

ASSESSMENT OF NIPAH VIRUS TRANSMISSION AMONG PORK SELLERS IN SEREMBAN, MALAYSIA

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Abstract. Between September 1998 and May 1999, 265 cases of encephalitis were reported from among those involved in pig rearing. A few cases were also reported among abattoir workers. This raised questions of the risk of transmission among those who handled raw pork. A serosurvey was conducted among pork sellers in Seremban town, which is about 20 km from one of the pig rearing areas which had reported cases of encephalitis. It was found that out of the 28 pork sellers tested, only one tested positive for Nipah virus antibodies and that this pork seller also worked in an abattoir in the same district, removing the urinary bladders from slaughtered pigs. Based on these findings, it was concluded that the risk of transmission of the virus from handling raw pork appeared to be low.

INTRODUCTION

From September 1998 through May 1999, 265 encephalitis cases [105 (40%) fatal] were reported from 3 states in Malaysia (CDC 1999a,b). The largest number of cases were reported from Negeri Sembilan State, where the outbreak began in late December 1998 with 7 reported encephalitis cases in and around the state capital of Seremban. Most of the cases were from Sikamat, a suburb of Seremban, among those involved in the pig rearing industry. In February 1999, similar cases were reported among pig farmers from Bukit Pelandok, an area located 20 miles from Seremban that contains the largest number of pig farms in Malaysia with an estimated pig population of 700,000. By the end of March, a total of 187 encephalitis cases with 64 deaths had occurred in Bukit Pelandok. In March 1999, tissue culture isolation from central nervous system specimens from a few patients identified a new paramyxovirus, now called Nipah virus. Further testing of serological specimens from patients confirmed that Nipah virus caused the outbreak.

Nipah virus is most closely related to the Hendra virus, which was identified in 1994 as the causative agent of an outbreak of severe respiratory disease among horses and persons involved

in horse rearing in Australia (Murray *et al*, 1995a,b; Selvey *et al*, 1995). Three cases of human Hendra virus infection have been reported to date, of whom two have died (Murray *et al*, 1995 a,b; Selvey *et al*, 1995; Hooper *et al*, 1996; Rogers *et al*, 1996; O'Sullivan *et al*, 1997). Hendra virus appears to be transmitted from horses to humans through direct contact with secretions from an infected animal (McCormack *et al*, 1999). The two persons who died from Hendra virus infection had cared for infected horses and had assisted in their necropsies.

While most patients with Nipah encephalitis were pig farmers, 5 cases were reported among abattoir workers who slaughtered pigs. During March 1999, 9 cases of encephalitis (1 fatal) and 2 cases of respiratory illness caused by Nipah virus were also reported among abattoir workers in Singapore (Patton *et al*, 1999). With the reports of cases among abattoir workers both in Malaysia and Singapore, there was concern about the risk of transmission of Nipah virus to those who handled pig carcasses and raw pork. To address this concern, we conducted a cross-sectional study of pork sellers in Seremban to determine the prevalence of Nipah virus infection.

MATERIALS AND METHODS

The study population comprised of an "exposed" group of all pork sellers in Seremban town and a "non exposed" group that included vendors in the main market who sold items other than pork.

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We aimed to obtain 2 non-exposed controls for each pork seller. Participants were interviewed during 20 to 29 April 1999, to obtain information on demographics, illness, exposure to pork, and other non-pork-associated ante-mortem exposures to pigs. A single sample of 10 ml of blood was obtained from each study subject and tested for the presence of antibodies against Nipah virus. Hendra virus antigens, which cross-react with antibodies against Nipah virus, were used in the serological assays.

RESULTS

Of the 71 pork sellers registered with the Seremban municipality, a total of 28 (39.4%) could be located and agreed to participate in the study. In addition, 20 non-exposed control subjects were enrolled. Characteristics of the respondents are shown in Table 1. All pork sellers obtained their

meat from sources in Negeri Sembilan until one month before the study when 20 obtained pork from the neighboring state of Malacca and 2 stopped selling pork.

The use of personal protective equipment (*eg*, gloves, aprons, boots) was low. Two pork sellers reported wearing aprons while working and one wore boots. The others did not wear any protective equipment. Twenty-two pork sellers reported sustaining injuries while working which were mainly cuts from knives and sharp edges of bone.

All except one of the pork sellers and all of the non-exposed vendors were negative for Nipah virus antibodies. The pork seller who tested positive also worked in an abattoir where he removed the urinary bladders from slaughtered pigs. He reported no contact with live pigs but did come into contact with urine and blood of slaughtered pigs. He did not wear any personal protective equipment other than boots while working. He

Table 1
Characteristics of study participants.

Characteristic	Pork sellers (N = 28)	Non-pork sellers (N = 20)
Gender		
Male	17	15
Female	11	5
Ethnicity		
Chinese	28	10
Malay	0	4
Indian	0	6
Age in years (mean)	48.6 years (sd=8.8)	47.4 (sd=10.6)
Nature of employment		
Stall owner	21	15
Stall worker	7	5
Duration of employment in years (mean)	18.5 years (sd=10.4)	17.9 (sd=11.6)
Number of days worked per week (mean)	5.6 (s=0.6)	5.9 (s=0.67)
Number of hours worked per day (mean)	7.3 (s=2.4)	8.0 (s=2.8)
Mean amount of meat sold per day		
Before the outbreak	Pork: 1,116.8 kg (sd=1,859.2)	Mutton: 63.0 kg (sd=20.5) Chicken: 252.5 birds (sd=168.3) Beef 20 kg
During the outbreak	Pork: 158.4kg (sd=314.5)	Mutton: 58.0 kg (sd=24.5) Chicken: 163.3 birds (sd=168.9) Beef 20 kg

became ill with fever on 10 February 1999 but did not report any neurological or respiratory symptoms.

DISCUSSION

An important limitation that should be considered in the interpretation of the findings of this study is its relatively small sample size. Because pork shops were shut down before this investigation was initiated, we could only enroll about 40% of all registered pork sellers in Seremban. Before the outbreak, each of these pork sellers handled an average of more than 1,000 kg of pork per day that came primarily from farms in Negeri Sembilan State that was most affected by the Nipah outbreak in Malaysia. Farms in the Bukit Pelandok and Sikamat areas of Negeri Sembilan had pigs with laboratory-confirmed Nipah infection, and it is quite possible that some of the meat handled by these pork sellers came from infected pigs. In addition, most pork sellers did not use any personal protective equipment and several had sustained injuries while working. However, despite the potential for exposure to pork from infected pigs, only one of the 28 pork sellers studied tested positive for antibodies to the virus. This person also reported exposure to pig secretions and body fluids in an abattoir, and it is not possible to determine accurately the source of his infection. Based on these findings and the fact that no encephalitis cases were reported during the outbreak among persons whose only exposure to pigs was handling pork, the risk of Nipah infection from handling pork is low.

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