International Journal of TROPICAL DISEASE & Health
15(1): 1-12, 2016, Article no.IJTDH.24501
ISSN: 2278–1005, NLM ID: 101632866

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Soil Transmitted Helminths; Prevalence, Perception and Determinants among Primary School Children in Rural Enugu State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author ECA did the study design and wrote the protocol. Author ECA did the statistical analysis. Authors NDU and LNI did the literature searches while analyses of study was done by authors ECA and CO. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJTDH/2016/24501
Editor(s):
(1) Anthony R. Mawson, Public Health & Director Institute of Epidemiology & Health Services Research, Jackson State University, USA.
Reviewers:
(1) Mramba Nyindo, Kilimanjaro Christian Medical University College, Tanzania.
(2) Anonymous, University of Zambia, Zambia.
Complete Peer review History: http://sciencedomain.org/review-history/13744

Original Research Article

Received 23rd January 2016
Accepted 1st March 2016
Published 17th March 2016

ABSTRACT

Aim: The study was to explore parents knowledge and practice of deworming as well as prevalence of soil transmitted diseases and potential benefit of deworming among primary school children.
Study Design: Descriptive cross sectional study.
Place and Duration of Study: Selected public primary schools in Enugu state, Nigeria, between January and June 2013.
Methodology: Pupils and their parents eligible for voluntary participation were selected and

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studied. Parents were interviewed using questionnaires. Pupils stool were analyzed at baseline and after 3 months following deworming. Level of significance was at $p \leq 0.05$

Results: It was based on 859 pupils and 410 parents. The mean age of pupils was 9.50Â±2.10. Males > females. The mean age of parents was 30.47Â±5.47. Farming 166 (40.49) and trading 120 (29%) were their predominant occupation. At baseline 220 (25.6%) of the pupil were infected; Ascariasis 111 (12.95%), hookworm 42 (9.7%), mixed infection 9 (4.1%) and protozoa 20 (2.4%). Three months following deworming 24 (2.8%) were infested; Ascariasis 9 (1.0%), and hookworm 8 (0.9%), protozoa 8 (0.9%). There was no mixed infection detected. There was a significant difference in worm infestation at baseline and at 3 months following deworming ($p < 0.001$). Majority of their parents have heard of worm infection 364 (88.8%), knew about deworming 261 (63.7%), knew abdominal discomfort 247 (67.9%) and eating without gaining 191 (52.5) as features of worm infection, stated that worm infection can be contracted by walking barefoot 89 (24.5%) and through eating sweet foods 158 (43.3%). About 27 (13.5%) stays over a year before deworming their children. There was no significant association between socio-demographic variables of pupils, their parents, mean knowledge and practice of deworming with worm infection in pupil.

Conclusion: Knowledge and practice on worm infection and deworming were fairly good among the respondents studied. Prevalence of worm infection in this study was low. Deworming marginally reduced worm infection.

Keywords: Worm infestation; deworming; knowledge; practice; prevalence; worm infestation.

1. INTRODUCTION

Worm infection has plagued humans for centuries now [1]. This predates the era of our earliest recorded history and still poses a great threat to global health. Ova of intestinal helminths can be found in the mummified feces of humans dating back thousands of years [2-4]. The ancient writings of Hippocrates, Egyptian medical papyri, as well the Bible abound with many of the characteristic clinical features of helminth infestations [2-4].

Soil transmitted helminths is one of the leading Neglected Tropical Diseases due to its low mortality irrespective of its high morbidity even when compared with the so called “the big three,” including HIV/AIDS, tuberculosis, and malaria [5]. The diseases caused by helminths infection receives less than 1% of global research funds, [4]. The global burden of disease caused by these intestinal nematodes is estimated at 22.1 million disability adjusted life years (DALYs) lost to hookworm, 10.5 million to *A. lumbricoides*, 6.4 million to *T. trichiura*, giving a combined total of 39 million DALYs [6]. The disease burden is as great as that due to tuberculosis (34.7 million DALYs) or malaria (46.5 million DALYs) [5].

Worm infection is world-wide with increasing number of cases being reported from Europe and the USA [7]. However, Intestinal helminth infections are prevalent in most developing communities [8]. It is estimated that over one billion people living in developing regions of sub-Saharan Africa, Asia, and the Americas are infected with one or more helminthes [5,9] especially the very poor ones plagued with other diseases and living on less than two US dollars per day. It causes about five hundred thousand to one million deaths annually [9]. School-age children (including adolescents) and preschool children for reasons not well understood, compared with any other age group harbor some of the most intense infections. Of 246 children, aged 7–12 years, attending school in rural Guatemala, 91% carried *Ascaris lumbricoides* and 82% carried *Trichuris trichura* [10]. In Madagascar, a study revealed prevalence of 93% for *Ascaris lumbricoides*, 55% for *Trichuris trichiura* and 27% for Hookworm [11]. Findings have shown that about 50% of school children in semi-urban communities were infected by one or more helminths, the most prevalent STH being *Ascaris lumbricoides* (47.6%) [1]. Studies in Nigeria reported prevalence levels of between 17.8 to 87% in various parts of the country [12-16].

These infection produce adverse effects on health, growth, and learning ability with diminished physical fitness as well as impaired memory and cognition [17-19]. These adverse health consequences combine to impair childhood educational performance, reduce school attendance and subsequent productivity [20]. As Soil Transmitted Helminths (STHs) affect education and health it thus directly and indirectly has a negative impact on economic growth. Studies have shown that infection with hookworm

during childhood is associated with a 43% reduction in future wage-earning capacity [4,21]. While the Soil Transmitted Helminths promote poverty, poverty also promotes Soil Transmitted Helminths infections. This is evidenced by the fact in countries where STH infestations are endemic, afflicting much of the population, are the countries where sanitation system is lacking, i.e. lack of latrines, houses are poorly constructed (floors are not cemented) and inhabitants do not wear shoes. In pregnancy, worm infection are also important diseases causing neonatal prematurity, reduced neonatal birth weight, and increased maternal morbidity and mortality [22].

As some developing countries like Nigeria tend to make progress in achieving the Millennium Development Goal (MDG) 4 with goal to reduce child mortality and target to reduce by two-thirds the under-five mortality rate (U5MR) between 1990-2015 through successful vaccination programs, [23] these immunized children face new and continuing threats to their health. These affect their physical development and may also prevent them from taking full advantage of their opportunity for formal school education [24].

Although the World Health Organization (WHO) recommends deworming of school-age children as a feasible and cost-effective control strategy, [9] there is no policy-backed approach for helminth control in Nigeria. Ideally, we should have a functional school heath programme in all our schools, that would include deworming and health education. However, in practice, there were almost non-existent, especially in our rural schools. Even where there is one, it is usually physical examination and treatment of minor ailments that are established without deworming and focused health education [25]. This study would explore the parents knowledge and practice of deworming as well as prevalence of STHs and potential benefit of making deworming a routine in our primary schools in Enugu state, Nigeria.

2. MATERIALS AND METHODS

2.1 Setting

The study was carried out in selected public primary schools in rural Enugu state during rainy season. Enugu state is located in the southeast geopolitical zone of Nigeria with a total population of 4,881,500 people within a total area of 7,618 sq. km [26]. Politically, the state is divided into three senatorial district (Enugu East, Enugu North and Enugu west). The state has three urban centres; Enugu, Nsukka and Orji River. The inhabitants of Enugu state are predominantly Igbo and Christianity is practiced by most of them. The predominant occupations include farming, trading and civil/public servants.

2.2 Study Design

This was a descriptive Cross sectional study using interviewer administered Questionnaire for the parents or caregivers' of the pupil to know their socio-demographic factors, knowledge, and practice of deworming of their children. The pupils were equally dewormed and their worm infection ascertained before and after 3 months following deworming.

2.3 Sampling Technique

The multistage sampling technique was employed. In stage one, two out of three senatorial zones were selected by simple random sampling (Enugu North and Enugu West). Stage two, one Local Government Areas (LGAs) one from each selected senatorial zone was selected by simple random sampling (Nsukka LGA from Enugu North and Ezeagu LGA from Enugu West); and stage three, the communities in which the study schools are sited equally were selected by simple random sampling from the selected LGAs (Obukpa from Nsukka LGA and Mgbagbu Owa from Ezeagu LGA). Four (4) schools with about 450 pupils each from a particular community were studied. Every pupil in the selected schools was studied. (see Appendix for names of the schools).

2.4 Sample Size

This was determined using minimum sample size formula for descriptive study in population > 10,000 (adding power component). The prevalence of helminth infection was taken as 54.2%, from studies in different parts of the country [13-16]. Attrition rate of 10% was added. A total of 859 pupils with their corresponding 410 parents/caregivers were studied.

2.5 Study Participants

These comprised pupils irrespective of their age (age range 5-14 years) and their parents in selected government approved (public) primary schools as they harbor most of these parasites [10].

2.6 Study Instrument

1. Questionnaires: interviewer administered (for the pupils' parents or caregivers)
2. Laboratory kit including Universal bottle used to collect stool samples and Brine for stool analysis
3. Laboratory form for parasitology.
4. School records: attendance registers to aid in making sure that adequate sample size was studied and in labeling their names (initials) and numbers on the bottle for easy identification.
5. Checklist: Inspection of compound looking out for type of sewage and waste disposal, condition of the structure and sanitary nature, adequacy in terms of number and separate for sexes, water supply for washing hands after using the toilets or urinals, hand towel for cleaning hands and the surroundings of the entire compound.
6. Antihelminthics (Albendazole, a brand from FAMZY pharmaceuticals with trade name AXITOL) at dose of 400mg once were provided for all pupils. The administration of the drugs was supervised by the teachers or by their parents at home (for parents who objected to their wards being given medication in school). In such cases the pupils later brought the empty sachets to school for confirmation. Any complaint following the drugs was reported to the teachers by either the pupil or their parents and this was well documented by the research assistants.

2.7 Data Analysis

Data were collated and analyzed using Statistical Packages for Social Sciences (SPSS) version 18. Chisquare (Pearson and McNemar) as a statistical test of association or significance was used to measure associations and significance on the effects of the different variables on the observed worm infestation among the school children. The level of statistical significance was at 0.05.In course of the study, the proportions of correct responses were graded as: Good = 70% to 100%; Fair = 50% to 69%; and Poor = less than 50%.

2.8 Ethical Consideration

Ethical clearance was sought from the Health Research and Ethical Committee of University of Nigeria Teaching Hospital (UNTH), Ituku Ozalla. Permission was also sought and granted from the LGAs Educational Authority (LGEA) and the Parents Teachers Association (PTA) of the respective primary schools. Furthermore, informed consent was obtained from the pupils' parents/caregivers. The pupils were informed of the study, during which their cooperation was sought. Confidentiality was maintained in the entire study.

3. RESULTS

Table 1 shows mean age (standard deviation) of the pupil was 9.50 (2.10). Slightly higher proportion were males 452 (52.62%).

Table 2 shows that the predominant age range for parents and caregivers studied was 25 to 34 years (70.24%). Their mean age (standard deviation) was 30.47 **(**5.47) years. Over 80% of studied parents or caregivers were female. Over 80% had primary education. Farmers 166 (40.49) and traders 120 (29%) were the predominant occupation. About 75% of respondents had married and lives with husband. Majority (57.32) of the respondents have 1 to 2 pupils in the school. About 62.0% lived in 1 to 3 room apartment. While 50.73% used bush (Open space), 3.42% used pit latrine for sewage disposal. There was a similarity 20% in the sources of water supply.

Table 3 shows that 220 (25.6%) of the pupil were infected with the predominant worm being Ascariasis (roundworm) 111 (12.95%) followed by hookworm 42 (9.7%) at baseline. Among those infected 9 (4.1%) had mixed infection. Majority of pupil in both groups were not infected. In addition 20 (2.4%) had protozoa (*Entamoeba histolytica* and *Giardia lamblia*) infection. Following deworming and waiting period of 3 months, 24 (2.8%) were infected. Ascariasis and hookworm infection dropped to 9 (1.0%) and 8 (0.9%) respectively. None had mixed infection however 8 (0.9%) still had protozoa (*Entamoeba histolytica* and *Giardia lamblia*) infection. There were significant difference in worm infection at baseline and 3 months following deworming ($p < 0.001$).

Table 4 shows that majority of the respondents have heard of worm infection 364 (88.8%) and 261(63.7%) knew about deworming. About 247 (67.9%) of the parents knew abdominal discomfort as a feature while 191 (52.5) identified that the pupil infected with worm eat without gaining weight. Most of them also had poor knowledge of other features of worm infection

including, diarrhea, coughing and rashes. Majority of the parents has poor knowledge of mode of transmission of worm with just 89(24.5%) of their parents knowing that worm can be contacted by walking barefoot and 158(43.3%) believing that that it can be contacted through eating sweet foods. They have a fair correct knowledge of ways to prevent worm infection like washing foods properly 230(63.2%). However 244(67.0%) stated that it can be avoided by avowing sweet foods. About 134 (36.8%) and 132 (36.3%) of respondents heard from their parents and health staff of worm infestation respectively while 235 (64.6%) stated that it affects all ages.

Table 5 shows that of those who knew about deworming, 200(76.6%) have been deworming their children. While 114 (57.0%) have been deworming their children more than twice yearly, 27(13.5%) stays over a year before deworming their children. Of those who knew of deworming but have not been practicing it, 37 (60.7%) never deemed it necessary as they believe their children were not infested, while 4 (6.6%) tried it before and their children complained after the drugs.

Table 6 shows that there were no statistically significant association between socio-demographics of pupil with worm infestation; age in categories ($p = 0.424$) and sex ($p = 0.601$). Equally there were no statistically significant association between socio-demographics of their parents with worm infestation; age in categories ($p = 0.579$), sex ($p = 0.292$), educational level ($p = 0.435$), occupation ($p = 0.370$), marital status ($p = 0.969$) and number of children of school age ($p = 0.918$).

Table 7 shows that there were no statistically significant association between environmental variables of their parents with worm infestation; number of apartments ($\chi^2 = 0.841$, $p = 0.359$), sewage disposal method ($\chi^2 = 1.864$, $p = 0.601$) and source of water ($\chi^2 = 1.917$, $p = 0.590$).

There was also no statistically significant association mean knowledge ($\chi^2 = 0.327$, $p = 0.578$) and practice of deworming ($\chi^2 = 1.450$, $p = 0.249$).

Section A: Socio-demographic and environmental characteristics of pupils and their parents

Table 1. Socio-demographic and environmental characteristics of pupils and their parents

Socio-demographic characteristics	Frequency	Percent
PUPIL	**n = 859**	
Age in categories (years)		
5-9	521	60.65
≥ 10	338	39.35
Mean (SD)	**9.50(2.10)**	
Sex		
Male	452	52.62
Female	407	47.38

Table 2. Socio-demographic characteristics and environmental variables of parents

Socio-demographic characteristics	Frequency	Percent
Age in categories (years)		
15-24	46	11.22
25-34	288	70.24
35-44	76	18.54
Mean (SD)	**30.47(5.47)**	
Sex		
Male	77	18.78
Female	333	81.22
Educational level		
No formal education	71	17.32
Primary	191	46.59
Secondary	116	28.29
Tertiary	32	7.80

Socio-demographic characteristics	Frequency	Percent
Occupation		
Farmer	166	40.49
Artisan	38	9.27
Trader	120	29.27
C/P servant*	35	8.54
Housewife	51	12.44
Marital status		
Married with spouse**	304	74.15
Others***	106	25.85
Number of school age children		
1-2	235	57.32
≥3	175	42.68
Environmental variables		
Number of apartments		
1-3 rooms	252	61.46
➢ 3 rooms	158	38.54
Sewage method		
Bush (Open space)	208	50.73
Pit	178	43.42
Water closet	14	3.42
Bucket & Stream	10	2.44
Source of water		
Borehole	110	26.83
Stream	109	26.59
Pipe borne water#	84	20.49
Rain/well/tankers	107	26.10

Civil/Public servant; ** Married and lives with spouse; ***** Single, divorced, separated, widowed*
#Public water supply borne through pipe usually from government

Section B: Prevalence of STHs in school children

Table 3. Distribution of STH among pupil

Prevalent soil transmitted helminth	Frequency n = 859	Percent
Baseline (before deworming)		
Ascaris lumbricoides	111	12.95
Hookworm*	42	9.7
Trichuris trichiura	4	0.8
Strongyloides stercoralis	10	2.3
Mixed	**9**	**4.1**
Total infected	**176**	**20.4**
Protozoa**	20	2.4
After 3 months of deworming		
Ascaris lumbricoides	9	1.0
Hookworm*	8	0.9
Trichuris trichiura	3	0.4
Strongyloides stercoralis	4	0.5
Mixed	0	0.0
Total infested	24	2.8
Protozoa**	8	0.9
Comparison worm infestation at baseline and 3 months following deworming		
Baseline	176	20.4
3 months following deworming	24	2.8
	McNemar χ^2	**p < 0.001**

Hookworm (A. duodenale); Protozoa** (Entamoeba histolytica and Giardia lamblia)*

Section C: Questionnaire survey findings

Table 4. Knowledge of features of worm infestation, mode of transmission and prevention

Variables	N =410	
	Yes	No
	Freq (%)	Freq (%)
Ever heard of worm infestation	364(88.78)	46(11.22)
Knowledge about deworming	261(63.66)	149(36.34)
	Frequency	**Percent**
Features of worm infestation#	**n= 364***	
Abdominal discomfort/pain	247	67.86
Eating without gaining weight	191	52.47
Diarrhea	122	33.52
Coughing	68	18.68
Rashes	43	11.81
Mode of transmission#	**n= 364***	
Drinking water	203	55.77
Flies that perch on food	160	43.96
Eating sweet food eg banana,	158	43.41
Contaminated hand to mouth	169	46.43
Walking barefoot	89	24.45
Ways of prevention#	**n= 364***	
Washing food items properly especially ones taken raw	230	63.19
Washing hands after defecating	223	61.26
Avoiding sweet/sugarly foods eg banana	244	67.03
Source of knowledge (first)	**n= 364***	
Parents	134	36.81
Health staff	132	36.26
Friends/Neighbors	58	15.93
Social media/gathering. Eg church	40	10.99
Age infested most	**n= 364***	
All age	235	64.56
Children only	98	26.92
Adult only	31	8.52

*#Multiple choice; * Number that had ever heard of worm infestation*

Table 5. Practice of de-worming of their parents

Variables	Frequency	Percent
Those that have been practicing deworming*	**n = 261**	
Yes	**200**	76.63
No	**61**	23.37
If yes, frequency of deworming n =200	**n = 200**	
≥ 2 times yearly	114	57.00
Once yearly	59	29.50
> 1 year before deworming	27	13.50
If No, reason for not practicing it	**n = 61**	
Never deemed it necessary as my children are not infected	37	60.66
Cost of the drugs	12	19.67
Cannot see the drugs to buy	8	13.12
Tried it and my child had problem after the drug	4	6.56

***Number that knew about deworming*

Section D: Relationship between SHTs infection in children and parents demographics

Table 6. Associations between pupils and their parents' socio-demographic characteristics with worm infestation among pupil

Variables	Worm infestation (n=859)		Test statistic	p value
	Yes	No		
	Freq (%)	Freq (%)	χ^2	
PUPIL				
Age in categories (years)				
5-9	134(25.72)	387(74.28)	1.821	0.424
≥ 10	86(25.44)	252(74.56)		
Sex				
Male	111(24.56)	341(75.44)	0.593	0.601
Female	109(26.78)	298(73.22)		
Parent/Caregiver				
Age in categories				
15-24	20(23.80)	64(76.20)		
25-34	155(25.58)	451(74.42)	1.971	0.579
35-44	36(24.83)	109(75.17)		
>45	9(37.50)	15(62.50)		
Sex				
Male	35(22.29)	122(77.71)	1.110	0.292
Female	185(26.35)	517(73.65)		
Educational level				
No formal education	39(22.54)	134(77.46)		
Primary	104(25.74)	300(74.26)	2.732	0.435
Secondary	63(26.03)	179(73.97)		
Tertiary	14(35.00)	26(65.00)		
Occupation				
Farmer	81(24.25)	253(75.75)		
Artisan	24(32.88)	49(67.12)	4.273	0.370
Trader	61(23.28)	201(76.72)		
Civil/public servant	22(26.19)	62(73.81)		
Housewife	32(30.19)	74(69.81)		
Marital status				
Married & with spouse*	166(25.58)	483(74.42)	0.002	0.969
Others	54(25.71)	156(74.29)		
Number of children of school age				
1-3	195(25.56)	568(74.44)	0.011	0.918
>3	25(26.04)	71(73.96)		

**Married and still lives with spouse*

Table 7. Associations between environmental variables of parents, mean knowledge and practice of deworming with worm infestation among pupil

Variables	Worm infestation (n=859)		Test statistic	p value
	Yes	No		
	Freq (%)	Freq (%)	χ^2	
Number of apartments				
1-3	129(24.53)	397(75.47)	0.841	0.359
>3	91(27.33)	242(72.67)		
Sewage disposal method				
Pit	116(27.55)	305(72.45)		
Bush (Open)	91(23.39)	298976.61)	1.864	0.601
Water closet	7(26.92)	19(73.08)		
Bucket & stream	6(26.09)	17(73.91)		

Variables	Worm infestation (n=859)		Test statistic	p value
	Yes	No		
	Freq (%)	Freq (%)	χ^2	
Source of water				
Borehole	66(28.33)	167(71.67)		
Stream	52(22.71)	177(77.29)	1.917	0.590
Pipe borne water	43(25.75)	124(74.25)		
Rain/well/tankers	59(25.65)	171(74.35)		
Mean knowledge score				
Good	106(25.5)	314(74.5)	0.327	0.578
Low	114(25.95)	325(74.05)		
practice of deworming				
Good	84(26.45)	235(73.55)	1.450	0.249
Low	136(25.35)	404(74.65)		

4. DISCUSSION

In this study we recruited 859 primary school children (and 410 parents) aged 5 to 9 years with mean age of 9.50±2.10. This is in line with expected age for those in primary school. There were slightly more boys than girls. A study on primary school enrollment and gender gap of rural households' children in south western Nigeria, the probit model predicted a gender gap of 12.56% in favour of boys. Most of the gap is due to differences in the ways households perceive male and female children [27]. Other factors are tradition'- a tradition that attaches higher value to boys than girls. In Nigeria boys receive special favors to excel because they are considered apparent inheritors of family property.

About two thirds of their parents are in age range 25 to 34 years. This is expected as those in rural areas marry earlier than their urban mates who prefer to have established means of livelihood and its attendant stress before settling down with marriage. The literacy level among the parents was good compared with the Nigerian national because the Igbos respect highly the marriage instruction marriage and would go a long way to keep it intact average for adults aged 15-24 years and above (65% for females and 78% for males) [26]. This is good for the pupil and communities as educated or well informed mothers are well informed about the wellbeing, progress and development of their children [26,28]. Unsurprisingly, there are no government establishment, factories/industries nor agencies where they can work to earn a living so making them take to what is readily available, subsistence farming and petty trading. About two thirds of the women were married and lived with their husbands. This may be partly because the Igbos respect highly the marriage instruction marriage and would go a long way to keep it intact. Majority of the parents have 2 or 3 pupil in the school. It may due to the fact that the parents are young and of reproductive age from the age distribution given above or that it is the number they can fend due to the economic situation of the country.

While 50.73% uses bush (open space) method, 3.42% use pit latrine for sewage disposal. This is expected as bush method is commonly used in rural areas in the part of the country. A similar proportion (about 20.0%) used varied sources of water supply. The proportion is good for a typical rural setting in Nigeria and may contribute to the low prevalence of helminthes in the study population. About 25.6% of pupils were infected with the predominant worm being Ascariasis (roundworm) (13.0%) followed by hookworm (9.7%). However 2.4% had protozoa in their stool. Local studies in Nigeria on patterns of helminth infection in Enugu and other states on intestinal parasite infection in Ishiagu, Abia state had similar findings of total 23.6% Ascaris 8.7%, *Trichuris trichura* 3.1%, and total 34.7% Ascaris 17.80%, Hookworm 14.80% *Entamoeba histolyca* (3.70%) and *Trichuris trichiura* (2.3 %) [12,29]. Other studies outside Nigeria on prevalence, distribution and risk factors of intestinal helminthic infection done in district of Bagh (Azad kashmir) [30] and on intestinal helminthic infections among school children in Kathmandu Valley [31] equally had similar findings of total (21.7%) Ascaris (51.72%) hookworms (0%). *Hymenolepis nana* (27.59 %). *Entrobius vermicularis* (13.79%), Trichuris (3.45%) and total (34%) *Trichuris trichiura* (55%), *Ascaris lumbricoides* (26%), Hookworms (12%), *Hymenolepis nana* (5%) and *Strongyloides stercoralis* (2%). While some studies had a high total prevalence of 82.4%, 83.3% and 94.30% [14,32,33] others had low total prevalence of 16.9% and 11.8% [34,35].

Among those infected, 4.1% pupil had mixed infection. This is in variance with findings in other studies which found mixed infections of 56.7%, 37.5%, 11.8%, 1.9% and 1.54% [14,16,29, 36,37]. Majority of pupils in both groups were not infected. This is expected as most parents are learned and had fair to good knowledge about worm infection and deworming. They equally had a prevailing fair environmental condition in terms of in terms of availability of toilets and sewage disposal as well as source of water supply.

Following deworming, the worm infection dropped substantially to 2.8%. This is in agreement with findings of study conducted in Akoko-Edo Local Government Area of Edo State which was statistically significant χ^2 =13.92, $p < 0.05$) [33]. This shows that deworming alone reduced the worm infestation. A similar study in Gaza strip of Palestine study in which the children were divided into two groups the first group received treatment only but the second group received treatment and health education post intervention prevalence of intestinal parasites declined from 21.5% to 5.1%.

Majority of their parents had heard of worm infestation (88.8%) and de-worming (63.7%). They had an average good knowledge (about 60.0%) of ways to prevent worm infestation even though (67.0%) stated that it can be avoided by avowing sweet foods. A good proportion has been deworming their children. This is good and may have contributed to low prevalence of STHs from this study.

Neither age in categories nor sex of the pupils showed a statistically significant association with worm infestation in both group. Age range 5-9 was infected most. A study among Children in Delta State, Nigeria showed highest prevalence in age group 5-7 years which supports the finding while another study on among children of Kupwara district, Kashmir, India (a prospective study) showed that children in the age group of 8-11 years were mostly infected (26.92%) followed by the 4-7-year age group (24.03%) and 12-15-year age group (20.19%) [36].

Boys and girls were almost equally infected (B:G 24.6%: 25.4%). Another study had similar prevalence of 49.5% for males and 50.5% for females [31]. Some other studies showed differences in sex related prevalence with males more than females (M>F) 76.6%: 63.6% [36] and18.3%: 15.5% [34] while females had higher 76 (55.47%) compared to the males with the rate of 49 (39.84%) in a study in Ozubulu, Anambra State [16].

Age of parents did not show any association with worm infestation. Though most parents were females there were still no significant association and this is supported by study on prevalence, distribution and risk factors of intestinal helminthic infestation in district Bagh (Azad Kashmir) where gender of parents seems to play no role [30]. Over 80% of parents in both groups had at least primary education. While similar studies supports the findings that educational standard did not reduce positive rates of infection [30] others refute it showing that low educational level is associated with worm infestation [14,38]. The finding may likely be due to the fact that majority had formal education which would directly and indirectly influence their knowledge, attitude and practice on worm infestation as well as deworming.

The parents were mainly farmers and traders. Though there was no association in this study, some studies associated parents occupation with worm infestation such as farmers [16,33] keeping of pigs [38]. This is expected as such work involves coming in contact with soil and sewage which are either reservoir or source of worm transmission. These parents once infested have higher chance of transmitting it to their children. The study did not show any significant association between method of sewage disposal and method used to obtain water for domestic purposes. There was no significant association between parents' source of knowledge, knowledge of worm infestation, features of worm infestation, mode of transmission, age affected most, mode of prevention and practice as well as parents' knowledge of deworming and reasons for practice or non-practice of deworming with worm infestation in pupil. Studies done by other researchers showed significant associations between knowledge, attitude and practice. Such associations include: poor environmental sanitation walking barefoot was the only risk factor for hookworm infection while licking of fingers as well as drinking from well and surface tank were risk factors for *A. lumbricoides* and *T. trichiura* infections [39,40].

5. CONCLUSION

Prevalence of worm infection in this study was low compared to some studies in Nigeria, Africa and other parts of the world. The knowledge and practice on worm infestation and deworming were fairly good among the respondents studied. Male children enrollment in school was slightly higher than their female cohorts at primary school from the study. Literacy level of the

parents was generally good when compared to national average. Deworming marginally reduced the worm infection. Socio-demographic factors of the school children as well as that of their parents, knowledge and practice on worm infection were not associated with worm infection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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