



Public awareness of One Health in China

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ABSTRACT

One Health is recognized as an increasingly important approach to global health. It has the potential to inform interventions and governance approaches to prevent future pandemics. Successfully implementing the One Health approach in policy will require active engagement from the public, which begs the question: how aware is the public of One Health? In this study, we examine the level and distribution of One Health awareness among the general public in China using a survey conducted in Beijing ($n = 1820$). We distinguish between awareness of the term of “One Health” versus awareness of the core set of ideas – the interconnection between the health of people, animals, and the environment. Our analysis shows that 40% of respondents reported that they have heard of the term, but more than double the number indicated that they recognize the core idea of interconnection between people, animals, and the environment. Specifically, about 83% of the respondents said that they believe people's health is closely connected to animal health and 86% believe people's health is closely connected to plant and environmental health. Multiple regression analysis indicates that women, younger people, and individuals with a higher level of education show higher levels of One Health awareness than their counterparts. Being aware of the term is associated with higher recognition of the core ideas. Policymakers and health practitioners should consider these findings when designing public awareness campaigns and educational initiatives to promote One Health principles.

1. Introduction

The importance of human-wildlife coexistence for a healthy planet is widely accepted [1]. However, the expansion of human activities has led to major environmental changes that have posed growing threats to animals, plants, and humans [2]. In particular, the last several decades have seen a significant increase in zoonotic diseases whereby pathogens move from animals to infect humans [3,4]. More than 6 of every 10 known infectious diseases among humans have originated from animals, and the number is even higher for new or emerging infectious diseases, with 3 of every 4 infectious diseases coming from animals [5]. More recent outbreaks include SARS in 2003, Ebola in 2014, and Zika virus in 2015. The COVID-19 pandemic caused by the SARS-CoV-2 virus may also have emerged from wildlife reservoirs, potentially driven by environmental disruption [6,7]. As these recent cases powerfully

demonstrate, zoonotic disease outbreaks can lead to wide-ranging economic and health consequences including the loss of life, strain on healthcare systems, disruption of economies and businesses, and negative impacts on mental health and well-being [8–10].

A One Health approach to policy and governance has increasingly received attention to prevent and control zoonotic diseases [7,11]. One Health, first proposed by the Wildlife Conservation Society at a symposium in New York in 2004, recognizes the crucial linkages between human, animal, and environmental health and thereby the critical need for a collaborative, multisectoral, and transdisciplinary approach to attain optimal health and sustainability for humans, animals, and the environment [11–14]. While the term is relatively new, the core idea of One Health is rooted in Rudolf Virchow's “One medicine, one pathology” thinking, which was developed more than a century ago [15]. Virchow stated that “Between animal and human medicine there is no dividing

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line – nor should there be. The object is different but the experience constitutes the basis of all medicine” [16].

More recently, policy- and decision-makers have increasingly used One Health principles as an approach and framework for policy implementation and governance. Evidence suggests that policies and governance that integrate a One Health lens have been successful in reducing the impact of a number of zoonotic infectious disease outbreaks [17,18]. For example, multi-sectoral coordination and collaboration among health, veterinary, and environmental sectors helped improve disease surveillance, identify and control the source of the outbreak, and develop effective response strategies during the Ebola outbreak in West Africa in 2014 [19]. During the COVID-19 pandemic, countries whose governance systems integrate a One Health approach and prioritized formal coordination across multiple sectors have performed better in curbing the pandemic [20]. Given the growing evidence on the potential for One Health approaches to policy to *mitigate* pandemics, many have also argued that using a One Health approach will be critically important to *prevent* future pandemics [21].

Public awareness and acceptance of One Health is key for ensuring successful policy implementation and adoption [20,22]. First, when citizens are aware of the One Health concept and the interconnectedness of human, animal, and environmental health, they can better understand how their actions and behaviors may impact the health of animals and the environment. In turn, this awareness can help them make informed decisions about their health and wellbeing and how they can work together to promote better health outcomes for all [20]. Achieving the goal of One Health will be difficult without the engagement of the public. Second, when citizens are aware of the One Health approach and share its related ideas, they are more likely to demand One Health governance from politicians and policymakers thereby generating political will and commitment to address these obstacles and to make One Health governance a priority [23,24]. The public can also provide critical support for the often-difficult decisions that need to be made in order to promote the One Health approach [25]. The general public will likely be more accepting of policies/practices that aim to prevent/mitigate pandemics if they are aware of and understand the importance of One Health.

Currently, there is a paucity of research that has assessed awareness of One Health among the general public [11,26]. Several studies have considered the awareness of One Health among professionals, such as medical students, researchers, and health officials [27–32]. Some studies also asked professionals to rate the level of public awareness from their perspective and found that awareness is generally low among the public [30,31]. But few have examined awareness among the general public directly [28,29]. In this study, we fill this important research gap through a direct survey of the general public in China's capital city of Beijing. Specifically, we assess the levels of public awareness of One Health, both the term of One Health (同一健康) as well as the core set of ideas – that is, the interconnection between the health of people, and animals. In the present study, we consider how sociodemographic variables such as gender, age, and education may be related to One Health awareness. We also test whether awareness of the term is associated with higher recognition of the interconnectedness of human, animal, and environmental health.

2. Data and methods

2.1. Data

We conducted a face-to-face survey interview from August 4, 2022, to October 18, 2022 in Beijing, China. The study was reviewed and approved by the Office of Research Ethics at York University (e2021–212)

Two studies that have assessed One Health awareness of residents have a rather small sample size (400 in [28]; 1440 respondents in [29]). In this study, we aimed to recruit 2000 respondents to ensure a big

enough sample size to explore how social and demographic variables such as gender, age, and education may shape the variation in One Health awareness. We used a stratified sampling method with the city districts as the strata. Out of the target sample size, the number of respondents to interview in each district was determined by comparing each district's population relative to the city's total population (see Appendix Table A). We recruited 13 research assistants who helped conduct interviews across all 16 districts in Beijing. A half-day training session was held before the fieldwork to familiarize interviewers with the general goal of the study, research ethics, and specific guidelines for conducting the interviews.

Our student interviewers conducted the survey through face-to-face interviews in the assigned district. They randomly selected individuals and introduced themselves and the survey's purpose. After obtaining the respondents' consent, the interviewers asked them to complete the questionnaire on the spot. In cases where the respondents were elderly and had difficulty reading, the interviewers read the questionnaire to them and filled out the questionnaire based on their answers. In total, we were able to conduct 1950 interviews, and with questionable entries including incomplete responses and speeders including those who completed the survey in under 2 min and incomplete survey responses removed in the data cleaning process, we obtained an analytical sample of 1820. Note that in our analysis the sample size may vary due to the missing values of the variables included.

2.2. Measures

We asked several questions to measure One Health awareness. We separated between awareness of the term of One Health, and awareness of the core ideas. To measure awareness of the term of One Health, we asked “Have you heard of the term of 同一健康 (the common translation of One Health)?”. Responses were binary, where 0= “No, I haven't” and 1= “Yes, I have”. To assess awareness of the core ideas of One Health, we asked two questions: (1) “How closely do you believe people's health is connected to animal health?” and (2) “How closely do you believe people's health is connected to plant and environmental health?” Likert-scale responses were collected for both questions, where 1= “Not at all”, 2 = “Somewhat”, 3 = “Very”, and 4 = “Extremely”. To enable interpretation of the responses, the responses were grouped into binary categories where “1=Not at all” and “2 = Somewhat” was a negative response, and “3 = Very” and “4 = Extremely” was a positive response

The sociodemographic variables we considered include gender, age, level of education, Chinese Communist Party (CCP) membership, monthly household income, and subjective social class. Past studies suggest that CCP members may have different opinions or behaviors compared to non-members, particularly in areas related to politics, governance, and social issues [33]. Gender was coded as a binary variable between men and women. Age included six groups: 1 = “15–25 years”, 2 = “26–35 years”, 3 = “36–45 years”, 4 = “46–55 years”, 5 = “56–65 years”, 6= “66 or older”. Education includes five categories: 1= “Less than high school”, 2 = “High school”, 3 = “Some college”, 4 = “University graduate”, and 5 = “Postgraduate”. Monthly household income is also coded into five categories: 1= “Less than C\$5,000”, 2 = “C\$ 5000-10,000”, 3 = “C\$ 10,001-20,000”, 4 = “C\$ 20,001-30,000”, and 5= “C\$ 30,001 or more”. Subjective social class includes three categories: 1 = “Lower class”, 2 = “Middle class”, and 3 = “Upper class”.

2.3. Analysis

Our analysis takes three general steps. First, we report the summary statistics of key variables included in our analysis. We focus on describing participant characteristics and the key outcome variables: awareness of the One Health concept and awareness of the core ideas of One Health (the connections between (1) human health and animal health and (2) human health and plant and environmental health). Second, we explore the sociodemographic variations in these outcome

variables. We first describe levels of awareness of the One Health concept across sociodemographic variables. We then use a multivariable logistic regression model with all sociodemographic variables included as independent variables and awareness of the One Health concept as the outcome variable. We report odds ratios, comparing the relative levels of public awareness of the One Health concept across sociodemographic groups. We repeat this analysis with each of the two remaining outcome variables: public awareness of the connection between human and animal health; and public awareness of the connection between human and plant and environmental health. Finally, we consider whether respondents who have heard of the One Health concept are more likely to agree with the core ideas of One Health. Specifically, we use logistic regressions to estimate the association between participants' awareness of the One Health concept on their awareness of the core ideas that people's health is closely connected to animal health and that people's health is closely connected to plant and environmental health, while controlling for all sociodemographic variables

3. Results

Of the 1820 participants, 53% were female, 47% were aged 36 years or older, and 25% were identified as members of the CCP. The majority (78%) identified as middle class, while 56% had a university degree or higher. Additionally, 43% reported a monthly income exceeding C\$ 10,000 (US\$ 1500). Table 1 provides the summary statistics of key variables in analysis. Table 1 also shows that about 40% of respondents indicated that they have heard of the term. However, we observed that the proportion of participants who recognized the core idea of One Health is more than double the number of those who have heard of the concept. Specifically, about 83% of participants said that they believe people's health is closely connected to animal health and 86% said they

Table 1
Summary statistics of key variables in analysis ($n = 1820$).

Variable	% of the sample
One Health awareness	
Have you heard of the term 同一健康 (0 = no, 1 = yes)	40
How closely people's health is connected to animal health? (0 = not closely, 1 = very closely)	83
How closely people's health is connected to plant and environmental health? (0 = not closely, 1 = very closely)	86
Gender	
Female (0 = no, 1 = yes)	53
Age group	
15–25	25
26–35	28
36–45	24
46–55	15
56–65	5
66 or older	2
CCP member	
Are you CCP member (0 = no, 1 = yes)	25
Education	
Less than high school	13
High school	18
Some college	13
University	41
Postgraduate	15
Monthly household income	
Less than C\$5000	20
C\$5000–10,000	38
C\$10,000–20,000	24
C\$ 20,001–30,000	11
C\$30,001 or more	7
Subjective social class	
Lower class	15
Middle class	78
Upper class	7

believe people's health is closely connected to plant and environmental health.

Table 2 explores the sociodemographic variations in the awareness of the One Health concept. The left column reports the descriptive statistics and the right column reports the inferential estimations based on multivariate logistic regression analysis with all covariates included all at once. Results show that there are significant sociodemographic variations in awareness of the concept by gender, age, CCP membership, education, and class. Individuals who identify as women, are in the 15–25 age groups, have a CCP membership, have higher levels of education, and identified as middle and upper class show significantly higher odds of being aware of the One Health concept than their counterparts.

Similarly, there are also significant sociodemographic variations in the awareness of the core idea of One Health. Table 3 shows that women, younger generations, and better-educated individuals are significantly more likely to believe that people's health is closely connected to animal health as well as to plant and environmental health. By contrast, party membership, household income, and subjective class show few significant associations with public understanding of the core idea of One Health.

Finally, we consider whether participants who have heard of the term were more likely to recognize that people's health is connected to the health of animals and plants and the environment. To do so, we use multivariate logistic regression models estimating the effect of awareness of One Health as a concept (having heard of the term One Health) on the awareness of the ideas of One Health – believing that people's health is closely connected to animal health (Model 1) and that people's health is closely connected to plant and environmental health (Model 2). Both models are adjusted for gender, age, party membership, education, household income, and subjective social class. Fig. 1 shows the respondents who are aware of the term were 88% more likely to believe that people's health is closely connected to animal health (odds ratio = 1.88; 95% CI:1.4–2.5) and 115% more likely to believe that people's health is closely connected to plant and environmental health (odds ratio = 2.15; 95% CI:1.56–2.97).

4. Discussion

The global implementation of the One Health approach will require China's active participation and engagement. In fact, China has embraced the approach in recent years [34]. Many efforts from across sectors have been made to advance the approach, especially after the outbreak of the COVID-19 pandemic [35,36]. For example, a One Health Zoonotic Disease Prioritization workshop was held in May 2019, bringing together representatives from the human, animal, and environmental health sectors in China to develop a list of priority zoonotic diseases for multisectoral, One Health collaboration [35]. More recently, the Chinese government has also made a large-scale and systematic revision of the old *Wild Animal Conservation Law* to address One Health concerns, including preventing zoonotic spillover, managing captive-bred wild animals, improving wildlife rescue and rehabilitation, and outlining the private sector's role in preventing wildlife crime [37]. It is argued that the revised law has the potential to significantly decrease the consumption of wildlife and help prevent future outbreaks of zoonotic diseases [38,39].

Further advancement of One Health approaches to policy in China will need engagement and participation from the Chinese public. An important first step is assessing the level of awareness of One Health among the Chinese public, which will inform strategies to improve public understanding of One Health concepts and ideas. In this study, we examined the public awareness of One Health through a direct survey of the general public in China's capital city of Beijing. Our analysis shows that respondents have a generally low level of awareness of the term One Health, with only 40% of respondents reporting they heard of the term. However, respondents did show a high level of awareness of the core set

Table 2
Estimating sociodemographic variations in awareness of the term One Health.

	Have you heard of One Health?	
	Descriptive (%)	Inferential (odds ratio) [†]
Gender		
Male	37%	Reference
Female	42%	1.315**
Age		
15-25	49%	Reference
26-35	37%	0.623***
36-45	37%	0.544***
46-55	40%	0.650*
56-65	29%	0.342***
66 or older	33%	0.426*
CCP member		
No	40%	Reference
Yes	40%	1.356*
Education		
Less than high school	36%	Reference
High school	40%	1.311
Some college	50%	1.735*
University graduate	42%	1.087
Postgraduate	30%	0.674
Monthly household income		
Less than C\$ 5,000	43%	Reference
C\$5,000-10,000	42%	0.837
C\$10,001-20,000	36%	0.663*
C\$ 20,001-30,000	37%	0.689
C\$30,001 or more	36%	0.685
Subjective class		
Lower	35%	Reference
Middle	40%	1.449*
Upper	45%	1.726*
N	1,709	

Exponentiated coefficients; t statistics in parentheses

* p < 0.05, ** p < 0.01, *** p < 0.001

[†] Multivariable logistic regression including all variables at once

of ideas: 83% of respondents reported they believe people's health is closely connected to animal health and 86% reported they believe people's health is closely connected to plant and environmental health. We also found that women, younger people, and individuals with higher socio-economic status have higher levels of awareness of One Health as a concept than their counterparts. These findings align with those of [28], which presents a survey of 400 individuals in Wah, Pakistan. Finally, our study is also the first to show that being aware of the concept is associated with higher recognition of the core idea that health among humans, animals, and the environment are interconnected.

Past studies have shown that more people recognize the core idea of One Health- linkages between health, environment, and animals- than the term of One Health [26]. Here, we have found the same pattern from our Beijing survey, suggesting most people do understand that human health is connected to animal health and environmental health. The high levels of public awareness of the core idea of One Health among Chinese respondents could come from their exposure to traditional philosophical concepts such as *tianren heyi* (天人合一), or “unity of man and nature”, which promotes respect for nature and the need to live in harmony with nature [40,41], and also to *shengtai wenming* (生态文明), or “ecological civilization”, China's long-standing political framework to achieve sustainable development and to promote the overall well-being of people and the planet [42,43]. To further increase awareness and support of One Health in China, it is best to emphasize the links with these existing ideas that are already well-established in the culture. Strategies that aim to increase the awareness of One Health and its core ideas (e.g., informational brochures, changes to the curriculum in schools) could help to

accelerate the implementation and acceptance of policy approaches that use a One Health lens to prevent future pandemics and disease outbreaks. Additionally, framing One Health in a way that aligns with existing Chinese concepts, such as *tianren heyi* (天人合一) and *shengtai wenming* (生态文明) can help to make it more relatable and accessible to a Chinese audience. This can be done through effective communication and engagement strategies, education and training programs, and partnerships with local stakeholders and institutions [15].

Still, it is also important to recognize that not everyone is equally aware of One Health. Our findings show that women, younger people, and those with higher levels of education show increased awareness of One Health (both the concept itself and the core ideas) than their counterparts align with previous research demonstrating a similar pattern [28]. Therefore, efforts to raise awareness of One Health needs to target specific groups, such as men and those with lower levels of education. In fact, the finding that being aware of the term is associated with higher recognition of the core idea lends support that working to promote both the term and the core ideas will lead to an increased public awareness of One Health. However, greater public awareness may not lead to action.

Of note, the results of this study may not be representative of the larger population, and further research with larger sample sizes may be needed to confirm the findings. For example, the majority of the sample has a university degree or post-graduate education, so they may be more likely to respond to the survey and/or have heard of the concepts. Furthermore, a more comprehensive analysis can be conducted on the factors that impact the public's comprehension and perception of the

Table 3
Estimating sociodemographic variations in awareness of the core idea of One Health.

	How closely people's health is connected to animal health?		How closely people's health is connected to plant and environmental health	
	Descriptive (%)	Inferential (odds ratio)†	Descriptive (%)	Inferential (odds ratio)†
Gender				
Male	78%	Reference	82%	Reference
Female	87%	1.975***	90%	2.070***
Age				
15-25	89%	Reference	90%	Reference
26-35	84%	0.551**	86%	0.574*
36-45	81%	0.519**	87%	0.771
46-55	80%	0.704	84%	0.874
56-65	77%	0.667	82%	0.798
66 or older	47%	0.177***	58%	0.262**
CCP member				
No	82%	Reference	85%	Reference
Yes	86%	1.170	88%	1.277
Education				
Less than high school	71%	Reference	76%	Reference
High school	78%	1.561*	79%	1.381
Some college	81%	1.837*	85%	2.053**
University graduate	87%	2.521***	90%	3.036***
Postgraduate	90%	3.482***	92%	3.862***
Monthly household income				
Less than C\$ 5,000	78%	Reference	85%	Reference
C\$5,000-10,000	83%	1.189	85%	0.947
C\$10,001-20,000	83%	1.003	85%	0.794
C\$ 20,001-30,000	89%	1.457	90%	1.200
C\$30,001 or more	85%	1.324	86%	0.911
Subjective class				
Lower	79%	Reference	85%	Reference
Middle	84%	1.102	87%	0.867
Upper	77%	0.585	79%	0.508*
N	1,718		1,715	

Exponentiated coefficients; t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

† Multivariable logistic regression including all variables at once

One Health approach. This can involve expanding the analysis to encompass traditional ecological perspectives, ethical considerations, national customs, and the evolving outlook on national development. Future research may explore how awareness of the term One Health and its core ideas can translate into improved efficacy of policies and interventions. More research is needed to understand how people's recognition of the core ideas in One Health affects their actions and the extent of heterogeneity of opinions that exist in the population about whose responsibility is to bring about change and how that change is to be enacted. It is crucial to develop measures that assess the public's understanding, awareness, and acceptance of the One Health concept. These measures should be rigorously tested for their validity and reliability across diverse populations. Implementing such measures would prove valuable in evaluating policies and programs related to pandemic prevention and the prevention of zoonotic spillover.

5. Conclusion

The One Health approach is increasingly acknowledged as a critical framework to inform the prevention and management of infectious diseases that emerge from the interconnectedness of humans, animals, and environment. In discussing big challenges facing One Health, Gibbs [11] asked: "Why is One Health not known by the general public? Is it not as important, arguably even more important, than climate change?"

Indeed, public awareness is key to successfully implementing the One Health framework [20,22]. So far, there is a dearth of published evidence regarding the level of public awareness about One Health. Using a survey conducted in Beijing, this study found that while many respondents had heard of the concept of One Health, there was a greater recognition of the core idea of interconnectivity between people, animals, and the environment. The study also found that women, younger people, and those with higher education showed higher levels of awareness. Policymakers and health practitioners should consider these findings when designing public awareness campaigns and educational initiatives to promote One Health principles. Ultimately, future research can look at how One Health concepts and ideas influence people's perspectives and actions of risk, benefit and cost of various policy interventions rooted in One Health, as well as people's willingness to change their own behaviors. This can help policymakers reframe discourses in moving from awareness to action that can lead to more informed decision-making, better policy implementation, and improved health outcomes for both humans and animals.

Author statement

We, Cary Wu (carywu@yorku.ca), Zhiwen Gong (gongzhiwen@ustb.edu.cn), and Tarra Penney (tpenney@yorku.ca), the corresponding authors of this manuscript, certify that the contributors' and conflicts of

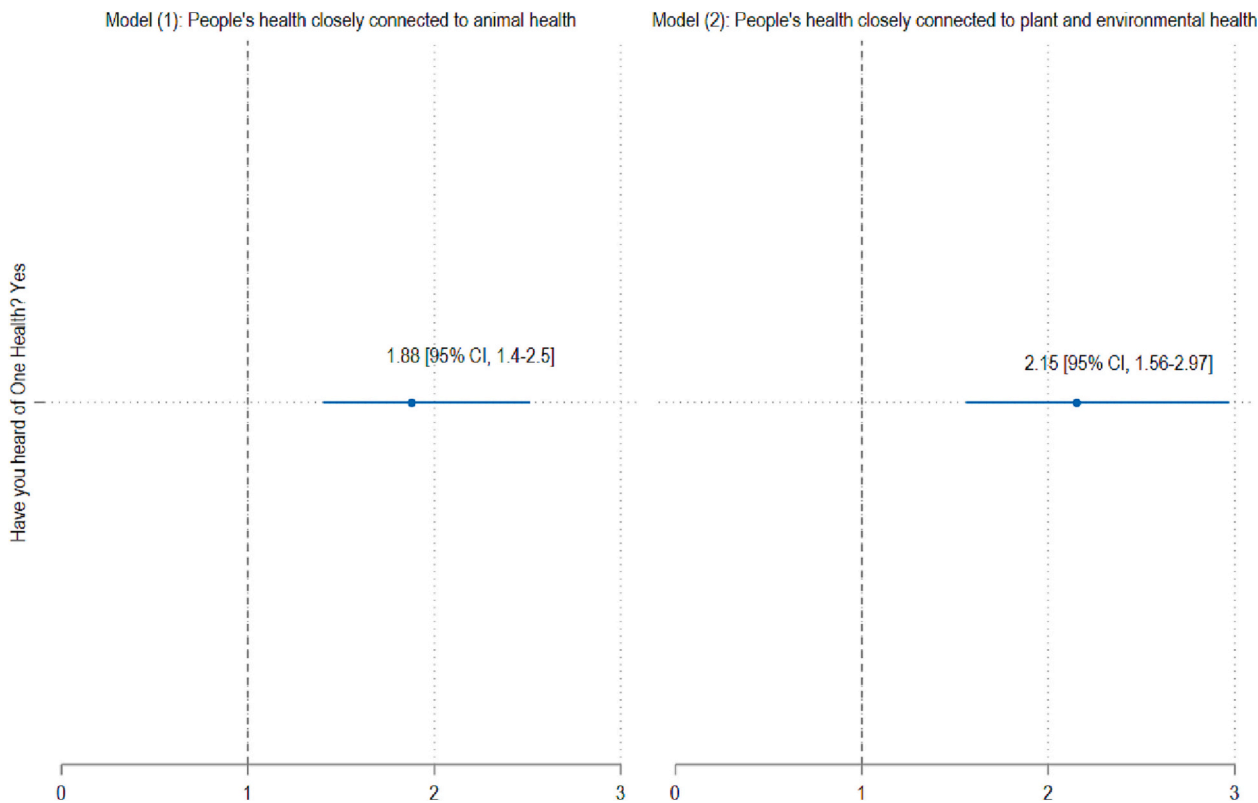


Fig. 1. Higher awareness of the One Health term is associated with higher recognition of the core ideas.

interest statements included in this paper are correct and have been approved by all co-authors.

Declaration of Competing Interest

We declare that we have no conflicts of interest that could potentially influence the research or the submission of the manuscript to the One Health. Additionally, we declare that the research conducted and the findings presented in the manuscript are original and have not been published previously or submitted for publication elsewhere. We also attest that all ethical considerations and guidelines for the responsible conduct of research have been adhered to, and that any potential conflicts of interest or ethical concerns have been addressed and reported appropriately.

Appendix A. Appendix

Table A

Sample distribution by district.

	Population (Million, 2020)	Percent	Target sample	Number of people interviewed	Valid sample
Dongcheng (东城区)	0.709	3%	65	53	49
Xicheng (西城区)	1.106	5%	101	131	125
Chaoyang (朝阳区)	3.451	16%	315	287	273
Fengtai (丰台区)	2.019	9%	184	208	176
Shijingshan (石景山区)	0.568	3%	52	62	62
Haidian (海淀区)	3.132	14%	286	234	225
Mentougou (门头沟区)	0.393	2%	36	40	39
Fangshan (房山区)	1.313	6%	120	142	107
Tongzhou (通州区)	1.84	8%	168	233	229
Shunyi (顺义区)	1.324	6%	121	83	83
Changping (昌平区)	2.269	10%	207	79	78
Daxing(大兴区)	1.994	9%	182	179	154
Huairou (怀柔区)	0.441	2%	40	36	35
Pinggu (平谷区)	0.457	2%	42	58	55

(continued on next page)

Table A (continued)

	Population (Million, 2020)	Percent	Target sample	Number of people interviewed	Valid sample
Miyun (密云区)	0.528	2%	48	69	72
Yanqing (延庆区)	0.346	2%	32	57	58
Total: City of Beijing	21.89	100%	2000	1951	1820

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