

Original Article



Willingness to Pay for Measures of Managing the Health Effects of Heat Wave in Beijing, China: a Cross-sectional Survey*

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Abstract

Objective There are evidences that heat wave events cause deaths and emergency cases. This article used the contingent valuation method to find the willingness to pay for the protective measures and investigated the factors that influence the willingness to pay.

Methods A cross-sectional face-to-face household survey was completed by 637 urban long-term residents and 591 rural long-term residents aged 15-79 in Beijing, China. Binary logistic regression was used to identify factors that influenced the payment rate or payment amount for the protective measures, including independent variables for district, gender, age, education, income, air conditioner ownership, heat wave experience, and chronic non-communicable disease.

Results The payment rate was 41.1% for protective measures provided by the government and 39.5% by measures provided by the market. Most of the respondents were willing to pay 40 CNY per capita annually for measures provided by the government or the market. The factors influencing willingness to pay were district, gender, income, air conditioner ownership, heat wave experience, and chronic non-communicable disease.

Conclusion Protective measures for heat waves need to be provided immediately. More attention should be paid to the situation of vulnerable groups, such as people who live in urban areas, those without air conditioning, and those who have experienced a heat wave in the past.

Key words: Heat wave; Protective measure; Willingness to pay; Influencing factor

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INTRODUCTION

Heat wave events have occurred frequently in recent years and have adversely affected public health worldwide. From 1995 to present, additional deaths and emergency cases caused by heat waves were reported, especially among vulnerable groups such as the elderly and children, in Chicago (United States), Victoria (Australia), and Beijing (China)^[1-3].

Some studies report that heat wave events will be more intense, more frequent, and longer in duration in the future^[4-5]. These heat wave events will be a challenge in the field of public health and cause a severe burden to society. The public have detected the increase in temperature, and this has implications for their willingness to respond to climate change^[6]. Thus, public health action for heat wave events is needed immediately. However, limited research has focused on how to manage the

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health effects for heat wave events and climate change^[7], a crucial step in achieving maximum effectiveness.

Highly efficient measures must be geared to the needs of public, so understanding the attitude of the public toward protective measures would contribute to the process of developing and implementing these measures. Moreover, there is also a requirement for the evidence-based economic assessment of protective measures to understand the current status of payment attitude. In China, however, protective measures (measures taken to protect people from the adverse effects of heat waves) have never been systematically applied, so there is no such experience to draw upon. Furthermore, few studies have shown whether and how the public support these measures. Additionally, worldwide, the price of protective measures for heat wave events are seldom reported, and information about these prices is critical for the future evaluation of the cost-benefit analysis of the measures conducted. These elements bring a significant amount of uncertainty to the providers of such measures. In 1963, Davis was the first to use the contingent valuation method (CVM) for detecting willingness to pay (WTP) among the public^[8]. CVM was later developed as a proper method for assessing the implications of the structure of demand for public goods^[9], making it appropriate for the present study. CVM obtains the preference and WTP directly from the individual. At the beginning of the questionnaire used in this study, respondents were given a what-if scenario about protective measures provided by the government or the market, allowing them to state their WTP under conditions similar to real circumstances in the future. CVM has been widely used in China and abroad and is considered as a well-developed method^[10-13]. Therefore, to gain the knowledge necessary to carry out the relevant steps more successfully, CVM is a useful method to employ to explore the provision of protective measures for heat waves.

Huang et al. argued that the early warning system, the increase of green spaces and trees, the awareness and education and the government-run cooling center can improve the public health adaptation to heat events in response to climate changes^[7]. United States and some European countries have already provided protective measures to the public according to their risk characteristics and demands, such as early warning systems^[14-16]. China, with its larger population and heavier population

density, faces similar challenges while also being confronted with an aging society. Without protective measures, China has and will continue to have more vulnerable people. Therefore, protective measures, such as developing early warning systems, improving municipal construction, enhancing the publicity and building emergency shelters of heat wave, need to be provided immediately in China. The present study used CVM to assess the prices of protective measures for heat waves for the first time in China. To conform to the trend of marketization, in addition to the government as the traditional provider of public services, the market was brought into the study as a future provider. The study aimed to assess the public's WTP for heat wave protective measures and to explore the factors that influence the WTP decision. The WTP results of this study reflect the public's level of concern and are very important for improving the efficiency of investments by the government or the market in heat wave protective measures. Further, the influential factors found in this study can be used to increase the public's WTP through changing the influence of factors in the future and to increase the benefit-cost over the long run.

METHODS

The study applied CVM to learn the WTP of public for heat wave protective measures. A cross-sectional household face to face survey was completed from July 29th to August 9th 2013. Every respondent have provide informed, written consent before the interview. The questionnaires were filled by the interviewers according to the answer of the respondents.

Questionnaire

The questionnaire consisted of two main groups of questions: i) WTP of the respondents for the protective measures of heat wave adverse effects on health, which contented the core questions, using CVM, and were asked residents directly to get their willingness to pay; ii) individual social-economics factors, such as district, gender, age, education, household income, and other vulnerable factors, such as having air conditioner, heat wave experience, chronic non-communicable disease (NCD) or not. It takes respondents about 10 min to finish the questionnaire.

After looking for the protective measures reported in the literatures in China or abroad^[7,14-15, 17-18], and

considering the situation of China, the protective measures were decided as follows: the protective measures were decided as follows: (1) developing early warning systems (releasing heat wave predictions, providing fine-detailed information on health risk forecasting and guidelines to avoid heat); (2) improving municipal construction (increasing public lawn and trees, street sprinklers as well as artificial rainmaking to lower ambient temperature); (3) enhancing the publicity (inviting specialists to expand health education and daily protection on heat wave, providing health consulting in communities); (4) building emergency shelters of heat wave (constructing a number of emergency shelters with cooling equipments, food, drinking water and first aid team). The WTP was divided into two parts in accordance with the measures provided by the government or the market. Before asking for the WTP of protective measures for the government, the respondents were provided with a description about the definition of the heat wave event, the adverse effects of heat wave. Also, the assumptive scenario as ‘the government want to carry out the following protective measures to reduce the health adverse effects of heat wave events. Because of the funding limit of the government, the financial support of the individual was needed. Assuming the fixed amount of money would be collected by relevant departments annually, which would be used as the society funding to provide the following protective measures, and the expenditure of the society funding would be publicized regularly. You will...’. Similarly, before asking for the WTP of protective measures of the market, the respondents were provided with a description ‘the market would provide the protective measures which could effectively reduce the health adverse effects caused by heat events. Are you willing to pay money annually to buy the following protective measures?’. Then, the WTP for the protective measures provided by the government or the market was asked in accordance with the payment card (Table 1). If their payment amount was not covered, the interviewees were requested to fill the exact amount on the questionnaire.

Study Population

Because the social economic conditions, temperature and other meteorological conditions in the urban area are different from rural area, in Beijing, the survey used multi-stage stratified sampling method in Xicheng district in downtown

and Shunyi district in suburban of Beijing (Figure 1). After the calculation of sample size, and considered the refusal rate (10%), the sample included 640 individuals in Xicheng district and 600 individuals in Shunyi district. First, the Probability Proportionate to Size Sampling (PPS) method was used to choose 20 communities or villages respectively from Xicheng district or Shunyi district. Secondly, 32 families and 30 families were chosen randomly from each chosen community in Xicheng district and Shunyi district, respectively. Thirdly, after collect the gender and age information of the family members, a Kish^[19-20] method for the selection within the household was used to avoid the age or gender bias of the sample. The respondents were permanent residents who had lived in Xicheng district or Shunyi district for 2 or more years, and their ages were between 15 to 79 years old. The respondents must do not have serious

Table 1. Payment Card

The Amount of Money (CNY)				
10	20	30	40	50
60	70	80	90	100
150	200	250	300	350
400	450	500	550	600
650	700	750	800	850
900	950	1000	1500	2000
2500	Other amount			

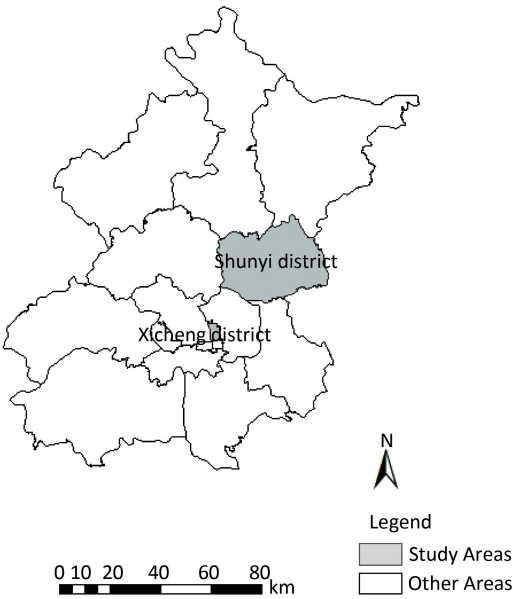


Figure 1. Study areas in Beijing.

detectable organ dysfunction or mental disorders, and voluntarily accepted the questionnaire survey.

Statistical Analysis

After data cleaning, recoding and explorative descriptive analyses, the payment rates of the protective measures were calculated for all of the respondents and the respondents who were willing to pay for one or more protective measures were sighted as 1. The payment amount was collected from the respondents who were willing to pay, and equals the sum of money which was willing to pay for each of the four protective measures. The 1.5% cut-off point for payment amount was applied, before the payment amount was analyzed, to avoid unrealistically high amount for WTP^[21]. Because the distribution of payment amount does not apply with the normal distribution, the median and mode were used to describe it.

In order to uncover what are the factors influencing people to pay the money more than median amount, the payment amount was converted into 2 groups as the ‘higher group’ and ‘lower group’, and the divided point was the median of payment amount (40 CNY). The binary logistic regression model was used to identify the factors that influenced the

payment rate and the groups of payment amount for the protective measures. The details of the dependent and independent variables were shown in Table 2. Each categorical explanatory variable was transformed into a dummy variable for the regression analysis. The backward method was used. The entry criteria of the dependent variables on the modeling process was 0.05 and the removal criteria was 0.10, anchored on the likelihood ratio test backward. The partial regression coefficient (β values), probabilities (p), and the odds ratio (O.R.) is calculated. When the O.R. equals 1, it indicates that the payment rate or the payment amount was not influenced. When O.R. is greater than 1, it indicates that the chance or the amount of the respondents to pay is higher, vice-versa.

RESULTS

Sample Profile

The survey was completed by 1228 individuals (637 from an Xicheng districtnd 591 from a rural district). After data cleaning, there were 1210 valid questionnaires: 629 from Xicheng district and 581 from Shunyi district. Respondents’ ages ranged from

Table 2. Dependent Variables and Independent Variables Analyzed

Items	Description
Dependent Variables	
Payment rate	0=‘unwilling to pay’, 1=‘willing to pay’
Groups of WTP amount for all protective measures	0=‘¥40 or less’, 1=‘¥41 or more’
Groups of WTP amount for early warning system	0=‘¥40 or less’, 1=‘¥41 or more’
Groups of WTP amount for improving municipal construction	0=‘¥40 or less’, 1=‘¥41 or more’
Groups of WTP amount for enhancing the publicity	0=‘¥40 or less’, 1=‘¥41 or more’
Groups of WTP amount for building emergency shelters of heat wave	0=‘¥40 or less’, 1=‘¥41 or more’
Independent Variables	
District	0=‘Rural’, 1=‘Urban’
Gender	0=‘Male’, 1=‘Female’
Age group	0=‘15-24’, 1=‘25-44’, 2=‘45-64’, 3=‘65-79’
Years of education	0=‘6 or less’, 1=‘7 to 9’, 2=‘10 to 12’, 3=‘13 to 16’, 4=‘17 to 19’, 5=‘20 or more’
Household net income per month per capita	0=‘¥700 or less’, 1=‘¥701 to ¥1400’, 2=‘¥1401 to ¥5000’, 3=‘¥5001 to ¥10,000’, 4=‘¥10,001 or more’
Have air conditioner	0=‘No’, 1=‘Yes’
Have heat wave experience	0=‘No’, 1=‘Yes’
Have chronic non-communicable disease (NCD)	0=‘No’, 1=‘Yes’

15 to 79 years, with an average of 48 years and a standard deviation of 16 years. Most of the respondents were female (52.3%), and 88.5% had at least 10 years of education. The majority of the respondents (82.3%) had an air conditioner, and 57.6% said that they had experienced a heat wave. The non-communicable disease (NCD) morbidity rate was 26.0% among the respondents. Table 3 shows the results for the payment rate of the respondents. The payment rate was 41.1% on protective measures from the government and 39.5% on those from the market.

After omitting the highest 1.5% of payment amounts, the results were recalculated for those who were willing to pay for protective measures. Table 4 shows the central tendency by presenting medians and modes and the dispersion by presenting minimums and maximums. The median payment amounts were 40 CNY annually whether all

of the protective measures were provided by the government or by the market. The modes also indicate that most of the respondents were willing to pay 40 CNY annually for the protective measures.

Logistic Regression Results

Payment Rate Table 5 shows the results of the binary logistic regression analysis with payment rate as the dependent variable. When protective measures were provided by the government, respondents whose income ranged from 1401 to 5000 CNY showed 2.39 times more WTP compared with those whose income was 700 CNY or less. Those who had an air conditioner showed 1.40 times more WTP, compared with those who did not have one. The odds ratio (OR) for living in Xicheng district was 0.38, indicating that the chance of paying for the government provision of protective measures was

Table 3. Payment Rate on the Protective Measures by Socio-demographic Characteristics

Related Factors		Payment Rate		
		Case	Government %	Market %
Total		1210	41.1	39.5
District	Urban	629	31.3	32.1
	Rural	581	51.6	47.5
Gender	Male	577	40.4	37.4
	Female	633	41.7	41.4
Age group (y)	15-24	90	34.4	32.2
	25-44	420	41.0	42.1
	45-64	492	41.3	40.4
	65-79	208	43.8	35.1
Years of education	6 or less	26	57.7	38.5
	7-9	113	40.7	35.4
	10-12	329	47.1	42.6
	13-16	345	42.9	42.9
	17-19	373	34.0	35.1
	20 or more	24	25.0	37.5
Household net income per month per capita	¥700 or less	69	31.9	26.1
	¥701-¥1400	147	40.8	38.8
	¥1401-¥5000	727	46.8	43.1
	¥5001-¥10,000	226	28.8	34.5
	¥10,001 or more	41	24.4	29.3
Have air conditioner	Yes	996	41.8	40.5
	No	214	37.9	35.0
Have heat wave experience	Yes	697	38.6	35.9
	No	513	44.4	44.4
Have chronic non-communicable disease (NCD)	Yes	315	44.1	38.7
	No	895	40.0	39.8

Table 4. Payment Amounts for Protective Measures by Socio-demographic Characteristics

Related Factors		Government (CNY/year)					Market (CNY/year)				
		Case ^a	Minimum	Median	Maximum	Mode	Case ^a	Minimum	Median	Maximum	Mode
Total		423	1	40	200	40	406	2	40	200	40
District	Urban	158	8	40	170	40	171	2	40	200	40
	Rural	265	1	40	200	40	235	5	40	200	40
Gender	Male	192	1	40	200	40	177	3	40	200	40
	Female	231	5	40	200	40	229	2	40	200	40
Age group (y)	15-24	27	10	40	200	40	26	5	40	160	40
	25-44	152	5	40	200	40	152	10	40	200	40
	45-64	167	1	40	200	40	164	2	40	200	40
	65-79	77	10	40	200	40	64	10	40	200	10
Years of Education	6 or less	14	10	55	120	10 ^b	10	5	30	120	10 ^b
	7-9	38	10	40	200	40	36	10	40	200	40
	10-12	136	1	40	200	40	117	2	40	200	40
	13-16	125	5	40	200	40	125	3	40	200	40
	17-19	105	5	40	200	40	110	3	40	200	20
Household net income per month per capita	20 or more	5	20	40	100	20 ^b	8	20	35	100	20
	¥700 or less	19	10	40	200	40	16	10	40	120	40
	¥701-¥1400	53	10	40	200	40	53	10	40	200	40
	¥1401-¥5000	300	1	40	200	40	276	2	40	200	40
	¥5001-¥10,000	45	5	80	200	40	54	3	40	200	20
	¥10,001 or more	6	40	75	200	50 ^b	7	20	50	150	20 ^b
Have air conditioner	Yes	349	5	40	200	40	338	2	40	200	40
	No	74	1	40	200	40	68	3	40	200	40
Have heat wave experience	Yes	223	1	40	200	40	209	2	40	200	40
	No	200	5	40	200	40	197	3	40	200	40
Have chronic non-communicable disease (NCD)	Yes	109	8	40	200	40	95	2	40	200	40
	No	314	1	40	200	40	311	5	40	200	40

Note. ^a, the 1.5% of the highest WTP amount was cut-off; ^b, Multiple modes exist. The smallest value is shown.

lower for respondents living downtown than for those living in the rural district. When the protective measures were provided by the market, women showed 1.25 times more WTP, compared with men. Similarly, respondents whose income ranged from 1401 to 5000 CNY and from 5001 to 10,000 CNY showed 2.62 times and 2.24 times more WTP, respectively, compared with those whose income was 700 CNY or less. Those who had an air conditioner had 1.42 times higher WTP compared with those who did not have one. The ORs for living in Xicheng district and for those who mentioned

having experienced a heat wave were 0.45 and 0.71, respectively, indicating that the odds of respondents living downtown or having heat wave experience paying for protective measures provided by the market were lower than the same odds for respondents living in the rural district.

Payment Amount Table 6 shows the results for the binary logistic regression analysis with groups of payment amounts as the dependent variable. When the protective measures were provided by the government, respondents whose income ranged from 5001 to 10,000 CNY and those with an income

Table 5. Binary Logistic Regression Model Predicting Willingness to Pay for Protective Measures for Heat Wave^a

Factors	Government ^c			Market ^c		
	OR	β	P	OR	β	P
District urban (1)	0.38	-0.96	0.00 ^b	0.45	-0.81	0.00 ^b
Gender female (1)	-	-	-	1.25	0.22	0.07 ^b
Household net income per month per capita						
¥700 or less (baseline)						
¥701-¥1400 (1)	1.43	0.36	0.26	1.71	0.54	0.10
¥1401-¥5000 (2)	2.39	0.87	0.00 ^b	2.62	0.96	0.00 ^b
¥5001-¥10,000 (3)	1.36	0.31	0.34	2.24	0.81	0.02 ^b
¥10,001 or more (4)	0.91	-0.10	0.84	1.63	0.49	0.29
Have air conditioner - yes	1.40	0.34	0.05 ^b	1.42	0.35	0.05 ^b
Have heat wave experience - yes	-	-	-	0.71	-0.34	0.01 ^b
Constant		-0.79	0.00		-1.04	0.00

Note. ^a, Odd ratios, partial regression coefficients, and probabilities associated with payment rate for the protective measures for heat wave provided by the government or the market. The independent variables that were not statistically significant in the models for any of the dependent variables are not shown. ^b, $P<0.10$, statistically significant. ^c, The factor which was removed from the regression model shows as the symbol as ‘-’.

Table 6. Binary Logistic Regression Model Predicting Willingness to Pay Amount for Protective Measures for Heat Wave^a

Factors	Government ^c			Market ^c		
	OR	β	P	OR	β	P
Household net income per month per capita						
¥700 or less (baseline)						
¥701-¥1400 (1)	0.76	-0.27	0.63	-	-	-
¥1401-¥5000 (2)	1.16	0.15	0.77	-	-	-
¥5001-¥10,000 (3)	2.68	0.99	0.09 ^b	-	-	-
¥10,001 or more (4)	8.84	2.18	0.07 ^b	-	-	-
Have heat wave experience - yes	1.73	0.55	0.01 ^b	1.79	0.58	0.01 ^b
Have chronic non-communicable disease (NCD) - yes	1.55	0.44	0.06 ^b	-	-	-
Constant		-0.97	0.05		-0.90	0.00

Note. ^a, Odd ratios, partial regression coefficients, and probabilities associated with payment amount for the protective measures of heat wave provided by the government or the market. The independent variables that were not statistically significant in the models for any of the dependent variables are not shown. ^b, $P<0.10$, statistically significant. ^c, The factor which was removed from the regression model shows as the symbol as ‘-’.

of at least 10,001 showed 2.68 times and 8.84 times more WTP for the higher amount, respectively, compared with those whose income was 700 CNY or less. Those who had experienced a heat wave showed 1.73 times more willingness compared with those who did not have such experience, and those who had an NCD showed 1.55 times more willingness compared with who did not have an NCD. When the protective measures were provided by the market, the only significant factor was whether the respondent had experienced a heat wave (OR=1.79).

DISCUSSION

For the first time, this survey measured the value of heat wave protective measures in the form of currency and introduced the government and the market as two possible providers of these measures. To accomplish this, vivid assumptive scenarios were described to the respondents. Not only did the respondents conduct the valuation process for each provider, but there was also a comparison between the two providers. To find out how to increase the payment rate and the payment amount, besides exploring the factors influencing the payment rate, the factors influencing the payment amount were analyzed for the first time, and an interesting psychological phenomenon was found. Importantly, groups likely to be vulnerable in the coming heat wave events were identified. This study also offers for further exploration crucial data that can introduce the market mechanism into the realm of public services that are traditionally provided by the government.

Main Findings

More than one-third of the respondents were willing to pay for protective measures, and most of them were willing to offer 40 CNY annually for these measures. This indicates that heat waves cause adverse health effects to the respondents, so there is demand for protective measures among the public. Thus, the government should consider providing these measures immediately. According to the Almanac of China's Population 2013, for urban residents in Beijing, 40 CNY was 0.11% of the average disposable income and 0.32% of the average account balance annually; for rural residents in Beijing, 40 CNY was 0.24% of the average disposable income and 0.87% of the average account balance annually^[22]. The money the public is willing to pay is a very small part of their disposable income and

even a small part of their average balance, so the payment amount can be considered as reasonable. However, the figures indicate that people would only spare a small amount of money on the measures of managing the health effects of heat wave, which leads to the implication that while people recognized the adverse effects of the heat wave, they have not yet understand the severity totally. Government and related organizations should focus more on such phenomenon and boost residents' awareness in the future.

According to the logistic regression results for payment rate, factors such as district of residence, household net income, and having air conditioner had a similar influence whether services were provided by the government or the market. This may be possibly because that all the three factors indicate the similar family social-economic status. Respondents living in Xicheng district had a lower probability of being willing to pay, in contrast to the hypothesis that respondents in the district with higher temperatures would be more willing to pay^[6]. Respondents who had an air conditioner were more willing to pay, which also opposed the hypothesis that respondents who did not have an air conditioner would suffer more from high temperatures and would be more willing to pay. This result is inconsistent with a previous finding that people who have fans are more likely have a high risk perception regarding heat waves^[23]. In the field of psychology, this phenomenon has been called 'psychological typhoon eye' (a phenomenon that the closer to the center of the devastated area, the lower the level of concern felt by residents about safety and health)^[24-25], with the higher risk and lower WTP indicating that people living in urban areas and those with no air conditioner are more vulnerable in heat wave events. Respondents at the middle levels of net income were more willing to pay than those who had the lowest or highest net income. The reason for this might be that people with the lowest incomes do not have the ability to pay for protective measures, and people with the highest incomes do not recognize that it is necessary for them to pay, in the context of their better maintained living facilities and medical advantages. Similar to the claim made by Hajat et al.^[20], because the poorest populations have the least economic capacity to adapt to the heat wave event and less motivation to participate in protective measures, they might have the largest heat wave burden.

In addition to the factors mentioned above,

gender and heat wave experience also influenced the payment rate when protective measures were provided by the market. Several studies have shown that, given the similar scenarios, women are more sensitive to the risks than men^[26-27]. Therefore, women were more willing to pay for protective measures provided by the market, indicating that women might believe that the heat wave can bring more harm to them or their families. In addition, this finding suggests that women are more receptive to marketization than men. Respondents who had experienced a heat wave were less willing to pay for protective measures. This might be that because of the psychological immunization effect^[28]; people who have survived heat wave events no longer consider them as serious threats. However, when the next heat wave comes, the health status of these people might be worse and the heat wave event might be more severe^[5], making this group vulnerable if protective measures are provided by the market. Additionally, the differences in influencing factors between the two kinds of providers suggest that information about the provider is very important in the CVM. Thus, the information on which the provider will be needs to be provided as a critical part of the assumptive scenario.

The factors that influenced payment rate did not necessarily influence payment amount. Additionally, the direction of influence could be opposite. This might be because the payment rate reflects the public recognition of whether protective measures are necessary, whereas the payment amount assesses how much benefit the public expects from the protective measures^[29]. The binary logistic regression results in the present study showed that, instead of the highest income group, the medial income groups were the most willing to pay for protective measures. However, respondents in the highest income group who were willing to pay were more inclined to pay the higher payment amount. A similar phenomenon was also found for the factor of having heat wave experience. On the one hand, helping to raise public awareness of the severity of heat wave events to achieve higher payment rates may be a way of increasing the payment amount of those with higher incomes. On the other hand, after persuading people of the necessity of protective measures, the benefits of such measures will increase considerably.

Methodological Considerations

The valid questionnaires accounted for 97.6% of

the sample size, and the refusal rate was lower than the 10% maximum established in the calculation of the sample size. This indicates that the sample was sufficient. Based on the years of education, most of the respondents had the ability to understand the questionnaire. This, combined with the use of random sampling, indicates that the results of this survey can be trusted.

Although the WTP method has been well developed, there are some disadvantages. Ma et al.^[30] have argued that respondents in developing countries may have difficulty understanding the method and meaning of WTP and that this may influence survey results. To make up for this disadvantage, the present study used a household face-to-face survey, and, because the interviewers played a particularly important role in the respondents understanding the questionnaire, strict interviewer training and examinations were carried out to ensure that the interviewers correctly described the scenarios and the purpose of the WTP surveys. Because the survey aimed to understand the respondents' payment rate and the payment amount for protective measures provided by the government or the market, as well as the factors influencing the payment rate and the payment amount, respondents were asked to answer many questions on multiple dimensions. Therefore, based on a comprehensive consideration of feasibility and accuracy, the improved CVM payment card was used to decrease the difficulty of this survey. This differs from the traditional payment card method^[31]. Respondents who were willing to pay selected the highest amount that they could offer, directly on the payment card. If the highest payment amount was not shown on the payment card, the interviewer was instructed to fill in the exact number on the questionnaire, so the respondents did not need to be given the possibilities for each given the amount of WTP. Some studies have found that asking respondents to choose the payment amount directly may be limited by the psychological impact of 'carefulness' and the frugality of the respondents^[32], so the results of the payment amount in this survey may be lower than results from the traditional payment card method, therefore underestimating the payment amount. However, the improved payment card has many advantages that allow the respondents to understand the survey quickly (e.g., the simpler survey method) and increase the cooperation of the respondents (e.g., the shorter

survey time) compared with the traditional payment card method. Therefore, the quality of the completed questionnaire is higher. Additionally, because of the shorter interview time, this method is more suitable for large sample and multi-site surveys similar to this study.

Indeed, there are certain fields not discussed in this research. Interviewees only from two districts in Beijing were selected, the socio-economic status of where may be different from other places in China. Thus, such results may not be totally applicable to all other areas nationwide. Moreover, researches focusing on various representative regions in China of multiple socio-economic as well as weather characteristics will be demanded.

Several suggestions for the government and the market can be made based on the results of this study. First, protective measures for heat waves need to be provided immediately. Second, in the future, more attention should be paid to the situation of vulnerable groups: people who live in urban areas, those without air conditioning, and those who have experienced a heat wave in the past. Third, in addition to the government as the traditional provider of public health services, the market is also an acceptable provider; however, when the market is the provider, men might be another group of vulnerable people. Finally, persuading people of the benefits of protective measures is a crucial part of carrying out these measures, because this step will influence the benefits of the protective measures significantly in the future.

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