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Epidemiological Study of dwarf tapeworm *Hymenolepis nana* in Najaf province / Iraq

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Abstract
The infection rate with *Hymenolepis nana* in Najaf province was 446 (1.79%) from the results of about 24.800 stool samples from different parts of Najaf province were examined by direct wet mount methodin Al-Sadder Medical City, Al-Hakeem Hospital, Al-Zahraa children and Maternity Hospital, Al-Menathera Hospital and Al-Sajad Hospital, in addition to medical centers and private clinics in province . This study was conducted during September 2013 to September 2014 . A questionnaire sheet, shown in appendix was filled for each individual studies . There was no significant difference ($p< 0.05$)in the rate of infection between male and female and there was a significant difference ($p<0.05$) between infected patients (6-12 years) in comparison with other age distribution . It was found that 20% of 150 house mouse *Mus musculus* were infected with *H.nana* . The highest rate of the total infection was 7.34% in grain stores and the lowest rate (4%) in restaurants .
Key Words: *H.nana* and epidemiology .

Introduction
Worldwide *H . nana* is found in tropics and subtropics; it most commonly occurs in children and in institutionalized people living in close quarters (1) . Transmission of*H . nana* occurs by the fecal-oral route, accounting for higher prevalence in young children and adolescents with poorly developed hygiene skills (2) . Estimates of viability of *H . nana* eggs in the external environment range from 17 hours (3) to 10 days (4), suggesting the transmission of *H . nana* via environmental contamination may be lower than by the transfer of eggs on contaminated hands and / or food shared between children (4) . Accidental ingestion of an intermediate host infected with resting cysticercoid stage is an alternative host infected with the resting cysticercoid stage is an alternative route transmission (5), although this is considered a rare occurrence by some (6) . For this to occur, *Tribolium* beetles infected with *Hymenolepis* cysticercoids would have to be ingested by the definitive host (7) . *Tribolium* beetles may be present in flour stored over long periods of time at room temperature, representing a source of contamination of *Hymenolepis* spp . The practice of swallowing live beetles is a Chinese folk medicine remedy practiced in areas of Malaysia and has been reported as potential source of transmission for *Hymenolepis* infections (8) . This is unlikely, however, to represent a major source of infection unless this practices is widespread in areas endemic for the infection . The successful transmission of *H . nana* between hosts is reliant on a number of factors that effectively aid its dispersal in "space and time" . The continuous shedding of eggs (iteroparity) from the adult worms of *H . nana* is a factor that almost certainly aids its dispersal over time (9) . Furthermore, the development of resting stages (cysticercoids) in inset species enables *H .nana* to persist in the environment even when condition become unfavorable for the egg stage (9) . Importantly, if a definitive host is temporarily unavailable, the dispersal of *H.nana* can be effectively delayed without adverse effects . Other factors which may aid in the dispersal of *H.nana* include the well documented behavioral changes that some hosts exhibit when infected with parasite stages (10, 11, &12) . For example, (13) reports an increase in coprophagic activity of the grain beetle *Tenebrio molitor* when fed feces infected with eggs of the rat tapeworm *H.diminuta* . It has also been shown that beetles infected with cysticercoids of *H.diminuta* have impaired chemical defense mechanism and are more likely to be ingested by a definitive host than infected beetles (14) . Due to its capability of development via both an indirect life cycle *H.nana*has the added advantage over other Hymenolepiasis in that it can adopt more than one strategy for transmission, a situation unique, with the cestodes, to this parasite (15) . Thus, *H.nana* increases its chances of dispersal over time by using alternative life cycle . This would greatly aid in the persistence infection in community even if

susceptible hosts of only one type were present . The aim of this study toevaluate the distribution of infection among patients in Najaf province .

Patients and Methods

About 24800 stool samples from different parts of Najaf province were examined by direct wet mount method in Al-Sadder Medical City, Al-Hakeem Hospital, Al-Zahraa children and Maternity Hospital, Al-Menathera Hospital and Al-Sajad Hospital, in addition to medical centers and private clinics in province . This study was conducted during September 2013 to September 2014 .

Survey of infected house mice

One hundred and fifty house mice, *Mus musculus* were trapped from different localities of province . Mice well killed, dissected and examined by opening the intestine in a Petri dish filled with normal saline or water, the worms allow relax, then examined and identified .

Results

Gender distribution

A total number of patients infected with dwarf tapeworm in this study was 446(1.79%), confirmed by direct wet mount, 213 (47.75%), 233 (52.24%) for male and female respectively . There was no significant difference between male and female infection ($P > 0.05$) (Table 1) .

Table (1) : Gender distribution of 446 patients infected with dwarf tapeworm in Najaf / Iraq .

Gender	No. of samples examined	No. of patients infected	Percent. of total infected
Male	10800	213	0.86
Female	14000	233	0.93
Total	24800	446	1.79

Age distribution

There are a significant difference ($P < 0.05$) of the patient ages (6-12) in comparison to other ages . The lowest percentage was seen in the age (18-24) (Table 2) .

Table (2) : Age distribution of patients infected with dwarf tapeworm in Najaf / Iraq .

Age (year)	No. of samples examined	No. of patients infected	Percent. of total infection
< 6	5200	50	0.20
6-12	8280	210	0.84
12-18	6120	140	0.57
18-24	5200	46	0.18
Total	24800	446	1.79

Geographical distribution

There was no significant difference ($p > 0.05$) between urban infection 256(57.4%) and rural infection 190 (42.6%) (Table 3) .

Table (3) : Geographical distribution of patients infected with dwarf tapeworm in Najaf / Iraq .

Area	No. of samples examined	No. of patients infected	Percent. of total infectin
Rural	8900	190	0.76
Urban	15900	256	1.03
Total	24800	446	1.79

Seasonal variation

The highest rate of infection was in summer, then followed by autumn, winter and spring . There was no significant difference ($p > 0.05$) between summer and other season (Table 4) .

Table (4) : Seasonal variation of patients infected with dwarf tapeworm in Najaf / Iraq .

Seasons	No. of samples examined	No. of patients infected	Percent. of total infection
Winter	6022	82	0.33
Spring	6048	68	0.28
Summer	6303	173	0.69
Autumn	6427	123	0.49
Total	24800	446	1.79

Epidemiology of dwarf tapeworm in domestic mice

One hundred and fifty house mouse were trapped and dissected from different localities of province . It was found that 20% of them were infected with *H.nana* . The highest number of infection in mice were in grain stores 11(7.34) and the lowest percentage were in houses (Table 5) .

Table (5) : Number of domestic mice, *Mus musculus* which were dissected to investigate the dwarf tapeworm infection in Najaf / Iraq .

Location	No. of mice examined	No. of mice infected	Percent. of total infected
Houses	14	4	2.66
Grain stores	46	11	7.34
Flour factories	62	9	6.00
Restaurant	28	6	4.00
Total	150	30	20

Statistical Analysis

The data were analyzed using the available soft-ware package . The results were presented as number, percentage whenever possible . The data were analyzed by using analysis of variance test taking $p < 0.05$ as the lowest limit significance according to (16) .

Discussion

Globally, *H.nana* is the most common cestode in humans (4) . The prevalence of *H.nana* is very common in countries with warmer, arid climates (17) and is endemic in many tropical and subtropical countries (4) . In this study, the prevalence of *H.nana* infections in Najaf province was 1.79% including infections in young children aged 4-14 years and also in adults of 20 years and above . A survey conducted of children indicated a prevalence of 1.6% of the total rate of infection (1.79%) with highest rates of infection found in children 6-12 years of age .*H.nana* is also common in rural and urban regions in Iraq and many areas of Najaf province . Rates of infection with *H.nana* in children and young adolescent are high . *H.nana* is the only cestode capable of completing its cycle without an intermediate host (18) . The direct life cycle can result in the establishment of heavy infections in mammalian host . This is due to the hermaphroditic nature of *H.nana* and the lack of a requirement for an intermediate host (9) . Thus, a single worm can potentially lead to the establishment of a large colony of adult worms within one host, as a result of self-fertilization (autoinfection) (9) . Furthermore, self infection (via faecal-oral contamination), especially in young children who may have poor hygiene skills (4) also contributes to the growth and maturation of more adult worms via the direct life cycle . The structure of the *H.nana* egg may be a useful adaptation to its direct life cycle, their hatching, increasing its close contact with mucosa, promoting its activation and delaying its expulsion from the host (19) . The arthropods such as the flour beetles *Tribolium confusum* and *Tenebrio molitor* were the most common intermediate hosts

capable of the transmission of this parasite (20) . Transmission of *H.nana* occurs by the fecal route, accounting for higher prevalence in young children and adolescent with poorly developed hygiene skills (2) . Estimates of the viability of *H.nana* eggs in the external environment range from 17 hours 90 (3) to 10days (4), suggesting the transmission of *H.nana* via environmental contamination may be lower than by the transfer of eggs on contaminated hand / or food shared between children (4) . Accidental ingestion of an intermediate host infected with the resting cysticercoids' stage is an alternative route of transmission (5) . In conclusion, the dwarf tapeworm requires no intermediate host . The house mouse is also common definitive host . Fleas and beetles can serve as transport hosts . Cysticercoid larvae can develop in the body cavity of these insects and are infective to either humans or rodents if accidentally ingested. Eggs in feces from infected mice and rats are a common source of human infection (1).

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