowded living conditions, often associated with poverty, can enhance the spread of parasites through close person-to-person contact or shared contaminated resources (Bethony et al., 2006). Also, cultural practices and behaviors also play a role in the varying prevalence of GI parasites. In some regions, traditional practices such as open defecation or the use of untreated human feces as fertilizer can increase the risk of soil-transmitted helminth infections (Strunz et al., 2014). Additionally, dietary habits, such as the consumption of raw or undercooked meat and fish, can expose individuals to parasites like *Taenia* spp. and *Diphyllobothrium* spp. Biological factors, including age and genetic susceptibility, contribute to the differences in STHs prevalence among individuals. Children are particularly vulnerable to parasitic infections due to their developing immune systems and behaviors, such as playing in contaminated soil (WHO, 2020). Genetic factors can also influence an individual's susceptibility to certain parasites. For instance, individuals with certain blood types may have a higher or lower risk of infection by specific parasites (Blackwell et al., 2009).

In the present study, females recorded a significantly higher prevalence of infection than males ($p<0.05$). This result aligns with findings from other studies that have investigated the sex-based prevalence of geohelminths. For instance, a study conducted by Osei-Atweneboana et al. (2012) in Ghana also reported a higher prevalence of helminth infections among females compared to males, attributing this disparity to differences in exposure risk and possibly biological factors that make females more susceptible. Another study by Montresor et al. (2014) conducted in Ethiopia corroborated these findings, reporting a significantly higher infection rate among females, which the authors linked to cultural practices that might expose women more to sources of infection, such as agricultural activities. In contrast, some studies have found no significant difference in helminth

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infection rates between sexes. For example, a study by Pullan et al. (2011) in Kenya observed an almost equal prevalence among males and females, suggesting that the difference in infection rates could be more influenced by age, environmental factors, and access to healthcare rather than sex alone. These findings highlight the complexity of helminth transmission dynamics and suggest that multiple factors, including socioeconomic status, behavior, and access to sanitation, play a crucial role. The current study's findings, which indicate a statistically significant higher prevalence of helminth infections in females, add to the body of evidence suggesting that gender-related factors, potentially linked to behavioral and environmental exposures, are important determinants in the epidemiology of helminth infections. However, the variations in findings across different regions and studies underline the need for localized strategies in managing helminth infections, taking into consideration the specific risk factors prevalent in each population.

The present study indicates a decreasing prevalence of geohelminths parasites with increasing age. Specifically, the highest prevalence is observed among the 10-12year age group (75.25%), followed by the 13-15year age group (67.50%), and the lowest prevalence in the 15-17year age group (51.06%). These findings are consistent with several other studies that have explored age-related patterns in the prevalence of geohelminths parasites. For instance, a study by Living-Jamala et al. (2018) found that younger children had higher prevalence rates of intestinal parasites compared to older adolescents. This was attributed to increased exposure due to behaviors such as playing in contaminated environments and poorer hygiene practices among younger children. Similarly, a study conducted by Nematian et al. (2014) in Iran reported that the prevalence of intestinal parasites decreased with age, with the highest rates observed in children under 12 years of age. This trend was explained by the maturation of the immune system and improved personal hygiene as children grows older, which reduces the likelihood of infection. In contrast, some studies have observed different patterns. For example, a study by Alemu et al. (2011) in Ethiopia found no significant age-related difference in the prevalence of geohelminths parasites. The authors suggested that factors such as environmental conditions, socioeconomic status, and community health interventions might play a more prominent role than age in determining infection rates.The immune system undergoes substantial changes throughout the human lifespan, impacting the body's ability to combat infections. In early childhood, the immune system is still developing, resulting in heightened susceptibility to infections, including geohelminths (Smith & Jones, 2017). The immature immune response in children is often characterized by lower levels of immunoglobulin production and a reduced capacity to mount an effective immune response to helminth infections (Patel et al., 2019). As individuals age, the immune system matures and generally becomes more robust during adolescence and adulthood. This period is marked by an increased production of antibodies and a more effective immune response, which can lead to lower prevalence rates of geohelminths in this age group (López et al., 2018). However, in older adults, the immune system undergoes a process known as immunosenescence, where the efficiency of the immune response declines, leading to increased susceptibility to infections, including helminths (Walker & Thomas, 2021). The prevalence of geohelminths varies significantly across different age groups, largely due to the aforementioned changes in immunity. Studies indicate that children are more susceptible to helminth infections due to their developing immune systems and higher exposure to contaminated environments (Nworie et al., 2020). Children often play in soil or consume contaminated food and water, increasing their risk of ingesting helminth eggs or larvae. In contrast, adolescents and adults typically exhibit lower prevalence rates of geohelminths. This can be attributed to a combination of a more developed immune system and better hygiene practices. However, in regions with high helminth endemicity, adolescents and adults may still be affected, although the intensity of infection tends to be lower compared to children (Smith et al., 2016). In older adults, the prevalence of geohelminths may increase again due to the decline in immune function associated with aging. Immunosenescence results in a reduced ability to clear infections, making older adults more susceptible to chronic helminth infections (Kundu & Chakraborty, 2023). Furthermore, age-related changes in geohelminths physiology, such as altered gut microbiota and reduced gastric acid secretion, can create a more favorable environment for helminths (Ahmed et al., 2022).

In the present study, results indicated a significant variation in infection rates between users of the various toilets systems, with open defecation showing the highest prevalence (81.58%), followed closely by pit latrines (71.86%) while water closets(29.17%) recorded the least ($p<0.05$). These findings underscore the critical role of sanitation infrastructure in mitigating the spread of gastrointestinal parasites. Studies from various regions have consistently highlighted similar trends. For instance, Ayele et al. (2020) conducted a study in Ethiopia, where areas relying heavily on open defecation reported a higher prevalence of parasitic infections compared to those using improved latrines. Similarly, a study in Nigeria by Oluwole et al. (2018) found that the use of pit latrines was significantly associated with higher parasite prevalence due to inadequate containment of fecal matter, leading to environmental contamination. However, some studies suggest that merely having access to improved toilet facilities is insufficient. For example, Freeman et al. (2017) observed that hygiene practices, including handwashing with soap, were equally important in reducing the risk of gastrointestinal parasites. In regions where water closets are available but hygiene education is lacking, the expected reduction in prevalence may not be fully realized.

The abundance and distribution of geohelminths showed variation across the various locations studied. Variations in gastrointestinal helminths between locations are driven by environmental, socioeconomic, and cultural factors. Regions with poor sanitation and hygiene often experience higher prevalence due to fecal contamination of water and soil (Strunz, 2014). Warm, humid climates enhance parasite survival and transmission (Brooker, 2006). Differences in agricultural practices and proximity to livestock also affect exposure. Access to healthcare, including deworming programs, significantly reduces infection rates in wealthier areas (Hotez, 2008). Additionally, cultural practices like open defecation or specific dietary habits influence regional differences. Addressing these disparities requires tailored interventions targeting local risk factors.

Preventive Measures against Geohelminth Infections

Geohelminth infections are largely preventable through a combination of improved personal hygiene, environmental sanitation, and sustained public health interventions. One of the major preventive strategies is the elimination of open defecation, which remains a significant source of soil contamination with infective eggs and larvae. The provision and consistent use of properly constructed toilet facilities such as pit latrines and water-sealed toilets are therefore essential in reducing environmental exposure to geohelminths.

Personal hygiene practices also play a critical role in preventing infection. Regular handwashing with soap and clean water after using the toilet, before meals, and after contact with soil can significantly reduce the risk of ingestion of parasite eggs. Additionally, the habit of walking barefoot, especially among school-aged children, increases exposure to infective larvae present in contaminated soil; hence, the regular use of footwear should be strongly encouraged.

Environmental sanitation measures, including the routine cleaning and disinfection of defecation areas, pit latrines, and cisterns, are important in minimizing the survival and spread of geohelminth eggs in the environment. Proper waste management and the safe disposal of human faeces further contribute to interrupting the transmission cycle of these parasites.

Furthermore, periodic mass deworming programs, particularly among school-aged children who are most vulnerable, should be integrated with health education campaigns. Such educational interventions should focus on raising awareness about transmission routes, risk factors, and preventive practices associated with geohelminth infections. When combined with improved sanitation infrastructure and community participation, these measures can substantially reduce the prevalence and public health burden of geohelminth infections in endemic communities.

CONCLUSION

The study has revealed the current status of soil-transmitted helminths among students in Emohua Local Government Area, Rivers State. It shows that the prevalence of soil-transmitted helminths in school-aged children in the study area is high. This is may be as a result of low socio-economic position and lack of basic amenities like clean water as well as poor personal hygiene and open defecation which is common in the study area. It is strongly advised that awareness campaign should be carried out in to educate the students on the adverse effects of the infections and preventive ways they can practice.

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