CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Freshwater snails are gastropod molluscs that inhabit different freshwater bodies including lakes, rivers, roadside ditches and backyard ponds. They are most commonly found along the shallow edges of water bodies (Lee, 2000). In general, the aquatic snail hosts of schistosomes occur in shallow water near the shores of lakes, ponds, marshes, streams and irrigation channels. They live on water plants and mud that is rich in decaying organic matter. They can also be found on rocks, stones or concretes covered with algae or on various types of debris. They are most common in waters where water plants are abundant and in water moderately polluted with organic matter, such as faeces and urine as is the case near human habitations (Robert and Janovy, 2000). Plants serve as substrates for feeding and oviposition as well as providing protection from high water velocities and predators such as fish and birds (Lee, 2000). Under natural conditions, snails are exposed to ranges of varying and often interacting environmental factors which produce collective effects on the snail populations (Njoku-Tony, 2011). These factors affecting snail distribution can be biotic and abiotic.

The biotic factors include the vegetation, food supply, human influence and predators while the abiotic factors include geology of the area, sunlight, turbidity, chemical analysis and climate (temperature and rainfall) of the area (Ayanda, 2009). These factors determine the suitability of a site to snail population. Freshwater snails play very important role in the transmission of most trematode diseases of man and domestic animals (Ekwunife *et al*., 2008). These include urogenital schistosomiasis caused by *Schistosoma haematobium* and intestinal schistosomiasis caused by *S. mansoni* and *S. japonicum.*Freshwater snails are also intermediate hosts of foodborne fluke infections affecting the liver, lungs and intestines of human and animals which include fascioliasis caused by *Fasciola* species, clonorciasis

caused by *Clonorchis sinensis*, paragonimiasis caused by *Paragonimus westermanni* among others(Robert and Janovy, 2000). Some of the snail intermediate hosts involved in these diseases transmission in Nigeria are *Lymnaea truncatula, L. natalensis, Potadoma liberensis, Melanoides tuberculata, Biomphalaria pfeifferi, B. rhodesiensis, Bulinus africanus, B. umblicatus, B. ugandae, Oncomelania nososphora* and *Tricula aperta* among others (WHO, 2014). Freshwater intermediate hosts of schistosomiasis in tropical Africa include *Bulinus globosus, B. truncatus, B. senegalensis, B. angolensis* and *B. rohlfsi* (Roberts and Janovy, 2000).

Schistosomiasis is one of the neglected parasitic infections of man in the tropical and subtropical areas of the world. The infection is widespread and prevalent in Africa where the snail intermediate hosts breed in waters contaminated with urine or faeces of infected persons. Globally, schistosomiasis ranks second to malaria as the world's most debilitating parasitic disease in terms of the extent of endemic areas and number of infected persons (WHO, 2017).

Schistosoma haematobium is the most prevalent of all schistosomes infecting man (WHO, 1993). *S. haematobium*, the causative agent of urogenital schistosomiasis is endemic in about 78 countries worldwide including 53 African countries and in the Middle East. It is found in several Islands of the Coasts of East and West Africa (WHO, 2014). In some areas, the distribution of *S. haematobium* overlaps with *S. mansoni* causing mixed infection. About 500-600 million people worldwide are at risk of infection and the annual deaths associated with schistosomiasis are estimated at 20,000 (WHO, 2017).

Schistosomiasis infects a large proportion of children under 14 years of age in many of the affected areas. Nigeria is one of the countries known to be highly endemic and the disease is prevalent in the 36 states of the federation including Federal Capital Territory (National Schistosomiasis Control Programme, 1996). Federal Ministry of Health (FMOH) estimates

that approximately 24 million Nigerians are at risk of schistosomiasis infections and 21 million are at risk of intestinal worms (FMOH, 2015).

In Anambra State, 15.7% prevalence of urogenital schistosomiasis was recorded in Orumba North and South Local Government Areas (Ugochukwu *et al*., 2013). Agulu lake is implicated as a focal point in the transmission of *S. haematobium* (Emejulu *et al*., 1994). Ude *et al,* (2009) reported a prevalence rate of 48.1% using haematuria as a screening tool and 58.3% using Polymerase chain reaction (PCR) in a study at Umuowele village in Agulu community. Obiekwe (2010), observed a prevalence rate of 4.28% among 280 primary school children examined for urinary schistosomiasis in Agulu, Anambra State. In Umuikwu-Anam, Anambra West LGA, a prevalence rate of 37.9% and 7.9% were recorded by Ekejindu *et al*., (2002) and *Ezeagwuna et al*, (2012) respectively.Amazigo *et al* (1997) recorded a prevalence of 26% among school children in Umueze-Anam, Anambra West LGA. Prevalence rate of 76% was recorded in Amagunze, Enugu State by Ozumba *et al*., (1989) while Nwaorgu and Anigbo (1992) recorded 48.4% among 1,017 subjects examined in the same area.

1.2 STATEMENT OF THE PROBLEM

Communities in Orumba North LGA are agrarian communities cultivating rice and other water-loving crops.The Federal Government policy on diversification of economy through revitalization of tourism, agricultural and recreational activities (fishing, swimming and farming) in endemic areas like Orumba North Local Government Area, does not only spur them to harder work but also predisposes the people to the transmission of urogenital schistosomiasis. Also there has been no concerted effort to evaluate and relate snail ecology with schistosomiasis prevalence in the area.Although much studyhas been conducted elsewhere in Nigeria and many parts of Anambra State, there is paucity of information on schistosomiasis epidemiology and snail ecology in Orumba North Local Government Area.

Since individuals whose occupation has to do with contact with infected waterbodies are at risk of infection, it became necessary to investigate the freshwater snails' ecology and schistosomiasis epidemiology in the area.

1.3 JUSTIFICATION OF THE STUDY

Several factors are involved in the epidemiology of schistosomiasis and they include geographical, meteorological and socio-economic factors (WHO, 2012). The distribution of the snail intermediate host is one of the main determinants of endemic schistosomiasis. In a multi-level analysis of the risk factors for *Schistosoma japonicum* infection in China, Yang *et al.,* (2009) observed that availability of lake, age and frequency of contacts with infected water by humans and livestock is a major factor to the infection. This was also confirmed by Rudge *et al.,* (2008) who observed that water contact patterns; availability of snail intermediate host and proximity of children's home to the site harbouring *S. haematobium* snail hosts were contributory factors. Children who contacted contaminated water on daily basis had significantly higher egg-positive rates than those who contact the water weekly or less often (Geleta *et al*, 2015). Swimming in rivers, bathing, washing of clothes, breadfruits and cassava and nearness to the river basin was observed by Ismail *et al*, (2014) as risk factors. Children who attend schools close to open water sources were at higher risk of infection; those who were involved in irrigation and those that swim in the water bodies had higher risk of becoming infected with the disease in Guma Local Government Area, Benue State (Amuta and Houmsou, 2014).

Individuals whose occupation has to do with contact with infected water like fishing, washing of cassava, breadfruits and farming were exposed to this infection (Cheesbrough, 2004). Individuals within developing countries of Africa who cannot afford proper water and sanitation facilities were at risk of being exposed to contaminated water containing the

infected snails. Hence, WHO, (2017) rightly pointed out that poverty, ignorance, deplorable hygiene practices and poor sanitary practices expose people to infection.

Transmission of schistosomiasis also varies according to shape, vegetation and geographical location of the water contact sites and it is distinctly seasonal too (Mazigo *et al.*, 2012). The majority of the transmission of schistosomiasis occurs within the large water bodies, dams, irrigation schemes and in temporal water bodies and where there is availability of suitable vegetations. The transmission pattern is seasonal and alternates between rainy and dry seasons (Mazigo *et al.*, 2012). All the observed factors are rife in Orumba North Local Government Area where the study was carried out.

1.4 AIM AND OBJECTIVES

The aim of the study was to investigate the ecology of freshwater snails in Obutu and Iyiegwu lakes and the epidemiology of urogenital schistosomiasis in Omogho and Ndikelionwu communities in Orumba North Local Government Area, Anambra State, Nigeria**.**

The specific objectives were to determine

1. The snail species composition,distribution and infectivity in Obutu and Iyiegwu lakes in Orumba-North Local Government Area.
2. Ecological factors influencing freshwater snails' survival and distribution in the lakes.
3. Urogenital schistosomiasis prevalence in Omogho and Ndikelionwu communities.
4. The people's knowledge, attitude and management practices as regards*Schistosoma haematobium* infection.
5. The predisposing factors of urogenital schistosomiasis infection in the communities and the water-contact activities in the lakes.

CHAPTER TWO

LITERATURE REVIEW

2.1 FRESHWATER SNAILS ECOLOGY

Freshwater snails live in all types of wet habitats from large lakes and rivers to roadside ditches and backyard ponds. Some species of freshwater snails can also be found in temporary wet areas where they survive by burrowing into the substrate to wait out dry periods. Burrowing is a strategy used by some molluscs to survive adverse weather conditions (drought and winter). Others avoid ice by retreating to unfrozen areas (Lee, 2000). A proportion of snail species are able to withstand desiccation for months while buried in the mud bottom by sealing their shell opening with a layer of mucus but most species survive outside water for short periods.

Generally, the presence and density of snails differ highly among sites, and their variability within irrigated areas, is related to the canal type, distance of sites from the canal source and the composition and density of aquatic vegetation (Boelee and Madsen, 2006). *Bulinus forskalis* is an afrotropical species and occur in almost all African countries. An extreme variant of *Bulinus forskalis* lives also in Sao Tome Island and Swaziland and has recently been introduced to Madagascar, it is also found in Nigeria and Sierra Leone (Appleton *et al,* 2009).

2.1.1 Freshwater Snails Distribution in Nigeria

Freshwater snails' distribution and abundance drive the links between transmission and environment and they help in the assessment of infection status of water bodies and play significant roles in the public and verterinary health of a community and also have wide range of social, economic and medical importance to man (Olorunniyi and Olofintoye, 2017). The continuous transmission of schistosomiasis and other snail-borne diseases are enhanced by the distribution of freshwater snail intermediate hosts in the area. Oloyede *et al*., (2016)

recorded a total of two thousand, two hundred and thirty (2230) freshwater snails in Eleye Dam, Ibadan, Oyo State consisting of *Melanoides* spp, *Potadoma* spp, *Lymnaea* spp, *Gabbiella* spp, *Indoplanorbis* spp, *Physa* spp, *Biomphalaria* spp and *Bulinus* spp. Ndifon and Ukoli (1989) reported the presence of nine pulmonates and five prosobranchs in freshwater habitats in South-Western, Nigeria which are *Biomphalaria* spp, *Bulinus* spp, *Lymnaea* spp, *Physa* spp, *Gyraulus* spp, *Ferrissia* spp, *Segmentorbis* spp, *Lanistes* spp, *Pila* spp, *Potadonia* spp and *Melanoides* spp. In a study carried out by Olorunniyi and Olofintoye (2017), on the occurrence and distribution of freshwater snails in Ekiti State, it was reported that only *Bulinus* spp, *Bellamyia* spp, *Potadomamoerete* spp and *Lanistes* spp were abundant. All the freshwater snails co-existed in the same habitat. In Nigeria, freshwater snails abound due to inadequate portable water and activities related to water resource development schemes for irrigation, fishing and hydro-electricity. Ecological changes resulting from damning of rivers and streams to create man-made reservoirs have given rise to more favourable breeding sites for freshwater snails of medical importance (Ofoezie, 1999). Njoku-Tony (2011) reported the presence of *Pila* spp, *Lymnaea* spp and *Anisus* sp in a study carried out in Imo State due to water contact sites that have the physic-chemical parameters such as contaminated water, pH, temperature, dissolved oxygen and conductivity and are also surrounded by vegetations that hold high density of snail species population.Out of 105 water bodies studied across Nasarawa State, Nigeria for snail hosts abundance, nine hundred and seventy seven (977) snails were collected which included *Bulinus* spp, *Biomphalaria* spp, *Lymnaea* spp and *Indoplanorbis* spp. No *Pila* spp was collected. The physico-chemical parametres (pH, temperature and dissolved oxygen) were significant for the abundance of the snails (Abe *et al*., 2017). In Ado-Ekiti, Ekiti State, Nigeria, Omonijo *et al*., (2016) reported that a total of two thousand, five hundred and fifty nine (2559) snails were collected belonging to five genera thus; *Bulinus* spp, *Potadoma* spp, *Melanoides* spp, *Lanistes* spp and *Biomphalaria*spp.

there was co-existence of the snail species in the study areas. Different types of freshwater snailsinvestigated in Jakara Dam, Kano State, Duwa (2017) collected a total of two thousand, eight hundred and thirty six snails and only *Bulinus* spp, *Melanoides* spp, *Bithynia* spp and *Lymnaea* spp were abundant in the Dam. Ikpeze and Obikwelu (2016) in their study in Agulu Lake shorelines on the seasonal abundance of gastropods of Public Health Importance reported the presence of *Bulinus* spp, *Lymnaea* spp and *Melanoides* spp in the study area. The gastropods' density was strongly and positively correlated with Calcium ions of the water body.

2.1.2Ecological Factors Affecting the Distribution of Freshwater Snails

Snail ecologists have tried to correlate snail distribution with physico-chemical factors to discover the ranges of these factors within which the snails thrive (WHO, 2017). Although any physical, chemical or biological factor can have a significant effect on the population dynamics of the freshwater snails, those related to climate (temperature and rainfall) are of particular importance in the natural history of Planorbid snails (Owojori *et al*., 2006).

2.1.3 Biotic Factors

a. Vegetation

Vegetation affects the freshwater snail density because they exhibit higher oxygen tension owing to photosynthesis. Aquatic plants provide oxygen and consume carbondioxide; broad-leafed vegetations provide a suitable surface for egg laying while microflora serves as food (Owojori *et al*., 2006). Some plant species in the family Nymphaceae; for example, white water lily, appear to favour the life of snails while some appear to be harmful to the snail population, example *Saponaria*. Out of the ten (10) species of aquatic vegetation identified in the man-made Oyan reservoir in Ogun State, six (6) correlated positively and significantly with various snail species in the area (Robert and Janovy, 2000).

The most important of the associating vegetation was *Impatiens irvingii* which correlated with all snail species and served as indicator plant in the area. *Ludwigia erecta* and *Acroceras zizaniodes* were the most frequently encountered macrophytes in Opa Reservior and Research Farm ponds in Ile-Ife but only *A. zizaniodes* stood out as the most dense (Owojori *et al.*, 2006).

b.Human Influence

Areas of the water body with much human activity always have high snail population for effective infectivity. Bathing, swimming, washing of clothes and household utensils in the stream, gardening, soaking and washing of cassava are main avenues through which people get in contact with water and possibly contaminated with *Schistosoma*. Influence of gender on water use patterns was found to be significant because females visit the water for domestic chores while males visit for recreational activities (Monde *et al*., 2016). The effect of human activity with respect to urogenital schistosomiasis is felt more in rural areas where the population uses natural water habitats for domestic water supply, fishing and other recreational and agricultural purposes. It was observed that livelihood strategies (farming and fishing) significantly influenced snail abundance (Monde *et al*, 2016).

c. Food supply

Pulmonate snails feed as they move and the total composition of the diet is important in conditioning the habitat. Robert and Janovy, (2000) observed that habitats that are poor in higher plants and rich in algae and diatoms have been found to contain thriving snail populations. Snails do not feed directly on higher plants but probably ingest decaying plant matter and the microflora of algae and bacteria covering it. In a study carried out by Lydig, (2009), it was observed that *Bulinus* spp and *Lymnea natalensis* were found in habitats with aquatic vegetation but absent in habitats without any clear aquatic vegetation.

d. Predators

The role of predation in regulating snail population is hardly known, but freshwater snails are popular food source for various birds, turtles, tortoise, crocodiles, lizards and other aquatic mammals. Man also uses snails for domestic and spiritual purposes (Robert and Janovy, 2000). In this way, predation may be responsible for mortality of snails. Rasser and Covich, (2014) reported that snails grew to be 1.3-2 times as large in temporary environment without predators and laid nine times as many eggs than in the ones with predators. Adults showed to be more abundant in the temporary ponds than the permanent ponds. The obvious difference they reported was the presence of molluscivorous central mud minnow (*Umbra limi*) in the permanent pond. This fish fed upon *Lymnea elodes* when eggs and juvenile snails were abundant. In the temporary pond, addition of the mud minnows lowered egg and juvenile snail survival where snail abundance had been increased. So vertebrate predators like mud minnow can be significant source of mortality for thin-shelled species of snails like *L. elodes* (Rasser and Covich, 2014).

2.1.4 Abiotic Factors

Ecology of freshwater snails depends on the physical geography of a given region. Land contours, soil composition, hydrography and climate have significant effect on snail ecology and population dynamics (Seuffert *et al*., 2010).Garg *et al*, (2009) attributed the richness of molluscs observed in Ramsagar Dam to the cumulative effect of alkaline nature of water, high calcium contents and presence of macrophytic vegetation. Seuffert *et al*., (2010) recorded a positive correlation between molluscs and temperature. Sharma *et al*, (2013) recorded that the pH of the stream studied ranged from slightly acidic to highly alkaline and furnished a positive relationship with gastropods. In a work carried out by Akande and Odetola (2011) on the comparative studies of two fresh water snail distribution and physico-

chemical parameters in some Dams in Nigeria, it was observed that snails thrive better in oxygenated, slightly acidic (pH 5.6), low turbidity and low saline water.

a. Temperature

Fluctuations in water temperature affect the survival of freshwater snails, low temperatures ($\leq 5^0$C) slow down their physiological functions and ones living in ponds with high temperatures ($\geq 30^0$C) struggle to survive (Farghnak *et al*., 2006).The snails can easily survive between 10^0C and 35^0C (Robert and Janovy, 2000). Temperature also affects the growth of snails. Fecundity decreases and mortality increases at temperature of 5^0C or less and above 30^0C. Temperature between 22^0C and 26^0C are usually optimal for snail reproduction but *Bulinus* snails in Ghana and other hot places have a wider temperature range. Lymnaeids undergo optimal development and reproduction at temperatures of 10-30^0C. When environmental conditions become unfavourable, Lymnaeids survive by aestivating during droughts and hibernating during the coldest months (Seuffert *et al*., 2010). *Oncomelania* snails survive periods of drought because they possess operculum capable of closing the shell opening. In temperate zone, they can survive for 2-4 months, but in the tropics, much less (Robert and Janovy, 2000).

Freshwater snails can produce thousands of eggs in their life time but they do not lay eggs in temperatures below 18^0C. Egg laying increases with temperatures up to 30^0C. Snail hatching and development is also directly linked to temperature because eggs hatch within 5-10days. Low temperatures tend to reduce activity and breeding. *Biomphalaria pfeifferi* are less tolerant of higher temperatures and are absent where temperature of more than 27^0C last for more than 120 hours per week. Bulinid snails appear better adapted to higher temperatures (Kalinda *et al*., 2017).Nunes and Santos (2012) also reported that atmospheric and soil temperatures affected the distribution and abundance of land snails in two hills in Brazil.

b. Sunlight

Snailsalso depend on light without which there will be no algal growth which they depend on for main food source (Perea *et al*., 2007). Some snails are not found in heavily shaded areas and their movement is considered to be influenced by light. Sunlight enables the macrophytic aquatic weeds and microflora to make use of carbondioxide to produce carbohydrate and release oxygen. However some snails are negatively photo-tactic and movement activities are usually noctural. For example, the freshwater snail, *Planorbis* is negatively photo-tactic and movement activity is nocturnal in case of a variety of aquatic and terrestrial pulmonate. *Bulinus* snails are reared successfully for several generations in total darkness and vertical migration away from the light (Kalinda *et al*., 2017). Light is also significantly involved in aquatic food cycle by promoting the growth of microflora/aquatic plants on which the snails feed. Light also stimulates sexual activity in vector snails and also affects cercarial emergence as both miracidia and cercariae are phototropic.

c. Rainfall

Seasonal variations have been reported in snail populations from a wide range of natural and man-made tropical habitats. In a study conducted by (Kimura *et al.*, 1997) in Kenya, it was revealed that snail populations were highest in March and April (beginning of the rainy season). The population decreased rapidly in late May when heavy rains occurred and flood dislodged them from their habitats. Akogun and Okon (1993) observed that *Bulinus* decreased in abundance during the dry season but picked up in May, the onset of rains with a peak between July and October. They also reported that *Biomphalaria pfeifferi* showed two peak prevalences between July and October and between February and April. Availability of snail intermediate host is influenced by the dry and rainy seasons (Greveldin, 2004). Most freshwater snails undergo seasonal changes pending on water size and level, rate of flow,

oxygen content, and flora and ion concentration. Rainfall sometimes provides stimulus for reproduction and an increase in snail population densities in some habitats. Rainfall may reduce population densities of snail because of flushing out of streams and suppression of breeding. Snail population peaks in habitats liable to flooding during dry season while in stagnant ones; highest density is noticed during rainy season.

d. Water Current

Water current and levels control snail population densities and vary between years and seasons. There is a range of water current for snails above which anchorage is difficult. Increase in water current may result in population fluctuations (Giovanelli *et al*., 2005). Detritus feeders remain motile in water current up to 30cm/sec but high current may sweep away large amount of potential food (Appleton *et al.,* 2009). Snail intermediate hosts are intolerant of strong current. When current is high as in rivers and streams, the snails are unable to relax, and cannot move, feed or maintain themselves (Giovanelli *et al*., 2005). Snails are found in areas where the water current is below 40cm/sec (Jones, 1993). Snails are not normally found at waterfalls, on exposed shores of a lake or in irrigation schemes with very swift flow. *Bulinus* species can withstand current better than *Biomphalaria* species (Senghor *et al*., 2015).

e. Turbidity

Opisa*et al.,* (2011) reported that clear water is a crucial condition for the population of freshwater pulmonates.High turbidity inhibits aquatic vegetation which may affect the food source of the snails. Adult and juveniles are not harmed by water turbidity but silt deposition harms the egg masses. Aquatic snails are found in turbid water but population growth is generally poor. In drinking water, the higher the turbidity level, the higher the risk of people developing gastrointestinal diseases (Mann *et al*, 2007). In water bodies such as lakes, rivers and reservoirs, high turbidity levels can reduce the amount of light reaching lower depths

which inhibit growth of submerged aquatic plants. Turbidity levels as high as 600 Nephelometric turbidity units (NTU), are needed for proper ecosystem health while turbidity as low as 5NTU or less is optimal for drinking water (WHO, 2017).

f. Salinity

An increase in salinity of water has adverse effect on the chances of survival of aquatic snails. WHO, (1977) reported that habitats having less than 150mg/l of dissolved solids were free of established colonies of *Bulinus globosus* in Puerto Rico possibly due to low concentration of one or more electrolytes. Egg laying also declined when the concentration of Sodium chloride (NaCl), Potasium chloride (KCl) and Magnesium chloride ($MgCl_2$) were below normal levels (357g/litre, 344g/litre and 745g/litre respectively) and immersion of snails in 0.3-1.0% NaCl causes an immediate increase in oxygen consumption. Concentration above 0.5% NaCl causes gross disturbance in respiration within a few hours and death within a few days. *Biomphalaria* species is inhibited at NaCl concentrations of 6000ppm and the optimal pH for development is 7.0-8.0 (WHO, 1977).

g. Calcium and Magnesium ions (Ca_2 and Mg_2)

These help to enhance shell formation. The quantity and quality of snail food substances may be affected by calcium levels. It has been shown that the composition of algae films vary according to the calcium concentrations. Snails thrive better with high calcium content (Agi and Okwuosa, 2001). There are various ranges of calcium needed for snail existence; at 10-30mg/l, egg laying rate of *Biomphalaria pfeifferi* was at its optimum. Okafor (1984) stated that normal ranges are 40-70mg/l in Nsukka area of Southeastern Nigeria.

h. pH

pH is one of the most important parameters in water chemistry that measures the acidity or alkalinity intensity in water, which in turn affects the distribution of aquatic snails. Snail intermediate hosts can breed between pH 4-10. Njoku-Tony (2011) observed that snails exist

in water bodies with pH values of 5.0-7.9 and Okafor (2004) also reported that in Anambra state, *Bulinus globosus* was comfortable in water with pH 5-8.1. Nnoruka *et al*, (2002) found a pH range of 6-9.0 and 7-8.6 for *Bulinus* spp in Sudan and South Africa respectively. Low pH value could be harmful to snails by coagulating the mucus on the exposed skin surface and inhibit lime deposition on snail shell.

i. Conductivity

The electrical conductivity is a measure of a material's ability to conduct an electric current. It is a measurement of the electric conductance per unit distance in an electrolytic or aqueous solution. It is commonly used in freshwater systems to monitor the amount of nutrients, salts or impurities in the water. Conductivity is a better indicator of the toxicity of the water. It is also the ability of a solution to conduct electricity. When a solute dissolves in a suitable solvent (usually water), an electrically conducting solution called electrolyte results. Conductivity is a limiting factor to snail growth and abundance. The effects of conductivity in freshwater habitats on vector snails was observed by Agi and Okwuosa, (2001) who noted that snails exist within conductivity of 50-600 microhms but snails are not found in habitats above 600 microhms (Agi and Okwuosa, 2001). Njoku-Tony (2011) reported that snail population was high in medium with conductivity range between 50-110 microhms than in medium with lower ranges. Conductivity was correlated with rainfall and it is higher in dry season than in rainy season because evaporation from open water bodies causes an increase in concentration of the substances dissolved in water (Agi and Okwuosa, 2001).

j. Dissolved Oxygen Tension

Oxygen tension is considered a chief limiting factor in the snails' ecology (Cowper, 1971). Snail populations are more abundant in oxygenated water although, *Bulinus africanus* prefer stagnant or shallow waters with high content of organic matter where they can feed on

decaying detritus while *Bulinus pfeifferi* seem to prefer deoxygenated water. *Bulinus truncatus* tolerates low oxygen tension. Dida *et al*., (2014) observed that snailsexist in a habitat with oxygen saturation of 3.64-8.23mg/l and attributed the decrease in snail population to low concentration of dissolved oxygen in water. In a study on the physico-chemical parameters of water bodies in Imo State, Njoku-Tony, (2011) found out that snails were found at sites with dissolved oxygen ranging from 2.2-8.5mg/l. At dissolved oxygen concentration above 7%, respiratory pigment of planorbid snails remained saturated (WHO, 2001). Dissolved oxygen was higher in slow or stagnant water bodies but at the tail end of the dry season, oxygen tension falls below 1% and snails tend to suffocate because ponds, ditches and even rivers get dry (WHO, 2001).

2.2 Urogenital schistosomiasis Epidemiology.

Snail-borne diseases have been counted as one of the most important public health problems second to mosquito-borne infections. The most serious disease of man traceable to snails is schistosomiasis (WHO, 2002). Schistosomiasis is a granulomatous disease caused by a group of digenetic trematode worms known as schistosomes. It is also known as Bilharziasis in respect of Dr. Theodore Maximillian Bilharz, a German pathologist, who identified the worm in 1851(Centron *et al*., 1996). It is a serious debilitating and sometimes fatal parasitic disease. Five species of schistosomes are important parasites of man, of which *Schistosoma mansoni, S. japonicum* (causative agents of intestinal schistosomiasis)and *S. haematobium*(causative agent of urogenital schistosomiasis) are the most important and widespread (Akinboye *et al*, 2011). These three species account for 95% of all human cases of schistosomiasis found in Africa, South Africa, Middle East and East Asia respectively. The other two species infecting man are *Schistosoma intercalatum* and *S. mekongi*.The first obvious symptom of urogenital schistososmiaisis infection is blood in urine. The early signs of morbidity that is common to the infection and which manifests in school aged children are anaemia, impaired growth and

development, poor cognition and substandard school performance (Cetron, *et al* 1996). An initial eruption may arise at the site of cercarial penetration and after a few weeks, there may be acute schistosomiasis (Katayama fever). The last stage directly depends on the *Schistosoma* species (intestinal or urogenital schistosomiasis). The clinical expression of the disease (light, massive, acute or chronic) may be very diverse depending on the parasite, the patient himself and the contamination mode (Gibobat, 2000). The late and life threatening consequences of schistosomiasis include bladder cancer or serious kidney malfunction caused by *S. haematobium* and severe complications of the liver and spleen in the case of intestinal schistosomiasis (Cheesbrough, 2004). Light infections with schistosomiasis can be asymptomatic and many people may live their lives without knowing they have ever been infected.

Schistosomiasis is endemic in about 78 countries in Africa, Asia and North America (WHO, 2013). It is of great public health and socio-economic importance in the developing world. *S. haematobium* is endemic in 54 countries mainly Africa and the Middle East, while *Schistosoma mansoni* is endemic in 52 countries mainly in territories of South America and Middle East (WHO, 2013). *S. haematobium* is responsible for urogenital schistosomiasis infecting over 112 million people annually in sub-saharan Africa alone (Luke and Michael, 2014). It is responsible for 32 million cases of dysuria, 10 million cases of hydronephrosis and 150,000 deaths from renal failure annually, making *S. haematobium* the world's most deadly schistosome (Luke and Michael, 2014). Infection varies from one part of the world to the other. Urogenital schistosomiasis is most prevalent in African countries and Nigeria is one of the countries known to be highly endemic. It is estimated that 101.28 million persons are at risk and that 25.83 million people are infected (Chitsulo *et al*., 2000). The estimate for morbidity and mortality in affected population are high with school children usually presenting with the highest prevalence and intensity of *S. haematobium* (WHO, 2002).It was

noted that children of age 13-14 years were affected more than other age groups; children whose parents' occupations are farming and fishing had infections twice higher than those whose parents are non-farmers. This was because these children assisted them in farm work and in the process swim, bath and wash cassava and water the cattle (Ismail *et al*., 2014).

2.2.1 Prevalence of Schistosomiasis in Nigeria

The disease occurs in all the 36 states of Nigeria and the Federal Capital Territory (National Schistosomiasis Control Programme, 1996). On Thursday June 4th, 2015, the Federal Ministry of Health of Nigeria released for the first time, comprehensive data on the national distribution of two major Neglected Tropical Diseases (NTDs) - schistosomiasis and Intestinal worms (FMOH, 2015). This information indicated that across 36 states and Federal Capital Territory, approximately 24 million Nigerians were at risk of schistosomiasis infections and 21 million were at risk of intestinal worms. Nigeria is said to have the highest burden of these NTDs in sub-Saharan Africa (FMOH,2015).

Records from the Nigerian Army units in Northern Nigeria revealed an overall prevalence rate of 26.3% (Ramsay, 1935) while Habiba *et al*., 2016 recorded 33.5% from Zaria. In Katsina Province, Orpin *et al*., (2017) recorded infection rates of 27.86%. Abdulkabir *et al*., (2017) indicated prevalence rates of up to 95% from Katsina, Kano, Zaria and Kaduna up to Birnin Kebbi and Argungu. Birnin Kebbi and Argungu were classified as hyperendemic areas. Ameh (2008) observed a prevalence of 40.7% of urogenital schistosomiasis in Ginga village, Kebbi State. Mbinkar *et al*., (2008) observed that 20% of urine samples examined amongst students of Baptist High School, Lira Mubi, Adamawa State, were positive for eggs of *S. haematobium*. Dawet *et al*, (2012) also reported that out of 242 urine samples examined among residents of Gwong and Kabong in Jos, 5(2.07%) of all from Gwong area were infected.

In Niger State, Barnabas *et al*, (2012) recorded a prevalence of 37% among school age children in Agaie. In Benue State, Mbata *et al*, (2009) investigated the prevalence of urinary schistosomiasis in Ogbadibo Local Government Area and reported that out 657 urine samples examined, 300 (46.6%) showed the presence of *S. haematobium*, of which, 23.13% were males while 22.52% were females. An overall prevalence of 41.5% was observed among the 1,124 children examined in two local government areas of Benue State namely: Buruku and Katsina-Ala (Houmsou *et al*, 2012). Secondary school children recorded higher prevalence rate than primary school children and pre-school children. In Etsako West Local Government Area, Edo State, out of 24% of subjects who were reported to be passing blood in urine, only 10.1% were positive of *S. haematobium* infection (Tobin *et al*, 2013). A survey of infection among communities around Kiri lake, Shelleng Local Government Area, Adamawa State by Birma *et al*., (2017) showed that prevalence rates varied from village to village among different groups.

Reports from Western states of Nigeria indicate that prevalence rates also varied from one area to another and even within the same locality. Akinwale *et al.*, (2011) recorded infection rate of 48.5% for *S. haematobium* infection in Epe in Lagos State while Nwabueze *et al*., (2009) recorded a prevalence of 46.6% in Ibadan. Abolarinwa (1999) recorded a prevalence of 30.6% in Esie community of Kwara State. Adewale *et al*., (2008) recorded 25.1% of *S. haematobium* in Ipogun while a prevalence of 43.8% of urinary schistosomiasis was reported in Ondo State (Oniya and Olofintoye, 2008). Ekpo *et al*, (2010) also recorded that, 97 (58.1%) of the 167 children examined for urinary schistosomiasis in a rural community near Abeokuta, had infection with no significant difference in infection rates between boys and girls. The overall geometric mean egg count was 1.17eggs/10ml urine and 47.4% of the children had microhaematuria. They attributed infection of pre-school children early in life to

exposures through bathing them with infected stream water by their mothers while older ones visit the stream for washing, fetching of water, bathing and swimming.

Ugbomoiko (2000) reported a prevalence rate of 7.8% in Ohaji Egbema, Imo State while Iwu *et al*, (2015) reported a prevalence of 8.3% out of the 108 people examined for urogenital schistosomiasis in Ehime Mbano, Imo State. Uneke *et al* (2007) in a survey carried out in Ohaukwu and Onicha town in Ebonyi State reported prevalence rates of 47.9% and 11.0% respectively.

Ngele and Oyeukwu (2008) reported a prevalence of 45% among school pupils in Afikpo North LGA in the same Ebonyi State.

A study in Adim community in Biase LGA, Cross River State also recorded a prevalence rate of 35% (Okon *et al*., 2007). Okon *et al* (2008) also reported a prevalence of rate of 45.3% among school children in Adim, Cross River State.

Also in Cross River State, Adie *et al* (2013) recorded that 10.2% female and 10.0% male pupils passed blood in urine in 218 schools examined with an overall prevalence rate of 10.2%. In Mayo-Belwa LGA of Adamawa State, Dunah and Bristone (2000) reported a prevalence rate of 27.2%. In a study carried out by Dawaki *et al*, (2015), the overall prevalence of schistosomiasis among rural communities in Kano State was 17.8% with 8.3% infected with *S. haematobium* and 8.9% infected with *S. mansoni* and 0.5% had co-infection of both species. Among the participants, 74.5% had prior knowledge about schistosomiasis with 67.0% of them having knowledge of how it is transmitted but 63.8% did not have knowledge of the preventive measures.

In Bornu State, Biu *et al*, (2009) reported a prevalence rate of 24.3% among school age children in Konduga LGA. Musa *et al* (2010) also reported an incidence of 14.5% among primary school pupils in Maiduguri. Joseph *et al*, (2010) reported an overall incidence of 14.5% among ten different primary schools in Maiduguri Metropolitan council. Out of 744

urine samples collected, 110 (14.5%) were positive for *S. haematobium* infection. In Dikwa Local Government Area, Balla *et al,* (2015) reported an overall prevalence of 48.7% with 72% of the 'Almajiri' being infected with urinary schistosomiasis. In Abarma village, Gusau LGA of Zamfara State, Bala *et al* (2012) reported a prevalence rate of 74.0%.

Poverty, ignorance, deplorable hygienic practices and poor sanitary facilities in these areas were common (WHO, 2017).

An overall infection rate of 8.7% was recorded among children aged 5-15years from Ruwan-Sanyin village, Kaduna State. The highest infection rates of 62.9% and 47.0% were recorded among those aged 10-12 years and 13-15 years respectively. Males had higher infection rate (59.3%) than females with 12.3% prevalence. Out of 300 urine samples examined in Guma Local Government Area of Benue State, an overall prevalence rate of 55% was recorded (Amuta and Houmsou, 2012).

In Bauchi, where a lot of physical development led to the creation of ponds, earth dams and streams due to excarvation of soils and channeling of water courses during road construction, prevalence rate of 21.2% was recorded for *S. haematobium* and 11.5% for *S.mansoni* while 4.1% had mixed infection. Akogun and Akogun (1996) reported 98% prevalence rate for urinary schistosomiasis and 79% for intestinal schistosomiasis among residents in an agricultural establishment near Yola with highest infection rate found among children aged 5-12 years old. Ekwunife *et al*., (2009) also recorded 25.7% urinary schistosomiasis in Ndokwa East Local Government Area of Delta State. In most of the studies, higher prevalence and intensity of the infection were recorded for males than females (Okon *et al*., 2007 and Ezeagwuna *et al*, 2012).

2.2.2 Schistosomiasis prevalence in Other African Countries

Schistosomiasis has been reported in other African countries like Egypt (Spencer *et al*., 1990) where approximately 55 million people are infected. In the Midlle East and North

AfricanRegion alone, 12.7 million individuals are infected among whom 10 million of infected individuals are clustered in Egypt and Yemen but during the past 20 years, significant changes had occurred in the region. Schistosomiasis was eliminated from Islamic Republic of Iran, Oman, Lebanon and Tunisia. Transmission has been greatly reduced in Egypt, Morroco, Saudi Arabia, Iraq, Jordan and Syria (Barakat *et al*, 2014). In East Africa, 122 million people are infected with either *S. mansoni* or *S. haematobium* or both concurrently (Schur *et al* 2013). In Uganda, Mozambique and Djibouti, the prevalence rates were recorded to be 12.9%, 40.9% and 11.9% respectively (Schur *et al* 2013). In Kenya, a prevalence rate of 0.2% and 16.3% was recorded for *S.haematobium* and *S. mansoni* respectively (Thomas *et al*, 2003). In the district of Niakhar, Senegal, Senghor *et al*, (2014) reported a prevalence of 57.6% with mean geometric count of 185eggs/10ml urine among children aged 7-15 examined for urinary schistosomiasis. Other countries with high prevalence of schistosomiasis include Liberia in West Africa and Algeria in North Africa (Dennis *et al*., 1983). In Lagdo District of the Republic of Cameroun, Mba and Useh (2008) recorded a prevalence rate of 39.2%. An investigative study carried out by Anto *et al*, (2013), showed that 11.7 million people have been treated of urinary schistosomiasis in sub-Saharan Africa. A study of in-school and out of school children aged 6-15 years living in communities along the Tono irrigation canal in North Ghana revealed a prevalence of 33.2% of *S. haematobium* infection (Anto *et al*, 2013). Also a study consisting of adult male and female subjects residing in the Volta Basin of Ghana revealed 46.5% prevalence of urinary schistosomiasis (Yirenya *et al*, 2011). In Zenu community in Ghana, 30.7% prevalence was recorded among the study population of school children aged 3-16years (Tetteh-Quarcoo *et al*, 2013). The report of a pilot study in 2010, in the Eastern Cape Province of South Africa with school aged children revealed an alarming prevalence of 73.3% (Meents and Boyles, 2010). A nationwide survey of the prevalence of schistosomiasis infection and soil-helminths

in school children in Mozambique reported a prevalence of 47% (*S. haematobium*) and 1% *S. mansoni* (Augusto *et al*, 2009). Some of the factors determining the continuous transmission in sub-Saharan Africa, they reported included climate changes, proximity to water sources, man-made ecological changes and socio-economic factors.

2.3Pathogenesis of Schistosomiasis.

The earliest symptoms of schistosomiasis infection are associated with cercarial penetration of the skin leading to cercarial dermatitis. This may be quite mild and so pass unnoticed or be marked by itching with erythema and papular eruption. Cowper (1971) noted that severe itching and dermatitis may develop particularly in young children being exposed for the first time to large numbers of *S. haematobium* infection. Swimmer's itch, a reaction leading to severe dermatitis resulting from invasion by non-human schistosome is common in non-tropical area, cases of cercarial dermatitis were recorded in Moscow in 1991 and was traced to contamination of seventeen natural and artificial water bodies in and around Moscow region with organic communal wastes creating favourable environment for the development of populations of molluscs belonging to different genera. Some species of *Lymnea, Planorbarius* and *Aisus* were found in these water and a lot of ducks were found there too (Beer and German, 1994).

2.3.1 Acute Schistosomiasis

Following *S. haematobium* infection, maturation of the worm is marked by acute toxaemic schistosomiasis (i.e. Katayama fever) which coincides with egg laying and occurs four to six weeks after the initial exposure. It may correspond to the first cycle of egg deposition and is associated with marked peripheral eosinophilia and circulating immune complex. It is most common with *S. japonicum* and *S. mansoni* infection and is most likely to occur in heavily infected individuals after primary infection (Behram, 2005). Acute schistosomiasis is commonly characterized by fever and chills (Robert and Janovy, 2000). Symptoms usually

resolve over several weeks but the syndrome can be fatal (Behram, 2005). It can have life threatening neurologic complication (Perez *et al*, 2006). Acute schistosomiasis is increasingly reported in travelers returning from the tropics especially from countries where schistosomiasis is endemic (Doherty *et al*, 1996) and more common in children living in Cairo, an urban area in Egypt (Farid *et al*, 1986).

Mild maculopapular skin lesion may develop in acute infection after exposure to cercariae. Significant dermatitis is rare with the major human schistosomal pathogens probably because the invading and developing cercariae are minimally immunogenic (Behram 2005). However, abortive human infection with schistosomal species that rely on other primary hosts may cause marked dermatitis or swimmers itch. This self-limited process may reoccur more intensely with exposures to the same species.

2.3.2 Chronic Schistosomiasis

In established infection due to *S. haematobium*, active and inactive stages are recognized. The pathology of chronic schistosomiasis, results from egg-induced immune response. Schistosomiasis is unusual among parasitic infection in that the pathogenesis is almost entirely due to the eggs and not the adult worm (Robert and Janovy, 2000). The first obvious clinical sign of *S. haematobium* infection is blood in urine (haematuria). A consequence of the deposition of the schistosome eggs in mucosa and tissues. In endemic areas, up to 50-70% of infected persons (80% of infected children), have symptoms of urinary tract diseases with haematuria, dysuria (difficult or painful urination) or frequency (Cheesbrough 2004). The onset of haematuria is usually gradual and becomes marked as the disease develops and the bladder wall becomes more ulcerated. Pain is most intense at the end of urination.

Eggs trapped in the wall of bladder and surrounding tissues cause inflammatory reactions with the formation of granulomata. Many of the eggs die and become calcified, this

eventually result to the formation of fibrous infiltration, thickening of the muscularies, ulceration and even obstructive uropathies (Behram, 2005). In heavy infections, eggs can be carried to other parts of the body such as the genitals, ureter, kidney, liver and eggs, which are swept back to the portal circulation where they lodge and induce granulomatous reactions in the portal tracks. Heavy infestations are more likely to produce hepatic disease. Eventually, severe fibrosis in a characteristic pipe stem pattern may occur.

Although hepatocellular function is spared, peritoral fibrosis can lead to portal hypertension with the usual possible sequelae, including splenomegaly ascites, oesophageal variceal bleeding and development of portosystemic collaterals. Through the collateral, eggs can reach the pulmonary circulation. The resulting pulmonary granulomatosis and fibrosis can lead to pulmonary hypertension with a high mortality rate. Co- infection with hepatitis B or hepatitis C can accelerate hepatic dysfunction and raise the risk for hepatocellular carcinoma beyond that seen with hepatitis alone (Behram, 2005).

Invasion of a female reproductive tract is most common with *S.haematobium* but can also happen in *S. mansoni. S. haematobium* causes genital lesions in 30% of women who are infected. Vulva lesion may also increase the risk of HIV transmission, intricate vascular link between the rectal and the bladder venous plexus provide to the migratory worm easy access to internal and external female genitals (Behram, 2005). Following prolonged untreated infection and a marked cellular immune response, the urethra may become blocked leading to thickening of the bladder, and eventually obstructive renal disease with kidney damage. In some endemic areas, chronic infection of long duration is associated with squamous cell bladder cancer (WHO, 2017). Ectopic egg deposition can also lead to additional clinical syndrome including involvement that can result in transverse myelitis (best described for *S. haematobium* and *S. mansoni*) or cerebral diseases (most common with *S. japonicum* infection).

Anaemia is a common finding in urogenital schistosomiasis, particularly in those with a low dietary intake, coexisting with hookworm infection or malaria (WHO, 2001). In Africa, urogenital schistosomiasis is associated with low weight or height in both children and adult. Sacko*et al.,* (2011) observed a high rate of iron deficiency associated anaemia (75.1%)in school children in an area endemic for urogenital schistosomiasis in Niger River Basin, Mali. The work capacity of rural inhabitants has been reported to be severely reduced because of the weakness and lethargy caused by the disease. The growth pattern and school performance of children are also retarded but these indications improve after successful treatment (Meremikwu *et al*, 2000).

Female genital schistosomiasis has been identified as a major social and medical problem. It was first reported from Egypt and recently, female genital schistosomiasis has been reported with some pathological manifestations particularly tumors and ulcers in the lower genital tract. In areas endemic to *S. haematobium* up to 75% of women who live in such areas may suffer from genital lesions due to infection (WHO, 2001).

Urogenital schistosomiasis is ranked high among parasitic diseases in terms of socio-economic point of view in tropical and subtropical areas. One measure of that importance within the development strategies of endemic countries is reflected in executive level planning and inclusion of schistosomiasis control activities in national budget (Uneke *et al*, 2007). Studies have shown that *S. haematobium* infection can cause preterm delivery. In a study by Mombo-Ngome *et al*., (2017), it was observed that in Bawku District, Ghana, there was a high rate of preterm deliveries (less than 37 weeks) among pregnant women infected with *S. haematobium.* They also observed that in the preterm deliveries, the birth weight of babies were significantly lower in infected group.

2.4 Immunology of Schistosomiasis

A mild localized reaction mediated by cercaria-provoked histamine released by mast cells, may be seen on initial infection, though a marked dermal reaction is unsual in persons who had no previous exposure (Wilson and Coulson, 2009). When such a local reaction occurs, it subsides within a week. In previously infected immunocompetent hosts, schistosomula are subject to two kinds of antibody-dependent cell-mediated cytotoxic assault. Antischistosomular antibodies cover the parasites, and the fragment crystallizable (Fc) portions of the Immunoglobulin G (IgG) antibodies attach to the receptors of eosinophils, which degranulate with the release of eosinophilic major basic protein, with consequent damage to the schistosomular membrane and possible death of the parasite. Macrophages may also contribute to elimination of the parasites at this stage, though the action of specific Immunoglobulin E (IgE), affecting the release of lysosomal enzymes from these cells. After a few days within the host, the schistosomules either become covered with host antigens or produce antigens that so resemble those of the host that the antibody-related responses are no longer effective. The maturing schistosomule and the adult worm do not evoke a measurable protective response on the part of the host, although it is possible to detect in vitro antibodies produced against the adult worms.

As the adult and larval worms migrate through the host's blood circulation, they avoid the host's immune system. The worms have many tools that help in this evasion, including the tegument, antioxidant proteins and defenses against host membrane attack complex (Wilson and Coulson, 2009).The tegument coats the worm and acts as a physical barrier to host antibodies and compliment. The worms produce antioxidant proteins that block the effect of superoxide produced by the host immune defenses (Wilson and Coulson, 2009).

2.5 Diagnosis of Schistosomiasis

Direct and indirect methods now exist for the diagnosis of schistosomiasis. Direct methods include parasitological techniques which detect schistosomes' ova in urine, stool or rectal mucosa and histological methods which reveal schistosomulae, adult worms or eggs in tissue biopsies. Clinical, biochemical and immunological disease markers can also be used to diagnose infection indirectly by detecting pathology often associated with the disease (Gray *et al.*, 2011). Immunological methods measure the immune response to certain schistosome antigens or the concentration of parasite-derived antigens in blood and urine. These methods can be applied in the diagnosis of infection due to *S. haematobium* as well as the other two major species (*S. mansoni* and *S. japonicum*).

2.5.1 Direct Parasitological Techniques

Quantitative techniques have replaced qualitative parasitological methods in most community studies because it provides additional information on egg output. Use of filtration methods using filters rather than sedimentation methods (centrifugation) offers the researcher the opportunity of counting eggs and calculating the intensity of infection (Gray *et al*., 2011). Semi-quantitative methods such as the Polymerase Chain Reaction (PCR) and Kato-Katz technique where eggs are counted up to a limit indicating light or heavy infection have been suggested by WHO, (1993).

2.5.2 Indirect Methods

Indirect diagnostic techniques are used most frequently in *S. haematobium* infections. Haematuria has been associated with urinary schistosomiasis since the disease was first described in 1852 by Bilharz but the relative presence of proteinuria was noted by Hassan *et al.*, (2017). In Egypt, Bahaa and Salwa, (2016) showed that the prevalence of egg excretion and proteinuria were parallel in different endemic regions. Gray*et al.*, (2011) also demonstrated the relationship between proteinuria, haematuria and intensity of infection in

different age groups and discussed the use of reagent strips for urine analysis to identify subjects with high egg counts.Reagent strips in current use have ranges of sensitivity of 5-15 red blood cells/ml and 0.015-0.03 mg of haemoglobin per 100ml urine. This indicates semi-quantitative assessment of up to nine different parameters including blood and protein.The strips have been commercially available about four decades ago (Meremikwu *et al,* 2000). They use a peroxide compound and orthotolidine as a chromogen. The colour distinction between negative and the first level of reactivity on the strips is well defined and in the presence of blood, the colour changes from yellow or pale orange to green or blue (Andrews, 2009). Degrees of haematuria and proteinuria are significantly related to the number of excreted eggs. The high cost of reagent strips prompted the use of history of haematuria for rapid diagnosis of urinary schistosomiasis in developing countries. Bello *et al.,* (2014) examined 300 people in Wurno Rural Area of Sokoto State, and recorded 97.3% for visible haematuria. He noted a positive association between frequency of visible haematuria and intensity of disease as measured by egg count, and recommended the application of visible haematuria as a cheap and reliable screening method for *S. haematobium* infection. In community surveys, it has been noted that the diagnostic value of haematuria as a single indicator may be biased in women of child bearing age since menstrual blood may contaminate the urine thus giving a false positive reagent strip reading. Socio-cultural factors such as female circumcision have also been shown to cause false-positive results. Most recently, simple questionnaire designed for use in schools have been used to identify communities at high risk for urinary schistosomiasis and mapping out areas that require intervention. Diagnosis using immunological techniques has been tested and results reveal the drawbacks of such techniques. Serodiagnosis based on measurement of antibodies has the problem of not being able to distinguish between active, previous and reinfection (Gray *et al*., 2011). Though these drawbacks may exist, other studies conclude that serodiagnosis can be

used to screen expatriates for recently acquired infection and that acute infection may be differentiated from chronic disease. Other immunological methods have been studied for their diagnostic potential such as detection of circulating schistosome antigens of adult worms. Two proteoglycan gut-associated antigens namely; the circulating cathodic antigen (CCA) and the circulating anodic antigen (CAA) have shown promising results for diagnosis. These antigens have been detected singly or both in serum, urine and breast milk of some patients with *S. mansoni;* in serum and urine of patients infected with *S. haematobium* or *S. intercalatum*; and in serum of patients infected with *S. japonicum* (Standley *et al*, 2010). Monoclonal antibodies are used in the antigen detection assays and a variety of immunological methods such as indirect haemagglutination (IH), Circumoval precipitation test (COPT), Alkaline phosphatase immunoassay (APIA) or enzyme linked immunosorbent assay (ELISA) have been used for measuring CCA or CAA with different limits (Standley *et al*, 2010).

Another form of indirect diagnosis is the use of radiological procedures for detecting morbidity from schistosomal infection. It includes plain abdominal radiography to detect calcification, intravenous pyelography to detect bladder and ureteral changes or obstructive uropathy, isotope renography, computed tomography for cerebral schistosomiasis, myelography for suspected cord damage, and portal venography for hepatosplenic schistosomiasis (Andrews, 2009). Ultrasonography can be used in the diagnosis of *S. haematobium* infection. Major changes in the diagnostic approach in individual patients and in epidemiological assessment of morbidity in communities have occurred in parallel with the introduction and expanded use of ultrasonography. The technique is non-invasive, simple and portable and has no biological hazard to the patient. It has high specificity and sensitivity and superior to physical examination of liver and spleen size and the best method for grading schistosomal periportal fibrosis and other bladder associated ailments (Andrews, 2009). It has

been demonstrated in community studies that sonographic lesions of periportal fibrosis in *S. mansoni* infection correlated with the number of eggs in the stool. An interesting outcome of ultrasonographic studies has been the demonstration that *S. haematobium* can cause mild degrees of schistosomal periportal fibrosis in an area where *S.mansoni* does not exist (Gray *et al.*, 2011); this confirms an observation first made in Upper Egypt that hepatosplenic disease caused by *S. haematobium* is a distinct entity (Bahaa and Salwa, 2016).

The detection of specific DNA sequences by Polymerase Chain Reaction (PCR) has proved extremely valuable for the analysis of genetic disorders and the diagnosis of a variety of infectious disease pathogens. A few studies were published for the detection of schistosomes in snails, monitoring of cercariae in water bodies, and diagnosis of human infection. Abath *et al*, (2006) in his work on the molecular approaches for the detection of *S. mansoni*, found out that PCR was able to detect *S. mansoni* DNA in stool samples containing2eggs/g;this amountis not detectable by Kato-Katz examination. Pontes *et al*., (2003) also reported the results of a more extensive comparison between the PCR assay and the parasitologic Kato-Katz technique, using faecal samples collected from individuals living in Brazilian endemic area.The prevalence using Kato-Katz was 25.3% while that of PCR was 38.1%. Gordon *et al.*, (2015) carried out the same work on the Phillipines and reported a high prevalence of *Schistosoma japonicum* using thr real-time PCR method. They reported that the prevalence (90.2%) and infection intensity (36.5 qGMEPG) values determined by the qPCR assay in this study were considerably higher than those obtained using the Kato Katz method (22.9%; 11.5 GMEPG). The Quantitative detection of *S. japonicum* cercariae in water was also carried out by Hung and Remais (2008) using a real time PCR method which shows a high sensitivity and specificity for the parasite. Similarly, Gomes *et al*, (2010) also carried out a research on the development and evaluation of a sensitive PCR-ELISA system suitable for detection of schistosome infections and found out that PCR is the best alternative for diagnosing

Schistosoma infection in urine and stool. PCR can be used to detect schistosome infection in snails and animal faeces. This was confirmed by Thanchomnang *et al*, (2011) in their work on the molecular detection of *S. japonicum* in infected snails and mouse faeces using a real-time PCR assay with FRET hybridization. As little as a single cercaria artificially introduced into a pool of ten non-infected snails and a single egg inoculated in 100mg of non-infected mouse faeces were detected by real-time FRET PCR.

Akande and Odetola, (2011) also carried out a research on the use of PCR in the detection of *S. haematobium* cercariae in water samples and observed that PCR assay is sensitive enough and possess capability of detecting the presence of as little as one cercaria in water samples.Although PCR gives more accurate result, the most available method for diagnosis of *Schistosoma haematobium* infection is microscopy because it is cheap and easy to use. Use of reagents strips for detection of proteinuria and haematuria serves as a marker for urogenital schistosomiasis.

2.6 OTHER FRESHWATER-BORNE TREMATODE INFECTIONS

Beside schistosomiasis, other snail borne trematode infections include:

2.6.1 Fascioliasis

Fascioliasis is caused by two species of parasitic trematodes that mainly affect the liver. They are zoonotic diseases caused by *Fasciola hepatica* and *F. gigantica*. Until recently, human cases occurred occasionally but are now increasingly reported from Europe, America, Oceania, Africa and Asia. The World Health Organization estimates that at least 2.4 million people are infected in more than 70 countries worldwide with several millions at risk (WHO, 2012). No continent is free from fascioliasis. The life cycle is complex; it involves a final mammalian host, an intermediate host and a carrier. The process starts when infected animals (cattle, sheep, donkeys, camels, horses, goat and other herbivores) defaecate in freshwater

sources, the eggs hatch into miracidia which lodge into a suitable snail host (*Lymnaea*), in which the miracidium metamorphoses into a sporocyst, redia, daughter redia and cercaria. The cercaria emerges and attach to leaves and stems of watercress and watermint. When animalsingest the infected watercress, the metacercaria excyst in the duodenum and run acute and chronic phases. In acute phase, the liver surface is punctured which causes internal bleeding. Symptoms include fever, nausea, hepatomegaly, skin rashes and abdominal pains. In chronic phase, the worm gets to the bile duct and the symptoms are intermittent pain, jaundice and anaemia (WHO, 2012).

2.6.2 Fasciolopsiasis

Fasciolopsiasis is caused by the largest intestinal fluke of man (*Fasciolopsis buski*) which infects amphibic snails (*Segmentina, Lymnaea, Hippentis* and other planorbids). After being released through faeces from this intermediate host, metacercaria infest aquatic plants like water spinach, they are eaten raw by pigs and humans. The water is infective when drunk unheated. Most infectionsare light and asymptomatic but in heavy infections, symptoms include; abdominal pain, chronic diarrhoea, anaemia, toxaemia and ascites. The disease is endemic in Asia and India and 10 million are estimated to be infected but the infection occurs often in school-aged children or in impoverished areas that lack proper sanitation systems (WHO, 2014).

2.6.3 Clonorchiasis

Clonorchiasis or Chinese liver fluke disease is caused by infection with *Clonorchis sinensis*. It is a common infection of dogs and other fish-eating carnivores. It is mostly found in China, the Democratic People's Republic of Korea, Republic of Korea and Vietnam. The adult flukes inhabit the bile ducts and lay eggs that are dispersed into the environment during defaecation. When the eggs reach freshwater, they develop into miracidia which are ingested

by various species of aquatic snails. The miracidia further develop and reproduce into cercariae which leave the snail and swim to penetrate beneath the scales of various species of carp-like freshwater fish where the metacercariae encyst in the subcutaneous tissue. When dogs eat raw fish, the metacercarial cysts excyst in the intestine and the young worms migrate to the bile ducts and the life cycle continues. Humans may substitute reservoir hosts when they eat raw or poorly processed fish thus ingesting the metacercariae. In humans, acute clonorchiasis may be asymptomatic but if the number of worms is significant, the person may come down with fever and right upper-quadrant pains (WHO, 2012).

2.6.4 Paragonimiasis

Paragonimiasis, or lung fluke disease, is caused by infection with a number of species of trematodes belonging to the genus *Paragonimus*. The most common are: *P. westermani, P. heterotremus* and *P. philippinensis* in Asia (China, the Democratic People's Republic of Korea, the Republic of Korea, the Lao People's Democratic Republic, the Philippines, Thailand, Viet Nam and other East Asian countries); *P. africanus* and *P. uterobilateralis* in western and central Africa; *P. caliensis, P. kellicotti* and *P. mexicanus* in north, central and south America (WHO, 2012).*Paragonimus* spp. is a common parasite of crustacean-eating mammals such as man, tigers, leopards, domestic cats, dogs, mongooses, opossums and monkeys(reservoir final hosts). The adult flukes live in the lungs and lay eggs that are coughed up through the airways and either expectorated in the sputum or swallowed and defecated. When they reach freshwater, the eggs develop into miracidia that penetrate various species of aquatic snails, where they further develop and reproduce asexually, and giving rise to cercariae (larvae). Cercariae released into water swim to penetrate suitable species of freshwater crabs, crayfish and other crustaceans and encyst in the gills, liver and muscles as metacercariae. When such animals are eaten, the metacercariae excyst in the intestine: young worms penetrate the intestinal wall and the peritoneum, then the diaphragm and the pleura;

they finally reach the lungs, where they live in pairs surrounded by a capsula, thus completing the cycle (WHO, 2012).

Humans may substitute reservoir hosts in the transmission cycle when they eat raw, salted, pickled, smoked, marinated, dried, partially cooked or poorly processed crustaceans, thus ingesting the metacercariae. In humans, the earliest stages of paragonimiasis may present an elusive clinical picture, and be asymptomatic or scarcely symptomatic. Conversely, when worms reach the lungs, symptoms may be significant and typically include chronic cough with blood-stained sputum; chest pain with dyspnea (difficulty in breathing) and fever; pleural effusion and pneumothorax are possible complications. Symptoms and signs mimic those of tuberculosis, and paragonimiasis should always be suspected in patients with tuberculosis who are non-responsive to treatment. Ectopic paragonimiasis may result from erratic migration of the juvenile worms: the most frequent locations include the abdominal cavity and subcutaneous tissues and, most frequently, the brain: cerebral paragonimiasis is a severe condition that may be associated with headache, visual impairment and epileptic seizures (WHO, 2012).

2.7CONTROL OF SCHISTOSOMIASIS

The control of urinary schistosomiasis as with many infectious diseases involves a multidisciplinary effort including management of water development projects, control of the snail intermediate hosts, and environmental management, chemotherapy and health education of the population to undertake activities to prevent transmission (WHO, 2017).

2.7.1 Control of Snail Intermediate Hosts

Different strategies have been applied with the aim of controlling the snail intermediate hosts and they include environmental, biological and chemical control. Ecological changes in the

snails' habitat are required to eliminate snails or prevent them from breeding. Some physical measures which help to control snails in irrigated areas and their drainage systems include use of drains to reduce surface water and use of closed conduits or sprinkler-irrigation in conveyance system. The association between schistosomiasis and water resources development project such as reservoirs and irrigation schemes is well established in Nigeria (Mafe *et al.*, 2001). These projects require the construction of dams and canals for drainage. The drainage and construction of these canals and the regulation of their water release pattern have a considerable influence on their capacity for harbouring snails. It is therefore important that adequate safeguards are included in plans for the construction of dams and canals. One way of ensuring this is to bring the project under the executive control of a coordinating committee consisting of all the officials concerned including water engineers, agriculturists, economists, health administrators and officers.

Another form of control is by constructing footbridges across infected water bodies (rivers and lakes). Safe water supplies should also be provided to villages to reduce as much as possible contact with infected water bodies.

Intermittent drying of the water has been reported to be effective in reducing snail population densities in small impoundments, irrigation canals and drains though the ability of aquatic planorbid and bulinid snails to withstand dessication must be considered. The high velocity of water along canals dislodges the snails. As the water velocity increases, the snails are first immobilized then dislodged but the appropriate velocity must be determined for effective control. Lining of canals have been cited as being beneficial in snail control by increasing velocity, reducing vegetation, helping drainage and drying when needed, reduced seepage to low-lying breeding sites and enhanced efficacy of molluscides (Mafe *et al*., 2001). The effect of different discharge patterns on water level fluctuations and on schistosomiasis transmission was studied in the artificial Oyan Reservior in Ogun State, Nigeria by Ekpo *et*

al., (2016). All indices of schistosomiasis transmission were reduced significantly during the dry season when discharge was high although they noted that continuous water discharge during this period may run counter to current water management policies. The advantages of environmental measures are numerous and are therefore considered a long-term hope for schistosomiasis control.

Chemical control of snails has been or is in use in many schistosomiasis endemic areas. Two strategies have been used, focal control and area-wide control. Surveillance and focal application of molluscides have been adapted in many countries like St Lucia, Ghana, Yemen, Sudan, Morocco and Saudi Arabia (WHO, 2002). Following reports of the presence of *Bulinus truncatus* snails in Jordan, the Ministry of Health became concerned with the threat of urinary schistosomiasis, adapted multiple control strategies including urine examination of all foreign labourers and treatment of detected cases, routine surveillance of all bodies of water that are potential breeding sites for *Bulinus* snails (eg. reservoirs, small rivers and streams, springs and irrigation canals) and in chemical treatment and environmental management of snail-infected water bodies (WHO, 2002).

Area-wide mollusciding is seen as the only practical and scientific approach if transmission is widespread in an irrigation system. Niclosamide (marketed as Bayluscide) is virtually the sole available molluscide in terms of effectiveness and completeness of evaluation; it is the molluscide of choice (WHO, 2002). There has not been any report of resistance to Bayluscide. Molluscides of plant origin has been studied with varying success. Fayez, (2009) reported that *Ambrosia maritima* prepared as bait formulations for the control of *Biomphalaria alexandrina* was effective. Adewole*et al*, (2015) showed that extracts from fruit and leaves of *Dialium guineense* makes it a potential molluscide which could be used in Nigerian villages. Other methods which can be used indirectly to control schistosomiasis transmission include improved sanitation and water supplies as well as health education and

community participation. Some reduction in prevalence rates of schistosomiasis have been reported in Brazil following the construction of latrines (Inobaya *et al*., 2014) and in South Africa where a communal water supply was supplemented by simple pools and wire fences for children which prevented them from having easy access to infected water. Also in farmlands in Zimbabwe, *S. haematobium* and *S. mansoni* had lower prevalence rates in children who lived in villages with pipe-borne water. In Kenya, there was no effect on the transmission of *Schistosoma haematobium* even when borehole wells were provided because well water is used for drinking and other domestic purposes while the pool is used for recreational and agricultural activities (Ezeagwuna *et al*., 2012).

Eniola *et al.,* (2018) recommended integrated approach to the control of snail vectors. On chemical method alone, he maintained that molluscides are expensive and toxic and have only a temporary effect. As for biological methods, none is effective yet. The combination of basic sanitation and clean water supply together with health education potentially constitute the most effective approach. Mass treatment alone reduces morbidity but does not control transmission.

In some African countries though major developmental projects has become the major factor in the transmission of infection however, natural bodies of water including rivers, streams, pools, ponds and swamps dispersed all over pose greater challenge for the people. In many areas where transmission occurred, programmes were aimed at controlling the snail intermediate host as a means of eliminating transmission. One of the major difficulties with integrated control methods is that they are often difficult and costly to implement, take a relatively long time to become effective and their upkeep is usually expensive and requires considerable effort. In as much as control of snail hosts are important, WHO (2002) called for integrated approach incorporating treatment with antischistosomal drugs, health education

and community participation. Sound knowledge of the epidemiology of disease in any area forms the basis of control

2.7.2 Health Education.

An important factor that has adversely affected control programmes is lack of scientific information on the disease in many communities among the high risk groups particularly school age children (Robert and Janovy 2000).

The public should adequately be informed on the severity and public health implications of the disease and on the need to prevent contamination of water bodies with urine. Although potentially very effective, education is often exceedingly difficult depending ultimately on the intractable task of persuading masses of uneducated poor people to change their behaviour, customs and tradition. In some communities, the prevalence rates appear to be decreasing (Ekejindu *et al*., 2002) which might be attributed to increase in people's awareness of the disease-causing agent. It has been shown that there is an increase in people's attendance to hospitals or chemists for treatment (Ekwunife*et al*, 2004).

Unfortunately not much has been achieved in the control of urinary schistosomiasis in the country largely because the disease is mainly a rural occupational disease that affects people engaged in agricultural activities and others residing in rural agricultural and semi urban areas. There is a high level of risk of becoming infected as a result of low literacy level, poverty, sub-standard hygiene and inadequate public infrastructure (Uneke *et al*., 2007).

2.7.3 Control by Chemotherapy

There is yet no vaccine available for the prevention and control of schistosomiasis. The current mainstay of control is chemotherapy with praziquantel, given as a single dose against all human schistosome parasites (WHO, 2002). The control is also based on large-scale treatment of the risk population groups, access to safe water, improved sanitary conditions,

hygiene, education and snail control (WHO, 2013). The World Health Organization strategy for schistosomiasis control focuses on reducing disease through periodic targeted treatment with praziquantel which involves regular treatment of all people in risk groups such as:

- school aged children in endemic areas
- adults exposed due to their occupations and domestic tasks
- entire communities living in highly endemic areas (WHO, 2013).

The Nigerian National Policy on Schistosomiasis Control adopted Praziquantel as the drug of choice in the treatment and control strategy aimed at reducing morbidity. An assessment was made on different channels for praziquantel delivery in mass treatment effort and for no other parasitic disease has there been such major advance in chemotherapy as has occurred since the 1960s in the treatment of schistosomiasis (Mafe *et al*., 2005). The introduction and widespread use, at both the individual patient level and in large scale community based operations, of the current highly effective orally administered, well tolerated, anti-schistosomal drugs have provided physicians, epidemiologists and public health practitioners with therapeutic opportunities not in existence at the end of the 1960s (Andrews, 2009).

The primary objective of chemotherapy is the cure of the individual patient of the infection of one or two species. Cure leads to cessation of the pathogenic agent, deposition of eggs in the tissues and prevention of additional organ damage and the existing lesions will in the majority of cases regress (Andrews, 2009). In the past, curing infected persons was not a practical strategy for control. The development of safe and effective schistosomide however altered that circumstance (Robert and Janovy, 2000). In an area where schistosomiasis is highly endemic, the present goal is to control morbidity (Utzinger *et al*., 2003). Three anti-schistosomal drugs were used globally and were all on the WHO list of Essential drugs, but the position now is different. The drugs that were considered in the recent past for mass chemotherapy include metrifonate, oxamniquine and praziquantel. However, metrifonate

which has been a drug that exhibits activity against *S. haematobium*, has been withdrawn from the market (Andrews, 2009). Oxamniquine is another alternative antischistosomal drug but its use is only in a few countries but the manufacturers have assured the WHO that production will continue for the foreseeable future (Andrews, 2009).

Praziquantel is the drug of choice and the mainstay for morbidity control. It is effective against all the schistosome species that occur in humans. It is also effective in the other snail-borne trematode infections e.g., clonorchiasis, paragonimiasis, and opisthorchiasis and in infections due to adult cestodes like *Taenia solium, T. saginata, Hymenolopis nana* and *Diphyllobothrium* spp. It is generally not effective in the treatment of infection caused by *Fasciola hepatica* and no therapeutic effect on protozoa and nematode infections (Andrews, 2009). It prevents chronic liver disease or bladder cancer and will certainly remain the drug of choice over the next several years since the 54th World Health Assembly recently put forth a target to treat at least 75% of school-age children in areas with high burden of schistosomiasis (Colley *et al*., 2001). Although dosage is standardized in large scale epidemiologically based morbidity control programmes, there is frequently a variation in dose in the treatment of individual patients. In field programmes, a single dose of 40mg/kg is effective in *S. haematobium, S. mansoni* and *S. intercalatum* infections. For *S. japonicum* infection, the dosages employed originally were a total dose of 60mg/kg, given at 4 hourly intervals as three 20mg/kg doses or two 30mg/kg doses, but present field practice, since the mid 1980s, has been to use a single oral dose of 40mg/kg body weight. Patients' tolerance is extremely good and virtually all trials have confirmed the absence of toxicity in the liver, kidney, hematopoietic system or other body organs and functions (Andrews, 2009). However, minor side effects do occur; those related to the gastrointestinal tract are epigastric or generalized abdominal pain or discomfort, nausea, anorexia and loose stools.

Cure rates are high, it can be up to 80% in small groups (Ezeagwuna *et al*, 2012) and 50-60% in large scale field operations where supervision is of necessity less stringent and where total compliance may be difficult to ensure (Andrews, 2009) and egg output reduction exceeds 90% in those not cured. Resistance to praziquantel has been claimed and documented on several occasions in the treatment control of *S. mansoni* (Andrews, 2009).It is known that artemisinin derivatives, (eg artemether and artesunate), best known for their antimalarial properties also display activity against schistosomiasis. It kills immature worms, have preventive effects in *S. japonicum* infections in animals models (Xiao, *et al*, 2002). This action was confirmed in humans in randomized double placebo controlled trials in China during the 1998 floods, where the incidence and intensity of infection in endemic areas was reduced significantly (Xiao *et al*, 2000, cited by Andrews, 2009).

Activity against *S. japonicum* was discovered later in animals with highest efficacy against schistosomula. Since artemether and praziquantel showed maximal activities against juvenile and adult worms, combinations of the two compounds were suggested. However, because artemisinin is one of the current mainstays in antimalarial chemotherapy and because endemic malaria and endemic schistosomiasis co-exist in numerous areas especially in Africa, wider use of these derivatives must await the clarification of several epidemiological and public health issues (Andrews, 2009).

Assessment of patients treated for schistosomiasis is conducted by repeated clinical observations, evaluation of symptomatic improvement, and disappearance of physical, radiological, and endoscopic signs. Direct parasitological examination of urine is essential and should be performed on repeated (three) specimens of excreta at about 6-8 weeks and 4-6 months after treatment (Andrews, 2009).

CHAPTER THREE

MATERIALS AND METHODS

3.1 GENERAL METHODOLOGY

3.1.1 Study area

The work was carried outin Omogho and Ndikelionwu communities in Orumba North Local Government Area of Anambra State (Figs 1 and 2). The towns, Ndikelionwu and Omogho live in close proximity with Ndiowuu, Ufuma, Awgbu, and Nanka communities. The closest major cities to the communities include Onitsha, Enugu, Owerri and Umuahia. It is 334km (207miles) south of Abuja and 58km (36miles)southwest of Enugu (www.maplandia.com/nigeria). Orumba North Local Government Area lies between longitude$7^0$8"E and latitude $6^0$5"N (www.maplandia.com/nigeria). The communities have tropical climate with typical rainforest vegetation characterized by freshwater swamps. The average daily temperature is 30.6^{0}C (Wikipaedia, 2015). Obutu Lake which is located at Iwollo village, Omogho is approximately 94 hectares and stretches for about 2kilometres while Iyiegwu Lake located at Okpunifite village in Ndikelionwu is approximately 61 hectares stretches for about one kilometer. There are other feeder streams (available only during the rainy season) that serve as the major water bodies in the area. People visit these lakes for fishing and excursions. They overflow during the rainy season covering a larger area of land. The Lake and streams are surrounded by different types of vegetations and appear brownish in colour all through the year. Activities on the lake decrease drastically to almost halting during the months of June to September as most people have sufficient water supply from harvested rain water. Activities such as swimming, washing, bathing and processing of foods take place mostly during the dry season.

The water level of the lake reaches its maximium in the month of October after the peak of rainfall in September. The water level drops gradually until the next rainy season which usually starts around May.

Omogho town has four villages viz: Iwollo, Umunaba, Kolilu and Isiamaenyi, with an estimated population of 9,218 people (NPC, 2010). Iwollo village is the nearest village with a distance of 168.3 metres to Obutu lake while Umunaba is 1530metres and Kolulu is 2698.3metres to the lake. Omogho is an agricultural community and their farm produce includes rice, vegetables, yam and cassava, however some are trading in the farm produce and other minor commodities.

Ndikelionwu has eleven villages viz: Ndinwedo, Aronota, Arogwe, Ndikpa, Obinagu, Umudim, Amagu, Obinikpa, Okpunoifite, Umuochu and Eziokwe with an estimated population of 12,473 people (NPC, 2010).Obinikpa village which uses Obutu lake in Omogho is the nearest village to lake with a distance of 306metres to the lake; Okpunoifite village which habours the popular Iyiegwu lake is the nearest with a distance of 122.4metres; Umuochu is 3580.2metres away from the Iyiegwu lake; Umudim village is 3519metres away from Iyiegwu lake while Aronota village is close to Awgbu town and does not use any of the lakes as source of water supply. This community also has several streams, ponds, and a popular Iyiegwu lake situated at Okpunifite village which serve as their only source of water for domestic, recreational, social and agricultural purposes. All the streams and ponds (Iyinta, Aronota, Nwaowelle, Nama and Aghomili) in this area transverse other communities like Ndiowuu, Ufuma and Awa but do not flow into or out of the lakes. Some of the villages in Ndikelionwu are contiguous with Omogho town and also make use of Obutu Lake for their water needs. It has a large land mass and farming is the main occupation of the inhabitants. The people maintain a busy link with Oko and Ekwulobia communities as traders from these

areas come to buy farm produce. The area has rich fertile soil for farming. They engage in the cultivation of rice, yams, cassava and vegetables as well as fishing.

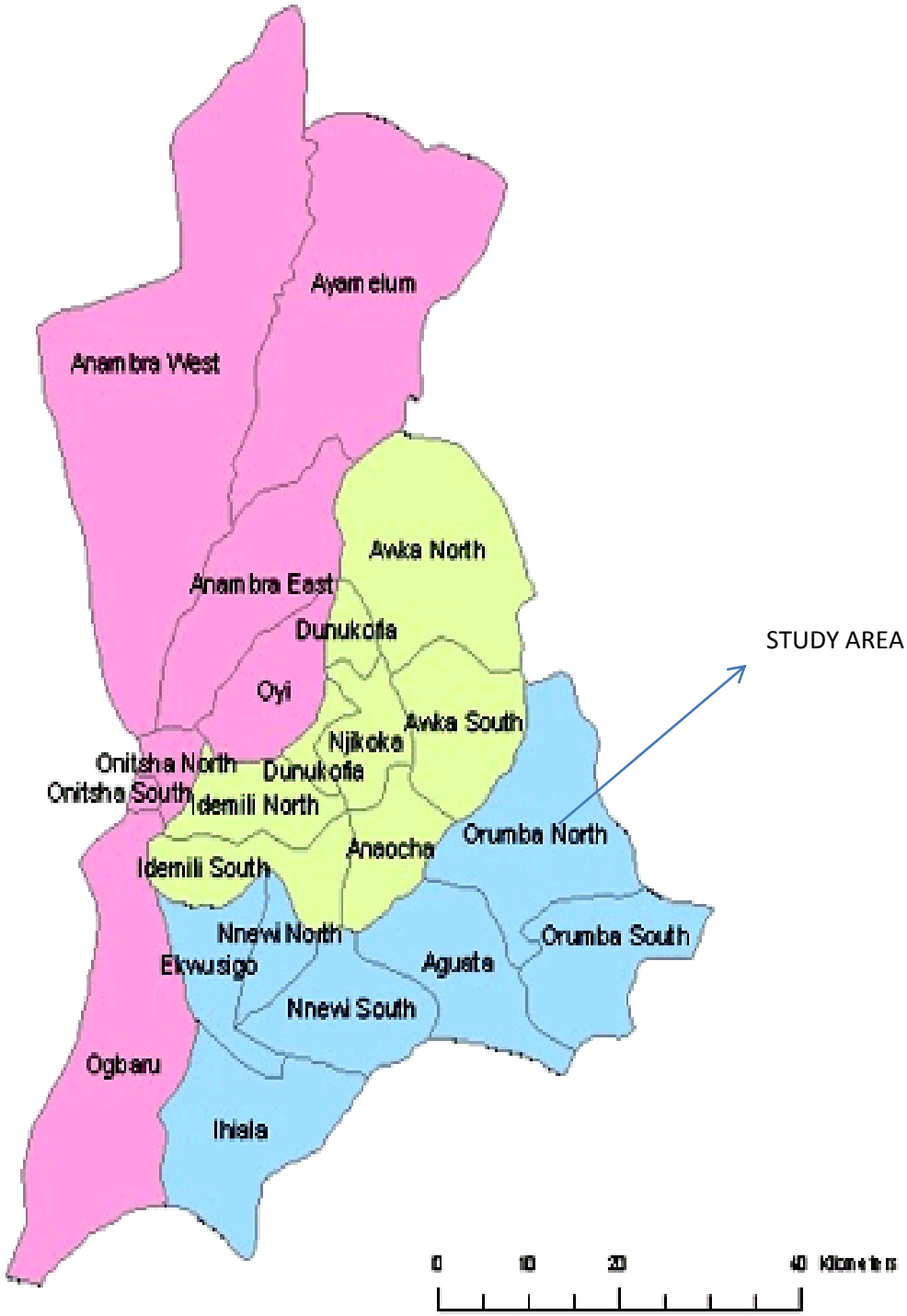

Fig 1: Map of Anambra State showing Orumba North Local Government Area (Wikipedia, 2018)

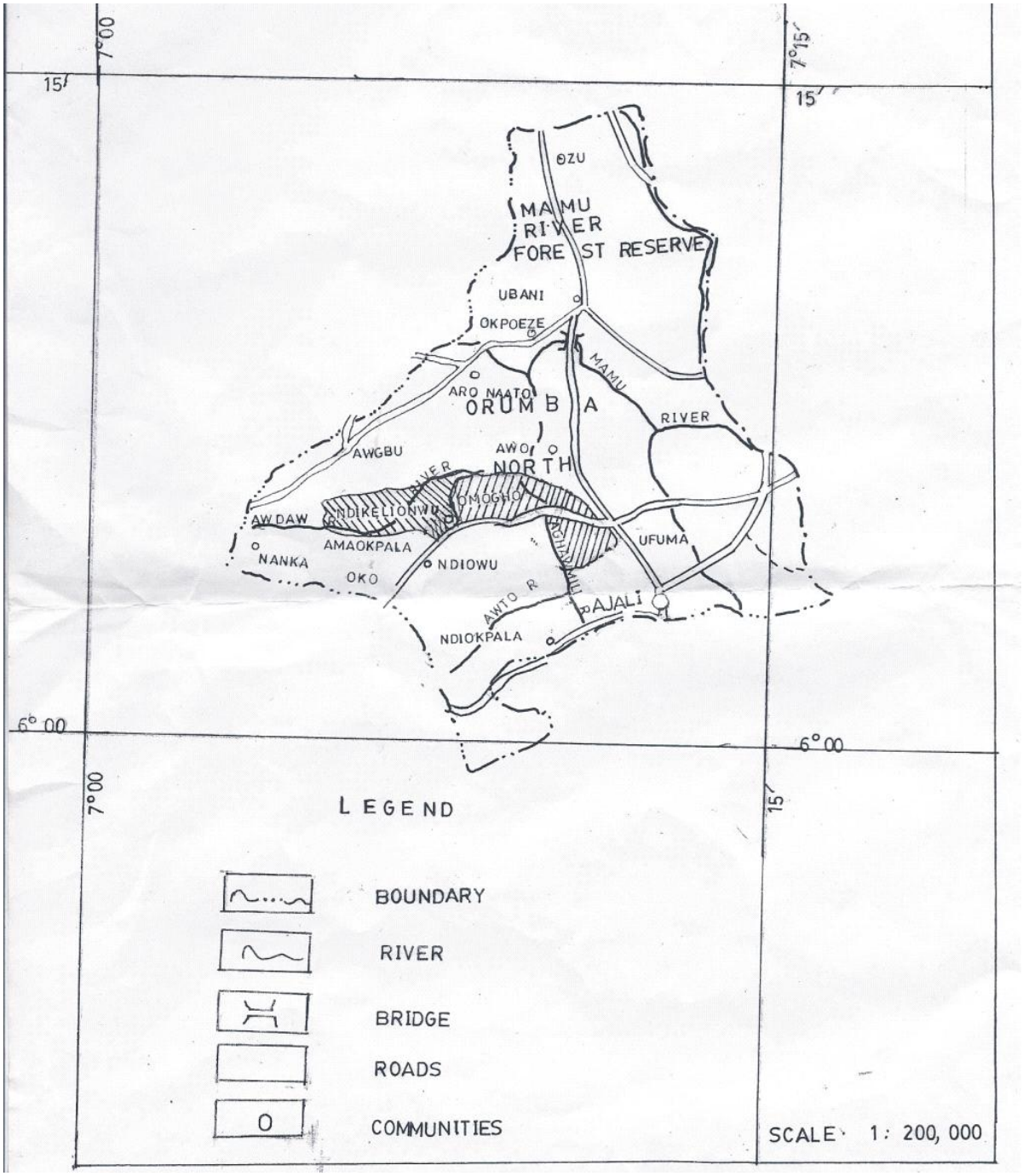

Fig 2: Map of Orumba North showing the study areas (Ministry of land, survey and town planning, Awka, Anambra State).

3.1.2 Study design

Snail ecology was a fieldsurvey of the lakes and ponds in the area to determine the snail species, their distribution and associated ecological factors. Monthly snail sampling was undertaken at five points –Iwollo, Ndiagu, Obutu Iyiezi, Isiamaenyi and Obinikpa sides of the Lake because of accessibility and human water contact points of the areas.

A cross-sectional survey of Omogho and Ndikelionwu people was used to determine urogenital schistosomiasis prevalence. Both males and females(school children and adults) aged between five and sixty years were randomly selected from the selected villages for the study. It was a one year study that cut across the two seasons of the year (wet and dry seasons). Questionnaires were used to determine the people's perceptions and practices against urogenital schistosomiasis.

3.1.3 Ethical clearance

The study protocol was reviewed and approved by the Research and Ethical Committee of the Nnamdi Azikiwe University Teaching Hospital (NAUTHEC), Nnewi, Anambra State (Appendix 1).

3.1.4 Advocacy visits and Community mobilization

Advocacy visits with a letter of introduction and intent from the Head of Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, (Appendix 2) was used to seek for approval from the Community Heads of the two communities (Eze Ndikelionwu-HM Eze Prof Chukwuemeka Ike and Igwe Omogho- Igwe S.N. Offor**) (**Appendices 3 and 4**).** The communities were mobilized through announcements in churches, schools and markets. Parents and children were enlightened on the purpose of the study through the Parents Teachers Association (PTA) and town meetings, in order to get their informed consent.

3.2 Snail Sampling Technique

Snails were sampledfrom the lakes using scoop nets (3m length and 30 cm diameter).Scooping was done for at least 15 minutes at each point once a month from August 2014 to July 2015 at all the sites. Hand picking was also done from vegetations, underside of parked boats, body of logs, body of large stones, stems of living trees, bamboo rafts, floating and submerged objects using hand gloves to avoid infection.

3.3Identification of the snails

The snails were identified using the World Health Organization key to the identification of freshwater snails of medical and verterinary importance (1983).The snails were measured using a transparent meter rule and the measurement recorded. These were then preserved in 70% alcohol and transported to the Department of Zoology, University of Nigeria, Nsukka, for confirmation by Prof F. C. Okafor (Parasitologist & Malachologist).

3.4 Snail Infections

To determine if the snails were infected, the snails were placed in well-labeled containers stocked with damp green vegetation and covered with perforated lids and transported to the Parasitology laboratoryof Nnamdi Azikiwe University Teaching Hospital, Nnewi for cercaria shedding. The snails were observed for cercariae shedding after exposure to sunlight for three (3) hours (Luka and Mbaya, 2015). This was done by putting each snail individually into a watch glass with water and exposing them for three hours (10:00am-13:00pm) under the sun. Exposed snails and the water were then mounted under the microscope for cercariae examination. Snails were also crushed in between two slides (crush method) and water added to it, mounted unto a microscope and examined for cercariae shedding (Worrell *et al.*, 2011).

3.5 Biotic factors

Aquatic fauna, especially predators like turtles and lizards were visually searched for in the water bodies and surrounding areas. Also aquatic flora such as algae blooms, water hyacinths and suspended vegetation around the edges were collected and taken to the Herbarium

ofBotany Department of Nnamdi Azikiwe University Awka, for proper identification. Human activities in and around the water bodies were equally observed.

3.5.1 Observation of the Predisposing factors of urogenital schistosomiasis around the lake

The predisposing factors of the infection around the lakes were observed by visual examination and recorded (Appendices 12-17).

3.6 Abiotic factors

Abiotic factors especially the physico-chemical properties of the water were studied. These were carried out during the dry and rainy season between August 2014 and July 2015 and they include:

3.6.1 Water depth

Using a boat to move round,a calibrated (in centimeter) rope attached to a weight (Sechi disc) was dipped into different areas of the lakeuntil it got to the bottom of the water. The rope was brought out and measurement taken for the depth of the water. This was done on five different points and the mean taken as described by Hanson, (2017).

3.6.2 Water turbidity

The turbidity was measured using a manually constructed Sechi disc (Appendix 6). With the aid of a calibrated rope, the Seechi disc was dropped into the lake gradually until the disc was no more visible. The depth at which the disc disappeared and the depth at which it reappeared as it is slowly brought up was taken and the average calculated as the turbidity (Cole, 1994).

3.6.3 Water velocity

The water velocity was also measured. Afloating object was placed into the water and the length of time it took the object to move to a marked distance down the water body was recorded (Darron, 2014). The water velocity was measured using the formula: S= D/T

Where S= Speed

D= Distance

T= Time (Siegler and Richards, 1979).

3.7Physico-chemical Analysis of the lakes

Water from the lake was collected in sterile containers monthly from August 2014 to July, 2015 and transported in a cold chamber to the Laboratory of the Technology Incubation Centre, Federal Ministry of Science and Technology, Nnewi, for Physico-chemical and biological analysis using the method described by the American Public health Association (APHA) (2000).

a. pH

Using a pH meter (Model 23A direct-reading pH meter), the pH of the water was measured by dipping the pH meter into the water body and the measurement taken.

b. Conductivity (uS/cm)

Conductivity was measured using a conductivity meter (conductometer- HANNA Instruments, Model DiST 1, Rhode Island USA). The water sample was poured into a glass dish. The red and black lead of the multimeter was plugged into its positive and negative ports respectively. The multimeter was turned on and its measurement dial switched to the resistance setting. The leads were touched to the water at opposite ends of the longest dimension of the glass dish. The resistance in ohms that appeared on the screen was noted. The length, width and depth of the glass dish were measured in centimeters. The width was multiplied by the depth to obtain the area of the sides of the glass dish in square centimeters. The length was divided by the product of the resistance and the area to arrive at the conductivity in units of siemens/meter. The conductivity was converted to microsiemens/cm by multiplying by 10,000.

c. Total Dissolved Solids (TDS) (mg/l)

An empty evaporating dish that has been dried at 180^0C for an hour was weighed and 100 ml of sample was well mixed and poured into a funnel with filter paper, then 75 ml of unfiltered sample was transferred into a porcelain dish. The oven was switched on and allowed to reach 105^0C. The dish was placed in the oven and dried for about 2hours; it was cooled in the

desiccator. Weighing and drying of the dish was continued until a constant weight was reached. The difference in the initial and final weight gives the TDS (mg/l).

d. Total Hardness (mg/l)

The total hardness of the water was measuredusing Varian AA240 Atomic Absorption Spectrophotometer.Fifty mililitres (50 ml) of the water was measured into an opaque white container. The pH of the water sample was adjusted from the acidic pH which it was to 7-10 by adding Ammonium hydroxide (NH_4OH) and Hydrochloric acid (HCl) solutions. Then 0.5ml of buffer solution was added with 0.2g of hardness indicator powder was added and the mixture was stirred. Standard Disodium Hydrogen Ethylene Dialene Tetraacetic Acid (Na_2H_2EDTA) solution was added slowly from a burette with continuous stirring. The titration was completed within five minutes after addition of the buffer and the colour changed from red to blue which is the end piont was noted and measurement taken.

The total hardness of the water was calculated as:

Total Hardness (mg/l) = titre value x 1000/volume of sample used.

e. Calcium Hardness (mg/l)

Fifty mililitres (50ml) of the water sample was measured into an opaque white container,2mls of Sodium hydroxide solution and 63-Hydroxy-4(2-hydroxy-4 sulfo-Inaphthy 1) azo-2,7, naphthalenedisulfonic acid, trisodium salt were added and stirred. Again 0.2g of Calcium indicator was added and stirred. Standard Na_2H_2EDTA solution was added slowly from a burette and stirred continuously. The titration was completed within five minutes after addition of the buffer and the colour change from red to royal blue which is the end piont was noted and measurement taken.

The Calcium hardness of the water was calculated as:

Calcium Hardness (mg/l) = titre value x 1000/volume of sample used.

f.Magnesium Hardness (mg/l)

50ml of the water sample was measured into an opaque white container. Then 2mls of Sodium hydroxide solution and 63-Hydroxy-4(2-hydroxy-4 sulfo-Inaphthy 1) azo-2,7, naphthalenedisulfonic acid, trisodium salt were added and stirred. Again 0.2g of Magnesium indicator was added and stirred. Standard Na_2H_2EDTA solution was added slowly from a burette and stirred continuously. The titration was completed within 5mins after addition of the buffer and the colour change from red to royal blue which is the end piont was noted and measurement taken.

The Magnesium hardness (mg/l) of the water was calculated as:

Magnesium Hardness (mg/l) = titre value x 1000/volume of sample used.

g. Nitrite concentration (mg/l)

Nitrite concentration of the waterwas determined using PD303 UV Spectrophotometer.Fifty mililitres (50ml) of the water sample was pipetted into a porcelain dish and evaporated to dryness on a hot water bath. Then 2ml of Phenol disulphonic acid was added to dissolve the residue by constant stirring with a glass rod, then2mls of concentrated solution of Sodium hydroxide, 5ml of 1molar zinc sulphate and distilled water were added with stirring to make it alkaline. This was filtered into a Nessler's tube and made up to 50ml with distilled water. The absorbance was read spectrophotometrically at 410nm after colour development.

h. Nitrate concentration (mg/l)

Nitrate concentration of the water was determined using PD303 UV Spectrophotometer.Fifty mililitres (50ml) of the water sample was pipetted into a porcelain dish and evaporated to dryness on a hot water bath. Then 2ml of Phenol disulphonic acid was added to dissolve the residue by constant stirring with a glass rod. After, 2mls of concentrated solution of Sodium hydroxide and distilled water weres added with stirring to make it alkaline. This was filtered into a Nessler's tube and made up to 50ml with distilled water. The absorbance was read spectrophotometrically at 410nm after colour development.

3.8 Biological Analysis of the Lakes within the study period

a. Total coliform(MPN/100ml)

The spread plate method was used (APHA, 2000). Nine millimeters of sterile normal saline solution was distributed in ten test tubes for serial dilution. The test tubes were sterilized by autoclaving at 121^0C for 15 minutes after which 1ml of the water sample was transferred into the tube containing 9ml of normal saline using sterile pipette to make the ten fold serial dilution. The first tube gave 10^{-1} dilution, subsequent ten fold serial dilutions were prepared up to 10^{-10}.

Using a sterile 1ml pipette, 0.1m from 10^{-3} and 10^{-4} dilution were transferredasceptically onto the surface of solid nutrient agar and MacConkey agar plates (Titan Biotech Ltd India). Each dilution was plated in duplicate. The innoculum were evenly spread over the surface of the medium using sterile wire loop. The plates were then incubated at 37^0C for 24hours. The colonies on each plate were counted and the colony forming units per ml of water samples were computed using its formular.

b. Faecal coliform (MPN/100ml)

Feacal coliform was enumerated using the most probable number technique. The test was performed using three columns of test tubes. This test was carried out in three stages. The three stages include presumptive, confirmatory and completed test stages.

Presumptive Test Stage Procedure

10ml of undiluted water sample was transferred into three tubes containing 10mls of double strength lactose broth. 1ml of the sample was inoculated into the tube containing 10ml of single strength lactose broth and 0.1ml of the sample which was diluted to 10^{-1} was inoculated into tubes containing 10ml of single strength lactose broth. In each case, sterile inverted Durham tube was inserted and triplicate tubes were made. A control was used. The tubes were inoculated at 37^0C for 24 hours and observed for gas production (which indicates the presence of faecal coliform in the water sample) in the Durham tubes. The total feacal counts from positive tubes were read.

Confirmatory Test Stage Procedure

Cultures from positive tubes from the presumptive tests were streaked into brilliant green lactose bile broth with the aid of a sterile wire loop and incubated at 37^0C for 24 hours. The tubes were observed for colour change from purple to yellow (acid) and gas production in the inverted Durham tubes indicating confirmation of the presence of faecal coliform in the water sample.

Completed Test Stage Procedure

The feacal coliform colonies observed in the confirmed test were then transferred asceptically onto eosine – methylene blue (EMB) agar plates with the aid of a sterile wire loop. The plates were incubated at 37^0C for 24hours and observed for growth of pink mucoid colonies with metallic sheen. Gram staining and spore staining were made with colonies from EMB plates. Non-spore forming gram negative rods from the agar plate constituted the completed test for faecal coliforms.

3.9 Sample size and sampling technique

A sample size of five hundred and twenty four (524) people aged 5-60 years was randomly selected from the three villages (Iwollo, Umunaba and Kolulu) from Omogho and five villages (Aronota, Okpunoifite, Ndinwedo, Umudim and Umuochu) from Ndikelionwu for the study. Two hundred and seventy nine (279) people from Ndikelionwuand two hundred and forty five (245) people from Omogho who gave their consent were selected. It was a school and community based study. This was estimated with the Statcalc software of Epi Info 6(Centre for Disease Control, Atlanta, USA) for population survey or descriptive study using random sampling. The sample size was calculated using the following figures:

Based on the population size of Omogho (9,218) and that of Ndikelionwu (12,473), expected frequency of Schistosomiasis of 10% and a confidence level of 95% the sample size was calculated thus:

$$N = \frac{PQ}{(E/1.96)^2}$$

Where,

N= sample size; P= maximum prevalence rate; Q= 100% -P and E= margin of sampling error.

Individuals were randomly selected from the villages of the two communities.Recruitment method was used. Exclusion criteria of individuals more than sixty years and inclusion criteria of individuals between five and sixty years, living in the study areas was used to select individuals for the study.

3.9.1Prevalence and intensity of urogenital schistosomiasis

3.9.1.1 Urine sample collection

Wide-mouthed calibrated transparent universal containers with covers were given out to the participants to collect their urine up to 15mls mark. The containers were well-labeled with the participants' numbers while their names, age, and sex were recorded in a notebook. The urine samples were collected between 10:00hrs and 14:00 hrs, Nigerian time and 25 samples were collected each day of visit to the study areas. The samples were preserved with 2 drops of 10% formalin. The samples were transported to the Parasitology Laboratory of Nnamdi Azikiwe University Teaching Hospital Nnewi for detection of eggs of schistosomes and urinalysis(WHO, 1991).

3.9.1.2 Urine analysis

The collected urine samples were examined in the laboratory using the standard filtration technique (WHO, 1991) and the number of eggs / 10mls of urine were recorded. Each urine sample was mixed properly and, 10 mls of urine sample was drawn out using 10ml syringe. The urine was slowly passed through the filter with the aid of the filter holder into a beaker. The syringe was removed, air- filled and repassed into the filter through the holder to remove

excess urine and eggs that adhered to the surface of the filter. The filter holder was opened and with the help of forceps, the filter was removed and placed in an upward position on a glass slide, covered with cover slip and examined under the microscope using x10 objective lens to detect eggs of *S. haematobium.* The eggs were counted and recorded as the number of eggs/ 10 mls of urine.

3.10 Distribution of Questionnaires

Structured and tested questionnaire that was validated by Prof A. E. Onyido (my supervisor)were distributed tothree hundred and ninety two subjectswho are ≥10years of age to establish the knowledge, attitude and practice of the people with respect to urogenital schistosomiasis, transmission and water-contact activities.The questionaire also sought for the demographic data (age, sex, occupation and educational status) of the participants (Appendix 5).

The questions were interpreted to the respondents who could not read and write and their responses carefully recorded.

3.11 Statistical analysis

All the data obtained were analyzed using SPSS (Statistical Package for Social Sciences) version 20. One sample T-test and Analysis of Variance (ANOVA) were used to compare percentage prevalence and mean egg output. Correlation co-efficient was used to determine the relationship between the physico-chemical properties of the water and the population abundance of the snails. All statistical analysis was carried out at 95% confidence interval.

CHAPTER FOUR

RESULTS

4.1SNAIL SPECIES COMPOSITION AND ABUNDANCE

A total of 1,631 freshwater snails were collected from the two lakes (Iyiegwu and Obutu), in the study area within the study period (Table 1). Of this number, 1117 (68.49%) were from Iyiegwu lake and514 (31.51%) were from Obutu lake. The difference in the freshwater snails abundance in the two lakes was significant ($P<0.05$) (Appendix 21).

The species collected were *Pila ovata* 1605(98.41%) and *Bulinus globosus* 26(1.59%). *Pila* species had a monthly mean of 114.666 ± 36.25 while *Bulinus* species had a monthly mean of 2.17 ± 1.32. *Pila* species was significantly higher in abundance than the *Bulinus* species ($P<0.05$) (Appendix 21).

Table 1: Freshwater Snails collected in Iyiegwu and Obutu lakes, Orumba North Local Government Area within the study period.

Snail species	Lakes		Total collection	Monthlymean	%totalcollection
	Iyiegwu	Obutu			
Bulinus globosus	9	17	26	2.17±1.32	1.59%
Pila ovata	1108	497	1605	114.666±36.25	98.41%
Total	1117	514	1631	135.917	100%

(X^2= 0.011; P<0.05) (Appendix 21)

The monthly abundance of the freshwater snails within the study period is shown in Fig 3-5. The highest numbers of*Pila ovata* (300-358) were collected between June and July for both lakes. Then followed by a decline of numbers to about 40 in August and a gradual rise to another population peak of 265 in October and another decline to 174 snails in November and a sudden decline to virtually no snail in the month of December. *Pila* species was collected from May to November coinciding with rainy season period while a high number of *Bulinus* species was collected from December to May coinciding with dry season. *Bulinus* species was most abundant (13) in the month of Januarywhile *Pila* species was most abundant (358) in the month of July.

In Obutu lake, *Pila ovata* was collected from June to October while *Bulinus globosus* was collected in the months of December, January and March. In Iyiegwu lake, *Pila ovata* was collected from May to November while *Bulinus globosus* was collected from January to May.

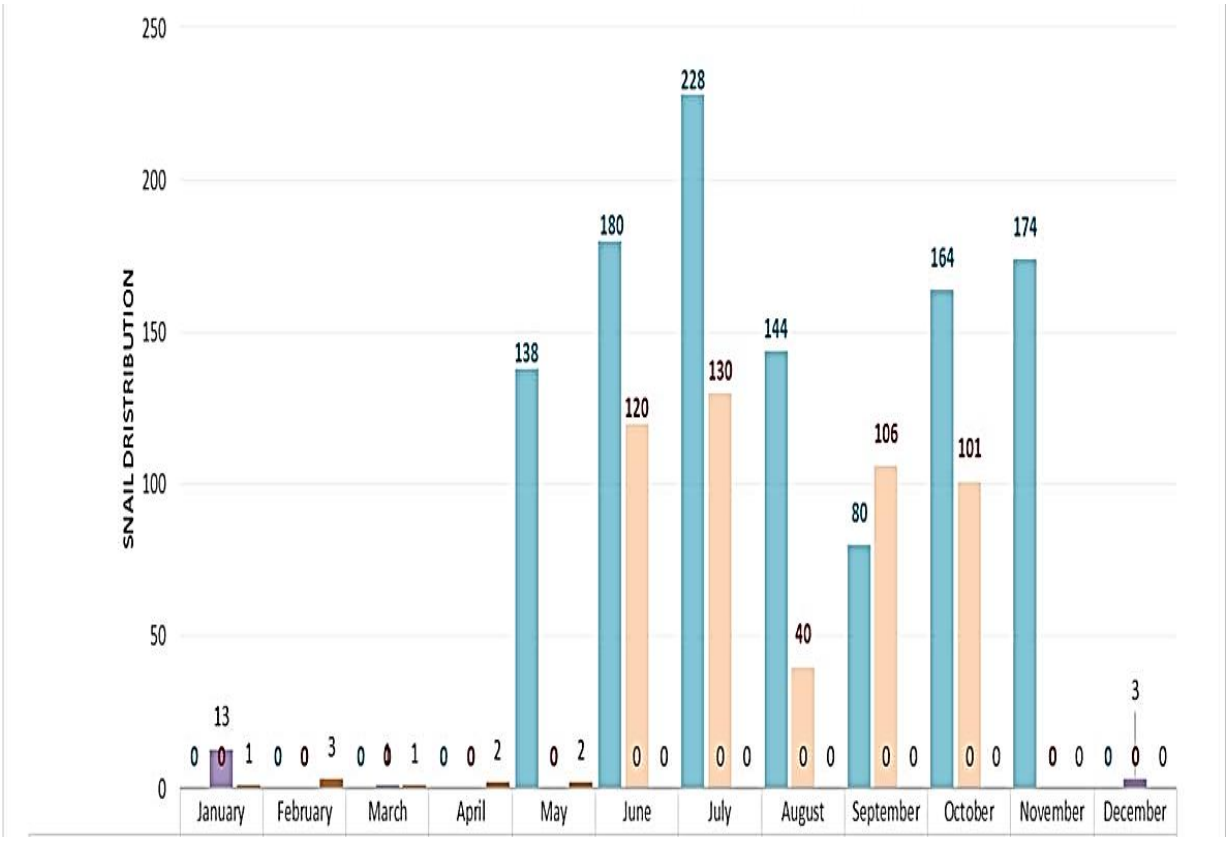

Fig 3: Monthly abundance of freshwater snail species in the lakes

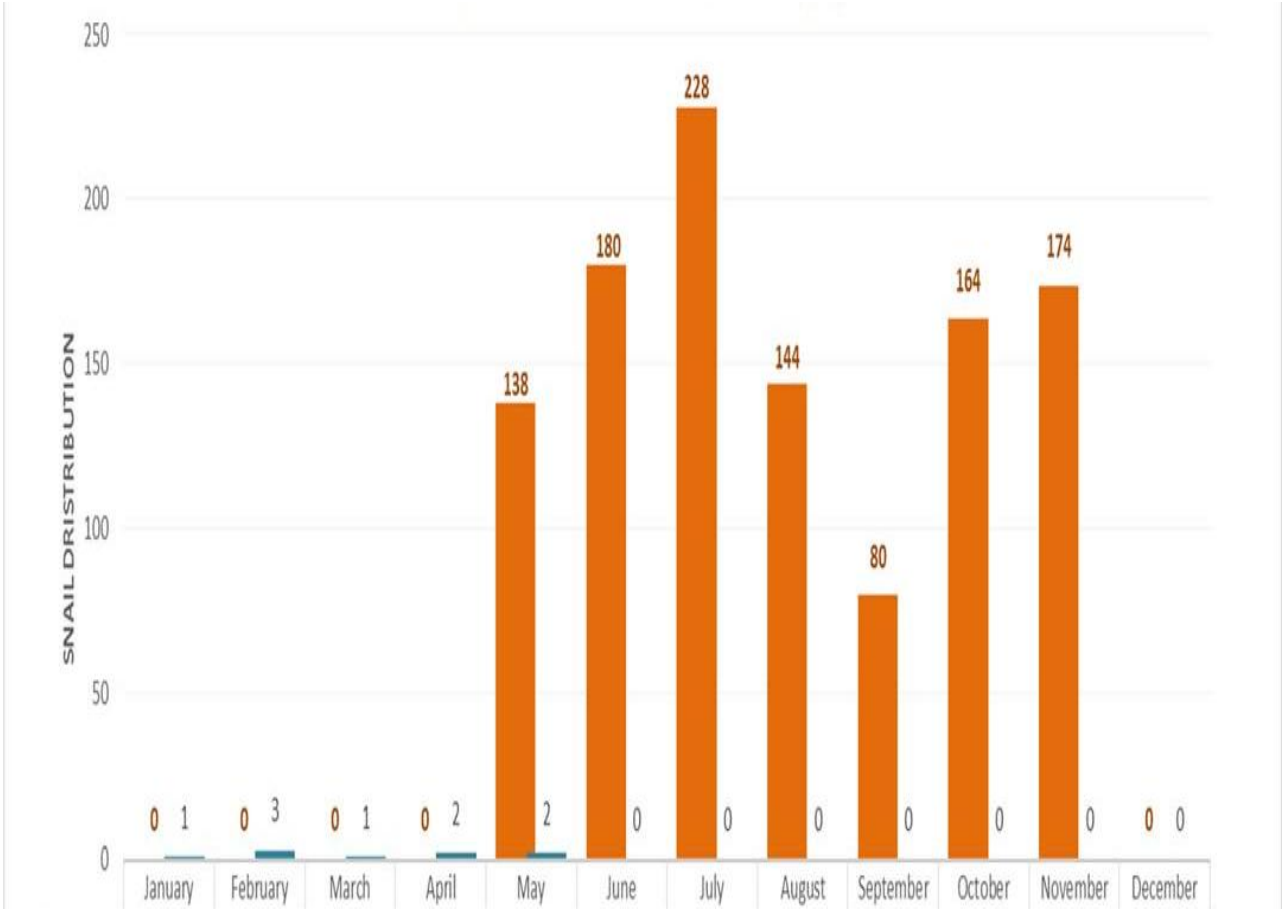

Fig 4: Monthly abundance of freshwater snail species in Iyiegwulake

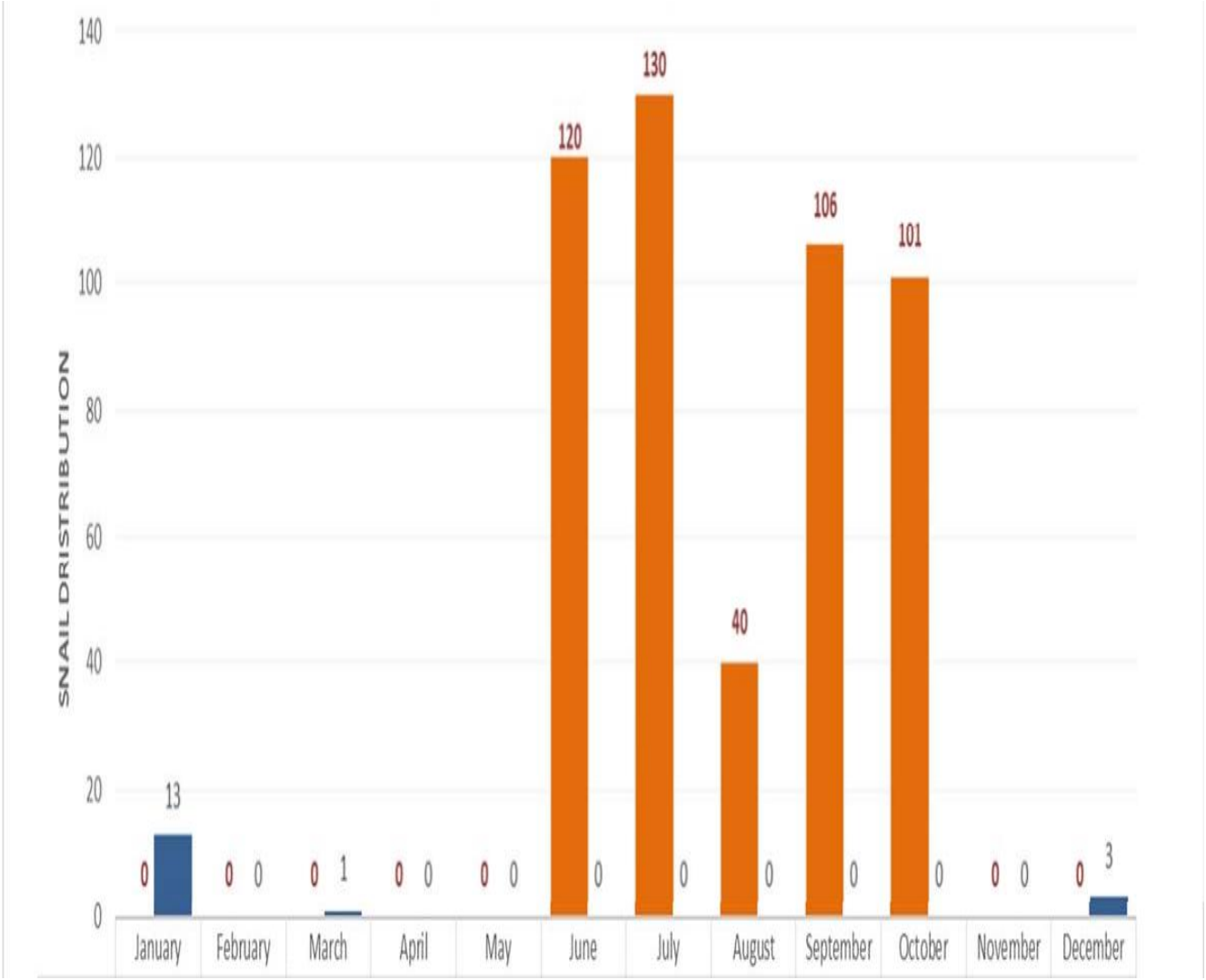

Fig 5: Monthly abundance of freshwater snail species in Obutulake

4.1.1 Spatial Distribution of freshwater snails in the lakes within the study period

Table 2 shows spatial distribution of freshwater snails in the lakes within the study period. Out of the 1,631 freshwater snails collected from the lakes,a total of 8(0.49%) were collected from underleaves of floating vegetation; 999(61.25%) were collected from water-contact areas with vegetation; 624(31.26%) were collected from water-contact points exposed to sun and deviod of vegetation. No freshwater snails were collected from body of parked boats, body of logs, body of large stones and stems of living trees.

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Table 2: Sites of collection of freshwater snails in Iyiegwu and Obutu lakes

Sites of	Snail species		Total Collection	% collection collection
	Bulinus	*Pila*		
1.Under leaves of floating vegetation	8	-	8	0.49
2.Floor of water-contact area with vegetation	13	986	999	61.25
3.Floor of water-contact area exposed to sun without vegetation	5	619	624	38.26
		-		
Total	26	1605	1631	100

4.2 ECOLOGICAL/PREDISPOSING FACTORS INFLUENCING FRESHWATER SNAILS SURVIVAL IN THE LAKES

The ecological factors perceived to influence the freshwater snails populations in the lakes were both biotic and abiotic factors.

4.2.1Biotic factors

i. Predators

The biotic factors observed were predators including the fish populations in the water, turtles and lizards especially monitor lizards usually seen near the lakes.

Other biotic factors were human population and their activities within and around the water bodies. Also aquatic vegetations including floating aquatic plants and overhanging vegetation providing shade in the water were observed.

ii. Humanpopulations and activities

Thriving human populations especially during the dry season were found within and around the water bodies.Children and adultswere observed doing house chores such as washing cloths, household utensils or even swimming, bathing or carrying out other recreational activities. Some were observed fetching water, fishing or farming within or near the lakes (Appendix 12-17).The common activites observed and supported by the questionnaire interview is shown in table 3. Of the 392 participants interviewed, 320 (81.6%) mentioned that swimming, bathing and washing of clothes and other household items are the activities that take them to the lake while 80 (20.4%) said that fishing take them to the lake. Other activities that take them to the lake were farming and farming related activities 175 (44.6%), helping parents in farm work 265 (67.6%) and following friends 142(36.2%). Cattle rearers were seen sparingly around the lake with their cattles using the lake as their source of

drinking water and the vegetation as source of food.The farmers also practice irrigation activities around the lakes.

Table 3: HUMAN ACTIVITIES WITHIN OR AROUND THE WATER BODIES IN RELATION TO UROGENITAL SCHISTOSOMIASIS INFECTION IN THE STUDY AREA.

1.	What activities normally bring you to the lakes and streams?	Yes response	Percentage
A	Fishing	80	20.4
B	Crop farming	175	44.6
C	Swimming/bathing	320	81.6
D	Washing clothes	319	81.4
E	Washing of other household items	319	81.4
F	Helping parents in farm work	265	67.6
G	Following friends	142	36.2

iiiVegetations found around Obutu and Iyiegwu lakes within the study period

The plant species associated with the lakes and their locations as identified in the Botany Department of Nnamdi Azikiwe University, Awka are shown in table 4.

Twenty plant species common around the lakes were identified. Seven plant species (*Aspilia bussei, Axonopus spp, Commelina diffusa, Hyphi saureolens, Pistia stratiotes, Sida acuta* and *Urena lobota*), were common to both lakes. Three plant species (*Commelina benghalensis, Eichlormia crassipes* and *Ludwigia decurrenas*) were peculiar to Iyiegwu lake. Seven plant species (*Alchornea cordiofolia, Calapognum mucunoides, Cissus spp, Cynodon spp, Ipomea spp, Ludwigia hyssopifolia, Melasoformastum capitulum* and *Phyllantus amarus*) were peculiar to Obutu lake. Of the twenty plant species identified, only one plant; *Pistia stratiotes* was aquatic, floating on the surface of the water while nineteen other plants were terrestrial plants located at the banks of the lake casting shadow in the water.

Table 4: **Common vegetations found in Obutu and Iyiegwu lakes within the study period**

Plant name	Habitat	Lake location	
		Obutu	Iyiegwu
Ageratum conzorydes	Terrestrial	√	-
Alchornea cordiofolia	√	√	-
Aspilia bussei	√	√	√
Axonopus spp	√	√	√
Calapognum mucunoides	√	√	-
Cissus spp	√	√	-
Commelina benghalensis	√	-	√
Commelina diffusa	√	√	√
Cynodon spp	√	√	-
Cyperus esculentus	√	√	-
Eichlormia crassipes	√	-	√
Hyphi saureolens	√	√	√
Ipomea spp	√	√	-
Ludwigia decurrena	√	-	√
Ludwigia hyssopifolia	√	√	-
Melasoformastum capitulum	√	√	-
Phyllantus amarus	√	√	-
Sida acuta	√	√	√
Urena lobota	√	√	√
Pistia stratiotes	*Aquatic*	√	√

4.2.2 Abiotic factors

The abiotic factors studied in the lakes were the water current, water depth and the physico-chemical and biological properties of the lakes.

4.2.2.1 Water depth and Water velocity

The water depths for the two lakes averaged 96cm for Obutu lake and 81cm for Iyiegwu lake. Their mean water velocities were 0.027metre per second (m/s) for Obutu lake and 0.025m/s for Iyiegwu lake.

Ten physico-chemical and two biological parameters namely pH, turbidity, conductivity, total dissolved solids, suspended matter, total hardness, calcium hardness, magnesium hardness, nitrite and nitrate concentrations, total and faecal coliforms respectively were studied (Tables 5& 6). These were correlated with freshwater snail abundance as follows (Appendix 25).

Table 5:Seasonal snail abundance and the physico-chemical and biological properties of Iyiegwu lake within the study period

Season	Month	PH	(NTU) Turbidity	Conductivity	Dissolved solid (mgl)	Total Suspended Matter	Total hardness	Calcium hardness	Magnesium hardness	Nitrit eN0_2- (PPM)	Nitrate (No_3+) concentration	Total coliform	Faecal coliform MPN/10ml	*Bulinus* spp	Others: (*Pila*spp)
Dry season (Nov-March)	Nov	6.46	6.32	20	29.85	30	65	20	50	0.20	0.958	3	-	-	174
	Dec	6.41	6.80	20	29.85	30	70	20	60	0.18	0.958	3	-	-	-
	Jan	6.40	6.66	20	29.85	30	75	30	70	0.18	1.345	6	-	1	-
	Feb	6.36	7.41	20	29.85	35	90	50	80	0.18	3.000	7	-	3	-
	Mar	5.38	7.64	120	29.85	35	120	80	80	0.16	5.000	7	3	1	-
Rainy season (April-Oct)	Apr	5.00	8.20	180	29.85	35	155	120	80	0.16	7.321	8	3	2	-
	May	4.13	8.46	180	268.66	40	250	150	100	0.16	8.000	10	5	2	138
	June	4.13	7.87	180	240.42	40	180	100	60	0.18	8.000	6	4	-	180
	July	5.12	6.50	180	220.00	40	120	80	50	0.18	9.000	5	2	-	228
	Aug	6.77	4.00	20	29.85	20	60	20	40	0.20	10.000	4	1	-	144
	Sept	6.51	5.23	20	29.85	20	60	20	40	0.20	1.042	4	1	-	80
	Oct	6.49	5.82	20	29.85	25	65	20	45	0.20	0.900	3	1		164
Total		69.16	80.9	980	997.73	380	1310	710	755	2.18	55.52	66	20	9	1108
Mean		5.76	6.74	81.67	83.14	31.66	109.16	59.16	62.91	0.18	4.62	5.5	1.67		

Table 6:Seasonal snail abundance and the physico-chemical and biological properties of Obutu Lake within the study period

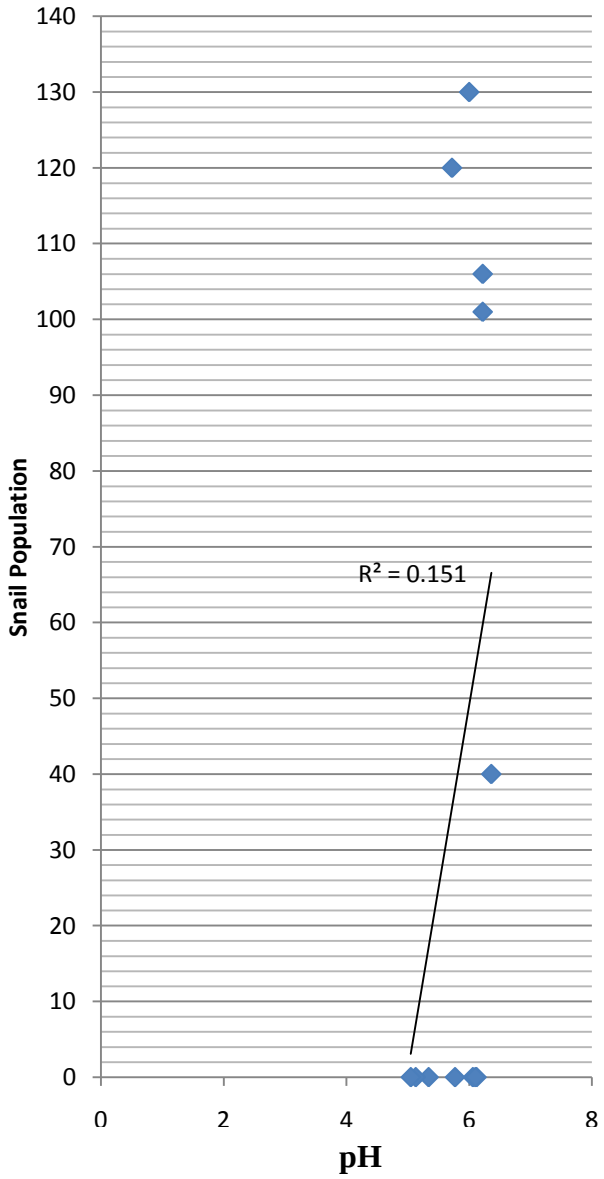
Season	Month	PH	(NTU) Turbidity	Conductivity	Dissolved solid (mgl)	Suspended Matter	Total hardness	Calcium hardness	Magnesium hardness	$N0_2$ Nitrit concentration	Nitrate (No_3+) concentration	Total coliform	Faecal coliform MPN/10ml	Snails= *Bulinus* SP	Others: (*Pila*spp)
Dry season (Nov-March)	Nov	6.06	5.5	10	14.93	15	65	25	35	0.14	0.521	6	-	-	-
	Dec	6.12	5.4	10	14.93	15	65	25	50	0.113	0.428	6	-	3	-
	Jan	6.10	5.6	10	16.42	20	70	30	60	0.113	0.426	7	4	13	-
	Feb	5.77	5.8	10	18.33	20	80	50	65	0.112	0.422	8	5	-	-
	Mar	5.34	6.2	15	20.58	20	120	70	70	0.111	0.416	8	6	1	-
Rainy season (April-Oct)	April	5.13	7.7	15	25.68	150	150	85	85	0.111	0.415	10	7	-	-
	May	5.05	8.4	20	28.85	200	200	115	55	0.111	0.413	15	8	-	-
	June	5.72	7.3	10	26.47	180	180	100	45	0.113	8	12	6	-	120
	July	6.00	6.8	10	20.00	120	120	65	70	0.114	12	11	4	-	130
	Aug	6.36	6.0	10	14.93	10	60	20	40	0.16	13	10	3	-	40
	Sept	6.12	5.8	10	14.93	10	60	20	40	0.15	13	7	2	-	106
	Oct	6.12	5.8	10	14.93	10	60	20	35	0.14	10	7	1	-	101
Total		69.89	76.3	140	230.98	770	1230	565	650	1.49	59.041	107	64	17	497
Mean		5.82	6.36	11.67	19.25	61.17	102.5	47.08	54.17	0.124	4.92	8.92	5.33		

a. Snail abundance and pH of the lakes

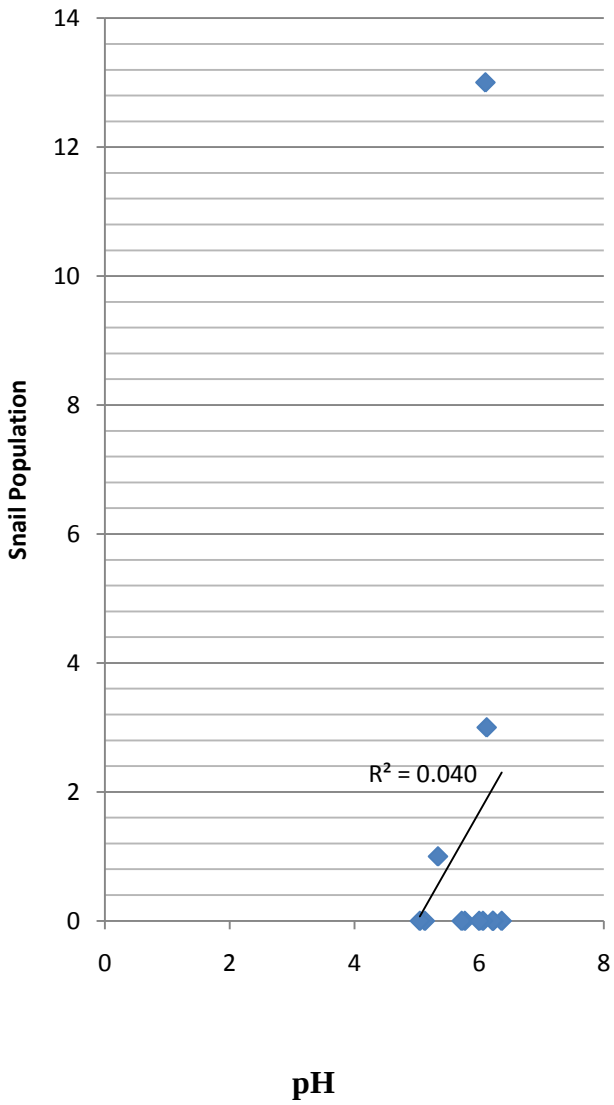
From January to December (dry season) of the study period, water pH ranged from 5.05-6.36 in Obutu lake and 4.13-6.77 in Iyiegwu lake. *Bulinus* species were collected at a pH range of 4.13-6.41 at Iyiegwu lake and 5.34-6.12 at Obutu lake (Appendix 22). The highest number of *Bulinus* species, 14 (53.85%) was collected in January when the mean pH in both lakes was 6.27 (Table 5).

Pila species was collected at a pH range of 5.72-6.36 in Obutu lake and 4.13-6.77 at Iyiegwu lake. The highest number of *Pila* species, 358 (22.31%) was collected in July (rainy season) (Appendix 23)when the mean pH in both lakes was 6.56. Both species (*Bulinus* and *Pila*) thrived in slightly acidic conditions andwere collected most when the mean water pH was6.27 and 6.56 respectively from the lakes.

Regression graphof the snail populations versus pH in both lakes are shown in Figs 6 and 7.*Bulinus* population had a weak negativecorrelation to pH (r=-0.047) in Obutu lake where a higher number of *Bulinus* 17 (65.38%) were collected and a weak negative relationship (r=-0.246) at Iyiegwu where only 9 (34.62%) were collected. *Pila* species had a weak positive correlation to pH (r= 0.368) at Obutu lake where a lesser number 497 (30.97%) were collected and a weak positive relationship (r= 0.121) at Iyiegwu lake where most of the *Pila* species 1108 (69.03%) were collected. pH was not significantly correlated to snail abundance in the lakes (P>0.05) (Appendix 25).

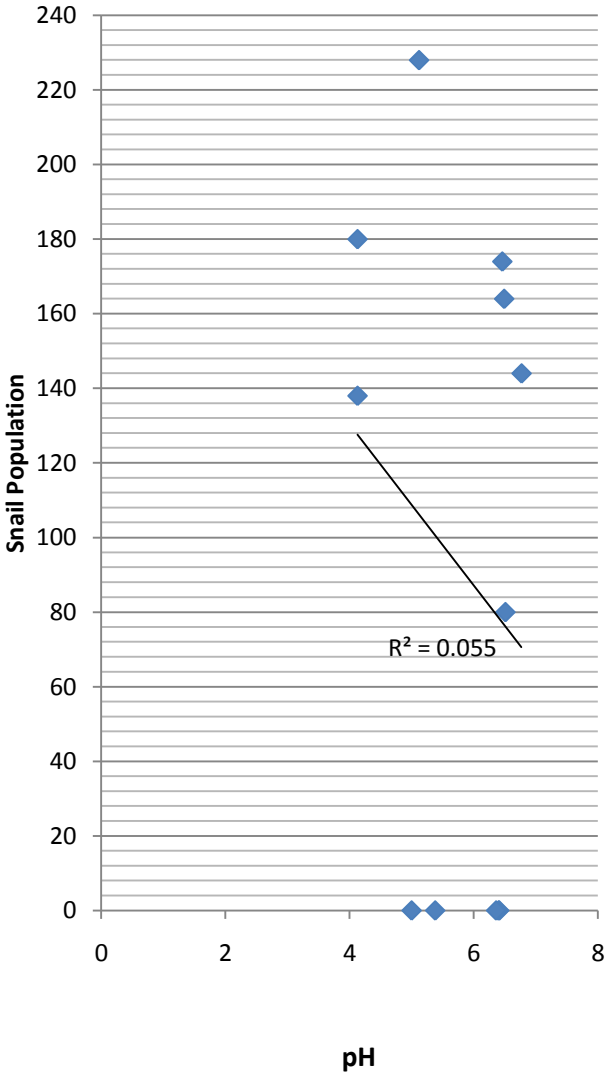


Relationship of pH to *Pila ovata* in Obutu lake (r = 0.368)

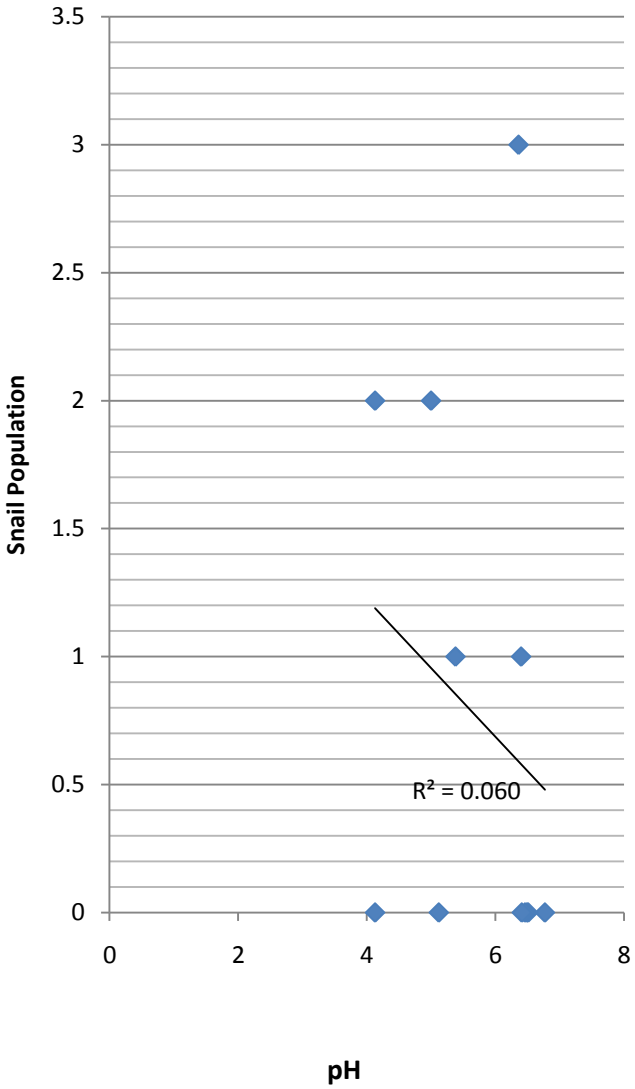


Relationship of pH to *Bulinus* in Obutu lake (r =-0.047)

Fig 6: Regression graph of snail populations versus pH in Obutu lake**.**



Relationship of pH to *Pila* spp in Iyiegwu lake (r = 0.121)



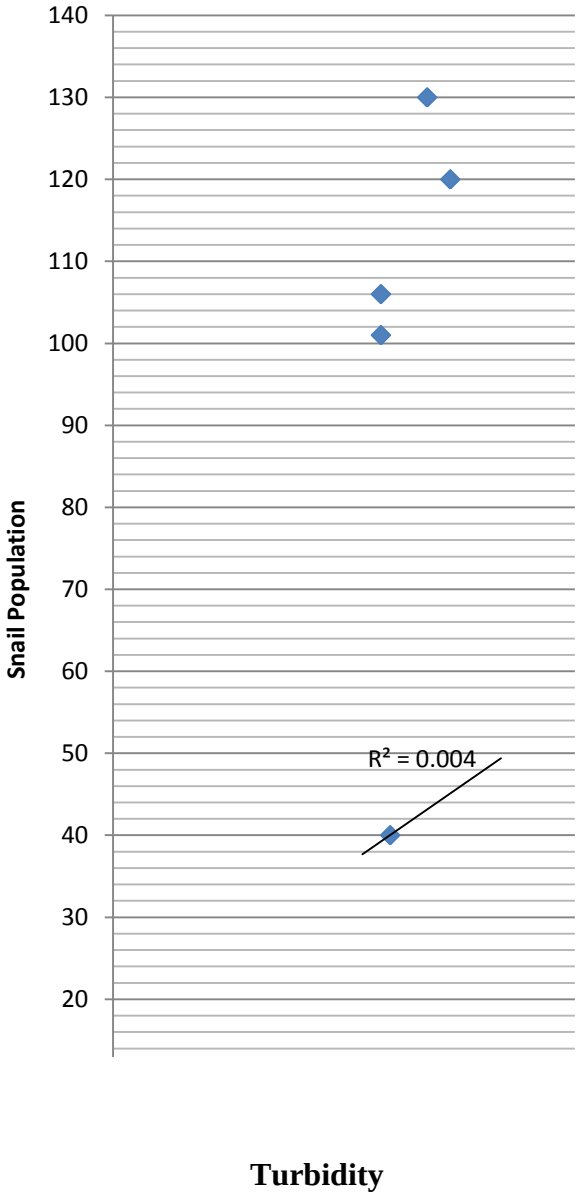
Relationship of pH to *Bulinus* in Iyiegwu lake (r = -0.246)

Fig 7: Regression graph of snail population versus pH in Iyiegwu lakes

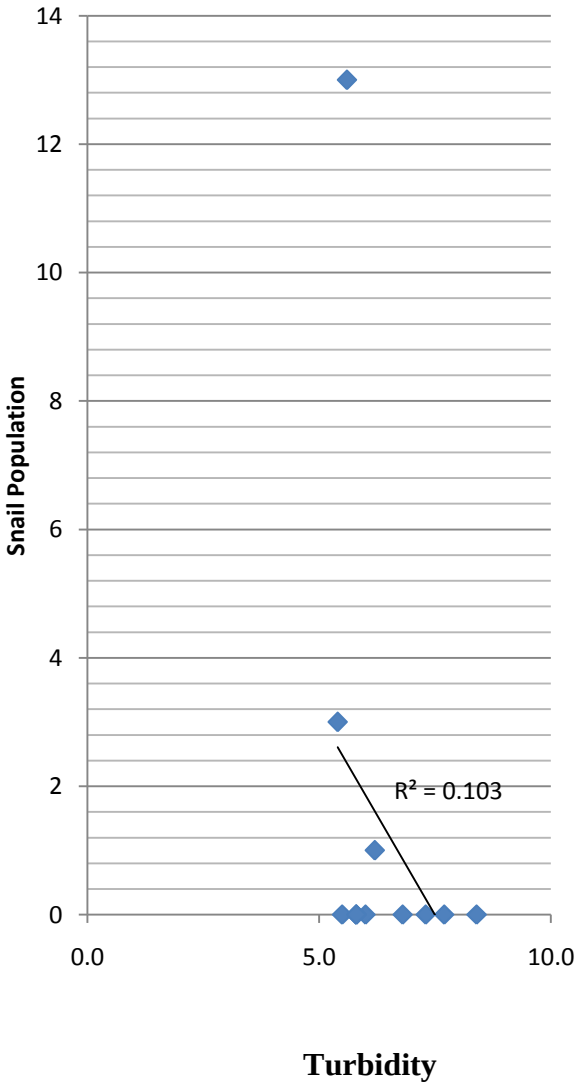
b. Snail abundance and turbidity of the lakes

Water turbidity ranged from 5.4-8.4Nephelometric turbidiy units (NTU)at Obutu lake and 4.0-8.46 at Iyiegwu lake. In both lakes turbidity was highest (8.4) in the month of May but lowest (5.4) in the month of December at Obutu lake and month of August at Iyiegwu lake. *Bulinus* species were collected at a turbidity range of 5.4-8.4NTU in Obutu lake and 4.0-8.46NTU at Iyiegwu lake. The highest number of *Bulinus* species 14(53.85%) was collected in January when the mean turbidity of both lakes was 6.13NTU. *Pila* species was collected at turbidity range of 5.5-8.4NTU at Obutu lake and 4.0-8.46NTU at Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in July when the mean turbidity value of both lakes was 6.65NTU.

Regression graph of snail populations versus turbidity in both lakes are shown in Figs 8 and 9 *Bulinus* species had a weak negative relationship to turbidity (r= -0.204) at Obutu lake and strong positive relationship (r= 0.609) at Iyiegwu lake. The highest number of *Bulinus* species 14 (53.85%) was collected in January when the mean turbidity of both lakes was 6.13NTU. *Pila* species had a weak negative relationship (r= -0.022) at Obutu lake and a strong negative relationship (r= -0.548) at Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in July when the mean turbidity of both lakes was 6.65NTU. Turbidity was significantly correlated to *Bulinus* abundance ($P<0.05$) but not correlated significantly with *Pila* species in the lakes ($P>0.05$) (Appendix 25).

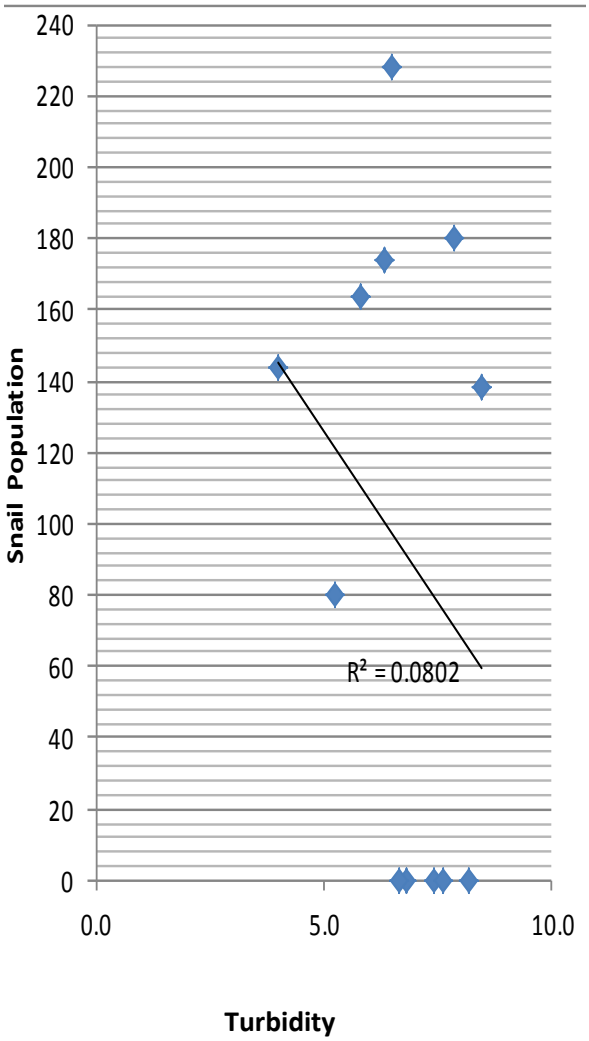


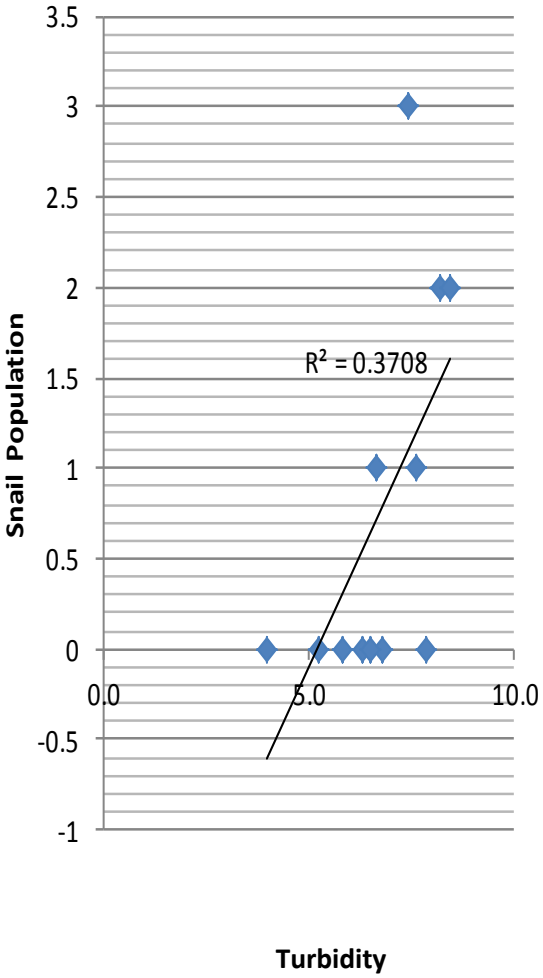
Relationship of turbidity to *Pila* spp at Obutu lake (r = -0.022)



Relationship of turbidity *Bulinus* at Obutu lake (r = -0.204)

Fig 8: Regression graph of snail populations versus turbidity in Obutu lake





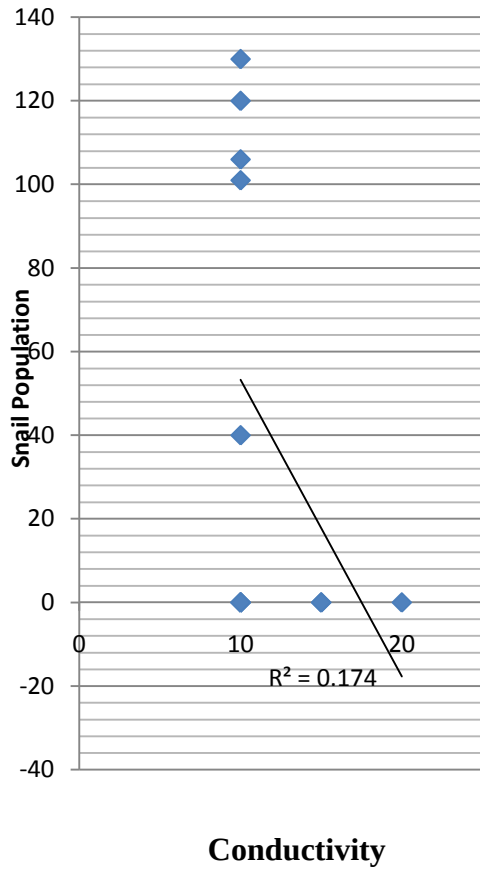
Relationship of turbidity to *Pila* in Iyiegwu lake (r = -0.548)

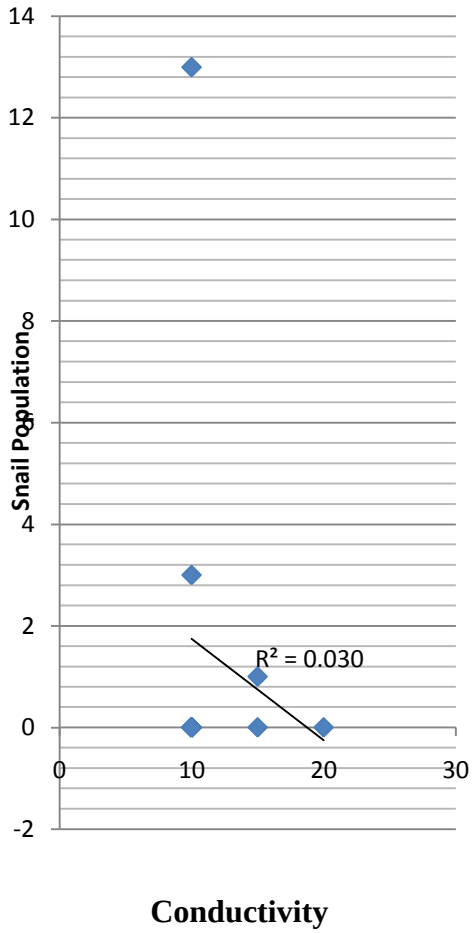
Relationship of turbidity to *Bulinus* in Iyiegwu lake (r = 0.609)

Fig 9: Regression graph of snail population versus turbidity in Iyiegwu lake

c. **Snail abundance and conductivity of the lakes**

Conductivity range was 10-20 microSiemens/centimetre (uS/cm) at Obutu lake and 20-180 microohms at Iyiegwu lake. The highest conductivity (20uS/cm) was observed in May at Obutu lake and the highest conductivity (180uS/cm) in the month of April-July at Iyiegwu lake.*Bulinus* species was collected at a conductivity range of 10-15uS/cm at Obutu lake and 20-180uS/cm at Iyiegwu lake. The highest number of *Bulinus* species 14 (53.85%) was collected in January (Appendix 22) when the mean conductivity of both lakes was 15uS/cm. *Pila* specieswas collected at a conductivity range of 10-20uS/cm in Obutu lake and 20-180uS/cm in Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in July (Appendix 23) when the mean conductivity of both lakes was 95uS/cm. The regression graphs of snail populations versus conductivity of the lakes are shown in Figs 10 and 11. *Bulinus* species had a weak negative correlation to conductivity (r= -0.174) in Obutu lake where most of the species were collected and a weak positive correlation to conductivity (r=0.205) in Iyiegwu lake while*Pila* species had a weak negative correlation (r=-0.367) to conductivity in Obutu lake where a lesser number 497 (30.97%) was collected and a weak negative relationship (r= -0.048) in Iyiegwu lake where a higher number 1108 (69.03%) was collected. The highest number of *Pila* species 358 (22.31%) was collected in July when the mean conductivity of both lakes was 95uS/cm. There was no significant correlation between conductivity and snail abundance in the lakes (P>0.05) (Appendix 25).

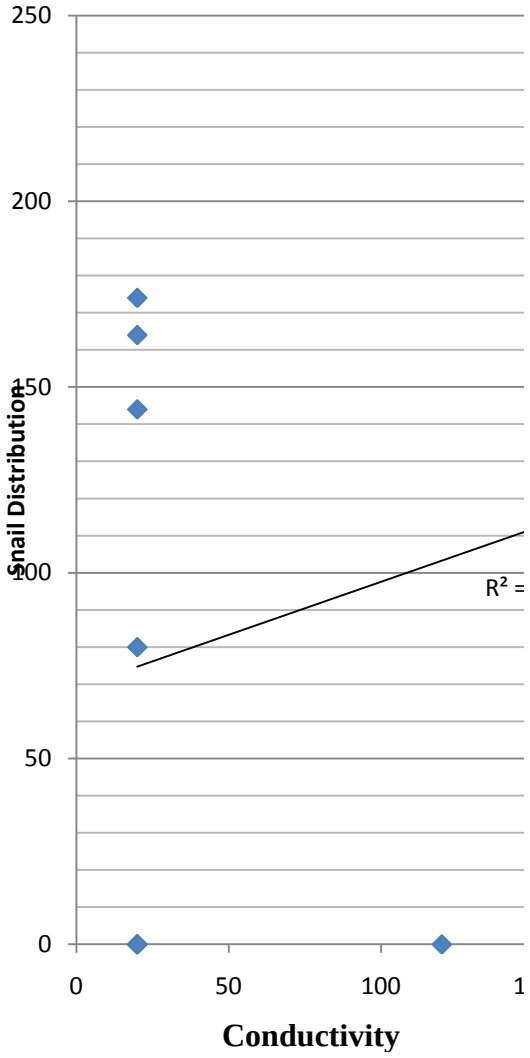


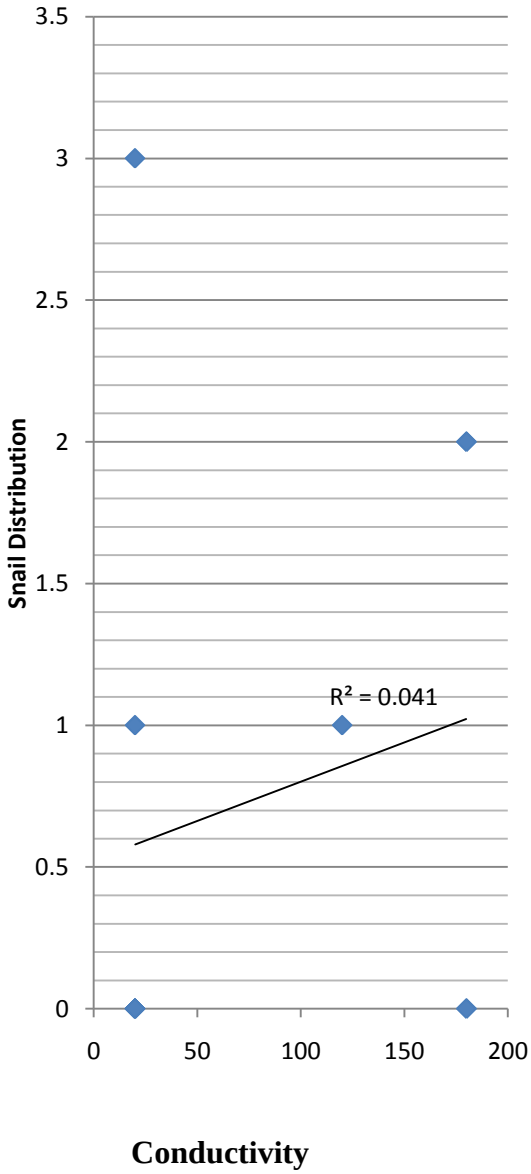


Relationship of conductivity to *Pila* in Obutu lake (r = -0.367)

Relationship of conductivity to *Bulinus* in Obutu lake (r = -0.174)

Fig 10: Regression graph of snail population versus conductivity in Obutu lake





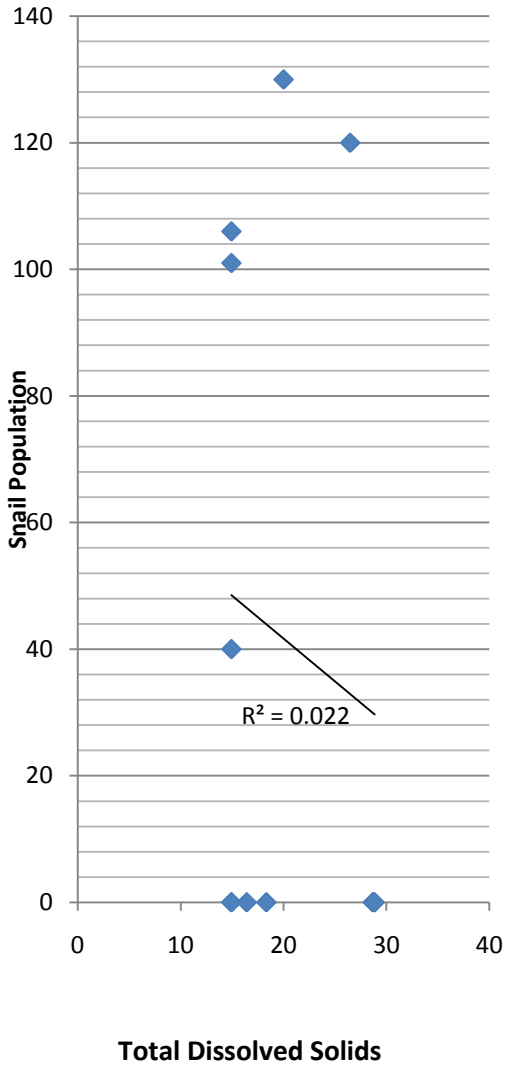
Relationship of conductivity to *Pila* In Iyiegwu lake (r = -0.048)

Relationship of conductivity to *Bulinus* in Iyiegwu lake (r = 0.205)

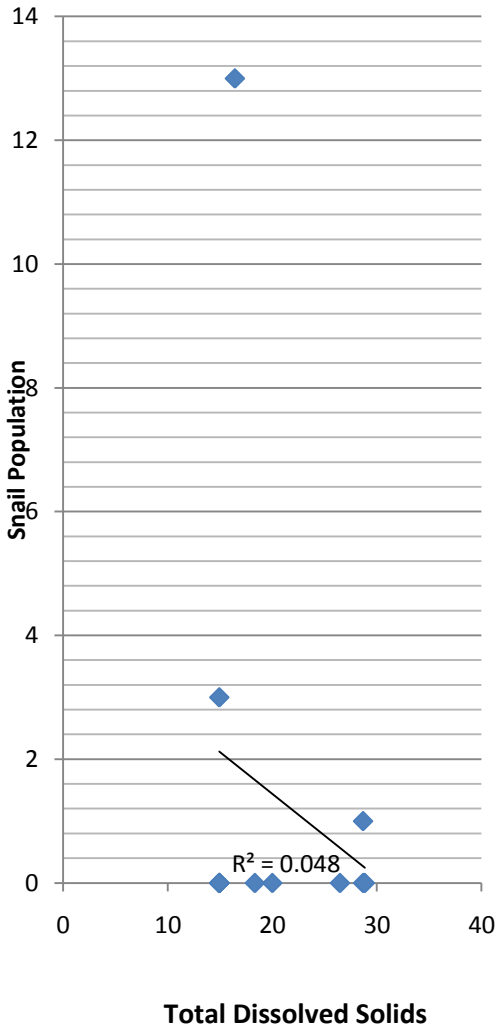
Fig 11: Regression graph of snail populations versus conductivity in Iyiegwu lake

d. Snail populations and total dissolved solids in the lakes

Dissolved solids values ranged from 14.93-28.85miligrammes per litre (mg/l) in Obutu lake and 29.85-268.66mg/l in Iyiegwu lake. In both lakes, the highest values of dissolved solids (28.85mg/l and 286.66mg/l) were observed in May in Obutu and Iyiegwu lakes respectively. *Bulinus* snails were collected at a dissolved solid range value of 14.93-28.85mg/l in Obutu lake and 29.85-268.66mg/l in Iyiegwu lake. The highest number of *Bulinus* species 17 (65.38%) was collected in January when the mean value of dissolved solids in both lakes was 21.14mg/l. *Pila* species was collected at a dissolved solid value range of 29.85-268.66mg/l in Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in July when the mean value of dissolved solids was 120mg/l in both lakes. The regression graphs of snail populations against dissolved solid in the lakes are shown in Figs 12and13. *Bulinus* species had a weak negative correlation (r= -0.066) to dissolved solids in Obutu lake and also a weak negative relationship (r= -0.002) in Iyiegwu lake. *Pila* species has a weak positive relationship (r = 0.192) in Iyiegwu lake and weak negative relationship (r = -0.070) in Obutu lake. Total dissolved solids was not significantly correlated with snail abundance in the lakes ($P>0.05$) (Appendix 25).

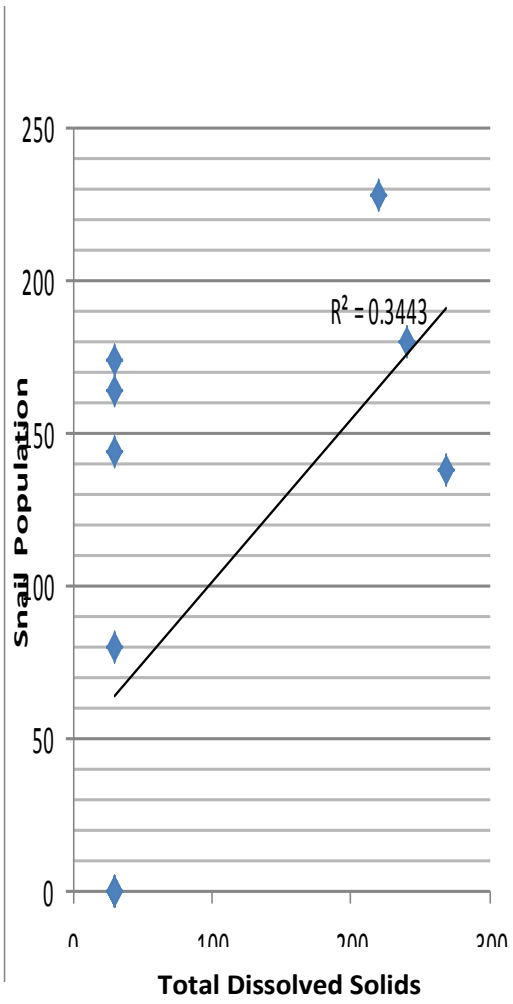


Relationship of dissolved solids to *Pila* in Obutu lake (r = -0.070)

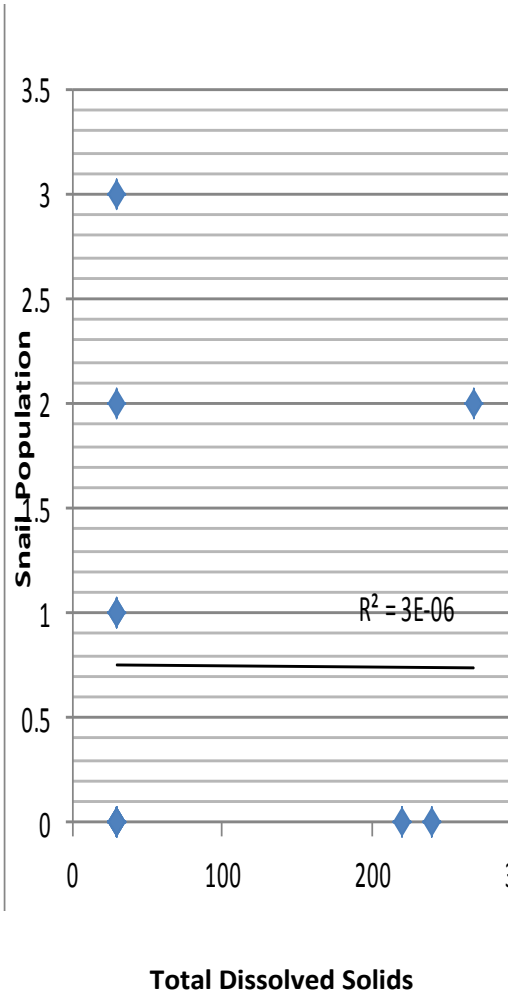


Relationship of dissolved solids to *Bulinus* in Obutu lake (r = -0.066)

Fig 12: Regression graph of total dissolved solids versus snail population in Obutu lake



Relationship of dissolved solids to*Pila* in Iyiegwu lake (r = 0.192)



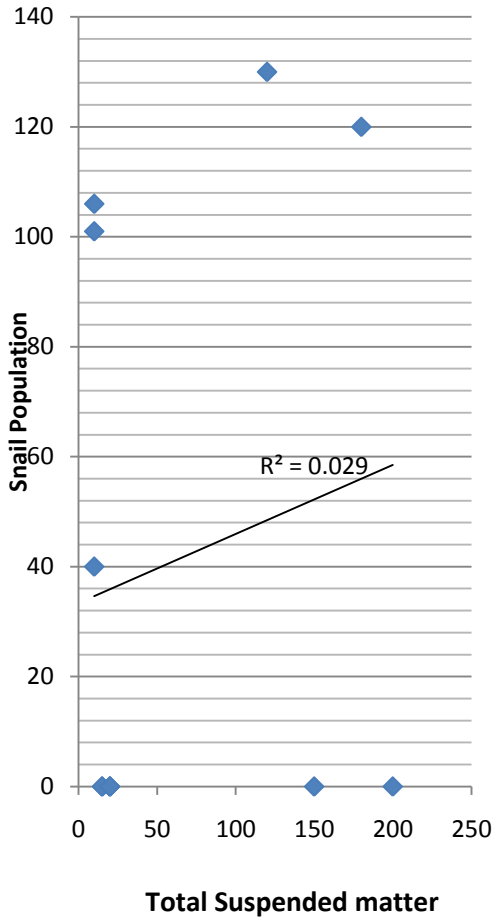
Relationship of dissolved solids to Bulinus in Iyiegwu lake (r = -0.002)

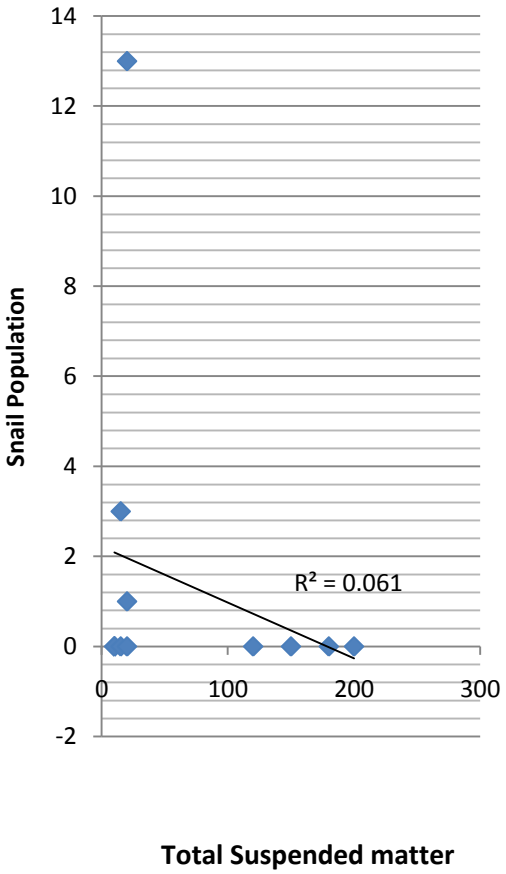
Fig 13: Regression graph of total dissolved solids versussnail populations in Iyiegwu lake

e. Snail populations and total suspended matter in the lakes

The total suspended matter values ranged from 10-200miligramme per litre (mg/l) in Obutu lake and 20-40mg/l in Iyiegwu lake. The highest value of total suspended matter (200mg/l) was observed in May in Obutu lake and 40mg/l in Iyiegwu lake. *Bulinus* species were collected at a suspended solid matter range value of 15-150mg/l in Obutu lake and 15-200mg/l in Iyiegwu lake. The highest number of *Bulinus* species 17 (65.38%) was collected in January when the mean value of suspended matter in both lakes was 25mg/l. *Pila* species were collected at a suspended matter range value of 10-180mg/l in Obutu lake and 20-40mg/l in Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in July when the mean of total suspended matter was 80mg/l.

The regression graphs of the snail populations against the total suspended matter are shown in Figs 14 and 15. *Bulinus* species had a weak positive correlation to suspended matter (r= -0.306) in Obutu lake and Iyiegwu lake (r= 0.420).*Pila* species had weak negative relationships to suspended matter in both Obutu (r= -0.527) and Iyiegwu lakes (r= -0.212). Total suspended matter was not significantly correlated with snail abundance in the lakes (P>0.05) (Appendix 25).

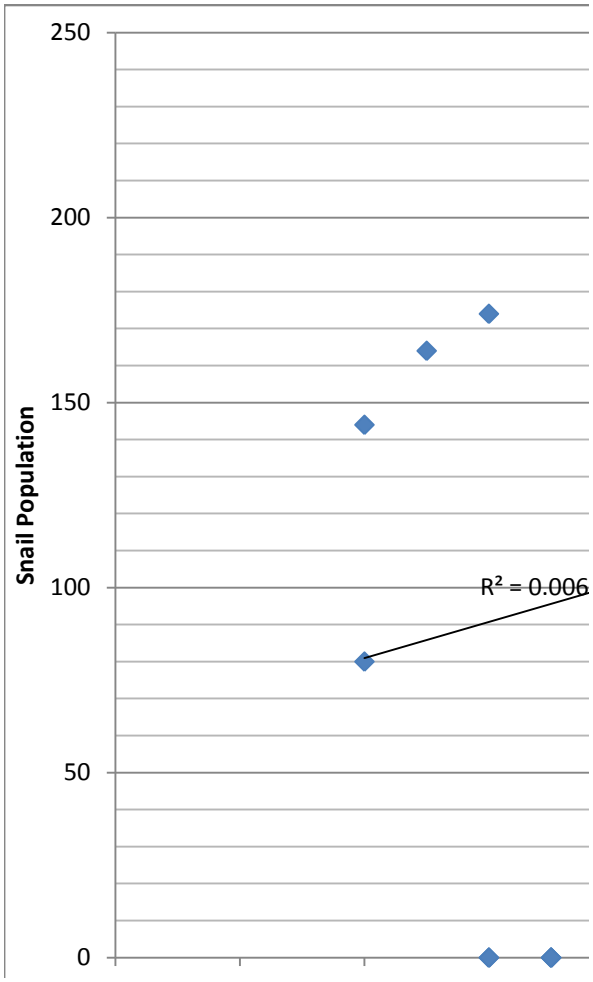




Relationship of total suspended matter To *Pila* in Obutu lake (r = -0.527)

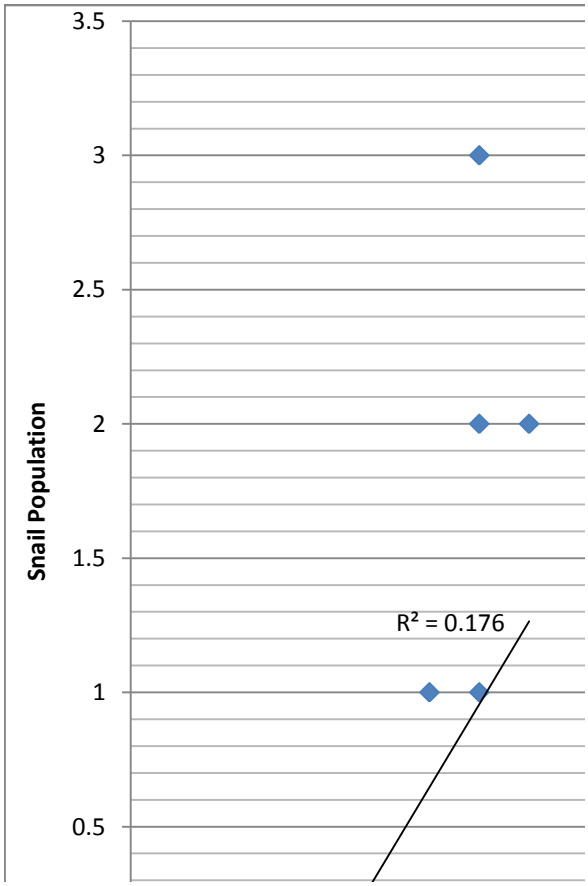
Relationship of total suspended matter to Bulinus in Obutu lake (r = 0.306)

Fig 14: Regression graph of snail population versus total suspended matter in Obutu lake



Total Suspended Matter

Relationship of total suspended matter to *Pila* In Iyiegwu lake (r = -0.212)



Total Suspended Matter

Relationship of total suspended matter to *Bulinus* in Iyiegwu lake (r = 0.420)

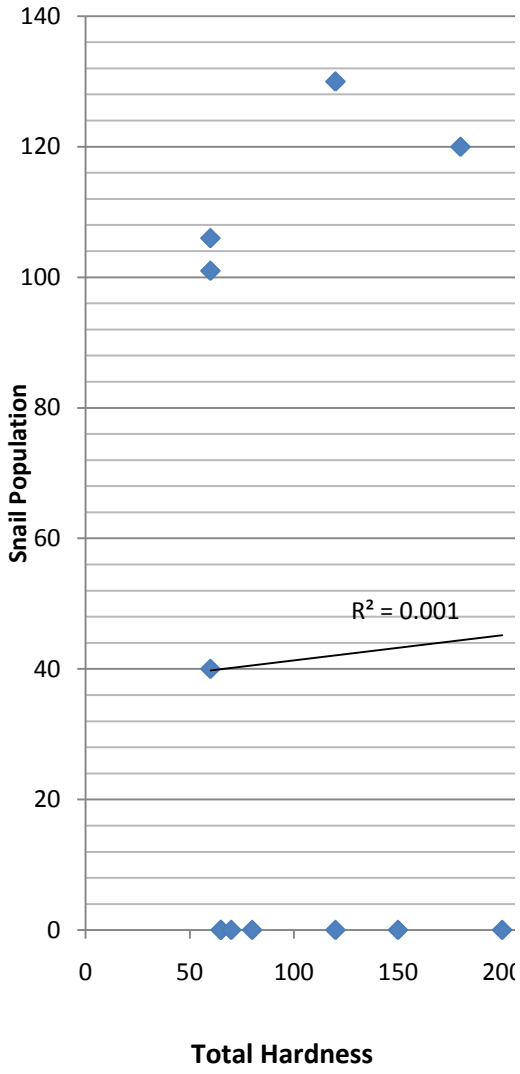
Fig 15: Regression graphof snail population versus total suspended matter in Iyiegwu lake

f. Snail populations and total hardness of the lakes.

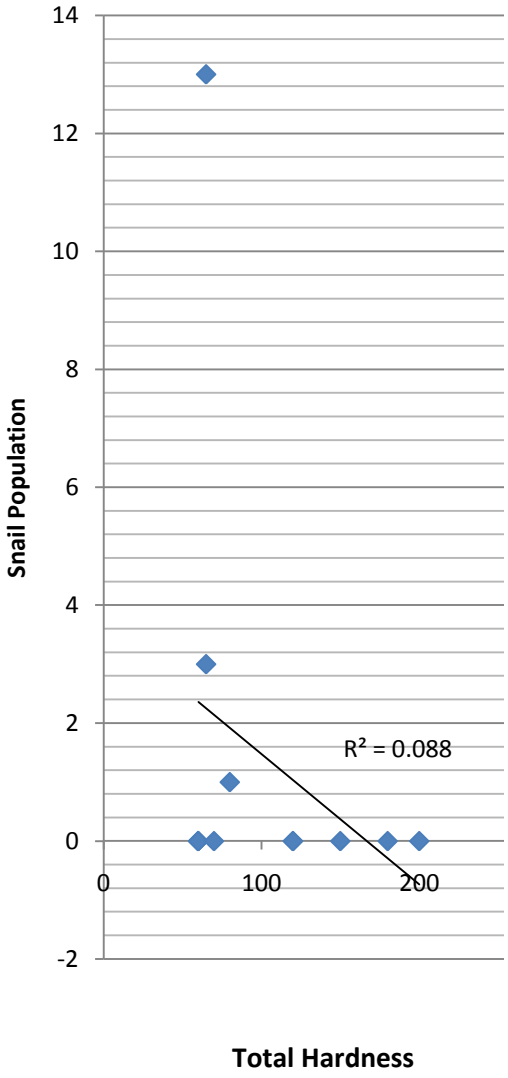
The total hardness values of the lakes ranged from 60-200mg/l in Obutu lake and 60-250mg/l in Iyiegwu lake. The highest values of total hardness in both lakes were observed in the month of May.

Bulinus snails were collected at a total hardness range value of 65-200mg/l in Obutu lake and 70-250mg/l in Iyiegwu lake. The highest number of *Bulinus* 17 (65.38%) was collected in January when the mean of total hardness value in both lakes was 72.5mg/l. *Pila* species was collected at a total hardness range value of 60-180mg/l in Obutu lake and 60-180mg/l in Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in July when the mean total hardness in both lakes was 120mg/l.

The regression graphs of snail population versus total hardness of the lakes are shown in Figs 16 and 17. *Bulinus* species had a weak negative correlation to total hardness (r= -0.164) in Obutu lake and a weak positive correlation (r= 0.423) in Iyiegwu lake. *Pila* species had a weak negative relationship to total hardness in both Obutu (r= -0.036) and Iyiegwu (r= -0.269) lakes. Total hardness was not significantly correlated to snail abundance in the lakes ($P>0.05$) (Appendix 25).

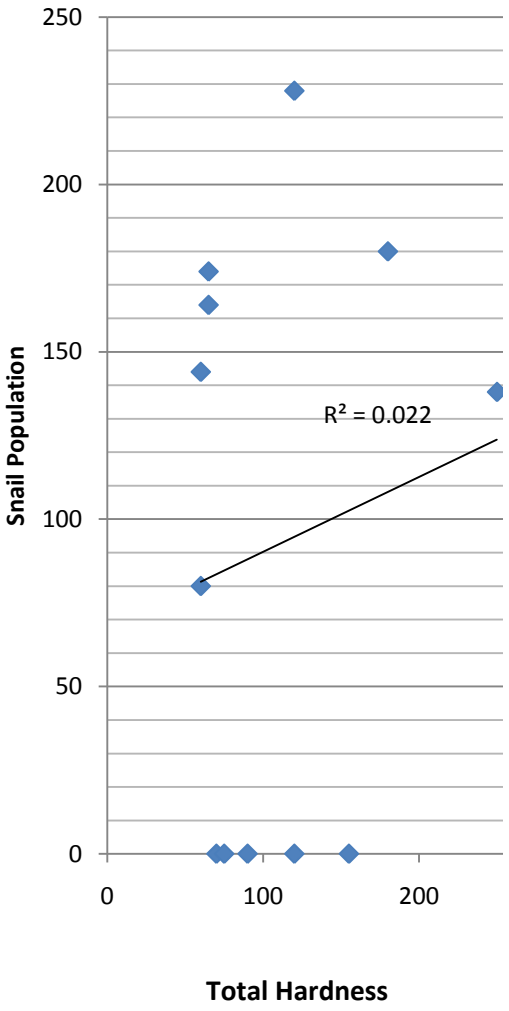


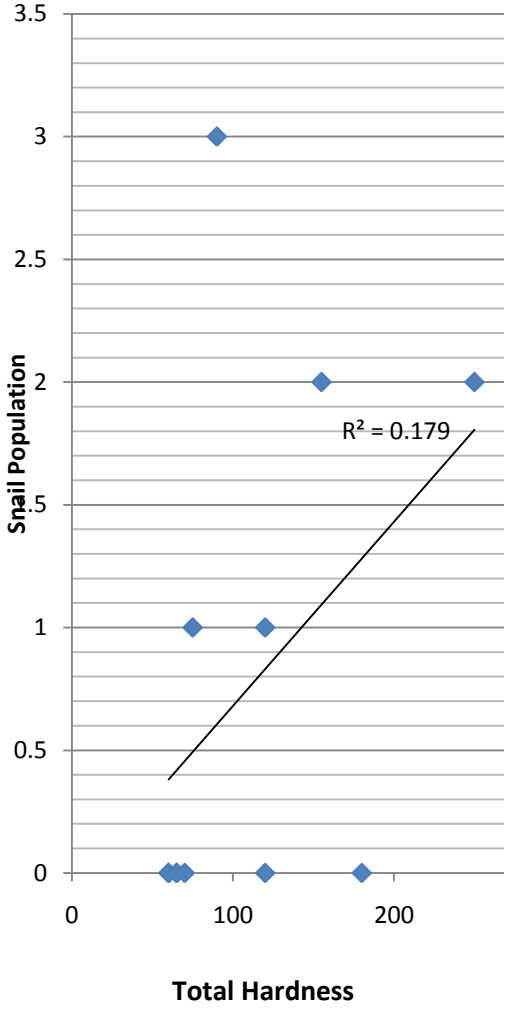
Relationship of total hardness to *Pila* in Obutu Lake (r =-0.036)



Relationship of total hardness to *Bulinus* in Obutu lake (r=- 0.164)

Fig 16: Regression graph of snail population versus total hardness in Obutu lake





Relationship of total hardness to *Pila* in Iyiegwu lake (r = -0.269)

Relationship of total hardness to *Bulinus* in Iyiegwu lake (r = 0.423)

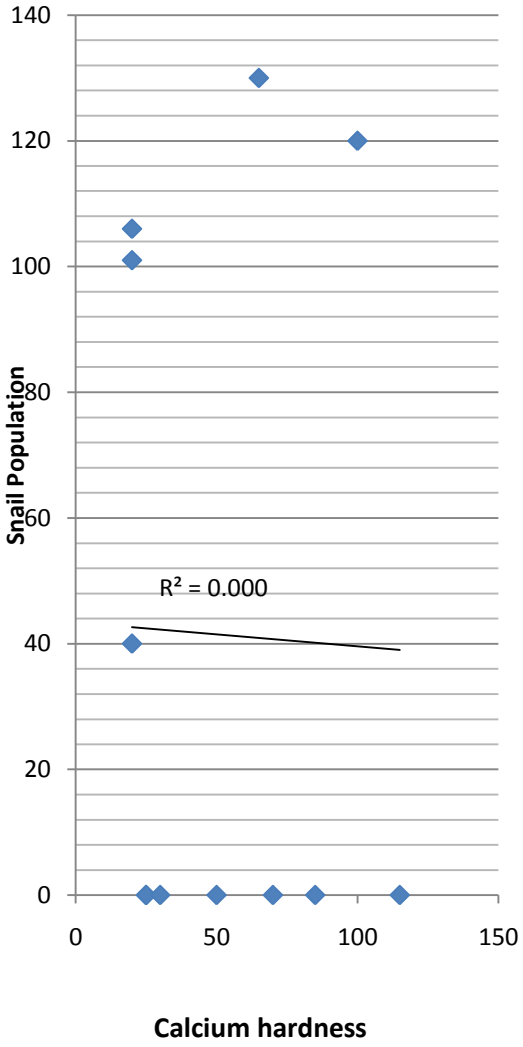
Fig 17 Regression graph of total hardness versus snail population in Iyiegwu lake

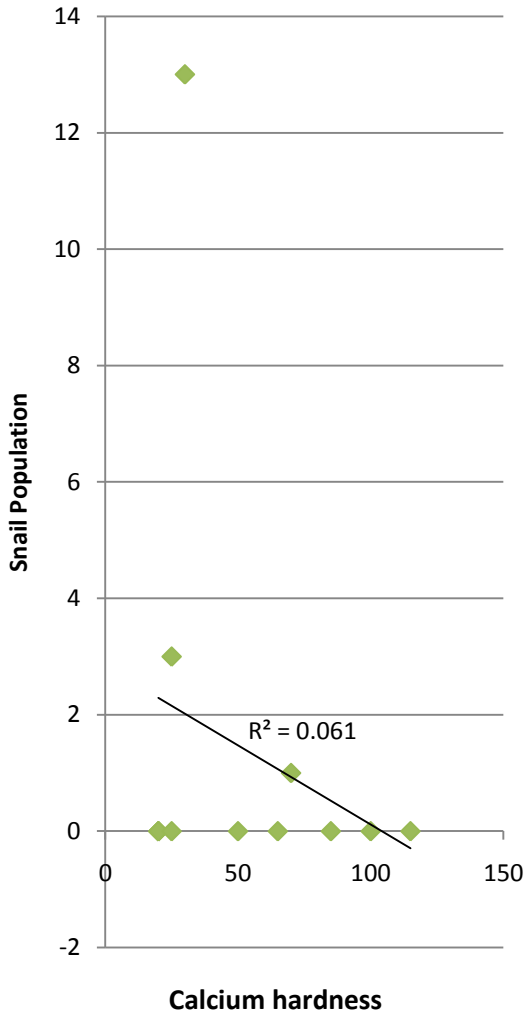
g. Snail populations and calcium hardness in the lakes.

Calcium hardness values ranged from 20-115mg/l in Obutu lake and 20-150mg/l in Iyiegwu lake. The highest values of calcium hardness were observed in May in both lakes.

Bulinus species were collected at a calcium hardness range value of 25-150mg/l in Obutu lake and 20-150mg/l at Iyiegwu lake. The highest number of *Bulinus* 14 (53.85%) was collected in January when the mean value of calcium hardness in both lakes was 27.5mg/l. *Pila* species was collected at a calcium hardness range value of 20-100mg/l in both lakes, *Pila* species was collected most 358 (22.31%) in July when the mean value of calcium hardness in both lakes was 72.5mg/l.

The regression graphs of snail populations versus calcium hardness in the lakes are shown in Figs 18 and 19. *Bulinus* had a weak negative relationship (r= -0.043) to calcium hardness in Obutu lake and a strong positive correlation (r= 0.503) in Iyiegwu lake. *Pila* species had a weak negative correlation (r= -0.111) in Obutu lake and a weak positive correlation (r= 0.325) in Iyiegwu lake. There was no significant correlation between calcium hardness and abundance of snails in the lakes ($P>0.05$).

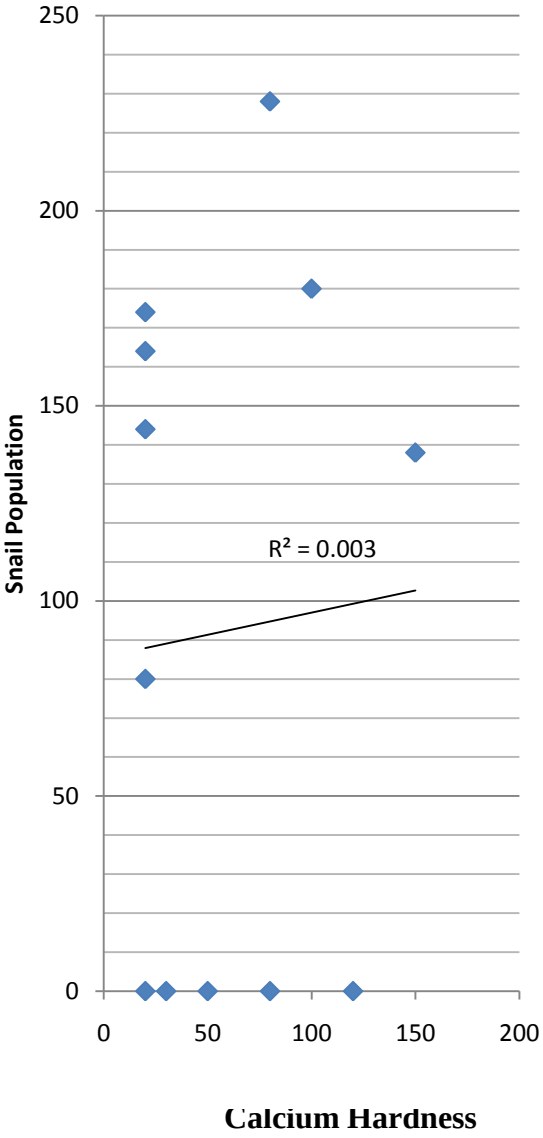




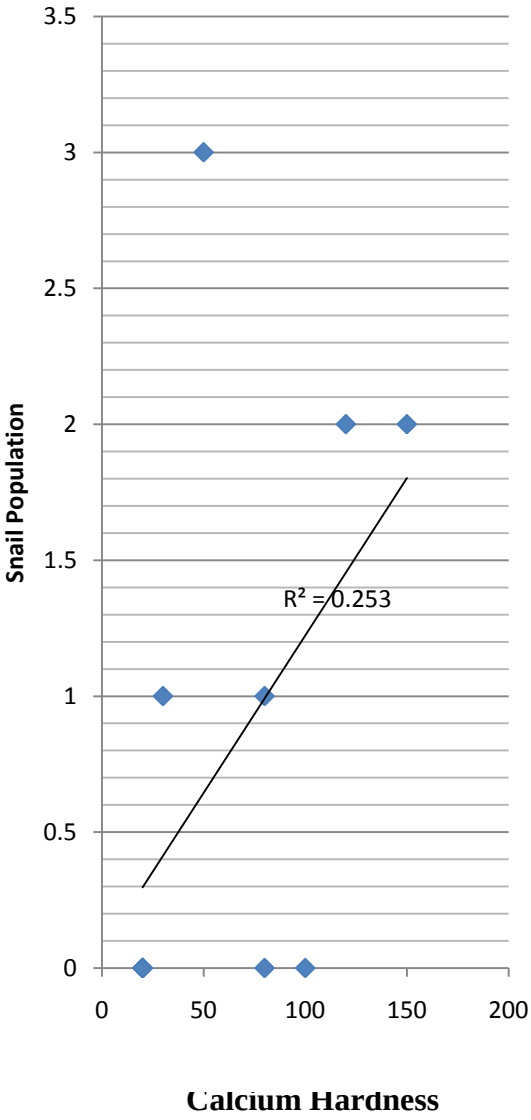
Relationship of calcium hardness to *Pila* in Obutu lake (r = -0111)

Relationship of calcium hardness to *Bulinus* in Obutu lake (r = -0.043)

Fig 18: Regression graph of snail populations versus calcium hardness in Obutu lake



Relationship of calcium hardness to *Pila* in Iyiegwu lake (r-0.311)



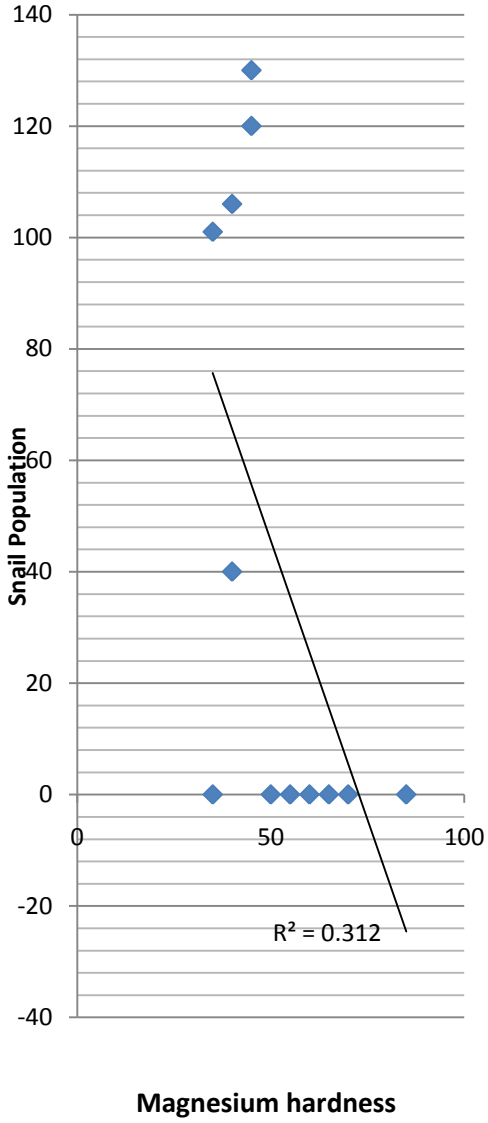
Relationship of calcium hardness to *Bulinus* Iyiegwu lake (r = 0.503).

Fig 19: Regression graph of snail populations versus calcium hardness in Iyiegwu lake

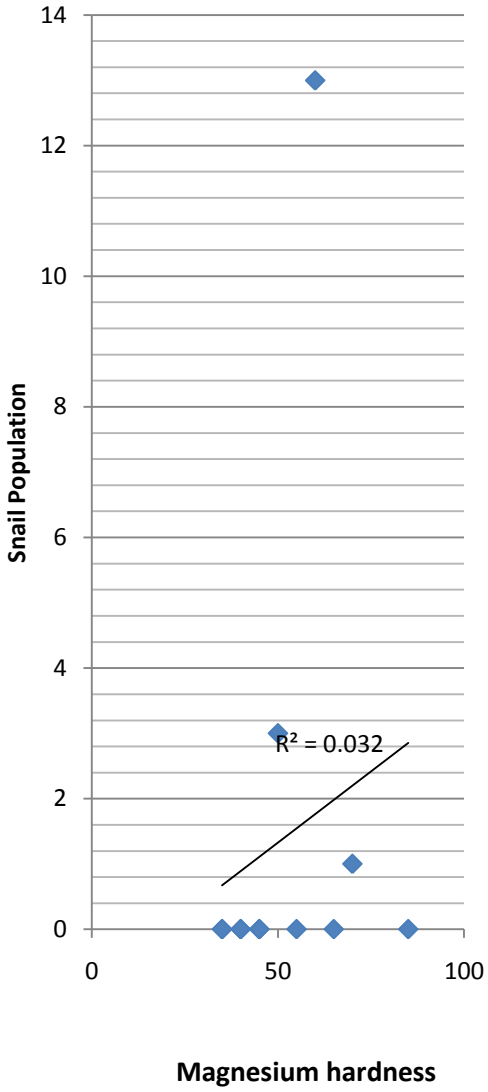
h. Snail populations and magnesium hardness

Magnesium hardness values ranged from 35-85mg/l in Obutu lake and 40-100mg/l in Iyiegwu lake. The highest value (85mg/l) was observed in April in Obutu lake while the highest value (100mg/l)was observed in Iyiegwu in May.

Bulinus species was collected at magnesium hardness (Mg^{++}) hardness range value of 50-85mg/l in Obutu lake and 60-100mg/l in Iyiegwu lake. The highest number of *Bulinus* 14 (53.85%) was collected in January when the mean Mg^{++} hardness in both lake was 65mg/l. *Pila* species was collected at a Mg^{++} hardness range value of 35-55mg/l in Obutu lake and 40-60mg/l in Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in July when the mean Mg^{++} hardness value in both lakes was 47.5mg/l. The regression graphs of snail populations against Mg^{++} hardness are shown in Figs 20 and 21. *Bulinus* had a weak positive correlation to Mg^{++} hardness (r= 0.194) in Obutu lake and a strong positive correlation (r= 0.773) in Iyiegwu lake. *Pila* species had a weak negative correlation (r= -0.341) in Obutu lake but a strongnegative correlation (r= -0.677) in Iyiegwu lake. Magnesium hardness was significantly correlated to snail abundance in the lakes ($P<0.05$).

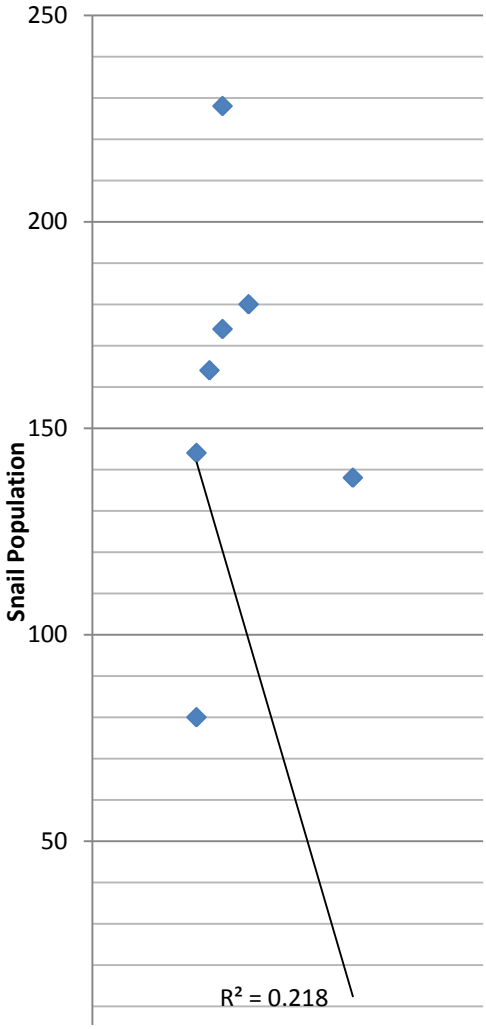


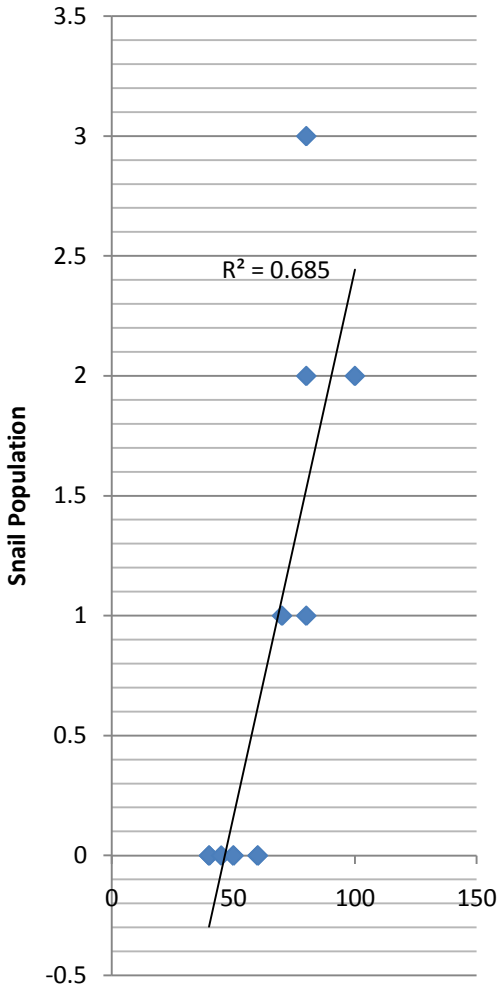
Relationship of magnesium hardness to *Pila* in Obutu lake (r = -0.341)



Relationship of Mg^{++} hardness to *Bulinus* in Obutu lake (r = 0.194)

Fig 20: Regression graph of snail populations versus Mg^{++} hardness in Obutu lake





Relationship of Mg^{++} hardness to Pila In Iyiegwu lake (r = -0.677)

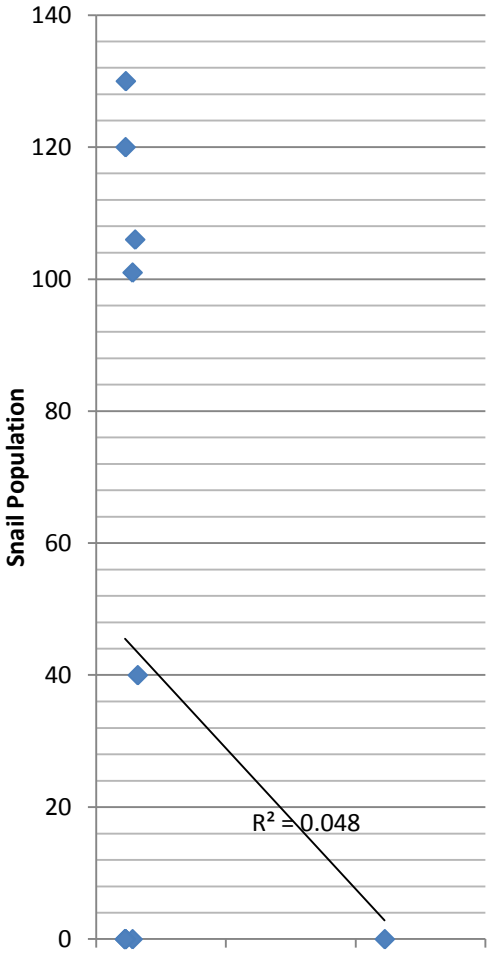
Relationship of Mg^{++} hardness to *Bulinus* in Iyiegwu lake (r = 0.773)

Fig 21: Regression graph of snail populations versus Mg^{++} hardness in Iyiegwu lake.

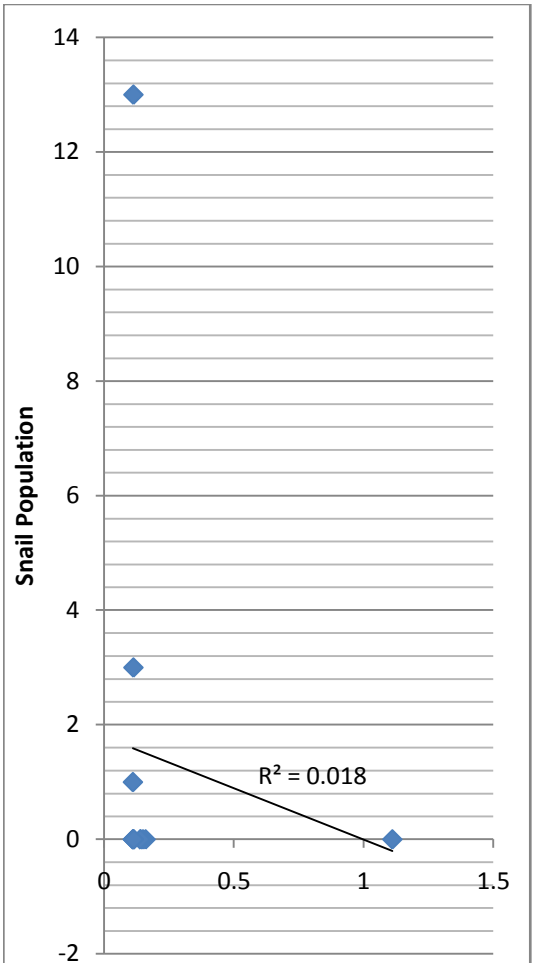
i. Snail populations andnitrite concentration (NO_2^-) in the lakes

Nitrite concentration values in the lakes ranged from 0.111-1.112parts per million (ppm) in Obutu lake and 0.16-0.20ppm in Iyiegwu lake. The highest value (1.112ppm) was observed in February in Obutu lakewhile the highest value (0.20ppm) was observed in Iyiegwu lake between August and November.*Bulinus* species was collected at a nitrite concentration range value of 0.111-1.112ppm in Obutu lake and 0.16-0.18ppm in Iyiegwu lake. The highest number of *Bulinus* 14 (53.85%) was collected in the month of January when the mean value of nitrite concentration (NO_2^-) was 0.15ppm in both lakes. *Pila* species was collected at NO_2^- concentration range value of 0.113-0.16ppm in Obutu lake and 0.18-0.20ppm in Iyiegwu lake. The highest number of *Pila* snails 358 (22.31%) was collected in July when the mean value of NO_2^- concentration in both lakes was 0.147ppm.

The Regression graphs of snail population versus NO_2^- concentration in the lakes are shown in Figs 22 and 23. *Bulinus* had a weak negative correlation to nitrite concentration (r= -0.271) in Obutu lake and a strong negative correlation (r= -0.625) in Iyiegwu lake. *Pila* species had a weak positive correlation (r= 0.455) in Obutu lake and a strong positive relationship (r= 0.696) in Iyiegwu lake. Nitrite concentration was significantly correlated with snail abundance in the lakes ($P<0.05$).

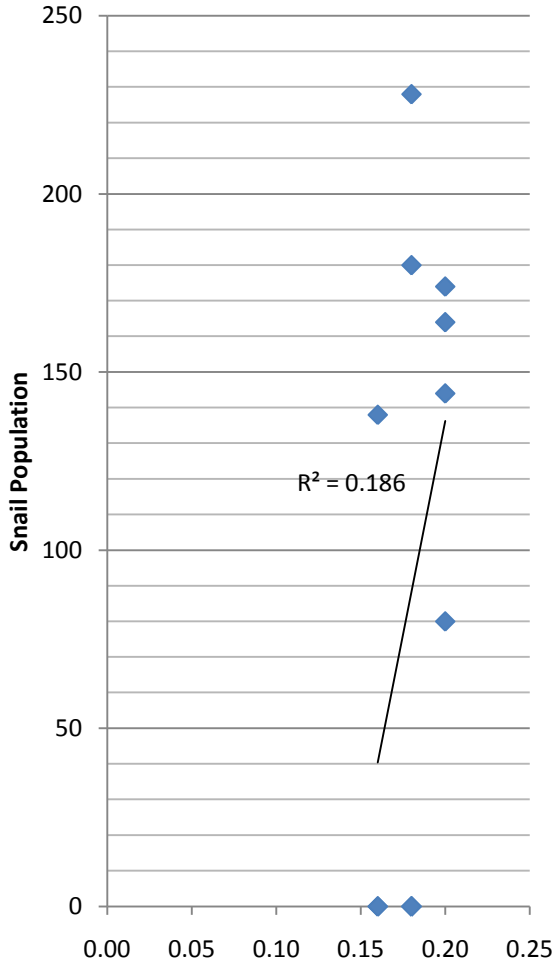


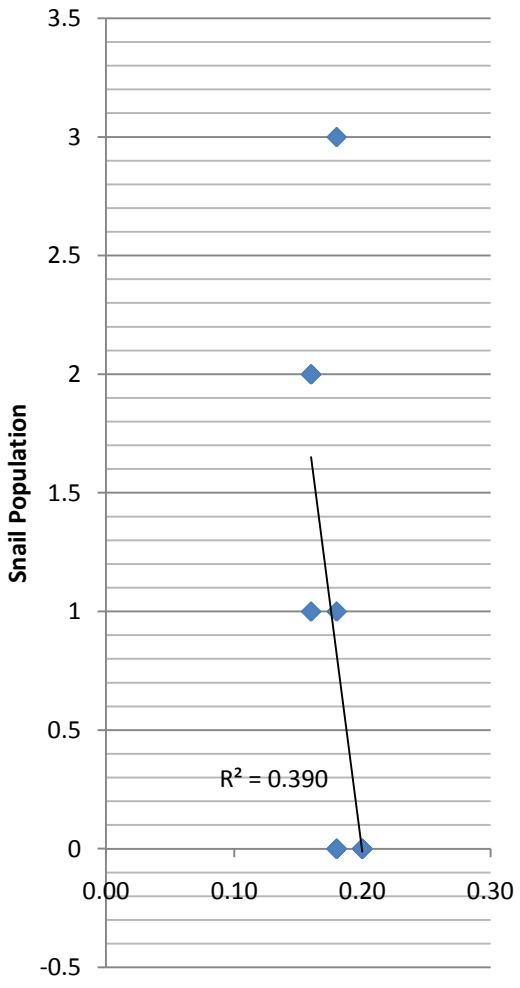
Relationship of nitrite concentration to *Pila* in Obutu lake (r = 0.455)



Relationship of nitrite concentration to *Bulinus* in Obutu lake (r = -0.271)

Fig 22: Regression graph of snail populations versus nitrite concentrations in Obutu lake





Relationship of nitrite concentration to*Pila* in Iyiegwu lake (r = 696)

Relationship of nitrite concentration to *Bulinus* in Iyiegwu lake (r = -0.625)

Fig 23: Regression graph of snail populations versus nitrite concentrations in Iyiegwu lake

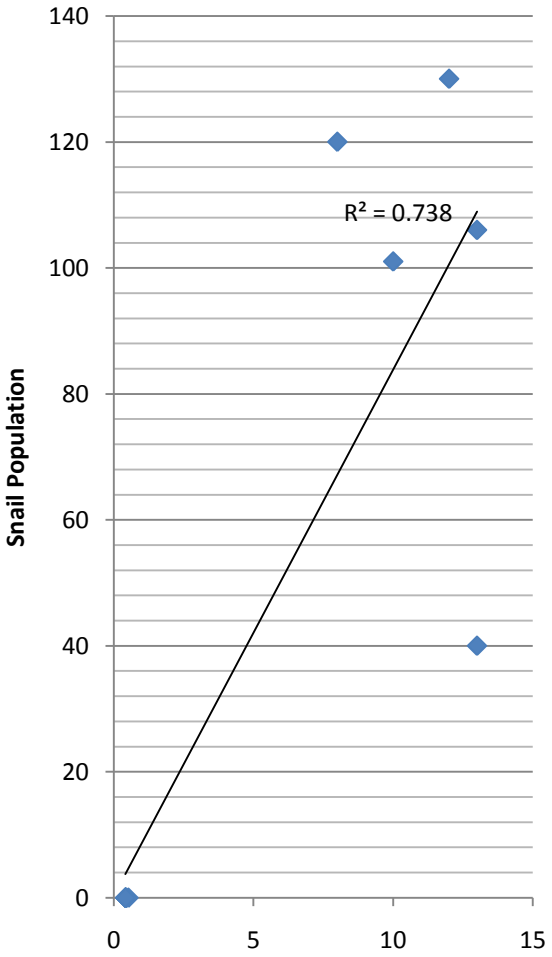
j. Snail populations and nitrate (NO_3^+) concentration in the lakes

Nitrate concentration values ranged from 0.413-13ppm in Obutu lake and 0.90-10.00ppm in Iyiegwu lake. The highest value (13.00ppm) in Obutu lake was in August and September while the highest value (10.00ppm) was in August in Iyiegwu lake.

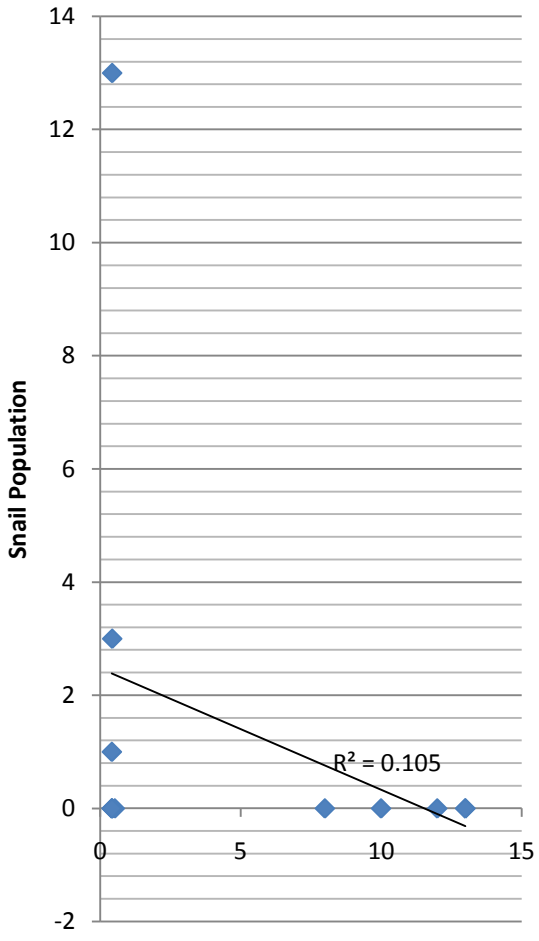
Bulinus snails were collected at a NO_3^+concentration range value of 0.416-0.428ppm in Obutu lake and 1.345-7.321ppm in Iyiegwu lake. The highest number of *Bulinus* snails 14(53.85%) was collected in January when the mean value of NO_3^+ concentration in both lakes was 0.886ppm. *Pila* species was collected at a NO_3^+ concentration range value of 8-13.00ppm in Obutu lake and 0.958-10.000ppm in Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in July when the mean value of NO_3^+ concentration in both lakes was 10.5ppm.

The regression graphsof the snail populations versus NO_3^+ concentration are shown in Figs 24 and 25. *Bulinus* species had a weak negative correlation (r= -0.325) in Obutu lake and a weak positive correlation (r= 0.103) in Iyiegwu lake. *Pila* species had a strong positive correlation (r= 0.713) in Obutu lake and a weak positive relationship in Iyiegwu lake

(r= 0.154). There was no significant correlation between nitrate concentration and snail abundance (P>0.05).

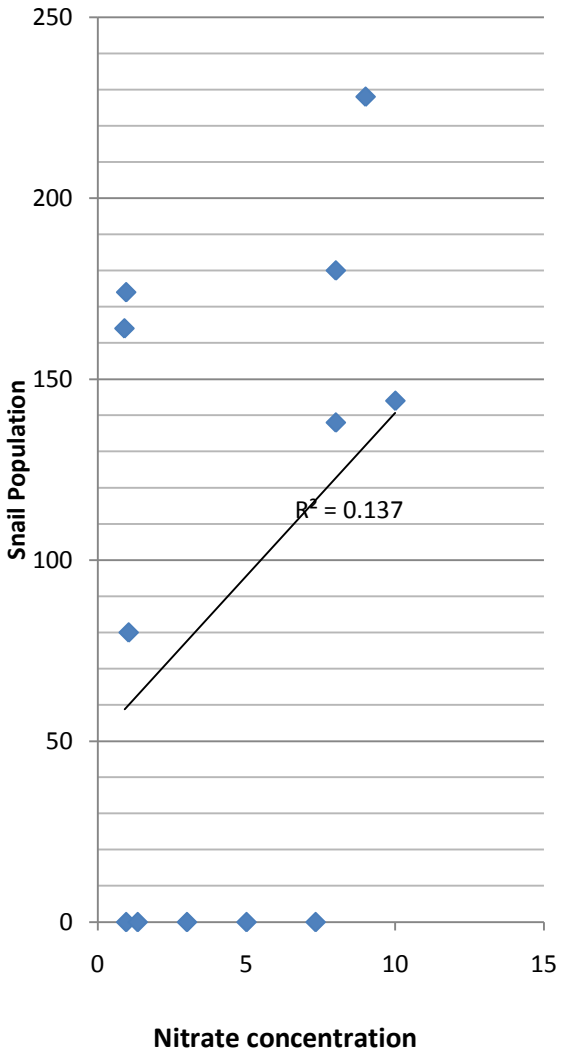


Relationship of nitrate concentration to *Pila* in Obutu lake (r = 0.713)

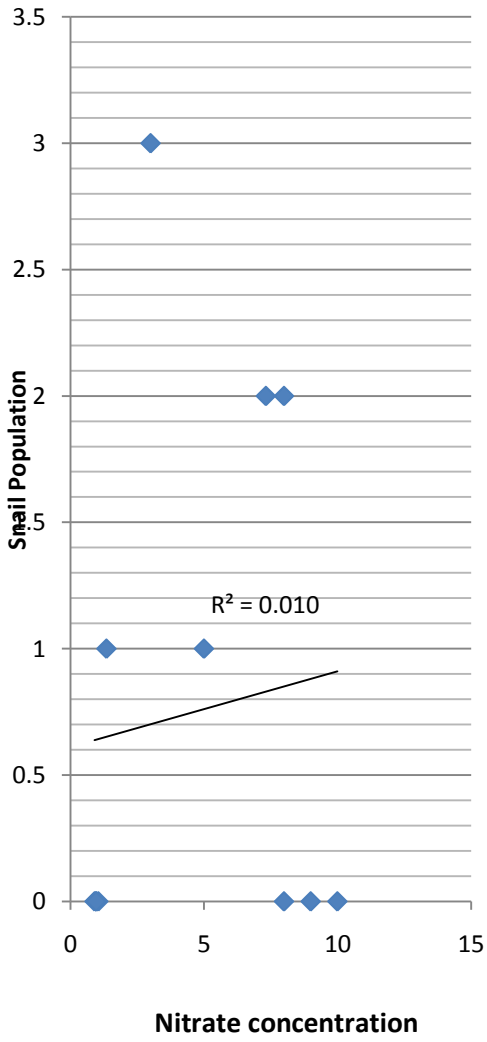


Relationship of nitrate concentration to *Bulinus* in Obutu lake (r = -0.325)

Fig 24: Regression graph of snail population versus nitrate concentration in Obutu lake



Relationship of nitrate concentration to *Pila* in Iyiegwu lake (r = 0.154)



Relationship of nitrate to *Bulinus* in Iyiegwu lake (r = 0.103)

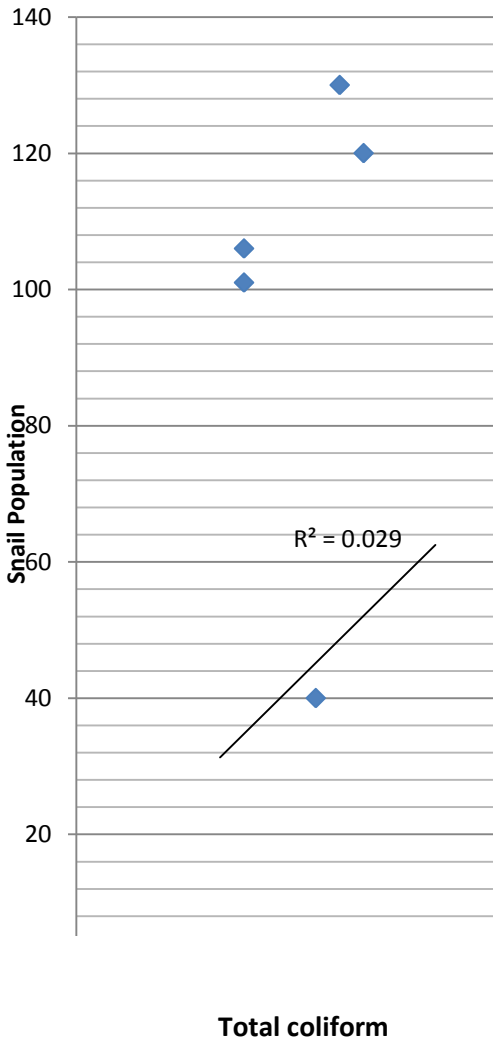
Fig 25: Regression graph ofsnail population versus nitrate concentration in Iyiegwu lake

k. Snail populations and total coliform

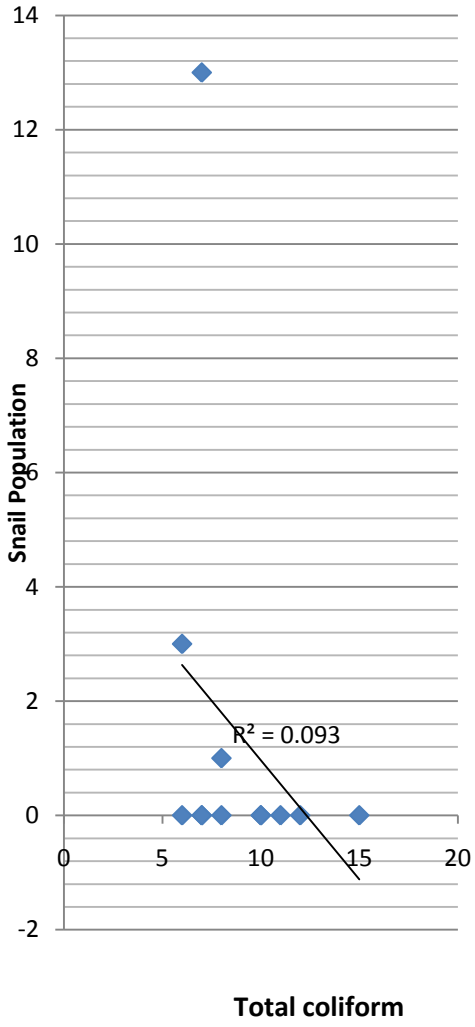
Total coliform values ranged from 6-15Most Probable Number/100ml (MPN)/100ml) in Obutu lake and 3-10MPN/100ml in Iyiegwu lake. The highest concentration of 15MPN/100ml and 10MPN/100ml in Obutu and Iyiegwu lakes respectively were observed in the month of May.

Bulinus snails were collected at a total coliform concentration range value of 6-15MPN/100ml in Obutu lake and 6-12MPN/100ml in Iyiegwu lake. The highest number of *Bulinus* 14 (53.85%) was collected in January when the mean value of total coliform in both lakes was 6.5MPN/100ml. *Pila* species was collected at a total coliform concentration range value of 6-12MPN/100ml in Obutu lake and 3-5MPN/100ml in Iyiegwu lake. The highest number of *Pila* species 358 (22.31%) was collected in the month of July when the mean coliform concentration in both lakes was 8.0MPN/100ml.

The regression graphs of snail populations versus the total coliform concentration in the lakes are shown in Figs 26 and 27. *Bulinus* snails had a weak negative correlation to total coliform (r= -0.146) in Obutu lake and a strong positive correlation (r= 0.790) in Iyiegwu lake. *Pila* species hada weak positive correlation (r= 0.030) in Obutu lake and a strong negative relationship (r= -0.607) in Iyiegwu lake. Total coliform was significantly correlated to snail abundance ($P<0.05$).

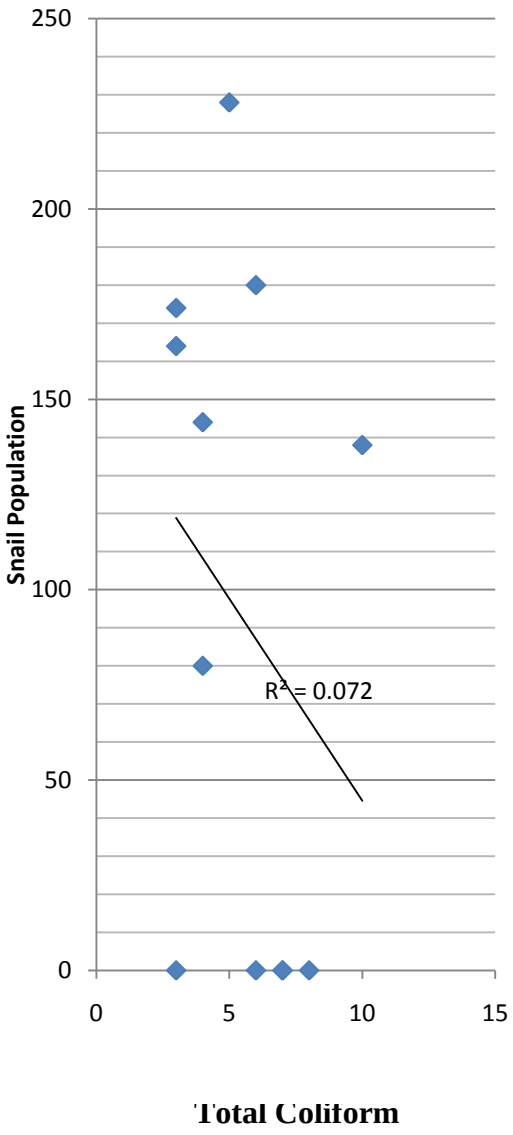


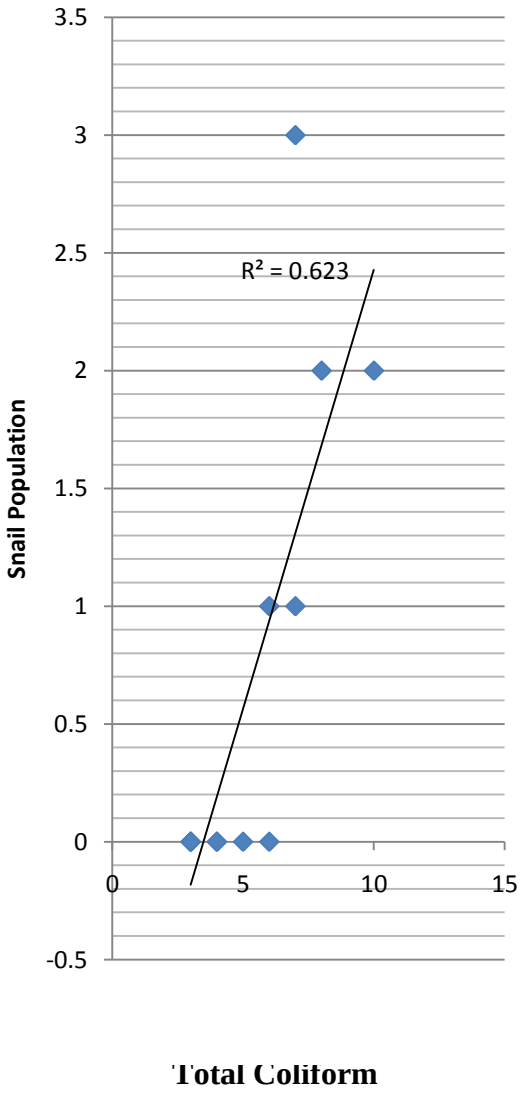
Relationship of total coliform to *Pila* in Obutu lake (r = 0.030)



Relationship of total coliform to *Bulinus* in Obutu lake (r = -0.146)

Fig 26: Regression graph of snail population versus total coliform in Obutu lake





Relationship of total coliform to *Pila* in Iyiegwu lake (r = -0.607)

Relationship of total coliform to *Bulinus* in Iyiegwu lake (r = 0.790)

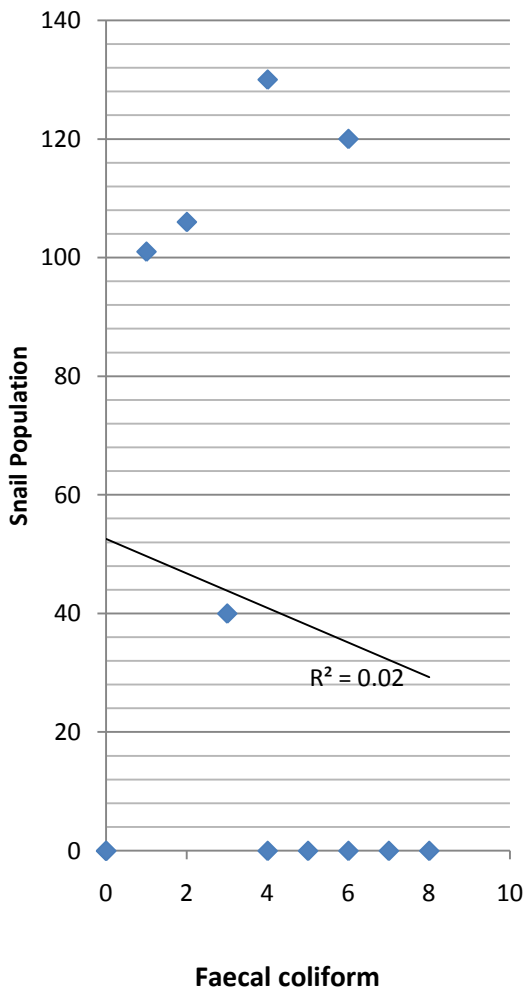
Fig27: Regression graph of snail population versus total coliform in Iyiegwu lake

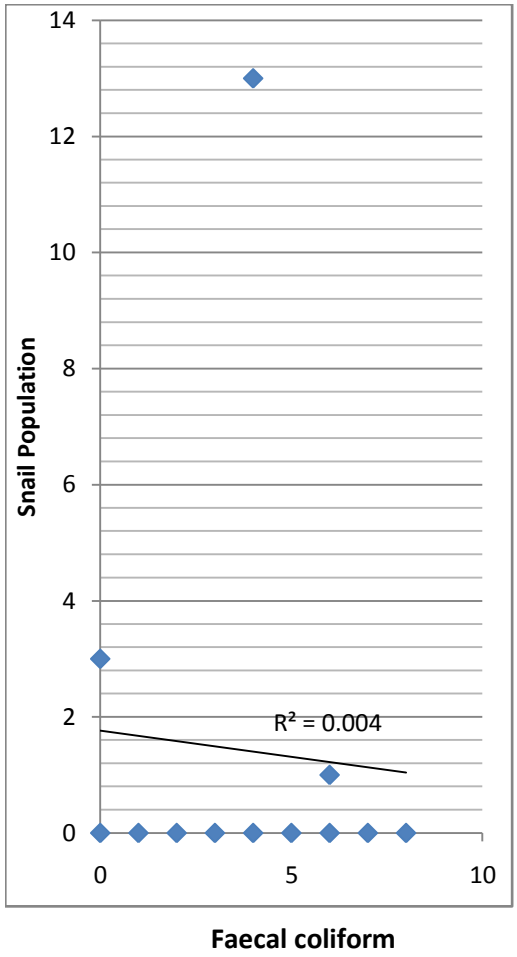
l. Snail populations and faecal coliform in the lakes

Faecal coliform values ranged from 0-8MPN/100ml in Obutu lake and 0-5MPN/100ml in Iyiegwu lake. The highest values of 8 and 5 MPN/100ml in Obutu and Iyiegwu lakes respectively were observed in the month of May.

Bulinus snails were collected at a faecal coliform range value of 0-8 MPN/100ml in Obutu lake and 0-5MPN/100ml in Iyiegwu lake. The highest number of *Bulinus* 14 (53.85%) was collected in the month of January when the mean faecal coliform value in both lakes was 2MPN/100ml. *Pila* species were collected at a faecal coliform range value of 0-6MPN/100ml in Obutu lake and 0-4MPN/100ml in Iyiegwu lake. The highest number of *Pila* snails 358 (22.31%) was collected in July when the mean value of faecal coliform in both lakes was 3MPN/100ml.

The Regression graphs of snail populations versus faecal coliform in the lakes are shown in Figs 28 and 29. *Bulinus* species had a weak positive correlation to faecal coliform (r= 0.170) in Obutu lake and a weak positive correlation (r= 0.200) in Iyiegwu lake. *Pila* species had a weak negative correlation in Obutu lake (r= -0.176) and Iyiegwu lake (r= -0.108). Faecal coliform was not significantly correlated with snail abundance in the lakes (P>0.05).

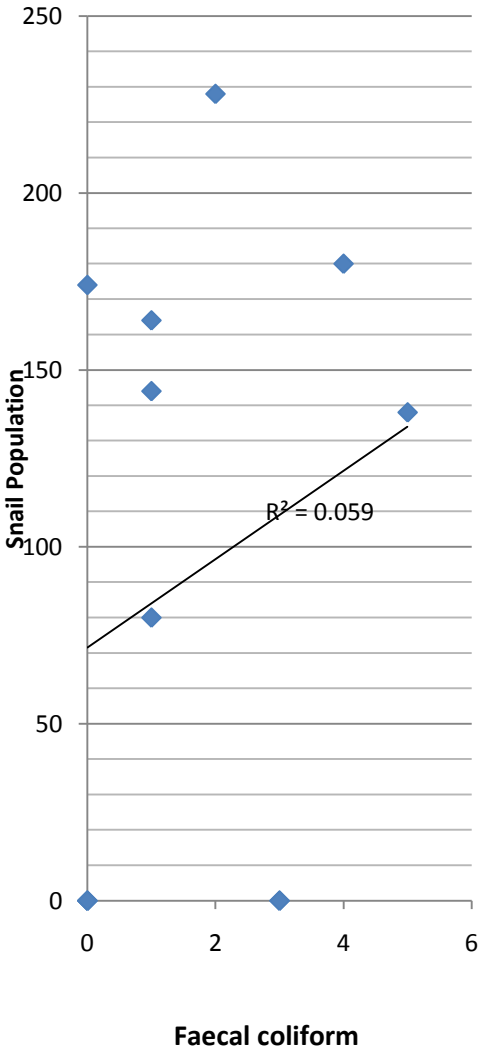




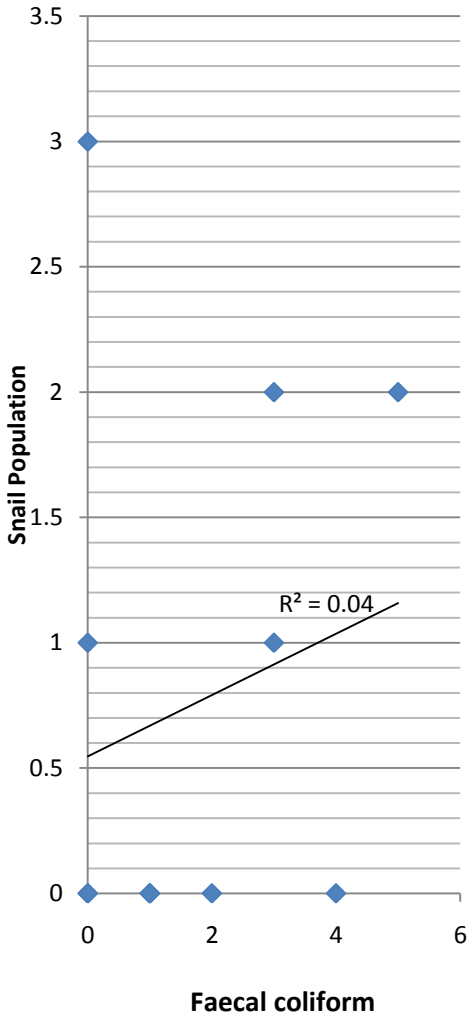
Relationship of faecal coliform to *Pila* in Obutu lake (r = -0.176)

Relationship of faecal coliform to *Bulinus* in Obutu lake (r = 0.170)

Fig 28: Regression graph of snail populations versus faecal coliform in Obutu lake



Relationship of faecal coliform to *Pila* in Iyiegwu lake (r = -0.108)



Relationship of faecal coliform to *Bulinus* in Iyiegwu (r = 0.200)

Fig 29: Regression graph of snail populations versus faecal coliform in Iyiegwu lake

4.3UROGENITAL SCHISTOSOMIASIS PREVALENCE AND INTENSITY IN THE COMMUNITIES

Table 7 shows the prevalence of urogenital schistosomiasis in the communities (Omogho and Ndikelionwu). Of the 524 participants examined for urogenital schistosomiasis infection at Ndikelionwu and Omogho, 88 (16.8%) tested positive, with a mean egg output of 17.05 eggs/10ml urine. Of the 88 positive cases, 26 (29.55%) were from Ndikelionwu community and 62 (70.45%) were from Omogho community. The mean egg output from the communities was 14.5eggs/10ml urine, from Ndikelionwu and 19.6eggs/10ml urine, from Omogho community. Thedifference in the prevalence of urogenital schistosomiasis in the communitieswas significant (X^2= 0.000; P<0.05) (Appendix 26).

Of the 88 individuals positive with schistosome eggs in the two communities, 59(20.3%) were males and 29 (12.4%) femaleswith mean egg output of 10.55eggs/10ml urine (table 8). The prevalence of urogenital schistosomiasis was significantly higher in males than in females (X^2= 0.017; P<0.05) (Appendix 27).

Table 7: Prevalence of Urogenital schistosomiasis in Ndikelionwu and Omogho communities

Communities	No examined	No infected	% prevalence	mean egg Output
Ndikelionwu	279	26	9.3	14.5
Omogho	245	62	25.3	19.6
Total	524	88	16.8	17.05

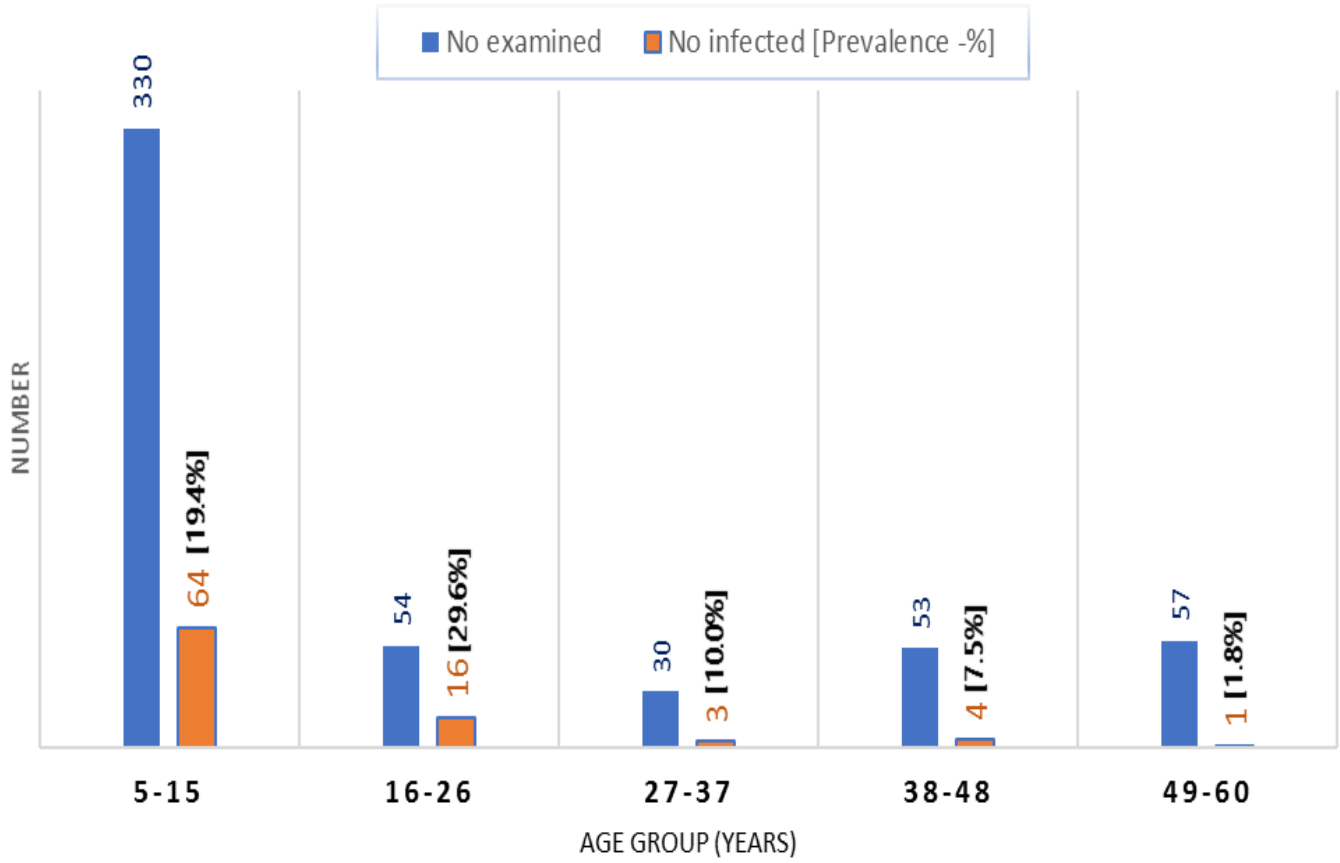
(X^2=0.000; P>0.05).

Table 8: Prevalence of urinogenital schistosomiasis by sex in the two communities studied.

Sex	No examined	No infected	% Prevalence	mean egg Output
Males	291	59	20.3	16.9
Females	233	29	12.4	4.2
Total	524	88	16.8	10.55

(X^2=0.017; P>0.05).

The prevalence of urogenital schistosomiasis by age in the two communities studied is shown in figure 30. Of the 524 individuals examined, the age group 16-26 years age had the highest prevalence of 16 (29.6%), while the age group 49-60 years had the least prevalence of 1(1.8%) with mean egg output of 17.75eggs/10ml urine. Urogenital schistosomiasis prevalence was significantly different with age. ($X^2 = 0.000$; $P<0.05$)(Appendix 28).



($X^2 = 0.000; P<0.05$).

Fig 30: Prevalence of urogenital schistosomiasis by age in the two communities studied.

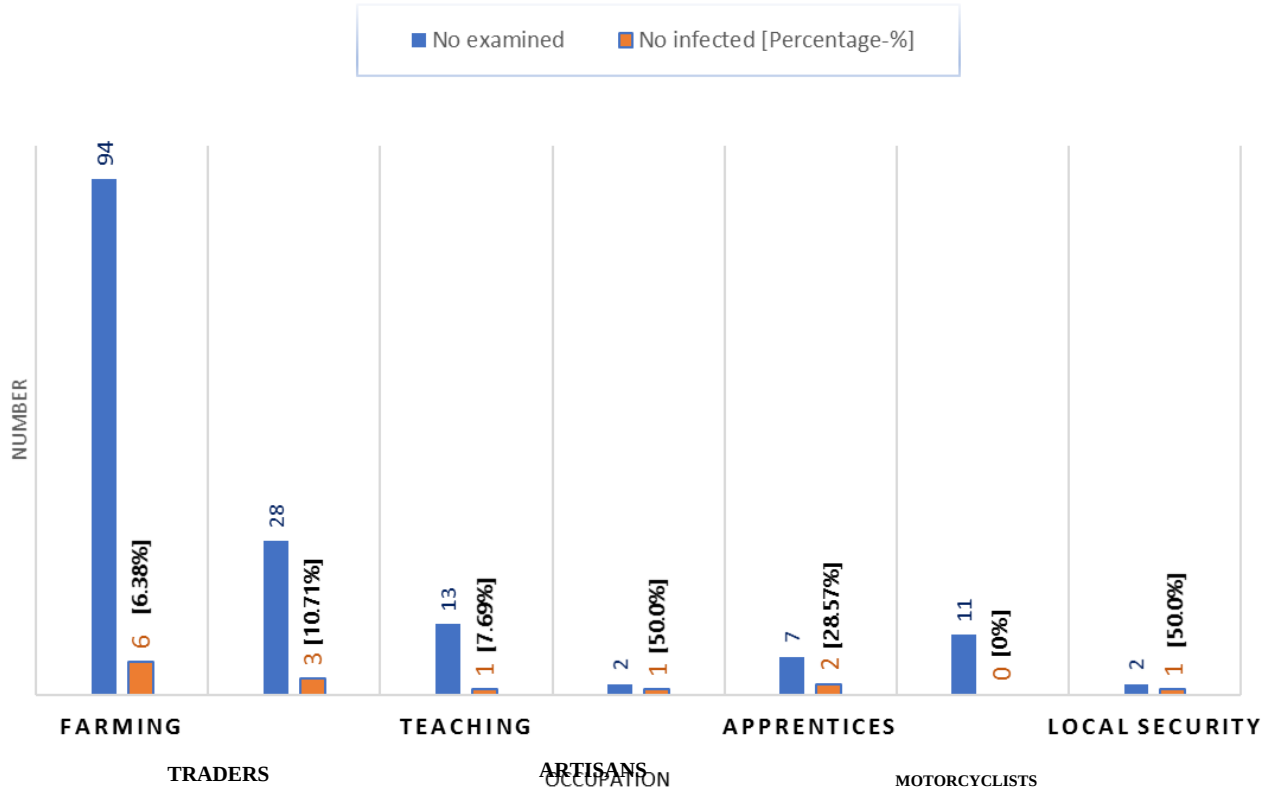
The intensity of urogenital schistosomiasis in the two communities studied shows that, out of the 524 individuals examined in both communities, Ndikelionwu community had lower prevalence of 26 (9.3%) and mean egg output of 14.7 eggs/10ml urine while Omogho community had a higher prevalence of 62 (25.3%) with a mean egg output of 19.6 eggs/10ml urine (table 9). There was no significant difference in the intensity of urogenital schistosomiasis infection in the study communities (X^2= 0.590; P>0.05) (Appendix 29).

Table 9: Intensity of urogenital schistosomiasis in the two communities studied.

Towns	No examined	No infected	Prevalence (%)	Mean egg Output
Ndikelionwu	279	26	9.3	14.7
Omogho	245	62	25.3	19.6
Total	524	88	16.8	

(X^2= 0.590; P>0.05).

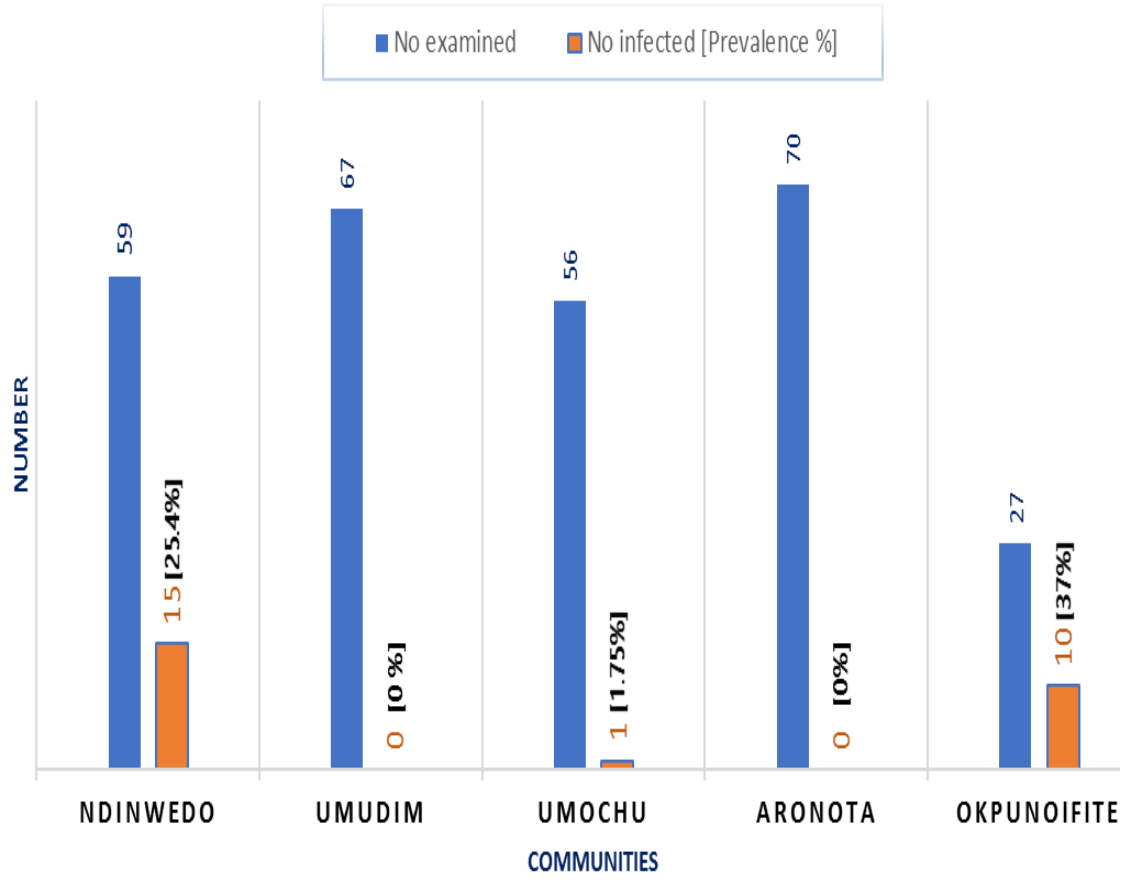
Figure 31 shows the prevalence of urogenital schistosomiasis by occupation. Of the 524 individuals studied, 94(17.94%) were farmers, 28(5.34%) were traders, 13(2.48%) were teachers, 2(0.38%) were Artisans (masons), 7(1.34%) were Apprentices, 11(2.09%) were commercial motorcyclists and 2(0.38%) were security men. Among these occupational groups, 6(6.38%) of the farmers, 3(10.7%) of the traders, 1(7.69%) of the teachers, 1(50%) of the artisans, 2(28.57%) of the apprentices, 1(50%) of the local security men tested positive of urogenital schistosomiasis. None of the commercial motorcyclists were positive to the infection. Artisans and security officers had higher percentage of infection followed by the apprentices. Though more farmers were infected but their percentage prevalence was less than other occupations while apprentices had high prevalence rate of 28.57%. The prevalence of schistosome infections was not significantly different among the occupational groups (X^2 =4.592; P>0.05)(Appendix 31).



(X^2 =4.592; P>0.05).

Fig 31: Prevalence of urogenital schistosomiasis by occupation

The prevalence of urogenital schistosomiasis among the five villages of Ndikelionwu community is shown in figure 32 Of the 279 individuals examined in the area, 26(9.3%) tested positive with an overall mean egg output of 14.5 eggs/10mls urine (Geometric mean intensity). None was infected in Umudim and Aronota villages. Okpunoifite had the highest prevalence of 10 (37.0%) and mean egg output of 1.7 eggs/10mls urine. Umuochu village had the least prevalence of 1 (1.79%) with the highest mean egg out-put of 34.0 eggs/10mls. Ndinwedo village had a prevalence of 15 (25.4%) and a mean egg output of 12.5 eggs/10mls urine. There was significant difference in schistosomiasis prevalence among the infected villages in the community (X^2=0.000; P<0.05) (Appendix 32).

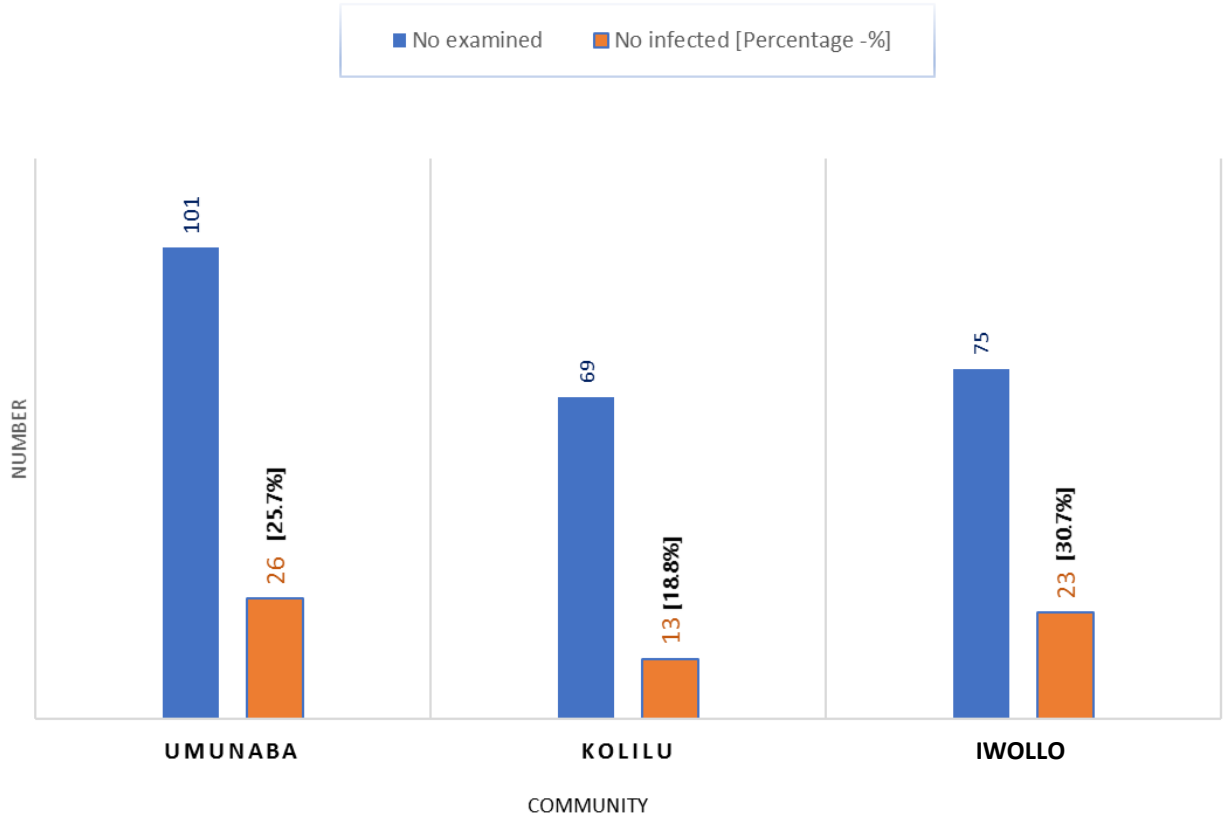


(X^2= 0.000; P<0.05)

Fig 32: Prevalence of urogenital schistosomiasis among the five villages in Ndikelionwu community.

The prevalence of urogenital schistosomiasis in Omogho community shows that out of the 245 individuals examined, 62(25.3%) tested positive with an overall mean egg output of 19.6 eggs/10mls urine (Geometric mean intensity) (Figure 33).Among the three villages of Omogho, Iwollo had the highest prevalence of 23 (30.7%) and a mean egg output of 35.9 eggs/10mls urine while Kolilu had the least prevalence of 13 (18.8%) and a mean egg output of 12.85 eggs/10mls urine.

There was no significant difference in the prevalence of urogenital schistosomiasis among the villages (X^2= 0.262; P>0.05) (Appendix 33).



(X^2= 0.262; P>0.05).

Fig 33: Prevalence of urogenital schistosomiasis in Omogho community

4.4 KNOWLEDGE, ATTITUDE AND PRACTICE OF THE PEOPLE TOWARDS UROGENITAL SCHISTOSOMIASIS IN THE STUDY AREAS

Table 10 shows the people's knowledge of urogenital schistosomiasis. Of the three hundred and ninety two (392) respondents, 332 (84.7%) were aware of the disease-urogenital schistosomiasis and 320 (81.6%) correctly gave the local name as "Amili Obara" while 19 (4.8%) did not know the local name. Of the 392 respondents, only 68 (17.3%) knew that the disease is transmitted by contact with infected water while 296 (75.5%) claimed that it is through eating of snails that one gets infected with urogenital schistosomiasis. Also 298 (76.0%) knew the symptoms by bloody urine while other respondents recognized it by other symptoms like itching of the body 265 (67.6%); aching body 17 (4.3%); regular fever 50 (12.8%); abdominal pain 56 (14.3%); blood in stool 282 (71.9%); swollen stomach 285 (72.7%); vomiting 269 (68.6%) and feeling of fatigue 58 (14.8%).

Table 10: THE PEOPLE'S KNOWLEDGE OF TRANSMISSION AND SYMPTOMS OF UROGENITAL SCHISTOSOMIASIS IN THE STUDY AREA AND WITHIN THE STUDY PERIOD

S/NO	QUESTIONS AND OPTIONS	RESPONSES	%
1.	Do you know what schistosomiasis disease is?	Yes = 332	84.7
2.	What is schistosomiasis locally called in this area?		
A	Amili Obara	320	81.6
B	Amili Mmiri	25	6.4
C	Oya Nwamili	27	6.9
D	Do not know	19	4.8
3.	How do people contact the infection?		
A	Eating snails	296	75.5
B	Contact with infested water	68	17.3
C	Mosquito bite	13	3.3
D	Do not know	16	4.1
4.	How do people recognize the disease?		
A	Aching body	17	4.3
B	Bloody urine	298	76.0
C	Regular fever	50	12.8
D	Itching of the body	265	67.6
E	Abdominal pain	56	14.3
F	Blood in the stool	282	71.9
G	Swollen stomach	285	72.7
H	Vomiting	269	68.6
I	Feeling of fatigue	58	14.8

The people's attitude and practices to urogenital schistosomiasis are shown in table 11. Of the 392 participants interviewed, 60 (15.3%) had been diagnosed of urogenital schistosomiasis in the past. On their attitude to blood in their urine, 280 (71.4%) said that they will feel uncomfortable while 50 (12.8%) answered that they will feel happy because it is a sign of maturity, 121 (30.8%) said that they will ignore it because it does not cause pains and 293 (74.7%) said that they will report to parents and/or guardians. On their treatment practices against schistosomiasis, 317 (80.9%) knew that the disease is curable. On further questioning on how the disease is treated in the community, 124 (31.6%) said they go to hospital or medical doctor, 58 (14.8%) said they use local herbs, 194 (49.5%) go to patent medicine stores to mix drugs for them and 17 (4.3%) visit prayer houses for healing. On their preventive measures against the disease, 319 (81.4%) agreed that the disease is preventable by avoiding swimming or bathing in lakes while 293 (74.7%) mentioned wearing of foot wears to the farm. Again, 62 (15.8%) agreed that avoiding washing of clothes and other household materials in the lake is another way of protecting oneself from contacting the disease while 81 (20.6%) said by avoiding fishing in the lakes. None of the participants said that they boil water before drinking or use for other household activities.

Table 11: THE PEOPLE'S ATTITUDE AND PRACTICES TOWARDS UROGENITAL

SCHISTOSOMIASIS IN THE STUDY AREA WITHIN THE PERIOD OF STUDY

S/NO	QUESTIONS AND OPTIONS	RESPONSES	PERCENTAGE
1.	Have you had schistosomiasis?	Yes = 60	15.3
2.	How will you feel when you see blood in your urine?		
A	Feel very uncomfortable	280	71.4
B	Ignore it because it does not cause pains	121	30.8
C	Feel happy because it is a sign of maturity	50	12.8
D	Report to my parents/guardians	393	74.7
3.	Do you know the disease is curable?	Yes= 317	80.9
4.	How do you treat the disease?		
A	Going to the hospital/medical doctor	124	31.6
B	Treatment with local herbs	58	14.8
C	Going to patent medicine dealers to mix drug	194	49.5
D	Going to prayer house for healing	17	4.3
5.	Do you know the disease is preventable?	Yes=319	81.4
6.	In what ways do you protect yourself from urogenital schistosomiasis?		
A	Wearing of footwear to the farms	293	74.7
B	Avoiding swimming/bathing in the lakes/streams	293	74.7
C	Avoiding washing of clothes and other household materials in the lake	62	15.8
D	Sleeping under bed nets	13	3.3
E	Avoiding fishing in the lakes.	81	20.6
F	Boiling water before drinking/using for household activities	0	0

CHAPTER FIVE

DISCUSSION

5.1 SNAIL ABUNDANCE, DISTRIBUTION AND SPECIES COMPOSITION

5.1.1Snail abundance and physico-chemical properties of the lakes studied

A total of 1631 freshwater snails, (1117 – 68.49%) from Iyiegwu lake and 514 (31.51%) from Obutu lake were collected from the study area (table 1). This indicates that there were abundant freshwater snails in the study areas though more snails were harvested from Iyiegwu than in Obutu lakewhichcoincide with the work of Oloyede *et al.,* (2016) who observed and collected a total number of 2230 freshwater snails in Eleye dam in Ibadan. Vyn, (2013) noted that freshwater snails live in various habitats depending on the species. Freshwater snails live in bodies of water of various volumes, depths and sizes. However, they almost always live in shallow water. Only a few species prefer deep water. Lake Iyiegwu yielded significantly higher number of snails than Obutu lake ($P<0.05$). This is in consonance with the work of Njoku-Tony who observed that snail abundance varied significantly from one site to another. Iyiegwu lake seems to have more vegetation, more decaying matter or algae and fertile soils. Presence and density of snails differ highly among sites. Sometimes it is related to water sites, composition and density of aquatic vegetation. Specific local conditions such as water stagnation, depth and shading may also be factors affecting snail abundance in certain areas (Boelee and Madsen, 2006).

The study identified two genera of snails;*Bulinusglobosus*(20mm long and 20mm wide) and *Pilaovata*(30mm long and 35mm wide) (Plates 2 and 3 respectively)in Obutu and Iyiegwu lakes. *Pila* species is an edible snailthat occurs during the rainy season and is of no known medical importance. It is only known to be a host of a trematode - *Multicotyle purvisi* which does not transmit any disease to humans (Aleva *et al*., 2015). *Bulinus* species is a recognized intermediate host for urogenital schistosomiasis in Nigeria (Agi and Okwuosa, 2001). *Bulinus* are found at sites with low-flow velocities and in water bodies with well aeration and food availability. Snails are found in areas where the water current is < 0.04m/s. When velocity is higher, snails are unable to relax, cannot move or feed, therefore, and cannot maintain themselves (Jones, 1993). Laamrani *et al.,*(2000) also noted that increasing water velocity beyond 0.04m/s kept *Bulinus* density low. Abundant suspended matters and water hardness aid in snail composition and availability. *Bulinus* cannot multiply where there is non availability of good conditions for its survival. Only juvenile *Bulinus* was observed and no cercaria was shed.

A total of 26 *Bulinus* spp (9 (34.62%) from Iyiegwu and 17 (65.38%) from Obutu lakes were identified which may be due to adequate availability of vegetation and decayed organic matter for feeding and constant human-water contact activities in the lake.*B. globosus* prefers cluttered areas and low water flow and occurs in habitats that were slightly polluted with faeces or decaying vegetation. Careless discharge of effluent, animal and domestic wastes may be another reason more *Bulinus* species were recorded at Obutu lake. More people were seen doing one programme or the other in and around the lake causing more contamination of the lake with body fluids which is very conducive for survival of the snails.*Pila* spp collected was 1617; (1108 (68.52%) from Iyiegwu lake and 497 (30.74%) from Obutu lakes). More *Pila* spp was collected from Iyiegwu lake probably because people do not scout for the snail in and around the lake as they do not live very close to the lake. *Pila* also prefers man-made habitats but *Bulinus* prefers shallow water where it may occur on bare substrate but commonly among aquatic plants. *Bulinus* can cling to or settle to the bottom of the water and later come out to the surface which would be made easier by the nature of the lake. Preference for different environmental conditions such as abundant microflora, depth of water, and other physico-chemical factors and natural behavioural mode of adaptation may explain why the snail species showed marked differences in each locality.

In both lakes,*Pila ovata* abundance was significantly higher than *Bulinus globosus.*This is in agreement with the work of Hug *et al*., (2000) who observed that *Pila globosa* was found more in Beel Chanda. He noted that an environment rich in *Pistia stratiotes* and other filamenteous algae always have high density of *Pila* species. This may be attributed to the fact that *Pila* species adapted more to the conditions or factors on the lake. The distribution of *Bulinusglobosus*is patchy may be due to the fact that some freshwater snails are important food source for many fish, turtles and other species of wildlife. Johnson *et al.*, (2010) reported that predators like Cyclops often consumed cercariae and this could be the reason Schistosome cercariae were not observed during the cercariae shedding process.The availability of *Bulinus* in the study area is an indication of imminent risk of urogenital schistosomiasis transmission in the area since the human water contact activities was observed in higher capacity.

Bulinus was collected from December to May coinciding with the period of dry season and early rains. It occurred at low density throughout the year in the lakes, but they showed a density-peak during the dry season. *Bulinus* thrive more during the dry season when there is no influx of rain when they can not be flushed out and this leads to frequency of activities in the lake due to inadequate water in the study areas.It was recorded that the population density

of *Bulinus truncatus* occurring in South east Ghana fluctuated markedly from season to season and greatest at the beginning of the dry season.

Pila ovata was collected more during the wet months (May-November)while *Bulinus globosus* was collected more during the dry months (January-April) in Iyiegwu lake. This is in consonance with the work of Greveldin (2004) who observed a lack of *Bulinus* spp during the rainy season.

In Obutu lake, almost the same observations were made where more *Pila* was collected during the rains (June-October) while *Bulinus*species was collected during the dry season of the year (December-March). This coincides with the work of Ezeugwu and Mafe, (1998) where they observed seasonal variations of snail species in two aquatic habitats. *Pila ovata*, they observed were more abundant during the wet season while *Bulinus globosus* decreased with change in season to wet months.The abundance of *Bulinus* during the dry season may be due to the fact that it coincides with the period when the aquatic habitats become stable in terms of water level and velocity. This also agrees with the report that *Bulinus* snail population drops during the heavy rains and picks up at the onset of dry season (Baalawy, 1972).*Bulinus* was not found during the rainy season but Akogun and Okon (1993) observed a fall in abundance of *Bulinus* during the dry season but picked up in May, the onset of rains with a peak between July and October.

Snails were collected from different parts of the lakes where there were frequent man-water contact points. Some were scooped from the floor towards the shallow edges of the lakes while some were picked on aquatic vegetation and trailing vegetations by the banks of the lakes. Most freshwater snails thrive in shallow water and also live in vegetations that serve them for shelter and feeding, they also stay around banks of water bodies for easy infestation to their hosts. Aquatic snail hosts of schistosomes occur in shallow water near shores of lakes, ponds, marshes and irrigation channels. They live on water plants and mud that is rich in decaying organic matter. They can also be found on rocks, stones or concrete covered with algae or on various types of debris.

Freshwater snails were collected from water contact points, water crossing routes and on underneath of floating vegetation.This makes it easier for the snail to infect human host through penetration and also for protection and feeding. Freshwater snails occur exclusively in low-depth marshes with plenty of floating, emergent, and submerged vegetation. Some live on aquatic plants or on rotten leaves found in lentic environments, or in water bodies with slow water flow and low pollution degree (Appleton *et al.,* 2009). Amawulu *et al*.,

(2008) observed that freshwater snail intermediate hosts of schistosomiasis are found in excavations, gutter/drains, water pools near and under vegetation and streams.

5.2 ECOLOGICAL/PREDISPOSING FACTORS

5.2.1 Human Influence

Some predators observed in and around the water were turtles, lizards and fishes. These are capable of feeding on the snails and probably reducing their population.Common human activities observed in these lakes were swimming, bathing, fishing, washing of farm produce (cassava and breadfruiuts), clothes, cars, motorcycles and implements. These individuals after their work jump into the lake to refresh themselves. Some urinate and/or defaecate in the water which may lead to infection and reinfection thereby seeding of the lake with schistosome eggs.Water bodies rich in organic matters are known to support thriving populations of macro invertebrates because of reduction in water current (Omudu and Iyough, 2005).

5.2.2 Associated vegetation to the lakes and snail population The study observed some aquatic plant species but the most observed plant species are *Aspilia bussei, Commelina diffusa, Ipomoea aquatic* and *Pistia stratiotes*. This could be because snails depend directly or indirectly on the aquatic plants, for food, shelter and oviposition sites. Snails prefer to deposit their egg masses on the plant materials as well as hard and broad leaves (Van Schaycj, 1985). The distribution and abundance of freshwater snails in the study areas may be attributed to the availability of food, shelter and oviposition sites. The favourable effect of vegetation on snail habitat preference was confirmed by the fact that most snails in their various habitats were attached to aquatic plants. Imafidon (1991) had previously reported the influence of aquatic vegetation on distribution of snails of medical importance. All the habitats in the study areas had some type of aquatic vegetation sparsely distributed within or at the verge of the habitat. Snails were seen clustering around *Pistia stratiotes*. Obureke *et al.* (1987) attributed the clustering of snails around plants to be due to high oxygen gradient produced by these plants. The most important of the associating vegetation was *Pistiastratiotes* which was seen everywhere and could serve as an indicator plant for *Bulinus* in selected sites. *Pistia stratiotes* serves more as food for the snails (the snails were observed browsing on *P. stratiotes*). *Ipomoea aquatic, Commelina diffusa* and *Aspilia bussei* play major roles as points of anchorage and shelter. This observation corroborates with the reports of Ukoli (1984); Odei (1978) and Ezeugwu and Mafe (1998) that aquatic weeds serve as

food, shelter and oviposition sites for snails and snails could partly be controlled by removal of weeds.

5.2.3Physico-chemical and biological factors

Bulinus spp were more abundant during the dry season when the total rains were between 9.12-11.42mm (NIMET) but *Pila* was more abundant during the rainy season in both lakes when the total rains were 362.9-472.2mm. This is in line with the work reported by Ezeugwu and Mafe (1998) and Douli, (1993). The lack of *Bulinus* spp during the rainy season may be due to the dilution effect of the influx of rains.

Bulinus species was collected at a pH range of 4.13-6.41 in both lakes while *Pila* specieswas collected at pH range of 4.13-6.77. This indicates that snails in this area thrived in slightly acidic conditions. This is similar to the work of Njoku-Tony (2011) who observed that snails exist in water bodies with pH values of 4.8-9.8. Abdel-Malek (1958) stated that the optimal pH for development of snails is in the range of 7.0 and 8.0. Opisa *et al*., (2011) observed snails were found at sites with pH ranging from 6.7 to more than 11 which may be caused by human contaminants such as cleaning products but on the contrary, Levitz *et al* (2011) reported that a lower pH (more acidic) was associated with higher snail abundance. The absence of correlation between pH and snail abundance in this study has also been reported previously by Steinauer *et al.*, (2008) and suggested that pH may not be an important key determinant for snail abundance.

Bulinus was seen at low turbidity of 5.4-8.40 in Obutu lake and 4.0- 8.46 at Iyiegwu lake. When the water is clear, it is dangerous to the freshwater gastropods; high turbidity inhibits aquatic vegetation and aquatic snails are found in turbid water (Meyer-Lasson *et al*., 1994). Both *Bulinus* and *Pila* spp were collected at conductivity of 10-20 microhms and 20-180 microhms in Obutu and Iyiegwu lakes respectively. During the dry season, conductivity of lakes tends to be low because of low dissolved solids but higher during the rains. Low conductivity ($\leq$ 1000microhms) helps snails to thrive. Conductivity is always high during the rainy season because of influx of some materials into the water. This low conductivity is similar to the work carried out by Okwuosa (1979) where he recorded abundance of snails at conductivity of 50-600microhms. Njoku-Tony (2011) also reported that snail population was high in low conductivity range between 50 and 110microhms. In contrary to this, El Deeb *et al*., (2017) reported abundance of snail (*Biomphalaria alexandrina*) under conductivity of 1302microhms and concluded that snails have the ability to thrive or tolerate a wide range of water hardness.

Pila and *Bulinus* spp were collected at total dissolved solid ranges of 14.93 and 28.85mg/l in Obutu lake and 29.85-268.7mg/l in Iyiegwu lake. These results gave an indication that the snails could survive under high concentrations of total dissolved solids (TDS). This could be confirmed by the observation of Monde*et al*., (2016) who reported that snails are not found in waters with low concentration of total dissolved solids. El-Deeb *et al*., (2017) also reported that snails were observed at total dissolved solid ranges of 120.1-901mg/l. However, significant relationship was not obtained between snail abundance and TDS. Snails can live in a wide range of mineral content in water till certain limit. The highestnumber of *Bulinus* spp was found under low total suspended matter (TSM) (15-200mg/l) in both lakes but there was no positive correlation between the abundance of snails and TSM. This may be due to the fact that *Bulinus* occurs during the dry season when total suspended matter is always low because of lack of rains. The survey observed *Bulinus* spp at total calcium hardness of 65-250mg/l. Calcium is one of the minerals that help in shell production and abundance of calcium will lead to good shell production by the snails. This is in line with the work of Ezeugwu and Mafe (1998) where total hardness appeared to enhance snail abundance; however, there was no significant correlation between calcium hardness and snail abundance. The study showed a correlation between abundance of snails and total magnesium hardness. As magnesium hardness increases, so snail abundance increases. A complimentary investigation had shown that quantity and quality of snail food substances are affected by calcium and magnesium levels in the habitat. Snails thrive better in environment or habitat with high calcium and magnesium content (Cowper, 1971). Magnesium is reported to be an important factor in snail reproduction as it is needed for the proper functioning of ovaries and testes (Schmidt-Nelson, 1975). *Bulinus* spp was collected at nitrite concentration range of 0.111-0.112ppm and 0.16 - 0.18ppm in Obutu and Iyiegwu lakes respectively. There was significant correlation in the nitrite concentration and abundance of the snail species. Presence of nitrite concentration increases snail population. *Bulinus* spp was collected at nitrate concentration range of 4.13-4.28ppm in Obutu lake and 0.958-8.000ppm in Iyiegwu lake. There was no significant correlation in the abundance of snail and nitrate concentration in the study areas.

The presence and diversity of snails could be increased or decreased depending on the class of pollutants. Snails are exposed to several environmental pollutants. *Bulinus* abundance increased when the total coliform was 6-15MPN/100ml and faecal coliform was 0-8MPN/100ml in both lakes. This indicated that total and faecal coliforms play a good role in the abundance of snail species and there was no correlation between snail abundance and

faecal coliform. In the study area, it appears that the overriding factors include turbidity, magnesium hardness, nitrite concentration and total coliform. It has been shown that sites in which snails are associated with macrophytes were characterized with high ranges of chemicals, conductivity and pollutants (El-Khayat *et al*., 2009).

5.3 UROGENITAL SCHISTOSOMIASIS PREVALENCE AND INTENSITY

An overall urogenital schistosomiasis prevalence of 16.8% was observed in the study area. Ugochukwu *et al*., (2013) earlier recorded a similar prevalence of 15.7% in their study of both Orumba North and South Local Government Areas.The result is also similar to 17.8% in Kano (Dawaki *et al*, 2015) and 18.1% in Obi Local Government Area, Benue State (Omudu and Odeh (2013). Lower prevalence rates of 7.9% at Umuikwu-Anam, Anambra State (Ezeagwuna *et al*, 2012), 12.9% in Minna (Chidozie and Danjuma, 2008) and 8.3% at Ehime Mbano, Imo State (Iwu *et al*, 2015) have been recorded. A higher prevalence of 25.5% was recorded in Umuikwu-Anam, Anambra State (Ekejindu *et al*, 2002). Meremikwu *et al*, (2000) Inyang-Etoh *et al*, (2004) and Soniran *et al*, (2015) recorded high prevalences of 69.1%, 62% and 39.7% respectively in Adim community and Afikpo of Ebonyi State. Other higher prevalences observed elsewhere include 41.3% in Ndinjor District of Langtang North Local Government Area, Plateau State(Nanvya *et al.* 2011), 49.2% in Ohaukwu Local Government Area, Ebonyi State (Anorue *et al*, 2017), 21.0% in Ovia West Local Government Area, Edo State (Adeyemi and Aisien, 2014), 44.84% at Awgu Local Government Area, Enugu State (Ngele and Okoye, 2016) and 55.4% in Guma local Government Area, Benue State (Kwaghbo *et al*, 2016). Urogenital schistosomiasis prevalence is comparatively low and endemic in the study area but with the aggressive agricultural policy in the country, the availability of snail hosts and water contact patterns in the area, urogenital schistosomiasismight excalateto epidemic proportions if nothing is done to control it.

5.3.1 Urogenital schistosomiasis prevalence in the communities

Urogenital schistosomiasis prevalence (25.3%) in Omogho community was significantly different from that of Ndikelionwu community (9.3%). This difference could be attributed to closeness to lake and dependence on the lakes for water supply. Omogho community lives very close to the lakes and depend solely on the lakes for their water supply.Most of the inhabitants of Ndikelionwu community live further away from the lake and only visit the lakes during the dry season when there is no rain. Most of theinhabitants live near the tarred road where they have access to water vendors (tankers) and rarely go to the lake.

The highest prevalence rate (30.7% and 25.7%) was recorded in Iwollo and Umunaba respectively. These two villages live very close to the lake and depend solely on it for their source of domestic water needs. Pupils and students from these villages drop their school bags to swim in the lakes during hot weather to cool off after school periods. Kolilu village had the lowest prevalence rate (18.8%) though high on its own. This may be due to the fact that the inhabitants live farther away from the lake but they still visit the lake for some recreational and domestic purposes especially during the dry seasons. Studies have shown that distance from home to a contaminated water source plays an important role in the risk of infection (Clenno *et al*., 2004). The infection was more in Okpunoifite (37.0%) followed by Ndinwedo (25.4%) villages. This was due to the fact that these two villages live very close to the lakes and depend solely on the lake for their domestic water needs. There was no infection in Aronota and Umudim villages probably because they have access to some fast flowing rivers (Nwaowelle and Aghomili). The high prevalence in these communities concurs with the work of Okon *et al*., (2007) who recorded a prevalence of 10% in Ogoja, Cross River State.Some part of these communities live close to each other and they share some part of the lake which makes it possible for this infection to thrive among them.

5.3.2 Urogenital schistosomiasis prevalence by sex

Males were found to be more infected than females in the study areas with an overall prevalence rate of 20.3% and there was significant relationship between gender and infection ($P<0.05$). This is similar to the work of Ekejindu *et al*., (2002), Ukatu *et al.*, (2015) and Pam *et al*., (2016). In most studies, higher prevalence and intensity of infection to schistosomiasis were recorded among the males than the females (Anorue *et al*., 2017; Ezeagwuna *et al.*, 2012; Nanvya *et al*., 2011 and Ameh 2008). In contrast to this, Ekwunife *et al*., (2009) recorded no significant relationship between sex and infection and concluded that gender played no significant role in *S. haematobium* distribution because of equal water contact activities by both sexes.

Although both sexes were exposed to the same water bodies which were close to their dwellings, females generally stayed out of the water while processing their foods (e.g. washing of cassava and bread fruits) or washing of plates and clothes while males stayed longer in water while swimming or fishing. Moreover, in the African setting including Igboland, girls are more associated with indoor activities.

5.3.3 Urogenital schistosomiasis prevalence by age

The highest prevalence of urogenital schistosomiasis (29.6%) was recorded among subjects aged 16-26 years followed by those in the age group of 5-15years (19.4%). This is similar with the work carried out by Anorue *et al*., (2017) who recorded higher prevalence among age groups 16-20years. Abdullahi *et al*., (2011), Ameh (2008), Ekejindu *et al*., (2002), Adebiyi *et al*., (2015), Ukatu *et al*., (2015) and Ukpai and Ahia, (2015) recorded high prevalence rates among age groups 14-16years; 21-30years; 10-14years, 12-24years, 11-20 years and 15-29years respectively.

Teenagers are always found swimming and doing some domestic chores in the water which increase the chances of infection while old people rarely visit or stay in the water for any reason so transmission of *S. haematobium* infection is obstructed. Ekwunife *et al*., (2009) and Mbah and Useh (2008) recorded higher prevalence rates 45.9% and 45.7% respectively among the age group 5-9years. Nale *et al.,* (2003) recorded a least prevalence rate of 3.1% among age group 5-7years because they rarely go to the stream for any domestic chores. *S.haematobium* was significantly related to age ($P<0.05$). This confirms the work done by Atalabi *et al*., (2016) where prevalence and intensity peaked in the 18-20years age group.

A higher intensity was recorded in Omogho (19.6eggs/10mls urine) than Ndikelionwu (14.7eggs/10mls urine) though there was no significant difference. This concurs with the work of Okon *et al*., (2007) where they recorded no significant difference in intensity of infection between males and females though males had high egg output of 14.9eggs/10mls urine and females had 10.9eggs/10mls urine. There was also a high mean egg output of 30.27eggs/10mls urine among senior high school students in Katsina state (Atalabi *et al*., 2016). Other previous records from Kaduna state (73.93eggs/10mls urine) and Republic of Chad (13.5eggs/10mls urine) further confirms the focal nature of urogenital schistosomiasis (Kanwai *et al*., 2011 and Brooker *et al*., 2002). The difference in intensity might be as a result ofthe fact that the age group is grown up to visit the lake at any point in time, frequency of visit, proximity to infected water bodies and natural tendency of inhabitants towards recreation (swimming).

5.3.4 Urogenital schistosomiasis prevalence by occupation

This study recorded an overall prevalence of 14(8.92%) among different occupations. Farmers had the highest number 6(6.38%) that were infected but the highest prevalence rate was recorded among Artisans 1(50%) and local security men 1(50%). This work is in contrastto the work carried out by Shashie *et al*., (2015) in Southwestern Ethiopia and

Houmsou, (2017) where it was observed that children whose parents' occupation is farming were more infected.Singh *et al.,* (2016) reported that the order of infection based on social status (occupation of pupil's parents) was farmers > fishermen > traders > civil servents > others. Children of farmers had a higher prevalence with 71.50%, followed by children of fishermen with 52.00%, and then those from children of traders with 45.71%. This could be due to lack of proper knowledge of the disease which leads to inability to properly educate their children/wards about the preventive measures against the disease. These children follow their parents to the farm and lakes where they get infected. Educational backwardness which has a great impact on the distribution of schistosomiasis in rural communities was reported by Etim (1995) in Cross River State.

5.4 PEOPLE'SPERCEPTION, ATTITUDE AND MANAGEMENT PRACTICES TOWARDS UROGENITAL SCHISTOSOMIASIS

Over 80% of the respondents have heard of urinary schistosomiasis but majority of them do not know the causes of the infection. This is in line with findings of Odhiambo *et al*., (2014) and Soniran *et al*., (2015) where there were low levels of awareness despite high prevalence of schistosomiasis among communities in Kenya, East African community and Afikpo in Nigeria, West Africa. There were vast misconceptions about mode of transimmion of the disease. The most mentioned transmission route is that urinary schistosomiasis is transmitted through eating of snails. Similar misconceptions have been reported in other studies in various African countries (Mwanga, 2005 and Onyeneho *et al*., 2010). Most of the respondents (81.6%) believe that the local name for the disease is 'Amiri obara' as it corresponds with the bloody urine. Correct knowledge of the disease was low with regards to the transmission route where only 17.3% of the respondents who were aware of the disease cited the correct route but many respondents were able to point out the risk behaviours. In Western Kenya, a study found out that some of the participants knew that snails and poor sanitation contributed to the spread of the disease but lacked understanding of the transmission cycle (Odhiambo *et al*., 2014). Thokozani *et al*., (2018) also recorded a low percentage of participants in Swaziland where 16.4% out of 97.3% that had heard about schistosomiasis knew the mode of transmission. In Nigeria, Dawaki *et al*., (2015) recorded that 67% out of 74.5% who had prior knowledge about schistosomiasis knew the mode of transmission. This lack of knowledge of transmission cycle among the population may create a burden in the control of the disease and may cause the failure of the schistosomiasis eradication programme. Majority of the respondents were aware of the preventive measures

as 74.7% answered that footwear should be worn to the farms andbut 81.4% responded that avoiding swimming or bathing in the lake is part of the preventive measure. More than two third of the participants do not believe that avoiding washing clothes and other household materials in the lake is a preventive measure. This will go a long in making the control of the disease difficult. Since the lake is the only source of water supply especially durig the dry season, it will be difficult or almost impossible for the community to stop going to the lake for domestic activities. This strongly indicates a lack of health education about the causes, prevention and control of urogenital schistosomiasis among the people.

More than half of the respondents (80.9%) knew that the disease is curable but some indicated that they would not go for treatment when blood is seen in urine. Few believed that going to the hospital or medical doctor is a curative measure but majority stated that visiting the patent medicine dealers to mix drug is the treatment method. They consequently become used to the disease and bad practices, and they view the disease as a part of their lives. When people live with a disease for a long time, they tend to regard it as a part of their everyday life (Thokozani, *et al*., 2018). Raised in a society of people that tend to have explanatory models about their illnesses, (i.e., how they become ill and what they can do to prevent and treat illnesses), the children have misconceptions about the disease. Previous studies in Ghana showed that more than 70% of the schistosomiasis individuals opt for traditional self-treatment without visiting a health facility (Danso-Appiah *et al*., 2010).

5.5 CONCLUSION AND RECOMMENDATION

This study showed the abundance of *Bulinus* spp though more juveniles were harvested and no cercaria was shed by the snail intermediate host. *Pila* spp which is not related to schistosomiasis but a host of *Multicotyle purvisi*was also observed. There was abundant vegetation that aided in the existence of the snail. The physico-chemical factors do not act entirely in isolation but play vital roles in determining the availability and fecundity of snail hosts of schistosomes and other aquatic fauna and flora.

This study also showed that urogenital schistosomiasis is on a high trend in Omogho and Ndikelionwu and there might be some undiscovered foci of endemic urogenital schistosomiasis in Orumba North Local Government Area. This disease is thus highly prevalent in most communities in Nigeria and would be a threat to important socio-economic development in all the infected areas. Notwithstanding the efforts made by the World Health Organization (WHO) to control the disease, global incidence is still increasing.

The study showed that the majority of the study population has good knowledge of the disease, the symptoms and the preventive/control measures, yet more health awareness about the mode of transmission is important in order to curtail the disease in this environment.

5.5.1CONTRIBUTION TO KNOWLEDGE

1. There is abundance of *Bulinus globosus* which is an intermediate host of *Schistosoma haematobium* in the study area.
2. The availability of the lake and the physico-chemical and biological properties of the lakes are very conducive for the snail intermediate host to thrive
3. The human-water contact activities that go on in the lakes make it possible for urogenital schistosomiasis infection to thrive and constantly expose the people to infections and reinfections
4. There is high prevalence of urogenital schistosomiasis in Omogho and Ndikelionwu communities of Orumba North Local Government Area of Anambra State
5. The inhabitants are not yet fully aware of the cause and transmission pattern of the infection

5.5.2 RECOMMENDATIONS

To disrupt transmission of urogenital schistosomiasis more effectively and achieve prolonged disease control,

1. The government of Anambra State should provide adequate water in these communities and environs for drinking and domestic purposes. Diagnosis, treatment, management of the environment and control of the intermediate host should be of paramount importance.
2. Mass drug administration, school and community-based health education regarding good personal hygiene and sanitary practices is imperative among these communities in order to significantly reduce the transmission and morbidity of schistosomiasis.
3. Government agencies should also intervene by adopting the integrated control measures in the total eradication of this scourge in all the rural communities in Nigeria in general and Orumba North Local Government Area in particular so as to attain the sustainable development goal being campaigned about.
4. The findings of the study imply the necessity of collaboration between, school health departments and teachers, and providing teachers with workshops about urogenital schistosomiasis to ensure that the children receive correct information about the disease. Other methods to improve the children's knowledge about schistosomiasis could involve the media and rural health motivators. Community health nurses in the Orumba North areas should develop community-based interventions that involve children in the control and prevention of schistosomiasis such as developing special cards and posters, and periodically screening and teaching children about urogenital schistosomiasis. There is also a need for periodic assessment of schistosomiasis knowledge, attitude and practice coupled with prevalence of schistosomiasis in children.
5. The World Health Organization recommends that children aged 10–14 years should be the target group in the control of schistosomiasis because of their water contact behaviours, and that they should normally be the study population for the baseline survey and for monitoring and the evaluation of intervention strategies because of the epidemiological importance of this group with regard to schistosomiasis. Nigeria has taken steps to control schistosomiasis through the establishment of the National Schistosomiasis Control Programme to provide intensive schistosomiasis surveillance, health education, and routine deworming in primary schools among children in the age group of 6–14 years old to reduce schistosomiasis-related morbidities.
6. Immense efforts are being made by the Federal Government to control morbidity caused by schistosomiasis; however, it should be borne in mind that monitoring and evaluation of

schistosomiasis (i.e., prevalence and intensity), knowledge, attitudes, and practices of the communities and knowledge of the snail ecology have a major role in sustainable control interventions.

7. Further research is still necessary in order to ascertain other species of *Bulinus* in the study area and their ability to shed cercaria.

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APPENDIX 1

NNAMDI AZIKIWE UNIVERSITY TEACHING HOSPITAL

P.M.B. 5025, NNEWI, ANAMBRA STATE, NIGERIA

Professor Ivara E. Esu, OFR
B.Sc. (Ife), M.Sc. (Minnesota), PhD. (ABU)
Chairman
Board of Management

B. O. Chukwuma
B.Sc., MA, MHA, AHA,
Director of Administration/
Secretary to the Board

Professor Anthony O. Igwegbe
MBBS, FWACS, FICS, FISS
Chief Medical Director/
Chief Executive

Dr. E. A. E. Afiadigwe
B.Sc (Hons) Nig. MBBS (NAU), FWACS, FICS
Chairman
Medical Advisory Committee

E-mail: nauthcmd@yahoo.co.uk
nauthnnewi@hotmail.com
Telegram: TEACHOS NNEWI

Our Ref: NAUTH/CS/66/VOL.7/46

Your Ref: _____

Date: 30th September, 2015

Ezeagwuna Dorothy Amauche
Department of Parasitology and Entomology,
Nnamdi Azikiwe University,
Nnewi Campus

ETHICS COMMITTEE APPROVAL

RE: URINARY SCHISTOSOMIASIS AND SNAIL INTERMEDIATE HOST ECOLOGY IN OMOGHO AND NDIKELIONWU COMMUNITIES, ORUMBA NORTH LOCAL GOVERNMENT AREA OF ANAMBRA STATE

We write to inform you that after due consideration of your research proposal, approval is hereby conveyed for you to commence the study.

The principal investigator is required to send a progress report to the Ethics Committee at the expiration of three (3) months after ethical clearance to enable the Committee carry out her oversight function.

Please note that this approval is subject to revocation if you fail to obtain proper authorization from your study site/unit.

.....
Prof. P.U Ele
Chairman, NAUTH Ethics Committee

.....
Ezeji James O
Assistant Sec., NAUTH Ethics Committee

APPENDIX 2

NNAMDI AZIKIWE UNIVERSITY

Faculty of Biosciences

Department of Parasitology and Entomology

Tel: _____

Our Ref: _____

Your Ref: _____

Head of Department

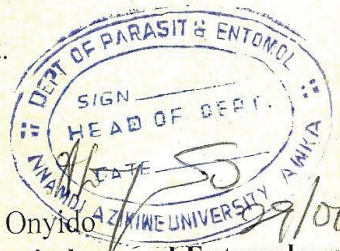
P.M.B. 5025
Awka
Anambra State Nigeria

Date: 29th June, 2015

To Whom It May Concern

The bearer, Ezeagwuna Dorothy Reg. No 2011567002P is a PhD student of the above named Department, in Nnamdi Azikiwe University, Awka. She is carrying out a project on Urinary Schistosomiasis and Snail Intermediate Host Ecology in Omogho and Ndikelionwu communities, Orumba North Local Government Area of Anambra State, Nigeria.

Kindly give her all necessary assistance to enable her successfully carry out the project.



29/06/2015

Prof. A.E. Onyido
HOD, Parasitology and Entomology

APPENDIX 3

His Majesty Eze Professor Chukwuemeka Ike, OFR, NNOM,
Ikelionwu XI, Eze Ndikelionwu

The Palace
P.O. Box 1, Ndikelionw
Orumba North LGA
Anambra State, Niger
ikelionwueleven@yah

25/5/15

TO WHOM IT MAY CONCERN

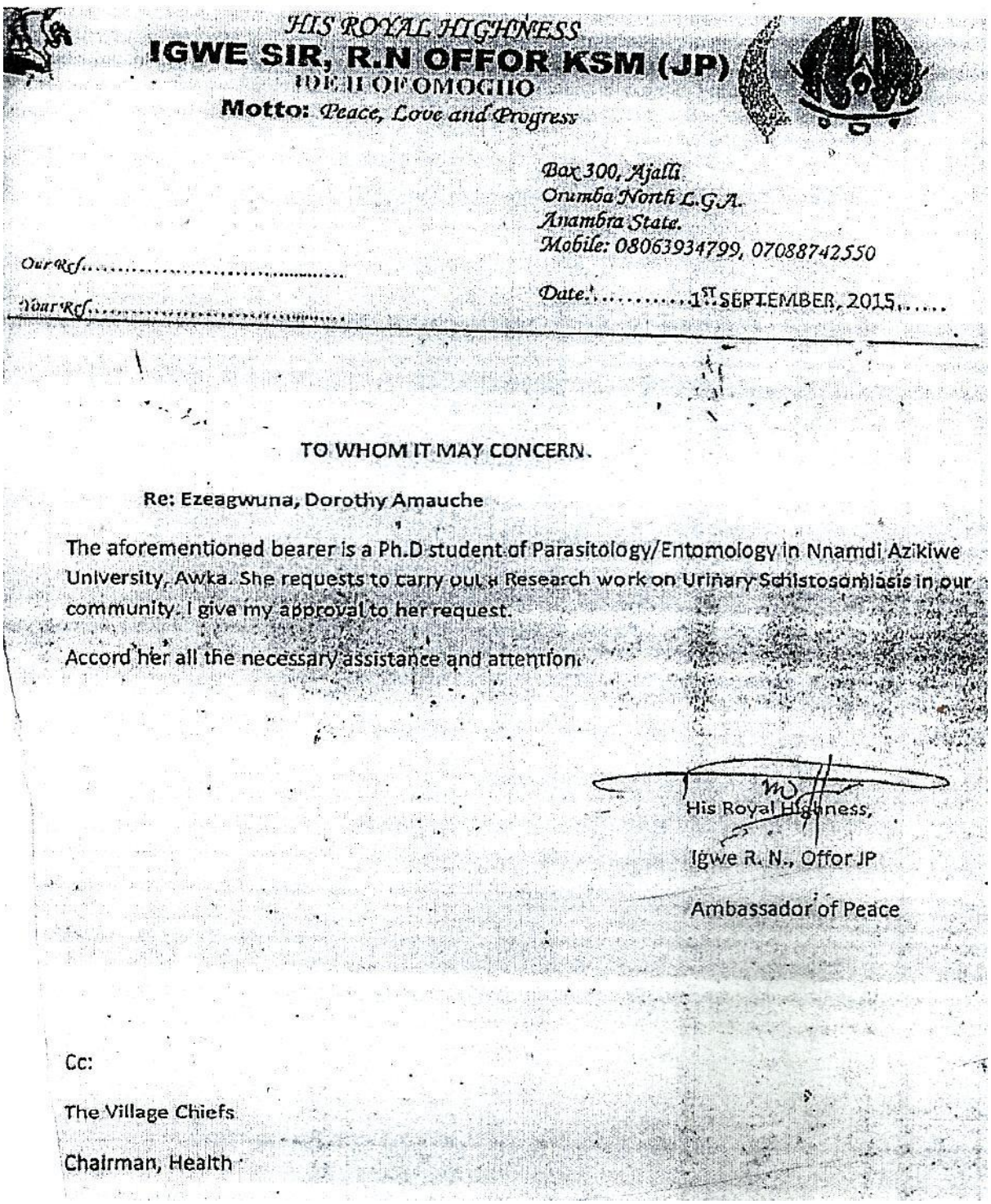
The bearer, Ezeagwuna Dorothy Amauche is a student of Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka. She wishes to carry out a PhD research work on Schistosomiasis in our community. She has been given approval to commence work.

Accord her all the necessary assistance.

HM Eze Professor Chukwuemeka Ike, Ugwu Aro, OFR, NNOM

Cc: All Village Ezeogo

APPENDIX 4



HIS ROYAL HIGHNESS
IGWE SIR, R.N OFFOR KSM (JP)
IDE II OF OMOGHO
Motto: *Peace, Love and Progress*

Box 300, Ajalli
Orumba North L.G.A.
Anambra State.
Mobile: 08063934799, 07088742550

Our Ref.....

Your Ref.....

Date.....1ST SEPTEMBER, 2015.....

TO WHOM IT MAY CONCERN.

Re: Ezeagwuna, Dorothy Amauche

The aforementioned bearer is a Ph.D student of Parasitology/Entomology in Nnamdi Azikiwe University, Awka. She requests to carry out a Research work on Urinary Schistosomiasis in our community. I give my approval to her request.

Accord her all the necessary assistance and attention.

His Royal Highness,
Igwe R. N., Offor JP
Ambassador of Peace

Cc:
The Village Chiefs
Chairman, Health

APPENDIX 5

QUESTIONAIRE

Dear Respondent,

I am Ezeagwuna Dorothy, a PhD student in Public Health Parasitology, Nnamdi Azikiwe University Awka.

I am carrying out a research work on SCHISTOSOMIASIS AND SNAIL INTERMEDIATE HOST ECOLOGY and will want you to answer the questions below.

Your sincere co-operation and response will be appreciated and treated with utmost confidentiality.

Thank you for your co-operation.

INSTRUCTION

Tick(v) in the boxes provided where appropriate

SECTION A (DEMOGRAPHIC DATA)

1. Serial number ----------
2. Sex: (M)--------- (F)----------
3. Age: 5-10 ( ), 11-20 ( ), 21-30 ( ),31 – 40 ( ), >40 ( ).
4. Occupation: Student ( ),Trader ( ), Farmer ( ), civil servant ( ), others specify
5. Level of education: Primary ( ), Secondary ( ), Tertiary ( )

SECTION B (LIFESTYLE)

6. Do you swim or go inside the river when doing domestic chores? Yes ( ), No ( )
7. Do you wear foot wear while workin with your parents in the farm? Yes ( ), No ( )
8. Do you eat snails in your house? Yes ( ), No ( )

SECTION C (ASSESSMENT OF KNOWLEDGE)

9. Do you know about schistosomiasis? Yes ( ), No ( )
10. How do you recognise the disease?.....
11. What is the cause of the disease?.....
12. What is the local name for schistosomiasis in your area?
13. Do you notice any blood when urinating? Yes ( ) , No ( )
14. If yes in No 13, when?
15. Was the infection treated that time? Yes ( ), No ( )
16. Apart from blood, what other signs and symptoms do you experience? Please specify
17. Do you experience any itching in your body? Yes ( ), No ( )
18. What do you use in treating the disease? Local herbs ( ), Mixed drugs ( ) , prayer ( ), Hospital ( )
19. What is your belief about blood in urine?.....

SECTION D (ATTITUDE)

20. How do you feel when you see blood in your urine?.....
21. Do you think it is a problem? Yes ( ), No ( )
22. Do you think it can be cured? Yes ( ), No ( )
23. Do you think it can be prevented? Yes ( ), No ( )

APPENDIX 6

Plate 1: Sechi Disc used in the study areas

APPENDIX 7

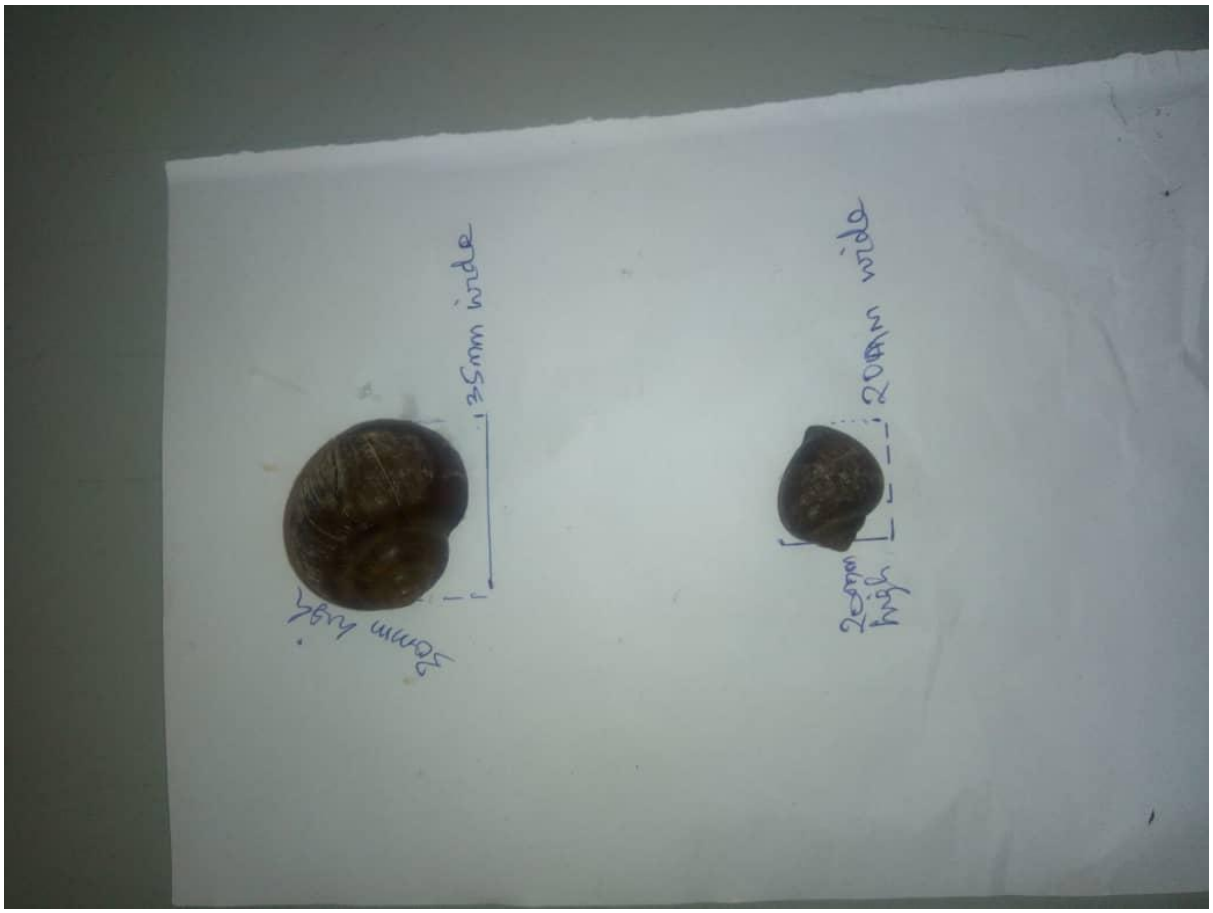


Plate 2*: Pila ovata* from Iyiegwu lake

APPENDIX 8

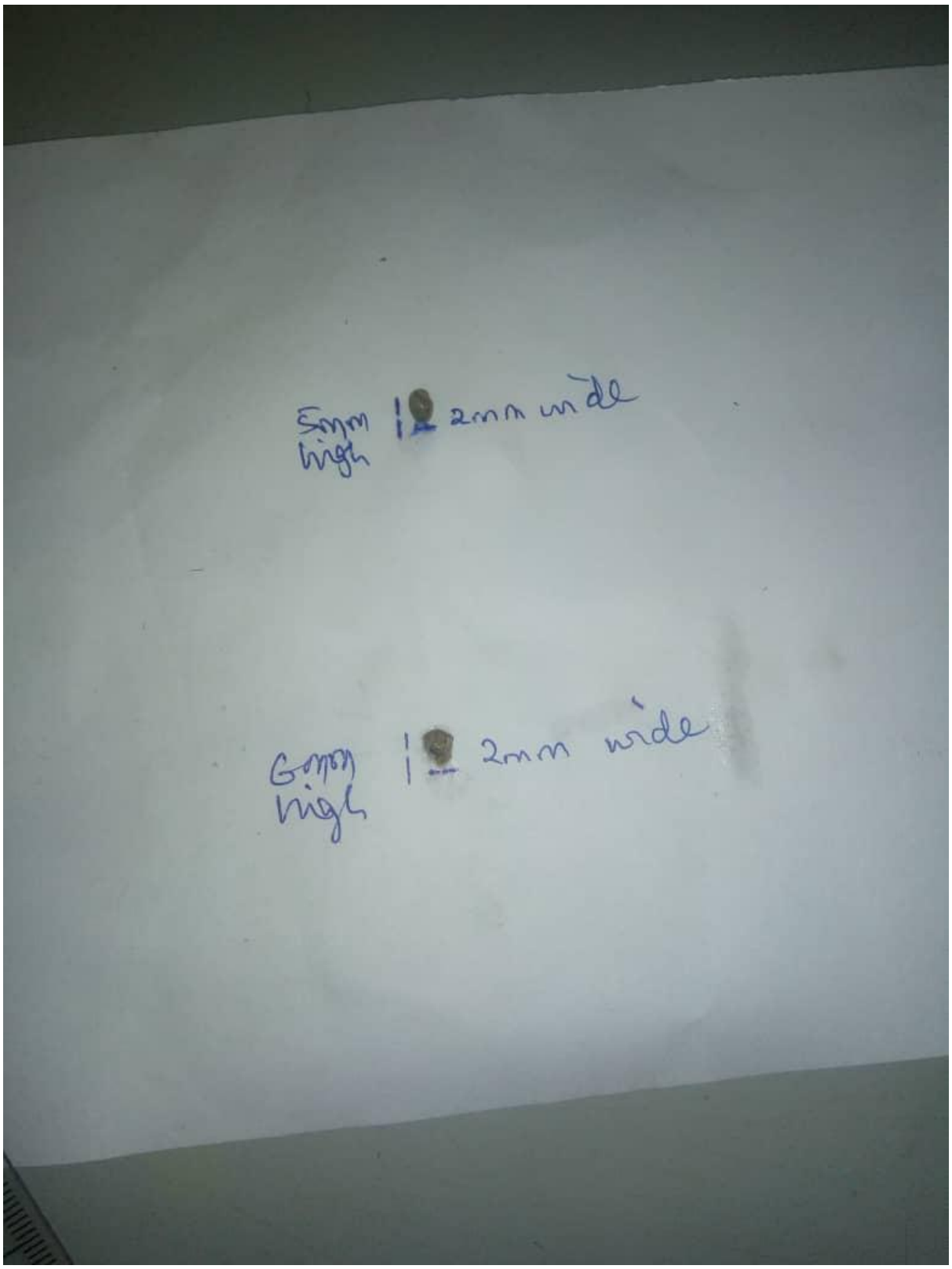


Plate 3: Juvenile *Bulinus globosus* from Obutu lake

APPENDIX 9

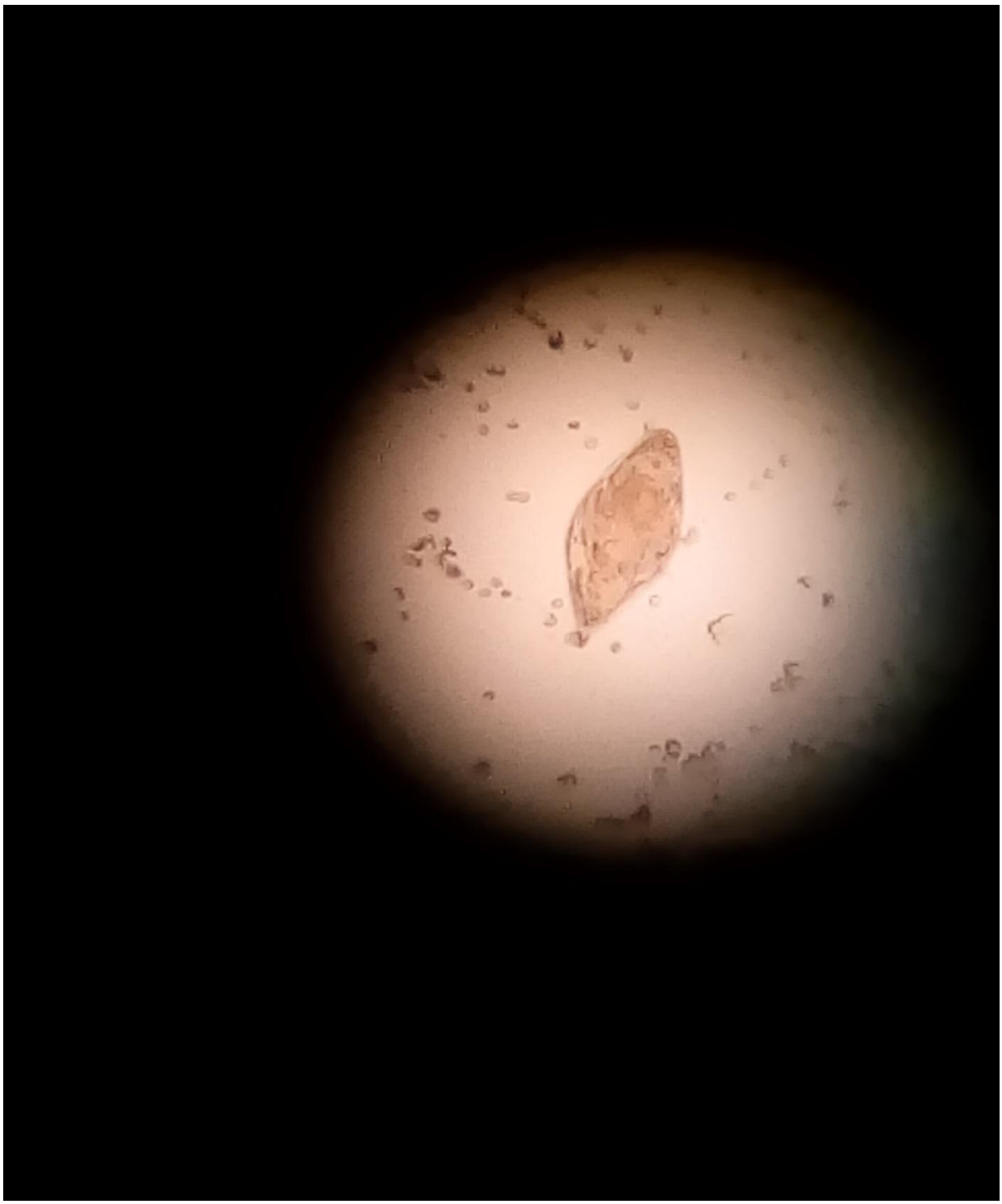


Plate 4: *Schistosoma haematobium* egg as seen under the microscope

APPENDIX 10

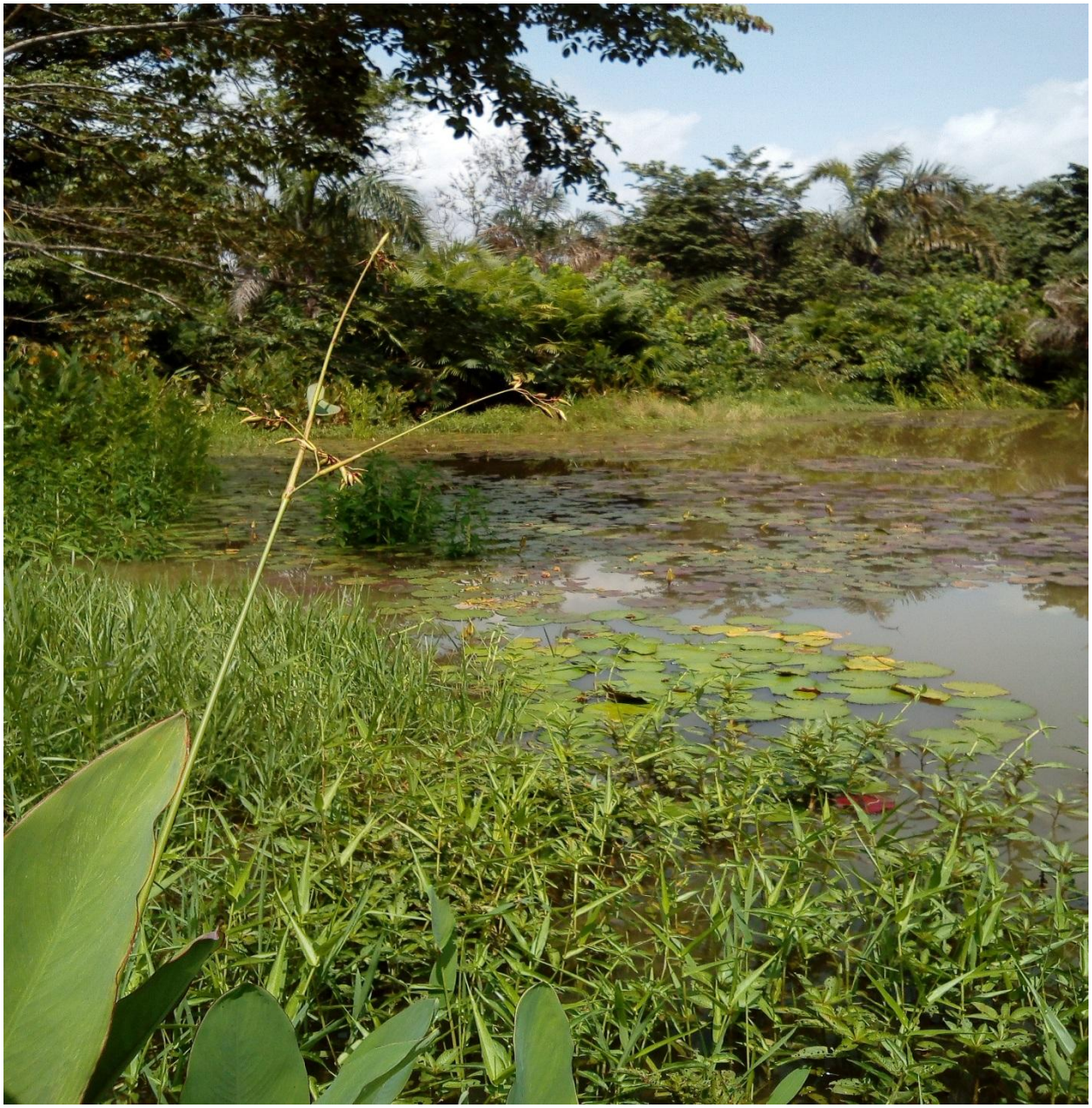


Plate 5: Obutulake showing aquatic and marginal vegetation

APPENDIX 11

Plate 6: Iyiegwu lake showing aquatic and marginal vegetation

APPENDIX 12:

SOME OF THE HUMAN ACTIVITIES IN THE LAKE

Plate 7: A young lady washing breadfruits beside Obutu lake

APPENDIX 13

Plate 8: A young lady washing clothes around the shores of Obutu lake

APPENDIX 14

Plate 9: A young man fetching water from Iyiegwu lake

APPENDIX 15

Plate 10: A fisherman in Iyiegwulake

APPENDIX 16

Plate 11: People swimming in Obutu lake

APPENDIX 17

Plate 12: Lorriesparked for washing around Obutu lake

APPENDIX 18

MONTHLY DISTRIBUTION OF THE SNAILS IN BOTH LAKES

MONTH	SNAIL SPECIES COLLECTED		TOTAL
	Pila	***Bulinus***	
January	-	14	14
February	-	3	3
March	-	2	2
April	-	2	2
May	138	2	140
June	300	-	300
July	358	-	358
August	184	-	184
September	186	-	186
October	265	-	265
November	174	-	174
December	-	3	3
Total	1605	26	1631

APPENDIX 19

MONTHLY DISTRIBUTION OF THE SNAILS IN OBUTU LAKE

MONTH	SNAIL SPECIES COLLECTED		TOTAL
	Pila	***Bulinus***	
January	-	13	13
February	-	-	-
March	-	1	1
April	-	-	-
May	-	-	-
June	120	-	120
July	130	-	130
August	40	-	40
September	106	-	106
October	101	-	101
November	-	-	-
December	-	3	3
Total	497	17	514

APPENDIX 20

MONTHLY DISTRIBUTION OF THE SNAILS IN IYIEGWU LAKE

MONTH	SNAIL SPECIES COLLECTED		TOTAL
	Pila	***Bulinus***	
January	-	1	14
February	-	3	3
March	-	1	2
April	-	2	2
May	138	2	140
June	180	-	300
July	228	-	358
August	144	-	184
September	80	-	186
October	265	-	265
November	174	-	174
December	-	-	3
Total	1108	9	1117

APPENDIX 21

T-TEST PAIRS=Iyiegwu WITH Obutu (PAIRED)

/CRITERIA=CI(.9500)
/MISSING=ANALYSIS.

T-Test

The abundance of snails in the study areas.

	Mean	No	Std. Deviation	Std. Error Mean
Abundance of *Pila* spp in the study area	114.6667	12	125.58542	36.25339
Abundance of *Bulinus* spp in the study area	2.1667	12	4.56933	1.31905

The abundance of snails in Obutu Lake.

	Mean	N	Std. Deviation	Std. Error Mean
Abundance of *Pila* spp in Obutu stream	41.4167	12	55.39356	15.99074
Abundance of *Bulinus* spp in Obutu stream	1.4167	12	3.75278	1.08333

The abundance of snails in Iyiegwu Lake

	Mean	N	Std. Deviation	Std. Error Mean
Abundance of *Pila* spp in Iyiegwu lake	73.2500	12	80.35051	23.19519
Abundance of *Bulinus* spp in Iyiegwu lake	.7500	12	1.05529	.30464

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of snail in Iyiegwu lake	74.0000	12	79.60813	22.98089
	Abundance of snail in Obutu stream	42.8333	12	54.35545	15.69107

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of snail in Iyiegwu lake	74.0000	12	79.60813	22.98089
	Abundance of snail in Obutu stream	42.8333	12	54.35545	15.69107

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Abundance of snail in Iyiegwu lake - Abundance of snail in Obutu stream	31.16667	57.73581	16.66689	-5.51692	67.85025	1.870	11	.088

```
T-TEST PAIRS=Obutubulinus WITH Iyiegwubulinus (PAIRED)
 /CRITERIA=CI(.9500)
/MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of Bulinus spp in Obutu stream	1.4167	12	3.75278	1.08333
	Abundance of Bulinus spp in Iyiegwu lake	.7500	12	1.05529	.30464

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Abundance of Bulinus spp in Obutu stream - Abundance of Bulinus spp in Iyiegwu lake	.66667	3.08466	.89047	-1.29324	2.62657	.749	11	.470

```
T-TEST PAIRS=Pila WITH Bulinus (PAIRED)
/CRITERIA=CI(.9500)
 /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of Pila spp in the study area	114.6667	12	125.58542	36.25339
	Abundance of Bulinus spp in the study area	2.1667	12	4.56933	1.31905

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Abundance of Pila spp in the study area - Abundance of Bulinus spp in the study area	112.50000	127.80703	36.89471	31.29529	193.70471	3.049	11	.011

```
T-TEST PAIRS=Pila Obutu WITH Bulinus Obutu (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Test

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Abundance of Pila spp in the study area - Abundance of Bulinus spp in the study area	112.50000	127.80703	36.89471	31.29529	193.70471	3.049	11	.011

```
T-TEST PAIRS=Pila Obutu WITH Bulinus Obutu (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of Pila spp in Obutu stream	41.4167	12	55.39356	15.99074
	Abundance of Bulinus spp in Obutu stream	1.4167	12	3.75278	1.08333

Paired Samples Test

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Abundance of Pila spp in Obutu stream - Abundance of Bulinus spp in Obutu stream	40.00000	56.66168	16.35682	3.99889	76.00111	2.445	11	.033

APPENDIX 22
SEASONAL SNAIL ABUNDANCE AND RANGE VALUES OF SOME PHYSICO-CHEMICAL PROPERTIES OF THE LAKE STUDIED
(DRY SEASON)

	Parameters			**Range-Values of Parameters**	
Dry season (November – March)	**Obutu lake**			**Iyiegwu lake**	
	Snail species	*Bulinus*	*Pila*	*Bulinus*	*Pila*
	Snail catch	17	0	5	174
	Ph	5.34 - 6.12	0	5.38 – 6.36	6.46
	Turbidity	5.4 – 6.2	0	6.32 – 7.64	6.32
	Conductivity	10 – 15	0	20 – 120	20
	Total Dissolved solid	14.93 – 20.58	0	29.85	29.85
	Suspended matter	15 – 20	0	30 – 35	30
	Total hardness	65 – 120	0	65 – 120	65
	Calcium hardness	25 – 70	0	20 – 80	20
	Magnesium hardness	50 – 70	0	50 – 80	50
	Nitrite concentration	0.111 – 0.113	0	0.16 – 0.20	0.20
	Nitrate concentration	0.416 – 0.428	0	0.958 – 5.000	0.958
	Total coliform	6 – 8	0	3 – 7	3
	Faecal coliform	4 – 6	0	3	0

APPENDIX 23

SEASONAL SNAIL ABUNDANCE AND RANGE VALUES OF SOME PHYSIO-CHEMICAL PROPERTIES OF THE LAKE STUDIED (RAINY SEASON)

Seasons	Parameters			Range values of Parameters	
Rainy season (April – October)	**Obutu lake**			**Iyiegwu lake**	
	Snail species	*Bulinus*	*Pila*	*Bulinus*	*Pila*
	Snail catch	0	497	4	934
	pH	0	5.72 – 6.12	4.13 – 5.00	4.13 6.77
	Turbidity	0	5.8 – 7.3	8.20 – 8.46	4.00 – 8.46
	Conductivity	0	10	180	20 – 180
	Dissolved solid	0	14.93 – 26.47	29.85 – 268.66	29.85 – 268.66
	Suspended matter	0	10 – 180	35 – 40	20 – 40
	Total hardness	0	60 – 180	155 – 250	60 – 250
	Calcium hardness	0	20 – 100	120 – 150	20 – 150
	Magnesium hardness	0	35 – 45	80 – 100	40 – 100
	Nitrite concentration	0	0.113 – 0.16	0.16	0.16 – 0.20
	Nitrate concentration	0	7 – 13	1.321 – 8.000	0.9 – 9.0
	Total coliform	0	7 – 12	8 – 10	3m- 10
	Faecal coliform	0	1 - 6	3 – 5	1 – 5

APPENDIX 24

Table 5: Snail abundance and range values of some physico-chemical properties of the lake studied.

Parameters	**Range values of Parameters**			
	Obutu lake		Iyiegwu lake	
Snail species	*Bulinus*	*Pila*	*Bulinus*	*Pila*
Snail catch	17	497	9	1108
pH	5.34-6.12	5.72-6.36	4.13-6.4	4.13-6.77
Turbidity	5.4-8.4	5.5-8.4	6.32-8.46	4.0-8.46
Conductivity	10-15	10-20	20-180	20-180
Dissolved solid	16.42-28.68	14.93-28.85	29.85	29.85-268.7
Suspended matter	15-150	10-200	30-35	20-40
Total hardness	70-120	60-200	70-250	65-250
Calcium hardness	30-70	20-115	20-150	20-150
Magnesium hardness	60-70	35-85	60-100	45-100
Nitrite concentration	0.111-1.113	0.111-0.16	0.16-0.18	0.16-0.20
Nitrate concentration	0.416-0.426	0.521-13.0	0.958-8.00	0.958-9
Total Coliform	7-8	6-15	6-10	3-10
Faecal Coliform	4-6	1-8	3-5	1-5

APPENDIX 25

		pH of Iyiegwu lake at 250C	Turbidity (NTU) of Iyiegwu lake	Conductivity of Iyiegwu lake	Abundance of Bulinus spp in Iyiegwu Lake	Abundance of Pila spp in Iyiegwu Lake
pH of Iyiegwu lake at 250C	Pearson Correlation	1	-.757**	-.951**	-.246	.121
	Sig. (2-tailed)		.004	.000	.442	.708
Turbidity (NTU) of Iyiegwu lake	Pearson Correlation		1	.665*	.609*	-.548
	Sig. (2-tailed)			.018	.036	.065
Conductivity of Iyiegwu lake	Pearson Correlation			1	.205	-.048
	Sig. (2-tailed)				.524	.882
Abundance of Bulinus spp in Iyiegwu Lake	Pearson Correlation				1	-.707*
	Sig. (2-tailed)					.010
Abundance of Pila spp in Iyiegwu Lake	Pearson Correlation					1
	Sig. (2-tailed)					

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Listwise N=12

Correlations[b]

		Total dissolved solute (mg/l) of Iyiegwu lake	Total suspended matter (mg/l) of Iyiegwu lake	Abundance of Bulinus spp in Iyiegwu Lake	Abundance of Pila spp in Iyiegwu Lake
Total dissolved solute (mg/l) of Iyiegwu lake	Pearson Correlation	1	.696*	-.002	.192
	Sig. (2-tailed)		.012	.996	.550
Total suspended matter (mg/l) of Iyiegwu lake	Pearson Correlation		1	.420	-.212
	Sig. (2-tailed)			.174	.508
Abundance of Bulinus spp in Iyiegwu Lake	Pearson Correlation			1	-.707*
	Sig. (2-tailed)				.010
Abundance of Pila spp in Iyiegwu Lake	Pearson Correlation				1
	Sig. (2-tailed)				

*. Correlation is significant at the 0.05 level (2-tailed).

b. Listwise N=12

Correlations[c]

		Total hardness (mg/l) of Iyiegwu lake	Calcium hardness (mg/l) of Iyiegwu lake	Magnesium hardness (mg/l) of Iyiegwu lake	Abundance of Bulinus spp in Iyiegwu Lake	Abundance of Pila spp in Iyiegwu Lake
Total hardness (mg/l) of Iyiegwu lake	Pearson Correlation	1	.965**	.818**	.423	-.269
	Sig. (2-tailed)		.000	.001	.170	.397
Calcium hardness (mg/l) of Iyiegwu lake	Pearson Correlation		1	.848**	.503	-.311
	Sig. (2-tailed)			.000	.096	.325
Magnesium hardness (mg/l) of Iyiegwu lake	Pearson Correlation			1	.773**	-.677*
	Sig. (2-tailed)				.003	.016
Abundance of Bulinus spp in Iyiegwu Lake	Pearson Correlation				1	-.707*
	Sig. (2-tailed)					.010
Abundance of Pila spp in Iyiegwu Lake	Pearson Correlation					1
	Sig. (2-tailed)					

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

c. Listwise N=12

Correlations[d]

		Nitrite concentration (PPM) of Iyiegwu lake	Nitrate concentration (PPM) of Iyiegwu lake	Abundance of Bulinus spp in Iyiegwu Lake	Abundance of Pila spp in Iyiegwu Lake
Nitrite concentration (PPM) of Iyiegwu lake	Pearson Correlation	1	-.380	-.625*	.696*
	Sig. (2-tailed)		.223	.030	.012
Nitrate concentration (PPM) of Iyiegwu lake	Pearson Correlation		1	.103	.154
	Sig. (2-tailed)			.750	.633
Abundance of Bulinus spp in Iyiegwu Lake	Pearson Correlation			1	-.707*
	Sig. (2-tailed)				.010
Abundance of Pila spp in Iyiegwu Lake	Pearson Correlation				1
	Sig. (2-tailed)				

*. Correlation is significant at the 0.05 level (2-tailed).

d. Listwise N=12

Correlations[e]

		Total coliform count (MPN / 100ml) of Iyiegwu lake	Faecal coliform count MPN/ 100ml of Iyiegwu lake	Abundance of Bulinus spp in Iyiegwu Lake	Abundance of Pila spp in Iyiegwu Lake
Total coliform count (MPN / 100ml) of Iyiegwu lake	Pearson Correlation	1	.708*	.790**	-.607*
	Sig. (2-tailed)		.010	.002	.036
Faecal coliform count MPN/ 100ml of Iyiegwu lake	Pearson Correlation		1	.200	-.108
	Sig. (2-tailed)			.533	.738
Abundance of Bulinus spp in Iyiegwu Lake	Pearson Correlation			1	-.707*
	Sig. (2-tailed)				.010
Abundance of Pila spp in Iyiegwu Lake	Pearson Correlation				1
	Sig. (2-tailed)				

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

e. Listwise N=12

CORRELATIONS (OBUTU)
/VARIABLES=pH Turbidity Conductivity TDS TSM TH CH MH Nitrite Nitrate TC FC Bulinus Pila

/PRINT=TWOTAIL NOSIG
/MISSING=LISTWISE.

Correlations[a]

		pH of Obutu lake at 250C	Turbidity (NTU) of Obutu lake	Conductivity of Obutu lake	Abundance of Bulinus spp in Obutu lake	Abundance of other snail species in Obutu lake
pH of Obutu lake at 250C	Pearson Correlation	1	-.790**	-.876**	-.047	.368
	Sig. (2-tailed)		.002	.000	.886	.239
Turbidity (NTU) of Obutu lake	Pearson Correlation		1	.757**	-.204	-.022
	Sig. (2-tailed)			.004	.524	.947
Conductivity of Obutu lake	Pearson Correlation			1	-.174	-.367
	Sig. (2-tailed)				.590	.241
Abundance of Bulinus spp in Obutu lake	Pearson Correlation				1	-.270
	Sig. (2-tailed)					.395
Abundance of other snail species in Obutu lake	Pearson Correlation					1
	Sig. (2-tailed)					

**. Correlation is significant at the 0.01 level (2-tailed).

a. Listwise N=12

Correlations[b]

		Total dissolved solute (mg/l) of Obutu lake	Total suspended matter (mg/l) of Obutu lake	Abundance of Bulinus spp in Obutu lake	Abundance of other snail species in Obutu lake
Total dissolved solute (mg/l) of Obutu lake	Pearson Correlation	1	.770**	-.066	-.070
	Sig. (2-tailed)		.003	.839	.829
Total suspended matter (mg/l) of Obutu lake	Pearson Correlation		1	.306	-.527
	Sig. (2-tailed)			.333	.078
Abundance of Bulinus spp in Obutu lake	Pearson Correlation			1	-.270
	Sig. (2-tailed)				.395
Abundance of other snail species in Obutu lake	Pearson Correlation				1
	Sig. (2-tailed)				

**. Correlation is significant at the 0.01 level (2-tailed).

b. Listwise N=12

Correlations[c]

		Total hardness (mg/l) of Obutu lake	Calcium hardness (mg/l) of Obutu lake	Magnesium hardness (mg/l) of Obutu lake	Abundance of Bulinus spp in Obutu lake	Abundance of other snail species in Obutu lake
Total hardness (mg/l) of Obutu lake	Pearson Correlation	1	.989**	.815**	-.164	-.036
	Sig. (2-tailed)		.000	.001	.611	.911
Calcium hardness (mg/l) of Obutu lake	Pearson Correlation		1	.861**	-.043	-.111
	Sig. (2-tailed)			.000	.895	.732
Magnesium hardness (mg/l) of Obutu lake	Pearson Correlation			1	.194	-.341
	Sig. (2-tailed)				.547	.278
Abundance of Bulinus spp in Obutu lake	Pearson Correlation				1	-.270
	Sig. (2-tailed)					.395
Abundance of other snail species in Obutu lake	Pearson Correlation					1
	Sig. (2-tailed)					

**. Correlation is significant at the 0.01 level (2-tailed).

c. Listwise N=12

Correlations[d]

		Nitrite concentration (PPM) of Obutu lake	Nitrate concentration (PPM) of Obutu lake	Abundance of Bulinus spp in Obutu lake	Abundance of other snail species in Obutu lake
Nitrite concentration (PPM) of Obutu lake	Pearson Correlation	1	.649*	-.271	.455
	Sig. (2-tailed)		.022	.395	.137
Nitrate concentration (PPM) of Obutu lake	Pearson Correlation		1	-.325	.713**
	Sig. (2-tailed)			.302	.009
Abundance of Bulinus spp in Obutu lake	Pearson Correlation			1	-.270
	Sig. (2-tailed)				.395
Abundance of other snail species in Obutu lake	Pearson Correlation				1
	Sig. (2-tailed)				

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

d. Listwise N=12

Correlations[e]

		Total coliform count (MPN / 100ml) of Obutu lake	Faecal coliform count MPN/ 100ml of Obutu lake	Abundance of Bulinus spp in Obutu lake	Abundance of other snail species in Obutu lake
Total coliform count (MPN / 100ml) of Obutu lake	Pearson Correlation	1	.773**	-.146	.030
	Sig. (2-tailed)		.003	.650	.926
Faecal coliform count MPN/ 100ml of Obutu lake	Pearson Correlation		1	.170	-.176
	Sig. (2-tailed)			.598	.584
Abundance of Bulinus spp in Obutu lake	Pearson Correlation			1	-.270
	Sig. (2-tailed)				.395
Abundance of other snail species in Obutu lake	Pearson Correlation				1
	Sig. (2-tailed)				

**. Correlation is significant at the 0.01 level (2-tailed).

a. Listwise N=12

APPENDIX 26

```
CROSSTABS
  /TABLES=Orumba BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Towns in the study area * prevalence of schistosomiasis Crosstabulation

Count

		prevalence of schistosomiasis		Total
		Yes	No	
Towns in the study area	Ndikelionwu	26	253	279
	Omogho	62	183	245
Total		88	436	524

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	23.860[a]	1	.000		
Continuity Correction[b]	22.730	1	.000		
Likelihood Ratio	24.248	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	23.815	1	.000		
N of Valid Cases	524				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 41.15.
b. Computed only for a 2x2 table

APPENDIX 27

OVERALL PREVALENCE BY GENDER

```
CROSSTABS
  /TABLES=Gender BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Sex of the study participants * prevalence of schistosomiasis Crosstabulation

Count

		prevalence of schistosomiasis		Total
		Yes	No	
Sex of the study participants	Male	59	232	291
	Female	29	204	233
Total		88	436	524

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.675[a]	1	.017		
Continuity Correction[b]	5.129	1	.024		
Likelihood Ratio	5.802	1	.016		
Fisher's Exact Test				.019	.011
Linear-by-Linear Association	5.664	1	.017		
N of Valid Cases	524				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 39.13.

b. Computed only for a 2x2 table

APPENDIX 28

Prevalence of urogenital schistosomiasis by age in the two communities studied.

Age groups (years)	No examined	No infected	Prevalence(%)	mean egg output
5-15	330	64	19.4	27.95
16-26	54	16	29.6	5.4
27-37	30	3	10.0	5.0
38-48	53	4	7.5	3.35
49-60	57	1	1.8	3.5
Total	524	88	16.8	17.75

(X^2=0.000; P<0.05).

COMPARING PREVALENCE BY AGE

```
CROSSTABS
  /TABLES=Age BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Age of the study participants * prevalence of schistosomiasis Crosstabulation

Count

		prevalence of schistosomiasis		Total
		Yes	No	
Age of the study participants	5 - 15 years	64	266	330
	16 - 26 years	16	38	54
	27 - 37 years	3	27	30
	38 - 48 years	4	49	53
	49 - 60 years	1	56	57
Total		88	436	524

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.424[a]	4	.000
Likelihood Ratio	26.117	4	.000
Linear-by-Linear Association	14.026	1	.000
N of Valid Cases	524		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.04.

APPENDIX 29

COMPARING INTENSITY IN NDIKELIONWU AND OMOGHO

```
ONEWAY Intensity BY Town
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

ANOVA

Intensity of urinary schistosomiasis infection in the study area

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	786.998	1	786.998	.293	.590
Within Groups	231345.445	86	2690.063		
Total	232132.443	87			

APPENDIX 30

Prevalence of urogenital schistosomiasis by occupation

Occupation	No examined	No infected	Percentage (%)
Farming	94	6	6.38
Trading	28	3	10.71
Teaching	13	1	7.69
Artisans	2	1	50
Apprentices	7	2	28.57
Commercial motorcyclist	11	-	-
Local Security	2	1	50
Total	157	14	8.92

(X^2= 4.592; P> 0.05)

CHI SQUARE FOR PREVALENCE BY OCCUPATION

OCCUPATION	INFECTED		NOT INFECTED		TOTAL
	OBSERVED VALUE	EXPECTED VALUE	OBSERVED VALUE	EXPECTED VALUE	
FARMING	6	8.38	88	85.62	94
TRADING	3	2.50	25	25.50	28
TEACHING	1	1.16	12	11.84	13
ARTISANS	1	0.18	1	1.82	2
APPRENTICES	2	0.62	5	6.38	7
COMMERCIAL MOTORCYCLIST	0	0.98	11	10.02	11
LOCAL SECURITY	1	0.18	1	1.82	2
TOTAL	14		143		157

df =(r-1)(c-1)

r=row; c=column

df= (7-1)(2-1)

= 6x1

=6

Calculated X^2= 13.55 =13.6

The critical value of X^2 with 6 degree of freedom is 12.592. since 12.592< 13.6, we reject the alternate hypothesis and conclude that the prevalence of urogenital schistosomiasis has no relationship with occupation of individuals in the study areas.

APPENDIX 31

Prevalence of urogenital schistosomiasis among the five villages in Ndikelionwu community.

Villages	No examined	No infected	Percentage(%)	mean egg output
Ndinwedo	59	15	25.4	12.5
Umudim	67	-	-	-
Umochu	56	1	1.79	34.0
Aronota	70	-	-	-
Okpunoifite	27	10	37	1.7
Total	279	26	9.3	14.5

($X^2 = 0.000$; $P<0.05$)

VILLAGES IN NDIKELIONWU

```
CROSSTABS
  /TABLES=Villages BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Comparing prevalence in the two communities

Villages in Ndikelionwu * prevalence of schistosomiasisin Ndikelionwu Crosstabulation

Count

		prevalence of schistosomiasisin Ndikelionwu		Total
		Yes	No	
Villages in Ndikelionwu	Ndinwedo	15	44	59
	Umudim	0	67	67
	Umuochu	1	55	56
	Aronota	0	70	70
	Okpunoifite	10	17	27
Total		26	253	279

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	60.495[a]	4	.000
Likelihood Ratio	60.374	4	.000
Linear-by-Linear Association	.470	1	.493
N of Valid Cases	279		

a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 2.52.

APPENDIX 32

Prevalence of urogenital schistosomiasis in Omogho community

Villages	No examined	No infected	Percentage(%)	mean egg output
Umunaba	101	26	25.7	11.96
Kolilu	69	13	18.8	12.85
Iwollo	75	23	30.7	35.9
Total	245	62	25.3	19.6

(X^2 = 0.262; P>0.05)

VILLAGES IN OMOGHO

```
CROSSTABS
  /TABLES=Villages BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Villages in Omogho * prevalence of schistosomiasisin Omogho Crosstabulation

Count

		prevalence of schistosomiasisin Omogho		Total
		Yes	No	
Villages in Omogho	Umunaba	26	75	101
	Kolilu	13	56	69
	Iwollo	23	52	75
Total		62	183	245

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.676[a]	2	.262
Likelihood Ratio	2.730	2	.255
Linear-by-Linear Association	.390	1	.532
N of Valid Cases	245		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 17.46.

AGE OF THE STUDY PARTICIPANTS IN NDIKELIONWU

```
CROSSTABS
  /TABLES=Age BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Age of the study participants in Ndikelionwu * prevalence of schistosomiasisin Ndikelionwu Crosstabulation

Count

		prevalence of schistosomiasisin Ndikelionwu		Total
		Yes	No	
Age of the study participants in Ndikelionwu	5 - 15 years	17	156	173
	16 - 26 years	5	20	25
	27 - 37 years	1	12	13
	38 - 48 years	3	25	28
	49 - 60 years	0	40	40
Total		26	253	279

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.644[a]	4	.106
Likelihood Ratio	10.606	4	.031
Linear-by-Linear Association	2.369	1	.124
N of Valid Cases	279		

a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is 1.21.

AGE OF THE STUDY PARTICIPANTS IN OMOGHO

```
CROSSTABS
  /TABLES=Age BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Age of the study participants in Omogho * prevalence of schistosomiasisin Omogho Crosstabulation

Count

		prevalence of schistosomiasisin Omogho		Total
		Yes	No	
Age of the study participants in Omogho	5 - 15 years	47	110	157
	16 - 26 years	11	18	29
	27 - 37 years	2	15	17
	38 - 48 years	1	24	25
	49 - 60 years	1	16	17
Total		62	183	245

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.272[a]	4	.004
Likelihood Ratio	18.723	4	.001
Linear-by-Linear Association	11.367	1	.001
N of Valid Cases	245		

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 4.30.

Gender in Omogho

```
CROSSTABS
  /TABLES=Gender BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Sex of the study participants in Omogho * prevalence of schistosomiasisin Omogho Crosstabulation

Count

		prevalence of schistosomiasisin Omogho		Total
		Yes	No	
Sex of the study participants in Omogho	Male	38	101	139
	Female	24	82	106
Total		62	183	245

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.702[a]	1	.402		
Continuity Correction[b]	.475	1	.491		
Likelihood Ratio	.707	1	.401		
Fisher's Exact Test				.459	.246
Linear-by-Linear Association	.699	1	.403		
N of Valid Cases	245				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 26.82.

b. Computed only for a 2x2 table

Gender in Ndikelionwu

```
CROSSTABS
  /TABLES=Gender BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Sex of the study participants in Ndikelionwu * prevalence of schistosomiasisin Ndikelionwu Crosstabulation

Count

		prevalence of schistosomiasisin Ndikelionwu		Total
		Yes	No	
Sex of the study participants in Ndikelionwu	Male	21	131	152
	Female	5	88	93
Total		26	219	245

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.332[a]	1	.037		
Continuity Correction[b]	3.488	1	.062		
Likelihood Ratio	4.736	1	.030		
Fisher's Exact Test				.053	.027
Linear-by-Linear Association	4.314	1	.038		
N of Valid Cases	245				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.87.

b. Computed only for a 2x2 table

Villages in Omogho

```
CROSSTABS
  /TABLES=Villages BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

[DataSet0] C:\Users\Chukwudi\Documents\Ezeagwuna Dorothy.sav

Villages in Omogho * prevalence of schistosomiasisin Omogho Crosstabulation

Count

		prevalence of schistosomiasisin Omogho		Total
		Yes	No	
Villages in Omogho	Umunaba	26	75	101
	Kolulu	13	56	69
	Iwollo	23	52	75
Total		62	183	245

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.676[a]	2	.262
Likelihood Ratio	2.730	2	.255
Linear-by-Linear Association	.390	1	.532
N of Valid Cases	245		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 17.46.

Comparing prevalence in the two communities

```
CROSSTABS
  /TABLES=Orumba BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Towns in the study area * prevalence of schistosomiasis Crosstabulation

Count

		prevalence of schistosomiasis		Total
		Yes	No	
Towns in the study area	Ndikelionwu	26	253	279
	Omogho	62	183	245
Total		88	436	524

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	23.860[a]	1	.000		
Continuity Correction[b]	22.730	1	.000		
Likelihood Ratio	24.248	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	23.815	1	.000		
N of Valid Cases	524				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 41.15.

b. Computed only for a 2x2 table

Overall prevalence by gender

```
CROSSTABS
  /TABLES=Gender BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Sex of the study participants * prevalence of schistosomiasis Crosstabulation

Count

		prevalence of schistosomiasis		Total
		Yes	No	
Sex of the study participants	Male	59	232	291
	Female	29	204	233
Total		88	436	524

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.675[a]	1	.017		
Continuity Correction[b]	5.129	1	.024		
Likelihood Ratio	5.802	1	.016		
Fisher's Exact Test				.019	.011
Linear-by-Linear Association	5.664	1	.017		
N of Valid Cases	524				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 39.13.

b. Computed only for a 2x2 table

Comparing prevalence by age

```
CROSSTABS
  /TABLES=Age BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Age of the study participants * prevalence of schistosomiasis Crosstabulation

Count

		prevalence of schistosomiasis		Total
		Yes	No	
Age of the study participants	5 - 15 years	64	266	330
	16 - 26 years	16	38	54
	27 - 37 years	3	27	30
	38 - 48 years	4	49	53
	49 - 60 years	1	56	57
Total		88	436	524

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.424[a]	4	.000
Likelihood Ratio	26.117	4	.000
Linear-by-Linear Association	14.026	1	.000
N of Valid Cases	524		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.04.

AGE OF THE STUDY PARTICIPANTS IN NDIKELIONWU

```
CROSSTABS
  /TABLES=Age BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Age of the study participants in Ndikelionwu * prevalence of schistosomiasisin Ndikelionwu Crosstabulation

Count

		prevalence of schistosomiasisin Ndikelionwu		Total
		Yes	No	
Age of the study participants in Ndikelionwu	5 - 15 years	17	156	173
	16 - 26 years	5	20	25
	27 - 37 years	1	12	13
	38 - 48 years	3	25	28
	49 - 60 years	0	40	40
Total		26	253	279

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.644[a]	4	.106
Likelihood Ratio	10.606	4	.031
Linear-by-Linear Association	2.369	1	.124
N of Valid Cases	279		

a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is 1.21.

AGE OF THE STUDY PARTICIPANTS IN OMOGHO

```
CROSSTABS
  /TABLES=Age BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Age of the study participants in Omogho * prevalence of schistosomiasisin Omogho Crosstabulation

Count

		prevalence of schistosomiasisin Omogho		Total
		Yes	No	
Age of the study participants in Omogho	5 - 15 years	47	110	157
	16 - 26 years	11	18	29
	27 - 37 years	2	15	17
	38 - 48 years	1	24	25
	49 - 60 years	1	16	17
Total		62	183	245

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.272[a]	4	.004
Likelihood Ratio	18.723	4	.001
Linear-by-Linear Association	11.367	1	.001
N of Valid Cases	245		

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 4.30.

Gender in Omogho

```
CROSSTABS
  /TABLES=Gender BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Sex of the study participants in Omogho * prevalence of schistosomiasisin Omogho Crosstabulation

Count

		prevalence of schistosomiasisin Omogho		Total
		Yes	No	
Sex of the study participants in Omogho	Male	38	101	139
	Female	24	82	106
Total		62	183	245

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.702[a]	1	.402		
Continuity Correction[b]	.475	1	.491		
Likelihood Ratio	.707	1	.401		
Fisher's Exact Test				.459	.246
Linear-by-Linear Association	.699	1	.403		
N of Valid Cases	245				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 26.82.

b. Computed only for a 2x2 table

Gender in Ndikelionwu

```
CROSSTABS
  /TABLES=Gender BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Sex of the study participants in Ndikelionwu * prevalence of schistosomiasisin Ndikelionwu Crosstabulation

Count

		prevalence of schistosomiasisin Ndikelionwu		Total
		Yes	No	
Sex of the study participants in Ndikelionwu	Male	21	131	152
	Female	5	88	93
Total		26	219	245

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.332[a]	1	.037		
Continuity Correction[b]	3.488	1	.062		
Likelihood Ratio	4.736	1	.030		
Fisher's Exact Test				.053	.027
Linear-by-Linear Association	4.314	1	.038		
N of Valid Cases	245				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.87.

b. Computed only for a 2x2 table

Villages in Ndikelionwu

```
CROSSTABS
  /TABLES=Villages BY Schistosomiasis
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Villages in Ndikelionwu * prevalence of schistosomiasisin Ndikelionwu Crosstabulation

Count

		prevalence of schistosomiasisin Ndikelionwu		Total
		Yes	No	
Villages in Ndikelionwu	Ndinwedo	15	44	59
	Umudim	0	67	67
	Umuochu	1	55	56
	Aronota	0	70	70
	Okpunoifite	10	17	27
Total		26	253	279

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	60.495[a]	4	.000
Likelihood Ratio	60.374	4	.000
Linear-by-Linear Association	.470	1	.493
N of Valid Cases	279		

a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 2.52.

Comparing intensity in ndikelionwu and omogho

```
ONEWAY Intensity BY Town
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

ANOVA

Intensity of urinary schistosomiasis infection in the study area

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	786.998	1	786.998	.293	.590
Within Groups	231345.445	86	2690.063		
Total	232132.443	87			

NPAR TESTS

/COCHRAN=Proteinuria Haematuria Microscopy
/STATISTICS DESCRIPTIVES
/MISSING LISTWISE.

Cochran Test

Frequencies

	Value	
	1	2
Prevalence of proteinuria	111	412
Prevalence of haematuria	79	444
Prevalence of schistosoma eggs in urine sample	88	435

Test Statistics

N	523
Cochran's Q	23.014[a]
Df	2
Asymp. Sig.	.000

a. 2 is treated as a success.

NPAR TESTS

/MCNEMAR=Proteinuria Proteinuria Haematuria WITH Haematuria Microscopy Microscopy (PAIRED)
/STATISTICS DESCRIPTIVES QUARTILES
/MISSING ANALYSIS.

McNemar Test

Prevalence of proteinuria & Prevalence of haematuria

Prevalence of proteinuria	Prevalence of haematuria	
	Positive	Negative
Positive	65	46
Negative	14	398

Prevalence of proteinuria & Prevalence of schistosoma eggs in urine sample

Prevalence of proteinuria	Prevalence of schistosoma eggs in urine sample	
	Positive	Negative
Positive	72	39
Negative	16	396

Prevalence of haematuria & Prevalence of schistosoma eggs in urine sample

Prevalence of haematuria	Prevalence of schistosoma eggs in urine sample	
	Positive	Negative
Positive	70	9
Negative	18	426

Test Statistics[a]

	Prevalence of proteinuria & Prevalence of haematuria	Prevalence of proteinuria & Prevalence of schistosoma eggs in urine sample	Prevalence of haematuria & Prevalence of schistosoma eggs in urine sample
N	523	523	523
Chi-Square[b]	16.017	8.800	2.370
Asymp. Sig.	.000	.003	.124

a. McNemar Test

b. Continuity Corrected

CORRELATIONS (IYIEGWU LAKE)
/VARIABLES=pH Turbidity Conductivity TDS TSM TH CH MH Nitrite Nitrate TC FC Bulinus Pila
/PRINT=TWOTAIL NOSIG
/MISSING=LISTWISE.

Correlations[a]

How to convert among different water hardness measures:

Water with hardness of 25 ppm = 25 mg. of hardness-causing minerals per liter of water.

Table of Degrees of Water Hardness	
Soft water	0-17.1 mg/L of minerals
Slightly hard water	16.1-60 mg/L of minerals
Moderately hard water	61-120 mg/L of minerals
Hard water	121-180 mg/L of minerals
Very hard water	more than 180 mg/L of minerals
- adapted from web search Wikipedia 01/31/2011	

Calculation of freshwater snail diversity at Iyiegwu

Snail species	Number of snails at Iyiegwu (n)	n(n-1)
Bulinus species	9	72
Pila species	879	771762
Total (N)	888	787656

Simpson's index $D = \frac{£\, n(n-1)}{N(N-1)}$

$$D = \frac{771834}{787656}$$

D = 0.98

1 – D (Simpson's Index of diversity) = 0.02

$\frac{1}{D}$ (Simpson's reciprocal index) = 1.02

Calculation of freshwater snail diversity at Obutu

Snail species	Number of snails at Obutu (n)	n(n-1)
Bulinus species	16	240
Pila species	497	246512
Total (N)	513	262656

Simpson's index $D = \frac{£\, n(n-1)}{N(N-1)}$

$$D = \frac{246752}{262656}$$

D = 0.94

1 – D (Simpson's Index of diversity) = 0.06

$\frac{1}{D}$ (Simpson's reciprocal index) = 1.06

INTERPRETATIONS

Table 1 Reliability Statistics

Cronbach's Alpha	N of Items
.865	30

Reliability coefficient of 0.865 shows that the instruments used is good.

Similarly, the validity of the instruments was tested using construct validity and shown in Table 2.

Table 2 Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
1.You swim or go inside the river doing domestic chores.	.747	.005	.010	-.086	.246	.356	.277
2. You wear foot wear while working with your parents in the farm.	.506	-.002	.029	.143	-.008	.622	.324
3.You eat snails in your house.	.811	.007	.009	-.008	.179	.243	.267
4. I know about schistosomiasis.	.168	-.075	.016	.260	.065	-.050	.704
5. I can recognise the disease by blood in the urine.	.158	-.028	.005	.083	.221	.155	.673
6. I can recognise the disease by itching in the body.	.156	-.018	-.005	.889	.217	.104	.211
7. I can recognise the disease by abnominal pain.	.100	-.028	-.029	.222	.874	.190	.215
8. I can recognise the disease by blood in stool.	.178	.002	-.010	.828	.305	.102	.233
9. I can recognise the disease by swollen stomach.	.174	-.012	.002	.329	.820	.082	.225
10. I can recognise the disease by vomiting.	.153	-.019	-.003	.891	.218	.097	.200
11. I can recognise the disease by fatigue.	.091	-.030	-.014	.224	.884	.179	.207
12. Schistosomiasis is caused by contact with infested water.	-.118	.024	-.051	.691	.262	-.039	-.262

13. Schistosomiasis is caused by eating of snails.	-.067	.030	.009	.281	.699	-.100	-.301
14. Schistosomiasis is caused by poison.	.770	.036	.034	.039	.098	.132	.209
15. The local name for schistosomiasis is "Amili Obara".	.359	.004	.010	.020	.127	.727	.337
16. The local name for schistosomiasis is "Oya Nwamili".	.822	.019	.017	.170	-.028	.079	.161
17. The local name for schistosomiasis is "Oya Mmiri".	.299	-.015	-.021	-.010	.162	.794	.249
18. I do not know the local name for scistosomiasis.	.779	-.011	.057	.064	.066	.208	.260
19. You see blood in your urine.	.050	.068	.951	-.038	-.009	.010	.006
20. You notice itching in your body.	-.011	.956	.068	-.004	-.006	.003	-.029
21. You notice regular fever.	.014	.033	.914	-.033	.017	-.018	.028
22. You were diagonised of a disease called schistosomiasis.	-.011	.899	.030	.007	-.019	.023	-.032
23. You had treatment of schistosomiasis disease by a medical doctor.	.050	.053	.883	.007	-.025	-.004	-.016
24. You treat schistosomiasis with local herbs.	.014	.890	.054	-.006	.018	-.001	-.020
25. You treat schistosomiasis with mixed drugs.	.018	.056	.913	.012	-.011	-.012	.007
26. You treat schistosomiasis prayer.	.006	.964	.060	-.011	-.027	.002	-.016
27. I feel uncomfortable when I see blood in my urine.	.662	-.028	.033	.047	.010	.180	-.231
28. Seeing blood in my urine is a problem.	.223	.020	-.032	.117	.031	.701	-.131
29. The presence of blood in urine is curable.	.668	-.032	.018	.116	-.097	.040	-.287
30. The presence of urine in blood is preventable.	.060	.017	.001	.037	.055	.797	-.145

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

According to Meredith (1969), 0.35 item factor loading is the benchmark for acceptance for the instruments used. All the question items were accepted.

The frequencies for the responses on practice is shown in Table 3

Table 3 Responses on Practice

Question item	SA	A	UD	D	SD	TOTAL
1. You swim or go inside the river doing domestic chores.	392 (74.8%)	35 (6.7%)	50 (9.5%)	30 (5.7%)	17 (3.2%)	524 (100%)
2. You wear foot wear while working with your parents in the farm.	392 (74.8%)	48 (9.2%)	36 (6.9%)	31 (5.9%)	17 (3.2%)	524 (100%)
3. You eat snails in your house.	374 (71.4%)	45 (8.6%)	58 (11.1%)	30 (5.7%)	17 (3.2%)	524 (100%)

Most respondents practice the question items enumerated in Table 3.

To find out if there are significant differences in mean responses by practice, knowledge and attitude of the people towards urinary schistosomiases, we shall propose hypotheses as follows:

Our null hypothesis (H_0) shall be

H_o : There are no significant differences in the mean responses on the attributes versus the alternative

H_1: There is at least one difference on the mean responses on the attributes.

Our decision rule is to reject the null hypothesis if F-calculated is greater than F-Tabulated, otherwise we shall accept. Or we reject the null hypothesis if p-value is less than 0.05, otherwise we accept.

If the null hypothesis is rejected, we shall conduct a multiple comparison test to separate the significant means from the non-significant ones.

The mean responses are shown in Table 4.

Table 4

Case Summaries (Practice by villages)

Villages		1. You swim or go inside the river doing domestic chores.	2. You wear foot wear while working with your parents in the farm.	3.You eat snails in your house.
Ndinwedo	N	59	59	59
	Mean	4.5085	4.5085	4.3051
	Std. Deviation	1.05655	1.05655	1.13341
Umugim	N	67	67	67
	Mean	4.5224	4.5075	4.3731
	Std. Deviation	1.04965	1.07834	1.11241
Umuochu	N	56	56	56
	Mean	4.5000	4.4821	4.3571
	Std. Deviation	.99087	1.07857	1.05190
Aronota	N	70	70	70
	Mean	4.5429	4.5000	4.4286
	Std. Deviation	1.03119	1.10007	1.08443
Okpunoifite	N	27	27	27
	Mean	4.5926	4.4444	4.4444
	Std. Deviation	1.00992	1.15470	1.08604
Umunaba	N	101	101	101
	Mean	4.3366	4.3960	4.3564
	Std. Deviation	1.13382	1.04956	1.10981
Kolilu	N	69	69	69
	Mean	4.3913	4.4638	4.4928
	Std. Deviation	1.10103	1.00849	1.03786

Isiamaenyi	N	75	75	75
	Mean	4.3067	4.4400	4.4000
	Std. Deviation	1.19654	1.09347	1.15079
Total	N	524	524	524
	Mean	4.4408	4.4637	4.3912
	Std. Deviation	1.08277	1.06420	1.09300

The analysis of variance Table is shown in Table 5

ONEWAY Responses BY Villages by practice

/MISSING ANALYSIS.

Oneway

[DataSet0]

Table 5

ANOVA (Practice by villages)

Mean responses

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.047	7	.007	1.170	.372
Within Groups	.091	16	.006		
Total	.138	23			

The mean responses among the villages by practice is not significant since the p-value of 0.372 is greater than 0.05.

The frequencies for the responses on assessment of knowledge is shown in Table 6

Table 6 Responses on assessment of knowledge

Question item	SA	A	UD	D	SD	TOTAL
4. I know about schistosomiasis	395 (75.4%)	48 (9.2%)	33 (6.3%)	31 (5.9%)	17 (3.2%)	524 (100%)
5. I can recognize the disease by blood in urine	399 (76.1%)	45 (8.6%)	34 (6.5%)	30 (5.7%)	16 (3.1)	524 (100%)
6. I can recognize the disease by itching in the body	356 (67.9%)	47 (9.0%)	73 (13.9%)	31 (5.9%)	17 (3.2%)	524 (100%)
7. I can recognize the disease by abdominal pain	359 (68.5%)	44 (8.4%)	74 (14.1%)	30 (5.7%)	17 (3.2%)	524 (100%)
8. I can recognize the disease	377	61	38	31	17	524

by blood in stool	(71.9%)	(11.6%)	(7.3%)	(5.9%)	(3.2%)	(100%)
9. I can recognize the disease by swollen stomach	380 (72.5%)	58 (11.1%)	39 (5.7%)	30 (5.7%)	17 (3.2%)	524 (100%)
10. I can recognize the disease by vomiting	359 (68.5%)	44 (8.4%)	73 (13.9%)	31 (5.9%)	17 (3.2%)	524 (100%)
1 1. I can recognize the disease by fatigue	359 (68.5%)	44 (8.4%)	74 (14.1%)	30 (5.7%)	17 (3.2%)	524 (100%)
12. Schistosomiasis is caused by contact with infested water	396 (75.6%)	44 (8.8%)	34 (6.5%)	32 (6.1%)	16 (3.1%)	524 (100%)
13. Schistosomiasis is caused by eating of snails	396 (75.6%)	46 (8.8%)	34 (6.5%)	31 (5.9%)	17 (3.2%)	524 (100%)
14. The local name for schistosomiasis is "Amilli Obara"	395 (75.4%)	34 (6.5%)	31 (5.9%)	46 (8.8%)	18 (3.4%)	524 (100%)
15. The local name for schistosomiasis is "Oya Nwamili"	345 (68.8%)	36 (6.9%)	75 (14.3%)	52 (9.9%)	16 (3.1%)	524 (100%)
16. The local name for schistosomiasis is "Amilli Mmiri"	356 (67.9%)	34 (6.5%)	68 (13.0%)	48 (9.2%)	18 (3.4%)	524 (100%)
17. I do not know the local name for schistosomiasis.	362 (69.1%)	60 (11.5%)	42 (8.0%)	44 (8.4%)	16 (3.1%)	524 (100%)
18. You see blood in your urine.	58 (11.1%)	2 (0.4%)	135 (25.8%)	79 (15.1%)	250 (47.7%)	524 (100%)
19. You notice itching in your body.	81 (15.5%)	3 (0.6%)	172 (32.8%)	115 (21.1%)	153 (29.2%)	524 (100%)
20. You notice regular fever.	66 (12.6%)	3 (0.6%)	133 (25.4%)	77 (14.7%)	245 (46.8%)	524 (100%)
21. You were diagnosed of schistosomiasis.	78 (14.9%)	2 (0.4%)	173 (33.3%)	117 (22.3%)	154 (29.4%)	524 (100%)
22. You had treatment of schistosomiasis disease by a medical doctor.	63 (12.0%)	3 (0.6%)	141 (26.9%)	76 (14.5%)	241 (46.0%)	524 (100%)
23. You treat schistosomiasis with local herbs	75 (14.3%)	2 (0.4%)	169 (32.3%)	110 (21.0%)	168 (32.1%)	524 (100%)
24. You treat schistosomiasis with mixed drugs.	57 (10.9%)	2 (0.4%)	141 (26.9%)	82 (15.6%)	24 (46.2%)	524 (100%)
25. You treat schistosomiasis with prayer.	79 (15.1%)	2 (0.4%)	165 (31.5%)	110 (21.0%)	168 (32.1%)	524 (100%)

Majority of the villagers have knowledge of the disease but very few were affected by the disease.

The analysis of variance is shown Table 7

Table 7 **Tests of Between-Subjects Effects**

Dependent Variable: Observation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.449[a]	7	.207	.193	.987
Intercept	2469.085	1	2469.085	2297.529	.000
Villages	1.449	7	.207	.193	.987
Error	189.142	176	1.075		
Total	2659.676	184			
Corrected Total	190.591	183			

The responses on the assessment of knowledge is the same since the p-value is greater than 0.05.

The frequencies for the responses on assessment of attitude is shown in Table 9

Table 9

Responses on attitude

Question item	SA	A	UD	D	SD	TOTAL
12. I feel uncomfortable when I see blood in my urine.	374 (71.4%)	82 (15.6%)	45 (8.6%)	21 (4.0%)	2 (0.4%)	524 (100%)
13. Seeing blood in my urine is a problem.	391 (74.6%)	80 (15.3%)	34 (6.5%)	19 (3.6%)	- ()0.0%	524 (100%)
14. The presence of blood in urine is curable.	348 (66.4%)	76 (14.5%)	85 (16.2%)	14 (2.7%)	1 (0.2%)	524 (100%)
15. The presence of urine in blood is preventable.	349 (66.6%)	77 (14.7%)	73 (13.9%)	25 (4.8%)	- (0.0%)	524 (100%)

The analysis of variance Table is shown in Table 10

Oneway (By attitude)

Table 11

ANOVA (By attitude)

Mean responses

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.222	7	.032	2.613	.037
Within Groups	.291	24	.012		
Total	.513	31			

From the ANOVA Table 11, the mean responses among the villagers by the attitude showed a significant effect.

The summary of the multiple comparison tests is shown in Table 12.

Table 12

Summary of multiple comparison tests

Compared villages	Mean difference	Leader	Rank
Ndinwedo vs Isiamaenyi	0.22932	Ndinwedo	5
Umugim vs Isiamaenyi	0.26328	Umugim	1
Umuochu vs Isiamaenyi	0.23695	Umuochu	3
Aronota vs Isiamaenyi	0.23072	Aronota	4
Okpunoifite vs Isiamaenyi	0.25333	Okponoifite	2
Kolilu vs Isiamaenyi	0.16275	Kolilu	6
Isiamaenyi vs Ndinwedo	-0.22932		
,, ,, Umugim	-0.26328		
,, ,, Umuochu	-0.23695		
,, ,, Aronota	-0.23072		
,, ,, Okpunoifite	-0.25333		
,, ,, Kolilu	-0.16275	Kolilu	6

The attitude towards the disease is mostly in Umugim followed by Okponoifite and next is Umuochu. The least is Kolilu village.

DEMOGRAPHIC ASSESSMENT

(a) Life style by age

Tests of Between-Subjects Effects

Dependent Variable: Observation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.146[a]	4	.036	8.590	.003
Intercept	295.814	1	295.814	69647.482	.000
Age	.146	4	.036	8.590	.003
Error	.042	10	.004		
Total	296.003	15			
Corrected Total	.188	14			

a. R Squared = .775 (Adjusted R Squared = .684)

The effect on age is significant since the p-value of 0.003 is less than 0.05. the summary of the multiple comparison is shown below.

Compared age	Mean difference	Leader	Rank
5-10yrs vs 21-30yrs ,, ,, > 40yrs	-0.1957 -0.2722	21-30yrs	1
11-20yrs vs > 40yrs	-0.1539	> 40yrs	2
21-30yrs vs 31-40yrs	0.1502	21-30yrs	3
31-40yrs vs 21-30yrs ,, vs > 40yrs	-0.1502 -0.2267	21-30yrs	3
> 40yrs vs 5-10yrs ,, vs 11-20yrs	0.2722 0.1539	> 40yrs	2

The age of 21-30yrs leads, followed by > 40yrs.

(b) Life style by occupation

Tests of Between-Subjects Effects

Dependent Variable: Observation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.013[a]	3	.004	.524	.678
Intercept	234.756	1	234.756	29367.521	.000
Occupation	.013	3	.004	.524	.678
Error	.064	8	.008		
Total	234.833	12			
Corrected Total	.077	11			

a. R Squared = .164 (Adjusted R Squared = -.149)

The responses by occupation is not significant.

(c) Life style by education

Tests of Between-Subjects Effects

Dependent Variable: Observation

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	.219[a]	2	.109	9.312	.014
Intercept	185.491	1	185.491	15799.169	.000
Education	.219	2	.109	9.312	.014
Error	.070	6	.012		
Total	185.780	9			
Corrected Total	.289	8			

a. R Squared = .756 (Adjusted R Squared = .675)

The response on education is significant since the p-value of 0.014 is less than 0.05. The summary of the multiple comparison is shown below.

Compared education	Mean difference	Leader	Rank
Primary vs Tertiary	-0.3471	Tertiary	1
Secondary vs tertiary	-0.3110	Tertiary	2
Tertiary vs Primary ,, vs Secondary	0.3473 0.3110	Tertiary	2

Tertiary education leads.

ASSESSMENT OF KNOWLEDGE.

(a) Assessment by age

Tests of Between-Subjects Effects

Dependent Variable: Observation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.587[a]	4	.147	.145	.965
Intercept	1452.712	1	1452.712	1438.479	.000
Age	.587	4	.147	.145	.965
Error	106.039	105	1.010		
Total	1559.217	110			
Corrected Total	106.626	109			

a. R Squared = .006 (Adjusted R Squared = -.032)

The responses by age is non-significant since the p-value of 0.965 is greater than 0.05.

(b) Assessment by occupation

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.093[a]	3	.031	.030	.993
Intercept	1167.572	1	1167.572	1121.777	.000
Occupation	.093	3	.031	.030	.993
Error	87.429	84	1.041		
Total	1255.095	88			
Corrected Total	87.523	87			

a. R Squared = .001 (Adjusted R Squared = -.035)

The responses by occupation is non-significant.

(c) Assessment by education

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.279[a]	2	.139	.131	.877
Intercept	888.219	1	888.219	837.293	.000
Education	.279	2	.139	.131	.877
Error	66.832	63	1.061		
Total	955.330	66			
Corrected Total	67.110	65			

a. R Squared = .004 (Adjusted R Squared = -.027)

The responses by education is non-significant.

ATITUDE

(a) Attitude by age

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.146[a]	4	.036	8.590	.003
Intercept	295.814	1	295.814	69647.482	.000
Age	.146	4	.036	8.590	.003
Error	.042	10	.004		
Total	296.003	15			
Corrected Total	.188	14			

The responses by age is significant. The summary of the multiple comparison is shown below.

Compared age	Mean difference	Leader	Rank
5-10yrs vs 21-30yrs ,, ,, > 40yrs	-0.1957 -0.2722	21-30yrs	1
11-20yrs vs > 40yrs	-0.1539	> 40yrs	2
21-30yrs vs 5-10yrs ,, ,, 31-40yrs	0.1957 0.1502	21-30yrs	3
31-40yrs vs 21-30yrs ,, vs > 40yrs	-0.1502 -0.2267	21-30yrs	3
> 40yrs vs 5-10yrs ,, vs 11-20yrs ,, vs 31-40yrs	0.2722 0.1539 0.2267	> 40yrs	2

The age of 21-30yrs leads, followed by > 40yrs.

(b) Attitude by occupation

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.013[a]	3	.004	.524	.678
Intercept	234.756	1	234.756	29367.521	.000
Occupation	.013	3	.004	.524	.678

Error	.064	8	.008		
Total	234.833	12			
Corrected Total	.077	11			

a. R Squared = .164 (Adjusted R Squared = -.149)

The responses by occupation is non-significant.

(c) Attitude by education

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.219[a]	2	.109	9.312	.014
Intercept	185.491	1	185.491	15799.169	.000
Education	.219	2	.109	9.312	.014
Error	.070	6	.012		
Total	185.780	9			
Corrected Total	.289	8			

a. R Squared = .756 (Adjusted R Squared = .675)

The responses by education is significant. The summary of the multiple comparison is shown below.

Compared education	Mean difference	Leader	Rank
Primary vs Tertiary	-0.3473	Tertiary	1
Secondary vs tertiary	-0.3110	Tertiary	2
Tertiary vs Primary	0.3473	Tertiary	1

Tertiary education is most significant.

APPENDIX

```
RELIABILITY
  /VARIABLES=Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17
Q18 Q19 Q20 Q21 Q22 Q23 Q24
    Q25 Q26 Q27 Q28 Q29 Q30
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE.
```

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	524	100.0
	Excluded[a]	0	.0
	Total	524	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.865	30

Item Statistics

	Mean	Std. Deviation	N
1.You swim or go inside the river doing domestic chores.	4.4408	1.08277	524
2. You wear foot wear while working with your parents in the farm.	4.4637	1.06420	524
3.You eat snails in your house.	4.3912	1.09300	524
4. I know about schistosomiasis.	4.4752	1.05913	524
5. I can recognise the disease by blood in the urine.	4.4905	1.04484	524

6. I can recognise the disease by itching in the body.	4.3244	1.11555	524
7. I can recognise the disease by abnominal pain.	4.3321	1.11330	524
8. I can recognise the disease by blood in stool.	4.4313	1.06619	524
9. I can recognise the disease by swollen stomach.	4.4389	1.06306	524
10. I can recognise the disease by vomiting.	4.3302	1.11644	524
11. I can recognise the disease by fatigue.	4.3321	1.11330	524
12. Schistosomiasis is caused by contact with infested water.	4.4771	1.05556	524
13. Schistosomiasis is caused by eating of snails.	4.4752	1.06093	524
14. Schistosomiasis is caused by poison.	4.3340	1.18512	524
15. The local name for schistosomiasis is "Amili Obara".	4.4160	1.14135	524
16. The local name for schistosomiasis is "Oya Nwamili".	4.2252	1.19386	524
17. The local name for schistosomiasis is "Oya Mmiri".	4.2634	1.19083	524
18. I do not know the local name for scistosomiasis.	4.3511	1.12285	524
19. You see blood in your urine.	2.1202	1.31721	524
20. You notice itching in your body.	2.5115	1.33273	524
21. You notice regular fever.	2.1756	1.36036	524

22. You were diagonised of a disease called schistosomiasis.	2.4905	1.31977	524
23. You had treatment of schistosomiasis disease by a medical doctor.	2.1813	1.34333	524
24. You treat schistosomiasis with local herbs.	2.4389	1.32562	524
25. You treat schistosomiasis with mixed drugs.	2.1412	1.30710	524
26. You treat schistosomiasis prayer.	2.4542	1.34342	524
27. I feel uncomfortable when I see blood in my urine.	4.5363	.84146	524
28. Seeing blood in my urine is a problem.	4.6088	.76591	524
29. The presence of blood in urine is curable.	4.4427	.86937	524
30. The presence of urine in blood is preventable.	4.4313	.90095	524

Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
1.You swim or go inside the river doing domestic chores.	.747	.005	.010	-.086	.246	.356	.277
2. You wear foot wear while working with your parents in the farm.	.506	-.002	.029	.143	-.008	.622	.324
3.You eat snails in your house.	.811	.007	.009	-.008	.179	.243	.267
4. I know about schistosomiasis.	.168	-.075	.016	.260	.065	-.050	.704
5. I can recognize the disease by blood in the urine.	.158	-.028	.005	.083	.221	.155	.673

6. I can recognize the disease by itching in the body.	.156	-.018	-.005	.889	.217	.104	.211
7. I can recognize the disease by abdominal pain.	.100	-.028	-.029	.222	.874	.190	.215
8. I can recognize the disease by blood in stool.	.178	.002	-.010	.828	.305	.102	.233
9. I can recognize the disease by swollen stomach.	.174	-.012	.002	.329	.820	.082	.225
10. I can recognize the disease by vomiting.	.153	-.019	-.003	.891	.218	.097	.200
11. I can recognize the disease by fatigue.	.091	-.030	-.014	.224	.884	.179	.207
12. Schistosomiasis is caused by contact with infested water.	-.118	.024	-.051	.691	.262	-.039	-.262
13. Schistosomiasis is caused by eating of snails.	-.067	.030	.009	.281	.699	-.100	-.301
14. Schistosomiasis is caused by poison.	.770	.036	.034	.039	.098	.132	.209
15. The local name for schistosomiasis is "Amili Obara".	.359	.004	.010	.020	.127	.727	.337
16. The local name for schistosomiasis is "Oya Nwamili".	.822	.019	.017	.170	-.028	.079	.161
17. The local name for schistosomiasis is "Oya Mmiri".	.299	-.015	-.021	-.010	.162	.794	.249
18. I do not know the local name for schistosomiasis.	.779	-.011	.057	.064	.066	.208	.260
19. You see blood in your urine.	.050	.068	.951	-.038	-.009	.010	.006
20. You notice itching in your body.	-.011	.956	.068	-.004	-.006	.003	-.029
21. You notice regular fever.	.014	.033	.914	-.033	.017	-.018	.028
22. You were diagonised of a disease called schistosomiasis.	-.011	.899	.030	.007	-.019	.023	-.032
23. You had treatment of schistosomiasis disease by a medical doctor.	.050	.053	.883	.007	-.025	-.004	-.016

24. You treat schistosomiasis with local herbs.	.014	.890	.054	-.006	.018	-.001	-.020
25. You treat schistosomiasis with mixed drugs.	.018	.056	.913	.012	-.011	-.012	.007
26. You treat schistosomiasis prayer.	.006	.964	.060	-.011	-.027	.002	-.016
27. I feel uncomfortable when I see blood in my urine.	.662	-.028	.033	.047	.010	.180	-.231
28. Seeing blood in my urine is a problem.	.223	.020	-.032	.117	.031	.701	-.131
29. The presence of blood in urine is curable.	.668	-.032	.018	.116	-.097	.040	-.287
30. The presence of urine in blood is preventable.	.060	.017	.001	.037	.055	.797	-.145

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

```
FREQUENCIES VARIABLES=Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17
Q18 Q19 Q20 Q21 Q22 Q23 Q24
   Q25 Q26
  /ORDER=ANALYSIS.
```

Frequencies

Frequency Table

4. I know about schistosomiasis.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	17	3.2	3.2	3.2
	D	31	5.9	5.9	9.2
	UD	33	6.3	6.3	15.5
	A	48	9.2	9.2	24.6
	SA	395	75.4	75.4	100.0
	Total	524	100.0	100.0	

5. I can recognise the disease by blood in the urine.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	16	3.1	3.1	3.1
	D	30	5.7	5.7	8.8
	UD	34	6.5	6.5	15.3
	A	45	8.6	8.6	23.9
	SA	399	76.1	76.1	100.0
	Total	524	100.0	100.0	

6. I can recognise the disease by itching in the body.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	17	3.2	3.2	3.2
	D	31	5.9	5.9	9.2
	UD	73	13.9	13.9	23.1
	A	47	9.0	9.0	32.1
	SA	356	67.9	67.9	100.0
	Total	524	100.0	100.0	

7. I can recognise the disease by abnominal pain.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	17	3.2	3.2	3.2
	D	30	5.7	5.7	9.0
	UD	74	14.1	14.1	23.1
	A	44	8.4	8.4	31.5
	SA	359	68.5	68.5	100.0
	Total	524	100.0	100.0	

8. I can recognise the disease by blood in stool.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	17	3.2	3.2	3.2
	D	31	5.9	5.9	9.2
	UD	38	7.3	7.3	16.4
	A	61	11.6	11.6	28.1
	SA	377	71.9	71.9	100.0
	Total	524	100.0	100.0	

9. I can recognise the disease by swollen stomach.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	17	3.2	3.2	3.2
	D	30	5.7	5.7	9.0
	UD	39	7.4	7.4	16.4
	A	58	11.1	11.1	27.5
	SA	380	72.5	72.5	100.0
	Total	524	100.0	100.0	

10. I can recognise the disease by vomiting.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	17	3.2	3.2	3.2
	D	31	5.9	5.9	9.2
	UD	73	13.9	13.9	23.1
	A	44	8.4	8.4	31.5
	SA	359	68.5	68.5	100.0
	Total	524	100.0	100.0	

11. I can recognise the disease by fatigue.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	17	3.2	3.2	3.2
	D	30	5.7	5.7	9.0
	UD	74	14.1	14.1	23.1
	A	44	8.4	8.4	31.5
	SA	359	68.5	68.5	100.0
	Total	524	100.0	100.0	

12. Schistosomiasis is caused by contact with infested water.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	16	3.1	3.1	3.1
	D	32	6.1	6.1	9.2
	UD	34	6.5	6.5	15.6
	A	46	8.8	8.8	24.4
	SA	396	75.6	75.6	100.0
	Total	524	100.0	100.0	

13. Schistosomiasis is caused by eating of snails.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	17	3.2	3.2	3.2
	D	31	5.9	5.9	9.2
	UD	34	6.5	6.5	15.6
	A	46	8.8	8.8	24.4
	SA	396	75.6	75.6	100.0
	Total	524	100.0	100.0	

14. The local name for schistosomiasis is "Amili Obara".

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	18	3.4	3.4	3.4
	D	46	8.8	8.8	12.2
	UD	31	5.9	5.9	18.1
	A	34	6.5	6.5	24.6
	SA	395	75.4	75.4	100.0
	Total	524	100.0	100.0	

15. The local name for schistosomiasis is "Oya Nwamili".

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	16	3.1	3.1	3.1
	D	52	9.9	9.9	13.0
	UD	75	14.3	14.3	27.3
	A	36	6.9	6.9	34.2
	SA	345	65.8	65.8	100.0
	Total	524	100.0	100.0	

16. The local name for schistosomiasis is "Oya Mmiri".

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	18	3.4	3.4	3.4
	D	48	9.2	9.2	12.6
	UD	68	13.0	13.0	25.6
	A	34	6.5	6.5	32.1
	SA	356	67.9	67.9	100.0
	Total	524	100.0	100.0	

17. I do not know the local name for scistosomiasis.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	16	3.1	3.1	3.1
	D	44	8.4	8.4	11.5
	UD	42	8.0	8.0	19.5
	A	60	11.5	11.5	30.9
	SA	362	69.1	69.1	100.0
	Total	524	100.0	100.0	

18. You see blood in your urine.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	250	47.7	47.7	47.7
	D	79	15.1	15.1	62.8
	UD	135	25.8	25.8	88.5
	A	2	.4	.4	88.9
	SA	58	11.1	11.1	100.0
	Total	524	100.0	100.0	

19. You notice itching in your body.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	153	29.2	29.2	29.2
	D	115	21.9	21.9	51.1
	UD	172	32.8	32.8	84.0
	A	3	.6	.6	84.5
	SA	81	15.5	15.5	100.0
	Total	524	100.0	100.0	

20. You notice regular fever.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	245	46.8	46.8	46.8
	D	77	14.7	14.7	61.5
	UD	133	25.4	25.4	86.8
	A	3	.6	.6	87.4
	SA	66	12.6	12.6	100.0
	Total	524	100.0	100.0	

21. You were diagnosed of a disease called schistosomiasis.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	154	29.4	29.4	29.4
	D	117	22.3	22.3	51.7
	UD	173	33.0	33.0	84.7
	A	2	.4	.4	85.1
	SA	78	14.9	14.9	100.0
	Total	524	100.0	100.0	

22. You had treatment of schistosomiasis disease by a medical doctor.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	241	46.0	46.0	46.0
	D	76	14.5	14.5	60.5
	UD	141	26.9	26.9	87.4
	A	3	.6	.6	88.0
	SA	63	12.0	12.0	100.0
	Total	524	100.0	100.0	

23. You treat schistosomiasis with local herbs.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	168	32.1	32.1	32.1
	D	110	21.0	21.0	53.1
	UD	169	32.3	32.3	85.3
	A	2	.4	.4	85.7
	SA	75	14.3	14.3	100.0
	Total	524	100.0	100.0	

24. You treat schistosomiasis with mixed drugs.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	242	46.2	46.2	46.2
	D	82	15.6	15.6	61.8
	UD	141	26.9	26.9	88.7
	A	2	.4	.4	89.1
	SA	57	10.9	10.9	100.0
	Total	524	100.0	100.0	

25. You treat schistosomiasis prayer.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	168	32.1	32.1	32.1
	D	110	21.0	21.0	53.1
	UD	165	31.5	31.5	84.5
	A	2	.4	.4	84.9
	SA	79	15.1	15.1	100.0
	Total	524	100.0	100.0	

Case Summaries (By assessment of knowledge)

Villages		4. I know about schistosomiasis.	5. I can recognise the disease by blood in the urine.	6. I can recognise the disease by itching in the body.	7. I can recognise the disease by abnominal pain.	8. I can recognise the disease by blood in stool.
Ndinwedo	N	59	59	59	59	59
	Mean	4.5085	4.5085	4.3898	4.3220	4.4746
	Std. Deviation	1.05655	1.05655	1.05073	1.15132	1.00612
Umugim	N	67	67	67	67	67
	Mean	4.5075	4.5373	4.2985	4.4030	4.4328
	Std. Deviation	1.04986	1.04922	1.18084	1.08795	1.13115
Umuochu	N	56	56	56	56	56
	Mean	4.4286	4.4643	4.3036	4.3750	4.4464
	Std. Deviation	1.10958	.99021	1.11060	1.00114	1.06035
Aronota	N	70	70	70	70	70
	Mean	4.4286	4.4857	4.3143	4.3000	4.4429
	Std. Deviation	1.07098	1.03199	1.12344	1.10794	1.07185
Okpunoifite	N	27	27	27	27	27
	Mean	4.4444	4.3704	4.2963	4.3704	4.4444
	Std. Deviation	1.05003	1.14852	1.17063	1.14852	1.12090
Umunaba	N	101	101	101	101	101
	Mean	4.4653	4.5050	4.2772	4.2574	4.3564
	Std. Deviation	1.07298	.99623	1.13242	1.13713	1.09164
Kolilu	N	69	69	69	69	69

	Mean	4.5362	4.5362	4.3623	4.3913	4.4638
	Std. Deviation	1.00849	1.03724	1.08426	1.10103	1.00849
Isiamaenyi	N	75	75	75	75	75
	Mean	4.4667	4.4400	4.3600	4.3067	4.4400
	Std. Deviation	1.09462	1.15361	1.13471	1.19654	1.09347
Total	N	524	524	524	524	524
	Mean	4.4752	4.4905	4.3244	4.3321	4.4313
	Std. Deviation	1.05913	1.04484	1.11555	1.11330	1.06619

Case Summaries (By assessment of knowledge)

Villages		9. I can recognise the disease by swollen stomach.	10. I can recognise the disease by vomiting.	11. I can recognise the disease by fatigue.	12. Schistosomiasis is caused by contact with infested water.	13. Schistosomias is is caused by eating of snails.
Ndinwedo	N	59	59	59	59	59
	Mean	4.4237	4.4068	4.3390	4.5085	4.4407
	Std. Deviation	1.11731	1.05240	1.15386	1.00641	1.11836
Umugim	N	67	67	67	67	67
	Mean	4.5224	4.3134	4.4328	4.4627	4.5522
	Std. Deviation	1.03511	1.18333	1.09023	1.13255	1.03402
Umuochu	N	56	56	56	56	56
	Mean	4.5000	4.3571	4.4107	4.5000	4.5536
	Std. Deviation	.93420	1.11890	1.00502	1.06173	.93263
Aronota	N	70	70	70	70	70
	Mean	4.4286	4.3571	4.3286	4.5000	4.5000
	Std. Deviation	1.04356	1.12978	1.11279	1.07339	1.04604
Okpunoifite	N	27	27	27	27	27
	Mean	4.4444	4.3704	4.4444	4.5185	4.5185
	Std. Deviation	1.12090	1.18153	1.15470	1.12217	1.12217
Umunaba	N	101	101	101	101	101
	Mean	4.3564	4.2475	4.2277	4.4356	4.4455

	Std. Deviation	1.09164	1.12611	1.13032	1.03359	1.07215
Kolilu	N	69	69	69	69	69
	Mean	4.4928	4.3333	4.3333	4.5217	4.4203
	Std. Deviation	1.03786	1.08012	1.09365	1.02338	1.07657
Isiamaenyi	N	75	75	75	75	75
	Mean	4.4000	4.3333	4.2800	4.4267	4.4267
	Std. Deviation	1.15079	1.13105	1.19186	1.08021	1.12914
Total	N	524	524	524	524	524
	Mean	4.4389	4.3302	4.3321	4.4771	4.4752
	Std. Deviation	1.06306	1.11644	1.11330	1.05556	1.06093

Case Summaries (By assessment of knowledge)

Villages		14. Schistosomiasis is caused by poison.	15. The local name for schistosomiasis is "Amili Obara".	16. The local name for schistosomiasis is "Oya Nwamili".	17. The local name for schistosomiasis is "Oya Mmiri".	18. I do not know the local name for scistosomiasis.
Ndinwedo	N	59	59	59	59	59
	Mean	4.2542	4.3559	4.1525	4.1356	4.2034
	Std. Deviation	1.25387	1.18558	1.22915	1.25200	1.20028
Umugim	N	67	67	67	67	67
	Mean	4.3881	4.4179	4.2388	4.3582	4.4179
	Std. Deviation	1.16717	1.15666	1.20717	1.13753	1.08919
Umuochu	N	56	56	56	56	56
	Mean	4.2321	4.5000	4.1964	4.2500	4.3214
	Std. Deviation	1.20591	1.07872	1.16650	1.20981	1.08052
Aronota	N	70	70	70	70	70
	Mean	4.4143	4.4571	4.3000	4.3000	4.4857
	Std. Deviation	1.14832	1.13809	1.18383	1.20806	1.07330
Okpunoifite	N	27	27	27	27	27
	Mean	4.5926	4.3333	4.4444	4.2963	4.4815
	Std. Deviation	1.00992	1.24035	1.08604	1.20304	1.12217

Umunaba	N	101	101	101	101	101
	Mean	4.2772	4.3465	4.1485	4.2079	4.2574
	Std. Deviation	1.22571	1.15270	1.23601	1.18589	1.17178
Kolilu	N	69	69	69	69	69
	Mean	4.4493	4.4928	4.2319	4.3478	4.4203
	Std. Deviation	1.09190	1.07953	1.17755	1.13534	1.04889
Isiamaenyi	N	75	75	75	75	75
	Mean	4.2267	4.4133	4.2400	4.2400	4.3200
	Std. Deviation	1.26889	1.18656	1.21744	1.25030	1.18732
Total	N	524	524	524	524	524
	Mean	4.3340	4.4160	4.2252	4.2634	4.3511
	Std. Deviation	1.18512	1.14135	1.19386	1.19083	1.12285

Case Summaries (By assessment of knowledge)

Villages		19. You see blood in your urine.	20. You notice itching in your body.	21. You notice regular fever.	22. You were diagonised of a disease called schistosomiasis.	23. You had treatment of schistosomiasis disease by a medical doctor.
Ndinwedo	N	59	59	59	59	59
	Mean	2.9153	2.6780	3.1186	2.5932	2.8305
	Std. Deviation	1.34277	1.23792	1.34016	1.20514	1.35383
Umugim	N	67	67	67	67	67
	Mean	2.5075	2.6567	2.7164	2.6119	2.8955
	Std. Deviation	1.19814	1.28573	1.34622	1.25475	1.26891
Umuochu	N	56	56	56	56	56
	Mean	2.0714	2.6429	2.0714	2.6429	2.0536
	Std. Deviation	1.39944	1.28528	1.39944	1.28528	1.34055
Aronota	N	70	70	70	70	70
	Mean	1.9000	2.9000	1.9000	2.9000	1.9000
	Std. Deviation	1.24120	1.25282	1.24120	1.25282	1.24120
Okpunoifite	N	27	27	27	27	27
	Mean	2.0000	2.0741	2.0000	2.0741	2.0000
	Std. Deviation	1.27098	1.23805	1.27098	1.23805	1.27098
Umunaba	N	101	101	101	101	101
	Mean	1.9010	2.4851	1.9307	2.4554	1.9307
	Std. Deviation	1.23697	1.42558	1.25106	1.40374	1.25106
Kolilu	N	69	69	69	69	69
	Mean	1.9565	2.0580	1.9565	2.0580	1.9565
	Std. Deviation	1.31098	1.23531	1.31098	1.23531	1.31098
Isiamaenyi	N	75	75	75	75	75
	Mean	1.8800	2.4000	1.8800	2.4000	2.0000
	Std. Deviation	1.27300	1.42374	1.27300	1.42374	1.33558
Total	N	524	524	524	524	524
	Mean	2.1202	2.5115	2.1756	2.4905	2.1813
	Std. Deviation	1.31721	1.33273	1.36036	1.31977	1.34333

Case Summaries (By assessment of knowledge)

Villages		24. You treat schistosomiasis with local herbs.	25. You treat schistosomiasis with mixed drugs.	26. You treat schistosomiasis prayer.
Ndinwedo	N	59	59	59
	Mean	2.3220	2.7797	2.3051
	Std. Deviation	1.22391	1.35275	1.26292
Umugim	N	67	67	67
	Mean	2.6866	2.4925	2.7015
	Std. Deviation	1.26980	1.17258	1.27938
Umuochu	N	56	56	56
	Mean	2.6429	2.0714	2.6429
	Std. Deviation	1.28528	1.39944	1.28528
Aronota	N	70	70	70
	Mean	2.8857	1.9429	2.8857
	Std. Deviation	1.31373	1.23811	1.31373
Okpunoifite	N	27	27	27
	Mean	1.7037	2.2963	1.7037
	Std. Deviation	1.06752	1.17063	1.06752
Umunaba	N	101	101	101
	Mean	2.4851	1.9010	2.4851
	Std. Deviation	1.42558	1.23697	1.42558
Kolilu	N	69	69	69
	Mean	2.0580	1.9565	2.0580
	Std. Deviation	1.23531	1.31098	1.23531
Isiamaenyi	N	75	75	75
	Mean	2.2933	2.0000	2.4000
	Std. Deviation	1.33329	1.33558	1.42374
Total	N	524	524	524
	Mean	2.4389	2.1412	2.4542
	Std. Deviation	1.32562	1.30710	1.34342

```
ONEWAY Responses BY Villages
  /MISSING ANALYSIS
  /POSTHOC=LSD ALPHA(0.05).
```

Oneway (By attitude)

ANOVA (By attitude)

Mean responses

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.222	7	.032	2.613	.037
Within Groups	.291	24	.012		
Total	.513	31			

Post Hoc Tests

Multiple Comparisons

Mean responses

LSD

(I) Villages	(J) Villages	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Ndinwedo	Umugim	-.03395	.07787	.667	-.1947	.1268
	Umuochu	-.00763	.07787	.923	-.1683	.1531
	Aronota	-.00140	.07787	.986	-.1621	.1593
	Okpunoifite	-.02400	.07787	.761	-.1847	.1367
	Umunaba	.10142	.07787	.205	-.0593	.2621
	Kolilu	.06657	.07787	.401	-.0941	.2273
	Isiamaenyi	.22932*	.07787	.007	.0686	.3900
Umugim	Ndinwedo	.03395	.07787	.667	-.1268	.1947
	Umuochu	.02632	.07787	.738	-.1344	.1870
	Aronota	.03255	.07787	.680	-.1282	.1933
	Okpunoifite	.00995	.07787	.899	-.1508	.1707
	Umunaba	.13538	.07787	.095	-.0253	.2961
	Kolilu	.10053	.07787	.209	-.0602	.2612
	Isiamaenyi	.26328*	.07787	.002	.1026	.4240
Umuochu	Ndinwedo	.00763	.07787	.923	-.1531	.1683
	Umugim	-.02632	.07787	.738	-.1870	.1344
	Aronota	.00623	.07787	.937	-.1545	.1669
	Okpunoifite	-.01638	.07787	.835	-.1771	.1443
	Umunaba	.10905	.07787	.174	-.0517	.2698

	Kolilu	.07420	.07787	.350	-.0865	.2349
	Isiamaenyi	.23695*	.07787	.006	.0762	.3977
Aronota	Ndinwedo	.00140	.07787	.986	-.1593	.1621
	Umugim	-.03255	.07787	.680	-.1933	.1282
	Umuochu	-.00623	.07787	.937	-.1669	.1545
	Okpunoifite	-.02260	.07787	.774	-.1833	.1381
	Umunaba	.10283	.07787	.199	-.0579	.2635
	Kolilu	.06797	.07787	.391	-.0927	.2287
	Isiamaenyi	.23072*	.07787	.007	.0700	.3914
Okpunoifite	Ndinwedo	.02400	.07787	.761	-.1367	.1847
	Umugim	-.00995	.07787	.899	-.1707	.1508
	Umuochu	.01638	.07787	.835	-.1443	.1771
	Aronota	.02260	.07787	.774	-.1381	.1833
	Umunaba	.12543	.07787	.120	-.0353	.2861
	Kolilu	.09058	.07787	.256	-.0701	.2513
	Isiamaenyi	.25333*	.07787	.003	.0926	.4140
Umunaba	Ndinwedo	-.10142	.07787	.205	-.2621	.0593
	Umugim	-.13538	.07787	.095	-.2961	.0253
	Umuochu	-.10905	.07787	.174	-.2698	.0517
	Aronota	-.10283	.07787	.199	-.2635	.0579
	Okpunoifite	-.12543	.07787	.120	-.2861	.0353
	Kolilu	-.03485	.07787	.659	-.1956	.1259
	Isiamaenyi	.12790	.07787	.114	-.0328	.2886
Kolilu	Ndinwedo	-.06657	.07787	.401	-.2273	.0941
	Umugim	-.10053	.07787	.209	-.2612	.0602
	Umuochu	-.07420	.07787	.350	-.2349	.0865
	Aronota	-.06797	.07787	.391	-.2287	.0927
	Okpunoifite	-.09058	.07787	.256	-.2513	.0701
	Umunaba	.03485	.07787	.659	-.1259	.1956
	Isiamaenyi	.16275*	.07787	.047	.0020	.3235
Isiamaenyi	Ndinwedo	-.22932*	.07787	.007	-.3900	-.0686
	Umugim	-.26328*	.07787	.002	-.4240	-.1026
	Umuochu	-.23695*	.07787	.006	-.3977	-.0762
	Aronota	-.23072*	.07787	.007	-.3914	-.0700
	Okpunoifite	-.25333*	.07787	.003	-.4140	-.0926
	Umunaba	-.12790	.07787	.114	-.2886	.0328
	Kolilu	-.16275*	.07787	.047	-.3235	-.0020

*. The mean difference is significant at the 0.05 level.

Case Summaries (By life style)

Age		1.You swim or go inside the river doing domestic chores.	2. You wear foot wear while working with your parents in the farm.	3.You eat snails in your house.
5-10yrs	N	53	53	53
	Mean	4.3396	4.3019	4.3019
	Std. Deviation	1.14259	1.20232	1.13654
11-20yrs	N	372	372	372
	Mean	4.4382	4.4839	4.3763
	Std. Deviation	1.10326	1.04469	1.11992
21-30yrs	N	49	49	49
	Mean	4.5510	4.5306	4.4490
	Std. Deviation	.89119	1.06266	.93678
31-40yrs	N	25	25	25
	Mean	4.4000	4.3200	4.3600
	Std. Deviation	1.19024	1.14455	1.18603
>40yrs	N	25	25	25
	Mean	4.5200	4.5200	4.7200
	Std. Deviation	.91833	1.00499	.73711
Total	N	524	524	524
	Mean	4.4408	4.4637	4.3912
	Std. Deviation	1.08277	1.06420	1.09300

```
UNIANOVA Observation BY Age
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=Age(LSD)
  /CRITERIA=ALPHA(0.05)
  /DESIGN=Age.
```

Univariate Analysis of Variance (By life style)

Between-Subjects Factors

		Value Label	N
Age	1.00	5-10yrs	3
	2.00	11-20yrs	3
	3.00	21-30yrs	3
	4.00	31-40yrs	3
	5.00	>40yrs	3

Tests of Between-Subjects Effects

Dependent Variable: Observation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.146[a]	4	.036	8.590	.003
Intercept	295.814	1	295.814	69647.482	.000
Age	.146	4	.036	8.590	.003
Error	.042	10	.004		
Total	296.003	15			
Corrected Total	.188	14			

a. R Squared = .775 (Adjusted R Squared = .684)

Post Hoc Tests

Age

Multiple Comparisons

Dependent Variable: Observation

LSD

(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
5-10yrs	11-20yrs	-.1183	.05321	.050	-.2369	.0002
	21-30yrs	-.1957*	.05321	.004	-.3143	-.0772
	31-40yrs	-.0455	.05321	.412	-.1641	.0730
	>40yrs	-.2722*	.05321	.000	-.3908	-.1536
11-20yrs	5-10yrs	.1183	.05321	.050	-.0002	.2369
	21-30yrs	-.0774	.05321	.176	-.1960	.0412
	31-40yrs	.0728	.05321	.201	-.0458	.1914
	>40yrs	-.1539*	.05321	.016	-.2724	-.0353
21-30yrs	5-10yrs	.1957*	.05321	.004	.0772	.3143
	11-20yrs	.0774	.05321	.176	-.0412	.1960
	31-40yrs	.1502*	.05321	.018	.0316	.2688

	>40yrs	-.0765	.05321	.181	-.1950	.0421
31-40yrs	5-10yrs	.0455	.05321	.412	-.0730	.1641
	11-20yrs	-.0728	.05321	.201	-.1914	.0458
	21-30yrs	-.1502*	.05321	.018	-.2688	-.0316
	>40yrs	-.2267*	.05321	.002	-.3452	-.1081
>40yrs	5-10yrs	.2722*	.05321	.000	.1536	.3908
	11-20yrs	.1539*	.05321	.016	.0353	.2724
	21-30yrs	.0765	.05321	.181	-.0421	.1950
	31-40yrs	.2267*	.05321	.002	.1081	.3452

Based on observed means.
The error term is Mean Square(Error) = .004.
*. The mean difference is significant at the 0.05 level.

```
SUMMARIZE
  /TABLES=Q1 Q2 Q3 BY Occupation
  /FORMAT=NOLIST TOTAL
  /TITLE='Case Summaries'
  /MISSING=VARIABLE
  /CELLS=COUNT MEAN STDDEV.
```

Case Summaries

Occupation		1.You swim or go inside the river doing domestic chores.	2. You wear foot wear while working with your parents in the farm.	3.You eat snails in your house.
Trader	N	138	138	138
	Mean	4.4275	4.3623	4.3551
	Std. Deviation	1.04559	1.15222	1.06573
Farmer	N	286	286	286
	Mean	4.4755	4.4895	4.4091
	Std. Deviation	1.09116	1.03867	1.10998
Civil servant	N	51	51	51
	Mean	4.3922	4.6275	4.3333
	Std. Deviation	1.11496	.91566	1.12546
Others	N	49	49	49
	Mean	4.3265	4.4286	4.4490
	Std. Deviation	1.12524	1.09924	1.06186
Total	N	524	524	524
	Mean	4.4408	4.4637	4.3912
	Std. Deviation	1.08277	1.06420	1.09300

```
UNIANOVA Observation BY Occupation
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=Occupation.
```

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Occupation	1.00	Trader	3
	2.00	Farmer	3
	3.00	Civil servant	3
	4.00	Others	3

Tests of Between-Subjects Effects

Dependent Variable: Observation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.013[a]	3	.004	.524	.678
Intercept	234.756	1	234.756	29367.521	.000
Occupation	.013	3	.004	.524	.678
Error	.064	8	.008		
Total	234.833	12			
Corrected Total	.077	11			

a. R Squared = .164 (Adjusted R Squared = -.149)

```
SUMMARIZE
  /TABLES=Q1 Q2 Q3 BY Education
  /FORMAT=NOLIST TOTAL
  /TITLE='Case Summaries'
  /MISSING=VARIABLE
  /CELLS=COUNT MEAN STDDEV.
```

Summarize

Case Summaries

Level of Education		1.You swim or go inside the river doing domestic chores.	2. You wear foot wear while working with your parents in the farm.	3.You eat snails in your house.
Primary	N	390	390	390
	Mean	4.4103	4.4615	4.3641
	Std. Deviation	1.11124	1.05981	1.12039
Secondary	N	116	116	116
	Mean	4.4741	4.4569	4.4138
	Std. Deviation	1.05056	1.07455	1.06378
Tertiary	N	18	18	18
	Mean	4.8889	4.5556	4.8333
	Std. Deviation	.32338	1.14903	.38348
Total	N	524	524	524
	Mean	4.4408	4.4637	4.3912
	Std. Deviation	1.08277	1.06420	1.09300

```
UNIANOVA Observation BY Education
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=Education(LSD)
  /CRITERIA=ALPHA(0.05)
  /DESIGN=Education.
```

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Level of Education	1.00	Primary	3
	2.00	Secondary	3
	3.00	Tertiary	3

Tests of Between-Subjects Effects

Dependent Variable: Observation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.219[a]	2	.109	9.312	.014
Intercept	185.491	1	185.491	15799.169	.000
Education	.219	2	.109	9.312	.014
Error	.070	6	.012		
Total	185.780	9			
Corrected Total	.289	8			

a. R Squared = .756 (Adjusted R Squared = .675)

Post Hoc Tests

Level of Education

Multiple Comparisons

Dependent Variable: Observation

LSD

(I) Level of Education	(J) Level of Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Primary	Secondary	-.0363	.08847	.696	-.2528	.1802
	Tertiary	-.3473*	.08847	.008	-.5638	-.1308
Secondary	Primary	.0363	.08847	.696	-.1802	.2528
	Tertiary	-.3110*	.08847	.013	-.5275	-.0945
Tertiary	Primary	.3473*	.08847	.008	.1308	.5638
	Secondary	.3110*	.08847	.013	.0945	.5275

Based on observed means.

The error term is Mean Square(Error) = .012.

*. The mean difference is significant at the 0.05 level.

Case Summaries

Age		4. I know about schistosomiasis.	5. I can recognise the disease by blood in the urine.	6. I can recognise the disease by itching in the body.	7. I can recognise the disease by abnominal pain.	8. I can recognise the disease by blood in stool.	9. I can recognise the disease by swollen stomach.	10. I can recognise the disease by vomiting.	11. I can recognise the disease by fatigue.	12. Schistosomiasis is caused by contact with infested water.	13. Schistosomiasis is caused by eating of snails.	14. The local name for schistosomiasis is "Amili Obara".	15. The local name for schistosomiasis is "Oya Nwamili".	16. The local name for schistosomiasis is "Oya Mmiri".	17. I do not know the local name for scistosomiasis.	18. You see blood in your urine.	19. You notice itching in your body.	20. You notice regular fever.	21. You were diagonised of a disease called schistosomiasis.	22. You had treatment of schistosomiasis disease by a medical doctor.	23. You treat schistosomiasis with local herbs.	24. You treat schistosomiasis with mixed drugs.	25. You treat schistosomiasis prayer.
5-10yrs	N	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
	Mean	4.4717	4.6415	4.2642	3.9245	4.3019	4.0189	4.3019	3.9623	4.4528	4.1887	4.3208	4.2642	3.9434	4.2075	2.4340	2.2264	2.4151	2.2453	2.5472	2.2453	2.4528	2.2075
	Std. Deviation	1.04888	.94247	1.14608	1.38466	1.13654	1.37967	1.15334	1.38623	1.10185	1.33094	1.26755	1.11201	1.39249	1.13270	1.48725	1.26554	1.48627	1.25431	1.61205	1.35740	1.48798	1.23036
11-20yrs	N	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372	372
	Mean	4.4543	4.4651	4.3602	4.4247	4.4624	4.5054	4.3683	4.4220	4.4892	4.5215	4.4220	4.1694	4.3199	4.3199	2.0134	2.5591	2.0672	2.5134	2.0565	2.5000	2.0376	2.4866
	Std. Deviation	1.08683	1.06721	1.08870	1.03170	1.03376	.98368	1.08723	1.03411	1.02917	.98620	1.13120	1.23987	1.15033	1.16662	1.28744	1.33348	1.33713	1.31027	1.29670	1.32262	1.26051	1.35874
21-30yrs	N	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
	Mean	4.5510	4.5510	4.2245	4.1633	4.4286	4.2857	4.2245	4.1429	4.3878	4.2449	4.4082	4.4490	4.2245	4.6531	2.3673	2.5102	2.6122	2.5918	2.5102	2.4082	2.2449	2.5714
	Std. Deviation	.91427	.91427	1.15948	1.23063	1.09924	1.17260	1.15948	1.22474	1.13314	1.29953	1.17115	.91427	1.24608	.77865	1.25323	1.43065	1.27175	1.47080	1.27675	1.41301	1.28340	1.41421
31-40yrs	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	Mean	4.4000	4.3600	4.0000	4.0800	4.1200	4.3600	3.9200	4.0400	4.4400	4.6400	4.3600	4.0400	4.1600	4.3600	2.9200	2.7600	2.8000	2.8800	2.9200	2.3200	2.9600	2.6400

	Std. Deviation	1.15470	1.15036	1.38444	1.28841	1.36382	1.22066	1.38203	1.27410	1.19304	.95219	1.15036
	1.39881	1.24766	1.15036	1.32035	1.36260	1.35401	1.42361	1.41185	1.24900	1.36870	1.41067	
>40yrs	N	25	25	25	25	25	25	25	25	25	25	25
	25	25	25	25	25	25	25	25	25	25	25	
	Mean	4.7200	4.5600	4.4400	4.4000	4.5600	4.7200	4.4400	4.4400	4.5600	4.6800	
	4.6000	4.7200	4.2800	4.5200	1.7600	2.1600	1.8000	2.0800	1.8800	2.1200	2.0000	
	2.0800											
	Std. Deviation	.84261	1.08321	1.08321	1.04083	1.00333	.84261	1.08321	1.04403	1.12101	.98826	1.00000
	.73711	1.13725	.91833	1.09087	1.17898	1.25831	1.07703	1.01325	1.20139	1.25831	1.07703	
Total	N	524	524	524	524	524	524	524	524	524	524	524
	524	524	524	524	524	524	524	524	524	524	524	
	Mean	4.4752	4.4905	4.3244	4.3321	4.4313	4.4389	4.3302	4.3321	4.4771	4.4752	
	4.4160	4.2252	4.2634	4.3511	2.1202	2.5115	2.1756	2.4905	2.1813	2.4389	2.1412	
	2.4542											
	Std. Deviation	1.05913	1.04484	1.11555	1.11330	1.06619	1.06306	1.11644	1.11330	1.05556	1.06093	1.14135
	1.19386	1.19083	1.12285	1.31721	1.33273	1.36036	1.31977	1.34333	1.32562	1.30710	1.34342	

```
UNIANOVA Observation BY Age
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=Age(LSD)
  /CRITERIA=ALPHA(0.05)
  /DESIGN=Age.
```

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Age	1.00	5-10yrs	22
	2.00	11-20yrs	22
	3.00	21-30yrs	22
	4.00	31-40yrs	21
	5.00	>40yrs	23

Tests of Between-Subjects Effects

Dependent Variable: Observation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.

Corrected Model	.587[a]	4	.147	.145	.965
Intercept	1452.712	1	1452.712	1438.479	.000
Age	.587	4	.147	.145	.965
Error	106.039	105	1.010		
Total	1559.217	110			
Corrected Total	106.626	109			

a. R Squared = .006 (Adjusted R Squared = -.032)

Case Summaries

Occupation 4. I know about schistosomiasis. 5. I can recognise the disease by blood in the urine. 6. I can recognise the disease by itching in the body. 7. I can recognise the disease by abnominal pain. 8. I can recognise the disease by blood in stool. 9. I can recognise the disease by swollen stomach. 10. I can recognise the disease by vomiting. 11. I can recognise the disease by fatigue. 12. Schistosomiasis is caused by contact with infested water. 13. Schistosomiasis is caused by eating of snails. 14. The local name for schistosomiasis is "Amili Obara". 15. The local name for schistosomiasis is "Oya Nwamili". 16. The local name for schistosomiasis is "Oya Mmiri". 17. I do not know the local name for scistosomiasis. 18. You see blood in your urine. 19. You notice itching in your body. 20. You notice regular fever. 21. You were diagonised of a disease called schistosomiasis. 22. You had treatment of schistosomiasis disease by a medical doctor. 23. You treat schistosomiasis with local herbs. 24. You treat schistosomiasis with mixed drugs. 25. You treat schistosomiasis prayer.

Trader	N	138	138	138	138	138	138	138	138	138	138	138	138
		138	138	138	138	138	138	138	138	138	138	138	
	Mean	4.3841	4.4783	4.2319	4.2101	4.3116	4.2826	4.2464	4.2174	4.5145	4.4275		
		4.3261	4.2391	4.1377	4.2899	2.1739	2.5507	2.1594	2.4783	2.2319	2.5217	2.1377	
		2.4855											
	Std. Deviation	1.08958	1.01246	1.12237	1.16176	1.08608							
		1.13979	1.12575	1.16981	.96837	1.08667	1.22124						
		1.11757	1.25676	1.10211	1.38244	1.31844	1.41548						
		1.34119	1.44126	1.37876	1.33012	1.33584							
Farmer	N	286	286	286	286	286	286	286	286	286	286	286	286
		286	286	286	286	286	286	286	286	286	286	286	
	Mean	4.4930	4.4720	4.3636	4.4021	4.4755	4.5105	4.3636	4.4091	4.4301	4.4720		
		4.4231	4.1888	4.3112	4.3671	2.0664	2.5035	2.1189	2.4965	2.0979	2.4476	2.1049	
		2.4510											
	Std. Deviation	1.08496	1.06833	1.10847	1.07729	1.05186							
		1.02164	1.10847	1.07465	1.12094	1.06504	1.12672						
		1.24224	1.16273	1.15234	1.28109	1.34751	1.31116						
		1.31322	1.28043	1.31485	1.27713	1.36216							
Civil servant	N	51	51	51	51	51	51	51	51	51	51	51	51
		51	51	51	51	51	51	51	51	51	51	51	
	Mean	4.6078	4.5882	4.4118	4.2941	4.5490	4.3725	4.3922	4.2745	4.5098	4.3922		
		4.6078	4.3529	4.4118	4.3529	2.2745	2.4510	2.3922	2.4706	2.3333	2.2157	2.2353	
		2.3725											

	Std. Deviation	.75042	.87582	1.06163		1.17122		.98618	1.11285			
	1.07849	1.16753	1.02708	1.16753	.98140	1.12825						
	1.13449	1.11038	1.31268	1.30098	1.32783	1.30158						
	1.30639	1.23796	1.33549	1.26429								
Others	N	49	49	49	49	49	49	49	49	49	49	49
	49	49	49	49	49	49	49	49	49	49		
	Mean	4.4898	4.5306	4.2653	4.3061	4.3878	4.5306	4.3061	4.2653	4.6122	4.7143	
	4.4286	4.2653	4.1837	4.4286	2.1224	2.5102	2.3265	2.5102	2.3673	2.3878	2.2653	
	2.4694											
	Std. Deviation	1.10156		1.17442		1.20374		1.12183		1.16934		
	1.00212	1.19380	1.11384	.93131	.81650	1.15470		1.20374				
	1.21918	1.04083	1.36371	1.35589	1.51915		1.35589					
	1.45336	1.33567	1.41090	1.37086								
Total	N	524	524	524	524	524	524	524	524	524	524	524
	524	524	524	524	524	524	524	524	524	524		
	Mean	4.4752	4.4905	4.3244	4.3321	4.4313	4.4389	4.3302	4.3321	4.4771	4.4752	
	4.4160	4.2252	4.2634	4.3511	2.1202	2.5115	2.1756	2.4905	2.1813	2.4389	2.1412	
	2.4542											
	Std. Deviation	1.05913		1.04484		1.11555		1.11330		1.06619		
	1.06306	1.11644	1.11330	1.05556	1.06093	1.14135						
	1.19386	1.19083	1.12285	1.31721	1.33273	1.36036						
	1.31977	1.34333	1.32562	1.30710	1.34342							

```
DATASET ACTIVATE DataSet2.
UNIANOVA Observations BY Occupation
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=Occupation.
```

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Occupation	1.00	Trader	22
	2.00	Farmer	22
	3.00	Civil servant	22
	4.00	Others	22

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.093[a]	3	.031	.030	.993
Intercept	1167.572	1	1167.572	1121.777	.000
Occupation	.093	3	.031	.030	.993
Error	87.429	84	1.041		
Total	1255.095	88			
Corrected Total	87.523	87			

a. R Squared = .001 (Adjusted R Squared = -.035)

Case Summaries

Level of Education 4. I know about schistosomiasis. 5. I can recognise the disease by blood in the urine. 6. I can recognise the disease by itching in the body. 7. I can recognise the disease by abnominal pain. 8. I can recognise the disease by blood in stool. 9. I can recognise the disease by swollen stomach. 10. I can recognise the disease by vomiting. 11. I can recognise the disease by fatigue. 12. Schistosomiasis is caused by contact with infested water. 13. Schistosomiasis is caused by eating of snails. 14. The local name for schistosomiasis is "Amili Obara". 15. The local name for schistosomiasis is "Oya Nwamili". 16. The local name for schistosomiasis is "Oya Mmiri". 17. I do not know the local name for scistosomiasis. 18. You see blood in your urine. 19. You notice itching in your body. 20. You notice regular fever. 21. You were diagonised of a disease called schistosomiasis. 22. You had treatment of schistosomiasis disease by a medical doctor. 23. You treat schistosomiasis with local herbs. 24. You treat schistosomiasis with mixed drugs. 25. You treat schistosomiasis prayer.

Primary	N	390	390	390	390	390	390	390	390	390	390
	390	390	390	390	390	390	390	390	390	390	390
	Mean	4.5282	4.5077	4.3615	4.3205	4.4564	4.4564	4.3667	4.3231	4.4923	4.4718
	4.4051	4.2179	4.2385	4.3256	2.1436	2.4538	2.1846	2.4436	2.2000	2.3923	2.1385
	2.4103										
	Std. Deviation	1.00281		1.01084		1.08035		1.10727		1.03258	
	1.04986	1.08100		1.10769		1.04829		1.07936		1.14948	
	1.20034	1.20498		1.14011		1.33949		1.32861		1.37056	
	1.30675	1.36274		1.32504		1.31094		1.33411			
Secondary	N	116	116	116	116	116	116	116	116	116	116
	116	116	116	116	116	116	116	116	116	116	116
	Mean	4.3362	4.4052	4.1983	4.3276	4.3448	4.3534	4.2069	4.3103	4.4224	4.4655
	4.4483	4.1810	4.2672	4.3966	1.9828	2.6983	2.1207	2.6897	2.0776	2.6034	2.0862
	2.6379										
	Std. Deviation	1.16428		1.16454		1.21741		1.17788		1.16547	
	1.14402	1.21953		1.17521		1.10454		1.04200		1.12168	
	1.19854	1.18950		1.08651		1.20854		1.34630		1.31318	
	1.37944	1.28639		1.33761		1.26882		1.37301			
Tertiary	N	18	18	18	18	18	18	18	18	18	18
	18	18	18	18	18	18	18	18	18	18	18

	Mean	4.2222	4.6667	4.3333	4.6111	4.4444	4.6111	4.3333	4.6667	4.5000	4.6111
	4.4444	4.6667	4.7778	4.6111	2.5000	2.5556	2.3333	2.2222	2.4444	2.3889	2.5556
	2.2222										
	Std. Deviation	1.43714	.97014	1.18818	.77754	1.14903	.77754				
	1.18818	.76696	.92355	.77754	1.14903	.97014	.73208	.97853	1.46528		
	1.29352	1.49509	1.11437	1.29352	1.24328	1.46417					
	1.30859										
Total	N	524	524	524	524	524	524	524	524	524	524
	524	524	524	524	524	524	524	524	524	524	
	Mean	4.4752	4.4905	4.3244	4.3321	4.4313	4.4389	4.3302	4.3321	4.4771	4.4752
	4.4160	4.2252	4.2634	4.3511	2.1202	2.5115	2.1756	2.4905	2.1813	2.4389	2.1412
	2.4542										
	Std. Deviation	1.05913	1.04484	1.11555	1.11330	1.06619					
	1.06306	1.11644	1.11330	1.05556	1.06093	1.14135					
	1.19386	1.19083	1.12285	1.31721	1.33273	1.36036					
	1.31977	1.34333	1.32562	1.30710	1.34342						

```
DATASET ACTIVATE DataSet2.
UNIANOVA Observations BY Education
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=Education.
```

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Level of Education	1.00	Primary	22
	2.00	Secondary	22
	3.00	Tertiary	22

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.279[a]	2	.139	.131	.877
Intercept	888.219	1	888.219	837.293	.000
Education	.279	2	.139	.131	.877
Error	66.832	63	1.061		
Total	955.330	66			
Corrected Total	67.110	65			

a. R Squared = .004 (Adjusted R Squared = -.027)

Case Summaries (Attitude)

Age		1.You swim or go inside the river doing domestic chores.	2. You wear foot wear while working with your parents in the farm.	3.You eat snails in your house.
5-10yrs	N	53	53	53
	Mean	4.3396	4.3019	4.3019
	Std. Deviation	1.14259	1.20232	1.13654
11-20yrs	N	372	372	372
	Mean	4.4382	4.4839	4.3763
	Std. Deviation	1.10326	1.04469	1.11992
21-30yrs	N	49	49	49
	Mean	4.5510	4.5306	4.4490
	Std. Deviation	.89119	1.06266	.93678
31-40yrs	N	25	25	25
	Mean	4.4000	4.3200	4.3600
	Std. Deviation	1.19024	1.14455	1.18603
>40yrs	N	25	25	25
	Mean	4.5200	4.5200	4.7200
	Std. Deviation	.91833	1.00499	.73711
Total	N	524	524	524
	Mean	4.4408	4.4637	4.3912
	Std. Deviation	1.08277	1.06420	1.09300

```
UNIANOVA Observations BY Age
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=Age(LSD)
  /CRITERIA=ALPHA(0.05)
  /DESIGN=Age.
```

Univariate Analysis of Variance (By Atitude)

Between-Subjects Factors

		Value Label	N
Age	1.00	5-10yrs	3
	2.00	11-20yrs	3
	3.00	21-30yrs	3
	4.00	31-40yrs	3
	5.00	>40yrs	3

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.146[a]	4	.036	8.590	.003
Intercept	295.814	1	295.814	69647.482	.000
Age	.146	4	.036	8.590	.003
Error	.042	10	.004		
Total	296.003	15			
Corrected Total	.188	14			

a. R Squared = .775 (Adjusted R Squared = .684)

Post Hoc Tests

Age

Multiple Comparisons

Dependent Variable: Obsrvations

LSD

(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
5-10yrs	11-20yrs	-.1183	.05321	.050	-.2369	.0002
	21-30yrs	-.1957*	.05321	.004	-.3143	-.0772
	31-40yrs	-.0455	.05321	.412	-.1641	.0730
	>40yrs	-.2722*	.05321	.000	-.3908	-.1536
11-20yrs	5-10yrs	.1183	.05321	.050	-.0002	.2369
	21-30yrs	-.0774	.05321	.176	-.1960	.0412
	31-40yrs	.0728	.05321	.201	-.0458	.1914
	>40yrs	-.1539*	.05321	.016	-.2724	-.0353
21-30yrs	5-10yrs	.1957*	.05321	.004	.0772	.3143
	11-20yrs	.0774	.05321	.176	-.0412	.1960
	31-40yrs	.1502*	.05321	.018	.0316	.2688
	>40yrs	-.0765	.05321	.181	-.1950	.0421

31-40yrs	5-10yrs	.0455	.05321	.412	-.0730	.1641
	11-20yrs	-.0728	.05321	.201	-.1914	.0458
	21-30yrs	-.1502*	.05321	.018	-.2688	-.0316
	>40yrs	-.2267*	.05321	.002	-.3452	-.1081
>40yrs	5-10yrs	.2722*	.05321	.000	.1536	.3908
	11-20yrs	.1539*	.05321	.016	.0353	.2724
	21-30yrs	.0765	.05321	.181	-.0421	.1950
	31-40yrs	.2267*	.05321	.002	.1081	.3452

Based on observed means.
The error term is Mean Square(Error) = .004.
*. The mean difference is significant at the 0.05 level.

Case Summaries(Attitude)

Occupation		1.You swim or go inside the river doing domestic chores.	2. You wear foot wear while working with your parents in the farm.	3.You eat snails in your house.
Trader	N	138	138	138
	Mean	4.4275	4.3623	4.3551
	Std. Deviation	1.04559	1.15222	1.06573
Farmer	N	286	286	286
	Mean	4.4755	4.4895	4.4091
	Std. Deviation	1.09116	1.03867	1.10998
Civil servant	N	51	51	51
	Mean	4.3922	4.6275	4.3333
	Std. Deviation	1.11496	.91566	1.12546
Others	N	49	49	49
	Mean	4.3265	4.4286	4.4490
	Std. Deviation	1.12524	1.09924	1.06186
Total	N	524	524	524
	Mean	4.4408	4.4637	4.3912
	Std. Deviation	1.08277	1.06420	1.09300

DATASET ACTIVATE DataSet2.
UNIANOVA Observations BY Occupation

/METHOD=SSTYPE(3)
/INTERCEPT=INCLUDE
/POSTHOC=Occupation(LSD)
/CRITERIA=ALPHA(0.05)
/DESIGN=Occupation.

Univariate Analysis of Variance (By Attitude)

Between-Subjects Factors

		Value Label	N
Occupation	1.00	Trader	3
	2.00	Farmer	3
	3.00	Civil servant	3
	4.00	Others	3

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.013[a]	3	.004	.524	.678
Intercept	234.756	1	234.756	29367.521	.000
Occupation	.013	3	.004	.524	.678
Error	.064	8	.008		
Total	234.833	12			
Corrected Total	.077	11			

a. R Squared = .164 (Adjusted R Squared = -.149)

Case Summaries(Education)

Level of Education		1.You swim or go inside the river doing domestic chores.	2. You wear foot wear while working with your parents in the farm.	3.You eat snails in your house.
Primary	N	390	390	390
	Mean	4.4103	4.4615	4.3641
	Std. Deviation	1.11124	1.05981	1.12039
Secondary	N	116	116	116
	Mean	4.4741	4.4569	4.4138
	Std. Deviation	1.05056	1.07455	1.06378
Tertiary	N	18	18	18
	Mean	4.8889	4.5556	4.8333

	Std. Deviation	.32338	1.14903	.38348
Total	N	524	524	524
	Mean	4.4408	4.4637	4.3912
	Std. Deviation	1.08277	1.06420	1.09300

```
UNIANOVA Observations BY Education
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=Education(LSD)
  /CRITERIA=ALPHA(0.05)
  /DESIGN=Education.
```

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Level of Education	1.00	Primary	3
	2.00	Secondary	3
	3.00	Tertiary	3

Tests of Between-Subjects Effects

Dependent Variable: Obsrvations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.219[a]	2	.109	9.312	.014
Intercept	185.491	1	185.491	15799.169	.000
Education	.219	2	.109	9.312	.014
Error	.070	6	.012		
Total	185.780	9			
Corrected Total	.289	8			

a. R Squared = .756 (Adjusted R Squared = .675)

Post Hoc Tests

Level of Education

Multiple Comparisons

Dependent Variable: Obsrvations

LSD

(I) Level of Education	(J) Level of Education	Mean Difference (I-	Std. Error	Sig.	95% Confidence Interval

		J)			Lower Bound	Upper Bound
Primary	Secondary	-.0363	.08847	.696	-.2528	.1802
	Tertiary	-.3473*	.08847	.008	-.5638	-.1308
Secondary	Primary	.0363	.08847	.696	-.1802	.2528
	Tertiary	-.3110*	.08847	.013	-.5275	-.0945
Tertiary	Primary	.3473*	.08847	.008	.1308	.5638
	Secondary	.3110*	.08847	.013	.0945	.5275

Based on observed means.
The error term is Mean Square(Error) = .012.
*. The mean difference is significant at the 0.05 level.

Calculation of freshwater snail diversity at Iyiegwu

Snail species	Number of snails at Iyiegwu (n)	n(n-1)
Bulinus species	9	72
Pila species	879	771762
Total (N)	888	787656

Simpson's index $D = \frac{£\, n(n-1)}{N(N-1)}$

$$D = \frac{771834}{787656}$$

D = 0.98

1 – D (Simpson's Index of diversity) = 0.02

$\frac{1}{D}$ (Simpson's reciprocal index) = 1.02

Calculation of freshwater snail diversity at Obutu

Snail species	Number of snails at Obutu (n)	n(n-1)
Bulinus species	16	240
Pila species	497	246512
Total (N)	513	262656

Simpson's index $D = \frac{£\, n(n-1)}{N(N-1)}$

$$D = \frac{246752}{262656}$$

D = 0.94

1 – D (Simpson's Index of diversity) = 0.06

$\frac{1}{D}$ (Simpson's reciprocal index) = 1.06

```
T-TEST PAIRS=Iyiegwu WITH Obutu (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of snail in Iyiegwu lake	74.0000	12	79.60813	22.98089
	Abundance of snail in Obutu stream	42.8333	12	54.35545	15.69107

Paired Samples Test

	Paired Differences	t	df	Sig.

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				(2-tailed)
					Lower	Upper			
Pair 1	Abundance of snail in Iyiegwu lake - Abundance of snail in Obutu stream	31.16667	57.73581	16.66689	-5.51692	67.85025	1.870	11	.088

T-TEST PAIRS=Obutubulinus WITH Iyiegwubulinus (PAIRED)
/CRITERIA=CI(.9500)
/MISSING=ANALYSIS.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of Bulinus spp in Obutu stream	1.4167	12	3.75278	1.08333
	Abundance of Bulinus spp in Iyiegwu lake	.7500	12	1.05529	.30464

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Abundance of Bulinus spp in Obutu stream - Abundance of Bulinus spp in Iyiegwu lake	.66667	3.08466	.89047	-1.29324	2.62657	.749	11	.470

```
T-TEST PAIRS=Pila WITH Bulinus (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of Pila spp in the study area	114.6667	12	125.58542	36.25339
	Abundance of Bulinus spp in the study area	2.1667	12	4.56933	1.31905

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			

Pair 1	Abundance of Pila spp in the study area - Abundance of Bulinus spp in the study area	112.50000	127.80703	36.89471	31.29529	193.70471	3.049	11	.011

```
T-TEST PAIRS=Pila Obutu WITH Bulinus Obutu (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of Pila spp in Obutu stream	41.4167	12	55.39356	15.99074
	Abundance of Bulinus spp in Obutu stream	1.4167	12	3.75278	1.08333

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			

Pair 1	Abundance of Pila spp in Obutu stream - Abundance of Bulinus spp in Obutu stream	40.00000	56.66168	16.35682	3.99889	76.00111	2.445	11	.033

T-TEST PAIRS=Pila Iyiegwu WITH Bulinus Iyiegwu (PAIRED)
/CRITERIA=CI(.9500)
/MISSING=ANALYSIS.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Abundance of Pila spp in Iyiegwu lake	73.2500	12	80.35051	23.19519
	Abundance of Bulinus spp in Iyiegwu lake	.7500	12	1.05529	.30464

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			

Pair 1	Abundance of Pila spp in Iyiegwu lake - Abundance of Bulinus spp in Iyiegwu lake	72.50000	81.09983	23.41150	20.97163	124.02837	3.097	11	.010

Plate1: Picture of *Bulinus globosus* as found in the lakes

Plate 2: Picture of *Pila ovata* as found in the lakes studied