

PREVALENCE OF WORM INFESTATION IN PATIENTS OF ANEMIA IN PEDIATRIC AGE GROUP.

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INTRODUCTION

Anemia is the most common hematological disease in children with highest prevalence in developing countries. ⁽¹⁾ Among the causes of anemia iron deficiency is the commonest. Almost one third of the world population has iron deficiency anemia and more than a third school children affected all over the world.⁽²⁾ Different studies in the Indian pediatric population have shown high prevalence of anemia varying from 27% to 90%.⁽³⁾ Environmental factors affecting the nutrition chiefly economic status, ethnic customs and geographic consideration influence the prevalence of anemia in different population ⁽⁴⁾.

Anemia is known to have severe consequences which are long lasting and possibly irreversible in children because their bodies are still developing, including the brain which is fastest developing organ in infancy and early childhood. The high prevalence and possible irreversible consequence of anemia have led international organizations like WHO, UNICEF as well as national agencies to make reduction and elimination a major goal.⁽⁵⁾ Several strategies like iron supplements, deworming, nutrition education have been implemented to achieve this goal.

Anemia is often associated with diseases such as malaria, round worm, hookworm infestations ^[6,7] Intestinal parasitic disease has been leading cause of anemia in developing countries: Improved hygiene and sanitation have reduced prevalence of worm infestation. ⁽⁸⁾ Government of India has initiated bi-annual deworming with albendazole to all children under the age of 18 years.

REVIEW OF LITERATURE

Anemia has been described way back in the 1500 BC in Papyrus Ebers, and Egyptian manual of therapeutics, believed to be the oldest complete manuscript existing. The knowledge of iron deficiency anemia and therapeutic use of iron was mentioned in Greek mythology in the story of "Iphiclus"⁽¹⁰⁾. Iron was introduced as a therapeutic agent with an idea that iron meant strength and protection.

The sufferer hoping to assume some strength was given wine or water in which sword was rusted. Centuries of research and discoveries have contributed to our knowledge.

WHO defines anemia as a reduction in red cell mass or blood hemoglobin concentration below the normal values for that particular age and sex.⁽¹¹⁾

WHO criteria for diagnosis of anemia⁽⁹⁾:

Children between 6 months to 5 years – less than 10.9 gram % of Hb.

Children between 5 years to 11 years – less than 11.4 gram % of Hb.

Adolescent male – less than 11.9 gram% of Hb

Adolescent female – less than 11.9 gram % of Hb

Worldwide, at any given moment, more individuals have iron-deficiency anemia than any other health problem⁽¹²⁾. Anemia is not a specific entity but rather can result from any number of underlying pathologic process. In order to narrow the diagnostic possibilities, anemia may be classified on the basis of morphology and/or physiology [Table 2]. Anemia is the most common morbidity among micronutrients and affects health, education, economy, and productivity of the entire nation. Anemia, like fever, is a manifestation and not a disease per se. The most common group among the causes for anemia is malnutrition and among that group, iron

deficiency makes up the bulk of it. A large portion of iron deficiency is preventable with appropriate and timely intervention. Iron deficiency is the most common nutritional disorder in the world. The numbers are staggering: two billion people – over 30% of the world's population – are anemic, mainly due to iron deficiency; and in developing countries this figure is frequently exacerbated by malaria and worm infestations. Iron deficiency affects more people than any other condition, constituting a public health epidemic. It exerts the heaviest overall toll in terms of ill-health, premature death, and lost earnings. The effects of anemia on children are the most dire because their bodies are still developing, including the brain, which is the fastest developing organ in infancy and early childhood. Anemias can be classified on the basis of RBC size as microcytic, normocytic and macrocytic.

Table 2: Causes of anemia ^(m):

| Microcytic | |
|--|---|
| Reticulocyte count | |
| Low | High |
| Iron deficiency | Thalassaemia syndrome |
| Thalassaemia trait | Hemoglobin C and E |
| Chronic disease Sideroblastic anemia Copper deficiency | |
| Normocytic | |
| Reticulocyte count | |
| Low | High |
| Chronic disease | Antibody mediated hemolysis |
| RBC aplasia | Hypersplenism |
| Malignancy | Microangiopathy (HUS, TTP, DIC) |
| Endocrinopathies | Membranopathies (spherocytosis, Elliptocytosis, ovalocytosis) |
| Renal failure | Enzymopathies (G6PD, PK deficiencies) |
| Acute Bleeding | Hemoglobinopathies |
| Hypersplenism | |
| Dyserythropoietic | |
| Hemophagocytic Syndromes | |

TABLE 2

| | |
|---|---|
| Macrocytic | |
| Reticulocyte count | |
| Low | High |
| Folate deficiency Vitamin B12 deficiency Acquired aplastic anemia Congenital aplastic anemia | Dyserythropoetic anemia Active hemolysis |
| Drug induced | |

Table 3

| |
|--|
| A) Iron Loss |
| Dysentery- Bacillary, amoebic |
| Recurrent bleeding |
| Worm infestation |
| Milk allergy |
| Diverticulum and polyps |
| Inflammatory bowel diseases |
| Hematuria |
| Celiac disease |
| Epistaxis |
| Ingestion of drugs |
| B) Inadequate dietary iron intake |
| Faulty Feeding practice. |
| Exclusive breast feeding after 6 months |
| Recurrent infestations |
| C) Impaired iron absorption |
| Achlorhydia |
| Celiac disease |
| Tropical sprue |
| D) Increased iron requirement |
| Preterm infant |
| Low birth weight |
| E) Causes unknown |
| Idiopathic hypochromic anemia |

Prevalence of Worm Infestation in Patients of Anemia in Pediatric Age Group

Iron deficiency, and the anemia that results from it, is a major health problem affecting more than 3.5 billion people in developing countries, reducing vitality for the young and old alike, and impairing the cognitive development of children. Anemia is most often a hidden deficiency, with a few overt symptoms.

Anemia has been a big problem in India and the National Family Health Survey (NFHS) III ⁽¹³⁾ data showed the prevalence of anemia among children less than five years of age to be around 70 % (Table 4). When we look at the data for anemia prevalence among children under three years of age, it jumps to 79% and this is five percent more than the NFHS II ⁽¹⁴⁾ survey done six years prior to the NFHS III survey, which was done in 2005 – 2006. However, it is noteworthy that there has been a slight reduction in the prevalence of severe anemia, while there has been an increase in the overall anemia, over the last seven years.

Studies done prior to 1985, in India, gave an average prevalence rate of 68% in pre-school children ⁽¹⁵⁻¹⁷⁾ The prevalence in different studies varied from 48 to 95%, placing all the states of India under the high magnitude category. However, this data is for children under five years of age and a specific age group of children under two years is not studied separately, where the prevalence is expected to be higher.

Study conducted at CMC Ludhiana in 1997 revealed a startlingly high prevalence of anemia among school children of upper and middle socio-economic classes. More than half (51.5%) of the total children studied were anemic. Among upper and upper middle class, 38% of the children had anemia although the mean Hb did show a rising trend with higher socio-economic status.

Thavraj and Reddy had also noted iron deficiency among 20% of healthy, non-anemic, high income group children ⁽¹⁸⁾.

Based on studies by the National Nutrition Monitoring Bureau, ⁽¹⁹⁾ anemia prevalence among children one to five years of age is around 66%, with a wide range of 33 to 93% across different states.

Prevalence of Worm Infestation in Patients of Anemia in Pediatric Age Group

Kotecha⁽²⁰⁾ studied anemia prevalence in children under three years of age in Vadodra urban slum and found anemia prevalence to be as high as 91%.

Table 4 NATIONAL FAMILY HEALTH SURVEY-3 FOR ANEMIA

| | Mild anemia | Moderate anemia | Severe anemia | Total anemia |
|-------------------|-------------|-----------------|---------------|--------------|
| India | 26.3 | 40.2 | 2.9 | 69.5 |
| North | | | | |
| Delhi | 26.3 | 30.0 | 0.7 | 57.0 |
| Haryana | 25.8 | 42.2 | 4.3 | 72.3 |
| Himachal Pradesh | 25.7 | 26.8 | 2.2 | 54.7 |
| Jammu and Kashmir | 25.8 | 30.4 | 2.4 | 58.6 |
| Punjab | 21.7 | 38.1 | 6.6 | 66.4 |
| Rajasthan | 22.8 | 40.2 | 6.7 | 69.7 |
| Uttaranchal | 28.5 | 30.6 | 2.3 | 61.4 |
| Central | | | | |
| Chhattisgarh | 24.0 | 45.2 | 2.0 | 71.2 |
| Madhya Pradesh | 27.1 | 43.6 | 3.4 | 74.1 |
| Uttar Pradesh | 25.4 | 45.0 | 3.6 | 73.9 |
| East | | | | |
| Bihar | 29.6 | 46.8 | 1.6 | 78.0 |
| Jharkhand | 29.3 | 39.1 | 1.9 | 70.3 |
| Orissa | 28.9 | 34.5 | 1.6 | 65.0 |
| West Bengal | 30.0 | 29.4 | 1.5 | 61.0 |
| Northeast | | | | |
| Arunachal Pradesh | 27.1 | 29.1 | 0.8 | 56.9 |
| Assam | 28.7 | 38.7 | 2.2 | 69.6 |
| Manipur | 25.6 | 15.2 | 0.3 | 41.1 |
| Meghalaya | 31.7 | 31.7 | 1.0 | 64.4 |
| Mizoram | 23.5 | 20.0 | 0.6 | 44.2 |
| Sikkim | 28.9 | 29.5 | 0.8 | 59.2 |
| Tripura | 27.5 | 34.6 | 0.7 | 62.9 |
| West | | | | |
| Goa | 19.5 | 17.1 | 1.5 | 38.2 |
| Gujarat | 25.0 | 41.1 | 3.6 | 69.7 |
| Maharashtra | 21.9 | 39.6 | 1.8 | 63.4 |
| South | | | | |
| Andhra Pradesh | 23.7 | 43.5 | 3.6 | 70.8 |
| Karnataka | 28.6 | 38.6 | 3.2 | 70.4 |
| Kerala | 23.5 | 20.5 | 0.5 | 44.5 |
| Tamil Nadu | 27.1 | 34.6 | 2.6 | 64.2 |

Source:⁽⁹⁾

Anemia is most common hematological problem in India, in which iron deficiency is commonest cause. It can be prevented by simple measures like

- Treating iron deficiency during pregnancy to ensure that the baby has a satisfactory hemoglobin concentration at the birth and good perinatal practice, e.g. late cord clamping and secured cord clamping.
- Introduction of foods containing good available iron during weaning.
- Supplementation with medicinal iron, particularly in preterm.
- Low birth weight infants and in children on low iron available diets, recurrent infestations and malnutrition is recommended.
- Control and treatment of conditions causing loss of iron from body like parasitic infestations and other disease states.
- Fortification of staple food e.g. cereals and formulas with iron.
- Education for dietary correction like after 6 months of age not more than 750ml of milk should be allowed, thereby lessening the dependency on milk and encouraging the consumption of iron rich food.
- Promotion of breast feeding due to high absorbability of breast milk iron;
- Enhancing the bioavailability of iron ingested by promoting the intake of iron absorption enhancers or reducing the ingestion of absorption inhibitors.

Impact of anemia on children:

Anemia is a serious condition that impacts cognitive development. The effects of iron deficiency that are observed in the first six months of life can lead to permanent brain damage.

An afflicted child is likely to remain vulnerable to infestation and continue to have lower immunity toward infection throughout childhood ⁽²⁰⁾. Also, the overall appetite is reduced and this vicious cycle perpetuates a series of events that must be stopped, to ensure the child's health.

Some investigators have examined the relationships between severity of anemia and developmental decline. In one study (Lozoff et al. 1987), a decline in concurrent motor development was found at hemoglobin values, 10.5 g/L, whereas a decline in mental development appeared at values, 10.0 g/L.

WORM INFESTATION:

Worm infestation rank among the most important health problem in developing countries. It causes anemia and malnutrition. It has also been observed that ankylostoma duodenale infestation is common in rural areas near rivers⁽²¹⁾. The common cause of iron deficiency anemia in adult male and post menopausal women is blood loss from GI tract, the commonest cause in India is ankylostoma duodenale infestation. Pre-school children are also prone to this parasitic infestation. Nearly 1/4th of the world population is infested with ankylostoma duodenale. It is estimated that ankylostomaduodenale alone is responsible for daily loss of blood equivalent to; total exsanguinations of about 1.5 million people⁽²²⁾.

Soil-transmitted helminthes are widely distributed in tropical and sub-tropical areas. Globally, more than 1, 500 million people suffer from these helminthes. Approximately 300 million people are estimated to be suffering from severe morbidity due to malnutrition and anemia^(23, 24). School aged children are at high risk for worm infestations because of their habit of playing in the dirt which may be contaminated with the infective stages of eggs/larvae and their lacks of good personal hygiene^(23, 25). Children in this age group are in a period of intense learning, but helminthic infestations hinder their performance, and may retard physical and mental growth and development⁽²³⁾.

The iron deficiency anemia that accompanies moderate and heavy ankylostoma duodenale burdens is sometimes referred to as hookworm disease⁽²⁶⁾. When host iron stores are depleted, the extent of iron deficiency anemia is linearly related to the intensity of ankylostoma duodenale infestation⁽²⁷⁾. Because of their underlying poor iron status, children, women of reproductive age, and pregnant women are frequently the ones most susceptible to developing hookworm anemia⁽²⁸⁾. Iron deficiency anemia during pregnancy has been linked to adverse maternal-fetal consequences, including prematurity, low birth weight, and impaired lactation⁽²⁹⁾.

In our country, intestinal infestation is one of the major health problems, because of its poor sanitary conditions. Habits of eating of uncooked food which may be contaminated, promiscuous defecation on the surface of ground, ignorance of hygiene and sanitation favour high incidence of

helminthic disease, social factors such as lack of health consciousness, illiteracy may cause a rapid spread of infestation in the community.

M. Yunus et al (1977) who had conducted a survey in the rural area near Aligarh observed that the problem of 15 parasitic infestations become more acute in rural areas because of the indifferent attitude of the population towards personal hygiene and prevailing poor environmental conditions along with low socioeconomic and low literacy status.

Helminthic infestation is common in children because of their habits and opportunity for exposure. Children are usually more heavily infested than adults and they are also principal seeders of the soil with ova of the roundworm, whip worm and hook worm because of promiscuous defecation.

Intestinal parasitic infestations cause a variety of clinical conditions, ranging from asymptomatic infestations to life threatening situations. Majority of the symptoms is related to gastrointestinal tract. They may present with manifestations like pain in abdomen etc., in some cases, an enlargement of liver or a palpable abdominal mass may be observed.

Intestinal parasitic infestations also cause generalized manifestations such as fever, breathlessness, allergic manifestations like urticarial rash, eosinophilia. They may also manifest as surgical emergencies, when infestations become advanced. The ascaris lumbricoides may cluster in a loop of the intestine and may present as a case of acute intestinal obstructions. Parasitic infestations often occur in conjunction with malnutrition.

Malnutrition is a major pediatric problem, and it is responsible for high rates of morbidity and mortality. At any given time, there are 80 million children suffering from malnutrition of which 3-4 percent suffers from severedegree of malnutrition. It is estimated that 80 percent of pre-school children are undernourished. In a vast majority of children mild to moderate malnutrition remain undetected and are hidden in the community, due to limited orientation and lack of awareness on the part of medical and paramedical workers to detect early malnutrition.

■ *Prevalence of Worm Infestation in Patients of Anemia in Pediatric Age Group*

A large proportion of pediatric problems are due to malnutrition and in considerable number of these, parasites are directly or indirectly responsible by using up nutrients, preventing the absorption of essential metabolites or by producing toxic reactions affecting efficient erythropoiesis (K.D.Ajawani et.al 1974).

Till the middle of the seventeenth century, knowledge of intestinal parasites was limited to the recognition of existence of the tapeworm, Ascaris and pinworms.

Most of the work on parasites was done during the first half of the nineteenth centuries when various new strains were discovered and further details of already identified parasites were studied.

PREVALENCE OF HELMINTHIC INFESTATION:

Worm infestation has been found to be more prevalent in the population where feces are used as agricultural fertilizer.

Owing to the greater opportunities for exposure, diseases produced by most animal parasites occur most frequently in children, a majority of who acquires the infestation by the age of one year in tropics. Furthermore, children are more likely to manifest acute evidence of these diseases, because in the early or tolerance to many of the parasites. (D.K. Guha. et. al 1979).

Ankylostoma :

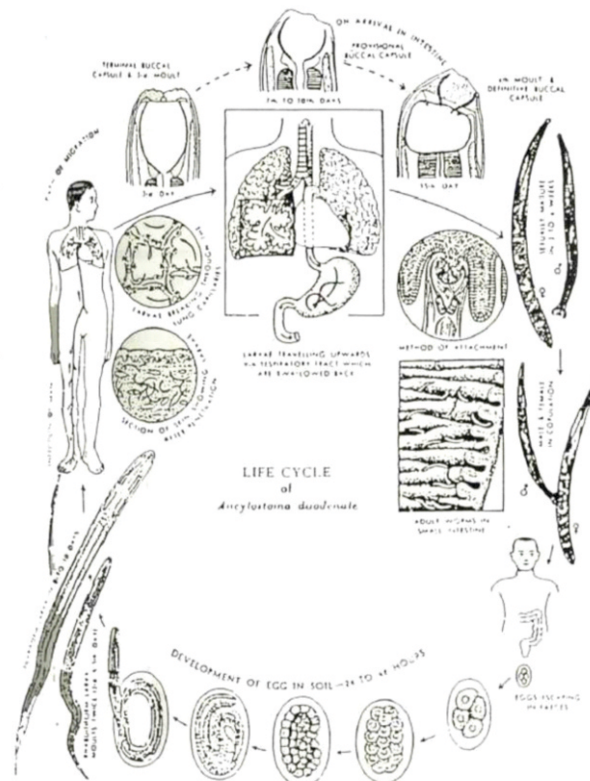
Ankylostoma duodenal was described by Dubini in 1843 and Creplin (1845). Stiles described Necator Americans in 1902. In 1878 grassi and Parona demonstrated that diagnosis of the infestation could be readily made by recovery of the characteristic eggs in the stools.

Stoll (1947) estimated that approximately one- fourth of the world's population suffers from hook worm infestation, including 359 million in Asia, 2.8 million in the USSR, 1.4 million in Tropical America and 1.8 million in North America (Craig & Faust's 1964). Ascaris and Ankylostoma are estimated to affect 25 percent of the world's population (D.K. Guha and S.K.Upadhyay, 1979).

Symptoms due to ankylostoma⁽³⁰⁾:

A. duodenale causes ankylostomiasis or hookworm disease. Most infestations are asymptomatic. Symptomatic infections are either due to larva or adults. Larvae produce pruritic maculopapular dermatitis at the site of skin penetration. Ground itch last for 3-4 weeks. Larvae migrating through the lungs can occasionally produce pneumonitis. This pulmonary lesion is rarely seen in hookworm disease. Adult *ankylostoma duodenale* produce epigastric pain, diarrhea and vomiting during early phase of infestation. Most important manifestation of *ankylostoma duodenale* infestation is microcytic hypochromic anemia. Adult worm sucks blood through the wound it produces during its attachment to the intestinal villi. A single adult *A. duodenale* sucks 0.2 ml of blood a day.

Utilize plasma as its food, while RBC's pass as they are through worm intestine. Worm change their feeding sites. It is important to note earlier site of attachment continues to bleed for length of time.



Ascaris:

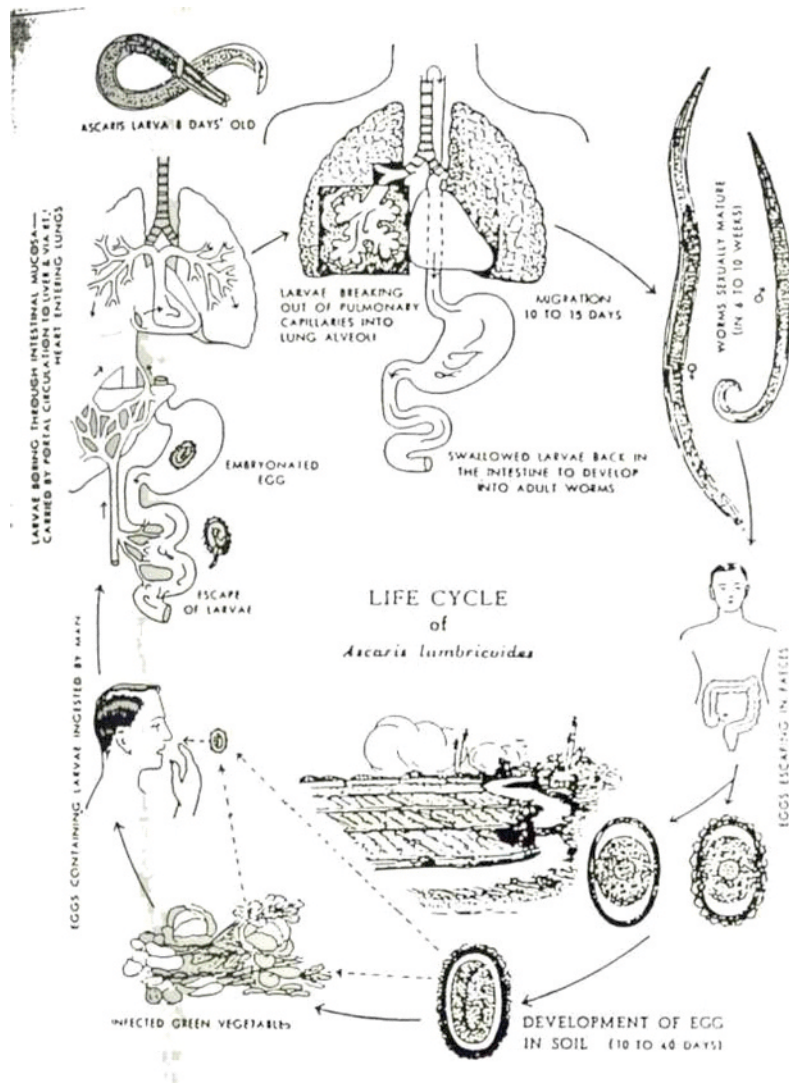
Ascaris is still cosmopolitan and its distribution is largely determined by local habits in disposal of faeces. Linnaeus first described *Ascaris lumbricoides* in 1758.

Occurring throughout the world, it affects an estimated 650 million persons but is most common in areas where sanitary practices are poor or non-existent. Possibly one in four of the world's population is infested with *Ascaris*. In central and South America the average rate of infestation is 45% and in parts of Africa 95 percent (Manson – Bahr. 1987).

Symptoms due to ascariasis⁽³⁰⁾:

A. lumbricoides causes ascariasis. The clinical manifestation of ascariasis is due to both larvae and adults. The migrating larvae produce symptoms and signs related mainly to the lungs. Patient develops non-productive cough, substernal discomfort and dyspnea. Occasionally, blood-tinged sputum may be expectorated. Fever, eosinophilia and urticaria accompany. These features are the result of larvae penetrating alveoli. Penetrating larvae produce microhaemorrhages and induce an eosinophilic response in the host. (Loeffler's pneumonia).

The adult worm may cause asymptomatic infection. But in some patients, especially in children, *A. lumbricoides* interferes with proper digestion and absorption of food. This may contribute to PEM and Vitamin A deficiency. Iron deficiency anemia may be seen in patients infected with *Ascaris*. Large numbers of entangled worms may cause intestinal obstruction which may be complicated by intussusceptions or volvulus. Worms may enter the appendix to cause appendicitis, may enter the ampulla of Vater leading to biliary colic, cholecystitis, cholangitis, pancreatitis and rarely intrahepatic abscess.



Various studies conducted in India for worm infestation: Study conducted in southern rural India by in 1998 Gagandeep kang etal⁽³¹⁾ has shown prevalence has shown prevalence of *A. duodenale* 61% and *Ascaris* 6%.

Retrospective study conducted in Bellary in 2009 by Narayan shrihari etal⁽³²⁾ has shown prevalence of *ascaris lumbricoide* 3.5% and *ankylostoma duodenale* 1.75%.

Prevalence of Worm Infestation in Patients of Anemia in Pediatric Age Group

Study of prevalence of worm infestation in Loni by Atul Aher et al⁽³³⁾ in district of Ahmednagar in 2011 has shown prevalence of ascaris 1.9% and A.duodenale 0.9%.

Relative prevalence of Ankylostoma duodenale:

| Authors | Year | Place | Prevalence |
|------------------------------|------|-------------|------------|
| B.R. Sannthana Krishna et al | 1974 | Madras | 00.20% |
| K.D.Ajawani et al | 1974 | Kanpur | 12.80% |
| Suraj Gupte | 1974 | Chandigarh | 05.30% |
| S.K.Kandle et al | 1988 | Maharashtra | 01.20% |
| M.Mahajan et al | 1991 | Delhi | 03.20% |
| B.Bhandari | 1985 | Udaipur | 10.80% |
| Awasthi | 2008 | Jharkhand | 03.90% |
| Dakshina et al | 2011 | Ghaziabad | 03.12% |

The Relative prevalence of Ascaris:

| Authors | Year | Place | Prevalence |
|------------------------------|------|-------------|------------|
| B.R. Sannthana Krishna et al | 1974 | Madras | 50.20% |
| K.D.Ajawani et al | 1974 | Kanpur | 39.60% |
| Suraj Gupte | 1974 | Chandigarh | 04.80% |
| S.K.Kandle et al | 1988 | Maharashtra | 0.00% |
| M.Mahajan et al | 1991 | Delhi | 0.00% |
| B.Bhandari | 1985 | Udaipur | 00.30% |
| Awasthi | 2008 | Jharkhand | 32.1% |
| Dakshina et al | 2011 | Ghaziabad | 6.25% |

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