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Eco-friendly masks preferences during COVID-19 pandemic in Indonesia

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ABSTRACT

Eco-friendly face mask is necessary to reduce the aggravates the environment due to increased face masks waste during COVID-19 pandemic. The successful eco-friendly masks development influenced by understanding of user's need and effectiveness of communications. The employed conjoint analysis obtained user mask preferences information to support effective communication strategies by business enterprises and policy makers on encouraging public to consume appropriate masks. The attribute importance followed from eco-friendly (32.1%), mask certification (26.5%), filtration efficiency (19.8%), price (13.9%), layers (5.6%), type of mask (1.5%), material (0.7%). The public expecting the mask with the ability to recycled and biodegradable, with certification, performance above 90% filtration efficiency, and affordable prices in the range of Rp.1.500-Rp.25.000. Also, 3-ply fabrics for the medical type and cotton material are generally preferred to polyester/polypropylene. The government needs to improve the effectiveness masks education, provide convenience process to masks certification by manufacturers, and provision of incentives to reduce masks production cost. Meanwhile, manufacturers ensure produce of the standard eco-friendly masks in affordable pricing. Furthermore, gender did not show significant effect on preferences, but varied with average expenditure.

1. Introduction

The coronavirus (COVID-19) is essentially transmitted via lesser droplets during speaking, coughing or sneezing (ECDC, 2020; Howard et al., 2021; World Health Organization, 2020). Based on the nature of transfer, various experts and organizations, including government recommended using the face masks to aid personal protection (Chua et al., 2020; Domingo et al., 2020; ECDC, 2020; Feng et al., 2020; Leung et al., 2020; Rubio-Romero et al., 2020; World Health Organization, 2020).

Excessive rate of mask utilization during the pandemic generates increased waste. The rate is changing the pattern and overconsumption to protecting health also reduce the quality and places undue pressure on the environment (Ammendolia et al., 2021; Biswas and Roy, 2015; Ghazali et al., 2018; Paço et al., 2019; Tonne, 2020). Unexpectedly, the face mask is mandatory use in public and more people continue to wear a daily basis, the amount of trash become substantial and further aggravates to a fresh environmental challenge in terms of accumulated waste materials (Aragaw, 2020; Chua et al., 2020; Fadare and Okoffo, 2020; Ilyas et al., 2020; Saadat et al., 2020; Vanapalli et al., 2021).

The existing disposable face masks on the market are mostly polymer-based and considered non-environmentally friendly materials. There

needed to redesign and development the face masks with considerations to environmental impact and sustainability to solve those problem. Furthermore, as one of a medical equipment which is made with materials containing plastic should be improved in design with more environmentally friendly rather than banned on used (Patrício Silva et al., 2021; Prata et al., 2019). Proper deliberations are anticipated in the product development stage include attempt to substituting PPE materials with low-carbon reusable alternatives is high priority to reducing waste (Patrício Silva et al., 2020).

The successful new product development affected by internal and external factors, among others understanding of user's need and effectiveness of communications (Cooper, 1980; Rothwell, 1974). The purpose of this study was to obtain relevant information and description of user preferences on face mask utilization, in order to support business enterprises and policy makers ascertain effective communication strategies, while considering the environment. Corporates need to enhance innovation performance based on consumer's green preferences as well as provide insights into protection planning decisions (Pillai et al., 2015; Yang et al., 2019). Furthermore, promotion of habits free from environment hazards by producers, marketers and policy makers must be considering with the understanding of consumer behavior (Liobikienė

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et al., 2016). There is need to stimulate scientific assessments to increase environmental awareness and instigate positive change in lifestyle, consumption patterns and behavior (Patrício Silva et al., 2021). Improving an integrated system on more environmentally friendly need to rely on legal requirement, extended producer responsibility, fees incentivizing for better design and material use, and public awareness (Patrício Silva et al., 2020).

The research's contribution was enriching the results of previous research on investigation and development appropriate facemask to meet the urgently needed during this pandemic. Consumer preferences indicates the public expectation of the suitable face mask, including the environmental impact of its use.

1.1. Face mask during pandemic

Studies on face masks have shown a significant increase in recent months due to the required of a scientific solution to this pandemic. Extensive discussions on material perspective (Aydin et al., 2020; Bagheri et al., 2021; Chua et al., 2020; Drewnick et al., 2021; Hao et al., 2020; Konda et al., 2020; O'Kelly et al., 2020; Tcharkhtchi et al., 2021; Teesing et al., 2020; Zhao et al., 2020), efficacy (Arumuru et al., 2020; Fischer et al., 2020; Hemmer et al., 2021; Liang et al., 2020; Lindsley et al., 2021; MacIntyre and Chughtai, 2020; Sharma et al., 2020), and after use impact (Ammendolia et al., 2021; Aragaw, 2020; Dharmaraj et al., 2021; Fadare and Okoffo, 2020; Sangkham, 2020) have commenced among various researchers. However, limited investigation into eco-friendly face mask, partially discussed in preliminary form with low technological readiness (Aydin et al., 2020; Hartanto and Mayasari, 2021). The studies by Aydin et al. (2020) implicitly stating the materials they tested considered environmentally friendly material, whereas Hartanto & Mayasari (2021) discussed on selection several materials which the best filtration efficiencies and breathability while having the lowest environmental impact.

1.2. Eco-friendly preferences

Consumer preferences provides an accurate prediction of consumer choices due to its consistency on trade-off the attributes (Amir and Levav, 2008; Bither and Wright, 1977), therefore mapping the relationship between user preferences and product attributes become a fundamental task in the product design process (Chen et al., 2020). Several experts studied in eco-friendly preferences in the various object, include appliances (Gill et al., 2020; Kulshreshtha et al., 2019; Sonnenberg et al., 2014), fabric and fashion (Gano-an, 2018; Na and Kim, 2012), vehicles (Kim et al., 2019; Tarigan, 2019; Won, 2014), and furniture (Khojasteh-Khosro et al., 2020). The undeveloped studies on eco-friendly face masks preferences indicated of the importance in fast-paced investigations to present up-to-date information.

1.3. Conjoint analysis

Conjoint analysis is a method to capture on user preferences in the product consumption, through understanding the pattern customers apply to estimate product preference structure by combining utility values of each attribute, and the levels (Mandy Ryan and Farrar, 2000). The process act as a major set of techniques for measuring buyers' trade-offs among multi-attributed product and services (P. E. Green and Srinivasan, 1990). The result provides quantitative information similar to the model of consumer needs for several combinations of attributes (Paul E. Green and Srinivasan, 1978).

The method shows increase application across several fields, including marketing and advertising (P. E. Green and Srinivasan, 1990; Paul E. Green and Krieger, 1991; Hille et al., 2019; Lappeman et al., 2019; Mann et al., 2012; Mehta and Bhanja, 2018; Meyerding and Merz, 2018), product development (Kulshreshtha et al., 2019; Leber et al., 2018), telecommunication and information technology (Burbach et al.,

2019; Lagos et al., 2019; Maeng et al., 2020), green product (Borchardt et al., 2011; Sonnenberg et al., 2014) and healthcare (Kreps et al., 2020; M. Ryan et al., 2001; Mandy Ryan and Farrar, 2000; Weernink et al., 2018). There is a lack of conducting the conjoint analysis in eco-friendly face masks design.

There is various different between conjoint analysis and other multi criteria technique, e.g analytic hierarchy process (AHP). AHP is a compositional approach with multi-attribute structured into a hierarchy and resulted the rank or dominance of attribute, whereas conjoint analysis is based on the decomposition principle where the respondents overall evaluation of a set of alternatives attributes (Mulye, 1998).

2. Methods

This study implemented traditional conjoint analysis based on stated preference ratings by respondent for profiles of hypothetical products that each described on the entire set of attributes (Rao, 2010). Therefore, the assessment is appropriate for this study using full profiles and ordinary least squares regression to evaluate the partworths (Agarwal and Green, 1991). Fig. 1., represents an experimental design and parameter estimation as a popular method to select lesser set of complete profiles (Rao, 2010), in order to avoid the burden on the respondent in providing preference judgments.

Designing a traditional conjoint analysis is based on the following five steps.

Step 1. Problem definition. This defines the problem and ensures necessary results are obtained.

Step 2. Design of profiles. Attributes and levels were selected by researcher (Hair et al., 2010), for constructing hypothetical product profiles. Systematic literature review conducted to gain the attributes and levels. Experimental design by fractional factorial design approach implemented to ensure a manageable size of the set full profiles while maintaining orthogonality (Paul E. Green, 1974). The minimum number of combinations is estimated using the formula (1) below (Hair et al., 2010).

$$\min(x) = \sum y - j + 1 \tag{1}$$

where, min(x) is minimum possible combination, y is the total number of levels in all attributes, j is number of attributes. Good conjoint analysis has a possible profile 1.5 to 3 times more compared to result of estimated possible combinations (Orme, 2010).

Step 3. Survey administration. This stage involves constructing questionnaires and distributed using third-party application internet based among a sample of relevant target population. The data collected using questionnaires designed in internet-based third-party form application to reach wider range of respondents. People use masks regularly is suitable as a respondent. The survey consists of 3 sections, termed questions due to wearing masks, demographics, and judgment of profile preferences employ interval comprising 5 scale range, as shown in Fig. 2.

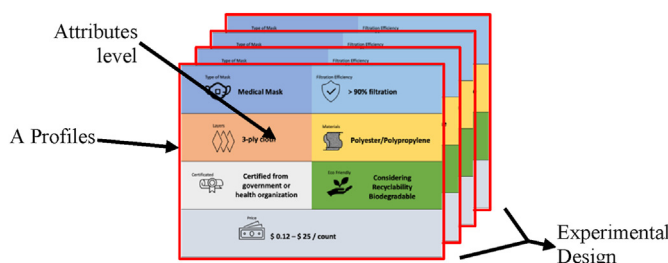


Fig. 1. Traditional conjoint analysis.

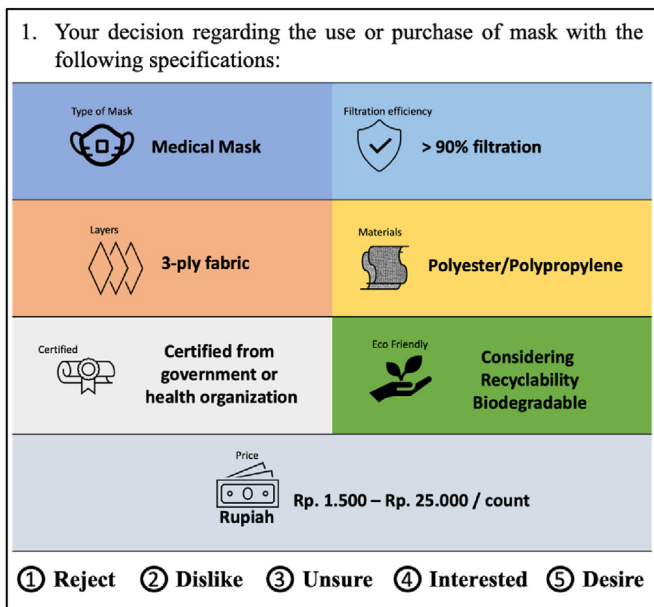


Fig. 2. The questionnaire of judgment of profile preferences.

The sampling determined with non-probability approach and Pearson correlation was implemented to reliability, validity and continued with descriptive analysis.

Step 4. Analysis. The estimation of the attribute-specific partworth functions and attribute importance represented the results for describing community preferences. The basic model of the conjoint analysis is shown in formula (2) below.

$$P = \mu + \beta_1(y_1) + \beta_2(y_2) + \beta_3(y_3) + \dots + \beta_i(y_i) + \epsilon \tag{2}$$

Where, P is respondents' preferences for mask attribute combinations, μ is constant value or coefficient intercept, β_i is coefficients of attribute i , y_i is a level of attribute i , ϵ is error term.

This step also consists of the following sequence.

- a. Implemented dummy variable regression to determined attribute utilities or coefficients. Furthermore, regression is known to generate the attribute coefficients or utilities.
- b. The weight of each attribute utilities or importance (I_i) score was determined from the formula (3) below.

$$I_i = \left(\frac{|j_i|}{\sum_{i=1}^n |j_i|} \right) \times 100 \tag{3}$$

Where, I_i is importance score of attribute i , j_i is the value of attribute utilities.

- c. The attribute-specific partworth functions or preference of level utilities of specific attributes (U_i) score were calculated. First, the level of each attribute with a value of 0 and equal to the absolute value of attribute i .

Secondly, centered coefficient (c) was evaluated from the formula (4) below.

$$c = \frac{y_i - j_i}{2} \tag{4}$$

Where, c is centered coefficient, y_i is the value assigned to the level of each attribute, j_i is the value of attribute utilities.

Thirdly, the calculation score of preference of level utilities using

formula (5).

$$U_i = \left[\left(\frac{c}{|j_i|} \right) \times I_i \right] \times 100 \tag{5}$$

Where, U_i is preference of level utilities i , I represent the attribute importance score.

Step 5. Accuracy test. The accuracy of prediction results was derived using the mean absolute percentage error (MAPE) approach, defined by the formula (6).

$$M = \left[\frac{1}{n} \sum_{t=1}^n \left| \frac{A_t - F_t}{A_t} \right| \right] \times 100\% \tag{6}$$

Where, M is MAPE value, A_t is the actual value for response of respondent, F_t is the prediction value from the dummy variable regression.

The accuracy test proves the accuration of prediction results of regression formula toward the scores of the respondent's judgements on each profile.

Step 6. Use of results. The community preferences enable designer to develop new and eco-friendly masks and ensures effective communication strategy for the policy maker to sensitize the public on the appropriate use.

3. Results and analysis

According to the conjoint analysis steps, the results of this study were described as follows:

Step 1. The problem which determined is the need for effectively policy makers and manufacturers communication strategies to encourage users to consume eco-friendly masks, based on investigating the user preferences variance and behavior.

Step 2. Implementation systematic literature review to generate the attributes and levels for each mask's product profile concepts, as shown in Table 1.

Protocols for practical screen were applied to search papers published on Scopus database up to September 30th, 2020. One hundred and thirty-eight results appeared on the title with combination keyword "face masks" OR "mask" AND "COVID-19". Article's selection was based on the limit of the title due to easier and explicit expression of the specified topic.

Price and eco-labelling or certification are additional key attribute, which known factors to influence green purchase intention and behavior (Joshi and Rahman, 2015; Liobikienė and Bernatoniene, 2017). Furthermore, ecological factors to evaluate the product consideration level on eco-friendly mask preferences, including recyclability and biodegradability, which described the fiber condition after use as end-of-life options contribute to disposal issues (Hartanto and Mayasari, 2021).

The designation of attributes obtained 128 possible combination profiles of mask product concept, and the minimum possible profile determined with formula (1) showed 24 available concept profiles needed for subsequent stages. Table 2 revealed the fractional factorial design approach used to achieve these profiles consisting of appropriate attribute combinations.

Step 3. Implementing survey administration conducted by questionnaires distribution between October–November 2020 to 133 respondents, where 123 were appropriated as samples. Furthermore, Pearson correlation result is 0.869, indicating all instruments are valid and reliable. The internal reliability and validity of conjoint results on certain studies were approximately 0.85 (Rao, 2014).

Table 1
Attributes and levels of eco-friendly mask.

Attributes	Details	Levels	Resources
Type of mask	Represent category of respiratory protective equipment for health worker and community	Medical mask Non-medical mask	(World Health Organization, 2020), (Rodríguez-Barranco et al., 2021)
Filtration efficiency	The value of the ability to barrier droplets or microorganisms provided by the fabric of face mask	Below 90% filtration Over 90% filtration	(World Health Organization, 2020), (Aydin et al., 2020), (Tcharkhtchi et al., 2021), (Konda et al., 2020), (Zhao et al., 2020)
Layers	The numbers of fabric combination used in single face mask	Below 3-ply fabric 3-ply fabric	(World Health Organization, 2020), (Konda et al., 2020), (Zhao et al., 2020)
Materials	A type of physical thing, such as fabric or cloth having qualities that allow it to be used to make face mask	Cotton Polyester/Polypropylene	(Konda et al., 2020), (Zhao et al., 2020), (Davies et al., 2013), (Rogak et al., 2020),
Mask certification	Approved by an official organization to ensure the face mask offer predictable product performance when used by health worker and community	Uncertified Certified	World Health Organization (2020)
Price	The amount of money for which something is offered for sale	Rp. 1.500 – Rp. 25.000 Over Rp. 25.000	(Kulshreshtha et al., 2019), (Liobikienė and Bernatoniė, 2017), (Joshi and Rahman, 2015)
Eco-friendly	Product have been designed to have little or no damaging effect on the environment	Not considering recyclability and biodegradable Considering recyclability and biodegradable	Muthu et al. (2012)

Table 2
Results fractional factorial design.

Profile	Type of mask	Filtration	Layers	Materials	Certified	Price (Rp)	Eco-friendly
X ₁	Non-medical	<90%	3	Cotton	Certified	>25k	Considering
X ₂	Medical	>90%	3	Polyester/Polypropylene	Certified	1.5k-25k	Considering
X ₃	Medical	>90%	<3	Polyester/Polypropylene	Certified	>25k	Not considering
X ₄	Non-medical	<90%	3	Polyester/Polypropylene	Certified	>25k	Not considering
X ₅	Non-medical	>90%	3	Cotton	Uncertified	>25k	Not considering
X ₆	Non-medical	>90%	<3	Polyester/Polypropylene	Certified	1.5k-25k	Considering
X ₇	Medical	>90%	<3	Cotton	Uncertified	>25k	Considering
X ₈	Non-medical	<90%	<3	Cotton	Uncertified	1.5k-25k	Considering
X ₉	Medical	<90%	3	Polyester/Polypropylene	Uncertified	>25k	Considering
X ₁₀	Medical	<90%	<3	Polyester/Polypropylene	Uncertified	>25k	Considering
X ₁₁	Medical	>90%	<3	Cotton	Certified	>25k	Not considering
X ₁₂	Non-medical	>90%	<3	Polyester/Polypropylene	Uncertified	1.5k-25k	Not considering
X ₁₃	Non-medical	>90%	3	Cotton	Certified	>25k	Considering
X ₁₄	Medical	<90%	3	Polyester/Polypropylene	Certified	1.5k-25k	Not considering
X ₁₅	Non-medical	<90%	<3	Polyester/Polypropylene	Uncertified	>25k	Not considering
X ₁₆	Medical	<90%	<3	Cotton	Certified	1.5k-25k	Considering
X ₁₇	Non-medical	>90%	3	Polyester/Polypropylene	Uncertified	1.5k-25k	Considering
X ₁₈	Medical	>90%	3	Cotton	Uncertified	1.5k-25k	Not considering
X ₁₉	Medical	<90%	3	Cotton	Uncertified	1.5k-25k	Not considering
X ₂₀	Non-medical	<90%	<3	Cotton	Certified	1.5k-25k	Not considering
X ₂₁	Medical	>90%	<3	Cotton	Certified	1.5k-25k	Considering
X ₂₂	Non-medical	>90%	3	Polyester/Polypropylene	Certified	>25k	Not considering
X ₂₃	Medical	<90%	3	Cotton	Certified	>25k	Considering
X ₂₄	Non-medical	<90%	<3	Polyester/Polypropylene	Uncertified	>25k	Considering

Table 3
Application of wearing masks of the sample (N = 123).

Characteristic	Characteristics' application	Frequency	Percent (%)
The practice of using masks	Always using masks in every activity	112	91.06
	Infrequently or use if necessary	11	8.94
Obtain the masks	Purchase on the market or drugstore	107	86.99
	Gifts or donations	10	8.13
	Self-production	2	1.63
	Others	4	3.25
Understanding the mask specification	Yes	107	86.99
	No	16	13.01

Table 3 represents the application details of wearing masks in section one of the questionnaire, which 91.06% of the respondents were regularly use face mask, and 86.99% purchase from the market or drugstore with proper specification understanding.

Subsequently, section 2 of the questionnaire is related to socio-demographic and Table 4 outlines the characteristics. The respondents are dominated with females' respondents (54.47%), 17–25 years age group (62.60%), education/study group (63.41%) in employment status, school graduates' group (41.46%) in education level, and spending more than 1 million Rupiah led the average expenditure characteristics.

This study also investigates the preferential differences of certain respondent group towards eco-friendly mask, including gender and average expenditure.

Step 4. The conjoint analysis implementation stage using data from section 3 of the questionnaire, describing preferences judgment of mask concept profiles. The user mask preference model is presented in equation (7):

$$\begin{aligned}
 P_{ef-m} = & \mu + \beta_{Type\ of\ mask} (non - medicalmask) + \beta_{Type\ of\ mask} (medicalmask) \\
 & + \beta_{Filtration\ efficiency} (< 90\%) + \beta_{Filtration\ efficiency} (> 90\%) + \beta_{Layers} (< 3 - ply) \\
 & + \beta_{Layers} (3 - ply) + \beta_{Materials} (Polyester / Polypropylene) + \beta_{Materials} (Cotton) \\
 & + \beta_{Mask\ certification} (Uncertified) + \beta_{Mask\ certification} (Certified) + \beta_{Price} (> Rp.25.000)
 \end{aligned}$$

Table 4
Socio-demographic characteristics of the sample (N = 123).

Characteristic	Characteristics' specification	Frequency	Percent (%)
Gender	Female	67	54.47
	Male	56	45.53
Age (years)	12–16	7	5.69
	17–25	77	62.60
	26–35	14	11.38
	36–45	14	11.38
	46–55	8	6.50
	56–65	3	2.44
Employment status	Housewife/housekeeper	4	3.25
	In education/study	78	63.41
	Self-employed/entrepreneur	5	4.07
	Teacher/lecturer	17	13.82
	Full-time employment	9	7.32
	Part-time employment	1	0.81
	Not specified	9	7.32
Education	School graduate	51	41.46
	Diploma graduate	5	4.07
	Bachelor's degree graduate	48	39.02
	Master's degree graduate	16	13.01
Average expenditure	Doctoral graduate	3	2.44
	<1 million rupiah	58	47.15
	>1 million rupiah	65	52.85

Table 5
Dummy variable for level of each attribute.

Attributes	Levels	Dummy variable
Type of mask	Medical mask	1
	Non-medical mask	0
Filtration efficiency	Over 90% filtration	1
	Below 90% filtration	0
Layers	3-ply fabric	1
	Below 3-ply fabric	0
Materials	Cotton	1
	Polyester/Polypropylene	0
Mask certification	Certified	1
	Uncertified	0
Price	Rp. 1.500 – Rp. 25.000	1
	Over Rp. 25.000	0
Eco-friendly	Considering recyclability and biodegradable	1
	Not Considering recyclability and biodegradable	0

$$+ \beta_{Price} (Rp.1.500 - Rp.25.000) + \beta_{Eco-friendly} (Not\ considering) + \beta_{Eco-friendly} (Considering) + \epsilon \tag{7}$$

The application of dummy variable for each attribute follows the rules on Table 5.

The conjoint analysis form consists of two information, termed attribute importance (I_i) and the level utilities of specific attributes (U_i) or partworth functions.

a. Eco-friendly mask preferences from total respondent perspectives.

Table 6 provides a summary of the dummy variable for mask concepts profile of each attribute toward the value of responses from the total respondents and regression results.

The profile judgment by total respondents derives the fit (R Square) at 0.953, while the coefficient μ was specified at 1.354. However, precise estimation of coefficient of attribute (β_i) with the profile concept was described by the lowest standard error of the coefficient.

Fig. 3 demonstrates the attribute importance by total respondents followed this order: **Eco-friendly** (32.1%) > **Mask certification** (26.5%) > **Filtration efficiency** (19.8%) > **Price** (13.9%) > **Layers** (5.6%) > **Type of mask** (1.5%) > **Material** (0.7%). First importance

indicated the respondent willingness to consumed environmentally friendly product and guarantee to receive the original masks and accordance with health regulations, since many counterfeit masks in market. Further, the public expectation to use mask with better material ability to block the virus and followed by price which constantly a consideration on purchase the masks.

The last three attributes with minor importance score emerged as relevant issues regarding mask characteristic as a personal protective equipment, and the community should aware and understand these attributes in mask selection, as mentioned in the guidance and practical considerations by World Health Organization (2020). Generally, the lack information in the public about the various technical characteristics of a mask product in the market, which most of the respondents assume that the masks have the identically technical characteristic, therefore less considered in the preference for the use of masks. These issues should concern for policy makers and mask manufacturers to escalate the public awareness of these three important attributes before consuming.

Fig. 4 demonstrates the level utilities of specific attribute by total respondents from the significant effect on mask preferences followed this order: considering the ability recyclability and biodegradability (16%) > mask certification (13.2%) > more than 90% filtration efficiencies (9.9%) > price range from Rp.1500 - Rp.25.000 (6.9%) > 3-ply fabric layers (2.8%) > medical mask type (0.7%). The total respondent paid less attention to layers and mask type attributes during selection. Meanwhile, the users did not report any issue while selecting the mask produced from cotton material (1%) and polyester/polypropylene (0.3%). This differs from judgement of the eco-friendly level utilities, where polyester and polypropylene were not considered environmentally friendly materials (Hartanto and Mayasari, 2021).

b. Eco-friendly mask preferences by genders

The experiment of mask preferences by gender was conducted by splitting the respondent data to male and female groups. Regression resulted in R Square at 0.943 and 0.955, for the male and female, respectively, with coefficient μ of 1.471 and 1.255, correspondingly.

Fig. 5 describes the variation from the interaction among conjoint variables and socio-demographic characteristics, which price, type, and materials showed higher preferential importance on the male compared to female, while eco-friendly, certification, filtration efficiency and layers were extensive for the female. Furthermore, price attributes demonstrated significantly diverse effect to mask preference by the two groups.

Fig. 6 represents the detailed descriptions for level of each attribute by gender groups. The female groups showed slightly higher effect to consider the recyclability and biodegradability ability (16.4%), certification (13.5%), 90% filtration efficiency (10.3%) than male.

Evidently, the male group indicated more sensitive in price range from Rp.1.500 to Rp.25.000 (8.7%) than female. Therefore, price is a significant factor instigating the male purchasing behavior, and the pricing sensitivity of the manufacturers is a more valuable consideration in the male market.

The gender classes revealed a minor effect in preferences for the 3-ply fabric and medical mask types, with cotton and polyester/polypropylene revealed a lowest effect by male (1.4%) and (0.5%) over the female (0.7%) and (0.2%), respectively.

This shows an equal expectation on mask consumption and assumed genders do not significant influence preference, except in price ranging.

c. Eco-friendly mask preferences by average expenditure

The average expenditure on conjoint analysis was estimated by splitting the total respondent data into groups below and above 1 million rupiah. Regression resulted in R Square of 0.952 and 0.946, alongside coefficient μ of 1.385 and 1.325, for groups below and above 1 million rupiah, respectively.

Fig. 7 also describes the influence of average expenditure on eco-

Table 6
The regression result for total respondent.

	Type	Filtration	Layers	Materials	Certified	Price	Eco-friendly	Responses
X ₁	0	0	1	1	1	0	1	3,08
X ₂	1	1	1	0	1	1	1	4,14
X ₃	1	1	0	0	1	0	0	2,43
X ₄	0	0	1	0	1	0	0	2,06
X ₅	0	1	1	1	0	0	0	2,00
X ₆	0	1	0	0	1	1	1	3,72
X ₇	1	1	0	1	0	0	1	2,65
X ₈	0	0	0	1	0	1	1	2,41
X ₉	1	0	1	0	0	0	1	2,24
X ₁₀	1	0	0	0	0	0	1	2,15
X ₁₁	1	1	0	1	1	0	0	2,50
X ₁₂	0	1	0	0	0	1	0	2,09
X ₁₃	0	1	1	1	1	0	1	3,45
X ₁₄	1	0	1	0	1	1	0	2,50
X ₁₅	0	0	0	0	0	0	0	1,71
X ₁₆	1	0	0	1	1	1	1	3,11
X ₁₇	0	1	1	0	0	1	1	2,93
X ₁₈	1	1	1	1	0	1	0	2,35
X ₁₉	1	0	1	1	0	1	0	2,03
X ₂₀	0	0	0	1	1	1	0	2,24
X ₂₁	1	1	0	1	1	1	1	3,86
X ₂₂	0	1	1	0	1	0	0	2,67
X ₂₃	1	0	1	1	1	0	1	2,85
X ₂₄	0	0	0	0	0	0	1	2,22
Coefficient	0,037	0499	0,141	-0,017	0666	0,349	0806	
Standard error	0,069	0068	0,068	0069	0,069	0069	0,069	

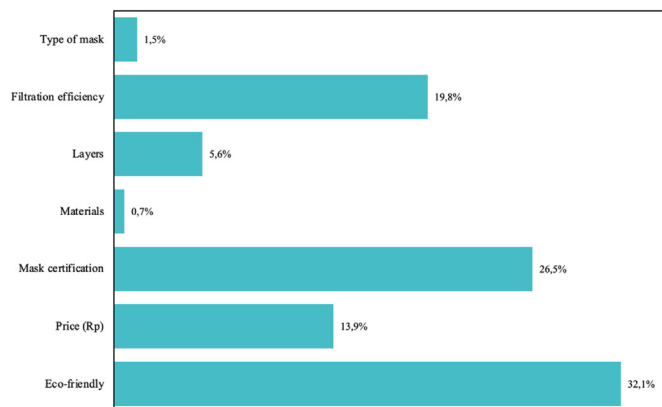


Fig. 3. Attribute importance score.

friendly preferences, which the attributes of eco-friendly, certification, and layers exhibited higher importance in <1M group compared to >1M. Subsequently, filtration efficiency, price and mask type showed considerable importance in >1M than <1M. The eco-friendliness, filtration efficiency and price assumed sensitive in the preferences with separately high effect between groups, and slightly different effect between groups for certification, layers, and mask type.

However, the >1M group was considered more willing to buy the mask with the highest safety performance and pricing sensitive, but not more eco-friendly compared to <1M group. Meanwhile, materials attribute showed the lowest and similar effect, therefore attribute is equally neglected between the two groups.

Fig. 8 represents level utilities score, the higher significant effect in preferences by <1M group are considering recyclability and biodegradability (18.2%), and certification (13.9%).

Furthermore, the >1M groups were willing to buy the mask above 90% filtration efficiency (11.4%) within the price range of Rp.1.500 - Rp.25.000 (8.1%) compared to <1M group.

Mask with 3-ply fabrics (3.3%) exhibit minor effect in preferences, as the <1M group is slightly more expectant in the criteria, and not the medical type (0.4%) than >1M group.

The two materials alternatives, including cotton (1%) and polyester/polypropylene (0.3%) showed lowest effect in preferences in both groups.

This shows the average expenditure varied in consumption and assumption of significant effect on preference.

Step 5. The accuracy of the prediction resulted in conjoint experiment toward preference responses calculated using equation (7) shows in Fig. 9, which consists of reactions of profile preference by respondent and the value of regression result.

The MAPE result was 4.2%, indicating very precise performance, and showed certain profile with nearly similar outcome, including X5, X6, X7, X10, X11, X13, X14, X18, X22, and X24.

Step 6. The conjoint result is beneficial to policy maker in encouraging public behavior in the use of eco-friendly mask and the producers, especially for designer during new product development.

4. Discussion

The traditional conjoint experiment satisfied to describe the variations of public preference and expectation in eco-friendly mask consumption, including in certain group.

The respondents seem to expect facemasks that are environmentally friendly and certified by official institutions with satisfy filtration efficiencies. Using of facemasks mentioned earlier in the advice and guidance of using facemasks by health authorities and organization, namely WHO, ECDC, and Ministries of health from various countries. However, choosing the environmentally friendly mask and certified product from official institutions have not been stated strictly as condition of facemask consumption. Accordingly, the government and policy makers shall urgently consider developing an appeal that encourage more people to use environmentally friendly masks with adequate filtration performance and certified by official institutions. The mask certification exhibit standardization of mask characteristic and production processes, while providing guarantee to public of a safety and healthy products.

Price is the fourth important attribute for respondents therefore the government needs to pay attention for the available of facemasks at

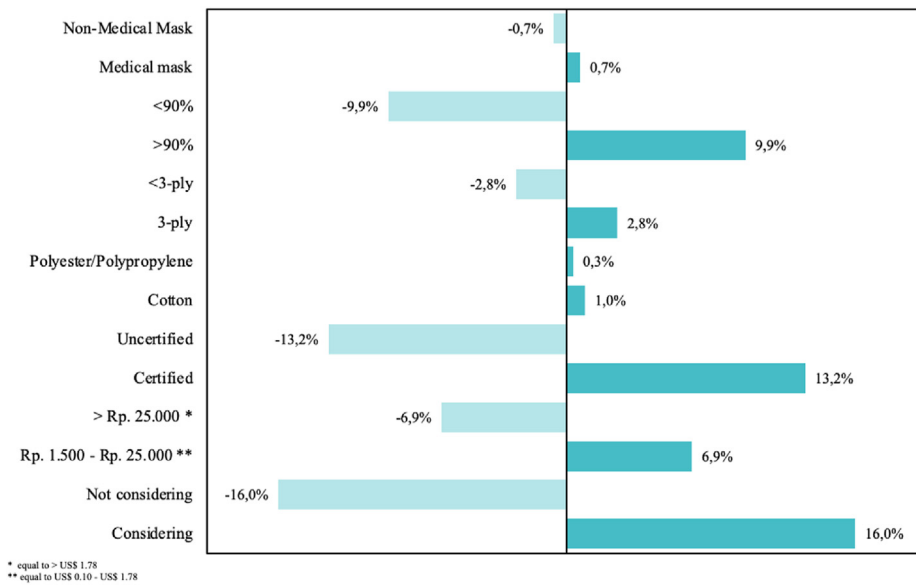


Fig. 4. Level utilities score.

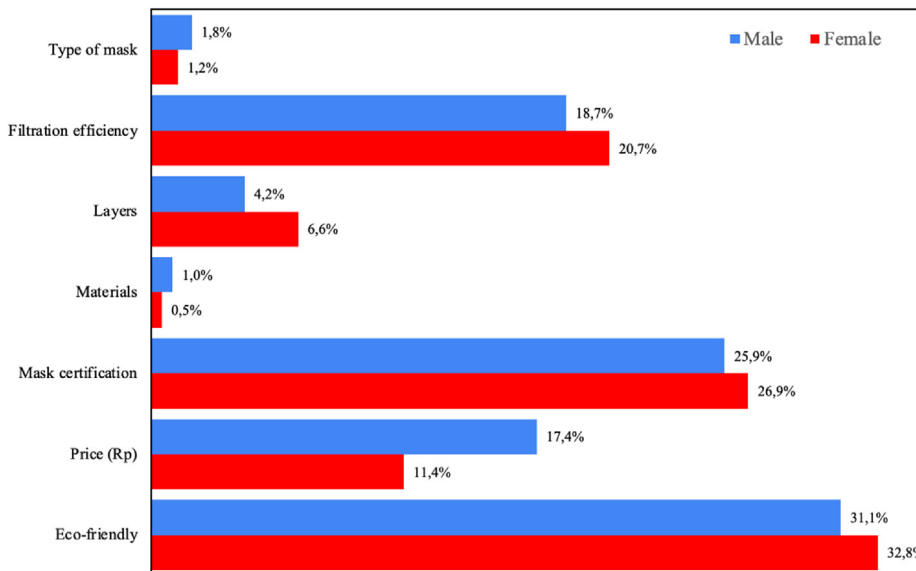


Fig. 5. Attribute importance score by genders.

affordable prices for all segments of society. The government could consider providing incentives and subsidies through various schemes, including tax reductions in terms of procurement of raw materials, equipment, and support to production cost. Furthermore, the motivations are believed to potentially instigate sustainable mask production at more affordable prices. Required efforts to enhance visibility and consumer preference, include using government policies to subsidize green product consumption (Kulshreshtha et al., 2017; Liobikienė et al., 2016; Liobikienė and Bernatoniene, 2017).

The respondents indicate does not considering the attributes of layers, mask type, and materials. Whereas results from various previous study is emphasizing these attributes as a critical factor in the protective face-mask during the pandemic, namely 3-ply fabric, use of medical and non-medical mask in certain conditions, and combination of material. The government need to design and organize education more effectively and applied through various channels, termed social media, television and radio network, public announcement, to encourage public awareness on those importance attributes, including emphasizing selection of eco-

friendly materials.

The total respondents are dominantly considering the eco-friendly mask. Therefore, producers need to be aware of the high public desire for eco-friendly products as a design necessity, with the ability to be recycled, well degraded and using more sustainable technology. Furthermore, manufacturers probably use Quilt and Cotton 600 TPI with 96.1% and 98.4% filtration efficiency, respectively as alternative materials (Hartanto and Mayasari, 2021).

The mask certification is a second consideration to guarantee optimal product performance and safety, and to ensure they offer predictable product performance when used by health workers (World Health Organization, 2020). This beneficial information is encouraging manufacturers to obtain mask certification from the official institutions and attaching on their product packaging.

The third expectation is a directive for manufacturers commitment to produce and sales a mask with above 90% filtration efficiency. The mask production by manufacturers should consider the material properties and their coating, the mask shape including the design, and the number of

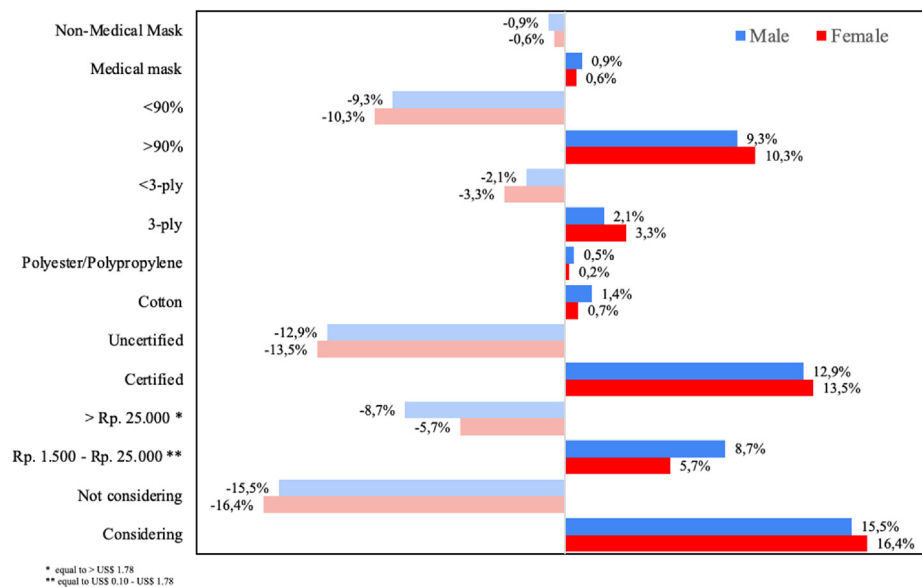


Fig. 6. Level utilities score by genders.

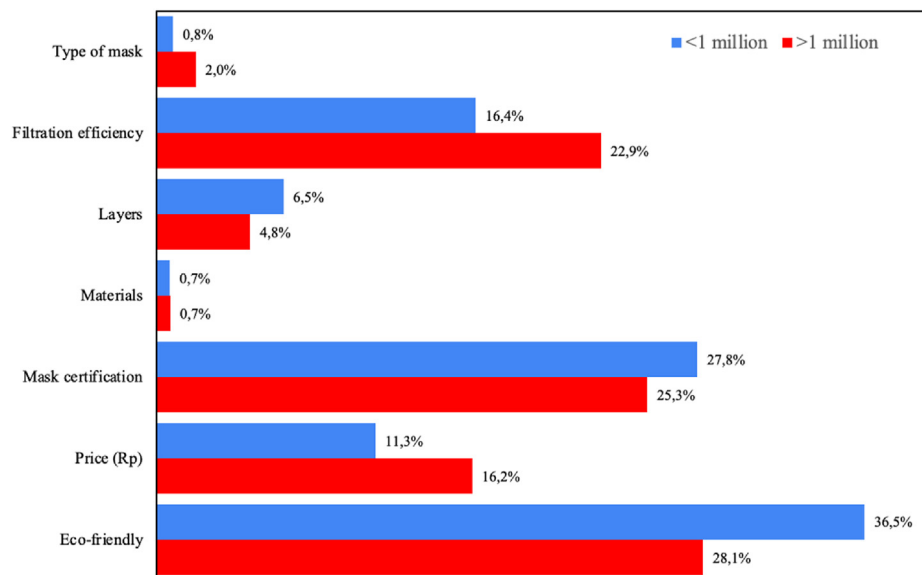


Fig. 7. Attribute importance score by average expenditure.

layers to gain the filtration efficiency. The material properties are regarding to the raw material to produce the cloth (natural, polymers based), fabric structure (woven, non-woven, knit, bonded), and the fluid resistance (hydrophobic and hydrophilic).

During COVID-19 pandemic, the price of masks is the fourth attribute importance and not overly considered or minor effect to preferences. Even though, several groups are sensitive to the prices, including the male and the >1M groups. The manufacturers necessary to regard pricing strategy, especially in the range of Rp.1.500 - Rp.25.000. Furthermore, implementing product discount, bundling sales, bonuses, and various marketing strategies are efforts towards ensuring the value of money and eco-friendly products appear more visible and attractive.

The layers, mask type, and material are also attributes with minor effect to preferences, and take it for granted by respondents, as indicated by low importance score. However, as stated in the guidance and practical considerations by World Health Organization (2020), manufacturers are expected to acquire the necessary standard criteria, comprising

material, breathability, temperature support, minimum number of layers, and hydrophobic tendencies.

5. Conclusion

Conjoint analysis has become a suitable method to describe the eco-friendly face mask preference during COVID-19 pandemic, with potentials to generate valuable information for policy makers and new product designers. The result fulfilled the goodness of fit, with R square of 0.953, which followed from the most important is eco-friendly, mask certification, filtration efficiency, price, layers, type of mask, material.

The public expectations including the mask with the ability to recycled and biodegradable, with mask certification and above 90% filtration efficiency, affordable prices in Rp.1.500-Rp.25.000, have 3-ply fabrics for the medical type and cotton material are generally preferred. An effectively appeal and education by government using various channels to enhance public awareness on use of eco-friendly mask and provide

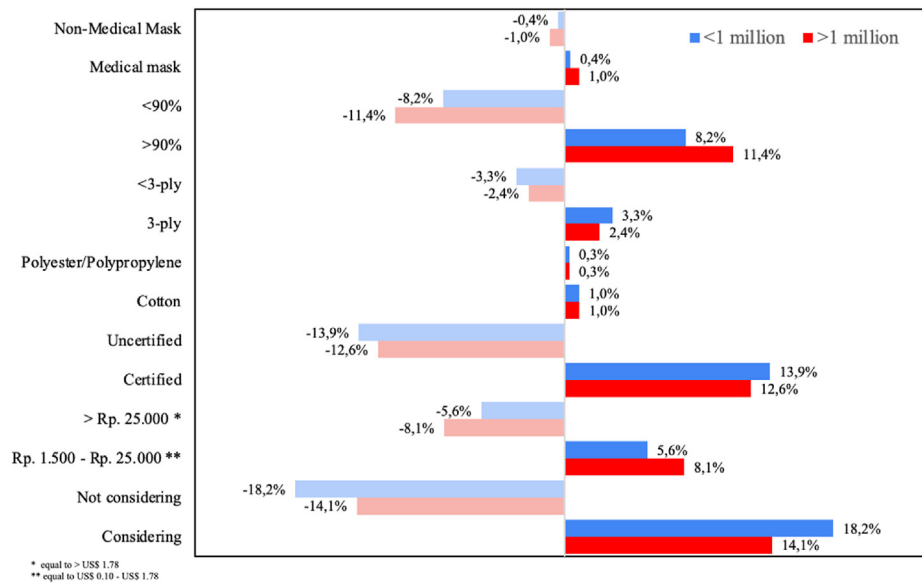


Fig. 8. Level utilities score by average expenditure.

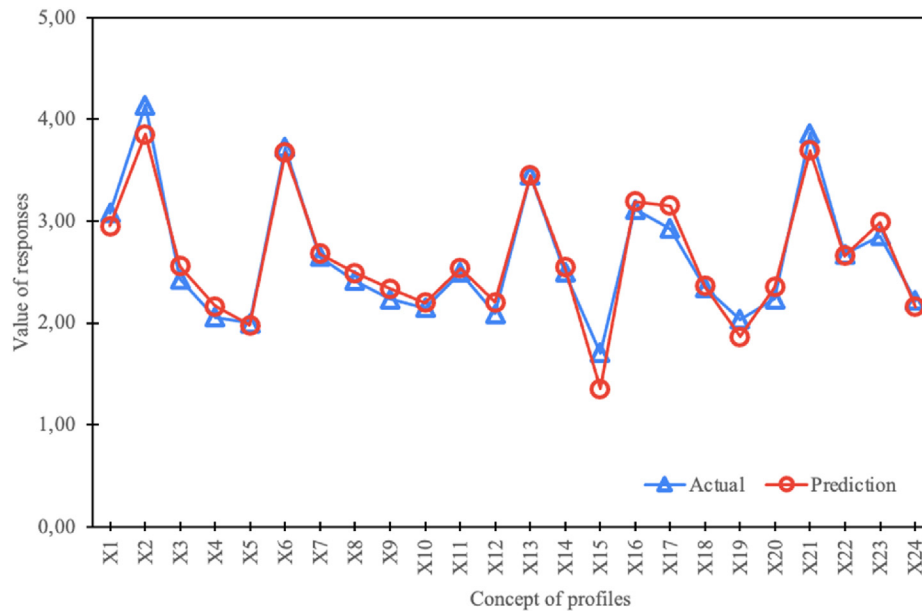


Fig. 9. The prediction accuracy test.

convenience for mask manufacturers in processing mask certification. Furthermore, provision of incentives is considered in order to reduce production cost. Manufacturers ensure proper design and produce of eco-friendly mask, and achieve standard criteria, according to consumer needs, in addition to developing affordable pricing and marketing strategies.

Based on the comparison of both groups toward eco-friendly mask, gender did not show significant effect on preferences, but varied with average expenditure.

The research shortcomings are the number of alternative combinations of attributes which must decide within the limited time and information are burdensome the respondent decision-making which affect the preferences. Addition of interviewing techniques can help generate a more balanced decision. Furthermore, this research did not evaluate the technical characteristics of masks attribute which may delicate on consumer preferences. Further studies tend to identify the technical characteristic of each attribute and level utilities as efforts in product

prototyping.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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