***Hymenolepsis nana*: An Intestinal Cyclophyllidean Helminthes Parasite**

**Abstract:** The present investigation deals with most common intestinal helminthes parasite *Hymenolepis nana.* The cestode *H. nana* is commonly known as dwarf tapeworm. H. nana parasite consists of a scolex with 4 suckers, a neck and a strobila. The parasite is present all over the world in warm tropical & sub-tropical regions including Asia, Central & South America, Southern and Eastern Europe, Africa, Sudan, Australia, Northern England and India. The tapeworm mainly parasitizes rodent and human, especially children and producing Hymenolepiasis disease. *H. nana* affect more commonly to rodent than human beings. In human, especially in children, tapeworm is the major cause of mortality and morbidity. The infection of cyclophyllidean parasite is mostly seen in the developing country with inadequate sanitation, improper personal hygiene condition, lack of quality education, population growth and socioeconomic conditions. This is considered as zoonotic parasite as both intermediate host and infected rodents such as mice and rat acts as a reservoir of infection. The mode of transmission of zoonotic parasite is fecal-oral route. Major factors causing disease are lack of personal hygiene and safe water, overcrowding and poverty. The parasite host can also get infection through autoinfection, in which eggs are not pass out with fecal matter and adult propagate into intestine of same host. The infections are frequently asymptomatic but in heavy infection, this interrupts the normal gastrointestinal functioning which result into symptoms of abdominal pain, headache, weight loss, itching, nausea, jaundice, diarrhea, fever, allergic response and even also anemia. Anthelminthes drugs are used in the therapy of Hymenolepis disease, in which praziquantel is most effectively used drug.

**Keywords:** *Hymenolepis nana*, helminthes, cestode, tapeworm, zoonotic.

# Introduction

*Hymenolepis nana* is a very small size Cyclophyllidean helminthes parasite. This is tapeworm parasite is commonly found in the intestine. This species was first time introduced by Bilharz in 1851 in the

small intestine of a boy in Cairo. This is a cosmopolitan parasite in distribution which is transmitted from one person to another by fecal-oral route either by ingestion of contaminated food or by hands to mouth infection. Life cycle involves no intermediate host and transmitted from one person to another. It is found most common and endemic in worldwide including Asia, Southern and Eastern Europe, Central and South America, Brazil and Africa (Malheiros et al., 2014), Cusco region in Peru (Cabada et al., 2016), Maxico and Cuba (Cabello et al., 1991; Saurez-Hernandez et al., 1998), in Sudan (Abdel Hamid et al., 2015), Southern United States, Latin America, Hawaii, USSR and certain pacific Island groups (Sturchler,1988), India (Singh et al.,2024; Mirdha and Samantray, 2002) and Australia (Thompson,2015). Infection is commonly found in poor communities area where there is lack of safe water and sanitation or hygiene. *H. nana* causes Hymenolepiasis disease in human beings, especially in young children of low hygiene area (Schantz, 1996; Acha and Szyfres, 2003; Craig and Ito, 2007; Kim et al., 2014; Cabeza et al., 2015; Aguilar- Marcelino et al., 2023). Kandi et al, 2019 and Mirdha and Samantray, 2002; Singh et al.,2024 reported in their investigations that improper hand hygiene, inadequate sanitation, inadequate nutrition/nutrition deficiencies, open defecation, poverty/ low socioeconomic conditions and overcrowding are some reasons or factors that are responsible for causing Hymenolepiasis disease. Kandi et al, 2019; Mirdha and Samantray, 2002; and Singh et al., 2024 also reported in their investigation that improper hand hygiene, inadequate sanitation, inadequate nutrition/nutrition deficiencies, open defecation, poverty/ low socioeconomic conditions and overcrowding are some reasons/ factors that are responsible for causing Hymenolepiasis disease.

# Discription

*Hymenolepis nana* is also known as *Rodentolepis nana* or *Vampirolepis nana*. *H. nana* is a parasitic tapeworm of the intestine of vertebrates, which comes under the class Cestoda in the phylum Platyhelminthes. *H. nana* is a narrow, thread like tapeworm with dorso-ventrally flattened, bilaterally symmetrical, without body cavity. The Cestode broadly falls into two categories namely; Cyclophyllidean and Pseudophyllidean. *H. nana* comes under the Cyclophyllidean category. The Scolex of *H. nana* bear four cup like structures called suckers. On the basis of hook, suckers are of two types; armed and unarmed. The suckers which are having hook like structures called armed suckers while those who are not having hooks like structures are known as unarmed suckers. Kandi et al., 2019 revealed that only single row of hook is present in arm of the sucker of *H nana*. *H. nana* is commonly known as ‘dwarf tapeworm’ due to its small size which is about 2-4cm long and 1mm wide. The body of *H. nana* is divisible into head, neck, proglottids and gravid regions. The head of *H. nana* is having scolex bear suckers with a single circle of 20-30 hooks on its arm and a retractable

rostellum. The neck is long and slender. The proglottids region is wider than longer. The strobila is a chain of 100 to 200 segments called proglottids. On maturity, the gravid region contains approximate 100-200 eggs and gets shed off from the strobila containing 30-47μm egg. Baker, 2006 reported that the eggs are oval in shape, colour less and size varies from 44-62 µm by 30-55µm. The eggs contain oncospheres and are infective stage. The oncosperes larva (hexacanth embryo) is double layered and many hair-like filamentous structures arise from its inner membrane and have three pairs of small hooks (Baker, 2006). Al-Olayan et al., 2020 also reported that *H. nana* size varies from 15 to 40mm in length.

Malheiros et al., 2014 recorded that it is more prevalent in warm climate. The impact caused by the emergence of Hymenolepis as prevalent intestinal parasites deserves close scrutiny (Cabada et al., 2016). Cabeza et al., 2015 reported it as most common found cestode in humans with prevalence rates of 0.1%- 58% in Southern Spain. Muniz-Junqueira and Queiroz, 2002 reported that children infected with *H. nana* are better nutrition indicators and retinol levels than uninfected children/ children infected with other parasites.

**Life cycle of *Hymenolepis nana***

The Hymenolepis sp. shows two types of life cycles i.e. direct and indirect life cycle. *H. nana* show monogenic life cycle with single host either man, mice or rats. This also shows heterogenic life cycle involving arthropod (Kim et al., 2014; Cabeza et al., 2015; Panti et al., 2017 and Aguilar- Marcelino et al., 2023). Ito and buke, 2021 reported that human beings are definitive host and ingestion of contaminated food with embryonated eggs of parasites is the main source of infection and parasite show direct life cycle for its propagation. Schantz, 1996 recorded that this cestode parasite generally found in small intestine of humans which attach to the mucosa membrane of villi. Gutierrez and Ruiz, 2014 recorded in their investigation that in stomach, infective stage; eggs hatched by the action of gastric and biliary juices. These juices soften the wall of eggs results in the release of oncospheres which further penetrate the microvilli of small intestine. On fifth day, oncospheres larva converts into cysticercoids larva which is movable through jejunum and ileum and then changed into adult stage. In adult stage, gravid proglottids get detached and thus release eggs. The eggs emerge out from the lateral pores present on the proglottids and now these eggs are able to infect other host /same host via feces as shown in figure 1. Acha and Szyfres, 2003 reported that after sexual maturity, terminal segment become mature and called as gravid and release the eggs in gut. These eggs are directly infective stage and can survive in nature for up to 2 weeks. *H. nana* directly passes from one person to another through direct transmission (Lloyd, 1998). Cabada et al., 2016 reported that mode of transmission of parasites from one person to another is through fecal-

oral route without involving an intermediate host and tapeworm life span is 4-6 weeks. It can re- infect the host resulting into long lasting infection. Eggs are infective when get shed off.



Galan- Puchades, 2015 reported that indirect life cycle involves two types of hosts; definitive host and intermediate host and they also found that it mainly occurs in rodents and occasionally in human beings by accidently ingestion of coprophagus arthropods. Lloyd, 1998 and Al-Mekhlafi, 2020 reported that this is also found more commonly in arthropods like flour beetles genus *Tribolium confusum* and *Tenebrio molitor* and flea larva such as *Pulex irritans, Xenopsylla cheopis, Ctenocephallides canis* which act as primary intermediate hosts infected by eating of feces containing eggs. The eggs present in feces having cysticercoid larva, settled into heamocoel of the insect. When ingested by host definitive, they released and enter into ileum and then settle down into adult phase. Galan- Puchades 2015 also reported that host can also get infection through autoinfection. In this, eggs are not passed from host intestine through the fecal matter; these remain inside host intestine and develop into adult stage. The people with such infection are having slow intestinal movements and therefore, they stay for long period of time in host body. Acha and Szyfres, 2003 reported that human can be both definitive and intermediate host. Mahammad and Hegazi, 2007 reported that *H. nana* infection is found to be related with low absorption of vitamin B12 in the alimentary canal, mainly intestines. Ikumapayi et al, 2019 and Spinicci et al., 2018 recorded that Hymenolepiasis is also related with anemia as it causes impeded iron absorption and hemorrhage which is secondary to inflammation and penetration of mucosal membrane.

# Diagnosis

Diagnosis may be parasitological, clinical and molecular (Aguilar-Marcelino et al., 2022).

# Parasitological method:

Galos et al., 2022 reported that eggs can be examined under the microscope by examining the stool sample. Steinmann et al., 2012 suggested that a simple test tube floatation technique (FLOTAC) is used for copro- diagnostic purpose which is a reliable qualitative method. This method is used to detect the presence of cestodes (*H. nana, H. diminuta*) and also nematodes. *H. nana* eggs were observed in stool slide and found to appear to have a double membrane and differently diagnosed by measure egg diameter 30×47μm. Becker et al., 2011 reported that infection by H. nana is caused by self-infection through contaminated food or water with the eggs contained in faces and there are many type of stood examination methods: formalin-ether-concentration technique (FECT), Merthiolate-lodure-Formol technique (MIF), Kremer and Molet technique. Kremer and Molet, 1975 reported that Kato-Katz Technique, Direct analysis, Willis and Ritchie methods etc. are different method of diagnosis of *H. nana* infection. Kato-Katz technique is found most common method for the research of helminthes eggs. But Montresor et al., 2004 found that this method carried out easily and advisable technique for the survey. Poda, 2007 recorded that in Burkina Faso, *H. nana* is one of the disease causing agent of diarrhoea. Cabada et al., 2016 suggested that Albendazole mass chemotherapy is used to treat Hymenolepiasis (Horton, 2000; Jagota, 1986). And this treatment requires expansion of mass chemotherapy programs (SoaresMagalhaes et al., 2013). Praziquantel (25mg/kg) is higher efficacy and safety profile drug, therefore it is recommended for treating *H. nana* infestations given as a single dose and niclosamide (2kg/day) is used in doses for seven days.

# Clinical Method:

Kandi et al., 2019 reported that clinical diagnosis is based on clinical symptoms such as diarrhea, abdominal pain, anorexia and anal pruritus. Symptoms seen in patients are headache, dizziness, sleep disturbance, irritability, itching, weight loss, reduced growth and fever. Schantz, 1996 recorded that tapeworm also cause hyper-infection which can be cured by T lymphocyte –mediated immunity.

# Molecular Method:

Restriction Fragment Length Polymorphism (RFLP) and Polymerase Chain Reaction (PCR) are used to study nuclear ribosomal internal transcribed spacer 1 and spacer 2 (rDNA-ITS1 &rDNA-ITS2) and also used to differentiate closely related genera and species by Sharma et al. 2016 and Navone, 2007. To solving taxonomic problems, *H. nana* digested by enzymes; RasI, HaeIII, or Hhal and shown by

distinct restriction patterns. There were found a demarfication between the secondary folded structures of the two species *H. nana* and *H. diminuta* with length difference in helices. The pyrimidine-pyrimidine mismatch and sites of motifs occurrence were be found verifying. Cheng et al., 2016 and Sharma et al., 2016 demonstrated that mitochondrial genome sequences used as genetic markers for population genetics and systematic studies. Sharma et al., 2016 revealed that the mt. COX1 markers are efficiently used marker to determine the Cyclophyllidea phylogenetic relationship at family and genus levels. Yang et al., 2017 demonstrated the molecular diagnosis of *H. nana* in rat through PCR by amplification of the internal transcribed spacer2 (ITS2) region of the nuclear ribosomal RNA gene and Mitochondrial cytochrome C oxidase subunit1 (COXI) gene.

# Conclusion

*Hymenolepis nana* affects the children mainly living in inadequate sanitation areas. *Hymenolepis* seems to be a major cause of diarrhea; therefore safe water and good sanitation are very important to stop fecal contamination of food and water especially in overpopulated areas. Overpopulation is the major contributory factor to transmit the infection from human to human. Therefore, to prevent the infection, laboratory diagnosis and chemotherapy such as Anthelminthes therapy should be used to cure the disease as per the severity of clinical manifestation. To decrease the incidence of infection, rodent control, hygienic measures, personal education and periodic deworming programs of children should be done. This can be done either by governmental and non-governmental organizations. The people must be educated about the sanitation measures and also must eradicate rodents to prevent the transmission of disease.

**References**

1. Abdel Hamid M, Eljack I, Osmam M, ElaagipA, Muneer M. The prevalence of Hymenolepis nana among preschool children of displacement communities in Khartoum state, Sudan: a cross-sectional study. *Travel Med Infect Dis*. 2015,13: 172- 177
2. Al-OlayanE et al. Morphological, molecular and pathological appraisal of Hymenolepsis nana (Hymenolepididae) infecting laboratory mice (*Musmusculus*). *Microscopy and Microanalysis*. 2020, 26(20): 348-362.
3. Acha PN and Szyfres B. Zoonoses and communicable disease common to man and animals Vol III. Parsitoses.1st editor. Washington Pen American Health Organisation. 2003.
4. Aguilar-Marcelino l, Aguilar- Figueroa BR, Oropeza-Guzman G, Mendoza-Galvez B,

Bautista-Garfias CR and Viladomat GRC. Hymenolepiasis. In: Aguilar-Marcelino L, Younus M., Khan A, Saeed NM and Abbas RZ (eds), One Health Triad, *Unique Scientific Publishers*, *Faisalabad, Pakistan. 2023*, 3: 122-127.

1. Baker DG. Parasitic diseases. The laboratory rat (second Edition) *Amrc. College of lab. Animal Med.* 2006*, pp: 453-478.*
2. Cabada MM, Morales, Lopez M et. al. Hymenolepis nana impact among children in the highlands of Cusco, Peru: An emerging neglected parasites infection. *Am. J Trop Med Hyg.* 2016, 95(5): 1031-1036.
3. Craig P and Ito A. Intestinal cestodes. *Curr Opin Infect Dis*. 2007, 20: 524-532.
4. Romero-Cabello R, Godinez-Hana L, Gutierrez-Quiroz M. Clinical aspects of hymenolepiasis in pediatrics. *Bol Med Hosp Infant Mex 1991*. 48: 101-105
5. Kandi V, Koka SS, Bhoomigari MR. Hymenolepiasis in a pregnant woman: A case report of Hymenolepis nana infection. *Cureus*. 2019, 11: e3810
6. Kim BJ. et al. Heavy Hymenolepsis nana infection possibly through organic foods: report of a case. *Korean J Parasitol*. 2014, 52(1): 85-87.
7. Lloyd S. Other cestode infections: Hymenolepiosis, Diphyllobothriosis, Coenurosis and other adult and larval cestodes. In Zoonoses. S.R. Palmer, L. Soulsby and D.L.H. Simpson (Eds). Oxford University Press.1998, pp: 651-663
8. Mirdha BR, Samantray JC. *Hymenolepis nana*: A common cause of pediatric diarrhea in Urban slum dwellers in India. *J Trop Pediatr*. 2002. 48: 331-334.
9. Menna-TalaZakairiaAbd-Elrahman, Amal SM Sayad, DoaaAbdelhafezYounes, Alam El-Din Mohamed Abdallah Ahmed, SamiaQasemAlghamdi, Amira A Saleh, Hind Alzaylaee, Manal F El-khadragy, EhabKotbElmahallawy. Morphological and molecular identification of *hymenolepis* spp. in *Rattusrattus* and children with diarrhea from Upper Egypt. *J infectDevCtries*. 2024, 18(10): 1601-1609. DOI:10.3855/jidc.18462.
10. Cabeza M I et al. Hymenolepis nana infection: associated factors with this parasitism in a health area of Southern Spain. *Revista Chilena de Ifectologia. 2015*, 32(5): 593- 595.
11. Peralla RDC, MazambaMde LS, Gomez PJP, Collguazo DMC, Landires EAG and Ramallo G.Hymenolepiasis Caused by Hymenolepis nana in Humans and Natural Infection in Rodents in a Marginal Urban Sector of Guayaquil, Ecuador. *Am. J Case Rep*. 2023, 24: e939476. DOI: 10.12659/AJCR.939476.
12. Schantz PM. Tapeworms (Cestodiasis). *Gastroenterol. Clin. N. Am*.1996. 25(3): 637-

653.

1. Singh S., Sen M., Raj N., Singh R., Agarwal J. Hymenolepis nana:a case report of an intestinal helminthic infection from Northern India. *MGM J Med Sci. 2024,* 11: 808- 810. DOI:10.4103/mgmj.mgmj\_55\_24
2. Spinicci M, Macchioni F, Gabrielli S, Rojo D, Gamboa H, VillagrianAL,et al. *Hymenolepis nana*- an emerging intestinal parasite associated with anemia in school children from the Bolivian Chaco. *Am J Trop Med Hyg.2018,* 99: 1598-1601.
3. Ikumapayi UN, SAnyang C, Pereira DI. A case report of an intestinal helminthes infection of human hymenolepiasis in Rural Gambia. *Clin Med Rev Case Rep*. 2019, 6: 251.
4. Muniz-Junqueira MI, Queiroz EF. Relationship between protein-energy malnutrition, vitamin A and parasitoses in children living in Brasilia. *Rev Soc Bras Med Trop*. 2002.35:133-142.
5. Thompson RCA. Neglected zoonotic helminthes: *Hymenolepis nana*, *Echinococcuscanadensis* and *Ancylostomaceylanicum*. *ClinMicrobiol Infect*. 2015, 21: 426-432.
6. Panti-May JA et al. A survey of zoonotic pathogens carried by house moth and Black rat puppulation inYacana, Mexico. *Epidemiology and infection*. 2017, 145(1): 2287- 2295.
7. Cheng T, Gao DZ, Zhu WN, Fang SF, Chen N, Zhu XQ, Liu GH, Lin RO. Genetic variability among Hymenolepis nana isolates from different geographical region in china revealed by sequence analysis of three mitochondrial genes. J DNA Map. Seq., Anal. 2016, 27(6): 4646-4650.
8. Sharma S, Lyngdoh D, Roy B, Tandon V. Differnetial diagnosis and molecular characterization of Hymenolepis nana and Hymenolepis diminuta (Cestoda: Cyclophyllidea: Hymenolepididae) based on nuclear rDNA ITS2 gene marker. *Parasitol Res.* 2016, 115: 4293-4298.
9. Suarez-Hernandez M, Bonet-Couce E, Diaz-Gonzalez M, Ocampo-Ruiz I, Vidal- Garcia I. Epidemiology study on Hymenolepis nana infection in Ciego de Avila Prvince, Cuba. *Bol Chl Parasitol.* 1998, 53: 31-34.
10. Galan-Puchades MT. Hymenolepis nana vs. *Taeniasolium* life cycle. *Parasite Immunology1. 2015*, 37(8): 429.
11. Guteirrez M and Ruiz. Hymenoepiaisis. En BecerrilM, editor. Parasitoloosia Medica: Mexico, McGraw Hill Education. 2014, pp: 171-175.
12. Yang D, Zhao W, Zhang Y, Liu A. Prevalence of Hymenolepis nana and H. diminuta from Brown Rats (Rattus norvegicus) in Heilogjiang Governorate. *Korean J Parasitol*. 2017, 55(3): 351-355.
13. SoaresMagalhaes RJ, Fancony C, Gamboa D, Langa AJ, Sousa-Figueiredo JC, Clements AC, VazNery S. Extending helminth control beyond STH and Shistosomiasis: the case of human Hymenolepiasis. *Plos Negi Trop Dis.2013,* 7: 1-4.
14. Mohammad MA, Hegazi MA. (2007). Intestinal permeability in Hymenolepis nana as reflected by non invasive lactulose/ mannitol dual permeability test and its impaction on nutritional parameters of patients. *J Egypt Soc Parasitol*.2007, 37: 877-892
15. Galos F et al. *Hymenolepis diminuta* infection in a Romanian child from an urban area. Pathogens. 2022, 11: 322.
16. Horton J. Albendazole: a review of anthelminthic efficacy and safety in humans. Parasitology. 2000, 121(Suppl): S113-S132.
17. Jagota SC. Albendazole, a broad spectrum anthelmintic in treatment of intestinal nematode and cestode infection: a multicenter study in 480 patients. *Clin Ther 1986,* 8: 226-231.