
The Potential Side Effect of the Face Mask

Yong Chhin Wai^{*}, Pon Jun Yee, Vaseela Rahima Binti Mohamed Thastheen, Charnishya a/p Jagathesa Rao, Adrian Dass a/I Simon Muthudass

Faculty of Medicine, Melaka-Manipal Medical College, Manipal Academy of Higher Education (MAHE), Melaka, Malaysia

Abstract

Face mask is a simple, loose fitting and disposable device that helps to block large particle droplets that may contain germs. It is widely used by the medical professions to maintain a sterile field during a surgery. On early January 2020, the general population was ordered to use face mask after the rapid spread of coronavirus worldwide. Therefore, face mask is playing an important role in controlling the spread of this virus. Its quality on daily wear is really an important issue to be studied so that it would be more protective and comfortable on wearing. This research was designed to study the important potential side effects of face mask and to determine the factors associated with skin allergy, headache, breathing difficulty, sight discomfort and skin breakdown when wearing a face mask. An analytical cross-sectional study was conducted from December 2020 to January 2021. A study population of 1500 undergraduate students in Melaka Manipal Medical College was selected. Purposive sampling was used to enroll students for this study and they were asked to answer the questionnaire. Frequency table, percentages, odd ratio and Chi-square test were used for data analysis. All the statistical significances were tested by two-tailed test ($p \leq 0.05$). A total of 183 medical students participated; 21.86% of the students experienced breathing difficulty problems while wearing the mask while 78.14% were not experiencing it. Besides that, 21.31% of the students participated reported having itchiness while wearing it and 78.69% of them did not have itchiness. Furthermore, 14.21% of the students experienced redness while wearing it. 132 students which is 72.13% showed presence of acne problem while wearing face mask. There were 62.30% of the students felt pain while wearing the mask and 37.7% of them did not have it. Dizziness or fatigue was experienced by 23.50% of the students which is 43 of them while wearing face mask. Last but not least, 67.76% of the students participated showed that sight discomfort was one of the problems faced by them while wearing face mask. In conclusion, the COVID-19 pandemic has forced the global population to adopt new ways of living, including the wearing of masks as a new norm. It has even accelerated R&D efforts in mask materials and design to offer better protection for users against airborne pollutants and pathogens. Mask wearing can be effective in the containment of communicable diseases.

Keywords

Side Effects, Face Mask, Cross Sectional Study, Undergraduate Students

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1. Introduction

According to the Cambridge dictionary, face mask is defined as a device worn over the nose and mouth to prevent you from breathing in harmful substances such as bacteria or pollution or from breathing bacteria or viruses onto anyone

else [1, 2]. Within a short span of time, thousands of cases were confirmed worldwide and World Health Organization (WHO) officially announced a pandemic outbreak on January 30, 2020. In January 2020, the first case in Malaysia was diagnosed in a foreign national individual entering the

* Corresponding author

E-mail address: cwy.yong@gmail.com (Y. C. Wai)

country and in February, the first local Malaysian case was identified [3]. Due to the spread of coronavirus through respiratory droplets, both the general population and healthcare professionals were ordered to wear a face mask as a preventive measure [4, 5]. In August 2020, Malaysia made it mandatory to wear a face mask in public places. As a result, public has to wear face mask for a prolonged period which causes many unwanted effects [6].

Even though wearing a face mask is a preventive measure to control highly contagious diseases such as tuberculosis, SARS or the current COVID-19, face mask does have its unwanted effect on the other hand [7]. Wearing a face mask causes quality of work to be less effective. The communication between two persons or a group of people are compromised as the quality and volume of speech are both affected [8]. Sometimes, the disposal of used face mask is inappropriate and the general guideline for usage of face mask is not followed properly such as changing the single use mask or frequent touching of the front of face mask [9, 10]. Some populations also have false security believe that wearing a face mask can effectively prevent transmissible disease without practicing other preventive measures such as frequent hand washing, social distancing and avoid crowded places or avoid indoor gathering [11, 12].

The most common effect of wearing a face mask for prolonged period is skin allergy. According to our observation, skin allergy can be influenced by the frequency of changing a face mask, duration of wearing them, thickness, type, material of a face mask. Skin allergy can also be caused by few other factors on a certain population if they had medical history of allergy and recent change of any skin care products. Effect of prolonged face mask wearing might show different effects on people with different skin types. A total of 212 healthcare workers participated in a study conducted on 2006 where they were required to wear N95 face mask. In that study, around 37% participants said that face mask caused headache and around 32% of them complained that the headache frequency was more than six times in a month [13]. Thus, fatigue or dizziness which leads to headache is also one of the variables that is taken into account in our research. Headache caused by prolonged usage of face mask can be affected by a few variables such as thickness, material, type, sealing of face mask, previous medical history of anemia, duration and frequency of changing a face mask [14].

Furthermore, prolonged usage of face mask can cause breathing difficulty but it is said to be experienced more in population who already have certain medical conditions such as severe chronic lung disease [15, 16]. Face mask can cause slight discomfort which may potentially lead to certain problems such as dry eye and fogging of spectacles lenses

[17]. This is because the exhaled air which is carbon dioxide is directly moving to the eyes before released to the environment [18]. Sealing of face mask influences formation of dry eyes and fogging of spectacles. Does prolonged wearing of face mask only has effect on the face? It can root to the problem of skin breakdown on the back of the ear and nasal bridge further [19]. Due to the constant irritation to the skin, it might cause problems such as skin breakdown around ears and nose [20]. In New York City, a study conducted to understand further the adverse effect of prolonged face mask use among healthcare professionals during COVID-19 shows that majority of respondents of 314 participants out of a total of 343 participants (91.5%) reported one or more adverse effects while 29 participants (8.5%) reported none of these adverse effects.

There are a few studies which had been conducted in the past to acknowledge the effects of wearing the face mask during the SARS outbreak [21]. Extensive studies had been performed this year to recognize the effect of wearing face mask for prolonged period among the healthcare workers, but the focus of our study would be on undergraduate students in a private medical college. By acknowledging and accepting the side effects of wearing a face mask, we can facilitate a better version of face mask in the future and achieve the desired effect of wearing face mask [22, 23]. It is important to realize these effects as wearing a face mask is one of the simple and low cost non-pharmaceutical interventions to protect oneself from respiratory infections [24, 25]. As to our understandings, there is no study conducted in the past regarding this issue among students of Melaka Manipal Medical College.

The objective of our research is to study the important potential side effects of face mask and to determine the factors associated with skin allergy, headache, breathing difficulty, sight discomfort and skin breakdown when wearing a face mask.

2. Methods

2.1. Study Design, Study Population, Time & Setting

This study is an analytical cross-sectional study which was conducted among the undergraduate students in Melaka Manipal Medical College (MMMC), Malaysia from December 2020 to January 2021. It is a private medical college which consists of one campus in Bukit Baru, Melaka and another campus in Muar, Johor. The population size of this college was approximately 1500 students. There is a total of three programmes in this college, which include Bachelor of Medicine and Bachelor of Surgery (MBBS), Bachelor of

Dental Surgery (BDS) and Foundation in Science (FIS).

2.2. Sampling and Sample Size

Purposive sampling was used to enroll students for this study, which is a non-probability sampling method. Melaka Manipal Medical College students from MBBS in the Muar campus and Melaka campus were selected to participate in this study. Students from BDS and FIS programme were also selected.

The inclusion criteria were that the student must be an undergraduate student of Melaka-Manipal Medical College, both male and female with age more than 16 years old and willing to provide consent. The exclusion criteria include students who didn't complete the questionnaire.

Based on a previous research on adverse effects of prolonged mask use among healthcare professionals during COVID-19, the prevalence of skin breakdown was 56%. Sample size (n) was calculated using 'Epi Info version 7.2.4.0'. With the population size of 1500, expected frequency 56.0% [7], confidence limit of 0.07 (7%), the minimum sample size required is 171. Non-response percentage of 20% was allowed and sample size was calculated by using the formula below: -

$$\begin{aligned} n(\text{final}) &= n(\text{calculated}) / 1 - \text{non response\%} \\ &= 171 / 1 - 0.2 \\ &= 213.75 \end{aligned}$$

Therefore, 214 was considered as the final sample size.

2.3. Data Collection Method

The questionnaire consisted of two parts. The first part is the consent form and demographic data which consist of the students' roll number, age (in years), gender (Female or Male), programme (MBBS, BDS or FIS), nationality (Malaysian or International) and ethnicity (Malay, Chinese, Indian or others).

The second part included 34 questions regarding medical students' knowledge on different types of face masks and its side effects.

The questionnaire was distributed using electronic survey (Google form) to medical students from MBBS, BDS and FIS programmes in Melaka Manipal Medical College. Multiple choice questions were given.

2.4. Data Processing and Data Analysis

The data was downloaded from the Google form and was entered into Microsoft Excel. Epi info version 7.2.4.0 from the Centers for Disease Control and Prevention (CDC) was used to analyse all the processed data in our research. In this

research, our independent variables included frequency of changing a face mask, duration of wearing face mask, thickness of the face mask, type of the face mask, medical history, skin type, sealing of the face mask, tightness of the of face mask, formation of water vapour on face mask, temperature of face felt while wearing the face mask and wearing of spectacles. The dependent variables were breathing difficulty, itchiness of face, redness of face, acne formation on face, sight discomfort, skin breakdown and headache. The quantitative data (age) was calculated with frequency, percentage, mean, standard deviation and range. All other data were categorical qualitative data. The frequency and the percentage of these data were calculated. The statistical test used in this research was Chi-square test for all the variables. Odds ratio was also calculated using the analysed data. Our level of significance was 5% (0.05).

Table 1. Variables and statistical tests used in data analysis.

Independent Variable	Frequency	Percentage (%)
Age		
<22	101	55.19
≥22	82	44.81
Mean (SD)	21.44 (1.57)	
Min-Max	18-25	
Gender		
Female	120	65.57
Male	63	34.43
Programme		
MBBS	94	51.37
BDS	80	43.72
FIS	9	4.92
Ethnicity		
Chinese	84	45.90
Indian	52	28.42
Malay	26	14.21
Others	21	11.48
Nationality		
Malaysian	167	91.26
International	16	8.74
Medical history Chronic illnesses		
Yes	13	7.10
No	170	92.90
Face allergy		
Yes	33	18.03
No	150	81.97
Respiratory illnesses		
Yes	20	10.93
No	163	89.07
Dry eye		
Yes	35	19.13
No	148	80.87

2.5. Ethical Consideration

Participants were informed that participation in this study was completely voluntary and participants can withdraw themselves from this study at any time without reason. All the information obtained were kept confidential and only be used for the purpose of this research. All the participants were asked to fill in the consent form provided at the

beginning of the questionnaire. This study was approved by the Research Ethics Committee of Faculty of Medicine, Melaka Manipal Medical College, Melaka, Malaysia.

3. Results

Table 2. Sociodemographic data of the undergraduate students participated in the study. (n=183).

Independent variables	Dependent variables	Statistical tests
Frequency of changing a face mask		
Duration of wearing the face	Breathing	
Thickness of face mask	difficulty	
Type of mask	Itchiness of face	Chi-square Test
Medical history	Redness of face	
Skin Type	Acne formation	
Sealing of face mask	Sight discomfort	
Tightness of the of mask	Skin breakdown	
Formation of water vapour	Headache	
Temperature		
Spectacles		

Table 2 shows the sociodemographic data of the participants. A total number of 183 out of 214 responses (response rate of 85.51%) were recorded. The ages of the participants were categorised into two groups, 101 participants were below 22 (55.19%) and 82 participants were more or equal to 22 years (44.81%). The mean age was 21.44 with a standard deviation of 1.57. Female participants (65.57%) showed a higher number compared to the male participants (34.43%) in our sample size. In term of programmes, we received the highest response from MBBS (51.37%) as compared to BDS (43.72%) and FIS (4.92%). In this college, there are more than three ethnicities, from which the Chinese community (45.90%) had the highest response, followed by Indian community (28.42%), Malay community (14.21%) and others (11.48%). From our sample size, we had more Malaysian participants (91.26%) than international participants (8.74%). Medical history of the participants was also playing an important role in this study. The number of participants with face allergy (18.03%) was the highest, followed by respiratory illnesses (10.97%), chronic illnesses (7.10%) and dry eye (19.13%).

Table 3 shows the responses of undergraduate students towards the face mask. The duration of wearing face mask included 1-2 hours (54.64%), 2-4 hours (27.57%), 4-6 hours (13.11%), 6-8 hours (3.83%) and more than 8 hours (0.55%). Next, water vapour formation on the face mask was seen in 62.84% of student population whereas not seen in 37.16% of population. The highest frequency was changing the face mask one per day (59.56%) and a few changed face mask once the mask was taken off (17.49%). Most of the participants reported that hours per face mask used was 2-4 hours (29.41%) and the hours of wearing face mask are more than 8 hours (13.73%) and 1-2 hours (13.73%). 66.67% of

participants reported that there is no sliding of face mask down during normal wearing while 80.23% reported that there is no sliding down of mask when they are not talking while wearing the face mask. The types of face mask worn were mainly medical face mask (98.36%), cloth mask (18.03%), N95 with valve (1.64%), N95 without valve (1.64%) and sponge mask (1.09%). Most of our participants prefer wearing 3ply face mask (79.23%).

Table 3. Responses of undergraduate students towards the face mask.

Independent variable	Frequency	Percentage (%)
Face mask:		
1. Duration of wearing		
1-2 hours	100	54.64
2-4 hours	51	27.87
4-6 hours	24	13.11
6-8 hours	7	3.83
More than 8 hours	1	0.55
2. Water vapour formation		
Yes	115	62.84
No	68	37.16
3. Frequency of changing		
Changes once i take off the mask	32	17.49
Once there is Water vapour	13	7.10
One per day	109	59.56
Two per day	10	5.46
Hours base	19	10.38
4. Wearing hours per mask		
1-2 hours	7	13.73
2-4 hours	15	29.41
4-6 hours	14	27.45
6-8 hours	8	15.69
More than 8 hours	7	13.73
5. Sliding down of face mask		
Yes	61	33.33
No	122	66.67
6. Sliding while not talking		
Yes	17	19.77
No	69	80.23
7. Sliding while talking		
Yes	44	68.75
No	20	31.25
8. Type		
Cloth mask	33	18.03
Medical face mask	180	98.36
N95 with valve	3	1.64
N95 without valve	3	1.64
Sponge mask	2	1.09
9. Thickness		
I do not know	22	12.02
1 ply	2	1.09
2 ply	14	7.65
3 ply	145	79.23

Table 4. Responses of undergraduate students towards breathing difficulty while wearing face mask.

Breathing difficulty	Frequency	Percentage (%)
1. Temperature felt in face mask		
Cool and nice	3	1.64
Hot	80	43.72
Normal	100	54.64
2. Sealing of face mask		
Good sealing	131	71.58

Breathing difficulty	Frequency	Percentage (%)
Too tight	4	2.19
Too loose	48	26.23
3. Respiratory illness		
Yes	20	10.93
No	163	89.07
4. Breathe normally		
Yes	143	78.14
No, I feel difficult to breathe.	40	21.86

Table 5. Responses of undergraduate students towards face allergy while wearing face mask.

Face allergy	Frequency	Percentage (%)
1. Skin type		
Combination of dry and oily skin	84	45.90
Dry skin	7	3.83
Normal Skin	32	17.49
Oily Skin	46	25.14
Sensitive Skin	14	7.65
2. Skin care product changed		
Yes	66	36.07
No	117	63.93
3. Itchiness of face		
Yes	39	21.31
No	144	78.69
4. Itchiness occurrence		
After wearing mask	41	100
Before wearing mask	0	0
5. Itchiness increases after wearing		
Yes	92	50.27
No	91	49.73
6. Redness of face		
Yes	26	14.21
No	157	85.79
7. Redness occurrence		
After wearing mask	25	83.33
Before wearing mask	5	16.67
8. Redness increases after wearing		
Yes	85	46.45
No	98	53.55
9. Acne formation on face		
Yes	132	72.13
No	51	27.87
10. Acne occurrence		
After wearing mask	47	35.88
Before wearing mask	84	64.12
11. Acne worsen after wearing		
Yes	142	77.60
No	41	22.40
12. Type of allergy experienced		
Cosmetic allergy	2	5.88
Dust	3	8.82
Eczema	2	5.88
Food allergy	13	38.24
Medication allergy	2	5.88
Pet allergy	6	17.65
Pollen allergy	6	17.65

Table 4 highlights the next variable which is breathing, normal temperature was the highest recorded variable

(54.64%). 71.58% recorded to have good sealing, 26.23% had too loose sealing whereas 2.19% recorded to have a tight sealing. A percentage of 89.07% did not have any respiratory illness such as asthma, rhinitis, pneumonia and emphysema. Most of them agreed to have a normal breathing while wearing a face mask (78.14%).

Table 5 shows the highest reported skin type in this questionnaire was combination of dry and oily skin (45.90%). The lowest reported skin type was dry skin, which is only 3.83%. A low percentage of 36.07% said that they did not change any skin product within 2 months of time. As for itchiness while wearing a face mask, mostly did not experience any itchiness (78.69%) whereas occurrence of itchiness after wearing a face mask did appear in 41 participants. Itchiness increases after wearing face mask in percentage of 50.27% among the participants. As for redness, the highest occurrence after wearing a face mask was 83.33% while redness did not increase in 46.45% of participants. Moving on to acne, 72.13% had experienced acne problems and in that, 64.12% agreed that they had gotten acne beforehand. 77.60% did think that wearing a face mask worsens their acne problems. The types of face allergy experienced by the participants included cosmetic allergy (5.88%), dust (8.82%), eczema (5.88%), food allergy (38.24%), medication allergy (5.88%), pet allergy (17.65%), and pollen allergy (17.65%).

Table 6. Responses of undergraduate students towards sight discomfort while wearing face mask.

Sight discomfort	Frequency	Percentage (%)
1. Wearing of spectacles		
Yes	135	73.77
No	48	26.23
2. Discomforts		
Dry eyes	9	4.92
Fogging of the spectacles lenses	121	66.12
No problem	59	32.24
3. Dry eye		
Yes	35	19.13
No	148	80.87

Table 6 isolates most of our participants wore spectacles (73.77%). The factors that made them uncomfortable were dry eyes (4.92%), fogging of spectacle lenses (66.12%) and moderate number of participants had no problem with their sight (32.24%). Least amount of participants reported to have dry eye problem before wearing a face mask (19.13%).

Table 7 is the data about problems on the skin, 93.44% said to not have any impression while 6.56% had impression on their face after wearing a face mask. Pain was experienced on the back of the ear (53.55%), cheeks (11.48%), chin (1.09%), nose bridge (14.75%) while no problem seen in 37.70%.

Table 7. Responses of undergraduate students towards skin breakdown while wearing face mask.

Skin breakdown	Frequency	Percentage (%)
1. Impression on face		
Yes	12	6.56
No	171	93.44
2. Pain		
Back of the ear	98	53.55
Cheeks	21	11.48
Chin	2	1.09
Nose bridge	27	14.75
No problem	69	37.70

Table 8. Responses of undergraduate students towards headache problems while wearing face mask.

Headache	Frequency	Percentage (%)
1. Fatigue/dizziness		
Yes	43	23.50
No	140	76.50

Table 8 is our final variable which is headache. Fatigue or dizziness which will lead to headache was seen in 23.50% and not seen in 76.50%.

Table 9. Association between independent variables and breathing difficulty.

Independent Variables	Breathing Difficulty		Odds Ratio (95% CI)	Chi-square value	P-value
	Yes (%)	No (%)			
1. Respiratory Illness					
Yes	8 (40.0)	12 (60.0)	0.37 (0.14-0.97)	4.33	0.038
No	32 (19.63)	131 (80.37)	Reference		
2. Duration of wearing					
≤ 4 hours	34 (22.52)	117 (77.48)	0.79 (0.30-2.09)	0.22	0.640
> 4 hours	6 (18.75)	26 (81.25)	Reference		
3. Thickness of mask					
≤ 2 ply	1 (6.25)	15 (93.75)	0.24 (0.03-1.85)	2.21	0.137
3 ply	32 (22.07)	113 (77.93)	Reference		
4. Tightness of mask					
Yes	1 (8.33)	11 (91.67)	3.25 (0.41-25.96)	1.38	0.241
No	39 (22.81)	132 (77.19)	Reference		
5. Sealing of mask					
Good sealing	22 (16.50)	113 (83.70)	3.08 (1.47-6.47)	9.32	0.002
Bad sealing	18 (37.50)	30 (62.50)	Reference		

*Chi-square test was used.

Table 10. Association between independent variables and itchiness of the face.

Independent Variable	Itchiness		Odd Ratio (95% CI)	Chi-square value	P-value
	Yes (%)	No (%)			
1. Water vapour formation					
Yes	29 (25.22)	86 (74.78)	1.95 (0.89-4.32)	2.82	0.093
No	10 (14.71)	58 (85.29)	Reference		
2. Duration of wearing					
≤ 4 hours	28 (18.54)	123 (81.46)	0.43 (0.188-1.00)	3.95	0.047
> 4 hours	11 (34.38)	21 (65.63)	Reference		
3. Thickness					
≤ 2 ply	7 (18.42)	31 (81.58)	0.80 (0.32-1.98)	0.24	0.625
3 ply	32 (22.07)	113 (77.93)	Reference		
4. Tightness					
Yes	4 (33.33)	8 (66.67)	1.94 (0.55-6.83)	1.11	0.293
No	35 (20.47)	136 (79.53)	Reference		
5. Skin Type					
Normal skin	6 (18.75)	26 (81.25)	Reference	1.55	0.213
Dry skin	0 (0)	7 (100.00)	Undefined		
Oily skin	14 (30.43)	32 (69.57)	1.90 (0.634-5.62)		
Combination of oily and dry skin	13 (15.48)	71 (84.52)	0.79 (0.27-2.31)		
Sensitive skin	6 (42.86)	8 (57.14)	3.25 (0.19-12.94)		
6. Frequency of changing					
Change according to duration	26 (18.84)	112 (81.16)	0.57 (0.26-1.24)	2.04	0.153
Change due to reason	13 (28.89)	32 (71.11)	Reference		
7. Temperature felt					
Cool and nice	2 (66.67)	1 (33.33)	13.38 (1.13-158.28)	6.74	0.009
Hot	24 (30.00)	56 (70.00)	2.87 (1.35-6.10)		
Normal	13 (13.00)	87 (87.00)	Reference		
8. Face allergy history					
Yes	8 (24.24)	25 (75.76)	1.23 (0.51-2.99)	0.21	0.650
No	31 (20.67)	119 (79.33)	Reference		

*Chi-square test was used.

Table 9 shows association between independent variables and breathing difficulty. It is seen that students who were having respiratory illnesses were 0.37 times more likely to have breathing difficulty compared to students who did not have respiratory illnesses (95% CI for OR 0.14-0.97, P-value 0.038). The other variables that showed positive association was sealing of the face mask. People that had good sealing of the face mask have 3.08 more times likely to have breathing difficulty compared to those that have bad sealing (95% CI for OR 1.47-6.47, P-value 0.002). Last but not least, other variables like duration of wearing face mask, thickness of face mask and tightness of face mask have no significance with breathing difficulty problems

Table 10 shows association between independent variables and itchiness of the face. It is seen that students who were wearing face mask less than 4 hours were 0.43 times less

likely to have itchiness compared to students who were wearing the face mask more or equal to 4 hours. (95% CI for OR 0.188 to 1.00, P-value 0.047). The other variables that showed positive association was temperature. It is seen that people that felt cool and nice while wearing a face mask were 13.38 times more likely to have itchiness compared to the people who felt normal. (95% CI for OR 1.13-158.28, P-value 0.009). It is also seen that people who felt hot while wearing face mask were 2.87 more likely to have itchiness on their face compared to those who felt normal. (95% CI for OR 1.35 to 6.10, P-value 0.005). Other variables such as water vapour formation on the face mask, thickness of the face mask, tightness of the face mask, skin type, frequency of changing the face mask, and face allergy have no significance with itchiness problems.

Table 11. Association between independent variables and redness of the face.

	Yes (%)	No (%)			
1. Water vapour formation					
Yes	19 (16.52)	96 (83.48)	1.72 (0.69-4.35)	1.36	0.244
No	7 (10.29)	61 (89.71)	Reference		
2. Duration of wearing					
≤ 4 hours	15 (9.93)	136 (90.07)	0.21 (0.09-0.52)	12.94	<0.001
> 4 hours	11 (34.38)	21 (65.63)	Reference		
3. Thickness					
≤ 2 ply	6 (15.79)	32 (84.21)	1.17 (0.43-3.16)	0.10	0.754
3 ply	20 (13.79)	125 (86.21)	Reference		
4. Tightness					
Yes	2 (16.67)	10 (83.33)	1.23 (0.25-5.94)	0.06	0.801
No	24 (14.04)	147 (85.96)	Reference		
5. Skin Type					
Normal skin	1 (3.13)	31 (96.88)	Reference		
Dry skin	0	7 (100.00)	Undefined	0.22	0.636
Oily skin	4 (8.70)	42 (91.30)	2.95 (0.31-27.73)	0.98	0.323
Combination of oily and dry skin	14 (16.67)	70 (83.33)	6.20 (0.78-49.25)	3.77	0.052
Sensitive skin	7 (50.00)	7 (50.00)	31.00 (3.27-294.16)	14.90	<0.001
6. Frequency of changing					
Change according to duration	16 (11.59)	122 (88.41)	2.18 (0.91-5.23)	3.14	0.076
Change due to reason	10 (22.22)	35 (77.78)	Reference		
7. Temperature felt					
Cool and nice	1 (33.33)	2 (66.67)	4.5 (0.37-54.16)	1.66	0.197
Hot	15 (18.75)	65 (81.25)	2.08 (0.88-4.92)	2.85	0.917
Normal	10 (10.00)	90 (90.00)	Reference		
8. Face allergy history					
Yes	6 (18.18)	27 (81.81)	1.44 (0.53-3.93)	0.52	0.470
No	20 (13.33)	130 (86.67)	Reference		

*Chi-square test was used.

Table 11 isolates the independent variables associated with redness of the face. The significant variables were the duration of wearing mask and the combination of oily and dry skin. It is seen that students who wore face mask for less or equal to 4 hours were 0.21 times less likely to have redness on the face as compared to those wore mask more than 4 hours (95% CI for OR 0.09 to 0.52; P-value less than 0.001). Students with skin type of oily and dry skin combination were significantly 6.20 times more likely to

have redness on the face as compared to students with normal skin type (95% CI for OR 0.78 to 49.25; P-value less than 0.001). Other variables which are water vapor formation in the mask, thickness of mask, tightness of mask, skin type except combination of oily and dry skin, frequency of changing mask, temperature on face while wearing mask and history of face allergy do not show significant associations with the redness of face while wearing face mask.

Table 12. Association between independent variables and acne formation.

Independent Variable	Acne		Odd Ratio (95% CI)	Chi-square value	P-value
	Yes (%)	No (%)			
1. Water vapour formation					
Yes	84 (73.04)	31 (26.96)	1.13 (0.58-2.19)	0.12	0.720
No	48 (70.59)	20 (29.41)	Reference		
2. Duration of wearing					
≤ 4 hours	107 (70.86)	44 (29.14)	0.68 (0.27-1.69)	0.69	0.405
> 4 hours	25 (78.13)	7 (21.88)	Reference		
3. Thickness of mask					
≤ 2 ply	28 (73.68)	10 (26.32)	0.56 (0.16-2.16)	0.66	0.417
3 ply	104 (71.72)	41 (28.28)	Reference		
4. Tightness of mask					
Yes	12 (100.00)	0 (0)	Undefined	4.96	0.026
No	120 (70.2)	51 (29.8)	Reference		
5. Skin Type					
Normal skin	16 (50.00)	16 (50.00)	Reference	2.98	0.084
Dry skin	6 (85.71)	1 (14.29)	6.00 (0.65-55.66)		
Oily skin	38 (82.61)	8 (17.39)	4.75 (1.70-13.31)		
Combination of oily and dry skin	58 (69.05)	26 (30.95)	2.23 (0.97-5.13)		
Sensitive skin	14 (100.00)	0 (0)	Undefined		
6. Frequency of changing					
Change according to duration	98 (71.01)	40 (28.99)	1.26 (0.58-2.73)	0.35	0.555
Change due to reason	34 (75.56)	11 (24.44)	Reference		
7. Temperature felt					
Cool and nice	3 (100.00)	0 (0)	Undefined	1.46	0.227
Hot	62 (77.50)	18 (22.50)	1.70 (0.87-3.32)		
Normal	67 (67.00)	33 (33.00)	Reference		
8. Face allergy history					
Yes	28 (84.85)	5 (15.15)	2.48 (0.90-6.82)	3.24	0.072
No	104 (69.33)	46 (30.67)	Reference		

*Chi-square test was used.

Table 12 shows association between independent variables and the acne formation on the face. It showed students who felt tight while wearing a face mask were more likely to have acne problem compared to those who did not feel that their face masks were tight. (95% CI for OR undefined, P-value 0.026). Furthermore, students with oily skin were 4.75 times more likely to have acne on their face compared to those with normal skin. (95% CI for OR 1.70 to 13.31, P-value 0.002).

On the other hand, people that had sensitive skin are more likely to have acne compared to those who had normal skin. (95% CI for OR undefined, P-value 0.001). Last but not least, the variables like water formation on the face mask, duration of wearing the mask, thickness of the face mask, frequency of changing the face mask, temperature and face allergy shows no significance with acne problems.

Table 13. Association between independent variables and sight discomfort from wearing a face mask.

Independent Variable	Sight discomfort		Odd Ratio (95% CI)	Chi-square value	P-value
	Yes (%)	No (%)			
1. Wearing of spectacles					
Yes	120 (88.89)	15 (11.11)	88.0 (37.70-279.53)	105.18	0.001
No	4 (8.33)	44 (91.67)	Reference		
2. Duration of wearing					
≤ 4 hours	99 (65.56)	52 (34.44)	0.53 (0.22-1.31)	1.91	0.167
> 4 hours	25 (78.13)	7 (21.88)	Reference		
3. Tightness of mask					
Yes	116 (67.84)	55 (32.16)	0.94 (0.27-3.28)	0.01	0.933
No	8 (66.67)	4 (33.33)	Reference		
4. Sealing of mask					
Good sealing	87 (64.44)	48 (35.56)	0.54 (0.25-1.15)	2.59	0.108
Bad sealing	37 (77.08)	11 (22.92)	Reference		

*Chi-square test was used.

Table 13 shows association between independent variables and sight discomfort while wearing a face mask. The table shows the variables that could lead to sight discomfort which

were spectacles, duration, tightness and sealing of face masks. Firstly, those who wore spectacles were more likely to have sight discomfort (95% CI for OR 37.70-279.53, P-

value 0.001). Next, those who kept their mask on for less or equal to 4 hours were 0.53 less likely to experience sight discomfort. (95% CI for OR 0.22-1.31, P-value 0.167). Moving on, those who experienced tightness while wearing a face mask were 0.94 less likely to have sight discomfort.

(95% CI for OR 0.27-3.28, P-value 0.933). Last but not least, those with good sealing of face mask were less likely to experience sight discomfort. (95% CI for OR 0.25-1.15, P-value 0.108).

Table 14. Association between independent variables and skin breakdown from wearing a face mask.

Independent Variable	Skin Breakdown		Odd Ratio (95% CI)	Chi-square value	P-value
	Yes (%)	No (%)			
1. Wearing of spectacles					
Yes	91 (67.41)	44 (32.59)	2.25 (1.15-4.40)	5.73	0.017
No	23 (47.92)	25 (52.08)	Reference		
2. Duration of wearing					
≤ 4 hours	93 (61.59)	58 (38.41)	0.84 (0.38-1.87)	0.18	0.669
> 4 hours	21 (65.63)	11 (34.38)	Reference		
3. Face allergy history					
Yes	22 (68.75)	11 (33.33)	1.26 (0.57-2.79)	0.33	0.567
No	92 (61.33)	58 (38.67)	Reference		
4. Tightness of mask					
Yes	10 (83.33)	2 (16.67)	3.22 (0.68-1516)	2.42	0.120
No	104 (60.82)	67 (39.18)	Reference		

*Chi-square test was used.

Table 14 shows association between independent variables and skin breakdown from wearing a face mask. The table shows the variables that could lead to skin breakdown which were wearing of spectacles, duration, tightness and face allergy due to wearing a face masks. Firstly, those who wore spectacles were 2.25 more likely to have skin breakdown (95% CI for OR 1.15- 4.40, P-value 0.017). Next, those who kept their mask on for less or equal to 4 hours were 0.84 less

likely to experience skin breakdown (95% CI for OR 0.38-1.87, P-value 0.669). Moving on, those who experienced tightness while wearing a face mask were 3.23 more likely to have skin breakdown. (95% CI for OR 0.86-1.52, P-value 0.120). Last but not least, those with face allergy due to face mask were 3.22 more likely to experience skin breakdown. (95% CI for OR 0.57-2.79, P-value 0.567)

Table 15. Association between the independent variables and headache.

Independent Variable	Headache		Odd Ratio (95% CI)	Chi-square value	P-value
	Yes (%)	No (%)			
1. Chronic illness history					
Yes	8 (61.54)	5 (38.46)	6.17 (1.90-20.04)	11.27	0.001
No	35 (20.59)	135 (79.41)	Reference		
2. Duration of wearing					
≤ 4 hours	32 (21.19)	119 (78.81)	0.51 (0.22-1.17)	2.55	0.110
> 4 hours	11 (34.38)	21 (65.63)	Reference		
3. Thickness of mask					
≤ 2 ply	2 (12.50)	14 (87.50)	0.47 (0.10-2.16)	0.99	0.319
3 ply	34 (23.45)	111 (76.55)	Reference		
4. Respiratory illness history					
Yes	7 (35.00)	13 (65.00)	1.90 (0.71-5.12)	1.65	0.199
No	36 (22.09)	127 (77.91)	Reference		
5. Tightness of mask					
Yes	1 (8.33)	11 (91.67)	0.28 (0.04-2.23)	1.64	0.200
No	42 (24.56)	129 (75.44)	Reference		

*Chi-square test was used.

Table 15 shows the association between the independent variables and headache. It showed that the students with history of chronic illnesses were 6.17 significantly times more likely to have fatigue or dizziness that lead to headache while wearing mask compared to those students without chronic illnesses (95% CI for OR 1.90 to 20.04); P-value 0.001). The other variables were all found to be insignificant. The duration of wearing mask, thickness of mask, history of

respiratory illnesses and tightness of mask were not significantly associated with fatigue or dizziness while wearing a mask.

4. Discussion

During this COVID-19 pandemic, the ministry of Malaysia has made it mandatory to wear a face mask in public places

to reduce the spread of the COVID-19 virus. As a result, the community has to wear a face mask for a prolonged period of time which has evidently caused many unwanted effects [6]. The aim of this cross sectional study is to determine the important potential side effects of face mask and to study about factors associated with skin allergy, breathing difficulty, skin breakdown, sight discomfort and headache when wearing a face mask.

In this study, 21.86% of the participants had breathing difficulty while wearing a face mask. 71.58% recorded to have good sealing, 26.23% had too loose sealing whereas 2.19% recorded to have a tight sealing. Based on the previous study by Jennifer L. Scheid, it showed that cloth masks that were less tight fitting than N95 mask will have less impact on breathing resistance and this proofed that tightness of the face mask can lead to breathing difficulty. [39] Besides that, most of the participants had skin related problem such as itchiness, redness and acne problems. In all these three problems, acne had the highest significance which was a staggering 72.13%. 22.31% and 14.21% of the participants also complained about itchiness and redness respectively. A previous study done in New York also showed that 47.8% of participants had skin problems and 53.1% had acne problem. [7] Furthermore, our study showed that 4.92% of our participants had dry eyes and 66.12% had fogging of the spectacles while wearing a face mask. In a previous study, it was stated that the duration of wearing a face mask which exceeded more than 4 hours had a higher percentage of sight discomfort which was 78.13%. [30] This proofed that wearing a face mask will certainly cause sight discomfort in some people. Moving on, we found 53.55% of participants had experienced pain at the back of their ears and 11.48% of participants had experienced pain at the cheeks while wearing a face mask. A previous study showed 32.1% and 28.6% people had experienced pain at the back of ear and cheeks respectively too. Previous study also showed 42.9% of people had experienced pain at the nose bridge and 14.3% at the chin. [7] However in our study, it showed 14.75% and 1.09% of participants had experience pain at the nose bridge and chin respectively. Last but not least, our study showed that 23.5% of participants had problems of fatigue/dizziness while wearing a face mask, whereas a previous study done by Lim Et al. shows that 37.3% of healthcare workers experienced headaches while wearing a face mask. [37]

This study showed that there were no significant association between duration, thickness and tightness with breathing difficulty among the medical students. However, respiratory illness and sealing had significant association with breathing difficulty among the medical students. In this study, it was stated that 40% who had respiration illness experienced difficulty in breathing and 19.63% of them who did not have

respiration illness develop difficulty too. From the previous study on physiological and psychological impact of face mask by Jennifer L. Scheid, it showed an observational study of impact of wearing N95 mask on physiological outcome in patients with hemodialysis and showed 70% of them presented reduction in partial pressure of oxygen and 19% developed hypoxemia [39]. Among the students, 22.52% of them who wore mask for less than or equal to 4 hours experienced breathing difficulty and 18.75% of the students wore the mask for more than 4 hours did not experience breathing difficulty. From the previous study on physiological and psychological impact of face mask by Jennifer L. Scheid, it showed that prolonged use of face mask had been associated with complains of headaches, light-headedness and increased in perceived shortness of breath [39]. Besides that, about 6.25% of the students wore less than 2 ply mask experienced breathing difficulty and 22.07% wore mask with 3 ply experienced breathing difficulty. Other than that, based on the tightness of the mask, 8.33% of the students experienced breathing difficulty while wearing tight mask and 22.81% of them experienced breathing difficulty while wearing mask which was not tight. Based on the previous study by Jennifer L. Scheid, it showed that cloth masks that were less tight fitting than N95 mask will have less impact on breathing resistance [39]. Last but not least, 16.50% of the students with good sealing of face mask experienced breathing difficulty while 37.50% of the others with bad sealing experienced breathing difficulty.

Our study showed that 22.31% participants had itchiness while wearing the face mask. In this study, it showed significant association between temperature and itchiness of face. Those who felt hot and cool and nice when wearing a face mask were more likely to have itchiness compared to those who felt normal. Besides that, this study also showed significant between duration of wearing face mask and itchiness of face. Both of these were proven by an article done by Harry Dao, MD, FAAD, a dermatologist for Loma Linda University Health. [26] Dao said that, "Masks impose heat, friction and occlusion on the skin and when combined with a moist environment from breathing, talking or sweating. On top of that, the prolonged occlusion, heat and sweat can cause the skin to become dry, itchy and raw." [26]. Moreover, our study showed no significance between water formation on face mask, thickness, tightness of face mask, skin type, frequency of changing a face mask, face allergy and itchiness of the face. There was a high percentage (85.79%) of medical students showed that they had redness on their face while wearing face mask. In our study, significant association was shown between skin type (sensitive) and redness as well as a significant association between skin type (oily/sensitive) and acne. It means that

those who were having sensitive skin were more likely to have face redness problem whereas those who were having oily/sensitive skin were more likely to have acne problems compared to people that were having other skin type. A study conducted in New York also showed that there was 47.8% of participant reported about having sensitive skin problems while wearing face mask [7]. Furthermore, a significant association was shown between duration of wearing a face mask and redness. Those who wore face mask less than or equal to 4 hours were less likely to have face redness problems than those who wore face mask more than 4 hours continuously. Similar results were also seen in a previous study which was done in Korea [27], a significant association was shown between duration and redness of skin. According to that study, skin redness may due to more prominent blood vessels. [27] However, there was no significance between duration and acne formation. In addition, 72.13% of participants showed that they had acne problem while wearing face mask. A previous research done in New York also showed 35.3% participant have acne problem while wearing face mask [7]. Our study showed significant association between tightness of the face mask and acne. This also showed us that those who felt tight while wearing a face mask were more likely to have acne problem compared to those who did not feel tight while wearing a face mask. Skin condition brought on by prolonged wear of face mask is termed as maskne. [26] An article showed, even face masks that were not too tight on the skin can still lead to the development of acne [28]. Without a doubt, those who felt their face masks were tight will surely have a higher probability to get face acne, and this statement had been proven so in our study. However, there was no significance shown between redness and acne with water vapour formation, thickness of face mask, frequency of changing a face mask, temperature and face allergy. Lastly, there was no significant between tightness and redness of face.

This study showed that there were no significant association between duration of wearing a face mask, tightness of face mask and sealing of the face mask with sight discomfort among the medical students. However, wearing spectacles with face masks had a significant association with sight discomfort among the medical students. This study stated that a high percentage of students (88.89%) who wore spectacles experiences sight discomfort compared to those who did not wear spectacles. [29] Dr Lyndon Jones, a Professor from School of Optometry & Vision Science, University of Waterloo stated that people who wore glasses were well aware of this, shown by the annoying lens fogging that often occurs when breathing under a mask and when masks were worn for extended periods, this repeated evaporation may lead to dry spots on the ocular surface.

Next, it was stated that duration of wearing a face mask which exceeded more than 4 hours had a higher percentage of sight discomfort which was 78.13%. [30] More research was being done on the subject, but the onset of dryness symptoms with extended mask wearing is being called MADE (mask associated dry eye), says Kelly Nichols, O. D., Ph.D., M.P.H., dean of the School of Optometry at The University of Alabama at Birmingham, and widely recognized dry eye authority. Moving on to the next variable, a percentage of 67.84% reported to experiences sight discomfort due to tightness of the mask masks they were wearing. In addition, there was only a difference of 1.17% between those who experienced sight discomfort with those who did not while wearing a face mask. [31] Many suspect that the link between face masks and dry eye has to do with airflow. "When you exhale in a mask that does not have a tight fit, air can escape from the top of the mask and flow across the surface of eyes," says Steinemann. The moving air dries out the tear film, a thin layer of fluid covering the eye's surface. Poorly fitting masks can also cause problems, pulling down the lower eyelids slightly, causing incomplete eyelid closure. Last but not least, bad sealing of face mask affected 77.08% of the participants' sight which was higher compared to those with good sealing. A study stated that masks with a pliable nose-wire should be used, with attention toward fitting the shape of the wire to prevent air being directed toward the eyes. The same study gave few tips where masks can also be taped at the top to impede upward airflow, but care should be taken to ensure that lower lid excursion is not inhibited.

This study showed that there were no significant association between duration, face allergy and tightness with pain among the medical students. However, spectacles had a significant association with pain among the medical students. In this study, it was stated that 67.41% who wore spectacles experienced pain and 47.92% did not wear spectacles experienced pain due to wearing face mask. [32] A study of healthcare staff in China during the outbreak found that goggles were particularly tough on the skin, especially on the bridge of the nose. Among the students, 61.59% of those who kept their masks on for less than or equal to 4 hours experienced pain whereas 65.63% of them who kept the mask on for more than 4 hours experienced pain. [33] Wang and Parish stated that health professionals wearing PPE for extended periods of time had reported skin changes, most commonly the nasal bridge, cheeks, forehead and hands, including erythema, papules and maceration, leading to burning, itching and stinging and sometimes, to skin tears. Moving on to the next variable, higher percentage of pain was reported by those who had face allergy compared to those who did not have face allergy. [34] Contact of urticaria

was seen in a nurse in Wales being 'fit-tested' for a face mask. The chemical used for the testing was denatonium benzoate, which had been previously reported to cause urticaria and asthma. Last but not least, tightness of face mask was seen to affect 83.33% of the participants and only 60.82% were fine with the tightness of the mask. [35] A study in England by NHS England advised on preventing facial skin damage from wearing FFP2 and FFP3 masks said skin can be protected with proper tightness and careful doffing of a mask.

This finding also revealed that duration of wearing mask, thickness and tightness of mask and presence of any respiratory illnesses was not significantly associated with fatigue or dizziness that will lead to headache while wearing mask. However, the presence of chronic illnesses such as anaemia, hypertension and asthma was significantly associated with it. From the previous study, Lim et al. (2006) administered a survey to healthcare workers to determine risk factors associated with development of headaches, this study showed that there was 37.3% of healthcare workers experienced headaches while wearing face mask. The reason may be wearing a mask will restrict the air flow in the breathing zone in the mask, accumulation of carbon dioxide may occur in the zone. [37] Breathing in carbon dioxide of concentration of 4-5% may lead to dyspnoea, increased blood pressure, dizziness and headache. [38] Participants who had chronic illnesses were also more likely to have fatigue or dizziness while wearing mask. A study showed that both migraine and non-migrainous headache were approximately 1.5 times more likely among those with current asthma, asthma related symptoms, hay fever, and chronic bronchitis than those without. [39] This means that there is a high chance that wearing a mask may precipitate headache, fatigue and dizziness in individuals with chronic illnesses.

There were few limitations faced during this study. Firstly, this study was conducted among medical students picked from only one private medical college which was Melaka Manipal Medical College (MMMC) at one point of time. Thus, the results were not reflective of the current clinical practice in Malaysia, reducing the generalizability factor in our study. All the responders were undergraduate students. So we faced difficulties in approaching all of them as they are located in different campus. Secondly, it was difficult for us to communicate with them due to current pandemic. Furthermore, the results obtained from senior year medical students would have given us relevant data as they were already in their final year and were soon approaching their final year exam. Other than that, the respondents in our study might have given whatever they thought would be an acceptable response to the researcher, rather than revealing the whole truth or selected the answers that resonated with

them the most. Last but not least, due to total lockdown we, the team mates faced difficulties to communicate with each other and our mentor throughout the research project. Since similar studies were yet to be done in the future, we recommended for the future researchers to be aware of the limitations that yet to be faced.

The face mask will really cause side effects. The medical history of chronic illnesses and respiratory illnesses, sealing and tightness of the face mask, duration of wearing face mask, temperature within the face mask, skin type and wearing of spectacles were really contributing to the side effects of mask. These factors need to be addressed by selecting a new thin breathable material for filtration, changing the shape and sensitive skin friendly inner material of mask and alternating the way of wearing mask to avoid skin breakdown. It is also recommended to study the gender, type of mask, air concentration within the mask and type of allergy presence to further evaluate the side effects of mask in the future studies. This will provide a more protective, comfortable and fit mask not only for the healthcare workers but also for the community in order to fight with COVID-19 in the future.

5. Conclusion

In conclusion, the COVID-19 pandemic has forced the global population to adopt new ways of living, including the wearing of masks as a new norm. It has even accelerated R&D efforts in mask materials and design to offer better protection for users against airborne pollutants and pathogens. Mask wearing can be effective in the containment of communicable diseases. The surge in demand for surgical masks and respirators has led to a global shortage of supply and raw materials. As a result, many people have resorted to making their own masks, recycling used masks, or settling for masks offering less protection than actually needed.

Based on our research, the knowledge of side effects of face mask among the students in Melaka Manipal Medical College is fairly good. Due to frequent usage of face mask, the participants are aware of all the possible side effects of wearing them. By acknowledging and accepting the side effect of wearing a face mask, we can facilitate the better version of face mask in the future and achieve the desired effect of wearing face mask. Therefore, we can conclude that, although face masks cause many side effects, they are included in one of the low cost non pharmaceutical interventions and serves an important role to prevent spread of respiratory infections.

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