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Influence of Sociodemographic, Knowledge, and Behavior of DKI Jakarta People on Willingness to Pay for Disposable Mask Waste during the Covid-19 Pandemic

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ABSTRACT

The use of masks is recommended to reduce the risk of widespread spread of the COVID-19 virus, but because of its high quantities use in a short time, it impacts the high waste of disposable masks. The problem of high mask waste not accompanied by good management is that it can pollute the environment, and disposable masks are included in the type of hazardous medical waste, so they require special waste management. This study aims to analyze the relationship between the sociodemographic characteristics of the people of DKI Jakarta and the Willingness to Pay (WTP) for disposable mask waste management to determine the WTP price for disposable mask waste management. The survey was conducted in DKI Jakarta Province by distributing questionnaires and obtained a total sample of 356 respondents. Furthermore, the logistic regression analysis method was used to determine the variables of sociodemographic characteristics that affect individual WTP. The next analysis method is to calculate WTP using the Contingent Valuation Method (CVM) and the question model with the Double Bounded Dichotomous Method. Based on the results, it is known that the dependent variables that can increase the WTP value are income (Δ+ 23.6%, $p \leq 0.05$), type of healing treatment (Δ+ 100%, $p \leq 0.1$), and knowledge (Δ+ 125.9%, $p \leq 0.01$), where a value of IDR 28,578 is ideal for the cost of managing disposable mask waste.

Introduction

Since the end of 2019, the disease caused by the COVID-19 virus strain began to occur and spread progressively almost all over the world until it is known as the COVID-19 pandemic. The rapid spread of the virus can occur airborne, so the use of masks to cover the nose and mouth has been recommended by the World Health Organization (WHO) to reduce the wider spread of the virus [1]. Disposable masks are an option where, in addition to being affordable, their use is efficient because they are easy to find and can be disposed of immediately. However, the negative impact of a significant increase in disposable masks is the high rate of disposable mask waste in the environment. Indonesia recorded a mask usage rate of 249,571,000 pieces/day, or equivalent to a contribution of 7.3% of mask waste every day. Therefore, we need to mitigate the impact of the increasing disposable mask waste during the pandemic, particularly its environmental consequences.

Disposable masks have a short life span, where their use is only recommended for a maximum of one use for one day because masks have a filtration saturation limit [2]. Thus, the impact of this disposable mask is the pile of waste that increases rapidly. Furthermore, according to Nababan and Ministry of Environment and Forestry [3,4], disposable masks are quite infectious waste and can be dangerous because they pollute the environment. Research by Fitria et al. [5] mentioned that disposable mask waste is included in the category of waste that cannot be recycled, and its disposal must be done properly. The problem in Indonesia is that household actors still dominantly dispose of disposable masks directly and mix them with household waste without any effort to separate the masks used [6]. Disposable mask waste is a type of B3 (*Bahan Berbahaya dan Beracun*) waste or Hazardous Toxic Material.

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Thus, the impact of improper disposal of disposable masks can increase the risk of B3 waste pollution to the environment [4]. Classification of disposable mask waste as B3 waste, requires special handling in waste management [7]. In addition, disposable mask waste must be destroyed before being sprayed with antiseptic and disinfectant liquids to reduce and kill bacteria and viruses on the masks. This is to prevent individuals from contracting infections from disposable mask waste and to avoid pollution from used masks to the environment. For this reason, along with the progressive increase in disposable mask waste, it is necessary to pay attention to the special and sustainable management of mask waste.

The research found a positive relationship between people accustomed to behaving positively toward the environment and the urge to manage the masks they use, known as environmental awareness [8]. Individuals with good knowledge positively have good awareness [9,10]. Based on this fact, it is known that there is a relationship between the three factors of knowledge, attitude, and behavior towards environmental awareness in everyone. However, in addition to increasing public concern and awareness, policy encouragement is also needed to encourage changes in community behavior. Wang et al. [11] argue that the right policymaking is crucial in encouraging people to change behavior related to environmental programs and internal factors within themselves or environmental awareness. However, policymaking must still be done with the heaviest consideration of the community factor as a community is the most important stakeholder that will directly participate in the proposed environmental program or policy [12]. Ren et al. [13] found that community participation in implementing the policy is the main point in implementing environment-related policies. Thus, policy implementation will be an effective tool, but in its preparation, it is important to consider public perceptions so that the implemented policies will run effectively.

One policy applied to overcome environmental problems is the Polluter Pays Principle (PPP). Valera et al. [14] emphasize preparing policies that assign responsibility to polluters or police, where compensation is given as payment obligations. Chamizo-González et al. [15] then mentioned that the urban environment can regress on the sustainability goals set, so the government can hold people responsible as waste-generating agents to pay a certain amount of taxes or fees in waste management, or what is known as Pay As You Throw. Combining this concept with the initial problem of the increasing use of disposable masks during the COVID-19 pandemic, the community, as mask users, can be held responsible for the cost of disposable mask waste management. However, economic aspects, such as the low income of the community, especially in developing countries like Indonesia, pose a barrier to implementing this policy, making it an important consideration when implementing payment policies for waste management [16,17]

Economic obstacles are one of the main obstacles in preparing policies based on the PPP principle, especially during the COVID-19 pandemic. This is explained in the research of Dou et al. [18], which states that the pandemic period, followed by a social restriction policy, then impacted threats to the economic aspects of society. For this reason, one of the analyses that can be done to measure the community's perception of the PPP concept policy is the Willingness To Pay (WTP) analysis, where WTP is defined as the highest value an individual is willing to pay for a product based on income level and risk presence [19]. WTP analysis on individuals can serve as a benchmark for determining the amount they are willing to pay to enhance environmental quality concerning the waste or pollution they generate.

One commonly used WTP analysis tool is the CVM (Contingent Valuation Method). This method can be interpreted as individual economic value preference for a commodity (goods/services) without trade value in the market [20–22]. According to Yulianto [20] CVM is an approach to how much an individual can pay for an item (WTP) and how much value an individual can accept to give up the item (willingness to accept / WTA). Research related to the value of WTP generally uses CVM analysis [13], however, no research has been conducted on calculating WTP for mask waste in Indonesia, particularly for mask waste that does not yet have a value in waste management. Therefore, CVM can be utilized to evaluate individuals' willingness to pay to safeguard their residential environment. The use of CVM is considered necessary because it determines how much an individual is willing to pay for a good or service, which in this research is the environmental service. Borzykowski et al. [23] said that the use of CVM can be necessary even when the general public obligatorily uses the product. Furthermore, according to Payal et al. [24] even though the use of masks is obligatory in this case, determining the public's willingness to pay for mask waste management using the CVM method could help the policymaker determine the importance of this issue and thus help design proper mask management that the public would accept.

Socio-demographic factors play a crucial role in determining an individual's ability to pay, as these factors encompass a range of characteristics that delineate different groups based on beliefs, education, ethnicity, gender, age, income, geographic location, and social class [25,26]. This study uses sociodemographic aspects

to see the relationship between sociodemographic factors and individual willingness to pay for the management of disposable masks. For this reason, based on the explanation above, this study aims to analyze the sociodemographic factors and knowledge of the community in DKI Jakarta on mask waste during the COVID-19 pandemic and its environmental impact. Furthermore, we will analyze which sociodemographic characteristics significantly affect individual WTP and determine the amount of payment the community is willing to give to manage disposable mask waste during the COVID-19 pandemic.

Materials and Methods

The research was conducted from July to August 2023 in DKI Jakarta Province in a cross-sectional manner. The population selected for this study comprises residents of DKI Jakarta, as this province has recorded the highest number of COVID-19 cases in Indonesia. DKI Jakarta, the nation's capital and business epicenter, was chosen because the pollution resulting from infected mask waste would significantly impact the entire country. The research sample includes individuals residing and working in DKI Jakarta Province, based on the rationale that the WTP assessment can be accurately gauged from mask usage among income-earning workers.

We surveyed by distributing questionnaires and obtained 469 respondents. From this total, we eliminated respondents who did not meet the predefined inclusion criteria and considered only those who fit the criteria for further analysis. The inclusion criteria referred to are: (1) living (permanent or non-permanent) in the DKI Jakarta Province area; (2) being more than 18 years old; (3) using disposable masks in daily activities; and (4) having a monthly income. After elimination, the final total of respondents used in the statistical analysis in this study was 356 respondents. The study's variables were sociodemographic characteristics, knowledge, and WTP. The questionnaire consists of three parts, each containing ten questions for the sociodemographic characteristics variable, ten for the knowledge variable, and four for the WTP variable. In the results and discussion section, we will provide a more detailed explanation of each sociodemographic characteristic and the questions related to WTP.

The analysis methods used were univariate analysis for each sociodemographic characteristic and contingent valuation methods. The question model used was single and double-bounded dichotomous. This question system is questioned by asking for the value that the individual is willing to pay so that it will produce 4 (four) types of data responses: "yes-yes,"; "yes-no,"; "no-yes," or "no-no." The double-bounded dichotomous question model can be seen in Figure 1 for more details. We will analyze the average value of WTP using the SPSS 20 application.

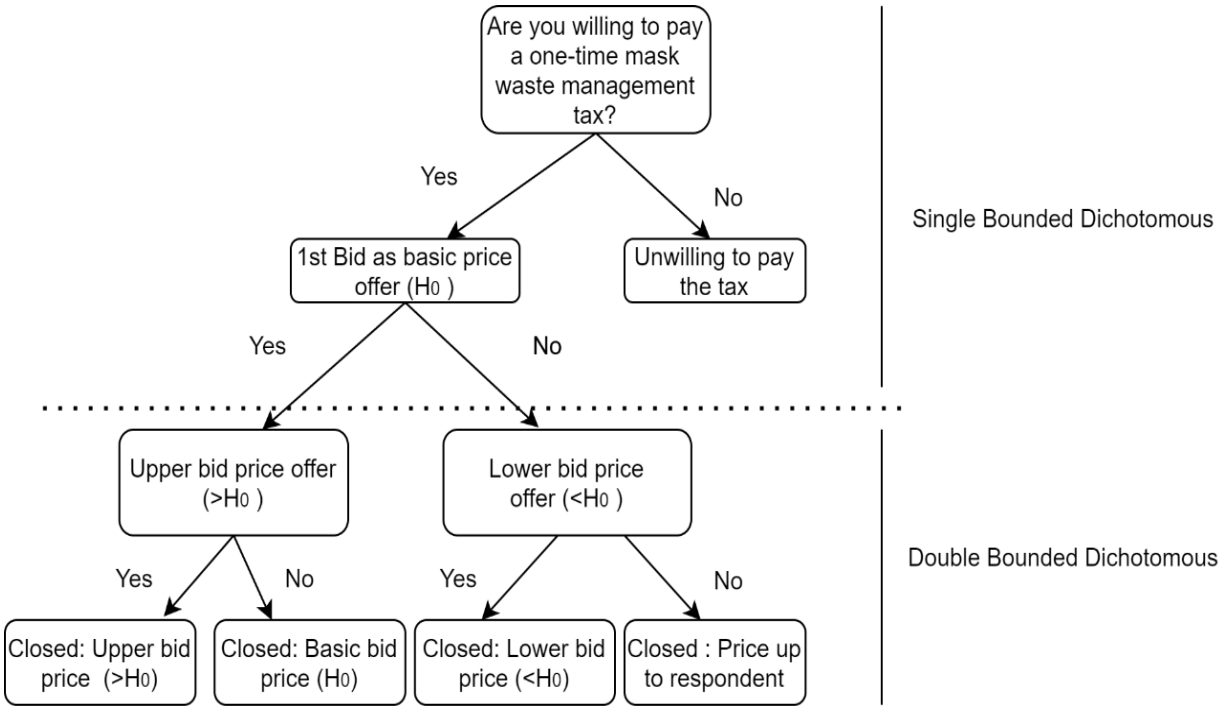

Figure 1. Dichotomous choice analysis diagram (single and double bounded).

In the questionnaire, respondents were given a choice regarding their willingness to pay for disposable mask waste management with a response of "yes" or "no." For respondents who answered that they were not willing to pay, an open-ended question on the reasons for their refusal would be asked, and they would not proceed to the next question. Furthermore, respondents who choose the answer willingness to pay will proceed to the question about the suitability of the price they are willing to pay. Price suitability will be based on two types of options; the first is with an upper bound offer (>H0) and the second is a lower bound offer (<H0) (Figure 1). Double-bounded dichotomous is used to obtain the construction of upper and lower price values for a given price. If the respondent does not want to pay the initial price, it will be reduced; if the respondent is willing to pay, it will be increased. The bid price is determined by calculating the cost of hazardous waste management, particularly disposable masks for customers in the healthcare industry. The bid price will be the base price (H0).

Validity and reliability tests were carried out with an initial survey of 34 respondents, the results of valid knowledge and behavior questionnaires, and the amount of each Cronbach's Alpha coefficient value of the knowledge variable, which is 0.714. The behavior variable, which is 0.733, indicates that the questionnaire statements are reliable (acceptable). Statistical analysis will be carried out twice: the first is logistic regression analysis, and the second is multiple linear regression analysis. The analysis is done twice because the first analysis, namely logistic regression analysis, is carried out to see which independent variables affect individual WTP so that WTP is the dependent variable in logistic regression analysis. The WTP variable as the dependent variable will be binary, namely 'Yes' or 'No.' Furthermore, suppose the independent variables that affect WTP have been found using these variables. In that case, the second analysis will be carried out, namely multiple linear regression analysis, which aims to calculate the value of WTP, where the dependent variable for multiple linear regression analysis is the value of WTP bids.

Results and Discussion

Respondents' Sociodemographics

Testing was conducted on a total sample of 356 respondents, using sociodemographic testing using age, income, education, living with whom, COVID-19 survivors, healing treatments, knowledge, and gender. The data can be seen in Table 1. Variable codification, while the survey results for each variable can be summarized in Table 2.

The first characteristic is for the age variable, where the age category is carried out by the Ministry of Health Regulation No. 5 of 2016 on the Implementation of Clinical Advisory, which emphasizes the importance of standardization in public health practices, supporting consistent frameworks for data collection and analysis. This principle underpins the categorization of age variables in this research, namely adolescents (12–25 years), adults (26–45 years), and the elderly (46–65 years). Based on the data in Table 2, the highest number of respondents is 287 people (80%), whereas age increases and the availability to pay will decrease. According to Odonkor and Adom [27] this is because young people tend to have the urge to do something about the environment. They tend to have more knowledge related to environmental issues, so they are likely to form feelings of contribution to protecting the environment.

Data from gender characteristics, where respondents based on gender indicators are divided into women or men. Based on the total number of respondents, 356 people, 44.7% are male, while 55.3% are female. This result shows that women dominated the respondents in this study. The results in Table 2 show that based on the comparison between men and women, women are more dominant in choosing to be willing to pay according to the price offered. This is explained by the fact that, in line with previous research, females tend to be aware of environmental issues and have positive traits and behaviors toward the environment [28].

Next is a description of the respondents based on the indicator of the latest education that has been taken. The last education data filling is divided into six categories: elementary school, junior high school, senior high school, Bachelor/Diploma, Master, and Doctorate. Based on respondents who have Diploma and Master education levels. In contrast, the dominant respondents chose not to pay WTP at the junior and senior high school levels. Previous research explains that education level is important in encouraging individuals to behave positively towards the environment. Odonkor and Adom [27] found the higher the level of education, the more opportunities there will be to learn about and about environmental issues.

Table 1. Variables codification.

Code	Variable	Category		
X1	Age	1	=	Adolescent (12–25 years),
	`	2	=	Adult (26–45 years),
		3	=	Elderly (46–65 years)
X2	Income level (IDR)	1	=	< 1,000,000
		2	=	1,000,000–5,000,000
		3	=	5,000,001–10,000,000
		4	=	10,000,001–15,000,000
		5	=	15,000,001–20,000,000
		6	=	20,000,001–25,000,000
		7	=	> 25,000,000
X3	Education level	1	=	Junior High School
		2	=	Senior High School
		3	=	Diploma and Bachelor
		4	=	Master
		5	=	Doctorate
X4	Live with whom	1	=	With Partner/Children/Relatives/Friends/Without Elderly
		2	=	With Parents/Elderly
X5	COVID-19 virus survivor	1	=	No
		2	=	Yes
X6	Healing treatment	1	=	Not Self-Isolating/Hospital
		2	=	Self-Isolation
X7	Knowledge	1	=	Low (1–4)
		2	=	Medium (5–7)
		3	=	High (8–10)
X8	Gender	1	=	Female
		2	=	Male
X9	Behavior	1	=	Good
		2	=	Bad

Furthermore, pointing to the Univariate Data of Respondents' Tribes, it can be seen that three majority tribes occupy the DKI Jakarta area, namely Javanese as many as 127 people (35.7%), Sundanese 94 people (26.4%) and Betawi tribe 55 people (15.4%), followed by Minangkabau 26 people (7.3%), Malay 18 people (5.1%), Batak 16 people (4.5%), North Sumatra 6 people (1.6%), East Nusa Tenggara 1 person (0.3%), South Sulawesi 4 people (1.1%), Bali 4 people (1.1%), Chinese 2 people (0.6%), and Maluku 3 people (0.8%). Based on the data, it can be informed that although Betawi is the original ethnicity of Jakarta, Javanese is the most common ethnicity in DKI Jakarta. Although this data only intends to show the ethnic diversity of respondents who reside in DKI Jakarta, research shows a relationship between ethnicity and culture to encourage the surrounding community to protect natural resources around their residence [29].

The next aspect is COVID-19 survivors and the healing treatment, where the question referred to here is whether respondents who have a history of exposure to COVID-19 choose to carry out isolation independently or isolation in a hospital / not independently isolated. The relationship between these two variables is the number of disposable masks used. Survivors will use more disposable masks when exposed to the virus because it is recommended that they use masks during isolation to avoid exposure to surrounding people. Availability to pay was asked to determine whether the increased awareness of using disposable masks during self-isolation encourages a person to be willing to pay for the management of used disposable masks. The results show that COVID-19 survivors and self-isolation survivors each predominantly choose to be willing to pay for the cost of managing used mask waste. The reason for the survivors' willingness to pay is likely because the survivors have experienced the direct impact of exposure to the COVID-19 virus, thus increasing the survivors' awareness of the dangers of the spread of the COVID-19 virus. Good management of disposable masks will be a good prevention measure. Guo et al. [30] stated that survivors of the COVID-19 virus will pay more attention to health and prevention of the virus after they recover and can return to their activities.

The last aspect of sociodemographic is the income level of 356 respondents (Table 2). Based on income level, it is known that most respondents, as many as 265 (74.44%) people, have income levels above the Provincial Minimum Wage of DKI Jakarta in 2023 (> IDR 4,900,798). The income level of most respondents, 149 (41.85%) out of 356 people, is in the income range of IDR 5,000,001 to IDR 10,000,000. According to Halkos et al. [31] research, an increase in income will get log ODDS in the calculation of individual WTP statistics, where in line with this research, it does show that income > IDR 5,000,000 has a higher percentage of respondents' WTP compared to respondents with household income < IDR 5,000,000.

Table 2. Survey recapitulation.

Variable		Willingness to Pay				Total	Percentage (%)
		Disagree		Agree			
		Respondent	Percentage (%)	Respondent	Percentage (%)		
Age	1	22	20.00	38	15.45	60	16.85
	2	84	76.36	203	82.52	287	80.62
	3	4	3.64	5	2.03	9	2.53
Income level	1	9	8.18	14	5.69	23	6.46
	2	29	26.36	39	15.85	68	19.10
	3	46	41.82	103	41.87	149	41.85
	4	10	9.09	44	17.89	54	15.17
	5	7	6.36	17	6.91	24	6.74
	6	3	2.73	9	3.66	12	3.37
	7	6	5.45	20	8.13	26	7.30
Education level	1	1	0.91	2	0.81	3	0.89
	2	27	24.55	48	19.51	75	22.32
	3	69	62.73	162	65.85	231	68.75
	4	13	11.82	34	13.82	27	8.04
Family members	1	68	61.82	145	58.94	213	59.83
	2	42	38.18	101	41.06	143	40.17
COVID-19 virus survivors	1	48	43.64	85	34.55	133	37.36
	2	62	56.36	161	65.45	223	62.64
Healing treatment	1	55	50.00	94	38.21	149	41.85
	2	55	50.00	152	61.79	207	58.15
Knowledge	1	2	1.82	1	0.41	3	0.84
	2	19	17.27	12	4.88	31	8.71
	3	89	80.91	233	94.72	322	90.45
Gender	1	58	52.73	101	41.06	159	44.66
	2	52	47.27	145	58.94	197	55.34
Behavior	1	62	56.36	148	60.16	210	58.99
	2	48	43.64	98	39.84	146	41.01

Disposable Mask Waste Knowledge Variable

The knowledge variable contains ten statements about disposable mask waste, covering topics such as the impact, regulation, management, and types of masks that can become disposable mask waste. A cross-tabulation was conducted between the knowledge variable and the respondent's education level; the tabulation results can be seen in Table 3.

Table 3. Cross tabulation of knowledge with education level.

Education level	Knowledge			Total
	Low	Medium	High	
Junior High School	0	0	3	3
Senior High School	1	4	70	75
Diploma and Bachelor	2	18	211	231
Master	0	9	38	47
Total	3	31	322	356
Percentage	0.8%	8.7%	90.4%	

Table 3 shows that most respondents, with 322 people (90.4%), have high knowledge about disposable mask waste. When comparing each level of education, we can conclude that the higher a person's level of education is, the higher the knowledge that person has. This is because the higher education level focuses on improving the quality of the generation of knowledge dissemination activities, resulting in knowledge being shared throughout the organization and ultimately increasing the knowledge of each individual [32].

Behavioral Variable Characteristics of Disposable Mask Users

Respondents assessed the behavior of medical mask users by filling in four statements: the intensity of using disposable masks outside the home (P1), the intensity of using disposable masks inside the home when infected (P2), damaging/tearing disposable masks before disposing of them (P3), and separating used disposable masks (P4).

Analysis was conducted using cross-tabulation between behavior and knowledge in Table 4. Most respondents with good behavior had high knowledge, namely 190 people (53.33%), while respondents with poor behavior who had high knowledge were 132 people (37.07%). The relationship between knowledge and behavior shows that increasing knowledge aligns with improving individual behavior. In Table 4, the dominant respondents are those who have high knowledge and good and positive behavior towards the environment. The relationship between these two variables may be due to the existence of knowledge in individuals related to environmental protection issues, which encourages individuals to behave positively to protect the environment. In line with the results of this study, mentioned in the research conducted Durmaz and Fidanoğlu [33], high environmental knowledge will be the main key to ensuring that individuals know the impact of every human activity and encourage humans to contribute to environmental protection. Therefore, in general, high knowledge will align with pro-environmental behavior.

Table 4. Cross tabulation of behavior with knowledge.

		Knowledge			Total
		Low	Medium	High	
Behavior	Bad	1	13	132	146
	Good	2	18	190	210
Total		3	31	322	356

Willingness to Pay

In calculating the WTP value using the CVM, where according to Huy et al. and Venkatachalam et al. [34,35], the calculation stages using the CVM method are divided into three parts: (1) Identifying the product or service to be valued, (2) Creating hypotheses or hypothetical scenarios, and (3) Elicitation of monetary values. In the Introduction Chapter, it has been discussed and explained related to stage no (1), where in this study, the problem identified is the high generation of disposable mask waste during the Covid-19 Pandemic, so it will be analyzed how much WTP for mask management based on the willingness of the community, especially in DKI Jakarta.

Stage (2) is the creation of a mortgage scenario, where, at this stage, the offer's value is determined using a mortgage scenario to pay mandatory contributions for sustainable management of disposable mask waste. A pilot survey was conducted by interviewing 30 households in DKI Jakarta. Based on the survey, a price range of IDR 9,400 to IDR 70,000 was obtained. Based on these bid prices, the price of processing disposable mask waste was offered to 356 respondents, starting with an initial offer of IDR 50,000. Furthermore, through the technicality of the double-bounded dichotomous choice format in Figure 2, the bidding was then increased to IDR 70,000 for the highest bid and IDR 30,000 for the lowest bid.

In this study, a part of the questionnaire was also given about why respondents chose not to be willing to pay the offered WTP. Based on Figure 2, in the initial part of the question (Single-Bounded Dichotomous), 110 respondents chose not to answer "Are you willing to contribute?". When answering no, the respondent will not be directed to continue answering the next questionnaire question to determine the WTP value. Still, the respondent will be asked to answer the last question. The last question was the reason for each respondent's answer of not being willing to contribute.

Figure 2 shows the flow of single and double-bounded dichotomous questions and answers for determining the WTP value. The first question is used to determine whether respondents are willing to pay a certain amount of fees for the management of disposable masks during the COVID-19 pandemic. Two hundred forty-six respondents answered 'Yes', and 110 answered 'No.' Based on Figure 3, there are five main reasons for respondents to choose not to be willing to pay fees for mask waste management during the COVID-19

pandemic. Most respondents, 66.36%, agreed that the government should be the party that fully implements the management of disposable mask waste. This is the reason most respondents chose it, as it is likely that people in Indonesia have not fully realized the importance of environmental management, so all environmental management costs are the government's responsibility.

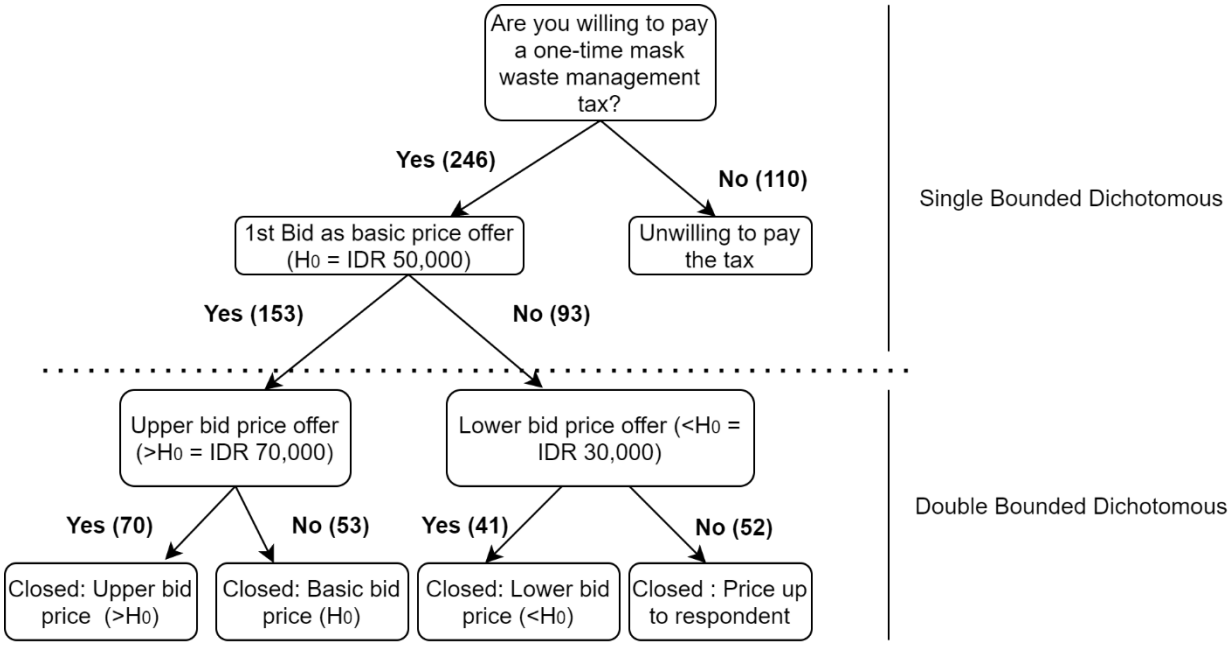

Figure 2. Distribution of willingness to pay with double bounded dichotomous method.

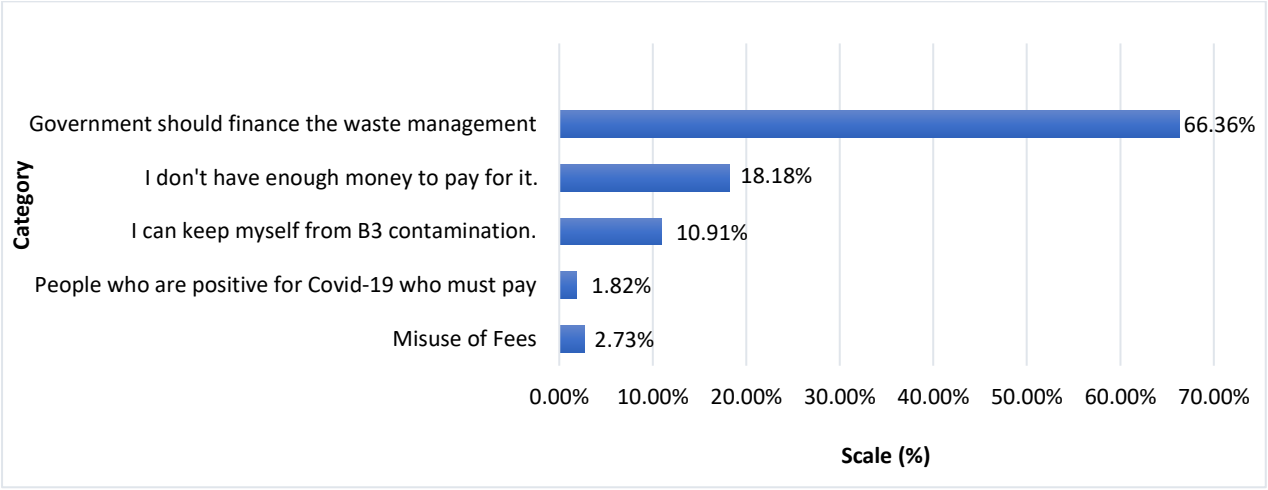

Figure 3. Reasons for rejection of willingness to pay.

Previous research also related to environmental awareness and WTP in the community towards an environmental issue; respondents who were unwilling to pay fees believed the government should play a role and be fully responsible for environmental management [36]. People generally think that the government, as one of the stakeholders in a country, is indeed a player in environmental protection, where the government can formulate policies and establish laws for violators of policies for environmental protection. However, the government's implementation has weaknesses, one of which is related to low financial resources. If the government supports all sectors, community independence and investment in the private sector will be reduced. For this reason, research related to environmental management is driven towards the Polluter Pay Principle (PPP); where according to Zhu [37], this principle places the principle of encouragement on the formation of awareness and responsibility in the community towards environmental management so that in producing pollutants, people can be responsible for their behavior.

The determination of WTP is then based on the results of respondents' answers, where, based on Figure 2, it is known that 246 respondents are willing to pay for the management of disposable mask waste, but 110 respondents are not willing to pay for the management of disposable mask waste. The respondents' WTP is further divided into two parts: respondents who are willing to pay at the price offered and willing to pay but cannot pay. The results obtained can be seen in Table 5.

Table 5. Respondent's willingness to pay.

Price offer (IDR)	Respondent	Percentage (%)
50,000	83	33.74
70,000	70	28.46
30,000	41	16.67
< 30,000	52	21.14
Total	246	100

Based on the results in Table 5, with 246 respondents willing to pay, most respondents chose the IDR 50,000 offer, while the least chosen offer was IDR 30,000. In detail, 52 respondents who provided prices below IDR 30,000 are presented in Table 6. Based on the data in Table 6, the price preference is < IDR 30,000, which is in the lowest range of IDR 5,000 to the highest of IDR 25,000. However, a price of < IDR 30,000 is not ideal, which, compared to the cost of retribution in DKI Jakarta, ranges from IDR 21,000 to IDR 43,000, where the price is still outside the cost of waste management and only as a transportation fee. For this reason, it was decided that the respondents who chose to pay < IDR 30,000 are the respondents who are willing to pay but can't pay the ideal cost yet.

Table 6. Respondents' price preferences that are not included in the WTP value.

Price preferences (IDR)	Respondent	Percentage (%)
5,000	8	15.38
10,000	27	51.92
15,000	4	7.69
20,000	11	21.15
25,000	2	3.85
Grand total	52	100

The analysis continued with cross-tabulation treatment between income variables and respondents' WTP; the results can be seen in Table 7. Based on the results of the cross-tabulation analysis, > 50% of respondents in each income range chose and were willing to pay the WTP offer. However, in the income range of IDR 5,000,000 to > IDR 25,000,000, the percentage of respondents who chose Yes for WTP increased compared to the lower income range. In line with research results by Zhu et al. [38], where income is one of the significant reasons for a person's willingness to pay for environmental products or services. This result explains that the higher a person's income, the more likely he is to spend on environmental protection.

Table 7. Cross tabulation of willingness to pay with Income.

Income (IDR)	WTP				Total
	No	%	Yes	%	
< 1,000,000	9	39.13	14	60.87	23
1,000,000–5,000,000	29	42.65	39	57.35	68
5,000,001–10,000,000	46	30.87	103	69.13	149
10,000,001–15,000,000	10	18.52	44	81.48	54
15,000,001–20,000,000	7	29.17	17	70.83	24
20,000,001–25,000,000	3	25.00	9	75.00	12
> 25,000,000	6	23.08	20	76.92	26
Total	110		246		356

Logistic regression statistical analysis was used to determine the independent variables that affect WTP with a value of p = 0.1. The independent variables used are shown in Table 1. Initial testing was carried out to test the feasibility of logistic analysis, and the initial tests carried out were the Omnibus test, the Hosmer-Lemeshow test, and the Classification Table test. The Omnibus test results can be seen in Table 8.

Table 8. Logistic regression omnibus test results.

		Chi-square	df	Sig.
Step 1	Step	29.842	9	.000
	Block	29.842	9	.000
	Model	29.842	9	.000

Table 8 presents the test known as the omnibus test. This is the first of a total of three tests that must be conducted prior to the main test, which is logistic regression. This test serves to determine whether logistic regression can be applied to the data. The results in Table 8 show a sig value of 0.01, where this result shows the sig < p, and it is concluded that at least one independent variable used has a significant effect.

Table 9. Logistic regression hosmer-lemeshow test results.

Step	Chi-square	df	Sig.
1	10.933	8	0.206

Table 9 presents the test known as the Hosmer-Lemeshow test. This is the second of the three tests that must be conducted prior to the main test. The Hosmer-Lemeshow test was conducted to determine the model's suitability between the prediction and actual data. The test results can be seen in Table 9, which shows a sig>p value, which means that there is no difference between the predicted model based on the actual data used, where the classification result of the comparison between the predicted and observed models is 71.1%, which means that the similarity between the predicted and observed models reaches 71.1%.

Based on the logistic regression analysis results in Table 10, it can be concluded that the independent variables of income, healing treatment, and knowledge each have a sig < p value, meaning that the three variables significantly influence the willingness of individuals to pay WTP offers. The income variable is a variable that affects WTP. In general, the income variable is one of the main things that is important to consider in research related to WTP because research related to WTP is related to the economic aspects of each individual [39]. The results in this study are also consistent with research Agag et al. [40], which shows that income significantly affects individual WTP, and the higher a person's income affects the urge to contribute to the environment. Other opinions that are in line also emphasize that income will be related to a person's expenses, where the higher the income, the more likely a person will be able to pay for needs other than primary needs, which in the case of WTP are still considered not as primary needs [41]. Communities, as actors in activities that generate waste, are sensitive to variables related to costs, so income is very important to consider in examining the perspective of community willingness in the proposed WTP cost offer. Thus, in the future, the WTP value obtained can be utilized as a reference in determining environmental waste management cost policies.

Table 10. Logistic regression analysis results.

	B	Sig	Exp(B)	90% C.I. for EXP(B)	
				Lower	Upper
Age	–0.075	0.821	0.928	0.538	1.600
Income	**0.236****	**0.024**	**1.266**	**1.067**	**1.503**
Education level	–0.012	0.960	0.988	0.665	1.467
Live with whom	0.084	0.750	1.088	0.705	1.677
Covid survivors	–0.676	0.237	0.509	0.199	1.303
Healing treatment	**1.000***	**0.072**	**2.719**	**1.088**	**6.792**
Knowledge	**1.259*****	**0.001**	**3.522**	**1.903**	**6.518**
Sex	0.388	0.137	1.473	0.960	2.261
Behavior	0.098	0.138	1.103	0.989	1.230
Constant	–5.157	0.001	0.006		

The second analysis was then conducted to calculate the WTP value, using three independent variables taken from variables that significantly affect WTP based on the results of the previous analysis (in Table 10). The three independent variables are income, healing handling, and knowledge, where the statistical analysis used is multiple linear regression on the dependent variable, namely the WTP Bids value. Before the analysis, the feasibility test of the independent variables is carried out using the influence test of the independent variable on the dependent variable. The influence test results are obtained using an ANOVA table analysis.

Table 11. Multiple regression analysis determination coefficient test results.

Model	Sum of squares	df	Mean square	F	Sig
Regression	11524364060.919	3	3841454686.973	5.401	.001b
Residual	250363838186.272	352	711260903.938		
Total	261888202247.191	355			

The results in Table 11 show a significant value of 0.001, which means there is a significant influence of knowledge, income, and handling of healing together on the value of WTP. Next is the linear regression analysis, where the statistical results are shown in Table 12. Based on the analysis results in Table 12, only the income and knowledge variables are significantly related to the WTP value. Therefore, only these two variables can calculate the WTP value. Table 12 is shown below, followed by the WTP value calculation.

Based on the logistic regression analysis results in Table 10, it can be concluded that the independent variables, namely income, handling of healing, and knowledge, each have a sig < p value, meaning that the three variables significantly influence the willingness of individuals to pay WTP offers. Table 12 shows the results of the second regression analysis conducted. This second regression analysis used only the independent variables, namely income, healing treatment, and knowledge, significantly affecting the WTP value in the logistic regression calculation in Table 10. If the first regression analysis used logistic regression analysis to determine which variables affect individual WTP, then this second analysis was carried out on the value of bids to determine the amount of WTP.

Regression analysis was carried out twice, in the first analysis, logistic regression analysis was used to determine which independent variables significantly affect WTP, where the dependent variable data for the first regression was in the form of binary categories 'Yes' and 'No' for the availability of paying WTP. The calculation of the WTP value in this study is IDR 28,578. This figure is obtained based on the results of calculations on a sample of 246 respondents who agree and are willing to pay contributions to the management of disposable mask waste. Based on the results of the WTP calculation in this study, the government can use this as a basis for study in formulating policies related to the management of disposable mask waste.

Table 12. Results of multiple linear regression analysis between three significant variables and WTP bids value.

	Unstandardized coefficients		Standardize coefficients beta	t	Sig.
	B	Std. Error			
(Constant)	–16,105.441	12,886.965		–1.250	.212
Income Level	1,959.512	960.066	.107	2.041	**.042**
Healing Treatment	3,694.366	2,895.464	.067	1.276	.203
Knowledge	13,137.950	4,262.326	.161	3.082	**.002**

Based on the results in Table 12, we compiled a mathematical equation to predict the value of WTP in rupiah (the equation can be seen above). The knowledge and income variables each have a significance value of P ≤ 0.1, which means that both significant variables affect the WTP amount and can be used to quantify WTP values. Meanwhile, the healing treatment variable cannot be used because this variable does not have a significant effect on predicting the WTP value. The two significant variables are each multiplied by the mean value derived from the stratification calculation of each variable adjusted to the income strata (refer to Table 1 and Table 2). The calculation then resulted in a WTP prediction value of IDR 28,578.524.

The knowledge variable is the third variable significantly related to respondents' willingness to pay the WTP offer provided. It is explained that knowledge is the basis for a person to make decisions. According to Durmaz and Fidanoğlu [33], a person's knowledge related to the environment will give a person an overview of environmental issues such as environmental problems, causes of environmental problems, and solutions to environmental problems. Later knowledge will also give a person an idea of the things that he can do so that he can choose to contribute to environmental protection activities. In line with this research, in recent years, the internet and social media have become a platform that is easily accessed by people, where according to Zhang and Gong [41] knowledge from the internet, especially social media, significantly affects environmental awareness. For this reason, knowledge is a variable that significantly determines a person's decision to pay the proposed WTP offer value.

Based on the results in Table 10, the healing treatment variable significantly affects individual decisions on WTP for disposable mask waste management. Individuals here include individuals with a history of being COVID-19 survivors and conducting independent isolation both at home and handling healing or healthy

individuals. According to Guo et al. [30], who researched with the research subject, namely the COVID-19 virus survivor group, COVID-19 survivors, when recovering, will form an awareness regarding the dangers of exposure to the COVID-19 virus and the importance of always implementing health protocols to reduce the risk of spreading the virus. Thus, when survivors recover, they will be more encouraged to support activities to protect against the spread of the virus. In contrast, in this case, the activity that will focus on in the future is managing disposable mask waste. Survivors will significantly support the WTP program with the aim of waste management to avoid exposure to viral infections if disposable masks are not properly processed. Thus, by achieving the goal of protection from exposure to the virus, the goal of environmental sustainability with disposable mask management can hopefully be achieved. However, in the second regression analysis, the results in Table 12 show that the healing handling variable has a significance value of 0.203, where the sig value > p, which means that this variable cannot be significantly used to calculate the WTP value. For this reason, the healing handling variable is not considered when calculating the WTP value.

If we calculate the current conditions, it is estimated that the number of mask piles in DKI Jakarta is 1.5 tons/day, so the total mask waste is 45 tons/month, according to Lyu et al. [42] research indicates that one of the recommendations for medical waste management is to incinerate and utilize it as an energy source from waste. For this reason, the calculation uses the estimated cost of managing masks and medical waste using incineration. According to Attrah et al. [43] the estimated cost of the incineration process is 800 USD/ton or 540 million USD/month. However, this is only a rough calculation and cannot be directly applied where further research is needed before a policy can finally be made to support the sustainability of disposable mask waste management. However, the output of our research is to recommend to the government the importance of focusing on increasing public knowledge on environmental issues, where in addition to income, knowledge is a significant factor for individuals to express their willingness to pay WTP to environmental programs by the government.

Conclusions

This study highlights that sociodemographic factors such as income, healing treatment, and knowledge affect individuals' WTP for disposable mask waste management in DKI Jakarta, with younger, female, higher-educated, and higher-income respondents showing greater WTP. The identified WTP value of IDR 28,578.524 can guide future policies. Our research contributes to post-COVID waste management by addressing social, economic, and environmental sustainability, providing insights into public valuation and investment willingness, and emphasizing the need for sustainable practices to enhance long-term environmental resilience.

Author Contributions

YQ: Conceptualization and Design of The Study, Acquisition of Data, Analysis, Interpretation of Data, Drafting and Writing the manuscript; **HH:** Critical review and Supervision; **KM:** Critical review and Supervision.

Conflicts of interest

There are no conflicts to declare.

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