

A STUDY ON ANCYLOSTOMIASIS PREVALENT AMONG 3 RURAL SETTINGS IN ELURU (WEST GODAVARI DISTRICT, A. P.)

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ABSTRACT

In this study area *Ancylostoma duodenale* infection prevailed in adults and children during summer, rainy and winter seasons. In Yanadigudem, females of 10-19 years age group was found as high risk age group in winter. In Vangayagudem, different age groups like 0-4, 5-9 and 10-19, 20-29, 40-49, 50-59, > 60 years showed lowest and highest prevalence of ancylostomiasis respectively. In Philhousepet, 32.5% of male children and 25% of men and 30.5% of women showed helminthic infection in rainy season. Much variation is seen in the prevalence of ancylostomiasis in rainy and winter seasons in all the age groups. The infected individuals were treated with Albendazole just after rainy season. Three weeks after antihelminthic treatment, the infection rate among them was lowered; health education also plays a role in reducing the % of infection.

INTRODUCTION

Prevalence of hookworm infections represents a major public health problem in tropical and subtropical parts of the developing countries (Ukpa and Ugwu, 2003). The large roundworm, *Ascaris lumbricoides* and the hookworms, *Ancylostoma duodenale* and *Necator americanus* occur in tropical and subtropical regions of Asia (Bundy, 1999). Soil transmitted helminthic infections result in severe morbidity mainly in school children because of their vulnerability to nutritional deficiency (Stephenson *et al.*, 1990; Adams *et al.*, 1994). Heavy infection of hookworms causes health problems in newborns, children, pregnant women and malnourished persons (Haburachak, 2006) and affect a significant proportion of World population (Olsen *et al.*, 2006). Hookworm infection is endemic in poor sanitation areas particularly in warm humid areas of the tropics and subtropics (Schad, 1991). Hookworm infection is transmitted via contaminated feces or urine (Adenusi and Ogunyomi, 2003) or direct penetration through skin (Albonico *et al.*, 2004). Hook worm infection causes anaemia and school children are more susceptible to this infection (Ayorinde, 2004). The prevalence of soil transmitted helminth infections was assessed among school children in South-Eastern Nigeria and found 16.9% of infection; stunted growth by 1.6m and 0.04 kg weight loss were recorded among infected children (Chigozie, 2007). Occurrence of intestinal geohelminthic infections namely *A. lumbricoides*, *A. duodenale*, *Strongyloides stercoralis*, *Taenia*, *Entamoeba* and *Giardia* were noticed in rural preschool children of administrative blocks of Khunti District, Jharkhand (India). Use of hand pump water and open air defecation, household crowding, uneducation and cattle ownership were mainly responsible for the prevalence of helminthiasis (Awasthi *et al.*, 2008). Stud-

ies on the prevalence and intensity of hookworm infections in a State specialist hospital in Ekiti, Nigeria revealed that both males and females of all ages are susceptible to hookworm infection but young children of males were found with higher infection than females (Adewole and Akingbolu, 2009). *Ancylostoma* infection was found as predominant infection in Jos-North local Govt. area of Plateau State Nigeria (Bala, 2010). Information on the prevalence and epidemiology of hookworm infection is lacking in South India. Therefore the present study is designed to estimate the prevalence of ancylostomiasis in rural population of 3 rural areas in Eluru, West Godavari District, Andhra Pradesh.

MATERIALS AND METHODS

Study areas

Yanadigudem, Vangayagudem and Philhousepet. Yanadigudem, Vangayagudem and Philhousepet located about 5 and 3 km of Eluru municipal corporation (West Godavari District) respectively. Yanadigudem is comprised only of the Yanadi Tribal population with a total of 246 individuals in 44 houses. The area is covered by paddy fields and the occupation is rag picking. People defecate in the open fields and behind their house yards. Fifty percent of the households have latrines using only for bathing and all the inhabitants defecate in the open places as a common practice. There being no water supply to houses, water is collected from a common tap which provides water once a day. Most of the houses have thatched houses.

Survey and analysis

At the beginning of the study, village programmes were initiated to create awareness among the people.

Sampling design

Stool samples from 240 subjects including 132 children (80 male and 52 female) and 108 adults (40 males and 68 females) belonging to Yanadigudem, 264 subjects having 92 children (36 males and 56 females) and 172 adults (92 males and 80 females) of Vangayagudem and 264 subjects having 128 children (40 males and 88 females) and 136 adults (64 males and 72 females) of Philhousepet were collected. Each of the stool samples were examined for helminthic infection.

Stool sample collection

Collection and examination of fecal samples was made as given in previous paper (Indira and Vardhani, 2009). Faecal sample collection was done in the morning in a labelled container. The samples were brought to the laboratory and processed within one hour. Fecal smears were made and examined for eggs of hook worms and other intestinal helminthes, by using direct smear method (Beaver, 1950). The intensity of infection was assessed by counting the number of eggs per gram (EPG) of faecal sample following Stoll's solution counting method (WHO, 1963) and infections were classified according to individual egg counts as heavy, moderate or light, following standard method (Renganathan et al., 1995). The species identification was determined on the basis of the morphological characteristics of the eggs of helminthic parasites.

The present epidemiological survey was carried out from March 2004 to April 2005 (on alternate days within 10 day period). The prevalence of infection was recorded in summer (March-June, 2004), rainy (July-Oct. 2004) and winter (Nov. 2004 – Feb. 2005) seasons. Immediately after the survey in rainy season, the infected individuals were treated with a single dose of Albendazole (500 mg) under the supervision of the Government medical practitioner. Stool examinations were carried out again and the prevalence of infection was recorded after 3 weeks period. Data were also collected on the living conditions of the infected individuals.

RESULTS

Prevalence of hookworm infection in Yanadigudem during the study period is shown in Tables 1 to 7. In summer season, of 132 children (Table 1) comprising 80 male and 52 female children of Yanadigudem, all the male and female children of 0-4 and 5-9 age groups were found negative and males and females of 10-19 showed 50.0% and 100% infection. One hundred and eight adults (Table 2) comprising of 40 males and 68 females (20-29 and 30-39 age groups showed 40.0% and 20.0% infection) showed 80.0% and 76.4% of infection (20-29, 30-39 and 40-49 age groups showed 100%, 100% and 75% of infection respectively). Males and females of 50-59 years were found negative.

In rainy season, 17.5% of males and 57.6% of females were found infected (Table 3). The age group of 5-9 years was identified as the high risk age group lodging 58.3% of infection. Females of 0-4, 5-9 and 10-19 age groups were infected with 50%, 50% and 66.6% of infection respectively. Of the 108 adults (Table 4), males (20-29 and 30-39 age groups harbored 100%) and females (40-49 and 50-59 age groups showed

75% and 25%) showed 82.5% and 76.4% of the helminthic infection. Highest prevalence rate was observed in females of 20-29 years with 90% and 30-39, 50-59 age groups with 60% and 50%.

In winter season, 2.5% males and 34.6% females were found infected with *A. duodenale* (Table 5). After treatment 0-4 and 10-19 years of males were found free of infection. 5-9 years age group was found infected with single infection of *A. duodenale* (8.3%). Females of the age group 10-19 years were found infected with 41.6% infection. The age groups of 0-4 and 5-9 have showed lower prevalence of 29.1% and 25% infection respectively. Of the 108 adults screened, the infection rate declined to 35.0% in males and 25.0% in females (Table 6). Males of 20-29 and 30-39 harbored 41.6% and 50.0% of infection. The age group of 40-49 showed 31.2% of infection. Males of above 60 years were free from the infection (0.1%); females harbored 30.0%, 15.0% and 25.0% of infection. Females of 20-29, 30-39 and 50-59 age groups harbored 30.0%, 15.0% and 25.0% of infection.

Season – wise prevalence

The maximum prevalence of 92.3% ancylostomiasis infection was noticed in both summer and rainy seasons in the age group of 20-29 years (Table 7). Maximum prevalence was noticed in 20-29 and 40-49 age groups. The incidence of infection was lower in all the age groups in winter season.

In summer season in Vangayagudem, of 92 children (comprising 36 males and 56 females) screened, all the males of different age groups were freed from of helminthic infection (Table 1). Whereas females of 5-9 and 10-19 age groups showed 25% and 37.5% infection. Out of 172 subjects examined, 92 males (20-29, 30-39, 40-49 and 50-59 age groups showed 25%, 20.0%, 75% and 50.0% infection respectively) and 80 females (20-29, 30-39 and 40-49 showed 50.0% each and above 60 years age group harbored 33.3% infection) showed 30.4% and 45% infection (Table 2). Males of above 60 years and females of 50-59 age groups did not show helminthic infection.

In rainy Season, males of 5-9 and 10-19 age groups showed 33.3% and 50.0% infection, while the children of 0-4 years were free from infection. Females of 5-9 and 10-19 age groups were negative for infection. Of 172 adults (Table 4) examined, males of 40-49 age group showed 100% of infection. 20-29, 30-39, 50-59 and >60 years age groups showed 50%, 20%, 50% and 33.3% of infection respectively. Females of 40-49 years had 100% of infection and that of 20-29, 30-39, 40-49 and >60 year age groups showed 40%, 56.2%, 87.5% and 58.3% of infection respectively.

In winter season, hookworm infection was found to be low in males of 5-9 (12.5%), 10-19 (25.0%) age groups (Table 5) when compared to the observations of before treatment. The age group of 0-4 years did not show helminthic infection females of 5-9 and 10-19 age groups showed 18.7% and 25% infection. Of 172 adults screened, (Table 6), the prevalence rate was low both in males and females. 15.2% of males and 20.0% of females were found infected. Males of 20-29, 30-39, 40-49, 50-59 and >60 years age groups showed 18.7%, 7.5%, 13.2%, 25%, and 8.3% infection respectively. In females of 20-29, 30-39, 40-49, 50-59 and >60 year age groups the infection rate was declined to 17.5%, 25.0%,

Table 1: Age and sex wise prevalence of *Ancylostoma duodenale* among children of Yanadigudem, Vangayagudem and Philhousepet in Eluru Town in summer season (Number in parenthesis indicates the sample size)

Sex	Age in years			Total	
	0 - 4	5 - 9	10 - 19		
In Yanadigudem					
Boys	0%(40)	0%(24)	50% (16)	10% (80)	No. of children tested – 132; No. of children infected–32; % of infection – 24.2
Girls	0%(24)	0%(4)	100%(24)	46.1% (52)	
Total	0%(64)	0%(28)	80% (40)	24.2%(132)	
In Vangayagudem					
Boys	0%(8)	0%(24)	0% (4)	0% (36)	No. of children tested – 92; No. of children infected–16; % of infection – 17.3
Girls	0%(8)	25%(16)	37.5%(32)	28.5% (88)	
Total	0%(16)	10%(40)	33.3%(36)	17.3% (92)	
In Philhousepet					
Boys	0%(8)	33.3%(12)	40% (20)	30.0% (40)	No. of children tested – 128; No. of children infected–20; % of infection – 15.6
Girls	0%(12)	0%(36)	20% (40)	9.0% (88)	
Total	0%(20)	8.3%(48)	26.6%(60)	15.6%(128)	

Table 2: Age and sex wise prevalence of *Ancylostoma duodenale* among adults of Yandigudem, Vangayagudem and Philhousepet in Eluru town in summer season (Number in parenthesis indicates the sample size)

Sex	Age in years					Total	
	20-29	30-39	40-49	50-59	> 60		
In Yanadigudem							
Men	100%(12)	100%(8)	75%(16)	0%(4)	-	80% (40)	No. of adults tested – 108; No. of adults infected–84; % of infection – 77.7
Women	90%(40)	80%(20)	-	0%(8)	-	76.4% (68)	
Total	92.3%(52)	85.7%(28)	75% (16)	0%(12)	-	77.7% (108)	
In Vangayagudem							
Men	25%(16)	20%(40)	75%(16)	50%(8)	0%(12)	30.4%(92)	No. of adults tested – 172; No. of adultsinfected–64; % of infection – 37.2
Women	50%(04)	50%(16)	50%(8)	0%(4)	33.3%(12)	45%(80)	
Total	42.8%(56)	28.5%(56)	66.6% (24)	33.3%(12)	16.6%(24)	37.2%(172)	
In Philhousepet							
Men	100%(4)	28.5%(28)	0%(16)	0%(8)	50%(8)	25% (64)	No. of adults tested – 136; No. of adultsinfected–32; % of infection – 23.5
Women	33.3%(24)	20%(20)	0%(8)	33.3%(12)	0%(8)	22.2%(72)	
Total	42.8%(28)	25%(48)	0% (24)	20%(20)	25%(16)	23.5% (136)	

Table 3: Age and sex wise prevalence of *Ancylostoma duodenale* among children of Yanadigudem, Vangayagudem and Philhousepet in Eluru town in rainy season (Number in parenthesis indicates the sample size)

Sex	Age in Years			Total	
	0 – 4	5 - 9	10 - 19		
In Yanadigudem					
Boys	0%(40)	58.3%(24)	0% (16)	17.5% (80)	No. of children tested -132; No. of children infected- 44; % of infection – 33.3
Girls	50%(24)	50%(4)	66.6% (24)	57.6% (52)	
Total	18.7%(64)	57.1%(28)	40% (40)	33.3% (132)	
In Vangayagudem					
Boys	0%(8)	33.3%(24)	50% (40)	27.7% (36)	No. of children tested - 92; No. of children infected -27; % of infection – 29.3
Girls	0%(8)	31.2%(16)	37.5% (32)	30.3% (56)	
Total	0%(16)	32.5%(40)	38.8% (36)	29.3% (92)	
In Philhousepet					
Boys	0%(8)	41.6%(12)	40% (20)	32.5% (40)	No. of children tested – 128; No. of children infected -23; % of infection – 17.9
Girls	8.3%(12)	0%(36)	22.5% (40)	11.3% (88)	
Total	5.0%(20)	10.4%(48)	28.3% (60)	17.9% (128)	

25.0%, 25.0%, 16.6% respectively.

Season – wise prevalence

The percent of prevalence of infection increased from summer season to rainy season in all the age groups (except 0-4 age group) with a maximum prevalence of 66.6% in summer season and 95.8% in rainy season in the age group of 40-49 years in both males and females (Table 7). Next higher prevalence (45.8%) was noticed in the age group of >60

years in rainy season. The minimum prevalence of 12.5% was found in both the age groups of 30-39 and >60 years in winter season.

In summer season in Philhousepet, out of 128 children (Table 7) 30.0% males, 9.0% females were infected with *A. duodenale*. Males of 5-9 and 10-19 age groups lodged of 33.3% and 40.0% infection; while the 0-4 age group children were free from helminthic infection.

Males of 20-29, 30-39 and above 60 years age groups had higher prevalence of *A. duodenale* (33.3%, 20%, 33.3%), 40-49 and 50-59 age groups were safe from the risk of helminthic infection (Table 1).

In rainy Season, of 128 children (40 males and 88 females), males of 5-9 and 10-19 years showed 41.6% and 40% of infection (Table 3), and females of 0-4 and 10-19 age groups showed 8.3% and 22.5% infection males of 0-4 years and females of 5-9 year group did not lodge infection.

Of 136 adults examined, males and females showed 25% and 30.5% infection respectively (Table 4). Males of 20-29

age group has higher prevalence of *A. duodenale* (100%) 30-39, 40-49 and >60 years showed 25%, 6.2% and 50.0% of infection respectively. 50-59 years were found negative for helminthic infection. Females of 20-29, 30-39, 50-59 and >60 years showed 41.6%, 30%, 41.6% and 12.5% of infection respectively. While 40-49 years were free from the risk of infection.

In winter season, of 128 children tested, males of 5-9 age group (33.3%) and 10-19 age group (30.0%) were found infected with single species of hookworm (Table 5). While 0-4 years were free of infection. Females of 10-19 years age

Table 4: Age and sex wise prevalence of *Ancylostoma duodenale* among adults of Yanadigudem, Vangayagudem and Philhousepet in Eluru town in rainy season (Number in parenthesis indicates the sample size)

Sex	Age in years					Total	
	20-29	30-39	40-49	50-59	> 60		
In Yanadigudem							
Men	100%(12)	100%(8)	75%(16)	25%(4)	-	82.5%(40)	No. of adults tested - 108; No. of adults infected - 85; % of infection - 78.7
Women	90%(40)	60%(16)	-	50%(8)	-	76.4% (68)	
Total	92.3%(52)	71.4%(28)	75% (16)	41.6%(12)	-	78.7% (108)	
In Vangayagudem							
Men	50%(16)	20%(40)	100%(16)	50%(8)	33.3%(12)	43.4%(92)	No. of adults tested - 172; No. of adults infected - 83; % of infection - 48.2
Women	40%(40)	56.2%(16)	87.5%(8)	100%(4)	58.3%(12)	53.7% (80)	
Total	42.8%(56)	30.3%(56)	95.8% (24)	66.6%(12)	45.8%(24)	48.2% (172)	
In Philhousepet							
Men	100%(4)	25%(28)	6.2%(16)	0%(8)	50%(8)	25%(64)	No. of adults tested - 136; No. of adults infected - 38; % of infection - 27.9
Women	41.6%(24)	30%(20)	0%(8)	41.6% (12)	12.5%(8)	30.5% (72)	
Total	50%(28)	27%(48)	4.5% (24)	25%(20)	31.2%(16)	27.9% (136)	

Table 5: Age and sex wise prevalence of *Ancylostoma duodenale* among children of Yanadigudem, Vangayagudem and Philhousepet in Eluru town in winter season (Number in parenthesis indicates the sample size)

Sex	Age in Years			Total	
	0 - 4	5 - 9	10 - 19		
In Yanadigudem					
Boys	0%(40)	8.3%(24)	0% (16)	2.5% (80)	No. of children tested -132; No. of children infected- 20; % of infection - 15.1
Girls	29.1%(24)	25%(4)	41.6% (24)	34.6% (52)	
Total	10.9%(64)	10.7%(28)	25% (40)	15.1% (132)	
In Vangayagudem					
Boys	0%(8)	12.5%(24)	25% (4)	11.1% (36)	No. of children tested - 92; No. of children infected -15; % of infection - 16.3
Girls	0%(8)	18.7%(16)	25% (32)	19.6% (56)	
Total	0%(16)	15%(40)	25% (36)	16.3% (92)	
In Philhousepet					
Boys	0%(8)	33.3%(12)	30% (20)	25% (40)	No. of children tested - 128; No. of children infected -18; % of infection - 14
Girls	0%(12)	0%(36)	20% (40)	9% (88)	
Total	0%(20)	8.3%(48)	23.3% 60)	14% (128)	

Table 6: Age and sex wise prevalence of *Ancylostoma duodenale* among adults of Yanadigudem, Vangayagudem and Philhousepet in Eluru town in winter season (Number in parenthesis indicates the sample size)

Sex	Age in Years					Total	
	20-29	30-39	40-49	50-59	> 60		
In Yanadigudem							
Men	41.6%(12)	50.0%(8)	31.2%(16)	0%(4)	-	35%(40)	No. of adults tested - 108; No. of adults infected -31; % of infection - 28.7
Women	30%(40)	15%(16)	-	25%(8)	-	25% (68)	
Total	32.6%(52)	25%(28)	31.2% (16)	16.6%(12)	-	28.7% (108)	
In Vangayagudem							
Men	18.7%(16)	7.5%(40)	31.2%(16)	25%(8)	8.3%(12)	15.2%(92)	No. of adults tested - 172; No. of adults infected - 30; % of infection - 20.5
Women	17.5%(40)	25%(16)	25%(8)	25%(4)	16.6%(12)	20% (80)	
Total	17.8%(56)	12.5%(56)	29.1% (24)	25%(12)	12.5%(24)	17.4% (172)	
In Philhousepet							
Men	75%(4)	21.4%(28)	0%(16)	0%(8)	37.5%(8)	18.75%(64)	No. of adults tested - 136; No. of adults infected - 28; % of infection - 20.5
Women	33.3%(24)	20%(20)	0%(8)	33.3%(12)	0%(8)	22.2% (27)	
Total	39.2%(28)	20.8%(48)	0% (24)	20%(20)	18.7%(16)	20.5% (136)	

Table 7: Age and season wise prevalence and intensity of ancylostomiasis in the study areas (based on stool examination) of Yanadigudem, Vangayagudem and Philhousepet

Age group	No. of subjects	A. duodenale infection %		
		Summer season	Rainy season	Winter season
In Yanadigudem				
0-4	64	0%	18.7%	10.9%
5-9	28	0%	57.1%	10.7%
10-19	40	80%	40%	25%
20-29	52	92.3%	92.3%	36.6%
30-39	28	85.7%	71.4%	25%
40-49	16	75%	75%	31.2%
50-59	12	12%	41.6%	16.6%
> 60	-	-	-	-
In Vangayagudem				
0-4	16	0%	0%	0%
5-9	40	10.0%	32.5%	15%
10-19	36	33.3%	38.8%	25%
20-29	56	42.8%	42.8%	17.8%
30-39	56	28.5%	30.3%	12.5%
40-49	24	66.6%	95.8%	29.1%
50-59	12	33.3%	66.6%	25%
> 60	24	16.6%	45.8%	12.5%
In Philhousepet				
0-4	20	0%	5%	0%
5-9	48	8.3%	10.4%	8.3%
10-19	60	26.6%	28.3%	23.3%
20-29	28	42.8%	50.0%	39.2%
30-39	48	25%	27%	20.8%
40-49	24	0%	4.1%	0%
50-59	20	20%	25%	20%
> 60	16	25%	31.2%	18.7%

group showed 20% of infection, the age group of 0-4 and 5-9 years were found negative for helminthic infection.

The prevalence of infection was found to be low in adults when compared to other seasons and before treatment. Males of 20-29, 30-39 and >60 years showed 75%, 21.4% and 37.5% infection respectively (Table 7). The age groups of 40-49 and 50-59 were found free of infection. Females of 20-29, 30-39 and 50-59 age groups showed 33.3%, 20.0% and 33.3% infection respectively. While 40-49 and >60 showed no infection.

Season – wise prevalence

Incidence of ancylostomiasis was higher in all the age groups in rainy season when compared to summer season (Table 7); this could be due to higher exposure stress. Comparatively lower incidence of ancylostomiasis was noticed in all the age groups in winter season.

DISCUSSION

The present survey on ancylostomiasis in three rural slum areas explain that the infection may go up to 67-100%. Unhygienic environment, consumption of improperly cooked or contaminated food / water may contribute to high prevalence of disease as suggested by Fernandez *et al.*, (2002) in rural children living in and around Chennai. *A. duodenale* infection prevailed throughout the year in all the subjects; this suggests the primary role of bad habits in people of study area. The high prevalence of infection in male children and male adults relates to the habits of working more in the fields and outdoors, and therefore, are prone to more infection as

compared to females. The % of prevalence of ancylostomiasis was found low in all the 3 slum areas in summer season.

In the present study (in Yanadigudem) children lodged more infection than adults in rainy season. Yadav and Tandon (1989) also reported a high prevalence of hookworm eggs/larvae in places where children are exposed. Also, Toma *et al.*, (1999) identified the age group of 4-14 years as the high risk group. Children and adults showed a decline of infection by winter season. The control of transmission of hookworm infection achieved in all the 3 slums with good medication, health education and promoting their social status.

In rainy season, in the population of Yanadigudem, male and female children of 0-4, 10-19 and male children of 5-9 years age groups were totally free of helminthic infection, while the females of age groups 0-4 (50.0%), 5-9 (50.0%) and 10-19 (66.6%) age groups harbored *A. duodenale* infection. Men of 20-29 and 30-39 age groups showed 100% *A. duodenale* infection, males of these age groups showed a higher rate of prevalence of infection suggesting an increased opportunity of exposure to contaminated food (with feces). With regard to children to adult ratio, the positivity of ancylostomiasis did not show much variation. Men of 20-29 and 30-39 year age groups were the high risk groups for ancylostomiasis and women of >60 years age groups were free of risk to ancylostomiasis. High prevalence of *A. duodenale* has also been recorded in other studies from Tamilnadu (Elkins *et al.*, 1986) and in fishing community in Eastern India (Bandyopadhyay, 1987).

In winter season, the females of 10-19 years age group were found as high risk age group (10-14 year age group represents

typical in lodging hookworm infection) as reported by Udonsi (1983) in Nigeria. The infection relates to semi urban epidemiology as they include coal miners and animal formers. Both the males and females of age groups 20-29, 30-39 and 40-49 years harbored heavy infection. Chemotherapy might have provided a cure but not check or predisposition of infection as suggested by Quinell *et al.*, (2001) in helminthic infections in rural population.

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REFERENCES

- Adams, E. J., Stephenson, L. S., Lantham, M. C. and Kinoti, S. N. 1994. Physical activity and growth of Kenyan School children with hookworm, and *Ascaris lumbricoides* infections are improved after treatment with Albendazole. *J. Nutrition*. **124**: 1199-1206. (s)
- Adenusi, A. A. and Ogunyomi, E. O. A. 2003. Relative prevalence of the human hookworm species, *Necator americanus* and *Ancylostoma duodenale* in an urban community in Ogun State, Nigeria. *African J. Biotechnology*. **2(11)**: 470 - 473.
- Adewole, S. O. and Akingbolu, I. A. 2009. Prevalence of intensity of hookworm infections in Ekiti, Nigeria; A cross sectional study in State Specialist Hospital and Federal Medical Centre. Bangladesh. *J. Scientific and Industrial Research*. **44(4)**: 399-402.
- Albonico, M., Stoltzfus, R., Savioli, L. and Tielsch, J. 2004. The epidemiology of hookworm infection and its contribution to anaemia among pre-school children on the Kenya coast. *Pub. Med. J.* **80**: 240-246.
- Awasthi, S., Verma, T., Kotecha, P. V., Venkatesh, V., Joshi, V. and Roy, S. 2008. Prevalence and risk factors associated with worm infestation in pre-school children (6-23 months) in selected blocks of Uttar Pradesh and Jharkhand, India. *Indian J. Medical Sciences*. **62(12)**: 484-491.
- Ayorinde, T. A. 2004. Studies on the prevalence and intensity of nematodiasis in school children in Ado-Ekiti, Excell. Pub. **20**: 5-17.
- Bala, A. Y. 2010. Relative prevalence of the human hookworm species, *Necator americanus* and *Ancylostoma duodenale* in Jos-North local Government Area of Plateau State. *Research J. Parasitology*. **5**: 18-22.
- Bandyopadhyay, A. K. 1987. Hookworm infection in man. In: Proceedings of workshop on intestinal parasitic diseases Calcutta, India. pp. 27 - 33.
- Beaver, P. C. 1950. The standardization of faecal smears for estimating egg production and worm burdens. *Journal of Parasitology*. **36**: 451 - 456.
- Bethony, J., Brooker, S., Albonico, M., Geiger, S.M., Loukas, A., Diemert, D., Hotez, P.J., 2006. soil-transmitted helminth infection: ascariasis, trichuriasis and hookworm. *Lancet*. **367(9521)**: 1521-1532(s).
- Bundy, D. A. P. 1999. Epidemiology and transmission of intestinal helminthes, in: Farthing MJG, Keusch GT and Wakelin D (Edn.), *Enteric infection 2, Intestinal Helminthes*, Chapman and Hall Medical.
- Chigozie, J. U., Kelvin, O. E., Patrick, G. O., Nelson, C. A. and Emmanuel, A. 2007. Soil-Transmitted helminth infection in school children in South-Eastern Nigeria: The public Health Implication. *The Internet J. Third World Medicine, ISSN 1539-4646*.
- Elkins, D. B., Elkins, M. H. and Anderson, R. M. 1986. The epidemiology and control of intestinal heminthes in the Pulicat lake region of South India. Study design and pre and post treatment of observation on *Ascaris lumbricoides* infections. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. **80**: 774-792.
- Fernandez, M. C., Susan, V., Bhuvanewari, R., Elizabeth, S. J., Mathew, T., Anitha, M. and Chitra, A. K. 2002. A comparative study of the intestinal parasites prevalent among children living in rural and urban settings in and around Chennai. *J. Communicable Diseases*. **34(1)**: 35.
- Haburachak, D. 2006. Hookworm of man Hlth. *Link. Pub.* **3**: 437-440.
- Indira, R. and Vardhani, V. V. 2009. Incidence of hookworm infection in people living in a slum area, Yanadigudem of Eluru, West Godavari District. Andhra Pradesh. *The Bioscan*. **4(3)**: 459-464.
- Olsen, A., Magnussen, P., Ouma, J. and Friss, H. 2006. The contribution of hookworm and other parasitic infection to haemoglobin and adults in Iron status among children and adults in Western Kenya. *Transactions of the Royal Society and Hygiene*. **11**: 643-649.
- Quinell, R. J., Griffin, J., Nowell, M. A., Raiko, A. and pritchand, D. I. 2001. Predisposition to hookworm infection in Papua, new guinea. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. **95(2)**: 139-142.
- Renganathan, E., Ercole, E., Albonico, M., Gregoria, G. De., Alawi, K. S., Kisumku, U. M. and Savioli, L. 1995. Evolution of operational research studies and development of a national control strategy against intestinal helminthes in Pemba Island, 1988 - 1992. *Bulletin of WHO*. **73(2)**: 183 - 190.
- Schad, G. A. 1991. Hookworm in tropical and Geographical medicine. Published by New York MC Craw hill. pp. 212-213.
- Stephenson, L. S., Lantham, M. C., Kinoti, S. N. and Brigham, H. 1990. Improvement in physical fitness of school boys infected with hookworm, *Trichuris trichura* and *Ascaris lumbricoides* following a single dose of Albendazole. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. **84**: 277-282. (s)
- Toma, A., Miyagi, I., Kamimura, K., Tokuyama, Y., Hasegawa, H., Selomo, M., Dahlan, D., Majid, I., Hasanudii, I., Nagatimin, R., Mogi, M. and Kuwabara, N. 1999. Questionnaire survey and prevalence of intestinal helminthic infections in Barru, Sulawesi, Indonesia. *Southeast Asian J. Tropical Medicine and Public Health*. **30** : 68 - 77.
- Udonsi, J. K. 1983. *Necator americanus*. A longitudinal study of an urban area in Nigeria. *Annals of Tropical Medicine and Parasitology*. **73**: 305 - 310.
- Ukpai, O. M. and Ugwu, C. O. 2003. The prevalence of gastrointestinal tract parasites in Primary school children in Ikwuano Government Area of Abia State, Nigeria. *Nigerian J. Parasitology*. **240**: 129-236.
- World Health Organization. 1963. CCT/WHO African conference on ancylostomiasis, *Technical Report Series* no. 666: 1-150.
- Yadav, A. K. and Tandon, V. 1989. Prevalence of Nematode eggs in the urban area of the city of Shillong, India - a public health problem. *Health and Hygiene*. **10**: 158 - 161.