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Risk Perception and Willingness to Perform Basic Life Support Following the 2019 Coronavirus Pandemic

Lim Yi Ern*, Liew Teck Vui, Sangkari Ramesh, Kalaivani Rajan, Thavisha Archani Arangala

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

Abstract

Up to 2020 June 09, Coronavirus disease 2019 (COVID-19), a novel pneumonia disease originated from Wuhan, has affected 8,329 people in Malaysia including 325 healthcare staffs. While it is a healthcare professional's duty to save people from this deadly infectious disease, it could be very intimidating to know that this highly infectious disease can be transmitted easily to themselves through droplets and close contact especially when they are performing Basic Life Support (BLS) which includes chest compression and mouth-to-mouth ventilation. Therefore, the aim of this research is to determine the perceived risk and willingness to perform Basic Life Support among medical students of Melaka-Manipal Medical College (MMMC) following the 2019 Coronavirus pandemic. A cross sectional study was conducted during May 2020 in MMMC. Purposive sampling was used to enrol students into this study and they were asked to respond to the validated online questionnaires designed to examine student's confidence in BLS skills, their perceptions of the risks associated with performing BLS and their willingness to perform BLS in varying situations. The analysis included frequency, percentages, mean, standard deviation, unpaired T-test, ANOVA, chi-square test and logistic regression. A total of 172 participants answered the questionnaire, including 119 fourth year students and 53 fifth year students. All of them underwent BLS training during 3rd year. 73.9% of the students were concerned about disease transmission during BLS and 83.8% of them stated that the risk of infection transmission was greater now than it was before the COVID-19 pandemic. Students seemed to be more willing to perform chest compressions only for both family members and strangers but were less willing to perform mouth-to-mouth ventilation in strangers although they were mostly willing to do so for their family members. The fear of COVID-19 was found to be the most important reason that would stop our respondents from performing mouth-to-mouth ventilation. There was a significant association between gender and perception of risk to the rescuer from performing BLS. It has also been found out that the more confident students felt about their skills in BLS, the more willing they were to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest. In conclusion, COVID-19 pandemic had affected the risk perception of our medical student to perform BLS but had not much effect on our medical students' willingness to perform BLS.

Keywords

Perception, Willingness, Basic Life Support, COVID-19, Medical Students, Cross-sectional

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1. Introduction

Basic Life Support (BLS) is a medical skill used to save victims from life-threatening emergencies such as cardiac arrest, as well as choking of foreign particles. [1] It has been shown to greatly improve the probability of survival of a person. [2] In fact, it is very important to know about BLS to save lives and improve the quality of community health

* Corresponding author
E-mail address: josephinelimyiern@gmail.com (L. Yi Ern)

especially outside of the hospital and it is compulsory for health care professionals to learn the skill since 1966. [3, 4] However, WHO has categorised that cardiopulmonary resuscitation (CPR) is an aerosol generating procedure (AGP), thus pose a significant risk of disease transmission to healthcare workers through droplets. [5] According to Centers for Disease Control and Prevention (CDC), one should be equipped with N95 facemask or a powered air-purifying respirator (PAPR), gloves, eye protection and full gown with long sleeves while performing any AGPs. [6] Although guidelines as such exists, the risk of infectious disease transmission from patients with acute respiratory disease to healthcare workers is still poorly understood. [7] Previous studies were even conducted and it shows the risk of virus transmitting through mouth-to-mouth ventilation is more than chest compression during CPR, thus creating reluctance among medically trained and lay rescuers to perform BLS, more specifically, mouth-to-mouth ventilation. [8, 9]

At the end of December 2019 an outbreak of cases of pneumonia of unknown aetiology appeared in Wuhan, China which was announced and notified to the World Health Organization (WHO) by the Wuhan Municipal Health Commission on 31st December 2019. [10] This COVID-19 pandemic was discovered in the Huanan seafood market in Wuhan city of China. [11] By the end of January 2020, 9720 cases of 2019-nCoV were confirmed throughout China, with further 15,238 suspected cases and 213 deaths. More worryingly, 106 cases were also confirmed abroad in 19 countries, from neighbouring countries such as Japan and Vietnam to more distant countries such as Finland, Canada, and Australia. [13] On 30 January 2020 this outbreak was declared as a Public Health Emergency of International Concern [14]. As of 18 May 2020 COVID-19 was affecting 213 countries and territories around the world. More than 4,618,821 cases had been confirmed globally while having the number of deaths rising up to 311,847. [15] The pathogen is found to be a novel enveloped RNA beta-coronavirus and has been named severe acute respiratory syndrome coronavirus (SARS-CoV-2). The clinical course of SARS-CoV-2 infection are mostly characterized by respiratory tract symptoms including fever, cough, pharyngodynia, fatigue, complications related to pneumonia and acute respiratory distress syndrome. [11, 12, 16, 17] To date, there's some uncertainty about the prevalence of extrapulmonary symptoms - those arising from gastrointestinal tract such as diarrhoea, anorexia, vomiting and some other uncommon symptoms such as headache, loss of taste and smell sensation, rash on skin or discolouration of toes. [18-20] Human-to-human transmission of SARS-CoV-2 has been widely shown in health care, community and family settings. The dominant mode of transmission is from the respiratory tract via droplets or indirectly via fomites, and to a lesser extent via aerosols. [10]

On 19 May, the Malaysian health authorities had reported total number of 6,978 cases of COVID-19 in Malaysia with death toll of 114, accelerated testing also revealed a comparatively low case fatality rate of 1.63% as of 19 May 2020. There were 1,218 active cases, with 11 in intensive care and 6 on ventilator support. Meanwhile, the total number of recovered is 5,646. [21, 22] According to Malaysian health authorities, a total of 325 medical workers had been tested positive for the COVID-19 virus. There were 185 medical workers that had recovered and been discharged but unfortunately 3 died from the COVID-19 disease. [23]

In view of this, it is not surprising if healthcare workers hesitate or even reject to perform BLS on patients during this COVID-19 pandemic. [24] Similar to COVID-19 (SARS-COV2), the SARS outbreak in 2003 is also a disease which has same mode of transmission that is through respiratory and contact routes. [25] The 2003 SARS outbreak in Hongkong had killed 6 healthcare workers with two of them probably contracted the disease after performing cardio-pulmonary resuscitation (CPR) on patients who were infected with SARS. [8, 26] This has definitely raise concerns among healthcare workers and will inevitably affect their willingness to perform BLS to save the lives of their patients.

According to a study done in 2005, which aimed to assess medical students' attitudes towards BLS following the 2003 SARS outbreak in Hong Kong, 52% of the medical students agreed on the fact that there was a higher risk of disease transmission through mouth-to-mouth ventilation following the SARS outbreak with 100% of the medical student agreed that the fear of SARS would not affect their willingness to perform BLS to their family members while only 80% of medical students agreed to perform BLS on strangers despite fear of contracting the disease. [8] In addition, another study was done to assess the effect of the SARS outbreak on Hong Kong bystander's willingness to perform BLS and it also revealed that SARS had adversely affect the willingness of lay communities to perform BLS, with a decrease from 87.2% to 84.9% of the respondents that agreed to perform standard CPR in pre-SARS era and in post SARS era. [27] As shown in the above studies, outbreak of such disease indeed has affected the attitude of medical and lay communities towards BLS although it has been shown to greatly improve the probability of survival of a patient, [25] any hesitation or delay in providing BLS to patients in need will definitely put their life at risk. It is therefore crucial to assess different communities' views towards BLS so that appropriate measures can be taken.

To date, there are a number of studies done regarding the COVID-19 pandemic but not much have been done regarding the perceived risk and willingness to perform BLS among medical undergraduates following the current on-going issue, especially in Malaysia. [8] Furthermore, with the increasing numbers of cases and mortality each day, the emergence of the global pandemic has caused widespread fear in both lay and medical communities, particularly associated with the risk of contracting the disease. [28, 29] Therefore, this study was conducted with an aim to determine the perceived risk and willingness to perform BLS among medical students of Melaka-Manipal Medical College (MMMC) following the 2019 Coronavirus pandemic.

2. Methodology

2.1. Study Design, Time, Setting and Population

A descriptive cross-sectional questionnaire-based survey study was carried out from 13 May 2020 to 27 May 2020 among medical undergraduates of Melaka-Manipal Medical College (MMMC). The MBBS program in MMMC is a twinning program where students spend their first 5 semesters in Manipal campus, India, followed by 2 semesters in Muar campus and the remaining 3 semesters in Melaka campus, Malaysia, adding up to a total of 10 semesters. Students usually undergo 1 BLS training in Manipal campus during their 5th semester and 1 elective BLS training later in Melaka campus. Hence, this study was done to evaluate the perceived risk and willingness to perform BLS among medical students of MMMC who are currently in semester 6, 7, 8, 9 and 10 following the 2019 Coronavirus pandemic.

2.2. Sample Size

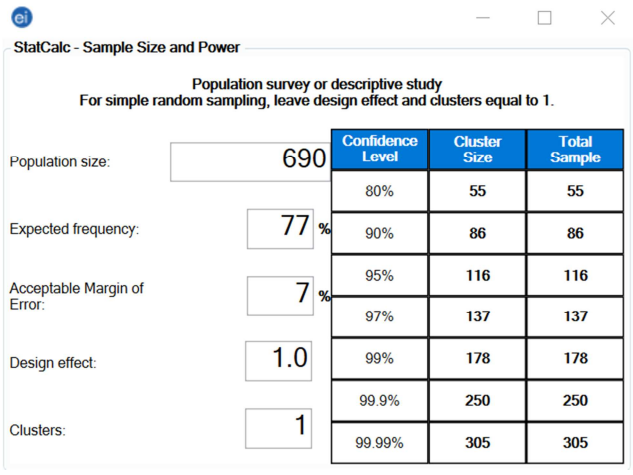

Figure 1. Calculation for sample size using the Epi Info version 7.2.2.6 software.

Based on the previous research that have been conducted on Year 4 medical students at Hong Kong University following the 2003 SARS outbreak in Hong Kong, they found out that 77% of the medical students were concerned about disease transmission to the rescuer during BLS. [8] Based on the application software "Epi Info" version 7.2.2.6 with our population size 690, expected frequency 77% and precise error of 7%, so with a confidence level of 95% we concluded our sample size as 116.

We allowed non-response of 30% and calculation is as below:

$$\text{n(final)} = \frac{\text{n(calculated)}}{1-(non-response)} = \frac{116}{1-0.3(30\%)} = 165.71$$

The final sample size obtained for this study after rounding off was 166.

2.3. Sampling

Purposive sampling was used as the sampling method while conducting the study. Inclusion criteria for our study were MBBS students of MMMC of semester 6, 7, 8, 9 and 10 who had completed the online questionnaire and given consent to participate in this study. Exclusion criteria included students who did not attend BLS course, failed to complete the online questionnaire and those who did not give consent to participate in our study.

2.4. Data Collection

This study investigates the relationship between the independent and dependent variables. The independent variables of this study were gender, ethnicity, religion, participation in BLS training during 5th Semester in Manipal Campus, India, participation in elective BLS training in Melaka campus, Malaysia, experience of performing CPR on a patient, perception of risk of disease transmission to rescuer during BLS. The dependent variables were perceived risk and willingness to perform BLS among medical students following the 2019 Coronavirus pandemic. Our online questionnaire and informed consent were circulated to MBBS students of semester 6 and 7 from Muar campus and semester 8, 9, 10 from Melaka campus via Google form, an online administered questionnaire.

The first part of the questionnaire consisted of sociodemographic questions related to age, gender, ethnicity, nationality, religion, semester and questions related to students' participation in BLS course. Then, the questionnaire was divided into three sections: (1) Students' opinions regarding the performance of BLS; (2) Students' perceptions regarding the risks to the rescuer from performing BLS; (3) Students' willingness to perform BLS in various situation [8]. The first section of consisted of 8 statements to which the students were asked to select responses from a five-point Likert rating scale: 1 – strongly

disagree; 2 – disagree; 3 – neither agree nor disagree; 4 – agree; 5 – strongly agree. The same rating scale was used for the second section, which consisted a list of 6 statements. In the third section, a set of five questions were targeted towards students' willingness in performing BLS following COVID-19 pandemic. The first and second questions were given in the form of a Likert scale containing 5 options ranging from strongly disagree to strongly agree. For the third question, students were asked to select response from four options given which were definitely, probably, probably not and definitely not, while for the fourth question, students need to choose among 3 options: more likely, no difference and less likely. The last question asked about the various reasons that would stop a student from performing mouth-to-mouth ventilation. There were 8 possible reasons given whereby students were allowed to choose multiple responses.

2.5. Data Processing and Data Analysis

The data collected from the distributed online questionnaires were processed with Microsoft Excel. We categorized semester into academic year in which participants from semester 5 and 6 were grouped as 4th year medical students while participants from semester 7, 8, 9 and 10 were grouped as 5th year medical students. We also categorized participants' age into <22, 22-25 and >25. The total score for questions related to students' opinions regarding the performance of BLS and students' perceptions regarding the risks to the rescuer from performing BLS were calculated. The answers for questions related to likelihood (definitely, probably, probably not, definitely not) of participants to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest in the situation of family member, elderly stranger, adult stranger and child stranger were further grouped into yes or no in which answers for definitely and probably were categorized into yes whereas probably not and definitely not were categorized into no. All the processed data were then analysed by using Epi Info version 7.2.2.6 from the Centers for Disease Control and Prevention website (CDC). For quantitative data such as age, the frequency, percentage, mean along with standard deviation (SD) and range were calculated. For qualitative data such as gender, ethnicity, religion, academic year, BLS training during third year, elective BLS training during fourth and fifth year, experience of performing BLS on a patient, opinion, perception and willingness of medical students to perform BLS following COVID-19 pandemic, frequencies and percentages were calculated. Also, the p-value and 95% confidential interval were calculated to identify any significant result. A p-value of less than 0.05 is considered as statistically significant. Bivariate test was used to calculate the Odds Ratio (OR) for the association between independent and dependent variables. The following statistical test was used in our study:

Table 1. Independent and dependent variables with statistical test.

Independent variable	Dependent variable	Statistical test
Gender	Perceptions regarding the risks to the rescuer from performing BLS	Unpaired T test
Ethnicity	Perceptions regarding the risks to the rescuer from performing BLS	ANOVA
Academic year	Perceptions regarding the risks to the rescuer from performing BLS	Unpaired T test
Elective Basic Life Support (BLS) training during 4th and 5th year	Perceptions regarding the risks to the rescuer from performing BLS	Unpaired T test
Experience of doing CPR on patient	Perceptions regarding the risks to the rescuer from performing BLS	Unpaired T test
Demographic characteristic (Gender, Ethnicity, Academic year, Elective Basic Life Support (BLS) training during 4th and 5th year)	Willingness to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation following COVID-19 pandemic to (a) Family member (b) Elderly stranger (c) Adult stranger (d) Child stranger	Chi- square test
Perception regarding the risk to the rescuer from performing Basic Life Support (BLS)	Willingness to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation following COVID-19 pandemic to (a) Family member (b) Elderly stranger (c) Adult stranger (d) Child stranger	Logistic regression
Opinion regarding the performance of Basic Life Support (BLS)	Willingness to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation following COVID-19 pandemic to (a) Family member (b) Elderly stranger (c) Adult stranger (d) Child stranger	Logistic regression

2.6. Ethical Consideration

Participation in this study is completely voluntary. Participants is assured of their data confidentiality and all the data collected should only be used for the purpose of the research. Besides, written informed consent form with

relevant explanation of the study was given to all the participants through online. Approval to conduct the research was obtained from the Research Ethics Committee, Faculty of Medicine, Melaka Manipal Medical College, Malaysia.

3. Results

Table 2. Sociodemographic profile of medical students of Melaka Manipal Medical College (MMMC) (n=172).

Variables	Frequency (%)
Age	
<22	30 (17.4)
22-25	142 (82.6)
>25	0 (0)
Mean (SD)	22.5 (1.1)
Minimum – Maximum	19-25
Gender	
Male	47 (27.3)
Female	125 (72.7)
Ethnicity	
Malay	19 (11.1)
Chinese	38 (22.1)
Indian	72 (41.9)
Others	43 (25)
Religion	
Buddhist	54 (31.4)
Christian	28 (16.3)
Hindu	58 (33.7)
Islam	29 (16.9)
Other	3 (1.7)
Academic Year	
Year 4	119 (69.2)
Year 5	53 (30.8)
Basic Life Support (BLS) training during 3rd year	
Yes	172 (100)
No	0 (0)
Elective Basic Life Support (BLS) training during 4th and 5th year	
Yes	24 (14)
No	148 (86.1)
Do you have any experience of doing CPR on a patient?	
No	162 (94.2)
Yes	10 (5.8)

We have a response rate of 24.92% (172/690). The results in table 2 shows the frequency and percentage of different variables that are age group, gender, ethnicity, religion, academic year, Basic Life Support (BLS) training during 5th Semester in Manipal Campus, Elective Basic Life Support (BLS) training in Melaka Campus, Malaysia and any experience of doing CPR on a patient. For age group, 17.4% of the students are from the age group of <22 while 82.6% of students are from the age group of 22-25. For gender, 72.7% of participants are female while only 27.3% of participants are male. For ethnicity, 41.9% of participant are Indian, 22.1% are Chinese, 11.1% are Malay and participants from others ethnicity are 25%. For religion, 33.7% of participants are Hindu, 31.4% are Buddhist, 16.3% are Christian and 1.7% fell under category of others. Most of the participants are year 4 medical students constituted up to 69.2% of participants while only 30.8% of participants are year 5 medical students. 100% of participants had Basic Life Support (BLS) training during 5th Semester in Manipal Campus, India while only 14% of participants had took Elective Basic Life Support (BLS) training in Melaka Campus, Malaysia. Majority of participants (94.2%) had experience of doing CPR on patient.

Table 3. Student's opinion regarding the performance of BLS.

Item	Strongly Agree n (%)	Agree n (%)	Neither agree or disagree n (%)	Disagree n (%)	Strongly disagree n (%)
I have received adequate training to enable me to perform BLS competently	20 (11.6)	87 (50.6)	48 (27.9)	14 (8.1)	3 (1.7)
I would feel confident in performing BLS should the need arise	12 (7.0)	90 (52.3)	50 (29.1)	18 (10.5)	2 (1.2)
I would like more practice at BLS before I have to perform it in a real situation	108 (62.8)	44 (25.6)	18 (10.5)	2 (1.2)	0 (0.0)
Medical students are not qualified to perform BLS in an out-of-hospital cardiac arrest	3 (1.7)	23 (13.4)	37 (21.5)	85 (49.4)	24 (14.0)
Chest compressions are easy to perform	7 (4.1)	56 (32.6)	58 (33.7)	46 (26.7)	5 (2.9)
Mouth-to-mouth ventilation is easy to perform	5 (2.9)	54 (31.4)	70 (40.7)	35 (20.4)	8 (4.7)
Mouth-to-mouth ventilation is an efficient way to provide oxygen for the patient	7 (4.1)	81 (47.1)	56 (32.6)	21 (12.2)	7 (4.1)
Performing chest compressions only is as effective as performing both chest compressions and mouth-to-mouth ventilation	21 (12.2)	40 (23.3)	36 (20.9)	58 (33.7)	17 (9.9)

Table 3 shows the students' opinions regarding their performance of BLS. 62.2% of the students agreed or strongly agreed that they had received adequate training to enable them to perform BLS completely. However, only 59.3% of the students felt confident about performing BLS if required and the vast majority 88.4% would like more practice before performing it in real situation. Despite this, 63.4% of the students disagreed or strongly disagreed with the statement that medical students are not qualified to perform BLS during a real cardiac arrest situation. The students were asked if they found chest compressions and mouth-to-mouth ventilation easy skills to perform, and 36.7% of the students felt that chest compression is easy to perform whereas only 34.3% considered performing mouth-to-mouth ventilation to be easy. The opinion as to whether mouth-to-mouth ventilation is an efficient way of delivering oxygen was agreed or strongly agreed by 55.2% of the students. However, 43.6% of the students disagreed or strongly disagreed that the opinion of performing only chest compression was as effective as performing both chest compression and mouth to mouth

ventilation during a cardiorespiratory arrest.

Table 4. Student's perception regarding the risks to the rescuer from performing BLS after COVID-19.

Item	Strongly agree n (%)	Agree n (%)	Neither agree nor disagree n (%)	Disagree n (%)	Strongly disagree n (%)
I am concerned about disease transmission to the rescuer during BLS	34 (19.8)	93 (54.1)	27 (15.7)	18 (10.5)	0 (0)
The risk from performing chest compressions is low	10 (5.8)	64 (37.2)	57 (33.1)	38 (22.1)	3 (1.7)
The risk from performing mouth-to- mouth ventilation is low	4 (2.3)	18 (10.5)	38 (22.1)	80 (46.5)	32 (18.6)
The risk of infection transmission during mouth-to-mouth ventilation is greater now than it was before the COVID-19 pandemic	72 (41.9)	72 (41.9)	17 (9.9)	8 (4.7)	3 (1.7)
The COVID-19 pandemic has no effect on my opinion regarding the safety of mouth-to-mouth ventilation	6 (3.5)	11 (6.4)	31 (18.0)	79 (45.9)	45 (26.2)
HIV is a greater risk to the rescuer than COVID-19 during BLS	5 (2.9)	25 (14.5)	41 (23.8)	54 (31.4)	47 (27.3)

Table 4 shows the perception of students regarding the risks to the rescuer from performing BLS after COVID-19. 73.9% of the students agreed or strongly agreed that they are concerned about the disease transmission to the rescuer during BLS and the majority 83.8% perceived that the risk of infection transmission during mouth-to-mouth ventilation is greater now than it was before the COVID-19 pandemic. 43% of the students accepted that there is low risk in performing chest compression, however 65.1% disagree or strongly disagree that risk is low from performing mouth-to-mouth ventilation. So, they agreed that there is high risk in performing mouth-to-mouth ventilation. 72.1% of the students has no effect on their opinion regarding the safety of mouth-to-mouth ventilation following COVID-19 pandemic. 58.7% of the students disagreed that HIV is a greater risk to the rescuer than COVID-19 during BLS. Thus, they perceived COVID-19 as a riskier transmission factor.

Table 5. Student's Willingness to perform BLS in various situation.

Item	Strongly agree n (%)	Agree n (%)	Neither agree nor disagree n (%)	Disagree n (%)	Strongly disagree n (%)
The fear of contracting COVID-19 would stop me from performing chest compressions for:					
family member	2 (1.2)	5 (2.9)	9 (5.2)	71 (41.3)	85 (49.4)
adult stranger	3 (1.74)	12 (7.0)	30 (17.4)	86 (50.0)	41 (23.8)
elderly stranger	4 (2.3)	10 (5.8)	30 (17.4)	86 (50.0)	42 (24.4)
child stranger	1 (0.6)	12 (7.0)	25 (14.5)	92 (53.5)	42 (24.4)
The fear of contracting COVID-19 would stop me from performing mouth-to-mouth ventilation for					
family member	8 (4.7)	13 (7.6)	17 (9.9)	73 (42.4)	61 (35.5)
adult stranger	14 (8.1)	49 (28.5)	52 (30.2)	42 (24.4)	15 (8.7)
elderly stranger	13 (7.6)	47 (27.3)	57 (33.1)	38 (22.1)	17 (9.9)
child stranger	11 (6.4)	43 (25.0)	54 (31.4)	39 (22.7)	25 (14.5)
Regarding strangers: reason that would stop me from performing mouth-to-mouth ventilation is					
the fear of COVID-19	26 (15.1)	67 (39.0)	30 (17.4)	34 (19.8)	15 (8.7)
the presence of vomit	7 (4.1)	76 (44.2)	47 (27.3)	25 (14.5)	17 (9.9)
the presence of blood in the victim's mouth	12 (7.0)	81 (47.1)	44 (25.6)	18 (10.5)	17 (9.9)
Regarding family members: reason that would stop me from performing mouth-to-mouth ventilation is					
the fear of COVID-19	6 (3.5)	21 (12.2)	23 (13.4)	69 (40.1)	53 (30.8)
presence of vomit	4 (2.3)	28 (16.3)	54 (31.4)	43 (25.0)	43 (25.0)
presence of blood in the victim's mouth	6 (3.5)	34 (19.8)	50 (29.1)	36 (20.9)	46 (26.7)

Table 5 shows students' willingness to perform BLS in various situations. First 2 categories include the reluctance to perform chest compressions and mouth-to-mouth ventilation for a family member, an adult stranger, an elderly stranger and a child stranger due to the fear of contracting the COVID-19 virus.

For questions related to the willingness of students to perform chest compressions in regard to fear of contracting COVID-19 in situation of family members, 90.7% of the students disagreed with 5.2% of them remained neutral and only 4.1% agreed to the statement. As for adult strangers, 73.8% of the students disagreed with 17.4% of them remained neutral and only 8.74% of them agreed to the statement. As for elderly strangers, 74.4% of the students disagreed with 17.4% of them remained neutral and only 8.1% agreed to the statement. As for child strangers, 77.9% of the students disagreed with 14.5% of them neither agreed nor disagreed and 7.6% of them agreed to the statement.

For questions related to the willingness of students to perform mouth-to-mouth ventilation in regard to fear of contracting COVID-19 in situation of family members, 77.9% of the students disagreed with 9.9% of them remained neutral and 12.3% of them agreed to the statement. As for adult strangers, 33.1% of them

disagreed with 30.2% of them neither agreed nor disagreed and 36.6% agreed to the statement. For elderly strangers, 32% of the students disagreed with 33.1% of them remained neutral and 34.9% disagreed to that statement. For child strangers, 37.2% of them disagreed with 31.4% of the students remained neutral and 31.4% disagreed to this statement.

The next 2 categories include the various reasons that would stop the students from performing mouth-to-mouth ventilation for strangers and family members. Regarding strangers, 54.1% of the students agreed, 28.5% of the students disagreed and 17.4% of them remained neutral that the fear of COVID-19 would stop them from performing mouth-to-mouth ventilation for the victim. For the same question related to the presence of vomit in causing students' reluctance to perform mouth-to-mouth ventilation, 48.3% of the students were on the agreeing side, 24.4% students disagreed and, 27.3% remained neutral. For presence of blood in mouth of victim, 54.1% of the students were on the agreeing side, 20.4% of them disagreed while 25.6% of them remained neutral.

Regarding family members, 15.7% of the students agreed, 70.9% disagreed while 13.4% of them remained neutral that the fear of COVID-19 would be the reason that would stop them from performing mouth-to-mouth ventilation to the victim. For the presence of vomit, 18.6% of the students agreed, 50% of the students disagreed and 31.4% of them neither agreed nor disagreed that the presence of vomit would be the reason that would stop them from performing mouth-to-mouth ventilation to a family member. For the presence of blood in mouth of victim, 23.3% of the students agreed, 47.6% disagreed while 29.1% of them remained neutral.

Table 6. Willingness to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest.

Item	Definitely n (%)	Probably n (%)	Probably not n (%)	Definitely not n (%)
family member	147 (85.5)	23 (13.4)	1 (0.6)	1 (0.6)
adult stranger	46 (26.7)	111 (64.5)	13 (7.6)	2 (1.2)
elderly stranger	47 (27.3)	109 (63.4)	12 (7.0)	4 (2.3)
child stranger	53 (30.8)	108 (62.8)	9 (5.2)	2 (1.2)

Table 6 displays the willingness of students to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest for family members, adult strangers, elderly strangers and child strangers. For family members, 98.9% of the students were willing while only 1.2% of them were not willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest. For adult strangers, 91.2% of the students were willing while only 8.8% of them were not willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest. For elderly strangers, 90.7% of the students were willing while only 9.3% of them were not willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest. For child strangers, 93.6% of the students were willing while only 6.4% of them were not willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest.

Table 7. The likeliness of students to perform mouth-to-mouth ventilation during the pre-COVID-19 era compared to the COVID-19 era.

Item	More likely n (%)	No difference n (%)	Less likely n (%)
Before COVID-19 pandemic, I would have been more or less likely than I am now to perform mouth-to-mouth ventilation for			
Family member	106 (61.6)	61 (35.5)	5 (2.9)
Adult stranger	56 (32.6)	100 (58.1)	16 (9.3)
Elderly stranger	57 (33.1)	97 (56.4)	18 (10.5)
Child stranger	55 (32.0)	102 (59.9)	14 (8.1)

Table 7 shows whether the students would have been more likely, no difference or less likely to perform mouth-to-mouth ventilation for family members, adult strangers, elderly strangers and child strangers during the pre-COVID-19 era than they are now. 61.6% of the students were more likely, 35.5% remained the same, and 2.9% of them were less likely to perform mouth-to-mouth ventilation for family members during the pre-COVID-19 era than they are now. 32.6% of the students were more likely, 58.1% remained the same and 9.3% of them were less likely to perform mouth-to-mouth ventilation for adult strangers during the pre-COVID-19 era than they are now. 33.1% of the students were more likely, 56.4% remained the same and 10.5% were less likely to perform mouth-to-mouth ventilation for elderly strangers during the pre-COVID-19 era than they are now. 32% of the students were more likely, 59.9% remained the same and 8.1% of them were less likely to perform mouth-to-mouth ventilation for child strangers during the pre-COVID-19 era than they are now.

Table 8. Reasons that would stop from performing mouth-to-mouth ventilation among medical students.

Reasons	n (%)
Fear of COVID-19	119 (69.2)
Fear of other infections	93 (54.1)
Fear of HIV	64 (37.2)
Fear of failure	63 (36.6)
Fear of being sued	59 (34.3)
Fear of vomitus	42 (24.4)
Mouth-to-mouth ventilation is unpleasant	21 (12.2)
Mouth-to-mouth ventilation is not useful	6 (3.5)

Table 8 shows the various different reasons that would probably stop medical students from performing mouth-to-mouth ventilation. The two most common reasons that would prevent the performance of mouth-to-mouth ventilation were the fear of COVID-19 and the fear of other infections, with both options checked by 69.2% and 54.1% of the students respectively. On the contrary, only 3.5% of the students felt that they would not perform mouth-to-mouth ventilation because it is not useful.

Table 9. Association between demographic characteristics & perception of risk to the rescuer from performing BLS.

Independent variables	Risk perception total score Mean (SD)	Mean difference (95% CI)	P value
Gender			
Male	21.2 (3.5)	-1.7 (-2.7, -0.7)	<0.001
Female	22.9 (2.8)		
Ethnicity			
Malay	22.3 (2.1)		
Chinese	22.1 (4.3)	-	0.687
Indian	22.8 (2.8)		
Others	22.2 (2.5)		
Academic year			
Year 4	22.5 (3.1)	0.3 (-0.7,1.3)	0.529
Year 5	22.2 (3.0)		
Elective Basic Life Support (BLS) training in Melaka Campus, Malaysia			
No	22.4 (3.1)	-0.3 (-1.6,1.1)	0.687
Yes	22.7 (3.2)		
Experience of doing BLS on patient			
No	22.5 (3.1)	1.0 (-1.0, 3.0)	0.327
Yes	21.5 (3.2)		

SD=Standard deviation; 95%CI=95% Confidence Interval.

Table 9 shows the association between demographic characteristics & perception of risk to the rescuer from performing BLS.

Male has a lower mean score of 21.2 (SD=3.5) compared to female which has a mean score of 22.9 (SD=2.8). The mean difference is -1.7 with 95% CI ranging from -2.7 to -0.7. The p-value is <0.001 thus showing there is indeed a significant association between gender and the perception of risk to the rescuer from performing BLS.

Indians have the highest mean score of 22.8 (SD=2.8), follow by Malays which have a mean score of 22.3 (SD=2.1) while other races have a mean score of 22.2 (SD=2.5) and Chinese has the lowest mean score of 22.1 (SD=4.3). The p-value is 0.687 which shows there is no significant association between ethnicity and the perception of risk to the rescuer from performing BLS.

For academic year, 4th year medical students have a higher mean score of 22.5 (SD=3.1) compared to 5th medical students who have a mean score of 22.2 (SD=3.0). The mean difference is 0.3 with 95% CI ranging from -0.7 to 1.3. There is no significant association between academic year and the perception of risk to the rescuer from performing BLS as the p-value of this category was shown to be 0.529.

Those who have not attended any elective BLS training during 4th and 5th year have mean scores of 22.4 (SD=3.1), slightly lower than the mean score of those who attended the elective BLS training during 4th and 5th year, which was shown to be 22.7 (SD=3.2). The mean difference is -0.3 with 95% CI of -1.6 to 1.1. The p-value is 0.687, thus showing there is no significant association between the attendance of the elective BLS training in Melaka Campus, Malaysia and the perception of risk to the rescuer from performing BLS.

Participants who do not have any experience of performing CPR on a patient have a higher mean score of 22.5 (SD=3.1) compared to those who do not have any experience of performing CPR on a patient, which has a mean score of 21.5 (SD=3.2). The mean difference is 1.0 with 95% CI ranging from -1.0 to 3.0. The p-value is 0.327, thus showing there is a significant association between the experience of performing CPR on a patient and the perception of risk to the rescuer from performing BLS.

Table 10. Association between demographic characteristics and Willingness to perform chest compressions and mouth-to-mouth ventilation for *family member* during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Variables	Willingness to perform				P value
	Definitely n (%)	Probably n (%)	Probably not n (%)	Definitely not n (%)	
Gender					
Male	40 (85.1)	7 (14.9)	0 (0)	0 (0)	0.834
Female	107 (85.6)	16 (12.8)	1 (0.8)	1 (0.8)	
Ethnicity					
Malay	16 (84.2)	3 (15.8)	0 (0.0)	0 (0.0)	
Chinese	30 (78.9)	8 (21.1)	0 (0.0)	0 (0.0)	0.614
Indian	63 (87.5)	8 (11.1)	0 (0.0)	1 (1.4)	
Others	38 (88.4)	4 (9.0)	1 (2.3)	0 (0.0)	
Academic year					
Year-4	99 (83.2)	19 (15.9)	0 (0.0)	1 (0.8)	0.182
Year-5	48 (90.6)	4 (7.6)	1 (1.9)	0 (0.0)	
Attended elective BLS course					
Yes	23 (95.8)	1 (4.2)	0 (0.0)	0 (0.0)	0.182
No	124 (83.8)	22 (14.9)	1 (0.7)	1 (0.7)	

Table 10 shows the association between demographic characteristics and willingness to perform chest compression and mouth-to-mouth ventilation for family members during an out of hospital cardiac arrest resuscitation after COVID-19 pandemic.

100% of male students were willing to perform chest compression and mouth-to-mouth ventilation for family members during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic. Out of female students, 98.4% were willing to perform while 1.6% were not willing to perform. The p value is 0.834 which is >0.05, showing there is no significant association between gender and willingness to perform chest compressions and mouth-to-mouth ventilation for family members during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Moreover, 100% of Malays were willing to perform. 97.4% of Chinese were willing to perform while 2.6% were not willing to perform. 84.7% of Indian were willing to perform while 15.3% were not willing to perform and 93.1% of other ethnicity were willing to perform while 6.9% were not willing to perform chest compression and mouth to mouth ventilation for family member during an out of hospital cardiac arrest resuscitation after COVID-19 pandemic. The p value is 0.188 which is >0.05, showing there is no significant association between ethnicity and willingness to perform chest compressions and mouth-to-mouth ventilation for family members during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

89.9% of year 4 students were willing to perform while 10.1% were not willing to perform and 94.3% of year 5 students were willing to perform while 5.7% were not willing to perform chest compression and mouth to mouth ventilation for family member during an out of hospital cardiac arrest resuscitation after COVID-19 pandemic. The p value is 0.052, which is >0.05, showing there is no significant association between academic year and willingness to perform chest compressions and mouth-to-mouth ventilation for family members during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

95.8% of students who attended elective BLS course were willing to perform while 4.2% were not willing to perform and 90.5% of students who didn't attend elective BLS course were willing to perform while 9.5% of students were not willing to perform. The p value is 0.813 which is >0.05, showing there is no significant association between the attendance of elective BLS course and willingness to perform chest compressions and mouth-to-mouth ventilation for family members during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Table 11. Association between demographic characteristics and Willingness to perform chest compressions and mouth-to-mouth ventilation for *adult stranger* during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Variables	Willingness to perform				P value
	Definitely n (%)	Probably n (%)	Probably not n (%)	Definitely not n (%)	
Gender					
Male	10 (21.3)	35 (75.5)	2 (4.3)	0 (0.0)	0.334
Female	36 (28.8)	76 (60.8)	11 (8.8)	2 (1.6)	
Ethnicity					
Malay	2 (10.5)	17 (89.5)	0 (0.0)	0 (0.0)	
Chinese	12 (31.6)	25 (65.8)	1 (2.6)	0 (0.0)	
Indian	19 (26.4)	42 (58.3)	9 (12.5)	2 (2.8)	0.188
Others	13 (30.2)	27 (62.8)	3 (6.9)	0 (0.0)	

Variables	Willingness to perform				P value
	Definitely n (%)	Probably n (%)	Probably not n (%)	Definitely not n (%)	
Academic year					
Year-4	38 (31.9)	69 (57.9)	10 (8.4)	2 (1.7)	0.052
Year-5	8 (15.1)	42 (79.2)	3 (5.7)	0 (0.0)	
Attended elective BLS course					
Yes	6 (25.0)	17 (70.8)	1 (4.2)	0 (0.0)	0.813
No	40 (27.0)	94 (63.5)	12 (8.1)	2 (1.4)	

Table 11 shows the association between demographic characteristics and willingness to perform chest compression and mouth-to-mouth ventilation for adult strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

95.7% of male students were willing to perform while 4.3% were not willing to perform chest compression and mouth-to-mouth ventilation for adult strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic. Out of female students, 89.6% were willing to perform and while 10.4% were not willing to perform. The p value is 0.334 which is >0.05, thus showing there is no significant association between gender and willingness to perform chest compressions and mouth-to-mouth ventilation for adult strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Moreover, 100% of Malay were willing to perform. 97.4% of Chinese were willing to perform while 2.6% were not willing to perform. 84.7% of Indian were willing to perform while 15.3% were not willing to perform and 93.1% of other ethnicities were willing to perform while 6.9% were not willing to perform chest compression and mouth to mouth ventilation for adult strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic. The p value is 0.188 which is >0.05, thus showing there is no significant association between ethnicity and willingness to perform chest compressions and mouth-to-mouth ventilation for adult strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

89.9% of year 4 students were willing to perform while 10.1% were not willing to perform and 94.3% of year 5 students were willing to perform while 5.7% were not willing to perform chest compression and mouth to mouth ventilation for adult strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic. The p-value is 0.052 which is >0.05, thus showing there is no significant association between academic year and willingness to perform chest compressions and mouth-to-mouth ventilation for adult strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

95.8% of students who attended the elective BLS course were willing to perform while 4.2% were not willing to perform and 90.5% of students who didn't attend elective BLS course were willing to perform while 9.5% of students were not willing to perform. The p-value is 0.813 which is >0.05, thus showing there is no significant association between the attendance of elective BLS course and willingness to perform chest compressions and mouth-to-mouth ventilation for adult strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Table 12. Association between demographic characteristics and Willingness to perform chest compressions and mouth-to-mouth ventilation for *elderly stranger* during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Variables	Willingness to perform				P value
	Definitely n (%)	Probably n (%)	Probably not n (%)	Definitely not n (%)	
Gender					
Male	11 (23.4)	33 (70.2)	3 (6.4)	0 (0.0)	0.498
Female	36 (28.8)	76 (60.8)	9 (7.2)	4 (4.2)	
Ethnicity					
Malay	2 (10.5)	16 (84.2)	1 (5.3)	0 (0.0)	0.457
Chinese	12 (31.6)	23 (60.5)	3 (7.9)	0 (0.0)	
Indian	19 (26.4)	43 (59.7)	7 (9.7)	3 (4.2)	
Others	14 (32.6)	27 (62.8)	1 (2.3)	1 (2.3)	
Academic year					
Year-4	38 (31.9)	69 (57.9)	10 (8.4)	2 (1.7)	0.086
Year-5	9 (16.9)	40 (75.5)	2 (3.8)	2 (3.8)	
Attended elective BLS course					
Yes	6 (25.0)	17 (70.8)	0 (0.0)	1 (4.2)	0.448
No	41 (27.8)	92 (62.2)	12 (8.1)	3 (2.0)	

Table 12 shows the association between demographic characteristics and willingness to perform chest compression and mouth to mouth ventilation for elderly strangers during an out-of-hospital cardiac arrest resuscitation after COVID-

19 pandemic.

93.6% of male students were willing to perform while 6.4% were not willing to perform chest compression and mouth to mouth ventilation for elderly strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic. Out of female students, majority of 88.6% were willing to perform and while 11.4% were not willing to perform. The p value is 0.498 which is >0.05, thus showing there is no significant association between gender and willingness to perform chest compressions and mouth-to-mouth ventilation for elderly strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Moreover, 94.7% of Malays were willing to perform while 5.3% were not willing to perform. 92.1% of Chinese were willing to perform while 7.9% were not willing to perform. 86.1% of Indian were willing to perform while 13.9% were not willing to perform and 95.4% of other ethnicities were willing to perform while 4.6% were not willing to perform chest compression and mouth-to-mouth ventilation for elderly strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic. The p value is 0.457 which is >0.05, thus showing there is no significant association between ethnicity and willingness to perform chest compressions and mouth-to-mouth ventilation for elderly strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

89.9% of year 4 students were willing to perform while 10.1% were not willing to perform and 92.4% of year 5 students were willing to perform while 7.6% were not willing to perform chest compression and mouth to mouth ventilation for elderly strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic. The p value is 0.086 which is >0.05, thus showing there is no significant association between academic year and willingness to perform chest compressions and mouth-to-mouth ventilation for elderly strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

95.8% of students who attended elective BLS course were willing to perform while 4.2% were not willing to perform and 89.9% of students who didn't attend elective BLS course were willing to perform while 10.1% of students were not willing to perform. The p value is 0.448 which is >0.05, thus showing there is no significant association between the attendance of elective BLS course and willingness to perform chest compressions and mouth-to-mouth ventilation for elderly strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Table 13. Association between demographic characteristics and Willingness to perform chest compressions and mouth-to-mouth ventilation for *child stranger* during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Variables	Willingness to perform				P value
	Definitely n (%)	Probably n (%)	Probably not n (%)	Definitely not n (%)	
Gender					
Male	13 (27.7)	31 (66.0)	3 (6.4)	0 (0)	0.746
Female	40 (32.0)	77 (61.6)	6 (4.8)	2 (1.6)	
Ethnicity					
Malay	2 (10.5)	17 (89.5)	0 (0)	0 (0)	0.119
Chinese	14 (36.8)	21 (55.3)	3 (7.9)	0 (0)	
Indian	21 (29.2)	43 (59.7)	6 (8.3)	2 (2.8)	
Others	16 (37.2)	27 (62.8)	0 (0)	0 (0)	
Academic year					
Year-4	42 (35.3)	68 (57.1)	7 (5.9)	2 (1.7)	0.128
Year-5	11 (20.8)	40 (75.5)	2 (3.8)	0 (0)	
Attended elective BLS course					
Yes	8 (33.3)	16 (66.7)	0 (0)	0 (0)	0.592
No	45 (30.4)	92 (62.2)	9 (6.1)	2 (1.4)	

Table 13 shows the association between demographic characteristics and willingness to perform chest compressions and mouth-to-mouth ventilation for child strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Out of the male students, a vast majority of 93.7% were willing to perform while 6.4% of the students were not willing to perform. Out of female students, there was also a vast majority of 93.6% who were willing to perform while 6.4% of the students were not willing to perform. The p-value is 0.746 which is >0.05, thus showing there is no significant association between gender and willingness to perform chest compressions and mouth-to-mouth ventilation for child strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Regarding ethnicity, 100% of Malay students and 100% of other ethnicities were willing to perform. 92.1% of Chinese students were willing to perform while 7.9% were not willing to perform whereas 88.9% of the Indian students were willing to perform and 11.1% were not willing to perform.

The p-value is 0.119 which is >0.05, thus showing there is no significant association between ethnicity and willingness to perform chest compressions and mouth-to-mouth ventilation for child strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Regarding academic year, 92.4% of Year 4 students and 96.3% of Year 5 students were willing to perform while 7.6% of Year 4 students and 3.8% of Year 5 students were not willing to perform. The p-value is 0.128 which is >0.05 showing there is no significant association between academic year and willingness to perform chest compressions and mouth-to-mouth ventilation for child strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

A perfect 100% of the students who attended the elective BLS course were willing to perform. Out of the students who didn't attend the course, 92.6% were willing to perform while 7.5% were not willing to perform. The p-value is 0.592 which is >0.05, thus showing there is no significant association between the attendance of elective BLS course and willingness to perform chest compressions and mouth-to-mouth ventilation for child strangers during an out-of-hospital cardiac arrest resuscitation after COVID-19 pandemic.

Table 14. Logistic regression analysis of association between opinion regarding the performance of BLS, perceptions regarding the risks to the rescuer from performing BLS and the willingness to perform chest compressions and mouth-to-mouth ventilation.

		Willingness to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation OR (95% CI)	**P value**
Student's opinion regarding the performance of BLS (Total score)	Family member	1.17 (1.12, 1.23)	<0.001
	Adult stranger	1.09 (1.07, 1.11)	<0.001
	Elderly stranger	1.09 (1.07, 1.11)	<0.001
	Child stranger	1.10 (1.08, 1.13)	<0.001
Student's perceptions regarding the risks to the rescuer from performing BLS (Total score)	Family member	1.22 (1.15, 1.30)	<0.001
	Adult stranger	1.11 (1.08, 1.13)	<0.001
	Elderly stranger	1.11 (1.08, 1.13)	<0.001
	Child stranger	1.13 (1.10, 1.16)	<0.001

OR=Odds Ratio; 95% CI=95% Confidence Interval.

Table 14 displays the simple logistic regression analysis of the association between opinion regarding the performance of BLS, perceptions regarding the risks to the rescuer from performing BLS and the willingness to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation. The odds of students who are willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation for a family member is significantly 1.17 times higher in students with a higher total score for their opinions regarding BLS compared to those who those who scored lower with a 95% confidence interval of 1.12, 1.23. The odds of students who are willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation for an adult stranger is significantly 1.09 times higher in students with a higher total score for their opinions regarding BLS compared to those who those who scored lower with a 95% confidence interval of 1.07, 1.11. The odds of students who are willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation for an elderly stranger is significantly 1.09 times higher in students with a higher total score for their opinions regarding BLS compared to those who those who scored lower with a 95% confidence interval of 1.07, 1.11. The odds of students who are willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation for a child stranger is significantly 1.10 times higher in students with a higher total score for their opinions regarding BLS compared to those who those who scored lower with a 95% confidence interval of 1.08, 1.13.

The odds of students who are willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation for a family member is significantly 1.22 times higher in students with a higher total score for their perceptions regarding the risks to the rescuer from performing BLS compared to those who those who scored lower with a 95% confidence interval of 1.15, 1.30. The odds of students who are willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation for an adult stranger is significantly 1.11 times higher in students with a higher total score for their perceptions regarding the risks to the rescuer from performing BLS compared to those who those who scored lower with a 95% confidence interval of 1.08, 1.13. The odds of students who are willing to perform

chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation for an elderly stranger is significantly 1.11 times higher in students with a higher total score for their perceptions regarding the risks to the rescuer from performing BLS compared to those who those who scored lower with a 95% confidence interval of 1.08, 1.13. The odds of students who are willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest resuscitation for a child stranger is significantly 1.13 times higher in students with a higher total score for their perceptions regarding the risks to the rescuer from performing BLS compared to those who those who scored lower with a 95% confidence interval of 1.10, 1.16.

4. Discussion

A cross sectional study was conducted among undergraduate medical students of Melaka Manipal Medical College (MMMC) in Malaysia to determine the perceived risk and willingness to perform BLS among Year 4 and Year 5 medical undergraduates following the 2019 Coronavirus pandemic. Upon analysing our data, we found that most of the students, which was 73.9% were concerned about disease transmission to the rescuer during BLS. This can be compared to the result of a previous study done on Iranian medical students. In that study, the cumulative score of risk perception of COVID-19 was 4.08 out of 8 which was in the moderate range and the risk perception was significantly different between stagers and interns and between those being trained in emergency room (ER) and non-ER wards. [30] According to another cross-sectional study which was conducted to assess knowledge of pandemic Influenza among all medical students at the University of Alberta, they agreed that placing doctors on the front lines as volunteers during pandemic would increase risk of contracting the disease. [31] Similarly, in our study, majority of the students where 83.8% agreed that the risk of infection transmission during mouth-to-mouth ventilation is greater now than it was before the COVID-19 pandemic. Our findings also said that students were concerned about the risks from performing both chest compression and mouth-to-mouth ventilation.

Among 172 students, most of them agreed that they would perform chest compression and mouth-to-mouth ventilation to family members, adult strangers, elderly strangers, and child strangers during an out-of-hospital cardiac arrest. In fact, majority of the students disagreed that the fear of contracting COVID-19 would stop them from performing chest compressions for family members, adult strangers, elderly strangers and child strangers. Most of the students also disagreed that the fear of contracting COVID-19 would stop them from performing mouth-to-mouth ventilation for family members. However, there were almost one third of them agreed, almost one third of them disagreed and almost one third remained neutral that the fear of contracting COVID-19 would stop them from performing mouth-to-mouth ventilation for strangers. To compare the above findings, a previous cross-sectional study was done among Year 4 medical undergraduates of Hong Kong University in Hong Kong and it showed that students appeared to be significantly more likely not to perform mouth-to-mouth ventilation for both family members and strangers. [8] According to a cross-sectional study via telephone interview done among the citizens of Taiwan, most of the participants who were unwilling to perform BLS for strangers were willing to perform BLS to family members, and more than half of the unwilling participants were willing to provide compression only cardiopulmonary resuscitation (COCPR) for strangers. [32] These findings showed some consistency with our findings as most of our participants were also more willing to perform chest compressions only for both family members and strangers, but less willing to perform mouth-to-mouth ventilation in strangers although they were mostly willing to do so for their family members. Also, most of the students agreed they would stop performing mouth-to-mouth ventilation for strangers due to the fear of contracting COVID-19, the presence of vomit as well as the presence of blood in the victim's mouth. Meanwhile, most of them disagreed that the fear of COVID-19, the presence of vomit and the presence of blood in the victim's mouth would be a reason to stop them from performing mouth-to-mouth ventilation to family members. Several studies had stated that bystanders were more likely to be willing to perform on child strangers compared to elderly strangers and could be put off by the victim's physical appearance like the presence of blood, or vomitus in the victim's mouth. [33-36] It was also said that the fear of infectious disease was among the most common reasons why people were reluctant to provide BLS for strangers. [32] Those statements were also consistent with our study's findings to a certain degree as our participants were found to be slightly more willing to perform mouth-to-mouth ventilation for child strangers compared to elderly strangers and almost half of the students agreed that the fear of COVID-19, which was an infectious disease, as well as the presence of vomitus and blood in the victim's mouth would stop them from providing mouth-to-mouth ventilation for strangers.

Although there were no significant association between most of the demographic characteristics (ethnicity, academic year, elective BLS training, experience of doing CPR on a patient) and BLS risk perception total score, however, our study revealed that significant association existed between gender

and BLS risk perception total score in which female scored higher than male. To be more specific, female was significantly more agreed that COVID-19 had greater risk of transmission to rescuer than HIV during BLS. The same results was also seen in a study done in 2005 to assess medical students' attitudes towards BLS following the 2003 SARS outbreak in Hong Kong in which male was significantly more concerned about the risk of HIV transmission and it could be due to the fact that HIV mostly affected male heterosexual. [8, 37] Interestingly, our study also showed that the concern about the risk of mouth-to-mouth ventilation was significantly higher in female medical student than male medical student. Even though there was limited study related as to why this occurred, it maybe owing to the fact that female had generally higher BLS knowledge than male as showed by a study conducted to assess knowledge of BLS among Egyptian Medical Students which showed that female achieving significantly higher scores in question related to BLS knowledge. [38] Similar results were also observed in a previous study done by Saquib SA et al. to assess knowledge and attitude about BLS amongst healthcare interns in University Hospitals at Saudi Arabia. [39]

There was no significant difference of willingness to perform chest compression and mouth to mouth ventilation for family member, adult stranger, elderly stranger and child stranger between different genders, different ethnicities, different academic years and whether the student attended elective BLS course or not. A study was conducted on Attitudes toward the performance of bystander cardiopulmonary resuscitation in Japan. About 70% of the subjects had experienced CPR training more than once. Only 10–30% of high school students, teachers, and health care providers reported willingness to perform Chest compression and mouth-to-mouth ventilation, especially on a stranger. The reason of the unwillingness among health care workers was fear of transmission of disease. [40] Another study was conducted at South Korea regarding the effect of BLS education on laypersons' willingness in performing bystander hands only cardiopulmonary resuscitation. Before and after training, the percentage of both willingness to perform standard CPR on stranger and perform CPR by hands only increased. But most of the respondents who were unwilling to perform CPR on stranger, stated that fear of liability and fear of disease transmission were deciding factors after the BLS training. [41] In Hong Kong, a study was conducted on attitudes to BLS among medical students following the 2003 SARS outbreak. Most of the students (100% and 80%) were willing to perform chest compression to family member and stranger during SARS outbreak. 100% of the respondent's stated that they were willing to perform mouth-to-mouth ventilation to family member, only 54% stated this in regard to strangers while 37% claimed that they were unwilling to perform mouth-to-mouth ventilation. [8] However, in a study previously done in Malaysia among undergraduate final year medical students and dental students showed that there was a significantly lower willingness to perform chest compression and mouth-to-mouth ventilation in female 34.4% compared to male 75%. [42] Based on a study among 4th year medical students at a U.S. medical school, 94.9% stated that their willingness to participate would have increased if they had prior training in BLS. [43] Interestingly, previous study among college students on effects of BLS training on factors associated with attitude toward CPR showed that the proportion of students showing willingness to perform BLS increased from 13% to 77% after the training even when the collapsed person is a stranger. [44]

There was a significant association between students' opinion regarding the performance of BLS and their willingness to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest, with a slightly higher association in their willingness to perform both skills in family members compared to strangers. Hence, we could say the more confident students felt about their skills in BLS, the more likely they would be willing to perform chest compressions and mouth-to-mouth ventilation during an out-of-hospital cardiac arrest.

There were few limitations in our study. Our study was a cross-sectional study which only allowed us to collect information from participants at one point in time. Therefore, we were unable to observe the effect of time on the changes in participants' perceived risk and willingness. Besides, our study was only done in one private medical school hence the findings cannot be generalized to other settings. Furthermore, in our study there was little participation from Year 5 students in comparison to Year 4 students. This might affect the results as final year students might have different risk perception and willingness.

Since the current studies show lack of knowledge among undergraduate medical students towards BLS we recommend early introduction of BLS training to the curriculum and regular reinforcement training to medical students. The first step in resuscitation is to ensure the safety of the rescuer hence protective equipment such as gloves, barrier masks, eye protection and viral filters should be used to prevent the risk of transmission of COVID-19 virus during resuscitation. In general, more studies have to be done to assess the perceived risk and willingness in undergraduate students. Accordingly, we would like to recommend future researchers to include more final year students and also health care professionals to access the same.

5. Conclusion

In conclusion, our female students were shown to have significantly higher perceived risk of BLS compared to males. Apart from that, our study found out that the more confident our students feel in their BLS performance, the more likely they will be willing to perform BLS. In regard to perceived risk of performing BLS, most of our students (73.9%) were concerned about the disease transmission to the rescuer during BLS and majority of them (83.8%) agreed that risk of infection transmission during mouth-to-mouth ventilation was greater now than it was before the COVID-19 pandemic. The most common reason causing the reluctance to perform mouth-to-mouth ventilation among our students was the fear of COVID-19 (69.2%), this was followed by the fear of other infection (54.1%) and fear of HIV (37.2%), when compared to various other reasons like blood and vomitus in mouth. Despite, most of our students denied that the fear of contracting COVID-19 would stop them from performing both chest compression and mouth-to-mouth ventilation to family members. As for strangers, most of our students were willing to perform chest compression but when it came to mouth-to-mouth ventilation, our students' responses were split evenly between disagreeing, agreeing and neutral response. While it is glad to know that the COVID-19 pandemic has little effect on our students' willingness to perform BLS, it is recommended that medical students should be well taught about the knowledge to assess the perceived risk of BLS correctly since not every cardiorespiratory arrest condition is due to infection. There must be a balance between rescuer's safety and patient's needs especially during this challenging period of time. Hence, frequent training and practice should be provided to students just so they are always updated with the latest BLS protocol such as wearing proper personal protective equipment (PPE), early use of automated external defibrillator, performing of hands only CPR and the ability to take into account patients risk factors to assess likelihood of patient survival before performing CPR.

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