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THE PREVALENCE OF NATURAL INFECTIONS OF *SCHISTOSOMA SPINDALE* IN DEFINITIVE HOSTS IN PENINSULAR MALAYSIA

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SUMMARY

In a survey of the natural prevalence of *Schistosoma spindale* in domestic ruminants, rodents, birds and bats in Peninsular Malaysia, it was found that the rat *Bandicota indica* had the highest prevalence rate (25%) and mean intensity of infection (74 worms/animal) among all animals studied. Among the ruminants, the prevalence of infection was found highest in the buffalo, *Bubalus bubalis* (21.57%) compared to cattle *Bos indicus* (11.21%) and goats, *Capra hircus* (6.06%). In terms of mean intensity of infection, cattle showed a higher rate (35 worm/positive animal) than the other ruminants. The goat had the lowest prevalence and intensity of infection. It was found that *S. spindale* infection in ruminants is distributed all over the country with the prevalence being highest in Perlis and Trengganu (above 20%) and lowest in Johor, Kedah and Perak (less than 5% infection). Among the rodents species, the prevalence and mean intensity of infection of *S.spindale* were highest in *B. indica* (25% and 74 worms/positive animal respectively), indicating that this rodent is the preferred host for *S. spindale* among the rodents.

Keywords: *Schistosoma spindale*, definitve hosts

INTRODUCTION

Infection of humans by non-human schistosome cercaria may cause cercarial dermatitis among paddy field workers, fisherman and swimmers who are infected with cercaria contaminated water (Buckley, 1938). In Malaysia, six species of schistosome have been recorded, two of which (*Trichobilharzia brevis* and *Pseudobilharziella lonchurae*) which belong to birds, and three belong to animals (*S. spindale* in goat, cattle, buffalo, sheep, horse, donkey, rodents and dog; *Schistosoma nasale* in buffalo and cattle, and *S. incognitum* in pig, dog and rodents) and one in humans (*Schistosoma malayensis)* (Buckley, 1938; Basch 1966; Fischthal and Kuntz, 1973; Saharee *et al.*, 1984; Lee *et al.*, 1986; Greer *et al.*, 1988).

A recent study by Inder Singh *et al.* (1992) in Alor Star, while collecting animals for a different project, found 1 out of 4 rats (*Bandicota indica*) infected with *S. spindale.* Subsequently, further studies by his team were carried out in the same place to investigate this infection, since it can pose a potential zoonotic disease. Experimental infection of various rodent species showed a severe infection in *B. indica* rats while *Rattus argentiventer*, *Rattus rattus diardii* can also act as hosts. In Labu, Negri Sembilan, the field rat, *Rattus tiomanicus jalorensis* was found to be another host for *S. spindale* (Inder Singh *et al.*, 1997).

In 1985, Kheong and Hiong (1985) reported a case of schistosomiasis in a Kedah-Kelantan bull. They (*loc.cit.*) could not identify the causative agent as it was based on histopathological findings. Though *S. spindale* was reported to be very rare among the animals in Malaysia by Shanta (1982), it has been recorded by Krishnasamy *et al.* (1991). *S. spindale* is reported to be very common in neighbouring countries such as Thailand and Indonesia (Harinasuta *et al.,*1965; Lee and Wykoff, 1966).

Since the natural hosts of *S. spindale* act as a reservoir for the etiologic agent of cercarial dermatitis in man, there is therefore a need to determine the natural infection of animals by this parasite. Through the knowledge of the various hosts involved, proper steps for control and prevention of cercarial dermatitis can be proposed based on the control of these natural animal hosts.

A study was thereby carried out to identify the presence of *S. spindale* in blood vessels of mammals in Peninsular Malaysia. The prevalence and intensity of infection of *S. spindale* in relation to the age of different animals (cattle, buffalo, goat and rodents) were determined.

MATERIALS AND METHODS

Specimens from animals (liver and hepatic portal vein, lungs and heart, kidneys, spleen, urinary bladder, uterus, rectal vein, reproductive tract, trachea, mesenteric veins, mesenteric and subserosal intestinal mesenteries, gall bladder and bile duct, pancreas, stomach, caecum, esophagus, brain, thyroid gland, thymus gland, peritoneal washing, chin of nodes or mesenteric tributeries of lymph notes covering the hepatic and peritoneal cavity, faeces and

blood were obtained from the field, (Table 1) slaughter houses and illegally slaughtered animals in villages and also from public markets and evening markets from different parts of Peninsular Malaysia. Field collected animals included rodents, birds and bats. Rodents were trapped from paddy fields throughout Peninsular Malaysia. Ruminants examined in this study were Malaysian breeds, namely, *Bos indicus* (cattle), *Bubalus bubalis* (buffalo) and *Capra hircus* (goats).

Live field animals were sacrified with an overdose of Nembutal, Ketamax[10] or chloroform. The animals were then dissected and organs including the liver, hepatic portal vein and intestinal mesenteries were removed and washed in normal saline. They were then examined for the presence of adult worms.

The age of each of the large animals, namely the buffalo, cattle and goat, where possible, was determined by using the method defined by De Bont *et al.* (1991), where the age is estimated by counting the number of permanent incisors, with 0, 2, 4, 6, and 8 incisors corresponding to approximate ages of 1, 2, 3, 4 and 5 years respectively.

Prevalence rates in different age groups were compared statistically using t-test for independent samples. ANOVA was used to compare the group means and c^2 test was used to find the association between the groups. Simple linear regression was used to find the relationship between the prevalence and intensity after taking log transformation.

Tissue samples of large animals, collected from the above places, were brought to the laboratory for further processing. All the organs were carefully separated and cut into small strips of approximately 1-2 cm. The organs were kept individually in 0.85% normal saline in polyethylene bags. These were stored overnight at 4°C to 6°C in a refrigerator. The samples were later examined individually and infections were diagnosed by the presence of eggs or by lesions from the tissues. The organs were taken out and screened well and examined for parasites, and finally teased so that the parasites were recovered completely. Blood was also collected directly from the animals (during slaughter) and mixed with sodium citrate solution (50 ml NaCl + 450 ml blood) to avoid clotting. Later, the samples were examined for presence of worms using a dissecting microscope.

Use of perfusion technique to recover immature and mature schistosome worms

The animals (Table 1) were sacrificed with 0.3 ml per 50 gm weight of anesthetic-anticoagulant solution injected intraperitonally. They were perfused with 0.85% sodium chloride solution containing 3% sodium citrate to keep the blood warm. The pleural cavities were opened to expose the viscera, large vessels and the portal vein, and then citrate saline solution was injected under pressure into the left heart. Blood vessels of the liver and the portal system were washed and the perfusion fluid was collected with its contents in a conical measuring cylinder. The worms were removed from the bottom of the measuring cylinder after the perfusion fluid settled within 30 minutes.

RESULTS

A total of 739 animals comprising 191 ruminants (cows, buffaloes and goats) and 548 small animals (Table 1) were collected and examined for the presence of schistosomes with particular reference to *Schistosoma spindale.*

Adult schistosome worms were found in the liver mesenteric and subserosal veins of the animals from naturally infected goats (Figures 1, 2 and 3). The results of the prevalence and intensity of infection of *S. spindale* among the cattle and rodents are as shown in Table 1. In addition to the animal hosts shown to harbour *S. spindale,* the following animals examined did not harbour the parasite: *Maxomys whiteheadi* (3), *Maxomys rajah* (3),

Table 1: Prevalence and intensity of *S. spindale* in field rats and domestic animals

Hosts	Animals examined (Total No.)	No. positive	Percentage positive	Total no. of worms	No. worms in pairs	Mean intensity of infection (worm/positve animal)
Buffalo (*Bubalus bubalis*)	51	11	21.57	77	3	7
Cattle (*Bos indicus*)	107	12	11.21	417	8	34.75
Goat (*Capra hircus*)	33	2	6.06	8	0	4
SUB –TOTAL	191	25	13.09	502	11	20.08
(Rodent) Bandicota indica	172	43	25.00	3180	1126	73.95
Rattus argentiventer	70	1	1.43	2*	1	2
Rattus rattus diardii	114	1	0.88	1	0	1
Rattus tiomanicus Jalorensis	192	1	0.52	4*	0	4
SUB –TOTAL	548	46	8.39	3,187	1,127	146.78
TOTAL	739	71	9.60	3,689	1,138	51.96

* Denotes immature worm, no egg *in-utero.*

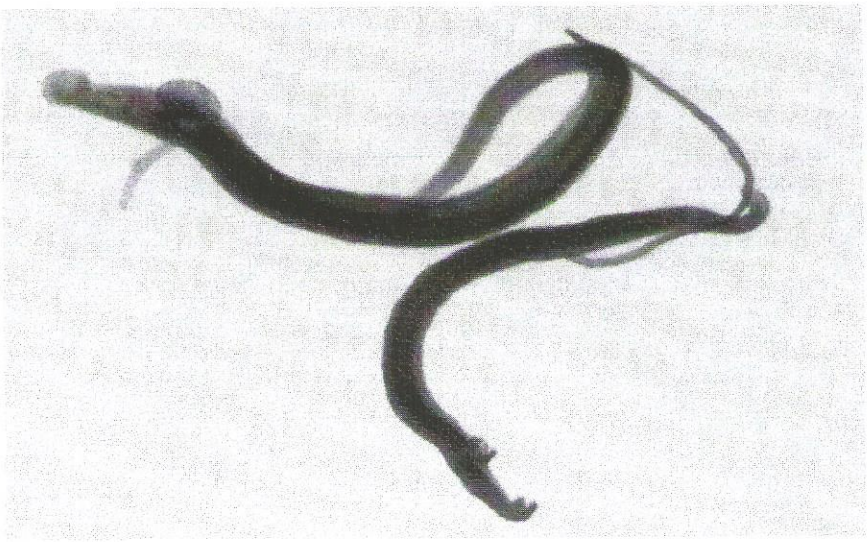

Fig. 1. The fully matured adult *Schistosome spindale* male and female *in-copula* collected from liver of naturally infected goat.

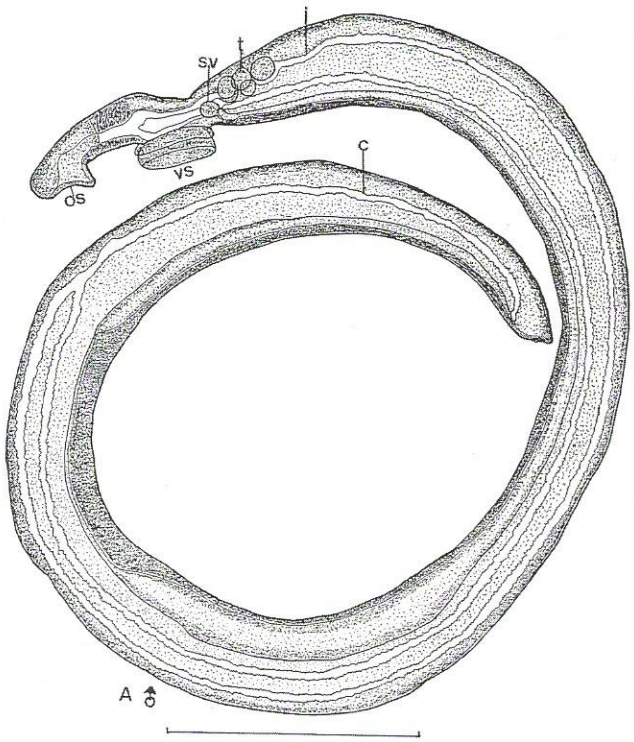

Fig. 2. The adult male of *Schistosoma spindale* from liver of the goat (*Capra hircus*). (Scale bar 1 mm). Oral sucker (os), ventral sucker (vs), seminal vesicle (sv), testes (t), intestine (i) and ceca (c).

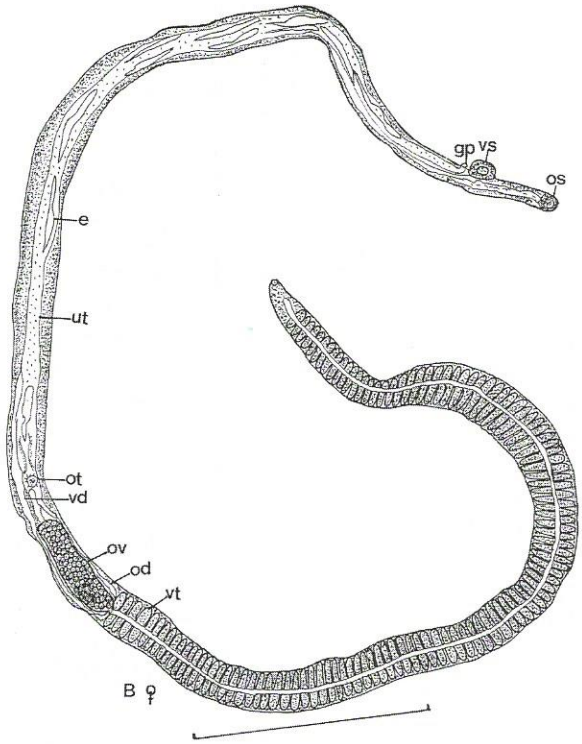

Fig. 3. The adult female of *Schistosoma spindale* from the liver of the goat (*Capra hircus*), (Scale bar 1 mm). Oral sucker (os), ventral sucker (vs), genital pore (gp), egg (e), uterus (ut), otype (ot), vitelline duct (vd), ovary (ov), vitellaria (vt) and oviduct (od).

Rattus exulans (3), *Rattus norvegicus* (5), *Rattus bowersi* (1), *Sundamys muelleri* (2), *Suncus murinus* (25), *Tupaia glis* (10), *Herpestes brachyurus* (17), *Paradoxurus hermaphroditus* (1), birds (52) and bats (18).

Among the ruminants, the prevalence of infection was highest in *B. bubalis* (21.57%) compared to *Bos indicus* (11.21%) and *Capra hircus* (6.06%). However, the higher prevalence in buffaloes was not statistically significant compared to the prevalence in cows and goats ($p>0.05$). In terms of mean intensity of infection, the cow showed a higher rate (35 worms/positive animal) than the other ruminants. In the goat, both prevalence and intensity of infection were the lowest among the ruminants.

Among the rodents species, the prevalence and mean intensity of infection of *S. spindale* were highest in *B. indica* (25% and 74 worms/positive animal, respectively), indicating that this rodent is a preferred host for *S. spindale* among the rodents, as the development of the schistosome was favorably supported.

The distribution of *S. spindale* among ruminants in the states of Peninsular Malaysia is summarised in Table 2. The results showed that *S. spindale* is distributed all over

the country. The prevalence of infection was found higher in Selangor, Perlis and Trengganu states (20% and above) while less than 5% of infection was recorded in Johore and Kedah states. However, the prevalence has no significant relationship with intensity of infection ($r = 0.284$; $p>0.05$).

The prevalence and intensity of infection according to age for 191 ruminants studied, namely buffaloes, cows, and goats, are summarised in Table 3. The overall prevalence of *S. spindale* infection was 13.09%. Prevalence was recorded higher (32 to 36%) at the age of 3 to 4 years and less than 10% in younger animals (less then 2 years of age). However, the prevalence does not show a significant difference between age groups ($c^2 = 5.87$; $P>0.05$). Among the 25 positive animals, 12 had low infection and only 4 were infected heavily.

The liver was the main organ infected in all animals studied and this was the main site from where worm pairs were recovered. In both the rats and ruminants, the majority of worm pairs were found in the hepatic portal vein. Overall, 30.8% of worms were in pairs and these were distributed in the liver-lobe, in the hepatic portal vein, in the mesenteries of the small and large intestines mesenteric tributaries of lymph nodes and superior mesenteric veins.

A morphological comparison of the *S. spindale* recovered from *B. indica* showed that it resembled those recovered from goats and water buffaloes (Table 4) as shown from a comparison of the various measurements of the adult worm (features of worms obtained from the ruminants as well as from the Bandicoot rat). The worms were adult males and females which were fully mature.

DISCUSSION

In this study, cattle, buffalos and goats were found to harbour *S. spindale* adults throughout Peninsular Malaysia. Prior to this study, adults of *S. spindale* had been found in the mesenteric veins of a buffalo in Negri Sembilan in 1938 by Buckley and later in the water buffalo and cattle (Euzeby, 1956; Sandosham and Lie,1969). The parasite was first reported in the goat by Krishnasamy *et al.* (1991).

Since these ruminants will always be utilised by the farmers for paddy cultivation and for milk and meat production, the presence of *S. spindale* in these domestic animals implies that these animals will always act as a potential reservoir of infection of cercarial dermatitis to the paddy farmers in Malaysia. Thus control of the disease

Table 2: The distribution of *S. spindale* among large animals in the states of Peninsular Malaysia

Hosts / States	*Buffalo* +ve	*Buffalo* -ve	*Cattle* +ve	*Cattle* -ve	*Goat* +ve	*Goat* -ve	Mean intensity of infection (worm/positive animal)	Total animal examined	Percentage positive (%)
Negeri Sembilan	6(24)*	21	-	9	-	8	4	44(24)	13.6
Johore	-	3	1(1)	18	-	7	1	29(1)	3.4
Selangor	1(4)	-	-	-	1(3)	-	3.5	2(7)	100.0
Perak	-	2	4(29)	16	-	9	7.5	31(29)	12.9
Kedah	-	10	1(3)	17	-	2	13	30(13)	3.3
Perlis	1(45)	3	3(12)	6	-	1	14.25	14(57)	28.60
Kelantan	-	-	3(362)	15	-	3	120.7	21(362)	14.2
Trengganu	-	1	-	3	1(5)	-	5	5(5)	20.0
Pahang	3(4)	3	-	11	-	1	1.33	18(4)	16.7
Total	**11(77)**	**40**	**12(417)**	**95**	**2(8)**	**31**	**20.08**	**191(508)**	**13.1**

*() = Total no. of worms

Table 3: Distribution of prevalence and intensities of *Schistosoma spindale* among different age groups from 191 large animals (cattle, buffalo and goats)

	Age groups (years) incisors					Total Number of Animals
	< 2	2	3	4	> 5	
Number Examined	80	8	28	46	29	191
Number Positive	2	4	6	11	2	25
Prevalence (%)	2.5	50	21.4	23.9	6.8	13.09
Intensity of infection* (worm/animal)						
Low (1 – 10)	2	1	5	3	1	12
Moderate (13 - 45)						
Heavy (100 +)	0 0	2 1	3 0	4 2	0 1	9 4

* Defined by numbers of paired worms in ranges given.

Table 4: Morphometry of the naturally infected *S. spindale* worm in ruminants and the bandicoot rat from Peninsular Malaysia

Hosts	Buffalo Mean± SD	Cow Mean±SD	Goat Mean±SD	Bandicoot rat Mean±SD
MALE:	n. 9	n.15	n.4	n.13
Body length*	1056.56 ± 1740.05	8933.33 ± 1437.59	9550.00 ± 2380.48	1100.00 ± 1914.85
Body width	330.00 ± 51.31	306.73 ± 86.36	393.75 ± 45.08	302.31 ± 71.11
Oral sucker length	252.00 ± 37.38	234.73 ± 29.03	263.25 ± 95.35	234.00 ± 47.91
Oral sucker width	246.00 ± 32.14	205.80 ± 35.49	222.75 ± 21.27	214.62 ± 38.16
Ventral sucker length	293.00 ± 51.53	276.00 ± 38.88	270.00 ± 00.00	273.46 ± 70.73
Ventral sucker width	279.00 ± 45.00	268.80 ± 34.33	252.00 ± 48.74	240.38 ± 49.34
Oesophagus length	280.00 ± 30.00	325.20 ± 56.81	299.25 ± 37.73	340.62 ± 56.55
Distance bt. two suckers	360.00 ± 31.82	396.20 ± 82.55	389.25 ± 87.68	385.38 ± 102.17
Testis length	95.83 ± 8.13	88.95 ± 27.02	90.25 ± 24.70	100.35 ± 18.07
Testis width	81.61 ± 11.71	76.87 ± 23.10	80.50 ± 13.28	87.28 ± 10.09
Semi vesical length	48.68 ± 7.68	55.32 ± 14.25	49.00 ± 6.00	56.27 ± 9.61
Semi vesical width	40.38 ± 4.81	48.42 ± 7.29	43.25 ± 9.14	48.37 ± 15.58
FEMALE:	n.8	n.7	n.2	n.12
Body length*	9875.00 ± 2642.37	8285.71 ± 2627.69	1450.00 ± 707.11	1550.00 ± 1314.26
Body width*	97.88 ± 10.14	88.71 ± 13.17	103.50 ± 6.36	123.00 ± 12.34
Oral sucker length*	36.01 ± 5.49	37.46 ± 6.47	28.80 ± 1.70	331.59 ± 55.00
Oral sucker width*	35.71 ± 4.75	35.79 ± 4.18	26.50 ± 4.95	312.42 ± 45.43
Ventral sucker length*	31.63 ± 5.73	38.00 ± 5.48	47.00 ± 1.41	262.58 ± 44.36
Ventral sucker width*	31.63 ± 5.46	30.19 ± 4.86	47.00 ± 1.41	265.17 ± 54.17
Oesophagus length*	92.38 ± 22.19	61.58 ± 38.82	132.25 ± 8.13	1951.17 ± 174.57
Distance bt. two suckers*	120.51 ± 22.63	141.50 ± 27.01	126.50 ± 32.53	1941.58 ± 218.74
Ovary length*	300.86 ± 5.63	309.29 ± 54.12	576.50 ± 38.89	435.00 ± 76.01
Ovary width*	112.50 ± 71.84	95.43 ± 9.29	99.00 ± 12.73	97.50 ± 14.27
Egg length*	230.63 ± 59.63	203.02 ± 50.12	210.75 ± 53.39	235.00 ± 4.26
Egg width*	35.26 ± 5.08	34.50 ± .00	31.50 ± 4.95	36.83 ± 2.82
Guno pore length*	163.31 ± 22.79	190.64 ± 6.45	201.25 ± 8.13	264.23 ± 20.58

*Shows significant difference between the animals with respect to the mean organ measurements (anova; $p<0.05$).

must also involve taking steps to treat these animals if they are infected, or to prevent trematode eggs from these animals from contaminating the aquatic surroundings.

Cattle and buffaloes frequently cross water bodies in search of pasture for grazing and hence they are ideal targets for *S. spindale* cercariae in the aquatic environment. However, goats are seldom seen in such habitats and their infection rate would thereby be lower. This is confirmed by the findings of this study (Table 1), where it is seen that the goat has the lowest prevalence rate of *S. spindale* infection among the ruminants studied (6.06% as comapred to 21.57% for buffalo).

The distribution of this parasite in ruminants in all the nine states studied (Table 2) shows that this parasite is ubiquitous, being present wherever cattle, buffaloes or goats are reared. In the survey of the snail intermediate hosts, cercariae of *S. spindale* were found only in *Indoplanorbis exustus* in Negri Sembilan, Johore, Trengganu and Kedah (Krishnasamy *et al.*,1998). From this present survey of animal definitive hosts, it becomes obvious that the snail survey does not give a true picture of the distribution of this parasite in Peninsular Malaysia. Rather, the survey of the mammalian hosts will give a better picture of the distribution of this parasite in the country. Thus the absence of *S. spindale* cercariae in *I. exustus* snails from any state does not imply that it is not present in that state.

This study indicates that the prevalence of *S. spindale* worm is very low (11.21%) in Malaysia compared to other Asian counteries. Similar results were reported by Shanta (1982) and Lee *et al.* (1991) in the ruminants while Inder Singh *et al.* (1992) reported heavy natural infection in *B. indica* rats in Kedah state. Among the ruminants, it was also shown in this study that *S. spindale* infection was found higher (21.57%) in the water buffalo (*B. bubalis*).

Epidemiological studies on bovine visceral schistosomiasis in Asia are limited (De Bont *et al.*, 1991). However, isolated outbreaks of *S. spindale* infections in bullocks, cows, buffaloes, sheep and goats associated with heavy mortality have been reported previously in India (Kulkarni *et al.*, 1954).

In Bangladesh, Islam (1975) examined the visceral organs of 224 cattle for the presence of *Schistosoma* spp. and reported an overall prevalence of 62%, with 43% *S. indicum*, 33% *S. spindale* and 13% mixed infections. He reported that animals older then 4 years had a higher prevalence of infection (95%) and had an average heavier worm burden than younger cattle. It was also reported by De Bont *et al.* (1991) that the prevalence and intensity of infection observed in Kandy, Sri Lanka increased with the age of the host. This trend is confirmed in this study, where it is seen that the animals aged between 2 to 4 years had the highest infection rate.

In north eastern Thailand, Upatoom *et al.* (1988) reported the prevalence of *S. spindale* in cattle is 60-80%. This was sometimes associated with severe clinical symptoms and mortality, particularly in calves. However, in this study, only one 2-year old calf *Bos indicus* was infected and was found to have a worm burden of 355 *S. spindale* but no clinical symptoms were observed.

De Bont *et al.* (1991) had expressed the opinion that the low worm burden observed from the natural infection in cattle arose either as an innate resistance of the local breeds or as an early development of protective immunity against the new infection. A similar observation of low worm burden was also found in this present study among the ruminants, ranging from 7 to 35 worms/positive animal (Table 1).

Among the rodents, *S. spindale* infection was found only in four species. The *S. spindale* recovered from *B. indica* morphologically resemble those reported from goats and water buffaloes, as was confirmed by a comparison of the adult features of worms obtained from the ruminants as well as from the Bandicoot rat (Table 4).

From this study, it was found that *B. indica* had a high postive rate of infection compared to other rodents and ruminants studied. Among the rodents studied, *B. indica* had the highest infection rate (25%) compared to the other rodents (less than 2%). It also had a higher worm load (74 worms/positive animal) compared with that of other rodents studied (less than 1 worm/positive animal). This may be due to the fact that *B. indica* rodents generally prefer the paddy fields as their habitat in the northern part of Malaysia resulting in their high infection rate and high mean worm-loads (Walker,1964; Medway, 1983). *B. indica* is primarily a field rat which is confined to open areas and moves freely at night close to water habitats. Thus, their contact with the snail intermediate hosts of the parasites is greater and hence resulting in a higher infection rate. These field rats are grassland inhabitants which are confined to lowlands (Medway, 1983).

The higher prevalence rate and the higher worm burden of *S. spindale* in *B. indica* when compared to the other rodents studied also indicates the probability that it is the most susceptible to *S. spindale.* It is possible that it has not acquired any immune resistance to multiple infections by *S. spindale*. That this is the case can be seen from the fact that the worms recovered from the other rodent species studied, namely, *R argentiventer, R. r. diardii* and *R. t. jalorensis*, were immature sub adults. Most of the organs in the worms recovered from these three rodent species were found to be poorly developed. It is generally known that worms do not reach maturity in an unnatural host. However, complete development of worms to maturity was seen in the goats, cattle and buffaloes that represent a natural host. This also indicates that this parasite has adapted well to the host defense systems without suffering adverse developmental effects in the hosts.

In a previous study by Inder Singh *et al.* (1992), *R. argentiventer, R. r. diardii* and *R. t. jalorensis* were reported to be negative for *S. spindale*. However, in a later study Inder Singh *et al* (1997) found the parasite in *R. argentiventer* and *R. r. diardii* in Alor Star, Kedah and in *R. t. jalorensis* in Labu, Negeri Sembilan. In the present study the results were the same as that of Inder Singh *et al.* (1997). Carney *et al.* (1977) also reported a high infection rate of *S. spindale* in *R. argentiventer*. In Thailand, though the rat *B. indica* was found naturally infected with adults of *S. spindale*, no eggs were found in the uterus of the female worms (Bunnag *et al.*, 1980). However, in the present study, the *B. indica* rats tested positive for the parasite were found to discharge a large number of viable eggs in their faeces. This once again showed that this parasite has adapted well to the *B. indica* rat in Malaysia.

Carney *et al*, (1977) in Indonesia and Bunnag *et al.* (1980) observed the sympatric occurrence of *S. spindale* and *Schistosom incognitum* in *B. indica*. *S incognitum* have been reported in Peninsular Malaysia in the pig (Lee *et al*, (1986). However, the sympatric occurrence of both species of *Schistosoma* in *B. indica* have not been observed in the present study. Niphadkar and Rao (1967) in India found another species of bandicoot rat, *Bendicota bengalensis* naturally infected with *S. spindale*. In Peninsular Malaysia *B. bengalensis* is known to occur but only from Penang Island (Medway, 1983). However, the status of *B. bengalensis* as host of *S. spindale* has not been elucidated as yet. Additional studies may add to our knowledge of the epizootiology of *S. spindale* in Peninsular Malaysia.

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RINGKASAN

Dalam satu tinjauan terhadap prevalens semula jadi *Schistosoma spindale* pada ruminan bela jinak, roden, burung dan kelawar di Semenanjung Malaysia, didapati bahawa tikus, *Bandicota indica* mempunyai kadar prevalens (25%) dan purata jangkitan keamatan (74 cacing/haiwan) yang tertinggi di kalangan haiwan yang dikaji. Di kalangan ruminan, jangkitan prevalens didapati tertinggi pada kerbau, *Bubalus bubalis* (*21.57%*) berbanding lembu, *Bos indicus* (11.21%) dan kambing, *Capra hircus* (6.06%). Dari segi purata jangkitan keamatan, lembu menunjukkan kadar lebih tinggi (35 cacing/haiwan yang positif) berbanding ruminan lain. Kambing mempunyai prevalens dan jangkitan keamatan yang terendah. Didapati bahawa jangkitan *S. spindale* pada ruminan terdapat di seluruh Semenanjung dengan negeri Perlis dan Trengganu (lebih 20%) mempunyai prevalans yang tertinggi sementara negeri Johor, Kedah dan Perak (jangkitan kurang daripada 5%) menunjukkan prevalens yang terendah. Di antara spesies roden, prevalens dan purata jangkitan keamatan *S. spindale* adalah tertinggi pada *B. indica* (masing-masing 25% dan 74 cacing/haiwan yang positif), ini menandakan bahawa roden adalah perumah yang digemari oleh *S. spindale* di kalangan roden.