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Investigating the Epidemiology and Prevalence of Helminths in Livestock Health in Niger Delta Region: Implications for Human Health

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ABSTRACT

Gastrointestinal helminths represent important human and animal pathogen impacting on farming systems, they are a major cause of ill-thrift and production loss in the specter of livestock species and humanity. Morbidity and mortality rate of helminth infection in these areas are unquantifiable due to inadequate/inaccurate data, especially in the fast growing Niger Delta regions of Nigeria. There is a dearth of studies using a specific diagnostic test and covering wider geographical areas and different management systems. This article aims to investigate the epidemiology, prevalence, and burden of helminthes in livestock and its implication on human, using anthelmintics and other means of parasite control. Fecal samples of 4050 cattle were obtained for coprological examination from nine Niger Delta Regions from cattle rearing ranches and pens where cattle are kept before slaughter were investigated, from May 2013 to March 2014. Respective genera of *Fasciola* (17.01%), *Paramphistomum* (15.06%), *Strongyle* (13.01%), *Monezia* (2.48%), *Toxocara* (1.03%) *and Trichuris* (0. 91%) were identified. Males had relatively higher helminth infection than females with mixed infection prevalence. Finding suggests that cattle in the Niger Delta Region may be subclinical carriers of helminthes. Public enlightenment of the farmers about the disease, and appropriate national control measures are recommended.

Keywords: Helminthes; Parasitic Infection; Incidence; Cattle; Niger-Delta.

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INTRODUCTION

Globally, the growing demand for livestock industry and the changing preference in consumers of livestock has over the years remain very critical in the economic development of many countries, and represent a major asset among smallholders in many developing countries. In the development of a livestock industry, disease containment and eradication are paramount. The incessant nomadic movement of Fulani herdsmen, who own about 95% of all food animal populations in Nigeria cattle due to trade and for sharing and use of open-range grazing, is a common practice in Nigeria, which expose many herds at risk of helminth infection[1]. Gastrointestinal(GIT) parasitic infection is one of the major causes of wastage and decreased productivity exerting their effect through mortality, morbidity, decreased growth rate, weight loss in young growing calves and late maturity of slaughter stock, reduced milk and meat production and working capacity of the animal mainly in developing countries [2]; which is detrimental to millions of people and livestock worldwide. Environmental contamination and indirect transmission through contaminated food and water may complicate control efforts. It is one of the major constraints on animal production in areas of the sub Saharan Africa that have the greatest potential for significant increases in domestic livestock populations and productivity. The Niger Delta Region with diversified industrial activities related to oil and gas exploration, which attracts agglomeration of emigrants, will increase the demand for food of animal origin, with economic importance derived from commercial and small scale livestock industries. It is projected that global population will consume about 120 million tons of meat and 220 million tons of milk above the current consumption[3]. The public health risk varies by animal species, age group, husbandry practice and health status, and certain human subpopulations are at a heightened risk for infection due to biological or behavioral risk factors. A number of helminths species are known to infect cattle worldwide. The most important ones include nematodes like *Strongyle* species (*Haemonchus, Ostartagia, Trichostrongylus, Cooperia*), *Toxocara Vitulorum* and trematodes of economic importance *Fasciola* species (*Fasciola hepatica* and *Fasciola gigantica*) and *Paraphistomum* species (*Paraphistomum cervei*), while cestodes like *Monezia* species (*Monezia benideni* and *Monezia expanza*) could also be important constraints in animal production [4].

Clinically affected animals may exhibit higher prevalence more than apparently healthy animals however; both can harbor helminths over long periods of time. Given that these diseased livestock are slaughtered and consumed, the health of Nigerian individuals is at risk unless there

is appropriate intervention. Absolute chemotherapy and control measures of these parasitic diseases are of utmost importance. Man is the sole final host for *these parasites*, while cattle and pigs serve as intermediate hosts. Infection is passed on when human carriers pass feces containing eggs and these are ingested by the intermediate hosts.[5]. In addition, environmental contamination and indirect transmission through contaminated food and water may complicate control efforts.

Although livestock represent a major asset among smallholders in many developing countries, these herds are seldom, if ever, treated for internal parasites. Resource-poor communities have limited access to facilities, infrastructure, and finance to support these services. There is a dearth of studies using a specific diagnostic test and covering wider geographical areas and different management systems. In order to assess the possible impact of helminth infections on this valuable resource, its scrutiny, prevalence and geo-ecological range of the parasites and their host, are mandatory. The objective of this study therefore was to use a structured, multistage sampling strategy, combined with a sensitive and specific diagnostic test, to estimate the prevalence of helminth infection in cattle in the aforementioned vicinity.

Creation of extensive data sets will eventually enable us to judge the seroprevalence of helminths in livestock and hosts community and vice versa. Such investigations will provide the baseline data needed to protect and sustainably manage the country's variety of livestock assemblage. This is especially critical as parasitic helminths can have a wide range of impacts on the ecology of their hosts in terms of health, behavior, sexual selection and regulation of host populations. It thus becomes necessary to examine them from the point of view of the ecological factors that determine parasite loads.

It is on this premise that we strive to investigate the epidemiology and serotype distribution of helmints in a variety of host species and review our current understanding of the public health risks associated with different types of contacts between humans and animals and animals to animals in public, professional or private settings, and, where appropriate, discuss potential risk mitigation strategies

MATERIALS AND METHODS:

Study setting: The target group of this livestock investigation consisted of mainly cows selected from cattle rearing ranches, livestock markets and pens where cattle are being kept on arrival from the northern part of Nigeria in the Niger Delta Region. The Niger Delta Region is a major precinct in the South-south geopolitical zone within Nigeria. It is also among the world's major wetlands; with one of the largest mangrove ecosystems and a major territory of the global

diversified industrial activities related to oil and gas exploration. It is the treasure base of the nation, comprising of nine states in the federation, with miscellaneous industrial implementations linked to oil and gas exploration, which attract agglomeration of residents, that have the greatest potential for significant increase in domestic consumption of livestock productivity.

Study design:

We randomly selected cows between the ages of > one to seven years who were resident at the cattle rearing ranches, livestock markets and pens. The estimated age was by dentition and proprietors and ranch attendants were also asked about animals' age whenever possible, sex and breed were recorded and the animals were grouped into male and female. Screening procedures identify cows that were at sufficient risk to warrant a diagnostic test for helminthes infection. These were herds imported into Nigeria from neighboring countries with potential for transmission and spread of helminths infection in transit and on grazing sites. Proprietors of the pens ranches and market stands received a focused group lecture and interview and were questioned about knowledge of anthelminthic treatment and the risks that their herds were exposed to, if left undetected and untreated. A short structured questionnaire on personal biodata, and history of anthelminthic therapy, and housing of animals was administered to the participating proprietors/ranch attendants.

Data collection and training of data collectors:

Data collection took place at farms, cattle rearing ranches, livestock markets and pens. A team of principal research investigators comprising of a veterinary doctor, an agricultural economist, a clinical epidemiologist/research analyst, and animal health assistants went to each animal and followed a standard protocol for the physical examination and collection of compulsory samples. The animal health assistants were also trained in data collection and all questionnaires and data collection tools were piloted over about 12 months during the set-up phase of the project in the Niger Delta region. Color code marker was used to identify and link samples to individual animals to avoid duplication of samples obtained. At the diagnostic field laboratory in the study centers, data were downloaded from the hand held device to a database and cross-checked against the paper records and any discrepancies resolved with the principal research investigators and animal health assistants that collected the data and samples.

Fecal Sampling Technique:

Fecal samples were directly collected per rectum with new, unused gloves for each animal. Each sample was put in plastic containers with lids and labeled with animal identification record including the age (based on their teeth eruption and by asking the owner), sex, body condition

(thin, moderate and good) and information obtained were recorded with indelible pen and 10 ml of 3% formalin was added into sample container. Each of these specimens were stored in different universal containers and labeled appropriately before sending to the lab for examinations and appropriate analysis daily.

Coprological Examination/Laboratory Analysis:

The collected fecal samples were processed and examined using qualitative techniques (floatation and sedimentation) as described by Urquhart et al.[20] and quantitative parasitological techniques by using McMaster egg counting methods according to the standard procedures given by Soulsby [21] and MAFF [22] . Those fecal samples that were positive for *Strongyles*, *Trichuris*, *Toxocara*, and *Monezia* were subjected to egg output (eggs per gram, EPG) of feces count using McMaster egg counting technique, and the degree of infestation was categorized based on literature Aiello and Mays [23]. Sodium chloride was used as flotation fluid for this study. Data was first entered into Ms Excel program (Microsoft Corporation, USA) and screened for errors that might have occurred during the entry. Any error detected was corrected by rechecking against the original data forms. The data was analyzed using SPSS 15 version and Pearson chi-square data analysis method to determine the association of prevalence of each GIT helminths with location, anthelminthic treatment, and body condition and host factors like sex and age of the animal. Result $P<0.005$ was considered as significant differences. Some animals that presented with diarrhea, soft stools, flatulence, and weight loss, a fecal flotation with Zinc Sulfate (specific gravity 1.18) was used on these patients to rule out Giarida zoonotic potentials.

Ethical Approval and Consent:

Prior to commencement of study, standardized description of goals and procedure of study, data uses and protection for Animal Protection Rights were provided in both written and verbal form to all designated proprietors of cattle rearing ranches and pens and livestock markets, where cattle are being kept on arrival from the northern part of Nigeria before slaughter. The National Institutes of Health guidelines for care and use of animals and Guidelines on Ethical Standards for Investigation of Experiment in Animals (NIH, 1985) were followed. Proprietors were free to decline participation, or opt out completely and withdraw their livestock at any given time during the investigation without reprimands.

RESULT AND DISCUSSIONS

A total number of 4050 cows were investigated, 1975 (47.76%) were males, while 2075 (51.23%) were females, with the mean age ranging from > one year to nine years and above, as depicted in. Table I

Table I: Age – Specific Of Cattle Investigated N = 4050

Age Groups	Male Subjects % N = 1975	Female Subjects % N = 2075
(A) > One Year – Two Years	144(7.29)	214(10.31)
(B) Three Years – Four Years	685(34.68)	772(37.20)
(C) Five Years –Six Years	666(33.72)	787(37.92)
(D) Seven Years-Eight Years	360(18.22)	212(10.21)
E) Nine Years and Above	120(6.07)	90(4.33)
Total	1975	2075

Prevalence distribution of helminthes genera and percentage of the cows surveyed in each state is captioned in "Tables II".

Table II: Prevalence Distribution Of Helminthes Genera And Percentage In Each State Of The Niger Delta

State/Capital	Size%	Paramphist%	TV%	Trich%	Stgyl%	Monezia%	Fasciola%
Abia St (Umuahia)	459(11.33)	34(5.57)	3(7.14)	5(13.51)	58(11.00)	9(10.34)	77(11. 17)
Akwa Ibom St (Uyo)	324(8.00)	21(3.44)	2(4.76)	3(8.10)	60(11.38)	11(12.64)	67(9.72)
Bayelsa St (Yenegoa)	369(9.11)	47(7.70)	4(9.52)	5(13.51)	44(8. 35)	8(9.19)	72(10.44)
C/R St (Calabar)	517(12.76)	91(14.91)	5(11.90)	2(5.40)	75(14.23)	10(11.49)	3(0.43)
Delta St (Sapele)	524(12.93)	101(16.55)	5(11.90)	4(10. 81)	66(12.52)	12(13.79)	99(14.36)
Edo St (Benin)	611(15.08)	120(19.67)	10(23.81)	9(24.32)	45(8.53)	8(9.19)	101(14.65)
Imo St (Owerri)	349(8.61)	59(9.67)	4(9.52)	4(10. 81)	53(10.05)	9(10.34)	87(12.62)
Ondo St (Akure)	539(13.30)	70(11.47)	7(16.66)	3(8.10)	88(16.69)	13(14.94)	113 (16.4)
Rivers St (PH)	358(8.83)	67(10.98)	2(4.76)	2(5.40)	38(7.21)	7(8.04)	70(10.15)
Total	**4050**	**610 (15.06)**	**42(1.03)**	**37(0.91)**	**527(13.01)**	**87(2.14)**	**689(17.01)**

Acronym Interpretation: St = State; C/R = Cross River; PH = Port Harcourt; Paramphist = Paramphistomum; Stgy = Strongyle; Trich= Trichuris; TV = Toxocara Vitulorum

The present study revealed that an overall sum of 1992(49.18%) of the animals were infected while the break down prevalence of gastrointestinal helminths egg with respect to their genera were: *Fasciola* 689(17.01%), *Paramphistomum* 610(15.06%), *Strongyle* 527(13.01%), *Monezia* 87(2.14%), *Toxocara* 42(1.03%) *and Trichuris* 37(0. 91%) as is portrayed in "Table III"

Table III: Sex – Specific Prevalence Of Helminth Parasites In Cattle Surveyed N=

Helminths	Male Prevalence % N = 1975	Female Prevalence % N = 2075	(P= 0. 005)
Paramphistomum	330(16.70)	280 (13.49)	(P= 0. 005)
Toxocara	22(1.11)	20 (0.96)	(P= 0. 005)

Trichuris	20(1.01)	17(0.81)	(P= 0. 005)
Strongyle	278(14.07)	249(12.00)	(P= 0. 005)
Monezia	49(2.48)	38(1.83)	(P= 0. 005)
Fasciola	401(20.96)	288(17.59)	(P= 0. 005)
Total Infected	**1100(55.69)**	**892(42.98)**	

The incidence and mean burden of helminths parasite was sex related as many gastrointestinal (GI), helminths were found relatively higher in males than females "Table III". There was a mixed infection in all the animals studied as 807(40. 86%) male cattle had mixed infection while 583(28.09%) of the female cattle had mixed infection with a (P = 0.005) "Table IV".

Table IV: Prevalence of Mixed Infection In Cattle Surveyed By Sex N = 4050

Names of Helminths	**No. Infected % Male N=1975**	**No. Infected % Female N=2075**
Paramphist. & Stgy	57(2.88)	50(2.41)
Paramphist., Stgy &Trich	6(0.30)	4(0.19)
Paramphist., Stgyl & Monezia	6(0.30)	4(0.19)
Paramphist. & Trich	5(0.25)	(0.14)
Fasciola & Paramphist.	120(6.07)	98(4.72)
Fasciola & Stgy	360(18.22)	239(11.51)
Fasciola, Paramphist., Stgy & TV	15(0.76)	13(0.62)
Fasciola, Paramphist., Stgy &Trich	30(1.52)	25(1.20)
Fasciola, Stgy & TV	27(1.36)	19 (0.91)
Fasciola, Paramphist., & TV	6(0. 30)	4(0.19)
Fasciola, Stgy &Trichs	36(1.82)	31(1.50)
Fasciola, Stgyl & Monezia	7(0.35)	0.24)
Fasciola, Paramphist., & Stgy	98(4.96)	88(4.24
Stgy & TV	19(0.96)	17(0. 82)
Stgy & Trich	9(0. 45)	7(0.33)
Stgy & Monezia	6(0. 30)	4(0.19)
Total Infected	**807(40. 86)**	**583(28.09)**

Acronym Interpretation: Paramphist = Paramphistomum; Stgy = Strongyle; Trich= Trichuris, TV = Toxocara Vitulorum

Results from this study constitute the first documented information on helminths of veterinary importance in the urban/peri-urban environment of the Niger Delta Region in Nigeria; and it is of paramount importance in the formulation of appropriate control strategies against helminth parasites in livestock. This study was prompted by an apparent increase in the occurrence of helminthes in the Niger Delta Region, and therefore the need to obtain an accurate estimate of its prevalence and examine the role of the commonly practiced traditional management system of livestock industries. In this study *Fasciola* 689 (17.01%) and *Paramphistomum* 610(15.06%) were reflected as the most important trematodes among the sampled cattle, a feature which has been reported in other studies in other parts of the sub Saharan region[6]. Paramphistomosis and

Fasciolosis are two important parasitic diseases in livestock all over the world where they cause huge losses to production[7,8]. The nematodes observed in the livestock were Strongyles 257(13.01%), *Toxocara* 42 (1.03%), *and Trichuris* 37(0. 91%). The *Strongyles* are known to depress growth rates in cattle when burdens are sufficiently high. It is clear that a substantial number of cattle had moderate to high nematode loads. The low prevalence of *Trichuris* in this study may be ascribed to the fact that they require intermediate hosts to complete their life cycles, comparing the percentage derived from cattle, this disagrees with the report of Estcehiwet, this might be due to the study design in ecology, season, management system and sample size differences [9].

Human fasciolosis has been reported from different parts of the world[10, 11. 12]. Fasciolosis Infections are acquired from ingestion of infective metacercariae encysted on water growing plants such as watercress [12]. The Niger Delta region is highly vegetative with variety of water growing edible greens and the possibility of human infections. This warrants investigation, considering that, sanitation in many parts of this region is poor and drinking water is occasionally subject to contamination by feces of animal origin including bovines [13]. *Monezia* 87(2.14), is the only cestode in this study, the occurrence of this parasite elsewhere in the tropics and Nigeria in particular has been described. Though the economic and pathogenic significance of the parasite is not well understood, however in Tandon et al, *Monezia, Anoplocephala and Taeniid* were found [14].

The prevalence of sexual related difference depicted in "Table III", postulates a higher incidence of infection in males than in females in all examined livestock; the variation can be translated into differential exposure to infection because of the reduced resistance and thus greater parasite intensities with male breeds, which had significantly larger adrenal glands, testes and seminal vesicles correlated for their age [15]. Consequently, the sex-related differences in prevalence and mean abundance may be due to the hormonal activity of the host. Domestic ungulate males have been reported to be more susceptible to infections with gastrointestinal tract parasites than females [15]. This has been attributed to male hormones debilitating immune functions, thereby favoring the growth and success of parasites in their gut [15]. Findings are in close agreement with the investigation of Bilal *et al*, which reported a variation in high prevalence of helminthic infection in males more than females [15].

Incidence of mixed infection was outstandingly high in this study as 1390(34.32%) of the animals were found to be infected with more than one helminths parasite; with *Fasciola & Strongyle* 599(14.79%) being the highest followed by *Fasciola, Paramphistomum & stongyle*

186(5.3%*)* etc. The existence of more than one nematode species in a host has an additive pathogenic effect on the host, and pathogenicity is usually high [16]. The Niger Delta Region of Nigeria is geographically located where extremes of temperature and rainfall are experienced, altitude being the most common denominator, distribution and survival of parasite. This could be a crucial reason influencing the development of mix infection being on the high side, other studies recorded same association between sex and parasitic prevalence[6].

Seasonal variation differed significantly in this study as the result of the study demonstrated that there was higher prevalence of the infection recorded during rainy season; whereas the lower mean abundance of the parasite species was recorded in dry season as the survival of most of nematodes eggs is higher under moist conditions. Fatima *et al.* observed a high incidence of these parasites during rainy season and this may possibly be due to high moisture content and temperature which favor the growth and development of eggs/larvae of these parasites, furthermore, during this season the pastures grow abundantly resulting in increased contact between the host and parasites[17]. This finding is also in concordance with Kanyari *et al*, who postulated that the highest eggs per grams (EPG), of gastrointestinal helminthes is in March (Rainy Season) and the lowest in November (Dry Season) [18].

The presence of helminth parasites in livestock can be explained in the light of the animals' feeding habits, as nutrition played an important role in the rate of infection prevalence and mean abundance in the animals studied, as is illustrated in "Table V".

Table V: Overall Prevalence And Mean Abundance Of All Helminths Per Types Of Diets

Diet History	Male Subjects % N= 1975	Female Subjects % 2075
Grazed Diet	1150(58.22)	1103(53.15)
Stall Fed	825(41.77)	972(46. 84)
Total	1975	2075

There were variations in overall incidence of helminth infection with higher intensity noted in graze fed animals than stall fed animals. The ingestion of food contaminated with parasitic eggs and 3rd stage (L^3) is a common mode of transmission of geo-helminthic namatodes [18]. Given that most of helminths community is transmitted orally by ingesting the infective stage in contaminated food; moreover its high prevalence in graze fed animals may be caused by highly contaminated sites. As evidenced by Teka, the type of diet affects the faecal egg counts of nematode in cattle [19].

History of anthelminthic treatment was recorded in the animals which divulged that 924 (22. 81%) had history of anthelminthic therapy, while the rest 3126(77.18%) was recorded in the animal with no history of anthelminthic treatment and is illustrated in"Table VI", which

described the anthelmintic treatment parameter that was outstandingly significant in the study

Table VI: History of Athelminthic Therapy Administered On Cattle Studied N = 4050

Treatment History	Male Subjects % N=1975	Female Subjects % N= 2075
Number Treated	415(21.01)	509(24.53)
Number Not Treated	1560(78.98)	1566(75.46)
Total	1975	2075

Out of the 2082(51.40%) infected cattle, 924(22.81%) of prevalence was recorded in animals having history of anthelmintic therapy while, 3126(77.18%) had a zero history of anthelmintic therapy, which could be a rationale for the high number of the helmintic infection, perhaps even those that were treated with anthelminthic therapy and also were stall fed may have contacted the infection due to ingestion of contaminated food and water.

However, free anthelminthic therapy, (avermectin) Ivermectin 1ml per 50 kilogram (kg), was administered to participating cattle that tested positive during follow up session. Proprietors were encouraged to provide decontaminated water and stall for the livestock.

This study has, through coprological investigation revealed the prevalence of various internal parasites in cattle with higher infection rate in grazers than the stall fed cattle. All of these parasites have both pathogenic and zoonotic importance, it would be important to further characterize their known pathogenicity to human. In recent years, the parasites are potential pathogens especially to immunocompromised humans particularly those suffering from HIV/AIDS. In the Niger Delta Region, the prevalence of HIV/AIDS is relatively high and it would therefore be important to determine the prevalence of these parasites in humans and their origin. For a rational and sustainable helminth control program, comprehensive knowledge on the epidemiology of parasites, and how they relate with a given climate and management is a prerequisite. It would be important to determine the relationship between the occurrence of the parasite and environmental factors, since helminthic infestation is grouped as one of the neglected tropical diseases (NTD) that is perplexing our sub-urban communities.

Concerning limitations, several caveats are noteworthy. The investigators believe it is unlikely that a study of this magnitude could ever be conducted in Nigeria, given the level of knowledge deficits relatively common in the proprietors'/livestock traders, regarding universal livestock screening and ethical constraints for animal subjects, and fear of making our research findings public which could affect their investments. Access to sites, bad roads, poor transportation facilities to and from livestock centers and level of illiteracy were some of the limitation we encountered. These were partially overcome by providing free anthelminthic therapy to each

participant during each session after sample collection.

AUTHORS CONTRIBUTION:

Onyeachonam FCO, Aburoma HLS and Okuduwor AA, implemented the study design, involved in the acquisition of data and data analysis over the past 12 months. Aburoma HLS drafted the original text. All authors revised the manuscript, read and approved the final manuscript.

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LICENSE FOR PUBLICATION:

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