

Number of Germs on the Inner Layer of a Cloth Mask

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ABSTRACT

The effectiveness of cloth masks is determined, among other things, by the filtration ability of the type of material used and the number of layers. There is still little information about the effectiveness of using cloth masks in terms of the number of germs and the length of time they are used. The study aimed to determine the number of germs present in 3-kind cloth of masks made from different types of materials and different durations of use.

This quasi-experimental study with a time series post-test-only design was carried out. The 3 types of cloth mask materials were tested on 37 workers from 3 minimarkets in the city of Yogyakarta, Indonesia and its surroundings. The germ was measured using the swab method after all respondents used the 3 masks everyday sequentially from 1st-3rd weeks. Data on the number of germs as many as 333 were analysed using ANOVA with a significant level of 0.05.

The results showed that there was no significant difference in the number of germs in the inner layers of the three different types of mask materials after 3 hours and 4 hours of use (p values 0.086 and 0.769). However, after 5 hours of use, the white cloth mask made from premium cotton showed the lowest number of germs significantly compared to the others (35.97 CFU, p-value 0.000). Cloth masks can be used by everyone to prevent transmission of Covid-19 and other diseases by replacing them every 5 hours of using.

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CI 95.2 to 98.8), cotton/silk hybrid (95% CI 92.2 to 95.8), and cottonblanket(95%CI94.2to97,8)[8].

Introduction

One of the ways to reduce the spread of the Covid-19 virus is by using masks [1]. Even though not all people comply with health protocols when in public places [2], the need for masks has increased in this new order era. Therefore, people need to have enough masks so they can change when the masks are damp and dirty. The use of masks for more than 4 hours, namely 6-8 hours, has a high risk of respiratory viruses [3]. Using it for too long may increase the number of germ colonies on the mask because, in the oral cavity, there are more than 700 types of bacterial species [4]. The highest average number of germs in the mouth was *Streptococcus Sp*, which was 277 CFU/m² [5].

To the researchers' knowledge, there is not much information about the length of time the use of three-layer cloth masks made of different materials has affected the number of germs caught on the inner layer of the cloth mask. This study will test the use of 3-layer cloth masks from different types of materials on the number of germs caught on the inner layer with 3-time variations. The hypothesis that is built is that there are types of cloth mask materials that are more effective in capturing germs within a certain time. The expected results can provide information to the public about choosing a 3-ply cloth mask from the right type of material and the maximum time for using or replacing it.

Method

Experimental research with a time series post-test-only design was carried out for 3 weeks in Yogyakarta, Indonesia. The research respondents were 37 workers from 3 minimarkets who were obtained by incidental sampling. Minimarket workers were chosen because visitors are a source of pollution in the room when they sneeze and cough without using proper ethics [9]. The independent variable is the use of 3 types of cloth mask coating materials (Masks A, B, and C), which can be seen in detail in Table 1. The dependent variable is the total number of germs (CFU/m²) which was measured using the swab method after all respondents used the 3 masks sequentially from 1st week to 3rd week. A detailed illustration of the use of masks can be seen in Table 2. The germ count is obtained by examining the inner layer or the 3rd layer

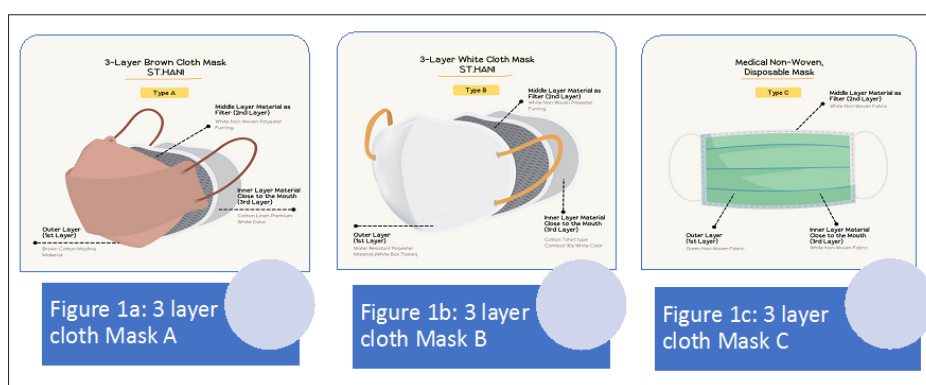
Cloth masks are widely used by the public in addition to standard masks on the market. Cloth masks made from rags can filter 73% of particles measuring 0.02 microns [6]. Cloth masks must be equipped with filters. The filter must be sandwiched between two layers of cloth [7]. In other words, the number of layers of cloth masks is at least 3 layers [6]. Filters on cloth masks are useful for holding back particles and making users feel more comfortable when breathing. The filter used must be replaced periodically. This is intended so that the filter is not inhaled by the wearer [7]. The fabric used for masks allows unobstructed breathing. Also, choose fabrics that do not have high amounts of lint or other synthetic materials that can be inhaled [7]. Laboratory-based studies show that only three fabrics exhibit >90% filtration efficiency. The three materials are cotton/chiffon hybrid (95%

which is close to the mouth after 3 hours, 4 hours, and 5 hours of use every day for 3 weeks. The examination of germ numbers was carried out at the Yogyakarta Health Polytechnic Environmental Laboratory. The time of the study was from August to September 2022. The germ count data obtained were analysed using ANOVA with a significance level of 0.05. This study was approved by the Health

Research Ethics Commission of the Yogyakarta Ministry of Health No. e KEPK /POLKESYO /0585/VI/2021, June 17, 2021

Table 1: Types of coating materials on 3-layer cloth masks on masks A, B, and C

Mask Type	3 layer mask		
	Outer layer (1 st layer)	Middle layer material as filter (2 nd layer)	Inner layer material close to the mouth (3 rd layer)
Mask type A is a brown cloth mask	Brown cotton Madina Material	White non-woven polyester furring	Cotton linen premium white colour
Mask type B is a white cloth mask	Water-resistant polyester material (white box taslan)	White non-woven polyester furring	Cotton t-shirt type combat 30s white colour
Mask type C is a medical, non-woven, disposable mask	Green non-woven fabric	White non-woven fabric	White non-woven fabric



Picture 1: 3 Kinds of the 3 Layers Cloths Mask A, B, and C

Table 2: Length of wearing masks, time, types of masks and number of mask samples

Length of use	Time		Types of mask coating materials A, B, C			The number of masks measured by the number of germs
			Mask A	Mask B	Mask C	
	Week	Day	Mask A	Mask B	Mask C	
3 hours	1 st	Monday	V			37
		Tuesday		V		37
		Wednesday			V	37
4 hours	2 nd	Monday	V			37
		Tuesday		V		37
		Wednesday			V	37
5 hours	3 rd	Monday	V			37
		Tuesday		V		37
		Wednesday			V	37
Number of mask samples			111	111	111	333

Research Result

Characteristics of Respondents

Respondents amounted to 37 people, 81.1% were women. The largest percentage of respondents is in the 35-44 year category (40.5%). The average age is 38.43 years, the youngest is 20 and the oldest is 55 years. Respondents declared themselves healthy as much as 94.6%. Details can be seen in Table 3.

Table 3: Characteristics of Respondents

Variable		f	%
Gender	Male	7	18,9
	Female	30	81,1
	Total	37	100
Age (years)	15-24 years	4	10,8
	25-34 years	8	21,6
	35-44 years	15	40,5
	45-54 years	9	24,3
	55-64 years	1	2,7
	Total	37	100
Healthy	Health	35	94,6
	Unhealth	2	5,4
	Total	37	100

Number of Bacteria

The germ rate 3 hours after the respondent wore a cloth mask with different inner coatings, can be seen in Table 4 below. Table 4 shows that mask B catches fewer germs than mask A and mask C. However, statistical analysis shows that there is no significant difference in the number of germs for the various types/materials of the inner lining of the mask (p value 0.086).

Table 4: The number of germs in cloth masks of different types of material after 3 hours of use

Variable		Number of Bacteria (CFU/m ²)			
		X ± SD	Min-max	F	.p value ^a
The type of coating material on the mask	Mask A (n ₁ =111)	31,73±18,02	11-85	2,509	0,086*
	Mask B (n ₂ =111)	27,86±16,10	8 -80		
	Mask C (n ₃ =111)	36,28±14,81	13-76		

^aAnova test.

*Level of significant 0,05

The germ count obtained in the measurement 4 hours after the respondent wore a cloth mask with different types of inner lining, can be seen in Table 5 below. Table 5 shows that mask B catches fewer germs than mask A and mask C. However, statistical analysis shows that there is no significant difference in the number of germs for the various types/materials lining the inside of the mask (p value = 0.769).

Table 5: The number of germs in cloth masks of different types of material after 4 hours of use

Variable		Number of Bacteria (CFU/m ²)			
		X ± SD	Min-max	F	.p value ^a
The type of coating material on the mask	Mask A (n ₁ =111)	28,08±6,98	14-47	2,509	0,086*
	Mask B (n ₂ =111)	27,54±16,55	11-90		
	Mask C (n ₃ =111)	29,73±15,18	11-69		

^aAnova test

* Level of significant 0,05

The germ count measured 5 hours after the respondent wore a cloth mask with an inner coating of different types, can be seen in Table 6 below. Table 6 shows that Mask A catches fewer germs than Mask B and Mask C. Statistical analysis shows that there are significant differences in the number of germs for the various types/materials lining the inside of the masks (p value = 0.000).

Table 6: The number of germs in cloth masks of different types of material after 5 hours of use

Variable		Number of Bacteria (CFU/m ²)			
		X ± SD	Min-max	F	.p value ^a
The type of coating material on the mask	Mask A (n ₁ =111)	35,97±11,61	14-47	2,509	0,086*
	Mask B (n ₁ =111)	61,59±32,06	11-90		
	Mask C (n ₁ =111)	45,65±19,48	11-69		

^a ANOVA test

* Level of significant 0,05

Data analysis from Table 6, followed by Post Hoc (LSD). The Result stated that the Mask A caught the lowest number of germs significantly.

Based on Tables 4, 5, 6 and Figure 1, it is known that the inside of mask A can catch the least germs significantly compared to the use of Mask B and Mask C when used after 5 hours.

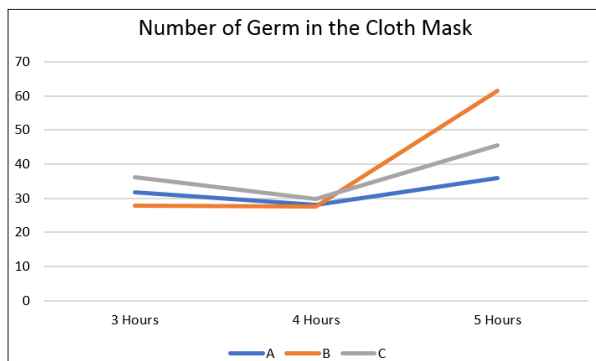


Figure 1: Number of germ in the face cloth's mask A, B, and C in 3,4,and 5 hours use

Discussion

The use of non-medical masks made of cloth is an alternative because they are simple, economical, and sustainable. Even though wearing a cloth mask with lower filtration efficiency than a surgical mask, it is still better than not wearing a mask at all when individuals are in groups of people who are at high risk [10]. Surgical masks are disposable only and are used specifically for the treatment of people infected with Covid 19 [11]. Cloth masks have an effective level of 7% -49% in trapping droplets released when people wearing masks sneeze, cough, or talk [12]. The filtration efficacy of cloth face masks varies. This depends on several things, including the type of material used, and the number of layers [13]. Cloth masks that are safe to use are layer 3 [12]. A single layer is only effective at reducing the number of droplets when used at a distance of < 30cm [14].

Many germs on the inner layer come from the wearer and germs come from outside. Germs originating from the wearer can be in the form of bacteria and viruses originating from the oral cavity. In the human oral cavity, there are many microorganisms, both normal and pathogenic flora. According to Miller and Cotton, a drop of saliva contains 50,000 potentially pathogenic bacteria [15]. According to experts from the Harvard School of Dental Medicine, there are more than 615 different types of bacteria in a person's mouth (16). In addition, germs can originate from the nose as the first place for oxygen to enter the body which is preferred by bacteria and germs to nest [16]. Coughing, sneezing, and talking activities have the potential to produce germs.

Germs that come from outside the individual can be reduced by using masks including cloth masks. The impact of using masks is determined by the number of people who use masks and the length of time they are used [17]. Transmission of the virus could be halved if 50 percent of the population wore masks. If 80 percent of the population wears a mask, the virus can disappear [17]. In this regard, it is very reasonable that several countries strictly enforce the use of masks during the Covid-19 pandemic [18].

The low number of germs in layer 3 of Mask A after 5 hours of use, shows the filtration ability of the 2nd layer or middle layer material. The 2nd layer of Mask A is made of polyester. Polyester

along with other materials (cotton, nylon, and silk fabrics) has a filtration efficiency of 5-25% [19]. In addition, the 3rd layer or inner layer which is close to the mouth is made of premium cotton linen. The material is like cotton which can absorb water. Thus the inner layer can reduce moisture.

Mask A is a mask that can last for 5 hours of use with the lowest number of germs (on the inner layer) compared to Masks B and C. However, its use should not be more than 5 hours because it will pose a risk of respiratory viruses [20]. As a precautionary measure, cloth masks are not recommended for healthcare workers, especially in high-risk situations [21]. In this study, the use of cloth masks was for ordinary people and was not recommended for use in medical services [13].

The limitation of this study is the possibility that there are differences in oral hygiene for each respondent. Efforts were made to minimize these limitations by believing the respondent's statement that 94.6% declared themselves healthy.

Conclusion

In the 3rd layer or the inner layer of a cloth mask made from premium cotton linen, there is the lowest germ rate compared to other materials, namely 35.97 CFU/m². Mask A 3-layer cloth mask, the first layer (outer layer) made of water repellent, the 2nd layer (middle layer) made of polyester and the 3rd layer (inner layer close to the mouth) made of premium cotton linen can be used by the general public for a maximum of 5 hours. then replace it with the same mask in the following hours.

Conflict of Interest

The authors stated, there is no conflict of interest in this research.

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