Impact of COVID-19 on Residents' Willingness to Consume Wild Animals: Empirical Insights From China

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Research

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Impact of COVID-19 on residents' willingness to consume wild animals: empirical insights from China

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Abstract

Background: It is argued that wild animals are the culprit of transmission of COVID-19 and poor health of the people, though any evidence is not found, the government has widely publicized the risk allied with eating wild animals. Therefore, this study attempts to explore the effect of COVID-19 on residents' willingness to consume wild animals (WCWA) and their amount of willingness to pay (AWP).

Methods: Data were gathered online from 1250 household heads of both urban and rural residents of Hubei, Hunan, and Guangdong provinces during the period of 19th to 26th March 2020 and Probit and Tobit model is employed to meet the study objectives.

Results: The results showed that around 39.20% of residents are willing to consume wild animals and their amount of willingness to pay was 34.65 USD/year. In the context of market control policy & home restriction policy, the mediating effect is 34.20% & 27.73% respectively. In contrast, in the context of ecological environment risk and food security risk perception, the mediating effects are 7.94% and 10.16% respectively.

Conclusions: Although COVID-19 reduced the probability of residents' WCWA, the effect on AWP was not significant. Moreover, COVID-19's effects on residents' WCWA through market control and home restriction policies were strong, but perceptions of the ecological environment and food safety risk were relatively weak. These results provide insights for policymakers in terms of raising public awareness of the negative consequences of consuming wild animals and increasing knowledge of the animals' protection.

Keywords: COVID-19; Willingness to consume wild animals; Amount of willingness to pay; health: China

1. Introduction

The COVID-19 pandemic is ravishing local, national, and global economies. It has negatively affected the whole economy, and some have even suggested that human civilization has not faced such catastrophe since World War II. The number of diagnosed cases around world have exceeded to 47,059,867, including 1207,327 deaths as reported by the World Health Organization by the 4th November 2020 [1]. In addition to the direct health impacts, the pandemic is having widespread adverse effects on employment, poverty, education, and the overall functioning of food systems [2,3]. Even COVID-19 is destabilizing supply chains at all levels, and creating instability in food prices and supply [4–6]. The outburst of a pandemic is a symptom of a broken relationship between humans and the natural world [7–9]. People encroach in natural ecosystems, results in the increased contact of humans and wildlife and ultimately results in exposure to new animal pathogens [10–12]. World Health Organization suggested that the frequent interaction between humans and wild animals are the main causes for the transmission of contagious diseases [13,14]. World Food Program [15] found that two widespread risks are linked to the emergence of infectious diseases, i.e. large-scale conversion of land into agriculture to feed the growing population and the trade of high-risk live wild animals. Reducing the frequency of unsafe contact between humans and wild animals is an effective measure to lessen the spread of contagious diseases [16,17]. In this regard, the governments need to halt the high-risk wildlife trade and increase monitoring and enforcement system to combat illicit wildlife trade.

In this study, we have emphasized on China as COVID- 19 emerged and spread from Wuhan, China. Moreover, wild animals have remained an essential source of food and income throughout the history of China. In China, urban demand for wild meat as a culinary delicacy is up surged which the triggered the sale and consumption of wild animals and eventually outburst the diseases. Moreover, the development of China's consumer economy also substantially increased the demand of wild animal products for medicinal purposes [18–20]. It is worth considering, that if the WCWA is not abated, then wild animal trading is likely to shift to the illegal market. The illicit trade of wild animals and unsafe handling practices increase human exposure to animal pathogens and lead to the movement of host species and animal pathogens across geographies. Every year, hundreds of thousands of wild animals are traded across international borders for commercial purposes. Also, the low safety standards associated with the unregulated sale and consumption of wild animal in markets presents further opportunity for human contact with wild species. As a consequence, the risk of infectious disease may further be aggravated.

Currently, in the era of COVID-19, the market conditions and psychological perceptions of people towards the consumption of wild animal is significantly altered. The supply of wild animals has banned in the market primarily due to COVID- 19, which in turn influenced the consumers' willingness to consume wild animals [21]. The home restriction policy further brought about by COVID-19 caused residents to only consume the species offered by the government. Under this situation, residents' WCWA and AWP is gradually reduced as risk perception has a significant negative effect on willingness to pay [22]. Although there is no

conclusive evidence found that wild animals are the culprit of transmission of COVID-19, the government has widely publicized the hazards of eating wild animals. As a result, residents' perceptions of risk associated with wild animals continued to increase, and their WCWA declined. Lastly, wild animals have obvious environmental externalities, and prohibiting their consumption can have apparent positive external effects [23]. COVID-19 has prompted residents to take into consideration the relationship between humans and wild animals in conserving natural ecosystems. Residents' increased environmental perceptions also inhibited their willingness to pay for wild animal consumption. Therefore, the present study aimed to explore the effect of COVID-19 on residents' WCWA and AWP in China. It is further hypothesized that the utility of wild animal products may be affected by market control and home restriction policies, as well as by residents' perceptions regarding food safety and ecological risk under COVID-19, which ultimately affect their WCWA. Therefore we proposed the following hypotheses:

H_0: COVID-19 significantly reduces residents' WCWA and AWP

H_1: The effect of COVID-19 is exerted through market control policy.

H_2: The effect of COVID-19 is exerted through the home restriction policy.

H_3: The effect of COVID-19 is exerted through food safety risk perception.

H_4: The effect of COVID-19 is exerted ecological environment risk perception.

2. Material and Methods

2.1 Study sites and research participants

Data were randomly collected online from household heads of both urban and rural residents of Hubei, Hunan, and Guangdong provinces during the period 19th to 26th March 2020 as these provinces are more involved in trading of wild animals. Furthermore, the Chinese government has divided COVID-19 areas into low-risk, medium-risk, and high-risk areas. The high-risk areas only comprised of 25 households, which are not truly representative; so only low- and medium-risk areas were retained. A total of 1250 respondents, i.e. 425 from Hubei, 399 from Hunan, and 426 from Guangdong households, accounting for 34.00%, 31.92%, and 34.08%, respectively, were chosen.

2.2 Variable Selection

Dependent Variable

Consumption willingness is an indicator that reveals the consumption of residents under unconstrained conditions. Due to large differences in residents' consumption behaviors, individuals inclined to consume wild animals are only selected. In our study, WCWA and AWP are the dependent variables, and WCWA is a discrete binary variable i.e. if anyone is willing to consume, the value is 1; if anyone is not willing, it is assigned 0 values. On the contrary, APW is a continuous variable for which respondents are asked "Are you willing to consume wild animal

meat?" and "How much are you willing to pay each year?"

Independent Variable

The independent variable is COVID-19, which is characterized by the severity of COVID-19 in different areas (low-risk and medium-risk regions). There are differences between low- and medium-risk areas as it is likely that the government implemented more stringent policies in medium risk areas which affected residents' perceptions of the ecological environment and food safety risk. Therefore, this study further attempts to explore the mediating effects of market control, home restriction policies, and residents' perceptions of the ecological environment and food safety risk between COVID-19 and WCWA and AWP.

Control Variable

The control variables included gender, age, education level, family income, consumption time, face perception, nutritional awareness, and urban or rural area. Compared to male household heads, female household heads act as the major players in making decisions about household food consumption [24]. The older the head of the household, the more inclined to the local food patterns [25]. Similarly, households having low educational level have weaker perceptions of the ecological environment and food safety risk [26]. Household income is also an essential factor in food consumption expenditure [27]. Consumption time is an essential indicator of food culture [28]. Residents' dietary consumption choices are closely related to face perception [29]. Compared to rural residents, urban residents' food consumption structure is more reasonable [30]. Regions such as Hubei and Guangdong were taken as dummy variables and Hunan was taken as a control group.

2.3 Statistical Analysis

In this study, we have employed Probit model to analyze the effect of COVID-19 on residents' WCWA. The model was set as follows:

$$\Pr ob(decision = 1 | COVID-19, X) = \varphi(\alpha + COVID-19\beta + X\theta + \varepsilon) \quad (1)$$

Where $decision$ $decision$ indicates WCWA; $decision = 1$ means residents are willing to consume wild animals and $decision$=0 means they are not. COVID-19 is the core independent variable. X represents the control variables, β and θ indicate the coefficient estimation vector of the regression model and ε represents the error term. $\varphi(\cdot)$ is the probability function of the normal distribution.

Based on the analysis of WCWA, it is necessary to analyze residents' AWP as AWP can better reflect the propensity to consume wild animals. Moreover, the notion of AWP may provide basis for the government to implement strict penalties in the future. If the imposed amount on consuming wild animals is lower than that of AWP, then residents may take the risk of consuming wild animals illegally. Therefore, this study further explores the effect of COVID-19 on residents' AWP. Considering that AWP has a value of 0, it belongs to limited continuous merged data. So, this study further adopts a Tobit model to explore the effect of COVID-19 on AWP. The model is formulated as follows:

$$\begin{cases} \deg ree^* = \alpha + COVID-19\gamma + X\rho + \varepsilon \\ \deg ree = \max(0, \deg ree^*) \end{cases} \quad (2)$$

Where $\deg ree^*$ represents the AWP, and γ ρ are the coefficient and the other variables are the same as in equation (1).

The study additionally explores the mediating effect of market control and home restriction policies, ecological environment, and food safety risk perception by following the approach suggested by Wen et al. [31] and the hierarchical regression method was used to establish the relationships among variables. The model is structured as follows:

$$\begin{aligned} Y &= cX + e_1 \\ M &= aX + e_2 \\ Y &= c'X + bM + e_3 \end{aligned} \quad (3)$$

Where X represents the independent variable, M represents the mediating variables and Y represents the dependent variable.

3. Results

Residents' WCWA and AWP are likely correlated, which may lead to biased results. Therefore, Heckman test was used to address this issue. The results showed that the independence test result (*rho=0*) supported the null hypothesis of two-way independence. Therefore, the Probit and Tobit models were appropriate to analyzing the effects of COVID-19 on residents' WCWA and AWP, respectively. Table 1 show that comparatively Model 1, the LR χ^2 value of Model 2 is significant, with 34.42 at the 1% significance level. Compared to Model 3, the LR χ^2 value of Model 4 is also significant, with 46.25 at the statistical level of 1%. The likelihood estimation parameter shows that the model is a better fit with the addition of control variables and regional dummy variables.

Moreover compared to Model 1, the marginal effect of COVID-19 is significantly lesser in Model 2, indicating that in addition to COVID-19, residents' WCWA is also affected by other factors. However, compared to Model 3, the marginal effect of COVID-19 in Model 4 remains unchanged. In particular, COVID-19 reduces the probability of residents' WCWA by 31.22%, but the effect on AWP is not significant. Thus, hypothesis H_0 is partially confirmed. The average residents' AWP was found to be 34.65 USD, which is much lower than the consumption amount of 3048 USD of urban and rural residents in China in 2019. Thus, wild animal consumption has not yet constituted a significant part of household expenditure. Therefore, COVID-19 didn't influence residents' AWP.

The findings in Table 1 further show that the WCWA of male household heads was higher than that of the female by 3.92%. Moreover, with a one-year increase in education, WCWA and AWP decrease by 9.14% and 2.9403 USD. If wild animal consumption time increases by one year, the probability of WCWA increases by 11.01%. Thus, the longer the consumption time, the more fixed the consumption concepts and habits, and wild animal consumption thereby becomes an

essential part of the diet structure. The WCWA and AWP of residents with sharp face perceptions increase by 8.16% and 4.8125 USD, respectively. Another reason for consuming wild animals is the perception that wild animal meat is free of pollution or chemicals and has higher nutritional value. So, if nutrition awareness is increased by 1 unit, then the WCWA and AWP increase by 12.39% and 1.7362 USD, respectively. Interestingly, although rural residents are more likely to catch wild animals, urban residents' WCWA and AWP are increased by 5.93% and 3.6922 USD, respectively, and their ability to pay is much higher than that of rural residents. Compared to other regions, the WCWA and AWP of Hubei residents are found significantly lower than the other two areas.

Table 1: Estimated effects of COVID-19 on residents' WCWA and AWP

Explanatory variables	WCWA		AWP	
	Model 1	Model 2	Model 3	Model 4
COVID-19	-0.3725***	-0.3122***	-19.2801	-16.2271
	(0.1160)	(0.1006)	(12.6002)	(10.9646)
Gender		0.0392**		9.8006
		(0.0187)		(4.0804)
Age		0.0649		8.2124
		(0.0482)		(9.0160)
Education level		-0.0914**		-2.9403***
		(0.0410)		(0.6723)
Family income		0.0685		3.2082***
		(0.0720)		(1.0411)
Consumption time		0.1101***		1.2625
		(0.0305)		(0.8024)
Face perception		0.0816*		4.8125**
		(0.0419)		(1.9011)
Nutritional awareness		0.1239*		1.7362**
		(0.0667)		(0.7809)
Urban or rural area		0.0593**		3.6922***
		(0.0268)		(1.2012)
Are you located in Hubei?		-0.0328***		-0.8285***
		(0.0080)		(0.2428)
Are you located in Guangdong?		0.0297		0.1867
		(0.0309)		(0.1501)
LR χ^2 value	31.67***	34.42***	42.12***	46.25***
Prob>F	0.0000	0.0000	0.0000	0.0000
Sample size	1250		1250	

Note: *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Moving forward to the mediating results, it is apparent in the context of market control policy, that the coefficient value of *b* is not significant. Still, the value of *a*, i.e. 0.3234, is substantial at 10% significance level, and according to the *Sobel* test, the mediating effect is 34.20%(0.0409/ 0.1196). In the context of home restriction policy, the regression coefficients of both *a* and *b* are significant, and *c'* is substantial, indicating the mediating effect of the home restriction policy is 27.73%(0.2021*0.1641/0.1196). Regarding perceptions of ecological environment risk, the coefficient *a* is not significant, but *b* is 0.1284, which is substantial at the significance level of 5%. Therefore the mediating effect of ecological environment risk perception is 7.94%(0.0095/ 0.1196). In terms of food safety risk perception, both *a* and *b* coefficients are significant, and *c'* is substantial. It indicates that the mediation effect of the home restriction policy is 10.16% (0.1234*0.0985/0.1196). Therefore, COVID-19 has effectively reduced residents' WCWA by raising perceptions of food safety risk. In summary, hypotheses H_1, H_2, H_3, and H_4 are all confirmed.

Table 2: Mediating effect results

Test steps	Coefficients	Std. error	P-value
Market control policy			
First step	c=0.1196***	0.0292	0.000
Second step	a=0.3234**	0.1399	0.021
Third step	b=0.0985	0.1101	0.221
	c'=0.1031***	0.0301	0.000
Sobel test	0.0316***	0.0101	0.000
Direct effect	0.0787**	0.0391	0.012
Indirect effect	0.0409***	0.0101	0.000
Total effect	0.1196***	0.0292	0.000
Home restriction policy			
First step	c=0.1196***	0.0292	0.000
Second step	a=0.2021*	0.1154	0.061
Third step	b=0.1641**	0.0774	0.023
	c'=0.0931**	0.0437	0.019
Ecological environment risk perception			
First step	c=0.1196***	0.0292	0.000
Second step	a=0.1705	0.1399	0.261
Third step	b=0.1284**	0.0558	0.023
	c'=0.0732***	0.0229	0.000
Sobel test	0.0292***	0.0932	0.000
Direct effect	0.1101***	0.0311	0.000
Indirect effect	0.0095*	0.0126	0.000
Total effect	0.1196***	0.0292	0.000
Food safety risk perception			

First step	c=0.1196***	0.0292	0.000
Second step	a=0.1234**	0.0536	0.021
Third step	b=0.0985**	0.0460	0.221
	c'=0.1031***	0.0302	0.000

Note: *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

4. Discussion

The protection of wild animals is essential for the harmonious coexistence of humans and nature [32]. But the long-term wild animal consumption by people may cause some viruses to mutate continually and results in infectious disease outbreak [33–35]. Many studies have proven that COVID-19 originated from wild animals. Therefore, examining COVID-19's effect on WCWA can provide guidelines for policymakers to prevent infectious diseases in the future. Moreover, the strict regulations imposed by the government also influence resident's willingness to consume wild animals [36,37]. The current study found that COVID-19 significantly reduced residents' WCWA. Specifically, the probability of WCWA in medium-risk areas was lower than in low-risk areas, which is generally consistent with the related declaration by the State Council of China [38]. The individual and demographic characteristics of the respondents further show that women in China are mainly responsible for purchasing meat products so more willing to consume new wild animals. And more educational level enables the individuals to apprehend the hazardous effects of consuming wild animal and thus results in lowering WCWA. In Chinese culture, face perception is an essential aspect of conduct in social relations. Face perception can influence individual behavior decisions and sometimes cause people to choose products they do not want. Moreover, in the case of regions, the effects are more pronounced in Hubei in consuming wild animals because COVID-19 first erupted in Hubei Province. But in the case of AWP, COVID-19 did not reduce residents' AWP. The reason could be that AWP is much lower than the daily household consumption expenditure of residents.

The mediating effects result further show that market control policies play a mediating role between COVID-19 and its effect on WCWA. The reason for the reduction of WCWA in medium-risk areas is because the government banned wild animal market and reduced the frequency of human–wild animal interaction. The mediating effect of the home restriction policy indicates that the system was strictly implemented in medium-risk areas, where wild animal consumption was sluggish, and the wild animal trading chain was cut off from the demand side. Perceptions of ecological environment risk had shown lesser effects and inferred that if residents' perceptions of environmental risk are lower, it may not influence the WCWA. Moreover, the mediating role of food safety risk perception indicates that residents are unaware of the fact that wild animals carry many pathogens and can lead to infectious diseases [39,40]. Furthermore, the mediating effects of market control and home restriction policies are more nuanced in the effects of COVID-19. The home restriction policy has emerged as an essential measure, which was also encouraged by the WHO [1] as it not only reduces the horizontal transmission of the virus amongst people but also cuts off vertical interaction of humans with wild animals. So, the home

restriction policy can efficiently lessen the possibility of residents' consumption of wild animals and gradually improve the dietary culture. It suggests that wild animals are an essential part of the ecosystem [41], and looking back at SARS in 2003, it can be concluded that the overexploitation of wild animals by humans adversely affect the economy.

5. Conclusions

The present study explored the effect of COVID-19 on Chinese residents' willingness to consume wild animals (WCWA) and amount of willingness to pay (AWP). And it is found that COVID-19 significantly reduced residents WCWA and AWP. Moreover, COVID-19 mainly had an inhibitory effect on residents' WCWA through market control and home restriction policies. By contrast, the effect of perceptions of the ecological environment and food safety risk perception is relatively weak. We can infer that loosening market control and lifting the home restriction policy can increase the risk of wild animal consumption. The study also confirmed that in response to COVID-19, government control measures are effective but have short-term effects. Moreover, guiding residents to abandon the consumption of wild animals and improve their dietary structure are important aspects of the government's future efforts to curb COVID-19. The results indicate that strengthening the government management system is vital and the government should build wild animal protection system through laws and regulations and inform residents about the consequences of consuming wild animals through mass media and training. Moreover, the government should strictly prohibit the illegal marketing of wild animal products, punish violators, and create a suitable environment for curbing wild animal consumption in the whole society.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

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Authors' contribution

Conceptualization, methodology, original draft =Ruishi si

Data sources & review, revise and editing, funding = Noshaba Aziz, Qian Lu

Ethics declarations

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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