Public acceptance of banana leaf-filtered cloth masks as an alternative for medical masks

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ABSTRACT One of the most basic control measures to prevent transmission of Coronavirus Disease 2019 (COVID-19) is that everyone should wear face masks wherever there are potential exposures such as public spaces and when there are suspected symptoms of COVID-19 infection. In addition to adherence to public safety protocols, community compliance in wearing face masks is mainly influenced by the comfort when the masks are worn. Several mask developments have been made to improve the comfort and function of the masks, including a modified cloth mask with a banana leaf filter. This study aimed to assess the public acceptance of this modified mask that we previously developed. We conducted a survey using an adaptation of the instrument called, *the Usefulness, Satisfaction and Ease of Use (USE) questionnaire*. The respondents consisted of 99 people from the Family Welfare Program and Islamic study group members in Tlogoadi, Sleman. The data analysis was conducted descriptively. The majority of the respondents agreed that the banana leaf-filtered cloth masks were useful, easy to use, and satisfying to be worn. The highest indicators were ease of use (83%) and satisfaction (83%). However, only a small percentage (30%) of respondents were interested in making their own homemade masks.

1. Introduction

Since the World Health Organization (WHO) declared Coronavirus Disease 2019 (COVID-19) as a pandemic on March 11, 2020, several control measures must be implemented to control the spread of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). One of the control measures that has been proposed is that everyone should wear face masks wherever there are potential exposures such as public spaces and when there are suspected symptoms of COVID-19 infection. This protocol is to ensure the safety of both the medical personnel as well as the family members of those suffering from infection (patients with confirmed COVID-19), considering that the transmission route of SARS-CoV-2 is usually person-to-person through droplets, especially when someone is coughing, sneezing, and talking.[1]

The availability of medical masks, particularly at the beginning of the pandemic, was very limited. Currently, the commercial availability of face masks is sufficient. However, the qualities of some of them are questionable. The presence of pseudo-medical face masks at low prices ultimately can increase the susceptibility of contracting SARS-CoV-2 because they do not provide an adequate barrier to filter the virus.[2] In fact, several SARS-CoV-2 variants are emerging, leading to a higher transmissibility. Thus, more caution is needed.[3] Several mask modifications have been developed to improve the function in filtering the viruses. A study by Brooks *et al*.[4] which has become the basis for the newest Center of Disease Control and Prevention (CDC) recommendations, suggests to wear a combination of a medical mask coated with a cloth mask on the outside.

Nevertheless, the use of standardized medical masks is limited because the price is more

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expensive than that of the cloth masks. A study by Pratiwi[5] showed that 55% of the respondents did not wear appropriate masks due to their high price (unaffordable). Economic problems in the midst of the pandemic continues to cause people to choose masks which are more affordable or not to wear them at all.[6]

Another problem with the use of medical masks is the increased medical waste as a consequence of the increased number of cases and the prolonged COVID-19 pandemic.[7] Medical masks are non-reusable and disposable, meaning that they can only be worn once within a maximum duration of four hours, and therefore, contribute to the increased medical waste.

Based on these problems, we previously developed a modification of face masks (banana leaf-filtered cloth mask or "*Masker Godong-Gombal*" *[Masker Go Go]*) made of local materials which are affordable.[8] This newly designed mask has two characteristics: 1) it can be made from various types of used cloths; and 2) it is layered with a banana leaf filter. Our previous study showed that the combination of cloth masks with banana leaf filters had better *Bacterial Filtration Efficiency* (BFE) compared to the cloth face masks alone. This mask combination also had 61.8% water resistance.[8] In addition, banana leaves are natural ingredients that can be used directly and are environmentally friendly because they are biodegradable.

This present study then assessed the public acceptance of this banana leaf-filtered cloth mask. The results of this measurement can indicate the aspect of comfort when someone wears the banana leaf-filtered cloth masks. A mask that is comfortable to use will affect the community compliance to wear it.[9] Based on the ASTM-F2100 standard, the comfort of a mask is measured through a breathability test which refers to the ability of the mask to flow the air. Accordingly, the wearers are comfortable in breathing. Measurements are conducted by assessing the air pressure that flowed through the mask layers.[10] However, under limited conditions, these measurements can be conducted in different ways.[11] The present study assessed the comfort of the masks from the indicators of people's

perceptions or the acceptance of prospective mask wearers. The results of the study showed that 93% of the respondents wearing the banana leaf-filtered mask stated that they did not experience breathing difficulty. Therefore, it is concluded that the modified masks are comfortable to use.[11]

2. Methods

2.1 Study design

This study used a survey to assess the public acceptance of the banana leaf-filtered cloth mask that we previously developed.[8] This survey used *the Usefulness, Satisfaction and Ease of use (USE) questionnaire* with some adjustments. The use of the USE questionnaires aims to see the overview of public acceptance based on three aspects: 1) the usefulness: 2) the satisfaction; and 3) the ease of use.

The USE instrument in the English version has been tested and considered to be reliable (Cronbach's alpha 0.98) and valid (r: 0.60-0.82; p < 0.001).[12] The USE questionnaire used in this study has been adapted with a total of 18 questions used. The validity and reliability tests of the adapted version were done on the first 30 respondents. Based on the results of the validity test, there were 5 invalid questions and the reliability test showed 0.884.

2.2 The study participant

This study was conducted in November 2020 in Nglarangan village, Tlogoadi, Sleman. The village of Nglarangan consists of 6 neighborhood units with a total of 240 families. This village was chosen because it was one of the Red Zone areas in Sleman regency since the initial period of the COVID-19 pandemic. In addition, although Tlogoadi is only ±10 km from the center of Yogyakarta city, the characteristics of this area are categorized as a rural area. The use of a banana leaf layer in the masks is expected to be a solution for people in rural areas who can easily get banana leaves at no cost.

The research populations were the residents of Tlogoadi village, while the study participants were the residents who participated in the Family Welfare Program *(PKK)* and Islamic study group members at the Tlogoadi village. The researcher team joined those events, explained the study objective and

(a)

(b)

(c)

Figure 1. Mask package: (a) mask information flyer. (b) user manual. (c) package view.

procedures, performed the intervention, and collected the data. The respondents were asked to fill out the paper-based questionnaire. During the filling questionnaire process, the researcher team facilitated the study participants if they did not understand the study questions.

They all received a mask package that consisted of two masks and a guideline for the use (Figure 1). Before starting the Family Welfare Program and Islamic study activities, the people who were willing to participate were guided on how to wear the mask and asked to wear the banana leaf-filtered cloth mask. Towards the end of the event, the participants were asked to fill out the acceptance questionnaire on the use of banana leaf-filtered cloth masks for 90 minutes. The questionnaire consisted of three kinds of question groups, i.e. the questions of the respondent characteristics, mask acceptance questions (USE questionnaire), and essay (qualitative) questions. A qualitative question was only filled out if the respondent felt it was necessary to give suggestions
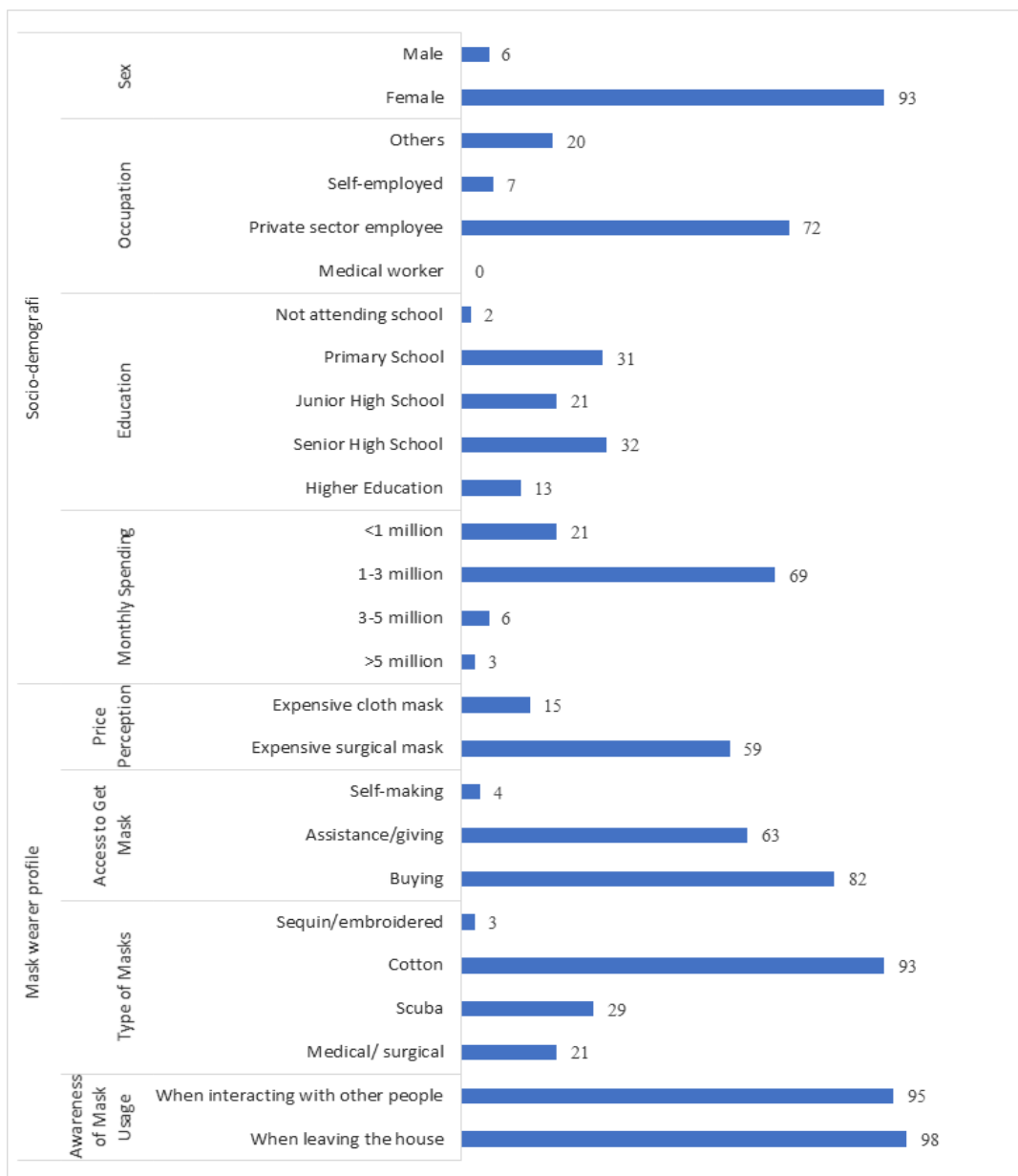
Figure 2. The characteristics of the respondents.

or corrections for the tested mask. The qualitative and quantitative data obtained were presented descriptively, without statistical analysis.

The total participants of Family Welfare Program and Islamic study group were 110 people but only 99 people met the participant criteria. The inclusion criteria for the participants in this survey are: adult men and women (>17 years old) and willing to participate in a series of survey processes. The exclusion criteria were people having respiratory disease or disorders. This number has met the minimum sample count.

2.3 Ethics statement

This study has received an ethical recommendation from the Medical and Health Research Ethics Committee of the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada (KE/FK/0831/EC/2020).

3. Results

3.1. Characteristics of respondents

The characteristics of the respondents in this study consisted of socio-demographic aspect and the mask

Table 1. Public acceptance of household cloth masks

Indicators	Question	Yes	
		n	%
Acceptance of household cloth masks	I know that cloths at home can be used for masks	89	89.9
	I want to make my own cloth masks	30	30.3
	I will make the masks from cloths available at home if I have my own sewing machine	32	32.3
	I will make the masks from cloths available at home if I have plenty of free time	37	37.4
	I will make the masks from cloths available at home if I do not have money to buy other masks	2	2.0

use aspect (Figure 2). Based on the socio-demographic aspects, the majority of the respondents spend 1-3 million per month (average regional minimum wage spending), have a minimum education of high school, do not work as health workers, and are female. The number of male respondents was very small because the study participants were obtained from the Family Welfare Program and most of them were females. In addition, we also obtained the study participant from the Islamic Study group. However, there were only few males who consented to participate in this study.

Furthermore, based on the aspect awareness of the mask use, the majority of the respondents wore masks when leaving the house or interacting with other people. The type of mask used was a cotton cloth mask and only 21 (21.2%) participants used medical (surgical) masks giving the reason that the majority of them thought medical masks were expensive. In addition, the majority of respondents got the commercial masks by buying them themselves (not given from the government).

3.2. Public acceptance of banana leaf-filtered cloth masks

The public acceptance of the banana leaf-filtered cloth mask is shown in the following graph (Figure 3). The measurement results using the USE questionnaire showed that the majority of respondents agreed that banana leaf-filtered cloth masks were useful and easy to use. In addition, the majority also expressed their satisfaction when wearing the mask.

The highest acceptance indicators were shown in the aspect of ease of use and satisfaction during the wearing. However, in the indicator of *"ease of use"*, there were 13 respondents (13.13%) stating as *"indifferent"*, meaning undecided or no difference. In addition, the measurement for the public acceptance of banana leaf-filtered cloth masks was also completed with some additional questions filled out by some respondents presented in Figure 4.

Figure 4 delineates suggestions from the 23 respondents for the tested masks. The results show that the majority of respondents stated that the masks were well-accepted. However, several suggestions or inputs were also conveyed as presented in Figure 4, including the need to increase the width of the nose and mouth section, the consideration to use the appropriate fabric material, and the suggestion to make a mask model fitted for children.

3.3. Public acceptance of the household cloth masks

The measurement for the public acceptance of household cloth masks is intended to identify the community's willingness to make their own masks from disposable cloths in their respective households. The results of the data collection are presented in Table 1 which show that the majority of the respondents knew that household cloths can be used as mask material. However, the majority of the respondents stated that they were still reluctant to make their own masks. Although they had free time or a sewing machine, there was still low interest in making their own masks.
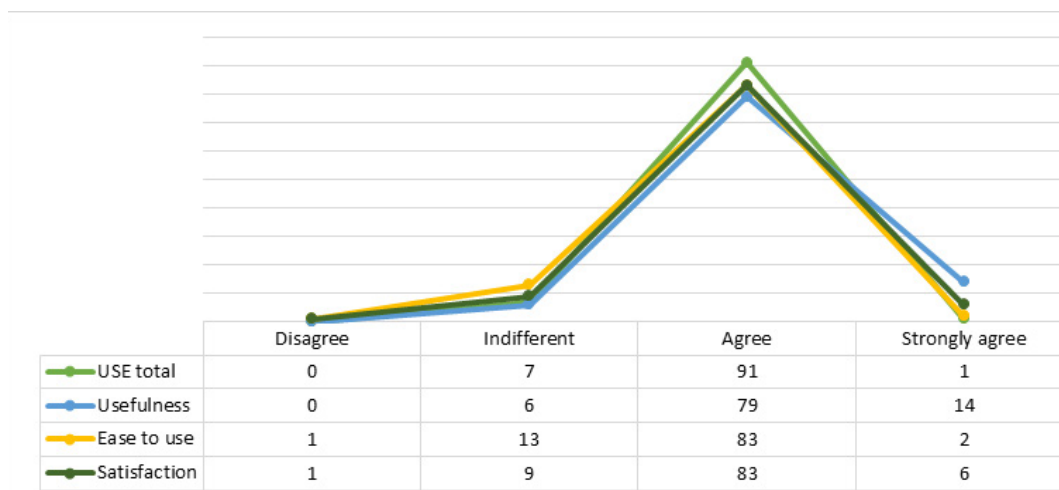
	Disagree	Indifferent	Agree	Strongly agree
USE total	0	7	91	1
Usefulness	0	6	79	14
Ease to use	1	13	83	2
Satisfaction	1	9	83	6

Figure 3. Public acceptance of the banana leaf-filtered cloth mask (n=99).

Good/ well-fitted, 5, 21%
Feeling uncomfortable with banana leaves, 2, 8%
Feeling comfortable with banana leaf layer, 4, 17%
The different inner layer absorbs more fluids, 1, 4%
The need to make the mask for children, 1, 4%
The width of nose section needs to be increased, 1, 4%
The width of mouth section needs to be increased , 9, 38%
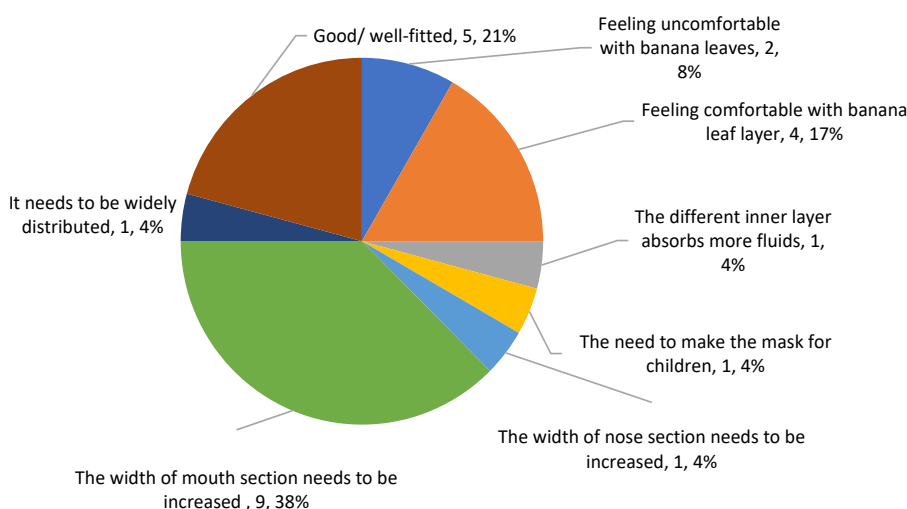It needs to be widely distributed, 1, 4%

Figure 4. Qualitative description of the public acceptance of innovated masks.

4. Discussion

The survey about public acceptance of wearing the banana leaf-filtered cloth mask (Figure 3) shows that the majority of the respondents accepted this mask, and the highest acceptance is because the mask was beneficial and easy to use. The respondent profile in wearing masks (Figure 2) demonstrated that the public awareness in wearing masks is already good in the majority of the respondents and the mask that was most chosen by the respondents is cotton cloth masks. Although most of the respondents are aware that it is possible to create masks by themselves, they were still reluctant to make the mask. They prefer to buy the masks because it is simpler and has an affordable price. Furthermore, the qualitative data (Figure 4) shows that the highest-three suggestions for the innovative masks are a mask with an increased width of the nose and mouth section, use appropriate materials, and provide mask fit for

children.

Despite having good filtration function, it is important that the ideal mask should consider the comfort when it is used.[9] This study examines the acceptance of respondents after wearing the cloth mask with a banana leaf filter for 1.5 hours. Our survey showed that the majority of respondents could accept the masks (total USE of 92%), and no respondents expressed any complaints or discomfort during wearing the mask.

Banana leaves are natural ingredients that can be used directly and are environmentally friendly because they are biodegradable. In our study, the use of banana leaves was to improve the functions of water-proofing and particle filtration. There are other studies that used natural ingredients to improve the function of masks. Asaduzzaman *et al*.[13] used natural ingredients to increase the bacterial filtration function by adding root extract of *licorice (Glycyrrhiza glabra)* to the mask material.

The selection of natural materials as a response to the prolonged pandemic conditions is considered to be essential because medical waste has the potential to cause new environmental problems.[14] The waste of personal protective equipment (PPE) from the use of gloves, masks, face shields, hazmat suits, and other stuffs has increased sharply. Meanwhile, the highest increase in PPE waste is due to the use of masks. The commercially available masks that have the most environmentally friendly impact are the non-reusable cloth masks. The energy loss in the production and decomposition process is only 0.036 kgCO2eq/usage, compared to surgical masks and N95 (> 0.05 kgCO2eq/single use).

Figure 2 shows that in general, the public awareness in wearing masks is already good, described by almost all residents who stated that they always wear masks when leaving the house or interacting with people other than the core family members. A survey conducted by the Indonesian *Badan Pusat Statistik (BPS)* around September 2020 also showed that the majority of people (91.98%) were aware to wear masks as an effort to prevent the transmission of SARS-CoV-2.[15] This description is also similar to the survey conducted in the same month by the Imperial College London in 26 countries including

Indonesia showing that 86% of people wear masks in public spaces. This percentage is much higher than the survey results in March 2020 (47%). The success on people's behavioral change to wear a mask is due to the awareness to take care of themselves, as well as a form of empathy to the social environment where the majority of people also wear a mask to protect others.[16] The impact of the mask mandate has been proven to reduce cases.[17] Payne *et al*.[18] reported that wearing a mask can reduce the risk of infection by 70%, and Adjodah *et al*.[19] showed that mask adherence is significantly associated with reduced COVID-19 incidence (-3.55 per 100K), deaths (-0.13 per 100K), and the proportion of hospitalization (-2.38 percentage points).

The type of mask chosen by most of the respondents in this study was a cotton cloth mask (93.9%). Several variations of mask materials are sold in the market, ranging from t-shirts and cotton, to the elastic materials commonly called as *"scuba"* masks. According to Davies *et al*[20], various household materials can be made as masks, such as t-shirts, pillowcases, towels, and kitchen rags. However, cotton is the most preferable material among others because it offers the higher level of comfort.

Almost all respondents stated that it was easier to get the cloth masks since more than half (59.6%) of the respondents said that surgical masks were more expensive than the cloth masks. The majority (82.8%) of the respondents got the commercially available masks by buying them themselves. A previous study showed that the access to affordable masks is an important factor in community compliance. The survey by the Indonesian BPS showed that one of the reasons people did not practice health protocols (using PPE) was due to the price that was considered expensive.[15]

The indicator of *"the acceptance of homemade masks from household cloth materials"* shows that the majority of the residents know that household cloths can be used as a mask material, but they are still reluctant to make their own. Although they have free time or a sewing machine, there is still low interest in making their own masks. This is related to the practicality, the ease, and the affordable price in getting the more commercially available cloth masks.

The qualitative data (Figure 4) show that the highest-three suggestions for the innovative mask are: 1) a mask with an increased in the width of the nose and mouth section; 2) utilizing appropriate materials; and 3) providing masks that fit for children. Masks with perfect fit size widely covering nose and mouth will give perfect protection in addition to its comfortable for use. Comfortable masks are associated with adherence in using a mask and will decrease unnecessary taking mask off.[21] The comfortable consideration is also related to the type of chosen mask material. The most comfortable cloth mask materials are cotton, linen, and silk. The comfortable indicators are able to breathe well (breathability), feel soft, and smell good to wear.[22] One of the challenges in using mask habits in a community is pursuing children to comply with the mask, because the children do not know the reason for wearing a mask.[23] Children's mask should be attractive with good design and fit. Hence, it will help children to wear the mask, leading to significant protection, the best functionality, and safety.[23,24]

The limitation of this study is that it is only implemented in one of the red zone areas in Sleman Regency, which is the city with the highest COVID-19 incidence. We do not compare with other red zone areas. Nevertheless, the results of this study are expected to be helpful for the community, especially in encouraging self-awareness to use masks without spending more money. They can make their own masks using the recommended materials from this study. Moreover, it is known from our previous study that banana leaves have the ability to filter the bacteria.[8] Therefore, it becomes an easy-to-obtain alternative to help people increase their self-defense against SARS-CoV-2.

5. Conclusions

The majority of the respondents agreed that banana leaf-filtered cloth masks were useful, easy to use, and satisfying. The highest indicators were the ease of use and the satisfaction during the wearing. In general, people's awareness in wearing masks was good, while the type of masks chosen by most of the respondents was made of cotton. Almost all of the respondents said that access to masks was easy, and the majority of them obtained more commercially available masks by buying them themselves. The indicator of "the acceptance of homemade masks from household cloth materials" shows that the majority of the residents knew that household cloth could be used as a mask material, but they were still reluctant to make their own.

Conflict of interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

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