



Title	Comparison of behaviors regarding live poultry exposure among rural residents in Vietnam and Thailand
Author(s)	Liao, Qiuyan; Lam, Wendy Wing Tak; Bich, Tran Huu; Dang, Vu Trung; Fielding, Richard
Citation	Journal of Infection in Developing Countries, 2014, v. 8, n. 4, p. 526-534
Issued Date	2014
URL	http://hdl.handle.net/10722/220889
Rights	Creative Commons: Attribution 3.0 Hong Kong License

Comparison of behaviors regarding live poultry exposure among rural residents in Vietnam and Thailand

Qiuyan Liao¹, Wendy Wing Tak Lam¹, Tran Huu Bich², Vu Trung Dang², Richard Fielding¹

¹ Behavioural Health Division, School of Public Health, The University of Hong Kong, Hong Kong, China

² Department of Epidemiology, Hanoi School of Public Health, University of Hanoi, Hanoi, Vietnam

Abstract

Introduction: Live poultry exposure and risk behaviors are more prevalent in rural communities, increasing the risk of influenza A/H5N1 infection. We examined the economic and socio-cultural influences on poultry-related practices by comparing the poultry-related practices among Vietnamese and Thai rural residents by family income and consumption preference.

Methods: Stratified cluster sampling was performed to select households. Within each household, one adult was randomly selected for a face-to-face interview in five Vietnamese and five Thai rural districts. Using a standardized questionnaire to assess domestic poultry husbandry, live poultry purchase, and demographics, logistic regression enabled comparisons of behaviors related to live poultry exposure and examination of associated factors.

Results: Among 994 Vietnamese and 907 Thai rural residents, live poultry exposure (prevalence of raising poultry, improper handling of sick or dead poultry, touching live poultry before buying, and slaughtering poultry at home) was more prevalent among Vietnamese than Thai respondents. After adjusting for other demographics, respondents with higher family incomes were less likely to rear backyard poultry in both Vietnam and Thailand, and with more likely to buy live poultry in Vietnam, but not in Thailand. Consumption preference for live poultry was associated with being more likely to rear backyard poultry in Vietnam and Thailand, and with being more likely to buy live poultry in Thailand, but not in Vietnam.

Conclusion: The findings suggest important roles of economic imperatives and cultural preference for live poultry for consumption in supporting poultry rearing and live poultry purchase among rural residents.

Key words: poultry; exposure; comparison; A/H5N1 risk; rural

J Infect Dev Ctries 2014; 8(4):526-534. doi:10.3855/jidc.3545

(Received 14 March 2013 – Accepted 02 October 2013)

Copyright © 2014 Liao *et al.* This is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Introduction

Highly pathogenic avian influenza (HPAI) A/H5N1, widespread throughout Southeast Asian countries since 2003 [1], continues to cause sporadic human infections and deaths. Initially, Thailand and Vietnam were the epicenters of the outbreaks. The epidemic peak was recorded in 2004 in Thailand and in 2005 in Vietnam [1]. However, although A/H5N1 human infection has been well controlled in Thailand since 2007, intermittent human cases continue to occur in Vietnam, totaling 123 human cases as of 15 February 2013, representing 20% of the global case burden [2].

Almost all human A/H5N1 cases are traceable to direct or indirect exposure to infected poultry, making such exposure the most important risk factor for human A/H5N1 infection [3,4]. Activity of A/H5N1 was higher in Vietnam than in Thailand [2], indicating more risky poultry exposure in the former. Live

poultry exposure was more prevalent in rural areas where backyard (domestic) poultry husbandry is more prevalent than in urban areas [5]. We estimated that exposure from backyard poultry comprised more than 96% of the total exposure in a Vietnamese sample [6]. Backyard poultry, compared with commercial poultry, were found to be more likely to be infected due to inadequate or absent biosecurity [7], and thereby represent a major potential vector for A/H5N1 virus transmission [8]. Furthermore, rural residents were more likely than urban residents to participate in hazardous behaviors when buying live poultry, such as touching the poultry directly and slaughtering poultry personally without appropriate protection [5]. Therefore, rural residents are a high-risk population for A/H5N1 infection.

However, while live poultry exposure in urban residents could be largely reduced by limiting availability of live poultry [9], it would be difficult to

reduce exposure among the rural residents due to economic and socio-cultural barriers. For example, in rural Vietnam, where around 90% of poor Vietnamese reside, small-scale domestic poultry husbandry predominates to provide an added source of eggs and meat for family consumption and extra cash from any poultry that can be sold [10]. Aside from being an essential livelihood source, poultry rearing is also an important component of the agricultural ecosystems deeply rooted in the Vietnamese's rural tradition. For example, droppings of chickens are used to feed aquatic animals or fertilize crops (which facilitates viral circulation and spreads infectious diseases) [11]. In Thailand, which has a much higher GDP per capita (~USD3,078 in 2006) compared to that of Vietnam (~USD731 in 2006) [12], poultry is predominantly raised by industrial-scale commercial exporters for international trade and national consumption [7]. Though backyard poultry husbandry remains the more important mode of poultry raising in Thailand [7], commercial poultry products are easily available and much cheaper than that in Vietnam [13,14]. Therefore, Thai rural residents may encounter fewer economic barriers in changing their poultry husbandry practices than Vietnamese rural residents. Moreover, rural residents traditionally believe poultry freshly slaughtered for cooking to be more tasty and nutritious than frozen/chilled poultry; this could be another major barrier for limiting poultry husbandry in rural areas [15]. In Vietnam, poultry is a food and is symbolically important for festivals; there is, therefore, strong cultural support for live poultry rearing or buying [16].

This study, based on the existing dataset for another project [17], aimed to compare backyard poultry husbandry practices and wet market live poultry exposures among rural resident in Vietnam and Thailand. Around 70% of the total population of Vietnam and Thailand are rural residents. We hypothesized that the differences in behaviors related to live poultry exposure could be partially explained by the disparity in economic and socio-cultural contexts between the two countries. Based on the available data, we used family income and consumption preference for live poultry as the proxies for the economic and socio-cultural factors, and we examined the influences of these factors on rural residents' behaviors related to live poultry husbandry. The two hypotheses tested in this paper were: (1) the hazardous practices related to live poultry exposure were more prevalent in Vietnam than in Thailand; (2) lower family income was associated with being more

likely to rear poultry but less likely to buy live poultry, while consumption preference for live poultry was associated with being more likely to rear or buy live poultry.

Methodology

Sampling

Following institutional review board approval at both the administering (University of Hong Kong) and participating institutions (University of Public Health, Hanoi; Chulalongkorn University, Bangkok), sampling was undertaken as follows.

Vietnam

Stratified cluster sampling was performed in five provinces located within 200 kilometers of Hanoi (Hatay, Haiduong, Thaibinh, Namdinh, and Bacgiang) with a combined population of 9.55 million. In three of the five selected provinces (Haiduong, Thaibinh, and Bacgiang), two districts were selected, one with and one without HPAI epidemic history at the time the study was conducted, while in the remaining two selected provinces, two districts in each were selected, one rural district and one urban district. Within each district, one urban and one rural commune were sampled, and 100 households within each commune were randomly selected from the registration records. One adult from each commune household was then selected using Kish grids (a sampling method using random number matrices based on household size) and invited for a face-to-face interview with trained local health bureau interviewers. All interviews were conducted between February 17 and March 15, 2006, when no A/H5N1 human cases were reported in Vietnam. The most recent A/H5N1 human case relative to the study period was reported on November 9, 2005 [1].

Thailand

Suphanburi province, located 150 kilometers northwest of Bangkok with a population of 868,681 people, comprised the sampling frame. This province was selected because it had experienced three major HPAI outbreaks since 2003. In this province, stratified cluster sampling was performed in two out of four highland districts (Nong Ya Sai and Doem Bang Nan Buat) and three out of six lowland districts (Songpinong, U Thong, and Muang Suphan Buri). Two hundred households within each of the first four districts (Nong Ya Sai, Doem Bang Nan Buat, Songpinong, and U Thong) and 100 households in the last district (Muang Suphan Buri) were randomly

sampled according to the registration records at Suphanburi Province. Finally, one adult within each household was selected using Kish grids and invited to complete a face-to-face interview with trained health sciences graduate interviewers from the Institute of Health Research at Chulalongkorn University, Bangkok. All interviews in Thailand were conducted between July 13 and October 16, 2006, when two A/H5N1 human cases were reported [1].

Of the 1,980 and 1,058 participants recruited in Vietnam and Thailand respectively, 994 (50%, 994/1980) and 907 (86%, 907/1058) subjects, respectively, were rural residents, and the remainder were urban. The estimated live poultry exposure for the whole sample of Vietnam has been reported elsewhere [6], while the sample size for Thai urban residents was too small to provide sufficient power to detect a medium difference between two groups. Therefore, the analyses only compared the live poultry exposure practices among the rural residents between the two samples.

Study instrument and data collection

Identical questionnaires administered by interview were used for both locations. The questionnaire was designed by epidemiologists and psychologists from the School of Public Health, the University of Hong Kong, and translated into each local language on site and translated back into English to check the accuracy of the translation. The translations were pretested for content validity, length, acceptability, and comprehensibility in local pilot studies. Final questionnaire content was resolved by the panel. Face-to-face interviews required approximately 20 minutes to complete. Questionnaire items addressing habits regarding poultry farming, shopping, and consumption along with demographic data were used for this analysis.

Habits regarding poultry farming, shopping, and consumption

Poultry rearing

Respondents were asked whether their households raised poultry or not before and after the A/H5N1 epidemic was announced in the studied areas. Respondents who still kept poultry after the A/H5N1 epidemic were asked about the types and numbers of poultry they kept as well as their reasons for keeping poultry. Respondents were also asked about whether any of their poultry had been sick or died over one year before the survey (yes/no); affirmative response

were followed by a question about how the sick/dead poultry were disposed.

Poultry shopping

Respondents were asked whether their households ever bought live poultry or not. If yes, they were asked about frequency of buying and of touching the poultry when buying live poultry (always / usually / occasionally / never) and about the frequency of bringing the poultry home and slaughtering it themselves (always / usually / occasionally / never). Respondents were also asked whether they preferred live poultry to already slaughtered poultry for family consumption and about the associated reasons.

Demographic data including gender, age, education, marital status, and family income were also collected.

Data analysis

Demographic information including gender, age, education, and marital status of both samples were compared using Pearson's Chi-square test, and median family incomes were compared using the median test. To compare the differences in practices related to live poultry exposure, logistic regression was performed to calculate the 95% confidence interval of proportions adjusted for demographic differences between the two samples. Multivariate logistic regression was then performed to examine the associations of family income and consumption preference for live poultry with live poultry rearing and live poultry purchase, respectively, in the two samples. Independent variables were consumption preference for live poultry, family income, and other demographics. District cluster effects were accommodated by adjustment within the logistic model. All statistic analyses were conducted using STATA software version 9.2 (STATA Corp., College Station, TX, USA).

Results

Respondent demographics

Overall, 994 and 907 rural residents in Vietnam and Thailand, respectively, were included in the analysis. Both samples comprised a larger proportion of female (61% Vietnamese, 62% Thai) and married or formerly married (86% Vietnamese, 88% Thai) respondents (Table 1). The two samples did not differ by gender and marital status but did differ by age distribution, education, and family income, with the Vietnamese respondents being younger, better

educated, and having lower family income compared to Thai respondents (Table 1).

Live poultry exposure practices

Backyard poultry husbandry

After adjustments for age, education attainment, and family income differences, ~71% of Vietnamese respondents reported keeping backyard poultry before A/H5N1 outbreaks were announced in their areas, of which only 9% reported stopping backyard poultry husbandry after the A/H5N1 outbreaks were announced (Table 2). In comparison, far fewer (53%) Thai respondents reported keeping backyard poultry, and more (34%) reported having stopped backyard poultry husbandry subsequent to A/H5N1 outbreaks ($p < 0.001$). Vietnamese respondents were less likely to report sick or dead backyard poultry in the year preceding the survey (19% Vietnam *vs.* 36% Thailand, $p < 0.001$). Among those reporting sick or dead poultry in the year preceding the survey, most (79% Vietnam *vs.* 95% Thailand, $p = 0.001$) reported destroying the sick or dead poultry by burying or burning them. However, fewer Vietnamese respondents (11% Vietnam *vs.* 23% Thailand, $p = 0.043$) informed the local administration if their poultry sickened or died. Vietnamese respondents also were more likely to throw the sick or dead poultry away without telling others (23% Vietnam *vs.* 2% Thailand, $p < 0.001$), but while more Vietnamese respondents reported selling or eating the sick or dead poultry, this difference was not significant (13% Vietnam *vs.* 6% Thailand, $p = 0.082$).

Purchase of live poultry

More Vietnamese respondents reported buying live poultry for family consumption over the past three years (17% Vietnam *vs.* 11% Thailand, $p = 0.010$). Of those who reported buying, almost all Vietnamese reported touching the poultry when buying (92% in Vietnam *vs.* 63% in Thailand, $p < 0.001$) and slaughtering the poultry at home themselves (85% Vietnam *vs.* 59% Thailand, $p = 0.001$) (Table 2).

Consumption preference for live poultry

While most Vietnamese respondents (67%) reported preferring live poultry for family consumption, few Thai respondents (6%) reported this preference ($p < 0.001$) (Table 2). Among those preferring live poultry for family consumption, major reported reasons included freshness (81% Vietnam and 67% Thailand), better taste (40% Vietnam and 33% Thailand), lower risk of buying spoiled meat (18%

Vietnam and 6% Thailand), better nutrition (11% Vietnam and 23% Thailand), and a matter of habit (9% Vietnam and 31% Thailand).

Types and purposes of poultry rearing

Types of backyard poultry differed, with most Vietnamese respondents (94%) keeping chickens for eggs and meat, whilst Thai respondents mainly kept fighting cocks (50%) and chickens for eggs and meat (55%) (Table 3). The scale of domestic poultry husbandry is generally greater in Thailand than in Vietnam. In both the Vietnamese and Thai samples, poultry were mainly kept for family consumption and sale (96% Vietnam and 72% Thailand). Additionally, around 27% of the households also reported keeping the poultry for other purposes such as cock fighting or ornamental purposes in Thailand (Table 3).

Factors associated with live poultry exposure

In Table 4, it is shown that after fully adjusting for other variables in the multivariate logistic regression models, respondents with higher family income reported being less likely to rear backyard poultry in Vietnam (OR = 0.56, 95% CI: 0.39-0.83 for monthly household income >USD48) and Thailand (OR = 0.67, 95% CI: 0.48-0.93 and OR = 0.56, 95% CI: 0.38-0.84 for monthly household income of ~USD162-324 and >USD324), but reported being more likely to buy live poultry in Vietnam (OR = 1.65, 95% CI: 1.07-2.55 and OR = 2.57, 95% CI: 1.59-4.15 for monthly household income of ~USD24-48 and >USD48). Family income was not significantly associated with buying live poultry in Thailand. Consumption preference for live poultry was consistently associated with being more likely to rear backyard poultry in Vietnam (OR = 1.60, 95% CI: 1.19-2.14) and Thailand (OR = 3.18, 95% CI: 1.72-5.91) and buying live poultry in Thailand (OR = 20.18, 95% CI: 10.40-39.15) but not with buying live poultry in Vietnam (OR = 0.53, 95% CI: 0.37-0.75) (Table 4).

Additionally, as shown in Table 4, females were less likely to buy live poultry in Thailand (OR = 0.60, 95% CI: 0.38-0.95). Respondents between 35 and 54 years of age were more likely to report poultry rearing compared to those between 18 and 34 years of age in Vietnam (OR = 1.38, 95% CI: 1.01-1.89). Respondents with tertiary or above education attainment were more likely to report buying live poultry in Vietnam (OR = 2.29, 95% CI: 1.12-4.71).

Table 1. Demographic differences between the Vietnamese and Thai samples

Sample	Vietnamese sample (N = 994)	Thai sample (N = 907)	Differences (p)
Gender			
Female	603 (61%)	559 (62%)	0.665
Age groups			
18-34	355 (36%)	162 (18%)	< 0.001
35-54	488 (49%)	414 (46%)	
≥ 55	151 (15%)	331 (36%)	
Median age (years)	40	50	
Education			
Primary or below	145 (15%)	648 (71%)	< 0.001
Secondary	792 (80%)	232 (26%)	
Tertiary or above	57 (6%)	27 (3%)	
Marital status			
Single	137 (14%)	113 (12%)	0.394
Married or formerly married	857 (86%)	794 (88%)	
Median family income [#]	US\$38	US\$162	< 0.001

[#] 1US\$ = 21,052 VND = 31 Baht

Table 2. Comparison of practices and perceptions of avian influenza risk related to live poultry exposure, Vietnamese and Thai samples

Live poultry related exposure and avian influenza risk perception	Vietnamese sample % (95%CI) [*]	Thai sample % (95% CI) [*]	Differences (p)
Kept poultry before the outbreak (Yes)	71 (67-74)	53 (49-57)	< 0.001
Kept but stopped after the outbreak (Yes) [±]	9 (7-12)	34 (28-39)	< 0.001
Poultry sick or dead in previous year (Yes)	19 (16-23)	36 (31-41)	< 0.001
Way of handling dead poultry [#]			
Destroyed it	79 (66-85)	95 (90-98)	0.001
Threw it away without telling others	23 (15-34)	2 (1-6)	< 0.001
Informed the local administration	11 (6-19)	23 (16-32)	0.043
Sold/ate/other	13 (8-23)	6 (3-11)	0.082
Bought live poultry (Yes)	17 (15-21)	11 (9-14)	0.010
Touched before buying the live poultry [¶] (always/usually/occasionally)	92 (85-96)	63 (50-75)	< 0.001
Slaughtered the poultry at home [¶] (always/usually/occasionally)	85 (77-90)	59 (46-70)	0.001
Consumption preference (preferring live poultry)	67 (62-73)	6 (5-9)	< 0.001

[±]Percentage was calculated within those who reported keeping poultry after the A/H5N1 outbreak was announced in their areas.

[#]Percentage was calculated within those who reported their poultry being sick or dead one year prior to the survey.

[¶]Percentage was calculated within those who reported their household bought live poultry.

^{*}All percentages were adjusted by age, education, and household income differences in the samples.

Table 3. Number and type of live poultry kept and purposes of keeping these poultry among rural residents continuing poultry husbandry after the AI outbreak, Vietnam and Thailand

Types of live poultry raised	Vietnam (N = 649)		Thailand (N = 329)	
	Median (range) [¶]	% household	Median (range) [¶]	% household
Fighting cocks	2 (1-50)	3%	10 (1-100)	50%
Ornamental cocks/birds	3 (1-20)	4%	5 (1-50)	8%
Chickens for eggs and meat	10 (1-800)	94%	20 (1-3500)	55%
Ducks	5 (1-500)	9%	10 (2-70)	10%
Swans/geese	6 (1-70)	8%	0	0
Other kinds of birds	4 (1-10)	2%	2 (1-10)	2%
Total	10 (1-800)	100%	15 (1-3500)	100%
Purposes of rearing poultry				
For own family consumption		60%		22%
For sale		12%		5%
Both consumption and sale		24%		45%
Other purposes		4%		27%

[¶]Number in these columns represent the median number of a particular type of poultry raised in the household (outside the parentheses) and the range of the poultry number (within the parentheses).

Table 4. Multivariate associations between demographics and consumption preference, and poultry rearing and live poultry purchase among rural residents in Vietnam and Thailand

Independent variables	Backyard poultry rearing after H5N1 outbreaks		Continued purchase of live poultry	
	Vietnam	Thailand	Vietnam	Thailand
Gender (female)	1.27 (0.96-1.67)	0.77 (0.58-1.02)	0.91 (0.64-1.28)	0.60 (0.38-0.95)*
Age group				
18-34	1.00	1.00	1.00	1.00
35-54	1.38 (1.01-1.89)*	0.78 (0.49-1.22)	0.94 (0.64-1.39)	1.80 (0.82-3.95)
≥ 55	1.40 (0.91-2.17)	0.85 (0.51-1.41)	0.71 (0.40-1.24)	1.69 (0.70-4.12)
Education				
≤ Primary	1.00	1.00	1.00	1.00
Secondary	1.26 (0.85-1.88)	0.74 (0.49-1.11)	0.92 (0.56-1.52)	1.20 (0.64-2.25)
≥ Tertiary	1.28 (0.66-2.48)	1.04 (0.43-2.53)	2.29 (1.12-4.71)*	1.18 (0.28-4.97)
Marital status				
Single	1.00	1.00	1.00	1.00
Married/formerly married	0.69 (0.45-1.06)	1.10 (0.69-1.74)	1.41 (0.82-2.44)	1.06 (0.48-2.34)
Family income (US\$) [¶]				
≤ 24/162	1.00	1.00	1.00	1.00
24-48/162-324	0.75 (0.55-1.04)	0.67 (0.48-0.93)*	1.65 (1.07-2.55)*	0.77 (0.44-1.34)
> 48/324	0.56 (0.39-0.83)**	0.56 (0.38-0.84)**	2.57 (1.59-4.15)***	0.89 (0.46-1.72)
Consumption preference (live poultry vs. pre-killed poultry)	1.60 (1.19-2.14)**	3.18 (1.72-5.91)***	0.53 (0.37-0.75)***	20.18 (10.40-39.15)***

[¶] p < 0.05, ** p < 0.01, *** p < 0.001

[¶] For each category of family income, the number on the left side of the slash is for Vietnam while the number on the right side of the slash is for Thailand; 1US\$ = 21,052 VND = 31 Baht.

Discussion

The findings of the study suggest that hazardous behaviors related to poultry exposure were more prevalent in the Vietnamese sample than in the Thai sample, consistent with our hypotheses. A general inadequacy of biosecurity in domestic premises makes domestic poultry significantly more vulnerable to A/H5N1 infection. Therefore, the higher prevalence of backyard poultry husbandry in Vietnam results in higher frequency of contact between people and poultry, which subsequently could lead to a higher risk of A/H5N1 infections [6]. In particular, the higher prevalence of improper handling of sick or dead poultry, touching live poultry directly, and slaughtering poultry personally, all of which increase risk of infection, may contribute to the continuing re-emergence of human A/H5N1 cases in Vietnam [2].

Economic differences may be one of the major reasons for the higher risk poultry exposure in Vietnam. Our study found that households with lower family incomes were more likely to rear backyard poultry in both Vietnam and Thailand, suggesting that rearing backyard poultry remains the major livelihood source for rural residents, particularly for the rural Vietnamese, whose family incomes were generally lower than that of the rural Thais (USD38 vs. USD162). Rural residents in the Vietnamese sample generally raised small sizes of poultry flocks for their own family consumption or sale for small income. Therefore, unlike those who have made large investments in commercial-scale poultry breeding in Thailand, the generally small-scale poultry farmers and households in Vietnam do not face significant economic loss if disease outbreaks occur [18]. In Vietnam, those who kept poultry before A/H5N1 outbreaks were announced were more likely to continue poultry rearing even after the A/H5N1 outbreaks occurred. Moreover, poultry were much more expensive in Vietnam than in other Southeast Asian countries due to the higher costs of poultry breeding and delivering and expensive protein supplementary foods [15]. This may restrict live poultry purchases to wealthier Vietnamese and encourage backyard poultry husbandry and full utilization of dead or sick poultry in Vietnam.

From the cultural perspective, this study found that most Vietnamese rural residents preferred live to pre-killed poultry for family consumption. The major associated reasons indicated by the respondents suggest that poultry slaughtered immediately before cooking are traditionally believed to be fresher, better in flavor, more nutritious, and less likely to be

contaminated, consistent with previous findings [16,19]. Preferring live poultry for family consumption was strongly associated with rearing but not with buying live poultry in Vietnam. That is, those who like to eat poultry probably have to raise their own for it to be perceived as safe as well as affordable. We have previously reported that rural residents generally attributed A/H5N1 to a variety of husbandry practices [18]. In particular, commercial poultry farming practices involving overcrowded poultry sheds, poor hygiene and unsanitary conditions, overuse of veterinarian drugs, and widespread use of growth promoters all geared to maximizing profit were perceived as encouraging or causing A/H5N1 [18]. These perceptions suggest significant distrust among rural residents towards the commercial poultry sector. In contrast, Thai respondents rarely expressed preference for buying live poultry for family consumption, though preference for live poultry was also associated with more backyard poultry husbandry practices and purchase of live poultry in Thailand. Industrial-scale commercial poultry production in Thailand ensures cheap pre-killed chickens are widely available [14], in contrast to Vietnam where the poultry industry is small and commercial standards are less stringent, incomes are lower, and fewer commercial outlets and cold chains exist [15,16].

Almost all Vietnamese respondents and more than half of the Thai respondents who bought live poultry reported touching the poultry before buying it and subsequently slaughtering purchased poultry at home themselves. Consumers who buy live poultry in wet markets traditionally rely on their own judgment on the quality and safety of the poultry by touching or feeling the poultry when buying [16,20]. Although poultry retailers in Vietnam will also slaughter a whole chicken when sold [16], consumers are more confident about avoiding avian influenza infection if they choose what appears to be healthy poultry and prepare it themselves [16]. For Vietnamese, the behavior and appearance of live poultry is more informative about the bird's health than is the appearance of butchered meat, which can also be bacteriologically contaminated in the absence of market cold chains [20]. In Thailand, a Buddhist country, where killing is considered to have karmic consequences, Thai people are less likely to slaughter the poultry themselves [20]. Already killed commercially reared poultry is more widely available and affordable in Thailand's supermarkets than in Vietnam's fewer (mostly urban) supermarkets [16].

Effective government control and preventive measures may have also contributed to the lower risk of poultry exposure in Thailand. Since the 2004 A/H5N1 influenza outbreak in Thailand, measures were implemented to control the disease, which included large-scale poultry culling, restriction on poultry movement, public health education to encourage proper animal handling practices, and improvements to biosecurity systems for poultry rearing [21,22]. In particular, timely public health education in Thailand may have been effective in promoting public knowledge of avian influenza and changing risky behaviors regarding poultry-handling practices [23]. Governmental compensation for economic losses due to poultry culling of up to 75% of the market prices of affected poultry may encourage small-scale Thai farmers to report sick or dead poultry to the authorities [22]. Vietnam is less developed than Thailand [24], and the poultry compensation system for culling was often seen to have been inadequate [18]. Destroying infected poultry could be generally involuntary and evoke high anxiety among the Vietnamese poultry raisers.

Study limitations include the cross-sectional nature of the surveys. Sampling involved the careful registration and selection of households from electoral rolls and randomized sampling within households, which is a robust sampling method. This together with large samples and highly standardized data collection ensured excellent data integrity. Notably, the Vietnamese sample overall had a much higher educational achievement than the Thai sample. Potentially, cultural differences between the two countries may have influenced understanding of the study measures despite careful piloting of both Thai and Vietnamese versions of the instrument. Questionnaire translation was rigorous and thorough, so any comprehension differences should have been slight. Despite potential limitations, this study enabled cross-cultural comparisons to reveal notable social, cultural, and economic influences on behaviors related to live poultry exposure and differences in epidemic patterns, which both further inform policy making for avian influenza prevention.

Acknowledgements

The study was funded by the Research Fund for the Control of Infectious Diseases Food and Health Bureau, Government of the Hong Kong SAR (grant no. 02040172). The funding body has no role whatsoever in study design, data collection, analysis, interpretation of data, writing of the articles, and in the decision to submit it for publication.

Ms. Venus Udomprasertgul implemented the questionnaire translation, planning, coordinating, and data collection for Thailand. We have been unable to reach and confirm with Ms. Udomprasertgul her agreement with the manuscript content for authorship and so acknowledge her role here instead. We also thank other research members in the study sites for performing the face-to-face interviews, data entry, data checking, and preparation of the datasets.

References

1. World Health Organization (2013) H5N1 avian influenza: timeline of major events http://www.who.int/influenza/H5N1_avian_influenza_update_20121217b.pdf. Accessed 11 February 2013.
2. World Health Organization (2013) Cumulative Number of Confirmed Human Cases of Avian Influenza A/(H5N1) Reported to WHO. http://www.who.int/influenza/human_animal_interface/EN_GIP_20130215CumulativeNumberH5N1cases.pdf. Accessed 11 February 2013.
3. World Health Organization (2011) Update on human cases of highly pathogenic avian influenza A(H5N1) virus infection, 2010 <http://www.who.int/wer/2011/wer8617.pdf>. Accessed 1 December 2011.
4. Dinh PN, Long HT, Tien NT, Hien NT, Mai le TQ, Phong le H, Tuan le V, Van Tan H, Nguyen NB, Van Tu P, Phuong NT (2006) Risk factors for human infection with avian influenza A H5N1, Vietnam, 2004. *Emerg Infect Dis* 12: 1841-1847.
5. Liao Q, Lam WT, Leung GM, Jiang C, Fielding R (2009) Live poultry exposure, Guangzhou, China, 2006. *Epidemics* 1: 207-212.
6. Fielding R, Bich TH, Quang LN, Lam WW, Leung GM, Tien TQ, Ho EY, Anht le V (2007) Live poultry exposures, Hong Kong and Hanoi, 2006. *Emerg Infect Dis* 13: 1065-1067.
7. Chantong W, Kaneene JB (2011) Poultry raising systems and highly pathogenic avian influenza outbreaks in Thailand: the situation, associations, and impacts. *Southeast Asian J Trop Med Public Health* 42: 596-608.
8. Tiensin T, Chaitaweesub P, Songserm T, Chaisingh A, Hoonsuwan W, Buranathai C, Parakamawongsa T, Premasithira S, Amonsin A, Gilbert M, Nielsen M, Stegeman A (2005) Highly pathogenic avian influenza H5N1, Thailand, 2004. *Emerg Infect Dis* 11: 1664-1672.
9. Liao Q, Cowling BJ, Lam WT, Fielding R (2011) Changing perception of avian influenza risk, Hong Kong, 2006-2010. *Emerg Infect Dis* 17: 2379-2380.
10. Pongcharoensuk P, Adisasmito W, Sat LM, Silkavute P, Muchlisoh L, Cong Hoat P, Coker R (2011) Avian and pandemic human influenza policy in South-East Asia: the interface between economic and public health imperatives. *Health Policy Plan*. doi: 10.1093/heapol/czr056.
11. Cristalli A, Capua I (2007) Practical problems in controlling H5N1 high pathogenicity avian influenza at village level in Vietnam and introduction of biosecurity measures. *Avian Diseases* 51: 461-462.
12. The World Bank (2006-2010) Table of GDP per capita (current USD) <http://data.worldbank.org/indicator/NY.GDP.PCAP.CD>. Accessed 18 January 2013
13. Amonsin A, Choatrakol C, Lapkuntod J, Tantilertcharoen R, Thanawongnuwech R, Suradhat S, Suwannakarn K,

- Theamboonlers A, Poovorawan Y (2008) Influenza virus (H5N1) in live bird markets and food markets, Thailand. *Emerg Infect Dis* 14: 1739-1742.
14. Safman R (2009) The Political Economy of Avian Influenza in Thailand, STEPS Working Paper 18. Brighton: STEPS Centre.
 15. Food and Agriculture Organization (2008) Poultry production systems in Viet Nam. Rome.
 16. Figuié M, Fournier T (2008) Avian influenza in Vietnam: chicken-hearted consumers? *Risk Anal* 28: 441-451.
 17. Fielding R, Leung GM, Lam WW, Jiang CQ, Sitthi-Amorn C, Ahn LV, Lu YM, Zhang WS (2009) A pan-Asian survey of risk perception, attitudes and practices associated with live animal markets. *Hong Kong Med J* 15 Suppl 6: 17-20.
 18. Liao QY, Lam WWT, Dang VT, Jiang CQ, Udomprasertgul V, Fielding R (2009) What causes H5N1 avian influenza? Lay perceptions of H5N1 etiology in South East and East Asia. *J Pub Health* 31: 573-581.
 19. Fielding R, Lam WWT (2007) Reducing avian influenza risk: a qualitative exploration of issues in Hong Kong. *Health Education* 107: 437-447.
 20. Fielding R, Jiang CQ, Sitthi-Amorn C, Ahn LV, Lu YM, Zhang WS (2007) A pan-Asian survey of risk perception, attitudes and practices associated with live animal markets. Final Report to the Health, Welfare and Food Bureau, Government of the Hong Kong Special Administrative Region, Hong Kong, China: School of Public Health, the University of Hong Kong.
 21. Auewarakul P (2008) The past and present threat of avian influenza in Thailand. *Emerging Infections in Asia* 1: 31-44.
 22. Chunsuttiwat S (2008) Response to avian influenza and preparedness for pandemic influenza: Thailand's experience. *Respirology* 13 Suppl 1: S36-40.
 23. Olsen SJ, Laosiritaworn Y, Pattanasin S, Prapasiri P, Dowell SF (2005) Poultry-handling practices during avian influenza outbreak, Thailand. *Emerg Infect Dis* 11: 1601-1603.
 24. Simmerman JM, Thawatsupha P, Kingnate D, Fukuda K, Chaising A, Dowell SF (2004) Influenza in Thailand: a case study for middle income countries. *Vaccine* 23: 182-187.

Corresponding author

Richard Fielding
 School of Public Health, The University of Hong Kong
 21 Sassoon Road, Pokfulam, Hong Kong
 Phone: +852 2819 9288
 Fax: +852 2855 9528
 Email: fielding@hku.hk

Conflict of interests: No conflict of interests is declared.