Knowledge and practices about hantavirus pulmonary syndrome in a cluster of Japanese communities in Argentina

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ABSTRACT

Objectives.   *To provide information on hantavirus pulmonary syndrome (HPS) knowledge and practices among a cluster of the rural Japanese communities near La Plata in central Argentina, an area with confirmed HPS cases. Particular emphasis was placed on testing the hypothesis that there would be differences between household use of HPS prevention measures based on the head-of-household's knowledge of HPS.*

Methods.   *A questionnaire was designed in three sections: (1) household demographic characteristics, (2) HPS knowledge, and (3) HPS preventive measures. Questionnaires were given to the household head or other adult representing the household at an HPS prevention seminar sponsored by the Japanese Association of La Plata in February 2007. Total HPS knowledge scores were dichotomized into high (equal to or more than the median knowledge score) and low (less than the median). Differences between the two household groups were categorized, according to the degree of HPS knowledge, and analyzed.*

Results.   *The 86 households that responded accounted for about 72% of the total study households in the area. The median knowledge score of 5 (range: 0–9, of 10) divided the study households into two groups: high knowledge score group (n = 40) and low knowledge score group (n = 46). The findings suggest an association between a household's accurate HPS knowledge and its respective use of HPS preventive measures.*

Conclusions.   *The findings of the study have important implications for taking further steps toward improved HPS management and prevention strategies.*

Key words   Hantavirus pulmonary syndrome, rodentia, ethnic group and health, Argentina.

Hantavirus pulmonary syndrome (HPS), a viral disease with a 40–60% mortality rate, is caused by the genus *Hantavirus*, family Bunyaviridae (1). It has a long-time association with its typical reservoir, the New World rodents of the family Muridae, subfamily Sigmo-dontinae. The reservoir host is usually asymptomatically infected. Transfer of the virus can occur when either a human enters the host's habitat or the host settles in the proximity of humans (2). People in contact with rodents or their excreta are at risk of hantavirus infection. Certain occupational groups, such as farmers, are at greater risk of infection and also exhibit higher hantavirus antibody prevalence than control groups. Certain activities, such as hand cultivating, woodcutting, reopening of unventilated rooms, and cleaning near infected rodent habitats, have been indicated as high-risk for HPS infection (3, 4).

In Argentina, the first cases of HPS were reported 1995 in the southwestern region. Since then, Argentina has been the South American country with the highest number of officially confirmed cases (5). Current cases are clustered in three geographically-separate areas, i.e., the north (Jujuy Province), the center (Buenos Aires Province—where the study communities are located) and in the southwest (Río Negro Province). The virus responsible for HPS cases in Ar-

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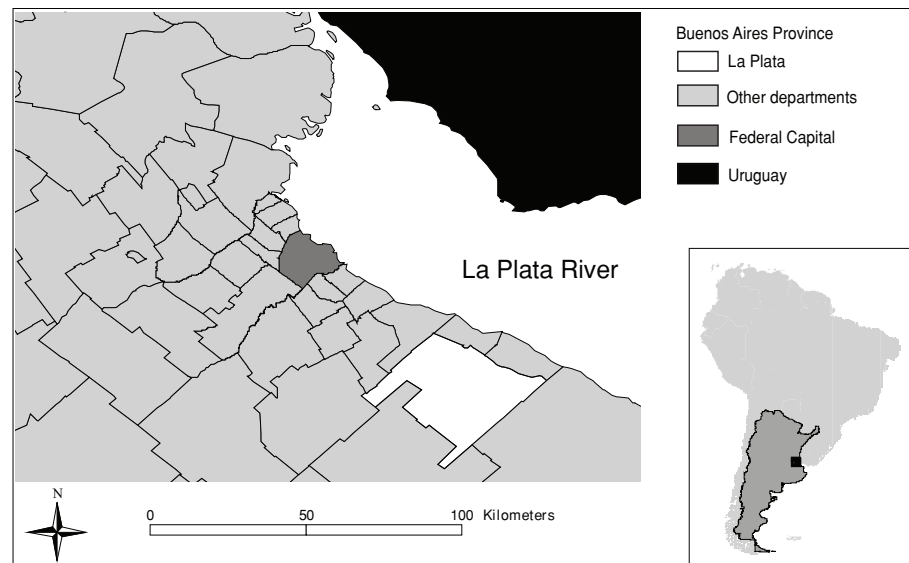
gentina, the Andes virus, was described in 1995 as a new kind of hantavirus, capable of person-to-person transmission (6, 7).

There are an estimated 100 000 to 200 000 cases of hantavirus infection worldwide per year (8). In Argentina, the total number of HPS cases from 1993–2004 was 592 (9). Public concern and fears are focused on rodents as the source of HPS. Especially those who work outdoors, such as farmers in hantavirus-affected areas, fear contracting and dying of the disease. Being a country of immigrants, Argentina has many first-generation citizens from foreign countries, such as Japan, that are especially concerned with obtaining precise information on HPS prevention, but are dealing with a language barrier (personal communication, Japanese Association, La Plata, 2007).

Although the results of actual condition surveys of medical staff, patients, and their families in relation to HPS have been publicized (10, 11), data focusing on population groups at high-risk for HPS infection are few (12). Researchers in Argentina have made positive efforts to further understanding of the molecular biology and epidemiology of hantaviruses and have discovered new ones, such as the Andes virus (13–18). On the other hand, additional research regarding the inhabitants of epidemiologically high-risk areas and those at risk due to their occupation is required to improve management and prevention strategies. Surveys of community-based knowledge, attitudes, behaviors, and practices (KABP) of a wide range of health issues, such as avian influenza, epilepsy, and HIV/AIDS, have been used successfully to gather information and develop systems and activities (19–21). However, there are no previous studies, as far as the authors know, on HPS knowledge and practices among any high-risk population groups in the world.

The objective of this study was to provide information on the knowledge and practices of HPS among a cluster of the rural Japanese communities in Argentina in which HPS cases have occurred in recent years. Particular emphasis was placed on testing the hypothesis that there must be differences between households relative to the degree of knowledge regarding HPS and the use of recommended preventive measures.

FIGURE 1. Map of La Plata, the capital city of the Buenos Aires Province. Inset: square indicates position of La Plata in Argentina (shaded) in South America

MATERIALS AND METHODS

Study area

La Plata is the capital of the Providence of Buenos Aires, located in the central part of Argentina (34°55′ S, 57°17′ W). The city is about 60 km southeast of the federal capital, the city of Buenos Aires, and is a separate administrative entity (Figure 1). Most of the area is fertile plains at 10 m above sea level. The city has a temperate climate, with a mean annual temperature of 16 °C and rainfall of 1 000 mm. The mean annual humidity is 78% and a prevailing wind blows from the southeast for four months a year. The total land area is about 940 km². The population is estimated to be 600 000 (22).

Of the 308 HPS cases registered in Argentina from 1998–2001, about 30% occurred in the Buenos Aires Province (23). Of the 58 HPS cases registered in Buenos Aires Province from 1997 through the first quarter of 2000, more than 50% occurred in La Plata and its neighboring localities. The two lineages of Andes virus (AND Cent Buenos Aires and AND Cent Plata) causing HPS in the province, were found to co-circulate only in La Plata (24). In 2002, Buenos Aires Province recorded more than twice the usual number of HPS cases (52 vs. 20–25); 40 of these occurred in La Plata (25). Colonia Urquiza, home to the Japanese communities that were studied, lies in the suburbs of La Plata. There are 120 Japanese households with approximately 500 Japanese residents, as well as an unknown number of households of various European origins (26). The first 10 Japanese families settled the area in the early 1960s (27). Three major Japanese communities formed in the area based on the time period in which the immigrants arrived (26). Of the study area, 724 hectares are dedicated to agriculture. The location is suitable for floriculture and 60% of the Japanese households engage in this activity.

In Colonia Urquiza, the first HPS cases were confirmed in 1998, including one case (recovered) from the Japanese communities. The first Japanese victim of HPS was confirmed in the communities in 2002. The communities had the second victim of HPS in January 2007, while nine HPS cases (not including Japanese) occurred in Buenos Aires Province in December 2006 (25).

Questionnaire design

Review articles focusing on HPS were used to design the framework for the questionnaire (1–4, 8, 28). HPS prevention materials designed by public health institutions for use at the household- and community-level were also consulted (29, 30). These were used in conjunction with the biological and epidemiological knowledge currently available to create questions. The questionnaire was de-

signed for anonymous self-completion and organized into three sections: (1) household demographics, (2) HPS knowledge, and (3) HPS preventive measures in use. The questionnaire was written in English and then translated into Spanish and pre-tested, after which a small number of changes were made to improve clarity of questions.

Demographic data collected were as follows: selected characteristics for household head, household members, and the house itself, respectively. Responses to some demographic questions were designed to allow comparison with the results of a field study by other researchers in 2002 (27).

There were 10 questions regarding knowledge of hantavirus transmission and HPS treatment. A summary score was developed from these 10 questions, assigning one point for each correct response and zero for each incorrect or uncertain response. Another 10 basic questions were asked in order to identify HPS preventive techniques common among respondents.

Questionnaire administration

Questionnaires were distributed at the HPS prevention seminar sponsored by the Japanese Association at its meeting hall in Colonia Urquiza on 23 February 2007. Each head-of-household, or if absent, another household adult in attendance, received a questionnaire. In addition, prior to beginning the seminar, an oral presentation in Japanese, designed especially for the newest immigrants, explained the purpose of the questionnaire and asked each head-of-household to complete it. The time allotted to complete the questionnaire was 20 minutes. All the completed questionnaires were then collected by the staff of the association. Any duplicates—from the same household—were eliminated by face-to-face assessment. Assistance was given to those who could not read the Spanish language questionnaire.

Data analysis

The data collected from the questionnaires were entered into a database using the OpenOffice.org 2.2 (Sun Microsystems, Santa Clara, California, United States of America). The statistical analyses were performed using the MCA package (31), Stata SE 9.2 (Stata Corpora-

tion, College Station, Texas, United States). Maps were produced using the geographical information system software ArcGIS 9.0 (ESRI Incorporated, Redlands, California, United States).

Univariate and multivariate analyses were used to describe the differences between two household groups categorized according to the degree of HPS knowledge. Total HPS knowledge score dichotomized into high (equal to or more than the median knowledge score) and low (less than the median), and univariate analyses were conducted using Fisher's exact test for categorical variables, to identify the variables significantly associated with the HPS preventive measures in use.

Following the univariate analyses, an exploratory multivariate analysis was conducted using multiple correspondence analysis (MCA) to better understand the relationships among a set of categorical variables.

A disadvantage of the univariate analysis was that a set of variables, of which each is weakly associated with the outcome, can become important predictors when they are taken together. To prevent this, a significance level that was relatively safe ($P < 0.45$) was selected for MCA (32). One of the main objectives of correspondence analysis is to create a visual summary (two-dimensional) of the complicated associations that exist among a set of categorical variables (both predictors and the outcome). The two axes are factorial axes that indicate the most inertia (variability) in the original predictor variables. The result is a

scatter-plot that determines clusters of closely-related predictors, with clusters farther from the intersection of the axes having stronger associations. The values of the outcome variable (also categorical) can also be projected on the same axes to identify which clusters of predictor variable values are associated with the outcomes of interest (33).

RESULTS

The 86 households that completed the questionnaire accounted for about 72% of the total Japanese households in the study area. The survey achieved 100% participation among the households attending the seminar, according to the staff of Japanese Association in La Plata, which was charged with collecting the completed questionnaires.

The demographic characteristics of the study households are shown in Table 1. The median number of household members and children was in broad agreement with the results of the field study mentioned above (three or four members, including one or two children in many families). Twelve percent of them responded that at least one family member had been diagnosed, clinically or serologically, with HPS during the preceding decade.

The percentage of the respondents' answers that reflected accurate HPS knowledge varied greatly between questions (Table 2). The percentage of questions that were answered correctly regarding the hantavirus-affected area, population at high risk, mortality, disinfection, and

TABLE 1. Demographic characteristics of study households (*n* = 86) in a cluster of Japanese communities in Argentina, 2007

Categories	Values (range or percent)
Gender of household head: male	98%
Median age of household head	52 (29–76)
Median number of family members	4 (1–8)
Median number of adults (≥ 15 years old)	3 (1–6)
Median number of children (< 15 years old)	0 (0–4)
Number of generations living together in the home	One (32%), two (40%), three (28%)
Median years since settling in the study area	34 (5–45)
Median number of hectares per household	4 (1–13)
Primary occupation of the family: agriculture	88%
Primary language used at home: Japanese	65%
Primary source of hantavirus knowledge	
person-to-person communication	54%
Newspaper	19%
Television	14%
Government publicity	9%
Radio	2%
Magazine	2%

TABLE 2. Percentage of the respondent's with accurate knowledge of hantavirus pulmonary syndrome (HPS) among a study sample of households (*n* = 86) in a cluster of Japanese communities in Argentina, 2007

Accurate knowledge	%
Hantavirus is not evenly distributed throughout Argentina	7
Ordinary disinfectants (not exclusively for the hantavirus) can kill the virus	26
One may be infected by the virus when bitten by a rat	26
Particular kinds of rats transmit the virus to humans	81
Mosquitoes do not transmit the virus to humans when sucking blood	72
Infected animals, other than rats, do not excrete the virus particles	60
Person-to-person transmission of the virus is not common	84
Workers in the field do not always have the virus infection	14
Those with HPS will not always die	19
We do not have a specific medicine for HPS	67

TABLE 3. Cross-tabulation of frequency-of-use of selected HPS preventive measures, grouped by knowledge scores, among a study sample of households (*n* = 86) in a cluster of Japanese communities in Argentina, 2007

Measures	High score group (%, *n* = 40)[a]	Low score group (%, *n* = 46)[b]	*P*[c]
Promptly clean up the dining table after meals	95	93	1
Properly dispose of leftover food	95	91	0.68
Store animal feed in a container with a lid	75	48	0.01
Wear rubber gloves when cleaning	67	35	<0.01
Use soap for washing hands after cleaning	95	89	0.44
Have sealed piping holes at the base of the house	65	48	0.13
Continuously use rat traps	45	17	<0.01
Clean garbage cans outside the house	45	48	0.83
Do not accumulate any junk outside the house	70	70	1
Clean up the barbeque area after use	85	74	0.29

[a] High score group = households with equal to or more than the median HPS knowledge score.
[b] Low score group = households with less than the median HPS knowledge score.
[c] Fisher's exact test.

path of infection was relatively low (< 30%). The median knowledge score of 5 (range: 0–9, of 10) divided the study households into two groups: high-knowledge score group (*n* = 40) and low-knowledge score group (*n* = 46). Table 3 represents the relationship between selected HPS preventive measures and the knowledge score categories. The percentages for each preventive measure variable of the low-score group (range: 17–93) were more variable than those of the high-score group (range: 45–95). The low-score group had lower percentages for each preventive measure variable, except for one regarding the cleanliness of outdoor garbage cans (no statistical significance) compared to those of the high-score group.

Of the 10 preventive measures shown in Table 3, six variables were selected for MCA (Figure 2). The two dimensions presented in the plot explain 55% of inertia. The first dimension distinguishes between use of various preventive measures, whereas the second separates according to the knowledge score category. Except for the preventive measure indicators "cleaning up the outdoor grill/barbeque" and "use of soap when washing hands," all the plots, including outcome variable points (knowledge score category), were clustered into two areas. On visual assessment in Figure 2, the cluster of the five variables coded 1 are more closely associated than the cluster of those coded 0.

DISCUSSION

This survey represents a first attempt to understand perceptions regarding HPS knowledge and practices among a cluster of the rural Japanese communities in an epidemiologically high-risk area in Argentina. The fact that more than 70% of the study households attended the HPS prevention seminar reflects high public interest in the disease. The seminar sessions organized both in
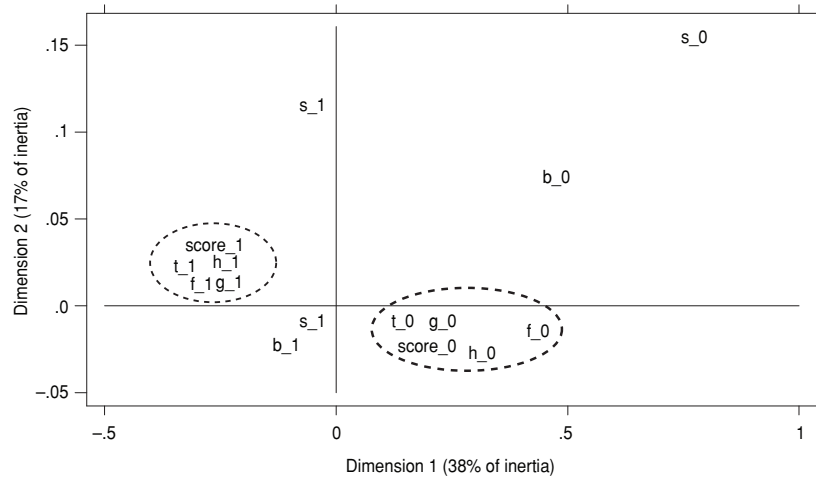
Japanese and Spanish were well received by the first and younger generation settlers. More than half of the respondents had obtained hantavirus knowledge through face-to-face communication, although the information may not always have been accurately interpreted. This might be explained by the fact about two-thirds of the study households used Japanese at home as the primary language, while HPS information was being disseminated in Spanish by the mass media. Educational materials, especially for the first generation settlers, were needed. Consequently, an informative leaflet on HPS prevention was produced in Japanese in order to improve the HPS knowledge of inhabitants (Japanese Association in La Plata, 2007, unpublished).

It is clear that for community-based disease prevention programs to be successful in the short-term and sustainable in the long-term, inhabitants have to receive a perceived benefit from the program, one that does not necessarily have to be measurable on purely economic grounds (8, 12). Therefore, it is important to create a trusting relationship between the general public and officials. In the seminar sessions, municipal officials in charge of HPS management and prevention gave a lecture and emphasized strengthening collaboration with the Japanese communities.

The findings in Figure 2 in conjunction with Table 3 suggest an association between the knowledge background of individual households and their respective attitudes and the measures they take to prevent HPS. As the authors hypothesized, knowledge influences practices. The current study indicates a significant association between those who practice these preventive measures: (1) store animal feed properly, (2) use rubber gloves when cleaning, and (3) use rat traps, and the accurate knowledge that these are standard hygienic practices that reduce the risk of contracting hantavirus. In addition, it is notable that the main source of information was the person-to-person communication (54%) and not the media or governmental publicity. These findings support the importance of media campaigns to implement educational and policy strategies.

Preventing exposure to rodents and their excreta lessens the risk of infection. Efforts should include the removal of rodent food sources from inside the home, measures to inhibit rodents access to the

FIGURE 2. Two-dimensional plot based on Multiple Correspondence Analysis of indicators of a household's HPS preventive measures in use. Indicators of preventive measures (coded 0 for "no" or 1 for "yes") are displayed as column coordinates[a] (Fisher's exact test, $P < 0.05$); while the knowledge score category (coded 0 for less than the median score or 1 for equal to or more than the median) is added as supplementary column points

[a] b: Cleans up the outdoor grill after use; f: Stores animal feed in a container with a lid; g: Wears rubber gloves when cleaning; h: Sealed piping holes at the base of the house; s: Uses soap for washing hands after cleaning; t: Continuously uses rat traps.

home, and elimination of possible nesting sites and food sources from the area surrounding the home. When cleaning up areas that are possibly rodent-infested, proper safeguards should be taken (aeration of the room before entering, use of rubber gloves and disinfectant, avoidance of stirring up and inhaling dust). Rodents should be managed by traps; use of gloves and masks is recommended during manipulation of traps and carcasses (8). For a more general prevention of human infections, especially in risk groups such as the Japanese communities in the study area, the development of a hantavirus vaccine is necessary (1).

Climatic and other environmental factors may govern the population size and migration pattern of relevant hosts. It is essential to pay attention to the consequences of land use changes, especially those that increase human contact with potential reservoirs, such as rodents living in wetlands. In recent years, for example, there was an increase in the number of sites near La Plata that were being used for soil extraction to support brick fabrication. These sites were then abandoned and converted into artificial wetlands with typical flora and fauna (34). The study communities have also expressed concerns over the municipal government's plans to build a city dump near the communities. A dump would likely become another breeding ground for rodents.

Another challenge lies in the fact that the reservoir of the two HPS-causing lineages of Andes virus in La Plata have not yet been identified (24). Detailed knowledge of rodent species distribution and their role as hantavirus reservoirs is needed.

When the potential respondents who were absent from the seminar were taken into account, it was apparent that the sample was not totally representative of the communities in general. The responses obtained are likely to represent inhabitants who are more motivated and interested in the topic. In addition, the questionnaire did not include questions regarding the educational level of respondents or their knowledge of warning signs and symptoms. This angle needs additional research. A lack of detailed demographics and HPS case statistics for the area, which is not a single administrative area, but rather straddles the border between districts, hampers the comparison of HPS cases among different ethnic groups (e.g., between those of Japanese descent vs. those of European descent).

Rodent control in and around the home remains the primary strategy for preventing hantavirus infection. From the public health point of view, the recommended measures that need to be used in concert are: (1) prevent rodents from entering the home by repairing gaps inside and outside the house, (2) trap rodents around the home to help reduce the population, (3) clean up rodent food sources and nesting sites, and (4) take precautions when cleaning rodent-infested areas. It is important to consider that dissemination and widespread adoption of preventive measures require education. Designing and implementing HPS educational programs and measuring their effectiveness should be priorities to incent the communities to take a more active role.

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RESUMEN

Conocimientos y prácticas relacionados con el síndrome pulmonar por hantavirus en un conglomerado de comunidades japonesas en Argentina

Objetivos. Documentar los conocimientos y las prácticas relacionadas con el síndrome pulmonar por hantavirus (SPH) en un conglomerado de comunidades rurales japonesas cerca de La Plata, en la parte central de Argentina, una zona con casos confirmados de SPH. Se hizo hincapié especial en probar la hipótesis de que habría diferencias en el empleo de medidas preventivas contra el SPH en los hogares según el nivel de conocimientos del jefe de familia sobre este síndrome.
Métodos. Se diseñó un cuestionario con tres secciones: a) características demográficas del núcleo familiar, b) conocimientos sobre el SPH y c) medidas preventivas contra el SPH. Los cuestionarios se aplicaron a los jefes de familia o a algún adulto que representara al núcleo familiar durante un seminario sobre prevención del SPH patrocinado por la Asociación Japonesa de La Plata en febrero de 2007. El conocimiento sobre el SPH se clasificó según su puntuación total en alto (igual o mayor que la mediana de las puntuaciones) y bajo (menor que la mediana). Se analizaron las diferencias entre los dos grupos según el grado de conocimientos sobre el SPH.
Resultados. Respondieron representantes de 86 hogares, aproximadamente 72% del total de la zona. La mediana de la puntuación fue de 5 (entre 0 y 9 en una escala de 10) y permitió clasificar los hogares en dos grupos: 40 tenían un nivel de conocimientos alto y 46, bajo. Los resultados indicaron una asociación entre los conocimientos correctos sobre el SPH en un hogar y el empleo de medidas preventivas contra el SPH en ese hogar.
Conclusiones. Estos resultados tienen implicaciones importantes para emprender acciones dirigidas a mejorar el control y la prevención del SPH.

Palabras clave Síndrome pulmonar por hantavirus, roedores, etnia y salud, Argentina.