Cross-sectional associations between intensity of animal and human infection with *Schistosoma japonicum* in Western Samar province, Philippines

Stephen T McGarvey,[a] Hélène Carabin,[b] Ernesto Balolong Jr,[c] Patrick Bélisle,[d] Tomas Fernandez,[e] Lawrence Joseph,[f] Veronica Tallo,[c] Ryan Gonzales,[c] Mushfiqur R Tarafder,[b] Portia Alday,[c] Arve Lee Willingham,[g] & Remigio Olveda[c]

Objective To estimate the association between the intensity of animal infection with *Schistosoma japonicum* and human infection in Western Samar province, the Philippines.

Methods We conducted an observational cross-sectional study of 1425 households in 50 villages. Stool samples were collected on each of 1–3 days from 5623 humans, 1275 cats, 1189 dogs, 1899 pigs, 663 rats and 873 water buffalo. Intensity of infection with *S. japonicum* was measured by the number of eggs per gram (EPG). Egg counts were done using the Kato–Katz method. We used a Bayesian hierarchical cumulative logit model, with adjustments for age, sex, occupation and measurement error.

Findings The adjusted proportions of humans lightly infected (classified as 1–100 EPG) was 17.7% (95% Bayesian credible interval = 15.3–20.2%); the proportion classified as at least moderately infected (>100 EPG) was 3.2% (2.2–4.6%). The crude parasitological results for animals indicated that 37 cats (2.9%), 228 dogs (19.2%), 39 pigs (2.1%), 199 rats (30.0%) and 28 water buffalo (3.2%) were infected. In univariate analyses the odds ratios corresponding to a unit increase in the mean number of EPG at the village-level in dogs was 1.05 (1.01–1.09), in cats 1.35 (1.02–1.78), in pigs 1.16 (0.24– 5.18) and in rats 1.00 (1.00–1.01). Mean EPG values in cats, dogs, pigs and rats were correlated with one another. This confounding made interpreting the odds ratios difficult, but the odds ratios for dogs and cats were more consistent.

Conclusion *S. japonicum* is endemic in areas of the Philippines despite implementation of control programmes. This may be due to the association of infections in dogs and cats with human infections. Infection control in dogs and cats is challenging, and there is a need to develop new methods to control transmission across all species.

Bulletin of the World Health Organization 2006;84:446-452.

Introduction

Schistosomiasis affects 200 million people in 74 countries worldwide; 120 million of these are symptomatic and 20 million have severe disease.[1] Unlike the other three schistosome species affecting humans, *Schistosoma japonicum* is a true zoonosis, infecting 46 species of mammals, including humans, all of which are definitive hosts necessary for transmitting the infection.[2–4]

S. japonicum is endemic in China, parts of Indonesia and the Philippines.[5] These parasites are found in the 22 provinces in the Philippines that do not have a definite dry season; this leads to continual transmission.[6,7] Approximately 6.7 million people live in endemic areas in the Philippines.[8] Transmission to humans requires that they come in contact with fresh water colonized by amphibian snail hosts (*Oncomelania hupensis quadrasi*) that have become infected with *S. japonicum* through contamination by faeces from infected mammals.[9] Pigs, dogs, cats, rats, cows and water buffalo may become infected and may potentially play a role in the transmission of *S. japonicum* to humans,[6,10,11] but the association between infection levels in animals and humans has not yet been estimated.

An ecological study conducted in China used simple correlation methods to estimate the association between the prevalence of *S. japonicum* in water buffalo and that in humans over 10 years. The researchers assumed that all observations were independent, which is a questionable assumption that may have resulted in biased estimates.[12]

The objective of our study was to estimate the strength of the association between the intensity of *S. japonicum* infection in animals and humans across 50 villages in the province of Western Samar, the Philippines.

Methods

Study design and location

A cross-sectional study was conducted between August 2003 and November

2004 in the province of Western Samar (on the island of Samar) in the Eastern Visayas region of the Philippines. In 2002, there were estimated to be 57 033 farms with an area of 101 954 hectares in Western Samar.[13] In Western Samar, *S. japonicum* is considered to be endemic in 13 municipalities and 133 villages by the National Schistosomiasis Control programme (R Martinez, personal communication, May 2002).

Selection of study villages

Of the 133 villages, 25 with predominantly rain-fed farms and 25 with manmade irrigation systems were chosen for the primary objective of determining the effect of irrigation on transmission of *S. japonicum*. The following steps were taken to select these 50 villages. A total of 58 villages were excluded because: 3 were inaccessible; 5 had fewer than 50 households; and 15 were near the coast or urban areas where there was little rice farming, leaving 75 villages. Based on the information from farmers or village leaders as to which type of irrigation systems were used, we selected the 25 rain-fed villages and 25 irrigated villages that formed the study villages.

Selection of participants

Thirty-five eligible households were randomly selected within each village. Households had to have at least five members to be eligible for participation. Households that declined to participate were replaced by the next available household on the list. A maximum of six participants were selected from each household. Five individuals in the household were selected at random in addition to at least one randomly selected fulltime farmer. If the household contained fewer than six individuals, all members

were recruited. A sociodemographic interview was held with each participant and it provided data on age, sex, occupation and health history regarding schistosomiasis.

Selection of animals

In the first 10 villages, all animals from each species belonging to different owners were selected. In the next 40 villages, an animal census determined the number of animals of each species in each household, and a random sample of households was generated for each species. If an animal could not be sampled, the next household was selected. To collect stools, dogs were tethered and puppies and cats were placed in cages and allowed to defecate. Intrarectal sampling was used for pigs and water buffalo.

In each village 30 rat traps were set for 3 days, with the trap location changing daily. Rats were kept in traps for three days and faecal samples were collected from the floor of the cage.

Measurement of human infection

Our goal was to collect three faecal specimens from all participants during a 5-day period. Two 50 mg Kato–Katz slides were prepared on site from each daily faecal specimen; these were refrigerated and read by trained medical technicians every 1–2 days.[14] For each participant each day, the average number of eggs from two slides was multiplied by 20 to obtain a measurement of eggs per gram (EPG).

Measurement of animal infection

Faecal samples from animals were put in insulated boxes with ice and processed for reading once a week. The Danish Bilharziasis Laboratory method was used to assay the samples and estimate

EPG.[15,16] The goal was to collect at least two faecal specimens from each animal. This was based on our pilot work demonstrating that 2 days of sampling provided sufficient sensitivity.[16]

Statistical analyses

We used a Bayesian three-outcome category cumulative logistic regression model with a hierarchical (random effects) component.[17] The outcome data consisted of EPG counts taken from 1–3 days for each of our human participants and clustered within villages. We defined three classifications for EPG levels: participants with 0 EPG were classified as uninfected; those with 1–100 EPG were classified as having a light infection; and those with >100 EPG had moderate to heavy infection. The odds ratio (OR) from this model estimates the odds of humans being in any infection class compared with the odds of not being infected. Based on the EPG results for each participant over 3 days, we estimated the probability that each participant's true infection status fell within each of these categories of EPG counts.

The first level of our hierarchical cumulative logit model estimates the true category of EPG count for each human participant and includes a random intercept parameter, with one intercept parameter for each village, as well as independent variables for occupation (working full time on a rice farm, working part time on a rice farm, working on a farm but not a rice farm, not working on a farm, may work on a farm), age (0–10 years, >10 to <40 years, ≥40 years), sex, and an interaction between age and sex. At the second level of our hierarchical model, the intercept parameters from each of our 50 villages were modelled as a linear regression,

Table 1. **Summary statistics of prevalence of infection with *Schistosoma japonicum* in humans at levels of 1–100 eggs per gram (EPG) and >100 EPG and mean number EPG in animals in 50 villages in Western Samar province, Philippines, 2003–04**

Species	Sample size	Mean across 50 villages %	Median across 50 villages %	Standard deviation %	Inter-village range %
Humans	5623				
1–100 EPG (light infection)		13.7	12.4	9.7	0–34.8
>100 EPG (at least moderate infection)		3.7	2.4	4.3	0–23.0
Cats	1274	0.5	0	1.7	0–10.9
Dogs	1189	7	2.2	11.6	0–45.3
Pigs	1899	0.1	0	0.3	0–1.6
Rats	663	37.6	3.2	125.2	0–796.7
Water buffalo	873	0.1	0	0.3	0–1.7

with independent variables including mean EPG counts within each species of animal within each village. At the third level of our hierarchical model, we specified prior distributions for all unknown parameters. All regression coefficient parameters were given normal distribution priors, centred at 0 and with variance of 10 000. All standard deviation parameters were given uniform prior distributions over the range from 0 to 20.

We used beta prior distributions to adjust our analyses for the imperfect sensitivity and specificity of the Kato–Katz methods. The priors used were slight modifications from our earlier work.[17] Here we used a beta distribution (17.3, 0.96) for the specificity of this test, which has a 95% range of 0.84–1.0, meaning that we are quite certain, a priori, that the specificity of this test is at least 84%. Similarly, we used a beta distribution (12.6, 10.7) for the sensitivity of the test in detecting light infections, which has an a priori range of 0.34–0.74. Finally, we used a beta distribution (5.5, 1.8) with a 95% a priori range of 0.47–0.99 for the sensitivity of moderate-to-heavy infection. The above sensitivities and specificities provide the probabilities for correct classification, but in each case classification errors must be further subdivided, since there are three categories rather than two. Hence, when an error is made (for example, when a participant who is truly negative tests positive) there are two possible errors (for example, 1 specificity must be divided into light or moderate/heavy errors). We used three independent uniform prior distributions for these subdividing probabilities.

To best represent the potential contribution of each animal species to village-level environmental contamination intensity, we used the mean EPG for each species. We chose this approach assuming that any egg from any definitive host species may contribute equally to environmental contamination.

We ran various models, including models with mean EPG values for each species separately, models with mean EPG values from more than one species at a time, and models including or excluding the census numbers of each species within each village. Since all results from models with or without census numbers produced similar conclusions, we present results only from models with mean EPG per animal species. We

also report Spearman's correlation coefficients (with 95% confidence intervals) calculated between the within-village mean EPG of the different animal species across villages.

Ethical approval

The chiefs of all villages were asked permission for the village to be included in the study. In addition, all eligible participants and owners of sampled domestic animals were asked for their consent to participate. The cross-sectional survey was followed by a mass treatment campaign in all study villages, which was coordinated by the National Schistosomiasis Control programme. The project was approved by the ethical boards of the Research Institute for Tropical Medicine, the Danish Bilharziasis Laboratory and Brown University.

Findings

A total of 1425 households were included in the study; 132 of these were replacements for originally selected household that were unable to participate. A total of 6917 individual members of the participating households agreed to participate, corresponding to an average of 28.5 households per village and 4.1 members per household per village. At least one stool sample was provided by 5623 individuals (81.3%). Stool samples from 1189 dogs, 1274 cats, 1899 pigs, 873 water buffalo and 663 rats were collected on each of 1–3 days. These correspond to 24% of the census of dogs, 28% of cats, 36% of pigs and 50% of water buffalo taken before the study began. No rat census was conducted.

Table 1 summarizes the statistics for the proportion of humans infected with 1–100 EPG and those infected with >100 EPG, unadjusted for measurement error. It also shows the crude mean EPG per animal species, measured at village level. Table 1 clearly shows a large intervillage variation in the levels of infection in all mammals, including humans. The estimated (true) proportion of humans lightly infected was 17.7% (95% Bayesian credible interval = 15.3–20.2%); and the estimate of those who were at least moderately infected was 3.2% (2.2–4.6%). The Kato–Katz analysis of one stool sample had good estimated specificity: the average probability of being classified as not infected was 99.3% (98.8–99.8%) when not infected. However, the average probability of being classified as not infected when lightly infected was 57.6% (51.9% to 63.8%); for being classified as not infected when at least moderately infected it was 12.0% (4.7–20.5%). In addition, the average probability of being classified as lightly infected was 26.0% (17.2–35.3%) when at least moderately infected.

In 14 villages we found at least one infected cat; in 37 villages we found at least one infected dog; in 17 villages we found at least one infected pig; in 33 villages we found at least one infected rat; and in 11 villages we found at least one infected water buffalo. A total of 37 cats (2.9%), 228 dogs (19.2%), 39 pigs (2.1%), 199 rats (30.09%) and 28 water buffalo (3.2%) — with 12 water buffalo found in one village — tested positive for *S. japonicum*. Infection in water buffalo, cats and pigs was rare, with crude prevalences of less than 4%.

Table 2. **Spearman's correlation coefficient (95% confidence interval) for the association between the mean number of eggs per gram of *Schistosoma japonicum* per village among cats, dogs, pigs, rats and water buffalo, Western Samar province, Philippines, 2003–04**

Species	Spearman's correlation coefficients			
	Dogs	**Pigs**	**Rats**[a]	**Water buffalo**
Cats	0.46 (0.21 to 0.65)	0.18 (– 0.11 to 0.43)	0.17 (– 0.12 to 0.43)	– 0.03 (– 0.30 to 0.25)
Dogs		0.12 (– 0.16 to 0.39)	0.29 (0.01 to 0.53)	0.13 (– 0.15 to 0.40)
Pigs			0.17 (– 0.11 to 0.43)	– 0.10 (– 0.37 to 0.18)
Rats[a]				0.10 (– 0.19 to – 0.37)

[a] For rats, the mean number of eggs per gram was available for only 49/50 villages.

Table 2 shows Spearman's correlation coefficients (with 95% confidence intervals) calculated across villages between the within-village mean EPG of the different animal species. The mean EPG for dogs was significantly correlated with that of cats; it was marginally associated with that of rats (Table 2). Even though the confidence intervals are wide, the observed correlations suggest some associations in mean EPG among cats, pigs and rats. The mean EPG of water buffalo was not associated with that in any other animals.

In univariate models, the ORs for human infection for a unit increase in the village-level mean EPG of cats and dogs were 1.36 (95% credible interval = 1.02–1.78) for cats and 1.05 (95% credible interval = 1.01–1.09) for dogs (Table 3). There is no obvious association between human infection and mean EPG in rats. The association between mean EPG in pigs and human infection is difficult to interpret due to the wide credible intervals. The associations between levels of animal EPG described above are reflected by a change in the point estimate or in wider 95% credible intervals for the ORs when more species are added to the model. This confounding effect of the mean EPG values among the different species makes the interpretation of the ORs difficult, even though the ORs for dogs and cats are more consistent and more precise.

We found that the irrigation status of the village had no effect on human infection in models with the dichotomous irrigation variable, both as a potential confounder for the effect of animal infection on human infection and also as a potential modifier of the effect of animal infection on human infection.

Discussion

Schistosomiasis japonica is theoretically the most difficult form of schistosomiasis to control because of the extensive reservoirs of *S. japonicum* in domestic and wild animals.[18,19] We found strong associations between the intensity of infection in cats and dogs and that in humans in Western Samar province, the Philippines. It is notable that the ORs represent the increased odds of human infection for each increase of 1 mean EPG at the village level for each animal species.

The associations among intensity of *S. japonicum* infection in dogs, cats and

Table 3. Estimates of odds ratio (95% credible interval) of a mean increase of 1 egg per gram (EPG) of *Schistosoma japonicum* in animals on three levels of human infection obtained from seven Bayesian hierarchical cumulative logit models adjusted for measurement error in the Kato–Katz method, age, sex and occupation of humans, Western Samar province, Philippines, 2003–04

Model[a]	Mean increase of 1 EPG at the village level	Odds ratio[b]
Cats only	Cats	1.35 (1.02–1.78)
Dogs only	Dogs	1.05 (1.01–1.09)
Pigs only	Pigs	1.16 (0.24–5.18)
Rats only[c]	Rats[c]	1.001 (0.997–1.005)
Cats and dogs	Cats	1.33 (1.03–1.73)
	Dogs	1.04 (1.00–1.08)
Cats, dogs and pigs	Cats	1.37 (1.00–1.88)
	Dogs	1.05 (1.00–1.09)
	Pigs	0.42 (0.08–2.02)
Cats, dogs and rats[c]	Cats	1.32 (1.01–1.72)
	Dogs	1.03 (0.99–1.08)
	Rats[c]	1.000 (0.996–1.004)

[a] All models are adjusted for age, sex, occupation and measurement errors in the measurement of infection in humans.

[b] The odds ratio compares individuals who are at least lightly infected (>0 EPG) with individuals who are not infected (0 EPG); it also compares individuals who are moderately or heavily infected (>100 EPG) with individuals who are lightly infected or not infected (0–100 EPG).

[c] There was one village where no rats were trapped. Thus, these analyses are based on 49/50 villages.

humans, and the correlation of infection between all mammals except water buffalo, suggest that either one strain of *S. japonicum* is capable of infecting all mammals or there are several strains able to coinfect species more or less equally. Our results suggest it is unlikely that there are species-specific strains unable to coinfect other species. We are pursuing molecular biological studies of genetic differences in *S. japonicum* obtained from different hosts to determine if this is the case.[20,21]

These cross-sectional analyses of the intensity of *S. japonicum* infection in humans and other mammals did not account for snail populations or infection parameters. It is possible that there are more snail colonies in villages with a higher intensity of infection in all mammals. This is to be expected because snails lie in the causal pathway between animal and human infection (and vice versa). Further analyses are needed to determine if the presence of infected snails and proportion of infection of *O. quadrasi* snail colonies are independently related to the intensity of infection among humans.

Only one ecological study in two Chinese counties estimated the relationship between *S. japonicum* infection in animals and humans.[12] The correlation

between the annual incidence of infection in humans and domestic animals over 10 years varied from 0.84 to 0.87. These correlations may be overestimates due to a lack of control for repeated measurement over time. Indirect evidence of an association between animal infections and human infections was obtained from intervention studies in China where water buffalo and humans were treated for infection, sometimes in association with snail-control measures.[1,12]

Unlike the findings from China,[22] we did not find any association between the intensity of infection in water buffalo and infection in humans nor did we find a correlation between the mean EPG in water buffalo and that in other animals. This may be due to the low prevalence of infection (3%) in water buffalo and the aggregation of almost half of these infected animals in one village. This suggests that the epidemiology of *S. japonicum* in mammals and its link to human infection is different in Western Samar province from that reported in China.

The strength of our study is that we used a sample size of 50 villages and sampled more than 650 animals of each species and more than 5600 humans, allowing for variability in levels of infection between units of analysis.

Research

Infection with *S. japonicum* in humans and animals in the Philippines   Stephen T McGarvey et al.

We adjusted for the clustering of infection in humans at the village level, thus avoiding underestimating the variance of our estimates. We also adjusted for measurement errors in human infection. None of these approaches was used in prior studies of the link between animal infection with *S. japonicum* and human infection.

One limitation of our study is that we did not adjust for potential measurement error in animal EPG counts. Most pigs and water buffalo were sampled on at least 2 days, which should provide a sensitivity of at least 95%. In dogs and cats, about one-quarter of the animals were sampled only once, giving a sensitivity of 67% for dogs and a sensitivity of 75% for cats.[16] It is unlikely that such an adjustment would modify our conclusions, but it might improve the accuracy of estimates of the associations between animal and human infections.

It could be argued that using the mean EPG per mammalian species within the village does not represent the skewed distribution of infection intensity in which most animals are not infected and a minority are heavily infected. However, this approach best fulfils our goal of representing the village-level environmental contamination with the eggs of *S. japonicum*. Each egg releases miracidia that will infect snails regardless of which animal was initially infected. Using the mean EPG allows us to consider that each egg contributes equally to environmental contamination, regardless of which particular animal is infected.

S. japonicum is endemic in areas of the Philippines, and several years of control programmes have failed to eliminate it. This may be due in part to the fact that infection is also present in dogs and cats and their infection is associated with infection in humans. Controlling infections in dogs and cats is challenging, and other methods, such as targeting snail environments through modification of irrigation systems, may prove fruitful for controlling transmission across all species. Nevertheless, these cross-sectional results suggest there is a need to develop ways to treat infected cats and dogs as well as to implement population-control methods for these household and village animals. These findings derive from the baseline results of a 1-year longitudinal study examining the impact of the incidence of animal infection on human infection after mass treatment of humans in 50 villages. Longitudinal models of *S. japonicum* transmission to humans resulting from animal infection, changes in snail numbers and proportions of infection, as well as irrigation and other farming practices should improve our understanding and may provide evidence for research into interventions and policies. ■

Résumé

Associations transversales entre l'intensité des infestations animale et humaine par Schistosoma japonicum dans la province du Samar occidental, aux Philippines

Objectif Evaluer l'association entre l'intensité de l'infestation des animaux par Schistosoma japonicum et l'infestation des êtres humains par cette espèce dans la province du Samar occidental, aux Philippines.

Méthodes Une étude transversale d'observation a été menée auprès de 1425 ménages, dans 50 villages. Des échantillons de selles ont été recueillis quotidiennement sur une période de 3 jours, auprès de 5623 êtres humains, 1275 chats, 1189 chiens, 1899 porcs, 663 rats et 873 buffles d'eau. L'intensité de l'infestation par S. japonicum a été mesurée par le nombre d'œufs par gramme (EPG). Le comptage des œufs a été effectué par la méthode de Kato-Katz. Un modèle logit hierarchisé cumulatif de type bayésien, avec des ajustements pour tenir compte de l'âge, du sexe, de la profession et de l'erreur de mesure, a été utilisé.

Résultats La proportion ajustée d'êtres humains légèrement infestés (catégorie correspondant à 1-100 EPG) était de 17,7 % (intervalle de crédibilité bayésien à 95 % = 15,3 - 20,2 %) et celle d'humains modérément infestés (> 100 EPG) de 3,2 % (2,2 à 4,6 %). Les résultats parasitologiques bruts pour les animaux ont indiqué que 37 chats (2,9 %), 228 chiens (49,2 %), 39 porcs (2,1 %), 199 rats (30,0 %) et 28 buffles d'eau (3,2 %) étaient infestés. Dans les analyses monovariées, les odds-ratios correspondant à l'augmentation d'une unité du nombre moyen d'EPG au niveau du village chez les chiens était de 1,05 (1,01-1,09), chez les chats de 1,35 (1,02- 1,78), chez les porcs de 1,16 (0,24-5,18) et chez les rats de 1,00 (1,00-1,01). Les valeurs moyennes de l'EPG chez les chats, les chiens, les porcs et les rats étaient corrélées entre elles. Ce facteur de confusion a rendu difficile l'interprétation des odds-ratios, mais on a constaté une plus grande stabilité entre les odds-ratios pour les chiens et les chats.

Conclusion S. japonicum est endémique dans certaines zones des Philippines en dépit de la mise en œuvre de programmes de lutte. Cette situation peut être due à l'association d'infestations canines et félines à des infestations humaines. La lutte contre l'infestation des chiens et des chats représente un vrai défi et il est nécessaire de mettre au point de nouvelles méthodes pour endiguer la transmission entre les espèces.

Resumen

Asociación transversal entre la intensidad de los casos de infección por *Schistosoma japonicum* en los animales y en el hombre en la provincia de Samar occidental, Filipinas

Objetivo Estimar la relación entre la intensidad de las infecciones animales por *Schistosoma japonicum* y la de la infección humana correspondiente en la provincia de Samar occidental de Filipinas.

Métodos Realizamos un estudio transversal observacional de 1425 hogares en 50 aldeas. Se recogieron muestras de heces de forma diaria durante 1-3 días en 5623 personas, 1275 gatos, 1189 perros, 1899 cerdos, 663 ratas y 873 búfalos de agua. La intensidad de la infección por *S. japonicum* se midió en función del número de huevos por gramo (HPG). Los recuentos de huevos se hicieron mediante el método de Kato-Katz, y utilizamos un

modelo logit acumulativo jerárquico de tipo bayesiano, con ajustes para la edad, el sexo, la ocupación y el error de medición.

Resultados La proporción ajustada de personas con infección ligera (1 - 100 HPG) fue del 17,7% (intervalo creíble bayesiano del 95% = 15,3% - 20,2%), y la proporción clasificada como afectada moderadamente (HPG > 100) fue del 3,2% (2,2% - 4,6%). Los resultados parasitológicos brutos para los animales mostraron que estaban infectados 37 gatos (2,9%), 228 perros (19,2%), 39 cerdos (2,1%), 199 ratas (30,0%) y 28 búfalos de agua (3,2%). En los análisis con una variable las razones de posibilidades (OR) correspondientes a un aumento de una unidad del número medio de HPG a nivel de aldea fueron de 1,05 (1,01 - 1,09) en los perros,

1,35 (1,02 - 1,78) en los gatos, 1,16 (0,24 - 5,18) en los cerdos, y 1,00 (1,00 - 1,01) en las ratas. Los valores medios de HPG en los gatos, perros, cerdos y ratas estaban correlacionados entre sí. Este factor de confusión dificultó la interpretación de las OR, pero las OR de perros y gatos fueron más coherentes.

Conclusión *S. japonicum* es endémico en algunas zonas de Filipinas pese a la puesta en práctica de los programas de control. Ello puede deberse a la asociación de la infección en perros y gatos a las infecciones humanas. El control de la infección en esas dos especies no resulta fácil, de ahí la necesidad de desarrollar nuevos métodos para controlar la transmisión a través de todas las especies.

ملخص

ترافق الشدة الشاملة للقطاعات للعدوى بالبلهارسيات اليابانية لدى الحيوانات مع شدتها لدى الإنسان في إمارة ساما – الغربية في الفلبين

الهدف: تقدير مدى الترافق بين الشدة الشاملة للقطاعات للعدوى بالبلهارسيات اليابانية لدى الحيوان مع شدتها لدى الإنسان في إمارة سامار الغربية في الفلبين.

الطريقة: قمنا بدراسة ملاحظة شاملة للقطاعات شملت 1425 من السكان في 50 قرية، فقد جمعنا عيّنات من البراز في كل يوم من الأيام الثلاثة الأولى من 5623 إنساناً و1275 قطة و1189 كلباً و1899 خنزيراً و668 جرذاً و873 من جواميس الماء. وقسنا شدة العدوى بالبلهارسيات اليابانية بعدد بيوضها في كل غرام من البراز، وأجرينا تعداد البيوض بطريقة كاتو – كاتز، واستخدمنا النموذج اللوغاريتمي التراكمي التراتبي البيسياني، مع التصحيح وفقاً للعمر والجنس والمهنة وأخطاء القياس.

الموجودات: بلغت النسبة المئوية المصحَّحة للعدوى الطفيفة لدى الإنسان والتي تصنَّف بتعداد البيوض 1 – 100 بيضة في غرامٍ من البراز 17.7%، وقد كانت فترة الثقة البيسيانية 95% إذ تراوحت النسب المئوية بين 15.3% و20.2%، فيما بلغت النسبة المئوية للعدوى المتوسطة الشدة والتي تميل لأن تكون الأقل في درجة توسطها والتي تصنف بتعداد البيوض الذي يزيد على 100 بيضة في غرام من البراز 3.2%، إذ تراوحت بين 2.2% و4.6%

وتشير النتائج الخام للفحوص الطفيلية أن 37 قطة (2.9%) و228 كلباً (19.2%) و39 خنزيراً (2.1%) و199 جرذاً (30%) و28 من جواميس الماء (3.2%) كانوا مصابين بالعدوى. ولدى إجراء التحليل الوحيد التفاوت بلغت نسبة الأرجحية المتعلقة بوحدة زيادة العدد الوسطي للبيوض في غرام من البراز على مستوى القرية لدى الكلاب 1.05، إذ تراوح بين 1.01 و1.09 ولدى القطط 1.35 إذ تراوح بين 1.02 و1.78 ولدى الخنازير 1.16 إذ تراوح بين 0.24 و5.18 ولدى الجرذان 1.00 إذ تراوح بين 1.00 و1.01. وقد ارتبطت القيم المتوسطة لعدد البيوض في غرامٍ من البراز لدى القطط والكلاب والخنازير والجرذان ببعضها البعض، وقد أدى هذا التداخل إلى صعوبة تفسير نسب الأرجحية، إلا أن نسب الأرجحية لدى الكلاب والقطط كانت متسقة مع بعضها البعض.

الاستنتاج: تتوطَّن البلهارسيات اليابانية في مناطق الفلبين رغم تنفيذ برامج المكافحة، وقد ينجم هذا التوطُّن عن ترافق العدوى لدى القطط والكلاب مع العدوى لدى الإنسان، وتعد مكافحة العدوى لدى القطط والكلاب من التحديات الكبيرة، وتمس الحاجة لابتكار طرق جديدة لمكافحة سراية البلهارسيات في جميع أنواع الحيوانات.

References

1. Dongbao Y, Ross AG, Musheng X, Yuesheng L, Yan C. Highlights on the World Bank Loan Schistosomiasis Control Program in China (1991-1998): a special focus on Hunan Province. *Southeast Asian J Trop Med Public Health* 1999;30:657-63.

2. Ross AG, Sleigh AC, Li Y, Davis GM, Williams GM, Jiang Z, et al. Schistosomiasis in the People's Republic of China: prospects and challenges for the 21st century. *Clin Microbiol Rev* 2001;14:270-95.

3. Shi F, Zhang Y, Ye P, Lin J, Cai Y, Shen W, et al. Laboratory and field evaluation of *Schistosoma japonicum* DNA vaccines in sheep and water buffalo in China. *Vaccine* 2001;20:462-7.

4. Li YS, He YK, Zeng QR, McManus DP. Epidemiological and morbidity assessment of *Schistosoma japonicum* infection in a migrant fisherman community, the Dongting Lake region, China. *Trans R Soc Trop Med Hyg* 2003;97:177-81.

5. Maszle DR, Whitehead PG, Johnson RC, Spear RC. Hydrological studies of schistosomiasis transport in Sichuan Province, China. *Sci Total Environ* 1998;216:193-203.

6. Dumag PU, Gajudo CE, Sena CY, Cardenas EC, Fementira EB. Epidemiology of animal schistosomiasis in the Philippines. *Philippine J Animal Industry* 1981;36:1-23.

7. Lewert RM, Yogore MG Jr, Blas BL. Schistosomiasis japonica in Barrio San Antonio, Basey, Samar, the Philippines. I. Epidemiology and morbidity. *Am J Trop Med Hyg* 1979;28:1010-25.

8. Leonardo LR, Acosta LP, Olveda RM, Aligui GD. Difficulties and strategies in the control of schistosomiasis in the Philippines. *Acta Trop* 2002;82:295-9.

9. Li Y, Sleigh AC, Williams GM, Ross AG, Forsyth SJ, Tanner M, et al. Measuring exposure to *Schistosoma japonicum* in China. III. Activity diaries, snail and human infection, transmission ecology and options for control. *Acta Trop* 2000;75:279-89.

10. Pesigan TP, Farooq M, Hairston NG, Jauregui JJ, Garcia EG, Santos AT, et al. Studies on *Schistosoma japonicum* infection in the Philippines. I. General considerations and epidemiology. *Bull World Health Organ* 1958;18:345-455.

11. Fernandez TJ Jr, Petilla T, Banez B. An epidemiological study on *Schistosoma japonicum* in domestic animals in Leyte, Philippines. *Southeast Asian J Trop Med Public Health* 1982;13:575-9.

12. Jiang Q, Zhang S, Yuan H, Liu Z, Zhao G, Brinkmann U. The effect of a combined approach to schistosomiasis control on the transmission of *Schistosoma japonicum* in Xingzi of Poyang Lake area, China. *Southeast Asian J Trop Med Public Health* 1996;27:535-41.

13. National Statistics Office, the Philippines. *A review of the agriculture sector in Eastern Visayas.* Manila: National Statistics Office; 2004. (Special Release No 126.)

14. Peters PA, El Alamy M, Warren KS, Mahmoud AAF. Quick Kato smear for field quantification of *Schisotosoma mansoni* eggs. *Am J Trop Med Hyg* 1980; 29:217-29.

Research

Infection with *S. japonicum* in humans and animals in the Philippines   Stephen T McGarvey et al.

15. Willingham AL, Johansen MV, Barnes EH. A new technique for counting *Schistosoma japonicum* eggs in pig feces. *Southeast Asian J Trop Med Public Health* 1998;29:128-30.

16. Carabin H, Balolong E, Joseph L, McGarvey ST, Johansen MV, Fernandez T, et al. Estimating sensitivity and specificity of a faecal examination method for *Schistosoma japonicum* infection in cats, dogs, water buffaloes, pigs and rats in Western Samar and Sorsogon Provinces, the Philippines. *Int J Parasitol* 2005;35:1517-24.

17. Carabin H, Marshall C, Joseph L, Riley S, Aligui E, Olveda R, McGarvey ST. Estimating and modelling the dynamics of the intensity of infection with *Schistosoma japonicum* in villagers of Leyte, Philippines. Part I: A Bayesian cumulative logit model. *Am J Trop Med Hyg* 2005;72:745-53.

18. Xianyi C, Liying W, Jiming C, Xiaonong Z, Jiang Z, Jiagang G, et al. Schistosomiasis control in China: the impact of a 10-year World Bank loan project (1992–2001). *Bull World Health Organ* 2005;83:43-8.

19. McGarvey ST, Zhou XN, Willingham AL, Feng Z, Olveda R. The epidemiology and host-parasite relationships of *Schistosoma japonicum* in definitive hosts. *Parasitology Today* 1999;15:214-5.

20. Shrivastava J, Barker G, Johansen MV, Zhou X, Aligui GD, McGarvey ST, et al. Isolation and characterisation of polymorphic DNA microsatellite markers from *Schistosoma japonicum*. *Mol Ecol Notes* 2003;3:406-8.

21. Shrivastava J, Gower CM, Balolong E Jr, Wang TP, Qian BZ, Webster JP. Population genetics of multi-host parasites — the case for molecular epidemiological studies of *Schistosoma japonicum* using naturally sampled larval stages. *Parasitology* 2005;131:617-26.

22. Guo J, Ross AGP, Lin D, Williams GM, Chen H, Li Y, et al. A baseline study on the importance of bovines for human *Schistosoma japonicum* infection around Poyang Lake, China. *Am J Trop Med Hyg* 2001;65:272-8.