Risk Perceptions of Swine Influenza Virus Infection Among At-risk Populations:

Observation from Rural Hubei Province (China) and Rural North Carolina (the United States)

by

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Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the Duke Global Health Program Duke Kunshan University and Duke University

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ABSTRACT

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Abstract

**Background:** Swine Influenza (SI) not only increases the burden of disease in pigs worldwide, but also presents a serious challenge for public health, especially for China and the United States. Although swine influenza viruses (SIVs) are not generally transmitted from pigs to humans, sporadic human infection cases do occur and this phenomenon appears to be increasing in recent years. Additionally, there is mounting evidence that swine workers and residents who live near areas with a high density of pig farms are at more risk for being infected with SIVs than is the general public. Thus, to help them prevent future SIV infection in humans, there is a need to understand their current risk perception and their responses to precautionary methods. This study measures the risk perception among at-risk populations in rural areas in Hubei (China) and North Carolina (the U.S.A.) and examines the association between those risk perceptions and their responses to precautionary methods.

**Methods:** A cross-sectional, quantitative method study was conducted in four rural counties of Hubei province and one rural county of North Carolina. Four rural counties in Hubei were selected because many of residents are pig farmers with backyard-sized pig farms. One rural county in North Carolina was selected because it is a residential area with a high density of industrial hog operations (IHOs). A total of 67 face-to-face questionnaire interviews in Chinese were conducted among participants in Hubei counties, while 33 face-to-face questionnaire interviews in English or Spanish were conducted among participants in North Carolina. All participants completed the same questionnaire that assessed their risk perception of swine influenza virus infection and responses to precautionary behavior. The measure of risk perception in this study is focused upon perceived likelihood and susceptibility of SIVs infections.
Results: In terms of perceived likelihood of SIVs infection, only 23.9% of respondents in the Hubei study part thought SIVs infection among swine workers was likely or strongly likely to occur in China and 20.9% of them thought this was likely or strongly likely to occur in Hubei. Additionally, overall 27.3% of respondents in North Carolina study part thought SIVs infection among swine workers was likely or strongly likely to occur in the United States and 39.4% of them thought this was likely or strongly likely to occur in North Carolina. In terms of perceived personal susceptibility of SIVs infections, the majority of respondents (80.6%) in the Hubei study thought they were at low risk, but most respondents in North Carolina (66.7%) perceived themselves to be at moderate risk. Furthermore, results showed that 16.4% of respondents in Hubei and more than half (60.6%) of respondents in North Carolina took no precautionary methods after touching pigs. In addition, considering the larger sample size in the Hubei part of the study, we further conducted single and multiple regression analysis to see the determinants of risk perceptions as well as the association between risk perceptions and intensity of precautionary methods. Results showed that female respondents and younger respondents were more likely to have higher risk perceptions. In addition, people who had high levels of risk perceptions were also more likely to take more precautionary measures.

Conclusions: This study provided evidence for the following conclusions: 1) Most pig farmers in the rural Hubei study, despite had relatively low risk perceptions, were still willing to use at least one precautionary method; and 2) Although participants in rural North Carolina had relatively high-risk perceptions, more than half of them still thought it was not necessary to take precautionary measures. In addition, further multiple regression analysis of data in the Hubei study also indicated that risk perceptions are significantly associated with gender and age, and the intensity of precautionary methods may be influenced by risk perceptions. These results carry
important policy implications about the need to better educate at risk populations about their risk of SIV infection and to promote appropriate precautionary methods for future disease prevention.
Dedication

This thesis is dedicated to all pig farmers in the rural counties of Hubei and participants in a rural county of North Carolina for their participation as well as to the CommWell Health Center for their cooperation with this study. Also, this thesis is dedicated to my family, and friends who have always encouraged me and helped me during the process of my study. This thesis would not be possible without their love, encouragement and support.
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1. Introduction

Swine influenza (SI) is caused by swine influenza viruses (SIVs). SI is a common highly contagious disease in pigs that regularly occurs as an epizootic or enzootic form. Usually this disease has higher morbidity (up to 100%) and lower mortality (1-4%) (Richt, et al., 2003), which can cause SIVs to quickly spread among pig herds, but it causes few deaths in these pigs. According to data from global influenza surveillance and response system (GISRS) (World Health Organization, 2017), SIVs have spread in pig herds throughout America, Asia, Europe, and Africa. The frequency and severity of outbreaks with SIVs in pigs have also increased in recent years (Vincent et al., 2008; Mastin et al., 2011). This phenomenon has raised concerns from pig farmers and researchers. For researchers, this phenomenon might increase their concerns about the epidemiology, diversity, and severity of SIVs among pigs or possible transmission of SIVs in other species, while concerns for pig farmers and the pig industry may relate to the negative affect that sick pigs have on farmer’s livelihoods and on the market. Although SIV pig mortality is low, pigs may not grow well and farmers incur the health costs in caring for these sick pigs. Hence, there is mounting evidence that diseases or outbreaks associated with SIVs cause significant economic losses to pig farmers and the pig industry worldwide (Mastin et al., 2011).

However, Swine Influenza not only threatens the lives of pigs and causes obvious economic losses in the pig industry worldwide, but also poses a serious threat
to human health. Most SIVs generally do not infect humans, but human infection cases have been reported in many countries especially in North America (Myers, Olsen, and Gray, 2007) and the frequency of these reported infections has also recently increased. Previously, sporadic cases of infection with SIVs in humans usually occurred in one particular area or one place, like the limited person-to-person transmission at Fort Dix of New Jersey in 1976. However, the recent swine influenza pandemic (2009 novel H1N1 pandemic) in humans caused between 123,000 and 203,000 deaths and millions of people were affected (Fineberg, 2014). A total of 74 countries and territories in nearly all regions of the World Health Organization (WHO) were confirmed to have been affected by this pandemic (Huang, 2010). Thus, the rapid spread of H1N1 virus throughout the world and sustained human-to-human transmission in this pandemic prompted the WHO to raise the pandemic level from 5 to 6 in June 2009.

Additionally, among all of these cases of human infection in previous events, people who have close contact with infected pigs are confirmed to have higher possibility of infection with SIVs than the general public (U.S. Centers for Disease Control and Prevention, 2016). Sufficient evidence also has shown that cases of human infection are often related to work that involves contact with pigs. Those who work directly with pigs, such as swine-exposed workers, are at greater risk of infection with SIVs. A recent study demonstrated that pig farmers had much higher risk for exposure to both swine H1N1 and H1N2 swine viruses (OR, 35.3; OR, 13.8) than both
veterinarians (OR, 17.8; OR, 9.5) and meat processing workers (OR, 6.5; OR, 2.7), compared to controls (Myers et al., 2006; ). Besides, several studies conducted in the United States (Olsen et al., 2002), China (Kong et al., 2014), northwestern Mexico (López et al., 2012) and some South Asian countries (Mackenzie et al., 2001) also support this argument that occupational exposure to pigs is one of the major risk factors for SIV infection among humans. As pigs are also thought to play an important role in human influenza epidemiology and interspecies transmission of influenza, they have the possibilities to directly transmit the virus from themselves to humans. So, when swine workers have contact with infected pigs during their daily work, they also have direct exposure to the virus on these infected pigs. Moreover, one study tried to measure the risk of swine influenza infections among swine workers and their non-swine-exposed spouses in a rural area of Iowa (Gray et al., 2007). The results of this study suggest that both the swine workers and their non-swine-exposed spouses had higher risk for being infected with SIVs than controls. The possible explanation for this finding might be that non-swine exposed spouses may become infected through indirect exposure to pigs (e.g. exposure to contaminated clothing), or by exposure to infected family members. Thus, if these swine workers could be motivated and encouraged to take precautionary methods (e.g. wear gloves) when they work with pigs, they might be less likely to be infected with SIVs and then the risk of SIV infections for other people who live near them might also be reduced (Rabinowitz et al., 2013; US CDC, 2016).
However, whether swine workers practice precautionary methods or not during the work with pigs is determined by their willingness and motivation towards cooperation. Empirical evidence shows that Protective Motivation Theory (PMT) and other health psychology models all suggest risk perception could be one of the major trigger points for people’s adoption of prevention behavior (Weinstein, 1988; Milne, Sheeran, & Orbell, 2000). Based on an extensive literature review, there are many studies that have examined risk perceptions and prevention behavior among the general public during or after swine influenza pandemics in the United Kingdom (Rubin et al., 2009), Australia (Seale et al., 2009), Netherlands (van der Weerd et al., 2011), Italy (Prati et al., 2011), Hong Kong (Lau et al., 2009), and the United States (Jones & Salathe, 2009). Researchers of these studies all found that members of the general public who have higher perception for the risk of swine pandemics are more likely to follow the public health specific prevention methods (e.g. wear mask, wash their hands, accept vaccination, etc.).

However, few studies are focused on the association between the risk perception about swine influenza infections among specific at-risk groups and their response for precautionary methods, such as swine workers or people who live near high-density areas of pig farms. Understanding the general public’s risk perception of swine influenza is important for helping health communicators to prepare an effective plan for motivating people to take prevention methods in the next pandemics. However,
understanding the perception of specific at-risk groups is even more important for health communicators for preventing the SIVs infection among humans before the next pandemic. For example, if swine workers and the people who live near high-density areas of pig farms have a perception of the risk of SIVs infections and comply with the relevant precautionary measures (e.g. wash their hands after touching pigs), they might also reduce the possibility of SIVs transmission to other healthy people. Therefore, this study aims to explore the risk perceptions of SIVs infections and responses for precautionary behavior in two specific at-risk groups. These two specific at-risk groups consist of swine workers in rural areas of Hubei province (China) and people who live near high-density areas of pig farms in rural North Carolina (the United States). The measure of risk perception in this study is focused on perceived likelihood and personal susceptibility of SIVs infections.

1.1 Study Setting Background

1.1.1 Hubei province, China

China is currently the largest pork producer in the world. According to recent data, China’s pork production contributed to over 50 percent of the world market (Ma et al., 2015). Moreover, the pork production in China has experienced an overall upward trend in the past 10 years due to increasing consumer demand for animal protein. The pig industry plays an important role in the livestock sector in China, and in the economy of the central Hubei province. Hubei’s economy ranks 8th in the country and its nominal
GDP for 2015 was nearly 3 trillion RMB (US$ 440 billion) and a per capita of 50,808.44 RMB (US$ 7,393.22) (National Bureau of Statistics of China, 2015). According to the data from Hubei provincial government in 2015, the pork production of Hubei province was approximately 332 million tons, which ranks fifth among all other provinces in China (Government of Hubei Province, 2015). Thus, the pig industry also accounts for a crucial part of animal husbandry in Hubei province.

Almost all of the pig farms are located in the rural areas of Hubei province, due to the environmental considerations of the provincial government. The size of pig farms is mainly divided into four categories in these rural areas, such as backyard size (pigs<10), small size (10-50 pigs), middle size (50-3,000 pigs), and large size (called modern farms, pig > 3,000) (Cheng et al., 2011). Among which, backyard and small size pig farms still account for a significant proportion of all of the pig farms in Hubei province. Although the number and sizes of pig farms in Hubei has not been reported, Cheng et al. estimate that approximately 80% of the rural families in China have on average 2-3 pigs (Cheng et al., 2011). In addition, most rural residents like to feed poultry (especially chickens) and pigs together based on Chinese traditional practices, but this unique feeding method will undoubtedly increase the risk for generating a novel SIV by re-assortment of avian and swine influenza viruses under such conditions.

Swine workers who are laboring in these backyard and small size hog farms generally do not receive any professional training about swine diseases and necessary
protective behavior in the work (Tian et al., 2011). Furthermore, the 2009 H1N1 pandemic also infected pigs in Hubei, and caused a potential threat to people’s health and the provincial economy (Kong, et al., 2014). Moreover, H1N1, H1N2, and H3N2 as the three main subtypes of SIVs have been circulating in pig herds in China for a long time. Avian Influenza, H9N2, H3N8, H5N1, and H6N6 subtypes have also been reported in many provinces, including the provinces of Hubei, Anhui, Fujian, and Guangdong (Kong et al., 2014). So, encouraging swine workers to take precautionary methods during work with pigs is not only necessary and important for protecting themselves and pigs, but also for reducing the risk of SIVs infection for other people and the provincial economy. In an effort to help swine workers prevent future SIV infections, this study is focused upon understanding their current perceptions about the risk of SIV infections and examining how those perceptions might influence their behavioral responses.

1.1.2 North Carolina, the United States

The United States is one of the top ten pork-producing countries in the world, ranking second in pork production behind China in 2015. Among all of the states of the U.S.A., North Carolina is ranked second in pork production, accounting for nearly 13% of the U.S. market in 2012 to 2014 (United States Department of Agriculture, 2012; USDA, 2015). Among the counties of North Carolina, Duplin County was ranked as first in pig sales in the nation in 2012, which accounted for 3% of the U.S. market (USDA,
2012). In 2009, North Carolina had the densest pig population in the whole nation (Greger, 2009). The hog farming industry is also one of the major sectors of the North Carolina economy.

Pigs are thought to be susceptible to being infected with various subtypes of influenza A viruses, thus many researchers think that large pork production farms are amplifiers for these various influenza viruses (Ma et al., 2009). A recent study asserts that modern swine facilities can provide the condition for the possibility of a novel SIV generation with pandemic potential in North America (Ma, et al., 2008). Additionally, three main subtypes of SIVs (H1N1, H1N2, and H3N2) are currently circulating in pig herds in the U.S.A. (U.S. CDC, 2016), which is the same as the situation in China. There is mounting evidence that pigs have the potential to both transmit a virus to humans and get an infection from humans (U.S. CDC, 2016). Hence, swine workers are at high risk for being infected with SIVs through working with pigs. If swine workers are infected with SIV, they may also increase the risk for their family members or community to get an infection. Saenz et al. found that when swine workers accounted for 15-45% of community, the human infection cases increased by 42-86% (Saenz et al., 2006). Therefore, in order to help swine workers and people who live near or with them to prevent and avoid SIV infections in the future, it is important to increase their awareness about SI and encourage them to use some personal prevention methods for
protecting themselves. Understanding their current perception about the risk of SI and current response for prevention methods is one of the aims in this study.
2. Methods

2.1 Study Design

This study was designed to explore the risk perceptions about swine influenza infections among at-risk populations in rural counties of Hubei province in China and a rural county of North Carolina in the United States. Hubei participants were pig farmers in four rural counties and participants in North Carolina study were patients selected from the CommWell Health Center, a not-for-profit, federally qualified health center in one rural county of North Carolina. This health center was located near a high-density area of pig farms. The study objectives were realized through a cross-sectional questionnaire. All of the participants were invited for face-to-face questionnaire interviews that lasted up to 20 minutes. The North Carolina portion of this study was conducted as part of Duke University Professor Gregory Gray’s larger research project, entitled “An Epidemiological Study of People Living in Rural North Carolina for Novel Zoonotic Respiratory Viruses and Antibiotic Resistant Bacteria.” This study was conducted from June of 2016 to March of 2017.

2.2 Data Sources

Data for this study came from three sources. The first source of data was a field questionnaire that collected information about demographics, risk perception, animal exposure, and use of precautionary methods among at-risk populations. The second source of data included information about currently licensed pig farms in Hubei
province and was collected from the “China Industry Intelligence Center” (China Industry Intelligence Center, 2016). The China Industry Intelligence Center is a data platform created by an economic consulting firm in China that provides diverse data from different industries (i.e. agricultural, electronic information industry, etc.) to customers from all fields. Tabular information regarding 6,247 licensed pig farms in Hubei Province in 2016 was obtained through this data platform, including the name, and detailed address of each licensed pig farm. Detailed locations of pig farms were captured as points on the county map of Hubei Province using ArcGIS software (see Figure 1). The exact number of pigs in each licensed pig farm was not clear, but each of these pig farms was of the medium (50-3,000 pigs) or large (pigs>3,000) size. Additionally, this latest list of licensed pig farms did not include any backyard (pigs<10) and small-size (10-50 pigs) pig farms, because these farms generally did not have licenses. Finally, the last source of data came from the North Carolina Division of Water Resources and included the address information for 2,328 licensed pig farms (updated January 5th, 2016) in North Carolina (North Carolina Department of Environmental Quality, 2016). Using these data we displayed the location of each pig farm on a map of North Carolina (See Figure 2).

2.3 Study Setting

Rural Area in Hubei Province
As can be seen in Figure 1, the Hubei part of this study was conducted in four rural counties in Hubei Province, including Huangpi, Hong’an, Macheng, and Qichun (see Figure 1). Three of these counties (Huangpi, Hong’an, and Macheng) were clustered in the northeastern part of Hubei. Qianchun County is located in the southeastern part of Hubei Province, but is still fairly close to the other counties. Although these counties have their own characteristics, they still have many similarities with each other, or with other counties in Hubei, or even other counties in China. The distribution of pig farms is one of these great similarities. Nearly 80% of rural families in China have backyard size pig farms with average 2 or 3 pigs. Pork is also the most popular meat among people in both the rural and urban areas (Jia et al., 2014). So a large number of residents in rural societies generally feed several pigs (<10), chickens, and other animals as well as grow some crops in their backyards based on traditional culture. This explains why there are many backyard pig farms in rural counties of Hubei. Most of the pigs that they raise are generally sold to the local market to increase their cash income. The remaining pigs are kept as pork meat for farmer families to eat, resulting in self-sufficiency.

Figure 1 provides an overall distribution of middle and large-scale pig farms (N=6,247) in each county of Hubei Province. As can be seen from this map, there were 22, 108, 77, and 39 licensed middle and large-scale pig farms in the county of Huangpi, Hong’an, Macheng, and Qichun, respectively, in 2016. However, as previously mentioned, unlicensed backyard and small size pig farms are not shown on this map,
thus the total number of pig farms in these counties is higher than the number given by this map.

Although SIVs infections previously did not cause serious outbreaks in these rural farms in Hubei, many studies still prove the existence of several subtypes of SIVs in pig herds in Hubei (Kong et al., 2014). Wu and his colleagues found that H1N1 subtype of SIVs were more prevalent among pigs than H3N2 SIV subtypes in Hubei (Wu et al., 2011).

Figure 1: Map of Study Sites and Middle and Large-scale Pig Farms in Hubei Province
Thus, all information indicates the potential threat of SIVs to both animals and humans in Hubei in the future. Moreover, pig farmers were confirmed to be at more risk for SIVs infection. Therefore, these four rural counties were deemed appropriate for this study.

*Rural Area in North Carolina*

The North Carolina part of this study was conducted in the CommWell Health Center. This Center is a not-for-profit community health center in North Carolina (NC) with 14 primary care practice locations throughout southeastern NC (i.e., Brunswick, Johnston, and Sampson Counties). The goal of this health center is to “provide comprehensive and best quality health care to help their communities get and stay healthy”. Among all the locations of CommWell Health center, our study location (a clinic) in the summer of 2016 was in Sampson County (see Figure 2). This clinic is located between the towns of Newton Grove and Spivey’s Corner in Sampson County, and is the oldest and largest of the CommWell Health care facilities. Both of these towns are very small towns, reporting populations of 569 and 408 people, respectively, in 2010 (the U.S. Census of Population and Housing, 2010). They are located very close to this health center; it is only an 8-10 minute car ride from either one of these two towns where the clinic patients live. The clinic site was chosen because it is centrally located in a high-density pig farming area.

As previously mentioned, North Carolina is the second largest hog producing state in the U.S.A. (Smithson et al., 2014). As can be seen from Figure 2, almost all of the
2,328 licensed industrial hog operations (IHOs) are concentrated in the southeastern region of NC, a region including Sampson County. Sampson County had 480 swine sites in 2016, which accounted for nearly 20% of all swine sites in the state of North Carolina. Moreover, according to the data from U.S. Agriculture Census in 2012, Sampson County also ranked as second, only behind Duplin County, in pork sales with more than $500 million. (The U.S. Department of Agriculture, 2012). In addition, the recent data showed that the ratio of pigs to people was more than 30 to 1 in Sampson and Duplin counties alone (NCDWR, 2015). It also indicated that people who live in communities in either of these two counties were more likely to live near areas of high density of pigs. One unique feature in Sampson and Duplin counties is the relatively high number of people who are Hispanic/Latino, compared with other parts of the state (DATAUSA, 2016). One report also recently indicated that those Hispanic/Latino residents have a greater probability than white residents of living within a few miles of an IHO (Wing & Johnston, 2014) in Sampson County, due to the relative living costs of the area.

IHOs are regarded as confined animal feeding operations (CAFO). Several reports indicated that confined animal feeding operations might affect those residents who live nearby and increase their risk to be infected with SIVs (Saenz et al., 2006; Lantos et al., 2016) because the workers who work in industrial pig farms might serve as a “bridge” to transmit SIVs from pigs to nearby human communities. Therefore, this location of the health center in Sampson County was deemed appropriate for this study.
2.4 Study Participants (Sample Size, Sampling, and Eligibility)

Hubei Province, China

Hubei study subjects were sampled from those four rural counties (Huangpi, Hong’an, Macheng, and Qichun) mentioned previously. There were several eligibility criteria participants needed to meet. Participants had to be swine workers who self-reported currently living or working at a swine population site for no less than 10 weeks with exposure to pigs or swine manure as part of their daily activity for more than five cumulative hours per week. They needed to be adults (aged 18 or above) and had to be residents of these rural counties of Hubei province. They had to speak Chinese fluently,
be able and willing to provide research participation consent and understand and complete the questionnaire. Exclusion criteria eliminated individuals who were not the rural residents in these rural counties of Hubei or who were unable to provide consent.

The snowball sampling method (as a non-probability sampling technique) was used to recruit the Hubei participants. Thus, the participants were recruited in the study through asking for assistance from the subject to help identify other pig farmers who might have an interest in participating. The first reason for using this sampling method is that pig farmers in these rural counties generally do not like strangers to visit their pig farms, no matter which type or size of pig farm they own, so it was difficult to make contact with them directly. Secondly, as mentioned before, there are generally a large number of rural families in rural counties with their own backyard or small size pig farms. It was hard for us to locate them. In total, 67 swine workers in rural Hubei were enrolled as participants in this study.

North Carolina, U.S.

Some of N.C. study subjects were patients sampled from the CommWell Health Center who met the following case definitions: 1) had experienced an influenza-like illness (acute onset of a respiratory illness with an oral / or equivalence from other body region measured temperature over than or equal to 100.5 °F (38°C) accompanied with a cough or sore throat for 4 or more hours; OR 2) had radiographic evidence of pneumonia; OR 3) self reported to have had a fever of 100.5 °F (38°C) or higher at home
within 72 hours. This part of the study was based on Professor Gray’s project, so participants who met any one of these three case definitions were suitable for both Professor Gray’s study and this study. His project was looking for zoonotic respiratory viruses and antibiotic resistant bacteria among patients. Additionally, some of study participants were staff who worked in this clinic and lived in nearby communities, but doctors were not engaged in. Then, because of the questionnaire used for participants in this study, patients and staff needed to meet other eligibility criteria as well. They had to be adults over 18 years; able to speak Spanish or English fluently; able and willing to provide consent; and able to understand the meanings of all questions on questionnaire. Exclusion criteria eliminated individuals who were below the age of 18 years, did not live in nearby communities, could not speak either Spanish or English and who were unable to provide consent. Overall, 33 participants met the criteria (7 out of 40 with missing values or who were not adults were removed) and were involved in this study.

The convenience sampling method (as a non-probability sampling technique) was used in this part of the study. Participants were recruited when nurses identified them as meeting the eligibility criteria for our studies. This method was selected because CommWell Health Center is located between Newton Grove and Spivey’s Corner in Sampson County so it is likely that the patients who come to this clinic live in the nearby communities previously identified to have a high density of pig farms. Thus, compared with other sampling methods, this method might be more viable for this study to find
subjects who live within the communities with a high density of pig farms. Moreover, it was also difficult to reach these people directly, due to language and cultural barriers.

2.5 Data Collection Tool

2.5.1 Questionnaire

The survey questionnaire contained four sections and was used for both groups of participants in Hubei and North Carolina. Section 1 requested the demographic information of participants, such as gender, age, household size, children under 5 at home, elder people over 55 at home and occupation. For North Carolina part, due to two language versions of questionnaires offered to participants, so the languages they chose were also recorded as demographic information. Section 2 sought information about animal exposure for these participants. Section 3 assessed risk perceptions among participants. Risk perceptions questions were developed based on the study about “the knowledge, perceived risk and precautionary behavior related to H1N1 pandemic” in Reunion Island (Taglioni et al., 2013). Section 4 elicited the intensity of participants’ precautionary measures.

All participants were invited for up to 20 minutes to finish this questionnaire interview, including completion of the informed consent and questionnaire. During this procedure, the informed consent was read and explained in the appropriate language to participants before they began the questionnaire. They had the right to ask any questions or provide their concerns before, during and after the face-to-face
questionnaire interview. They were also told that they could quit or stop this questionnaire interview at any time. Help was offered them to fill in the questionnaire.

2.6 Procedure

Hubei Province, China

A face-to-face questionnaire interview was used for each of the 67 pig farmers in these rural counties with the help of local key informants. All participants were pig farmers who met the inclusion criteria. Face-to-face questionnaires were conducted with the pig farmers at a place determined by each pig farmer. Both the informed consent and questionnaire (Chinese version see Appendix A) were translated into Chinese by two different bilingual people, and then proofed into one final version to ensure that participants could understand the study.

North Carolina, U.S.

English and Spanish versions of the informed consent and questionnaire (English version see Appendix B; Spanish version see Appendix C) were offered to participants in the clinic because there were many patients in the study clinic who could not speak English. Spanish version documents were translated from English into Spanish by two different bilingual people, and then revised into the final version. Our research staff and I conducted the face-to-face questionnaire interviews. Therefore, in an effort to reduce the interview bias, an interview guide was written for our research staff (affiliated with Duke University) to make sure that participants received consistent guidance.
In addition to trained research staff, we had a trained bilingual (English and Spanish) translator for the purpose of explaining the study to participants who could not speak English during the process of informed consent and questionnaire survey. Moreover, the study team (including the translator) completed ethical training before we had contact with patients. The questionnaire interview was conducted in one office room in the clinic. Nurses in this clinic were responsible for identifying patients who met study case definitions first, and then referring these potential participants to research staff. If these potential participants were willing to cooperate with research staffs, a face-to-face questionnaire interview was conducted in that office room.

During this procedure, if the participants were people who could only speak Spanish, the informed consent would be read and explained by research staff in Spanish. But if the participants were people who could speak English, the informed consent was read and explained by research staff directly in English.

2.7 Measures

Quantitative measurement was used to measure the outcomes. The measure of risk perception in this study consisted of three questions. These three questions were based on the literature review that focused on two dimensions of risk perception: perceived likelihood of harm and perceived personal susceptibility (Joseph et al., 2009; Raude & Setbon, 2011). In terms of perceived likelihood of harm, one question examined the participants’ perception about the likelihood of swine workers getting SIVs infection
in China/the United States. Another question probed the participants’ perception about the likelihood of swine workers getting SIVs infection in Hubei/North Carolina. This study tried to narrow down the participants’ residential space from the national level to the provincial/state level to determine if their risk perception about the risk for swine workers would be changed. For both of these questions, this study used psychometric scaling (5-point categorical ordinal response formats: 1(weakly unlikely) – 5(strongly likely)) to quantify the participants’ perceived risk (Fielding, 2005). The psychometric scaling method was chosen because this method was suitable for identifying and quantifying similarities and differences in risk perceptions among different people evidenced by Slovic et al. (Slovic et al., 1982). In addition, for perceived personal susceptibility of harm, the final risk perception question in this study was the likelihood they perceived for themselves to be infected with SIVs in their lifetime. The response choices for this question were “low”, “moderate”, and “high”. This study treated each of the risk perception questions as an ordered categorical dependent variable.

The association between demographic variables and participants’ risk perceptions was measured. The statistical strategies were only applied for the Hubei data (N=67), because the sample size was sufficient for analysis. This analysis consisted of two steps. First, Fisher’s exact test (as expected frequency was less than 5) was used to see if there was any significant relationship between demographic variables and each of ordinal variables about risk perceptions. In order to further understand the exact
association that might exist between demographic variables and each of the ordinal variables about risk perceptions, the ordinal regression model was then used. The main reason for using this regression model was that all outcome variables were all truly ordinal.

Furthermore, the variable of “participants’ response for precautionary methods” was based on self-reporting. Response choices of this question were “dedicated boots”, “dedicated clothing”, “mask or glove”, “shower in”, “shower out”, and “none” (Participants could choose all that applied). Except for these choices, participants could write down additional preventive method (e.g. washing hands with soap) on questionnaire. Moreover, all of these above preventive methods recommended by the U.S. CDC to people who had close contact with pigs, especially for swine workers, were also categorized into two groups: “personal protective equipment (PPE)” (e.g. dedicated clothing), and another one “hygiene practice” (e.g. shower in/out) (U.S. CDC, 2011). For this variable, this study tried to see what specific type(s) of preventive methods respondents might use in actual situations.

Additionally, behavior change theories (e.g. Rogers Protection Motivation theory and Rosenstock’s Health Belief Model) show that if perceived likelihood and perceived susceptibility are high, a person might pay more attention to their behavior and would be more likely to use more preventive methods (Becker, 1974; Raude & Setbon, 2011; Weinstein, 1988). Thus, based on the original variable of “participants’ response to
precautionary methods”, we generated a new variable called “intensity of precautionary methods” that was focused on recording the number of preventive methods participants claimed they would use. To be specific, the number of precautionary methods were coded from low intensity to high intensity as follows: 0 = use no methods; 1 = use single preventive method; and 2 = use two or more preventive methods. The aim was to determine if the risk factors affected responses about their intensity of precautionary method use. Again, the statistical strategies were only considered for use in analyzing the Hubei data (N=67).

Fisher’s exact test was also used first to see if any significant relationship existed between independent variables (demographic variables and ordinal variables about risk perceptions) and dependent variable (responses about the intensity of precautionary methods). Then, both ordinal and multinomial logistic regression models were used to further determine the exact association between same independent variables and same dependent variable. The biggest difference in multinomial logistic regression model was treating categories of dependent variable (responses about the intensity of precautionary methods) as three types of precautionary methods without any ordering.

2.8 Statistical Analysis

Descriptive analysis and single and multiple regression analyses were conducted. Fisher’s exact test assessed hypothesized null associations between categorical variables (e.g. gender and age) and risk perceptions. Independent effects of
demographical variables on the association with risk perceptions were then evaluated by ordinal logistic regression model. Additionally, Fisher’s exact test, ordinal and multinominal logistic regression models were used to determine whether demographical variables and risk perceptions might influence the intensity of precautionary methods. All statistical analyses were carried out with the software Stata/SE 14.0 (StataCorp, Texas, USA), and P<0.01 or P<0.05 indicated statistical significance.

2.9 Ethical Considerations

The study received ethical approval from both Duke Kunshan University and Duke University to protect the rights of human participants. This study was an exploratory study that examined the risk perception of SIV infection among at-risk population, so little or no harm to those study participants was expected. Furthermore, in order to mitigate the disclosed and confidentiality risk of study participants in the questionnaire survey, unique identification numbers without names or other identifying details were distributed to study participants. After data were collected, entered, and digitized, all data were input without personal identification in one file, then uploaded into Duke Box with privacy protections set.
3. Results

This section presents all of the results obtained from the analysis of quantitative data. The data examined the risk perceptions regarding swine influenza infection among at-risk populations in both rural areas of Hubei province and North Carolina.

3.1 Descriptive Analysis

3.1.1 Demographic Characteristics of Respondents

Table 1 shows the demographical characteristics of participants in both rural areas in Hubei province and North Carolina. In the Hubei part of the study, there were 67 pig farmers who participated. All of them were Chinese speakers. As shown in Table 1, 50.7% of pig farmers were males and 49.3% of them were females. For the age groups among them, the majority (46.3%) were of ages between 40 and 50 years; 19.4% were between 30 and 40 years; 17.9% were more than 50 years, and 16.4% were between 20 and 30 years of age. For the household size, the majority of respondents (77.6%) had household size between 3 and 4 people; 7.5% of respondents had household size of 2 people and 14.9% of respondents had household size of 5 or more people. No respondents lived alone. Although most of respondents (74.6%) did not have children under 5-years at home, still 25% of them did. The majority of respondents (67.2%) did not have people greater than 55 years of age living in their home.

In North Carolina, the total number of respondents was 33. All of them were people who lived in nearby communities with a high density of pig farms in Sampson
County. Although none of them were swine workers, 54.5% of them were healthcare workers (no doctors engaged) and 45.5% of them had other occupations (e.g. no occupation; occupations of agriculture, sales and services, and community and government services). As can be seen from Table 1, the majority of the respondents were females (93.9%). By age group, 9.1% of respondents were aged 10-20 years, 21.2% of them were 20-30 years, 36.4% of them were 30-40 years, 12.1% of them were 40-50 years, and 21.2% of them were more than 50 years of age. Most (42.4%) of the respondents lived in households of 3 or 4 people; 39.4% of had household size at 5 or more people; and 18.2% of them had household size at 2 people. No persons reported living alone. Nearly forty percent of respondents had children under 5-years at home and 60.6% of them did not. Only 15.2% of respondents reported that they lived with people greater than 55 years. Additionally, among respondents, 69.7% could speak English and 30.3% could speak Spanish.
Table 1: Demographic Distribution of Study Participants, N(%)  

<table>
<thead>
<tr>
<th></th>
<th>Hubei Province (N=67)</th>
<th>North Carolina (N=33)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>33(49.3)</td>
<td>31(93.9)</td>
</tr>
<tr>
<td>Male</td>
<td>34(50.7)</td>
<td>2(6.1)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 - 20</td>
<td>NA</td>
<td>3(9.1)</td>
</tr>
<tr>
<td>20 - 30</td>
<td>11(16.4)</td>
<td>7(21.2)</td>
</tr>
<tr>
<td>30- 40</td>
<td>13(19.4)</td>
<td>12(36.4)</td>
</tr>
<tr>
<td>40 -50</td>
<td>31(46.3)</td>
<td>4(12.1)</td>
</tr>
<tr>
<td>&gt;50</td>
<td>12(17.9)</td>
<td>7(21.2)</td>
</tr>
<tr>
<td><strong>Household Size</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>5(7.5)</td>
<td>6(18.2)</td>
</tr>
<tr>
<td>3 or 4</td>
<td>52(77.6)</td>
<td>14(42.4)</td>
</tr>
<tr>
<td>5 or over</td>
<td>10(14.9)</td>
<td>13(39.4)</td>
</tr>
<tr>
<td><strong>Children under 5 at home</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>17(25.4)</td>
<td>13(39.4)</td>
</tr>
<tr>
<td>No</td>
<td>50(74.6)</td>
<td>20(60.6)</td>
</tr>
<tr>
<td><strong>Elder over 55 at home</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>22(32.8)</td>
<td>5(15.2)</td>
</tr>
<tr>
<td>No</td>
<td>45(67.2)</td>
<td>28(84.8)</td>
</tr>
<tr>
<td><strong>Language Spoken</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>67(100.0)</td>
<td>NA</td>
</tr>
<tr>
<td>Spanish</td>
<td>NA</td>
<td>10(30.3)</td>
</tr>
<tr>
<td>English</td>
<td>NA</td>
<td>23(69.7)</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swine workers</td>
<td>67(100.0)</td>
<td>NA</td>
</tr>
<tr>
<td>Healthcare related workers</td>
<td>NA</td>
<td>18(54.5)</td>
</tr>
<tr>
<td>Others</td>
<td>NA</td>
<td>15(45.50)</td>
</tr>
</tbody>
</table>
### 3.1.2 Animal Exposure among Respondents

Table 2 shows the situation of animal exposure among participants in both rural areas in Hubei province and North Carolina. As can be seen, there were many interesting results in Hubei. For animal exposure in the last 30 days, all of the pig farmers (100%) reported close contact (within 1 meter) with pigs. Among these farmers, 56.7% also reported touching chickens, 11.9% reported touching ducks, and 7.5% reported touching geese in the same period. Additionally, it is important to note that only 43.3% of the pig farmers reported that they only touched pigs. In other words, more than 50% of these pig farmers (56.7%) touched both pigs and poultry in the last 30 days. Furthermore, for their self-report about animal exposure in the last 12 months, a similar situation occurred in their self-report during the last 30 days. There is no doubt that all of the pig farmers reported touching pigs in the last 12 months. However, when the number of exposure days increased from 30 days to 365 days (12 months), the percentages of farmers touching chickens (62.7%), ducks (16.4%), and geese (13.4%) increased. Moreover, the percentage of pig farmers who touched both pigs and poultry in the last 12 months also increased to 62.7%, compared with the same in last 30 days.

Table 2 also shows that although none of the North Carolina participants were pig farmers, still two of them reported touching pigs in the last 30 days and four of them reported touching pigs in the last 12 months. Only one person reported touching pigs and chickens together in both the last 30 days and 12 months. Then for the exposure to
chickens, 18.2% of respondents reported exposure in the last 30 days and 24.2% of them reported exposure in the last 12 months. Some of these respondents also reported exposure to both chickens and ducks in the last 30 days or in the last 20 months. None of respondents reported close contact with geese previously.

Table 2: Animal Exposure Among Respondents

<table>
<thead>
<tr>
<th>Percentage (%)</th>
<th>Hubei Province (N=67)</th>
<th>North Carolina (N=33)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Animal exposure in last 30 days</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigs</td>
<td>100.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Chickens</td>
<td>56.7</td>
<td>18.2</td>
</tr>
<tr>
<td>Ducks</td>
<td>11.9</td>
<td>9.1</td>
</tr>
<tr>
<td>Geese</td>
<td>7.5</td>
<td>-</td>
</tr>
<tr>
<td>Only pigs</td>
<td>43.3</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Animal exposure in last 12 months</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigs</td>
<td>100.0</td>
<td>12.1</td>
</tr>
<tr>
<td>Chickens</td>
<td>62.7</td>
<td>24.2</td>
</tr>
<tr>
<td>Ducks</td>
<td>16.4</td>
<td>12.1</td>
</tr>
<tr>
<td>Geese</td>
<td>13.4</td>
<td>-</td>
</tr>
<tr>
<td>Only pigs</td>
<td>37.3</td>
<td>9.1</td>
</tr>
</tbody>
</table>

3.1.3 Risk Perceptions among Respondents

Table 3 shows the results about risk perceptions from respondents in both parts of this study. For the first two risk perception questions, the mean score was separately calculated for responses from the pig farmers from Hubei and responses from the people who live near high-density areas of pig farms in North Carolina. As the answer choices for these two questions were all “strongly unlikely”, “unlikely”, “neutral”, “likely”, and
“more likely”, they were recorded as score points from 1 to 5. However, for the third risk perception question, due to answer choices of low (0-33%), moderate (33%-66%), and high (55%-100%), the percentage of respondents in each level from each part of study was calculated.

Table 3 shows the mean score of all Hubei respondents about the likelihood that swine workers will be infected with SIVs in China was 2.7 points (SD=0.1). However, the mean score of the same question but in relation to Hubei province decreased to 2.6 points (SD=0.1), compared with the first question. Figure 3 provides the overview of respondents’ specific answers for risk perceptions questions. As shown in this figure, the number of respondents who thought SIV infections would not occur among swine workers in both China and Hubei province was apparently more than the number of them who thought it might occur. What is more, when respondents were asked about the likelihood of SIVs infection among swine workers in China (national level), 38.8% of them thought SIV infection was strongly unlikely or unlikely. However, when asked the same question by shrinking the range (from China to Hubei province), an increase was observed in the percentage of respondents (46.3%) who thought it was strongly unlikely or unlikely. This finding was consistent with the findings in mean scores in Table 3. Moreover, in regard to respondents’ perception about their own susceptibility to SIV infection, the majority of them (80.6%) thought they had “low” risk and few of them (19.4%) thought they had “moderate” risk. Interestingly, no one regarded the situation
as “high” risk for himself/herself (see Figure 4). Therefore, all of these results indicated that most of Hubei respondents still had relatively low risk perceptions (combined two dimensions).

In addition, Table 3 shows that the mean score of North Carolina respondents about the likelihood of swine workers being infected with SIVs in the United States was 2.9 points (SD=0.2). But when the question narrowed down the space from the United States to the state of North Carolina, their mean score of the same question increased to 3.1 points (SD=0.2). Figure 5 provides an overview about respondents’ specific answers for these two questions. As can be seen from this figure, most of the respondents still showed neutral or strongly likely/likely attitude regarding the risk of SIV infection among swine workers in both the U.S.A and the North Carolina. Moreover, when respondents answered the first question, 27.3% of them thought this issue was strongly likely or likely to occur, but when they were asked the same question by changing from the U.S.A. to the North Carolina, a greater percentage (39.4%) of them believed this issue was strongly likely or likely to occur. This finding was consistent with the finding in Table 3. Additionally, for the third question, the majority of respondents (66.7%) chose the moderate level; about 18.1% of them chose the low level and 15.2% of them chose the high level (See Figure. 6). So overall, these results indicated that most of North Carolina respondents had relatively high-risk perceptions (combined two dimensions).
Table 3: Risk Perceptions Among Respondents

<table>
<thead>
<tr>
<th></th>
<th>Hubei Province (N=67)</th>
<th>North Carolina (N=33)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Risk Perception of Likelihood that swine workers will be infected with SIVs in China/the U.S. (Mean score, ±SD)</td>
<td>2.7±0.1</td>
<td>2.9±0.2</td>
</tr>
<tr>
<td>2. Risk Perception of Likelihood that swine workers will be infected with SIVs in Hubei/North Carolina (Mean score, ±SD)</td>
<td>2.6±0.1</td>
<td>3.1±0.2</td>
</tr>
<tr>
<td>3. Do you think you will be infected with SI in your lifetime (% of N)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>80.6%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Moderate</td>
<td>19.4%</td>
<td>66.7%</td>
</tr>
<tr>
<td>High</td>
<td>0.0%</td>
<td>15.1%</td>
</tr>
</tbody>
</table>

Figure 3: Respondents’ Perception about Likelihood of SIVs infection among Swine Workers in Rural Hubei
Figure 4: Respondents' Perception about Their Personal Susceptibility in Rural Hubei

Figure 5: Respondents’ Perception about Likelihood of SIVs infection among Swine Workers in Rural North Carolina
3.1.4 Response for Precautionary Methods among Respondents

Table 4 shows the self-reported data from participants about the precautionary methods they take if they touch pigs. For the part of the study in Hubei related to use of personal protection equipment, PPE, only 4.5% of respondents chose “dedicated boots”; 7.5% of them chose “dedicated clothing”; and 17.9% chose “masks or gloves”. But, in terms of hygiene practices, the number of people who chose this category showed an increase. Among which, 34.3% of respondents chose to shower out; 29.9% of them chose to wash hands with soap; and 25.3% of them chose to shower in. Finally, there were also 16.4% of respondents who chose not to take any precautionary methods after having contact with pigs.

Figure 6: Respondents’ Perception about Their Personal Susceptibility in Rural North Carolina

<table>
<thead>
<tr>
<th>Percentage of Total Respondents</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>R3</td>
<td>15.2%</td>
<td>66.7%</td>
<td>18.1%</td>
</tr>
</tbody>
</table>
Table 4: Response for Precautionary Methods Among Respondents

<table>
<thead>
<tr>
<th>Precautionary Measures (% of N)</th>
<th>Hubei Province (N=67)</th>
<th>North Carolina (N=33)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Personal Protective Equipment (PPE)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dedicated boots</td>
<td>4.5</td>
<td>33.3</td>
</tr>
<tr>
<td>Dedicated clothing</td>
<td>7.5</td>
<td>24.2</td>
</tr>
<tr>
<td>Mask or Gloves</td>
<td>17.9</td>
<td>21.2</td>
</tr>
<tr>
<td><strong>2. Hygiene practice</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shower in</td>
<td>34.3</td>
<td>15.2</td>
</tr>
<tr>
<td>Shower out</td>
<td>25.3</td>
<td>15.2</td>
</tr>
<tr>
<td>Wash hands with soap</td>
<td>29.9</td>
<td>NA</td>
</tr>
<tr>
<td><strong>3. None</strong></td>
<td>16.4</td>
<td>60.6</td>
</tr>
</tbody>
</table>

As can be seen in North Carolina data in Table 4, in regard to PPE, 33.3% of respondents chose “dedicated boots”; 24.2% of them chose “dedicated clothing”; and 21.2% of them chose to wear masks or gloves when in close contact with pigs. For the hygiene practices, 15.2% of respondents preferred to “shower in”, 15.2% of them preferred “shower out”, and no person mentioned washing hands with soap. However, it is important to note that over half of respondents (60.6%) responded that no precautionary methods were used after having contact with pigs. Even though these respondents were not pig farmers, taking no preventive methods when they have close contact with pigs still puts them at the risk for being infected with SIVs.
3.2 Single Variable Analysis

3.2.1 Relationship between Individual Characteristics and Two Dimensions of Risk Perceptions

As each of the risk perception questions was treated as an independent outcome variable, an analysis for the relationship between the individual characteristics and for each of them was conducted. Originally, two of three outcome variables had five categories (from strongly unlikely to strongly likely (1-5)). After considering the sample size, these two variables were finally divided into three categories (e.g. more unlikely, neutral, more likely). Additionally, only Hubei data was analyzed in this sub-section (as sample size was sufficient).

The first independent outcome variable was “likelihood of swine workers being infected in China” (See Table 5). In responding to this question, nearly half of the female respondents (45.5%) believed that this issue was more likely to occur, but more than half of male respondents (52.9%) though it was more unlikely and only one male believed it was more likely to occur. Then, in regard to trends about answers in different age groups, most of the respondents aged 20-30 thought SIV infection was more likely to occur. However, nearly every one of the respondents who were over 50 deemed infection more unlikely to occur. Moreover, it can be seen from Table 5 that there was a downward trend in the percentage of respondents from the age group 20-30 to the age group over 50 who thought SIV infection was more likely to occur, while among respondents who deemed infection more unlikely, the percentage of respondents was
significantly increased with the increase in age groups. These findings presented a striking contrast. The results show that both gender (P<0.001) and age (P<0.001) have a statistically significant relationship with respondents’ perception about the likelihood of swine workers being infected in China. However, for other demographic variables (including household size, children under 5 at home, and elder people over 55 at home), there is no statistically significant relationship.

The second independent outcome variable was respondents’ perception about the likelihood of SIVs infection among swine workers in Hubei province (See Table. 6). Compared with the same question with the range set as China, the percentage of female respondents who believed SIV infection was more likely occur in Hubei was decreased, but this percentage (39.4%) still accounted for the largest proportion of the total female respondents. There was also an increase in the percentage of male respondents who thought it was more unlikely to occur (from 52.9% to 61.8%) in Hubei than in China. In terms of the trend in age groups, the same finding was observed among respondents who thought SIV infection was more likely to occur. But for respondents who thought it more unlikely in Hubei, the percentage of respondents was decreased slightly from age group 20-30 to age group 30-40, before it was dramatically increased from age group 30-40 to age group over 50. Additionally, results suggest that both gender (P<0.01) and age (P<0.01) have a statistically significant relationship with respondents’ perception about the likelihood of SIVs infection among swine workers in Hubei, but other demographic
variables had no effect (P>0.05). As these two outcome variables were both in the first dimension of risk perceptions, only the two demographic variables - gender and age - were the statistically significant difference in this dimension.

Finally, the third outcome variable was respondents’ perception about their personal susceptibility to SIVs infection, which was also the second dimension of risk perceptions (See Table. 7). None of the participants chose the high level, so only low and moderate levels are discussed here. In terms of gender, for those who perceived personal susceptibility with SIV infection, more than fifty percent of them were males. But, among those who perceived personal susceptibility was at moderate risk, the majority of them were females (84.6%). In regard to the difference in age groups, the majority of respondents who were in the age groups 30-40, 40-50, and over 50 all thought they were at low risk for SIV infection. More than half of respondents in the age group 20-30 years thought they were at moderate risk for SIV infection. Results also showed that both gender (P<0.01) and age (P<0.05) had a statistically significant relationship with respondents’ perception of personal susceptibility of infection with SIVs, but other demographic characteristics were not statistically significant.

Therefore, all of the above results show that among all demographic variables in this study, only gender and age had a statistically significant relationship with two dimensions of risk perceptions. Females had higher risk perceptions and the elderly had lower risk perceptions compared to other respondents.
Table 5: Cross-tabulation of Risk Perception Question 1 and Individual Characteristics (Hubei Part)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Sample</th>
<th>Perceived Likelihood of Swine Workers be infected in China</th>
<th>P-Value (Fisher’s exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>More Unlikely</td>
<td>Neutral</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>33</td>
<td>8 (24.2)</td>
<td>10 (30.3)</td>
</tr>
<tr>
<td>Male</td>
<td>34</td>
<td>18 (52.9)</td>
<td>15 (44.1)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 - 30</td>
<td>11</td>
<td>1 (9.1)</td>
<td>3 (27.3)</td>
</tr>
<tr>
<td>30 - 40</td>
<td>13</td>
<td>1 (7.7)</td>
<td>6 (46.2)</td>
</tr>
<tr>
<td>40 - 50</td>
<td>31</td>
<td>13 (41.9)</td>
<td>15 (48.4)</td>
</tr>
<tr>
<td>&gt;50</td>
<td>12</td>
<td>11 (91.7)</td>
<td>1 (8.3)</td>
</tr>
<tr>
<td>Household Size</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>4 (80.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>3-4</td>
<td>52</td>
<td>17 (32.7)</td>
<td>22 (42.3)</td>
</tr>
<tr>
<td>5 or over</td>
<td>10</td>
<td>5 (50.0)</td>
<td>3 (30.0)</td>
</tr>
<tr>
<td>Children under 5 at home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>17</td>
<td>7 (41.2)</td>
<td>3 (17.7)</td>
</tr>
<tr>
<td>No</td>
<td>50</td>
<td>19 (38.0)</td>
<td>22 (44.0)</td>
</tr>
<tr>
<td>Elder over 55 at home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>22</td>
<td>9 (40.9)</td>
<td>9 (40.9)</td>
</tr>
<tr>
<td>No</td>
<td>45</td>
<td>17 (37.8)</td>
<td>16 (35.6)</td>
</tr>
</tbody>
</table>
Table 6: Cross-tabulation of Risk Perception Question 2 and Individual Characteristics (Hubei Part)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Sample</th>
<th>Perceived Likelihood of Swine Workers be infected in Hubei</th>
<th>P-Value (Fisher’s exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>More Unlikely</td>
<td>Neutral</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
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<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>33</td>
<td>10 (30.3)</td>
<td>10 (30.3)</td>
</tr>
<tr>
<td>Male</td>
<td>34</td>
<td>21 (61.8)</td>
<td>12 (35.3)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 - 30</td>
<td>11</td>
<td>2 (18.2)</td>
<td>3 (27.3)</td>
</tr>
<tr>
<td>30 - 40</td>
<td>13</td>
<td>2 (15.4)</td>
<td>7 (53.9)</td>
</tr>
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<td>40 - 50</td>
<td>31</td>
<td>17 (54.8)</td>
<td>10 (32.3)</td>
</tr>
<tr>
<td>&gt;50</td>
<td>12</td>
<td>10 (83.3)</td>
<td>2 (16.7)</td>
</tr>
<tr>
<td>Household Size</td>
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<td>-</td>
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<td>2</td>
<td>5</td>
<td>4 (80.0)</td>
<td>1 (20.0)</td>
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<tr>
<td>3-4</td>
<td>52</td>
<td>21 (40.4)</td>
<td>19 (36.6)</td>
</tr>
<tr>
<td>5 or over</td>
<td>10</td>
<td>6 (60.0)</td>
<td>2 (20.0)</td>
</tr>
<tr>
<td>Children under 5 at home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>17</td>
<td>7 (41.2)</td>
<td>1 (5.9)</td>
</tr>
<tr>
<td>No</td>
<td>50</td>
<td>24 (48.0)</td>
<td>21 (42.0)</td>
</tr>
<tr>
<td>Elder over 55 at home</td>
<td></td>
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</tr>
<tr>
<td>Yes</td>
<td>22</td>
<td>11 (50.0)</td>
<td>7 (31.8)</td>
</tr>
<tr>
<td>No</td>
<td>45</td>
<td>20 (44.4)</td>
<td>15 (33.3)</td>
</tr>
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Table 7: Cross-tabulation of Risk Perception Question 3 and Individual Characteristics (Hubei Part)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Sample</th>
<th>Personal Susceptibility</th>
<th></th>
<th></th>
<th></th>
<th>P-Value (Fisher’s exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>33</td>
<td>22 (66.7)</td>
<td>11 (33.3)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>34</td>
<td>32 (94.1)</td>
<td>2 (5.9)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 - 30</td>
<td>11</td>
<td>5 (45.5)</td>
<td>6 (54.5)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 - 40</td>
<td>13</td>
<td>12 (92.3)</td>
<td>1 (7.7)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 - 50</td>
<td>31</td>
<td>27 (87.1)</td>
<td>4 (12.9)</td>
<td>0 (0.0)</td>
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<td></td>
</tr>
<tr>
<td>&gt;50</td>
<td>12</td>
<td>10 (83.3)</td>
<td>2 (6.7)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household Size</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>4 (80.0)</td>
<td>1 (20.0)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>52</td>
<td>43 (82.7)</td>
<td>9 (17.3)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 or over</td>
<td>10</td>
<td>7 (70.0)</td>
<td>3 (30.0)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children under 5 at home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>17</td>
<td>13 (76.5)</td>
<td>4 (23.5)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>50</td>
<td>41 (82.0)</td>
<td>9 (18.0)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elder over 55 at home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>22</td>
<td>16 (72.7)</td>
<td>6 (27.3)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>45</td>
<td>38 (84.4)</td>
<td>7 (15.6)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.2.2 Relationship between Risk Factors and the Intensity of Precautionary Methods

As shown in Table 8, only one of the female respondents did not use any precautionary method when she had contact with pigs, but the majority of female respondents still preferred to use single or multiple methods. More than 50% of male respondents used one single method, and 29.4% of them did not take any precautionary measures. Using two or more preventive methods was not common among male respondents. The result by Fisher’s exact test shows that there was a significant relationship between gender and the intensity of precautionary methods (p < 0.01).

For the relationship between age and intensity of precautionary methods, most respondents who did not use any precautionary methods were mainly distributed into the age group of 40-50 years and the age group greater than 50 years, while most of the respondents who were willing to use two or more methods were usually aged 20-30 years. The result of Fisher’s exact test shows there is a significant relationship between age and the intensity of precautionary methods (P < 0.01).

For the relationship between household size and intensity of precautionary methods, most of the respondents who reported household size at 3-4 persons or more than 5 persons chose at least one precautionary method after having contact with pigs, but among respondents who had a household size of 2 persons, only 1 person chose to use two or more preventive methods. The result of Fisher’s exact test also showed that
was a significant relationship between household size and the intensity of precautionary methods (p < 0.01).

For respondents who thought the SIVs infection among swine workers was more unlikely to occur in China/Hubei, nearly every one of them (96.2%/96.7%) chose to not use preventive methods or use a single method. However, for respondents who thought this issue was more likely to occur in China/Hubei, most of them (93.7%/85.7%) chose to use two or more preventive methods. Results of Fisher’s exact test show the significant impacts of perceived likelihood of SIVs infection among swine workers in China or Hubei on the intensity of precautionary methods (both P < 0.01).

Additionally, among respondents who perceived personal susceptibility to SIVs infection as a moderate risk, 23.1% of them chose to use a single preventive method and 76.9% of them chose to use at least two preventive methods, while respondents who did not take any preventive measures all thought they were at low risk for being infected with SIVs. Thus, the result of Fisher’s exact test demonstrated that there was a significant relationship between perceived personal susceptibility and the intensity of precautionary methods (p < 0.01). Others factors (e.g. children under 5 years at home and elders more than 55 years of age at home) in this table did not show statistical significance.
Table 8: Cross-tabulation of Individual Characteristics and Intensity of Precautionary Methods (Hubei Part)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Sample</th>
<th>Response for Intensity of Precautionary Methods</th>
<th>P-Value (Fisher’s Exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>None (%), Single (%), 2 or More (%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>33</td>
<td>1(3.0), 17(51.5), 15(45.5)</td>
<td>0.003</td>
</tr>
<tr>
<td>Male</td>
<td>34</td>
<td>10(29.4), 18(52.9), 6(17.7)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>20 - 30</td>
<td>11</td>
<td>1(9.1), 1(9.1), 9(81.8)</td>
<td></td>
</tr>
<tr>
<td>30 - 40</td>
<td>13</td>
<td>0(0.0), 6(46.2), 7(53.8)</td>
<td></td>
</tr>
<tr>
<td>40 - 50</td>
<td>31</td>
<td>7(22.6), 19(61.3), 5(16.1)</td>
<td></td>
</tr>
<tr>
<td>&gt;50</td>
<td>12</td>
<td>3(25.0), 9(75.0), 0(0.0)</td>
<td></td>
</tr>
<tr>
<td>Household Size</td>
<td></td>
<td></td>
<td>0.006</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>4(80.0), 0(0.0), 1(20.0)</td>
<td></td>
</tr>
<tr>
<td>3 - 4</td>
<td>52</td>
<td>5(9.6), 30(57.7), 17(32.7)</td>
<td></td>
</tr>
<tr>
<td>5 or over</td>
<td>10</td>
<td>2(20.0), 5(50.0), 3(30.0)</td>
<td></td>
</tr>
<tr>
<td>Children under 5 at home</td>
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<td></td>
<td>0.175</td>
</tr>
<tr>
<td>Yes</td>
<td>17</td>
<td>1(5.8), 8(47.1), 8(47.1)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>50</td>
<td>10(20.0), 27(54.0), 13(26.0)</td>
<td></td>
</tr>
<tr>
<td>Elder over 55 at home</td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>Yes</td>
<td>22</td>
<td>3(13.6), 12(54.6), 7(31.8)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>45</td>
<td>8(17.8), 23(51.1), 14(31.1)</td>
<td></td>
</tr>
<tr>
<td>Perceived likelihood of SIVs infection for Swine Workers in China</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Neutral | 25 | 0(0.0) | 20(80.0) | 5(20.0)
More Likely | 16 | 0(0.0) | 1(6.3) | 15(93.7)

Perceived likelihood of SIVs infection for Swine Workers in Hubei

<table>
<thead>
<tr>
<th></th>
<th>Neutral</th>
<th>More Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Unlikely</td>
<td>31</td>
<td>11(35.5)</td>
</tr>
<tr>
<td>Neutral</td>
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</tr>
<tr>
<td>More Likely</td>
<td>14</td>
<td>0(0.0)</td>
</tr>
</tbody>
</table>

Perceived Personal Susceptibility

<table>
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<tr>
<th></th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Unlikely</td>
<td>31</td>
<td>11(20.4)</td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>54</td>
<td>11(20.4)</td>
<td></td>
</tr>
</tbody>
</table>
| More Likely| 13   | 1(23.1)  | 10(76.9)

3.3 Multiple Regression Analysis

3.3.1 Association between Individual Characteristics and Risk Perceptions

Table 9 shows the results of three ordinal logistic regression models that we used to determine demographic variables that were associated with two dimensions of risk perceptions among respondents. In terms of the first dimension of risk perceptions, the likelihood ratio chi-squared of 47.61 with the p-value of 0.0000 in model 1 and the likelihood ratio chi-squared of 34.09 with the p-value of 0.0000 in model 2 all tell us that these two models are statistically significant, as compared to the null model with no predictors. The pseudo R2 of 0.3298 and 0.2424 were also given in these two models.

Besides, these two models also had the same findings. First, the gender of respondents is
significantly associated with their risk perception (P < 0.01 in model 1 and P < 0.05 in model 2), given other variables are held constant. To be more specific, male respondents (OR <1) have lower risk perception about SIVs infection among swine workers, comparing with female respondents. For males, the odds of high category in risk perception versus the combined middle and low categories in risk perception are 0.15 times (Model 1) or 0.27 times (Model 2) lower than for females, given that all other variables are held constant. Likewise, the odds of the combined middle and high categories in risk perception versus low category in risk perception are 0.15 times (Model 1) or 0.27 times (Model 2) lower for males compared to females, given other variables are held constant. Second, the age of respondents was significantly and negatively associated with their risk perception (P < 0.01, OR < 1 in model 1 and model 2), given other variables are held constant. It means that older respondents (age >= 40) were more likely to have lower risk perception compared to younger respondents (age of 20-30). Other predictor variables did not show the statistical significance at the 95% confidence level in these two models.

In terms of the second dimension of risk perceptions, the likelihood ratio chi-squared of 20.72 with the p-value of 0.0042 in model 3 also tells us that this model is also statistically significant, as compared to the null model with no predictors. The pseudo R2 of 0.3143 is given. This model also produced the same findings as the previous two models. First, the gender of respondents significantly influenced their risk perception of
personal susceptibility as expected (P < 0.01). More specifically, male respondents had lower perception about their own personal susceptibility with SIVs rather than females (OR < 1), given other variables were held constant. Second, the age of respondents was significantly and negatively associated with their risk perception (P <0.05, OR < 1), given other variables were held constant. This means that those respondents who are younger (age of 20-30) have higher risk perception than that of older respondents (age of 30-50), while other predictor variables did not show the statistical significance at the 95% confidence level in this model.

### 3.3.2 Association between Risk Factors and the Intensity of Precautionary Methods

Model 1 in Table 10 shows the results of ordinal logistic regression model that we used to determine factors might influence the intensity of precautionary methods among respondents. The likelihood ratio chi-squared of 75.06 with the p-value of 0.0000 in this model tells us that it is statistically significant, as compared to the null model with no predictors. The pseudo R2 of 0.5604 is given. From the results, people who perceived SIVs infection among swine workers in China were more likely to take more precautionary measures than those who perceived this risk were more unlikely (P < 0.05, OR > 1), given that other variables were held constant. Moreover, people who perceived themselves were at moderate risk for being infected with SIVs were more likely to use more precautionary methods than those perceived as low risk (P < 0.05, OR > 1), given
that other variables were held constant. While other predictor variables did not show the statistical significance at the 95% confidence level in this model.

Model 2 in Table 10 shows the results of multinomial logistic regression model that we used to determine factors might influence the intensity of precautionary methods among respondents. The likelihood ratio chi-squared of 100.41 with $p < 0.0001$ also tells us that this model as a whole fits significantly better than an empty model without any predictors. Although no statistically significant relationship was found between any one of factors and the intensity of precautionary methods among respondents, this model still can provide us some information. In regard to those three factors about risk perceptions, the coefficient of each factor showed an increase from the base category (take none methods) to the highest category (take two or more methods), given that other variables are controlled. It indicates that there might be a positive association between risk perceptions and the intensity of precautionary methods, although Model 2 currently cannot give a conclusion to it.

Using two of these models in this study is an attempt to see which one is more likely to clearly explain the association between risk factors and the intensity of precautionary methods among respondents. But final results from both models show that they are suggestive but not conclusive. In other words, both models might not perfectly display the characteristics of the data in this study. For ordinal logistic regression model, three categories of the intensity of precautionary methods are
regarded to have an ordering (from none method to 2 or more methods). Thus, ordinal logistic regression model uses all of these data, which seems to have a larger sample size to make results significant. But it assumes parallel responses, which seems to be untrue, so any conclusion based on this model should be interpreted with caution.

Then, in terms of multinominal logistic regression model, there are several reasons might explain why results were not significant. First, comparing with ordinal logistic regression model, it assumed that there is no order to those three categories of the intensity of precautionary measures (categories are as nominal). So this model loses some information about the ordering and reducing sample size. Second, results through the test of Spearman’s correlation validated that three variables about risk perceptions were correlated with each other (p < 0.05). Especially, there was a highly correlation (Spearman’s rho = 0.8533) between the first two variables of “perceived likelihood of SIV infection among swine workers in China” and “perceived likelihood of SIV infection among swine workers in Hubei”. Thus, when these correlated variables were put into one model, they probably interacted with each other, which made them not be precisely estimated and then caused insignificant results.
Table 9: Demographic Factors Associated with Risk Perceptions

<table>
<thead>
<tr>
<th></th>
<th>Model 1 OR (95% CI)</th>
<th>Model 2 OR (95% CI)</th>
<th>Model 3 OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Male</td>
<td>0.15(0.05-0.52)**</td>
<td>0.27(0.09-0.80)*</td>
<td>0.05(0.01-0.46)**</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 - 30</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>30 - 40</td>
<td>0.51(0.09-2.83)</td>
<td>0.57(0.11-2.86)</td>
<td>0.03(0.00-0.47)*</td>
</tr>
<tr>
<td>40 - 50</td>
<td>0.07(0.01-0.35)**</td>
<td>0.13(0.03-0.64)**</td>
<td>0.08(0.01-0.57)*</td>
</tr>
<tr>
<td>&gt;50</td>
<td>0.00(0.00-0.07)**</td>
<td>0.02(0.00-0.21)**</td>
<td>0.29(0.03-3.04)</td>
</tr>
<tr>
<td><strong>Household Size</strong></td>
<td>1.76(0.48-6.49)</td>
<td>2.05(0.56-7.42)</td>
<td>1.60(0.36-7.21)</td>
</tr>
<tr>
<td><strong>Children under 5 at home</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>No</td>
<td>0.82(0.22-3.03)</td>
<td>0.29(0.08-1.07)</td>
<td>3.20(0.44-23.0)</td>
</tr>
<tr>
<td><strong>Elder over 55 at home</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>No</td>
<td>2.16(0.64-7.30)</td>
<td>2.26(0.67-7.60)</td>
<td>0.47(0.09-2.39)</td>
</tr>
</tbody>
</table>

Note: *P<0.05, **P<0.01
OR, odds ratios adjusted; 95%CI: 95% confidence interval
Model 1: Perceived likelihood of SIVs infection for Swine Workers in China
Model 2: Perceived likelihood of SIVs infection for Swine Workers in Hubei
Model 3: Perceived Personal Susceptibility
Table 10: Demographic Factors and Risk Perception Associated with Intensity of Precautionary Activities

<table>
<thead>
<tr>
<th></th>
<th>Model 1 OR (95% CI)</th>
<th>Model 2 Co-efficient (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>None (Base)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.70 (0.14-3.62)</td>
<td>-4.08 (-8.37-0.22)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-30</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>30-40</td>
<td>0.53 (0.02-12.34)</td>
<td>37.99 (-25561.46-25637.44)</td>
</tr>
<tr>
<td>40-50</td>
<td>0.10 (0.00-1.86)</td>
<td>17.09 (-8714.33-8748.51)</td>
</tr>
<tr>
<td>&gt;50</td>
<td>0.12 (0.00-3.20)</td>
<td>19.98 (-8711.44-8751.41)</td>
</tr>
<tr>
<td>Household Size</td>
<td>2.85 (0.58-13.88)</td>
<td>3.00 (-0.37-6.38)</td>
</tr>
<tr>
<td>Children under 5 at home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0.21 (0.03-1.42)</td>
<td>-2.23 (-5.74-1.28)</td>
</tr>
<tr>
<td>Elder over 55 at home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1.36 (0.27-6.78)</td>
<td>-0.82 (-2.90-4.55)</td>
</tr>
<tr>
<td>Likelihood of SIVs infection for Swine Workers in China</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Unlikely</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>8.46 (0.51-140.12)</td>
<td></td>
</tr>
<tr>
<td>More Likely</td>
<td>190.74(2.46-14796.72)*</td>
<td>16.07(-9121.85-9153.99)</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td><strong>Likelihood of SIVs infection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Workers in Hubei</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Unlikely</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>12.40(0.67-230.05)</td>
<td></td>
</tr>
<tr>
<td>More Likely</td>
<td>5.94(0.09-408.03)</td>
<td></td>
</tr>
<tr>
<td><strong>Perceived Personal Susceptibility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>41.21(1.99-853.33)*</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** OR, odds ratios adjusted for all variables shown in the table; 95%CI: 95% confidence interval

**Model 1:** Ordinal logistic regression model

**Model 2:** Multinomial logistic regression model
4. Discussion

4.1 Rural Hubei Province

4.1.1 Overview

Most of the Hubei respondents (swine workers) had relatively low risk perception about SIVs infection among general swine workers. Moreover, the majority of these respondents also perceived their personal susceptibility of SIV infection to be low. Thus, these two findings could suggest that the overall risk perceptions related to SIVs infection among these respondents were low. However, although they had low risk perceptions, based on their self-report, most of them were still willing to use at least one precautionary method if they had close contact with pigs. They usually focused upon following the preventive hygiene practices (e.g. wash hands or take shower) methods rather than the PPE methods (e.g. dedicated clothing, etc.).

Although these findings have not been documented in previous similar studies in China, there were several similar studies conducted among swine workers in other countries. Rabinowitz et al. found that swine workers who were from the Northeast and Midwest of the U.S.A. had low levels of concern about the risk of being infected with SIVs from pigs, and those workers who worked in small farms were less likely to use PPE methods, which was quite similar to our findings in this study (Rabinowitz et al., 2013a). In findings from another study, most Romanian swine workers who worked in large commercial swine facilities (70%) had high levels of concern about the risk of
getting SIVs infection from pigs (Rabinowitz et al., 2013b). Moreover, all of them reported the use of certain types of PPE methods in routine work, and most of them reported washing hands after finishing routine tasks. However, these results were dissimilar to our findings. Nevertheless, all of these previous findings seem to indicate that if swine workers work in smaller swine farms, they generally have relatively low risk perceptions about SIVs infection and rarely use PPE method. Also, if swine workers work in large swine facilities, they generally have high levels of concerns about the risk of SIVs infection, and are more likely to use both hygiene practice and PPE methods. A plausible explanation for this difference might be that large swine facilities usually have some professionals (e.g. veterinarians) who bring some basic information about SI to their pig workers and have strict requirements about wearing PPE at work, but small (especially for backyard-sized) swine farms do not have these resources.

In addition, it is interesting to note that our findings are similar to several prior studies that were conducted among poultry workers in rural counties of China. Li et al. found that poultry workers still had low concerns about the risk of avian influenza (AI A (H7N9, another subtype viruses of Influenza A) in rural Tianjin (China) (Li, et al., 2015). Despite the fact that these poultry workers had low concerns about avian flu, most of them still reported using at least one precautionary method at work. Moreover, these poultry workers, especially those who worked in their backyard farms, rarely used any PPE method, but the majority of them still washed their hands after touching
poultry. Liu et al. also found that poultry workers who worked in backyard-sized poultry farms in rural Guangzhou preferred to use hand hygiene methods rather than PPE methods after touching poultry (Liu et al., 2009). Researchers reported that these farmers were overly optimistic about the risk of avian influenza infections. Therefore, low risk perceptions regarding avian influenza or swine influenza and the preference to at least use hygiene practices after touching poultry or pigs might be a common phenomenon among these workers in rural areas of China, especially for those who work in backyard farms. However, further studies are needed to confirm this assumption.

4.1.2 Demographic Factors and Risk Perceptions

Based on results from single and multiple regression analysis for Hubei data, gender and age were proved to have significant impacts on participants’ risk perception. In terms of gender, it was not surprising that female participants had higher risk perceptions about SIVs infection than males as this result is consistent with many previous studies (Jacobs et al., 2010; Lin et al., 2011; and Williams et al., 2012). In terms of age, our results showed that older respondents had lower risk perceptions related to SI than younger respondents, but the studies of Jacobs et al. and Lin et al. both showed that older people were more likely to perceive the risk of SI than younger people (Jacobs et al., 2010; and Lin et al., 2011).
Although our results are different from prior studies, it still could be reasonably explained. To be specific, prior studies were focused on the general public’s risk perception about SI and found that when these people were older they knew more about SI and were more sensitive about the risk. But for swine workers in our study, most of them who were greater than the age of 40 years had raised pigs for more than 10 years. They may have thought that they had touched the pigs and lived near pigs for a long time, but they had never gotten any serious diseases from pigs before, so they also deemed that it was less likely that they would be infected with SIVs from pigs in the future. Even they knew more about SI from other people or from TV or somewhere, they might still have perceived the risk of it based on their personal experience. Just like one recent publication found that people’s personal experience generally has a stronger effect than experience of other people on reinforcing them to perceive the risk (Hsieh and Lo, 2017). Another reason for low risk perception in older swine workers may be differences in occupations. Swine workers might have lower perception about the risk of SIV infection than people with other occupations, but we did not recruit participants who were not swine workers in Hubei at this time, and therefore we could not ensure this difference. In the future, further analysis could focus on this point. Additionally, although household size was proved to have a significant impact on risk perception in a previous study (Ibuka et al., 2010), the current study did not find this result.
4.1.3 The Narrowing of Geographic Area and Risk Perceptions

The purpose of designing the first two risk perception questions was to see whether the narrowing of a geographic area might influence respondents’ risk perception. Results of this study suggest this influence might exist. To be specific, results in Table 3 showed a decrease in mean scores of perceived likelihood of swine workers to be infected with SIV from the national level (China) to the provincial level (Hubei). Moreover, results in Figure 3 demonstrate an increase in the percentage of Hubei respondents who thought SIVs infection was strongly unlikely/unlikely to occur in swine workers from the national level (China) to the provincial level (Hubei). These findings might be explained by two reasons. First, it seems possible that the risk perception in a geographical area would be affected by the size of that geographical area. For example, a person considering the risk at a large scale (national level) may make a different judgment when considering risk at a small scale (local level). Second, Hubei respondents might not hear about previous SIV infection cases in Hubei, so they might think swine workers in Hubei are safer than in other places in China. However, because the 95% CI ranges of these mean scores had overlap, these results still need to be confirmed in future studies.

4.1.4 Risk Factors and Intensity of Precautionary Methods

In terms of demographic factors associated with intensity of precautionary methods, the single variable analysis indicated that gender, age, and household size had
statistically significant impacts ($p < 0.01$). First, females were more likely to use two or more preventive methods, which is consistent with prior studies (Moran et al., 2016). Second, young respondents (20 – 30 years) appeared to be the most active in using two or more preventive methods rather than other age groups, which is similar to the study of Taglioni et al. (Taglioni et al., 2013). One plausible explanation for this finding is that these young respondents might be more likely to attend social events, and then they would hear or become aware about recommended precautionary methods from others in these events. After that, they might be more likely to accept and follow these methods mentioned by others. However, older respondents tend to adhere to a single precautionary method (e.g. hand washing with soap) based on their longstanding habits. Even if they heard about recommended precautionary methods by others or through social media, they would likely keep their habits. As several previous studies have mentioned, old habits are always hard to change (Teichaman, 2010). There may be other reasons that could explain this finding, but additional qualitative studies are needed. Third, respondents who had larger household sizes in this study were more likely to engage in more precautionary activities, which is similar to the finding in the study of Ibuka et al. (Ibuka et al., 2010). One plausible reason might be because there are children at home. Overall, our study findings for the association between demographic factors and precautionary methods are basically consistent with other previous studies.
Results from the Fisher’s exact test suggest that respondents who have higher risk perceptions about SIV infection are more likely to use more precautionary methods in this study. This result is similar with several previous studies. One previous study conducted in the U.K. at the beginning of the 2009 H1N1 pandemic (Rubin et al., 2009) showed that participants who had higher-level perception about severe consequences of swine flu outbreak were more likely to adopt one or more recommended behaviors. Another study showed that higher perceived severity and higher perceived personal vulnerability were both significant factors for using one or more precautionary method(s) against swine flu (Taglioni et al., 2013). All of these results also support protective motivation theory (PMT) suggesting the adoption of prevention behavior is influenced by risk perceptions (Milne, Sheeran, & Orbell, 2000). Therefore, if an effective intervention program tends to motivate people (including the general public and swine workers) to be more active in using precautionary method(s) against swine flu in the future, their risk perceptions must be one of the major factors researchers need to consider, explore, and understand before implementing an intervention program.

Although ordinal and multinomial logistic regression models were also attempted to determine if risk perceptions affect the intensity of precautionary methods, the results from both models could not perfectly present current data to give a conclusion. This might be because that the sample size of current data is still small, which might make the data be distributed unevenly in analysis. Thus, only the results
from the Fisher’s exact test were kept in this study to demonstrate the relationship between risk factors and intensity of precautionary methods among Hubei participants.

4.1.5 Risk for the Mixture of Human and Animal Species

Key message from Table 2 was that most of respondents (as swine workers) raise pigs and poultry together in their backyard-sized farms. Moreover, based on the observations in the fieldwork, we found that most of these respondents lived with these animals, usually the distance between human house and pig house was a 5-10 minute walk. Several of them raised pigs in a separate old house, and usually locked the door of this house before and after entering. But most of them raised pigs in semi-open houses (some without windows), and they usually left the door open. Moreover, among poultry species, chickens were the most popular one to be raised in respondents’ backyards based on observation. More than half of them generally raised 7-20 free-range chickens, which were raised for their food and not usually sold to the local market. While these free-range chickens always run around the backyard farms, and sometimes walk into the pig houses or jump on the low wall of semi-open pig houses, this could clearly show that these free-range chickens are fairly close to pigs on a daily basis. This phenomenon also implies that pig workers are usually not only exposed to pigs but also exposed to chickens or other poultry. Although the family members (including children) of pig workers generally do not enter the pig house and raise pigs, most of them still have close contact with those free-range chickens or other poultry. Additionally, all these
observations are also the common phenomenon in most rural communities of China (Jia et al., 2014), due to the traditions, culture, and habits in rural societies.

However, there is mounting evidence that pigs act as intermediate hosts for many subtypes of influenza A viruses (Scholtissek, 1990). Human and avian influenza viruses generally can both infect the pigs, and then the re-assortment among swine, avian, and human influenza viruses would occur in pigs and easily generate the novel influenza viruses. These novel influenza viruses might also pose the big pandemic potential threat (Ito et al., 1998). The 2009 pandemic H1N1 influenza virus was the best example of this. This evidence also tells us about the risk for the mixture of humans, pigs, and poultry. The current observations in most respondents’ backyards in rural counties of Hubei suggest that raising pigs and poultry together with people living nearby all provide ideal conditions for the transmission of the influenza A viruses. If either pigs or poultry were sick in the future, people would be at increased risk for being infected. In addition, swine workers were also documented to be at more risk for being infected with SIVs than the general public in priori studies in many countries (Gray, 2007; Kitikoon et al., 2011; Ma et al., 2015). Therefore, there is no doubt that these two conditions are more likely to increase the risk for our swine workers in rural Hubei.

Furthermore, when we look back through the history of human influenza pandemics, five pandemics were recorded from 20th century to present. Three (1957, 1968, and 1977) of them were originally detected in China. Moreover, the recent
publication by Yang and his colleagues also used their sample results from pigs in ten provinces of China to show the potential of Eurasian avian-like H1N1 swine influenza virus (EAH1N1 SIV) to transmit efficiently among humans and suggest that this virus might have a higher possibility to be a cause of the next human influenza pandemic (Yang et al., 2016). These facts also suggest that the risks of SIVs infection in pigs and humans should not be underestimated, although there was no serious consequences caused by them occur currently. Therefore, this is why this study emphasizes the importance of increasing risk perceptions of SIV infection and strengthening training of effective precautionary methods for pig farmers, especially for those who worked in backyard-sized pig farms in disadvantaged areas.

4.1.6 Summary

Although the education level of respondents was not measured in this study, several studies indicated that swine workers in rural areas of China generally had lower education level (under high school level) (Lin et al., 2009; and Qiu, 2014). Most of them showed they had little knowledge about SI (Lin et al., 2009), which was also observed in this study. Although no questions were designed to ask respondents about the knowledge of SI, most of them asked me, “what is the SI” during the face-to-face interview questionnaires. Additionally, these respondents had relatively low risk perceptions related to SI. They also seldom use specialized PPE (e.g. dedicated cloths, masks, and gloves). Further, this study also used the results to suggest that higher risk
perceptions might be one of major factors for motivating people to take more precautionary methods. Therefore, in order to help these swine workers in disadvantaged areas to more efficiently prevent SIVs infection, the health education and the training of effective precautionary methods among them should be strengthened in the future.

4.2 Rural North Carolina

4.2.1 Overview

Results showed that less than one third of North Carolina respondents (people living near a high density area of pig farms) thought that swine workers’ likelihood of being infected with SIVs was unlikely or strongly unlikely to occur in both the United States and in North Carolina. This suggested that although none of the respondents were swine workers based on self-report, they still perceived the likelihood of swine workers being infected with SIV to be high. Additionally, the majority of the respondents perceived their personal susceptibility to SIVs infection to be at the level of moderate risk. Thus, all of these results could suggest that the overall risk perception related to SIV infection among these respondents was high, which is a finding similar to that of a previous study (Jones & Salathe, 2009). This previous study pointed out that respondents in the U.S.A. perceived swine flu as the highest risk among all diseases (e.g. HIV and diabetes).
Our results might be due to following reasons. First, serious consequences of 2009 H1N1 swine flu pandemic in the U.S.A. extensively reported by media might make respondents more concerned about this risk, which was supported by the study of Jones and Salathe (Jones and Salathe, 2009). Second, the respondents live in the communities near the high density of pig farms and might hear from their friends or neighbors that human infection cases with SIVs previously occurred among swine workers there. Third, the respondents came to the study clinic to seek health care, so they might receive information that would affect their risk perception from their doctors. Generally, in influenza season, doctors always remind patients to pay attention or get a flu vaccination. Fourth, half of North Carolina participants were healthcare related staff, and might know more about SIV infection in humans and be more likely to perceive higher risk of it than the general public because of their profession. Fifth, the majority of North Carolina respondents were female might also cause higher overall risk perception (Williams et al., 2012). However, explanations other than media-induced awareness and gender affect cannot be confirmed by other studies, as limited studies have focused on risk perceptions of swine flu in the U.S.A.

Although most of these respondents had relatively high-risk perceptions, more than 50% of them reported they would not use any preventive methods if they touched pigs. This finding is different from most previous studies, in which higher risk perception has been linked to more active use of preventive methods (Ibuka et al., 2010;
Lin et al, 2011; and Taglioni et al., 2013). One possible explanation for this finding is that none of the North Carolina respondents are swine workers, and they might think that they will not be sick by touching pigs once or for a few times. Thus, they might believe that it is unnecessary to use any precautionary method(s) if they touch pigs. Additionally, for those respondents (40%) who would be willing to use one or more methods, they seem to prefer PPE method rather than hygiene practice method.

Nevertheless, the previous reports clearly indicated that even people who might accidentally touch pig(s) only one time still had the probability of being infected with SIV. For example, among previous infection cases, some people got an infection due to the attendance at agricultural fairs (Wong et al., 2015). Moreover, even for people who are not swine-related workers, the methods of PPE and hygiene practice (especially hand washing with soap) are still recommended if they have close contact with pigs regardless of how many times they are exposed to pigs (U.S. CDC, 2016). Therefore, the prevention methods training should be strengthened among these respondents.

4.2.2 Demographic Factors and Risk Perceptions

Based on demographic information (Table 1), the surprising finding was that 93.9% of North Carolina participants were females. This result might indicate two possible findings. As previously mentioned, the N.C. participants consisted of patients and staff who worked in the study clinic. Hence, the first finding is females might be more likely to seek health care when they have an illness, compared to males (U.S. CDC,
Second, there may be more female employees than male employees in the study clinic. In terms of the risk perceptions among these female respondents, most had high overall risk perceptions related to SIV infection, which was similar to many previous studies (Jacobs et al., 2010; Lin et al., 2011; and Williams et al., 2012).

In terms of race, the questionnaire actually did not ask participants’ race. However, through the language version (e.g. Spanish or English) of the questionnaire that participants chose, the race could be inferred. To be specific, when participants chose the English version, they might be whites or African-Americans, but when participants chose the Spanish version, they were most likely Latino/Hispanic persons. Thus, results indicated that nearly one third of N.C. respondents were Latino/Hispanic. In terms of risk perceptions, results showed that more than half of these minority populations had some levels of perceptions related to the risks of SIV infection. In particular, 8 out of 10 Latino/Hispanic persons perceived their susceptibility with SIV infection was at the moderate or high-risk level. This finding was consistent with one prior study that was focused on perceptions of SI pandemic among Latino Hard-to-reach (HTR) populations in California (Cassady et al., 2012).

In terms of occupation of N.C. respondents, 54.5 percent were healthcare related workers, and 45.5 percent were workers with other occupations, such as agricultural workers, sales workers, etc. Additionally, a previous study found that healthcare related workers (such as nurses) were more likely to perceive increased risks of acute
respiratory infectious diseases to themselves (Johnson et al., 2012). Thus, the Fisher’s exact test was used to see whether there was a difference in risk perceptions related to SIV infection between healthcare related workers and workers with other occupations. However, the results showed no statistically significant difference in risk perceptions related to SIV infection between these two groups in this study. One possible reason is that the small sample size led to the problem of small statistical testing power, which means this difference is hard to identify unless its magnitude is greater.

4.2.3 The Narrowing of Geographic Area and Risk Perceptions

Results of this study suggest the influence of the narrowing of geographic area on risk perceptions related to SIV infection might exist. To be specific, results in Table 3 showed an increase in mean scores of perceived likelihood of swine workers to be infected with SIV from the national level (the U.S.A) to the provincial level (North Carolina). This finding might be explained by two reasons. First, N.C. respondents thought swine workers were at much higher risk to be infected with SIV in North Carolina than in other places in the U.S.A. Second, the sample size was small enough that this finding might be obtained by chance. However, the same problem exists as was previously discussed in the Hubei part of the study, and thus these results still need to be confirmed in future studies.
4.2.4 Risk Factors and Intensity of Precautionary Methods

In terms of gender, although there were only two male respondents, both of them responded that they use no preventive methods after touching animals (e.g. pigs). In terms of race, most of those Latino/Hispanic respondents had high-risk perceptions related to SIV infection, but more than half of them chose to use no preventive methods after touching animals (e.g. pigs). As shown by a previous study, the unique experiences and socioeconomic realities of these minority populations might affect their attitudes about precautionary methods (Cassady et al., 2012). Therefore, in order to better understand the risk perceptions related to SIV infection among this minority group, their social factors (e.g. culture or socioeconomic status) could be also taken into account in further studies. In terms of occupation, 10 out of 18 healthcare related workers chose to use no preventive methods after touching animals (e.g. pigs). It seems that although they might have more knowledge about SI, they still thought it was not necessary to take preventive measures. There might be many reasons for this finding, and therefore this finding should be confirmed in additional studies.

4.2.5 Risk for the Mixture of Human and Animal Species

Although none of the N.C. respondents were pig farmers, one of the respondents reported touching pigs and chickens in both the last 30 days and 12 months, and four of the respondents reported touching chickens and ducks in the last 12 months. Additionally, not all of these respondents reported they would be willing to use
precautionary methods after touching animals. This finding suggests the training for use of recommended precautionary methods could be promoted among these people.

**4.2.6 Summary**

Although the small sample size in the North Carolina part of the study and the high percentage of female respondents does not represent all similar populations, there are two important implications of this study. First, the education about preventive methods needs to be strengthened in all people (including healthcare related workers) who live near high-density areas of pig farms. Second, Latino/Hispanic groups require more attention in future studies, as limited studies targeting this population are currently available. Cassady et al. found that Latino/Hispanic populations actually suffered disproportionately higher rate of being infected in 2009 H1N1 pandemic. Thus, in order to better help them to prevent future infections, education on effective preventive methods (i.e. vaccination and hygiene practices) is very important in the future.

**4.3 Study Strengths and Limitations**

The major strength of this study was to examine the risk perceptions related to SIVs infection and precautionary behavior among at-risk populations in disadvantaged areas rather than in the general population. As there were no similar studies to have targeted swine workers in rural China, results of this study could be used to do comparative research with similar studies in the future. There were also very limited
research focused on understanding risk perceptions and prevention behavior for SI among Latinos/Hispanic populations who live near high-density areas of pig farms, so results from this study might also provide suggestions for future studies of Latino/Hispanic groups. In addition, using both quantitative research methods and observations and communication with local people in the two parts of the fieldwork, a better understanding was acquired about the socio-economic and cultural background for those study participants.

However, this study also has several limitations. First, the small sample size and the non-probability sampling methods were applied in both of study parts and could have resulted in selection bias. Moreover, this selection bias could reduce the generalizability of this study. Second, all of the responses were based on self-reporting, thus responses about risk perceptions and precautionary methods could not be confirmed independently. Third, the face-to-face questionnaire interviews in North Carolina were conducted by multiple research staff, which might cause interview bias. To avoid this, all staff were trained to follow the same interview guidelines. Fourth, other previous similar studies showed that education level and socio-economic status level also had a significant impact on risk perceptions or precautionary behavior, but this study did not include these two demographic factors. The main reason for excluding these factors was that at the pre-test period, some swine workers did not feel
comfortable or did not want to answer questions related to these two factors, so these two questions were removed from the study.

5. Conclusion

This study provides evidence for the following conclusions: 1) Most pig farmers in the rural Hubei study, despite having relatively low risk perceptions related to SIVs infection, are still willing to use at least one precautionary method; 2) Although participants in rural North Carolina have relatively high-risk perceptions about SIVs infection, almost half of them did not think it was necessary to take precautionary measures. In addition, further multivariate analysis of data in the Hubei study also indicates that risk perceptions are significantly associated with gender and age, and the intensity of using precautionary methods was influenced by risk perceptions. These results carry important policy implications about the need to better educate at risk populations about the risk of SIV infections and to promote appropriate precautionary methods for future disease prevention.

Additionally, at the current stage, it is hard to predict how the swine influenza situation will develop and when the next pandemic related to SIVs will occur, but an overly optimistic or overly pessimistic perspective regarding the risks of SIV infection might impede people from effectively preventing the SIVs infection, especially for those special populations. An overly optimistic perspective might cause people to underestimate the risks of SIVs infection and become too confident that they will not get
infected, while, overly pessimistic people may overestimate the danger, causing public panic with unnecessary costs. Thus, increasing the perceptions of the risk but controlling those perceptions at the appropriate level among the at-risk populations is crucial for public health professionals considering future prevention plans. Furthermore, swine influenza is one typical type of zoonotic disease involving animals, human, and environmental health. Hence, the One Health concept could be also applied in the process of increasing risk perceptions related to SIVs infection among at-risk populations in the future. This would entail strengthening cooperation among veterinary experts, environmental professionals, and public health professionals to provide more comprehensive health education plans to prevent swine influenza.
Appendix A - 湖北省养殖人员对猪流感的风险认知调查

日期__________

I. 参与者个人资料

1. 性别
   □ 女  □ 男

2. 年龄
   □ > 10 岁 - 20 岁  □ > 40 岁 - 50 岁
   □ > 20 岁 - 30 岁  □ > 50 岁
   □ > 30 岁 - 40 岁

II. 参与者家庭信息

3. 您所居住地的邮编号

4. 不包括您自己，您家有多少人？
   □ 男，年龄小于 5 岁   □ 女，年龄小于 5 岁
   □ 男，年龄在 5-18 岁   □ 女，年龄在 5-18 岁
   □ 男，年龄在 18-55 岁   □ 女，年龄在 18-55 岁
   □ 男，年龄在 55 岁以上   □ 女，年龄在 55 岁以上

III. 动物的暴露和风险意识的认知

5. 在过去的 30 天内，您有近距离接触（距离为一米以内）过以下动物吗（可多选）？
   □ 猪
   □ 鸡
   □ 鸭
   □ 鹅
   □ 火鸡
6. 在过去的12月内，您有近距离接触（距离为一米以内）过以下动物吗（可多选）？
□ 猪
□ 鸡
□ 鸭
□ 鹅
□ 火鸡

7. 在过去的30天内，有任何居住在您家的人有近距离接触（距离为一米以内）过以下动物吗（可多选）？
□ 猪
□ 鸡
□ 鸭
□ 鹅
□ 火鸡

8. 在中国您认为养殖人员有多大可能感染上猪流感？
□ 绝对不可能
□ 不可能
□ 中立
□ 可能
□ 绝对可能

9. 在湖北省您认为养殖人员有多大可能感染上猪流感？
□ 绝对不可能
□ 不可能
□ 中立
□ 可能
□ 绝对可能

10. 您认为一个人（像你自己）在一生当中会感染上猪流感的机率是多少？
□ 低  (0-33%)
□ 中  (33%-66%)
□ 高  (66%-100%)

11. 当您近距离（距离为一米之内）接触动物时（比如：猪），你会采取以下哪种防御措施？（可多选）
□ 防护靴子
□ 防护服
□ 接触前淋浴
□ 接触后淋浴
□ 其他（如口罩，手套）
□ 不做

IV. 医疗记录

12. 在过去的 90 天里，您曾服用过任何抗生素吗？ 是 / 不是
13. 在过去的 90 天里，您曾住院治疗过吗？ 是 / 不是
Appendix B – Survey Questionnaire in English

Today’s Date __________

I. Participant Data
1. Gender
   □ Female
   □ Male
2. Age Group
   □ >10 yrs – 20 yrs
   □ >20 yrs – 30 yrs
   □ >30 yrs – 40 yrs
   □ >40 yrs – 50 yrs
   □ >50 yrs

II. Participant Demographic Information
3. What is zip code for your home? _________
4. Not including yourself, today how many individuals live in your home?
   □ Male (< 5 yrs)  □ Female (< 5 yrs)
   □ Male (5-18 yrs) □ Female (5-18 yrs)
   □ Male (18-55 yrs) □ Female (18-55 yrs)
   □ Male (>55 yrs) □ Female (>55 yrs)

III. Animal Exposure and Risk Perception
5. In the last 30 days have you come in close contact (touching or within 1 meter) with these animals (Check all that apply):
   □ Pigs
   □ Chickens
   □ Ducks
   □ Geese
   □ Turkeys
6. In the last 12 months have you come in close contact (touching or within 1 meter) with these animals (Check all that apply):
   □ Pigs
   □ Chickens
   □ Ducks
   □ Geese
   □ Turkeys

7. In the last 30 days has anyone live in your household had close contact (touching or within 1 meter) with these animals (Check all that apply):
   □ Pigs
   □ Chickens
   □ Ducks
   □ Geese
   □ Turkeys

8. How likely do you think it is for swine workers in the United States to become infected with germs from pigs? (Please choose 1)
   □ Strongly unlikely
   □ Unlikely
   □ Neutral
   □ Likely
   □ Strongly Likely

9. How likely do you think it is for swine workers in the United States to become infected with germs from pigs? (Please choose 1)
   □ Strongly unlikely
   □ Unlikely
10. What do you think is the chance of a person (like you) getting swine influenza in their lifetime is? (Please choose 1)
   □ Neutral
   □ Likely
   □ Strongly Likely

   □ Low (0-33%)
   □ Moderate (33-66%)
   □ High (66-100%)

11. If you have close contact (touching or within one meter) with animals, what protective measures do you use? (Check all that apply)
   □ Dedicated Boots
   □ Dedicated Clothing
   □ Shower In
   □ Shower Out
   □ Others ______ (e.g. mask or glove)
   □ None

IV. Health Care History
   12. In the last 90 days have you taken any antibiotics? Yes/No
   13. In the last 90 days have you been hospitalized? Yes/No
Appendix C – Survey Questionnaire in Spanish

Fecha de Hoy __________

I. DATOS DEL PARTICIPANTE
1. Género
   □ Masculino
   □ Femenino
2. Edad
   □ >10 años– 20 años
   □ >20 años – 30 años
   □ >30 años – 40 años
   □ >40 años – 50 años
   □ >50 años

II. INFORMACIÓN DEMOGRAFÍCA DEL PARTICIPANTE
3. ¿Cuál es el código postal de su hogar? __________
4. Sin incluirlo a usted, hoy ¿Cuántos individuos viven en su hogar?
   □ Masculino (< 5 años)   □ Femenino (< 5 años)
   □ Masculino (5-18 años)   □ Femenino (5-18 años)
   □ Masculino (18-55 años)   □ Femenino (18-55 años)
   □ Masculino (>55 años)    □ Femenino (>55 años)

III. EXPOSICIÓN ANIMAL Y PERCEPCIÓN DE RIESGO
5. En los último 30 días, ¿ha tomado usted contacto cercano (tocar o estar a menos de 1 metro) de estos animales? (Marque todos los que corresponda):
   □ Cerdos
   □ Pollos
   □ Patos
   □ Gansos
   □ Pavos
6. En los último 12 meses, ¿ha tomado usted contacto cercano (tocar o estar a menos de 1 metro) de estos animales? (Marque todos los que corresponda):
   □ Cerdos
   □ Pollos
   □ Patos
   □ Gansos
   □ Pavos

7. En los último 30 días, ¿alguien en su hogar ha tomado contacto cercano (tocar o estar a menos de 1 metro) de estos animales? (Marque todos los que corresponda):
   □ Cerdos
   □ Pollos
   □ Patos
   □ Gansos
   □ Pavos

8. ¿Qué posibilidades de infectarse con gérmenes de cerdo cree usted que tienen los obreros que trabajan con animales en los Estados Unidos? (Por favor, elija 1)
   □ Muy Improbable
   □ Poco Improbable
   □ Neutral
   □ Probable
   □ Muy Probable
9. ¿Qué posibilidades de infectarse con gérmenes de cerdo cree usted que tienen los obreros que trabajan con animales en Carolina del Norte? (Por favor, elija 1)
   □ Muy Improbable  
   □ Poco Improbable  
   □ Neutral  
   □ Probable  
   □ Muy Probable  

10. ¿Qué posibilidad de contraer Influenza porcina cree usted que tiene una persona en la vida? (Por Favor, Elija)
    □ Baja (0–33%)
    □ Media (33–66%)
    □ Alta (66–100%)

11. Usualmente, si tiene contacto cercano (tocar o estar a menos de 1 metro) con animales, que tipo de medidas preventivas utiliza? (Marque todas las que corresponda)
    □ Botas
    □ Vestimenta
    □ Ducha al interior
    □ Ducha al exterior
    □ Otras ______ (e.g. máscaras, guantes)
    □ Ninguna

III. Health Care History
12. ¿En los últimos 90 días ha tomado algún antibiótico? Sí/No
13. ¿En los últimos 90 días ha sido hospitalizado? Sí/No
References


5. China Intelligence Information Center (2016). Retrieved from: http://www.chinaiic.cn/plus/search.php?kwtype=0&q=%E6%B9%96%E5%8C%97 &searchtype=title&x=0&y=0


