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Evaluation of the willingness to perform cardiopulmonary resuscitation (CPR) with automated external defibrillator (AED) among Hong Kong Chinese using the theory of planned behaviour framework: an online cross-sectional survey

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ABSTRACT

Introduction Bystander cardiopulmonary resuscitation (CPR) and defibrillation by an automated external defibrillator (AED) in out-of-hospital cardiac arrest (OHCA) events were low in Hong Kong (HK). This study evaluated the willingness and associated factors of performing CPR with AED in HK using the theory of planned behaviour (TPB).

Methods A total of 1449 responses from HK Chinese aged 15–64 years were collected in a cross-sectional online survey using convenience sampling on social media including Facebook, Instagram and WhatsApp. Three TPB determinants, namely attitude, subjective norm and perceived behavioural control; and perceived barriers were asked using 5-point Likert scales. Associations between each predictor and willingness to perform CPR with AED were evaluated using univariate ordinal regressions. Predictive models were constructed using hierarchical multiple ordinal regressions (MOR) to explore associated predictors and the adjusted OR (OR_{adj}).

Results There were 44.8% and 47.8% of respondents who were willing to perform CPR and use AED, respectively. Young adults aged 18–25 years demonstrated the lowest willingness to perform CPR (OR_{adj}=0.63, 95% CI 0.42 to 0.94, p=0.023). Knowledge level was not associated with either CPR or AED willingness, thus was eliminated in backward selection in the MOR. Attitude, subjective norm and perceived behavioural control were all positively associated with both willingness (all OR_{adj}>1.5, p<0.001), while perceived barriers were associated with CPR willingness only (OR_{adj}=0.77, 95% CI 0.66 to 0.91, p=0.002).

Conclusions Utilisation of the TPB framework in CPR and AED community education would fill the 'know-do' gap and enhance the community's willingness to perform CPR and use an AED.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The survival rate of out-of-hospital cardiac arrests (OHCA) was low in Hong Kong (HK), coinciding with low rates of bystander cardiopulmonary resuscitation (CPR) and defibrillation by an automated external defibrillator (AED).

WHAT THIS STUDY ADDS

⇒ Less than half of the HK Chinese were willing to perform CPR and use an AED in an OHCA crisis.
⇒ The lowest willingness was demonstrated among people aged 18–25 years.
⇒ Knowledge level was not associated with either willingness to perform CPR or use an AED, while all theory of planned behaviour (TPB) determinants were significantly associated with both willingness.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Incorporating TPB determinants into the CPR and AED community training strategies and policies would enhance the public willingness to perform resuscitation.
⇒ The five established themes for laypersons to an OHCA response work along with the TPB framework, which provides concrete objectives for community CPR and AED promotion.

INTRODUCTION

Around 6000 out-of-hospital cardiac arrests (OHCA) happen annually in Hong Kong (HK), but only 2.3% of victims could survive in 30 days.[1 2] The American Heart Association (AHA) advocates the importance of early bystander cardiopulmonary resuscitation (CPR) and defibrillation by an automated external defibrillator (AED), that is,

the basic life support (BLS), to increase OHCA survival.[3] However, only a few OHCA victims received bystander CPR (13.1%–28.8%) and defibrillation attempts by an AED (1.4%) in HK.[4 5] Local studies revealed less than a quarter of respondents were willing to start CPR (21.4%) and use the AED (18.0%).[6]

Despite the effects of boosting relevant knowledge and skills, it was revealed that knowledge enhancement does not necessarily translate into willingness to perform BLS.[7] The theory of planned behaviour (TPB) incorporated three determinants influencing the willingness, namely (a) attitude, (b) subjective norm and (c) perceived behavioural control.[8] This study aimed to investigate the willingness of the local community to perform bystander CPR and use an AED in an OHCA crisis, and their associated factor using the TPB framework.

METHODS

Study design and sample size estimation

This cross-sectional online survey recruited 1645 HK Chinese aged 15–64 years using convenience sampling via social media, assuming a margin of error of ±2.5% at a level of significance of 5% and 30% of potential technical failure and incomplete responses.

Data collection and instrumentation

Consent was implied by the voluntary completion of the questionnaire. Demographic data including age, gender, monthly income, educational level, occupation and disease status of oneself and close family members were collected. Predictors included (i) training backgrounds, (ii) knowledge level, (iii) TPB determinants and (iv) perceived barriers regarding CPR and AED applications in OHCA. Types of training and years since the last training were asked. Knowledge level was assessed by eight multiple choices questions. Attitude, subjective norms and perceived behavioural control and perceived barriers were asked using 5-point Likert scales. Respondents were asked to indicate their willingness, by a 5-point Likert scale, to perform CPR and use an AED if they encountered an OHCA. No personally identifiable information was collected. Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research. Sample questionnaires in Chinese and English are provided in online supplemental documents.

Statistical analysis

Data were analysed using IBM SPSS Statistics V.26 (SPSS, Chicago, Illinois, USA). Descriptive statistics were used to give a response overview. Internal consistency of subscales in each TPB determinant and barriers were assessed by Cronbach's alpha tests. Pearson's correlations and Kruskal-Wallis H tests with post hoc Tukey's range tests were used to assess correlations between predictors. Extensively associated predictors were excluded from the multiple ordinal regression (MOR) to avoid multicollinearity.

Associations between the willingness to perform CPR and use an AED, and each of the predictors were tested by univariate ordinal regressions (UOR). Hierarchical MORs were executed for modelling. Significant demographics in the UOR were entered into the first block, followed by other independent predictors in the second block. Backward selection was conducted until all remaining variables were significant. ORs and 95% CIs were reported. A p value <0.05 was considered statistically significant.

RESULTS

A total of 1662 responses were collected. There were 1449 valid responses included in the analysis after eliminating 213 incomplete responses. The demographics and training backgrounds are summarised in table 1 and table 2, respectively. Significant differences were found in attitude, subjective norms, perceived behavioural control and barriers scores among 'training types' and 'years since the last training', suggesting extensive associations. Therefore, training backgrounds were excluded from the MOR to avoid multicollinearity.

The mean score and SD of knowledge level and each subscale regarding TPB determinants and barriers are summarised in table 2. For attitude, the subscale 'It is correct for a community member to perform CPR and use AED' scored the lowest of 2.88. For barriers, concerns of 'injuring the victim' and 'being sued' were rated higher among five subscales, with mean scores of 2.38 and 2.28, respectively. Moderate positive correlations were demonstrated between 'knowledge and perceived behavioural control' (Pearson's r=0.569, p<0.001), 'attitude and subjective norms' (Pearson's r=0.519, p<0.001) and 'subjective norms and perceived behavioural control' (Pearson's r=0.631, p<0.001).

Knowledge level and willingness

UOR demonstrated that knowledge level was independently associated with willingness to perform CPR (OR_{crude}=1.42, 95% CI 1.34 to 1.49, p<0.001) and use an AED (OR_{crude}=1.48, 95% CI 1.41 to 1.56, p<0.001). However, knowledge was not significantly associated with both willingness when it was analysed jointly with associated demographics, attitude, subjective norms, perceived behavioural control and barriers in the MORs. Therefore, knowledge level was removed from the MORs by backward selection.

Willingness to perform CPR and the associated factors

Less than half of the respondents were willing to perform CPR and use an AED while more than a quarter of respondents did not willing to do so (figure 1). The final MOR model of willingness to perform CPR included age, attitude, subjective norms, perceived behavioural control and barriers (table 3). Respondents aged between 18 and 25 years demonstrated significantly lower willingness to perform CPR (adjusted OR (OR_{adj})=0.63, 95% CI 0.42 to 0.94, p=0.023). Attitude (OR_{adj}=1.57, 95% CI

Table 1 Demographic characteristics

Demographic characteristics (n=1449)	Frequency (%)
Gender	
Female	790 (54.5)
Male	659 (45.5)
Age (years)	
15–17	106 (7.3)
18–25	440 (30.4)
26–40	500 (34.5)
41–64	403 (27.8)
Educational level	
Not at all	1 (0.1)
Primary school	3 (0.2)
Secondary school	298 (20.6)
Postsecondary (includes diploma and undergraduate)	786 (54.2)
Postgraduate (includes master's degree and above)	358 (24.7)
Others	3 (0.2)
Occupation	
Civilian	436 (30.1)
Healthcare professional	270 (18.6)
Non-healthcare professional	144 (9.9)
Retired	49 (3.4)
Housewife	23 (1.6)
Unemployed	23 (1.6)
Student	404 (27.9)
Others	100 (6.9)
Monthly income (HK$) (Note: 1US$=7.8HK$ approximately)	
<15 001	472 (32.6)
15 001–30 000	373 (25.7)
30 001–45 000	263 (18.2)
45 001–60 000	142 (9.8)
>60 000	199 (13.7)

	Frequency (%)			
	None of them	You only	Your family members only	Both you and your family members
Disease status				
Heart disease	1176 (81.2)	25 (1.7)	228 (15.7)	20 (1.4)
High cholesterol level	711 (49.1)	57 (3.9)	568 (39.2)	113 (7.8)
Hyperlipidemia	967 (66.7)	48 (3.3)	371 (25.6)	63 (4.3)
Hypertension	589 (40.6)	61 (4.2)	712 (49.1)	87 (6.0)
Diabetes mellitus	940 (64.9)	27 (1.9)	462 (31.9)	20 (1.4)
Overweight	786 (54.2)	139 (9.6)	321 (22.2)	203 (14.0)
Musculoskeletal pain	698 (48.2)	103 (7.1)	326 (22.5)	322 (22.2)
Asthma	1263 (87.2)	65 (4.5)	104 (7.2)	17 (1.2)

1.27 to 1.95, p<0.001), subjective norms (OR_{adj}=1.93, 95% CI 1.64 to 2.28, p<0.001) and perceived behavioural control (OR_{adj}=2.53, 95% CI 2.23 to 2.88, p<0.001) were all positive predictors of willingness to perform CPR, while barriers were the significant negative predictor (OR_{adj}=0.77, 95% CI 0.66 to 0.91, p=0.002).

Table 2 Training backgrounds, knowledge, TPB determinants and barriers

Training backgrounds	Frequency (%)	
Training type (n=1449)		
None of them	435 (30.0)	
CPR only	284 (19.6)	
AED only	17 (1.2)	
CPR and AED	713 (49.2)	
Years since the last training (n=1449)		
Never receive any training	435 (30.0)	
Within 1 year	453 (31.3)	
1–2 years ago	226 (15.6)	
3–5 years ago	185 (12.8)	
>5 years ago	150 (10.4)	
Continuous predictors	**Mean±SD**	**Cronbach's alpha**
Knowledge (n=1449)	**5.05±1.87**	**NA**
Attitude (n=1440)	**3.35±0.56**	**0.766**
CPR and AED are important in saving lives	3.63±0.55	
CPR and AED are beneficial to an unresponsive victim	3.38±0.73	
It is correct for a community member to perform CPR and use AED	2.88±0.94	
It is important for an AED to be available in the public	3.50±0.66	
Subjective norms (n=1424)	**2.65±0.87**	**0.928**
I believe that my family expects me to perform CPR and use AED on an unresponsive victim	2.55±1.02	
I believe that my friend …	2.70±0.99	
I believe that my colleagues/classmates …	2.73±1.00	
I believe that the local government …	2.65±0.98	
I believe that the general public …	2.63±0.93	
Perceived behavioural control (n=1414)	**2.13±1.18**	**0.945**
Performing CPR and using AED are easy tasks for me	2.17±1.19	
I have adequate knowledge and skill to perform CPR and use AED	2.17±1.32	
I am confident to perform CPR and use AED	2.09±1.31	
I will not hesitate to perform CPR and use an AED on an unresponsive victim	2.10±1.25	
Barriers (n=1407)	**1.55±0.70**	**0.697**
I am concerned about injuring the victim when performing CPR and using AED	2.38±1.15	
I am concerned about being sued if I perform CPR and use AED wrongly	2.28±1.20	
I am concerned about getting infections from the victim when performing CPR and using AED	1.59±1.08	
I am concerned about getting bad fortune when performing CPR and using AED	0.65±0.83	
Performing CPR and using AED is too time-consuming	0.85±0.84	

AED, automated external defibrillator; CPR, cardiopulmonary resuscitation; NA, not available; TPB, theory of planned behaviour.

Willingness to use an AED and the associated factors

For AED use, the final MOR model of willingness included monthly income, attitude, subjective norms and perceived behavioural control (table 3). Respondents with a monthly income >HK$60 000 were more willing to use an AED (OR_{adj}=1.75, 95% CI 1.27 to 2.41, p<0.001). Attitude (OR_{adj}=2.26, 95% CI 1.83 to 2.79, p<0.001), subjective norms (OR_{adj}=1.79, 95% CI 1.52 to 2.10, p<0.001) and perceived behavioural control (OR_{adj}=2.60, 95% CI 2.30 to 2.93, p<0.001) were all positively associated with willingness to use AED. All OR and 95% CI in UOR and MOR are presented in online supplemental table 1.

DISCUSSION

Younger adults were shown to have a lower willingness to perform CPR, which was comparable with a previous local study.[9] It was suggested that one's life experience in adulthood might boost their sense of social responsibility and self-efficacy, becoming more willing to perform

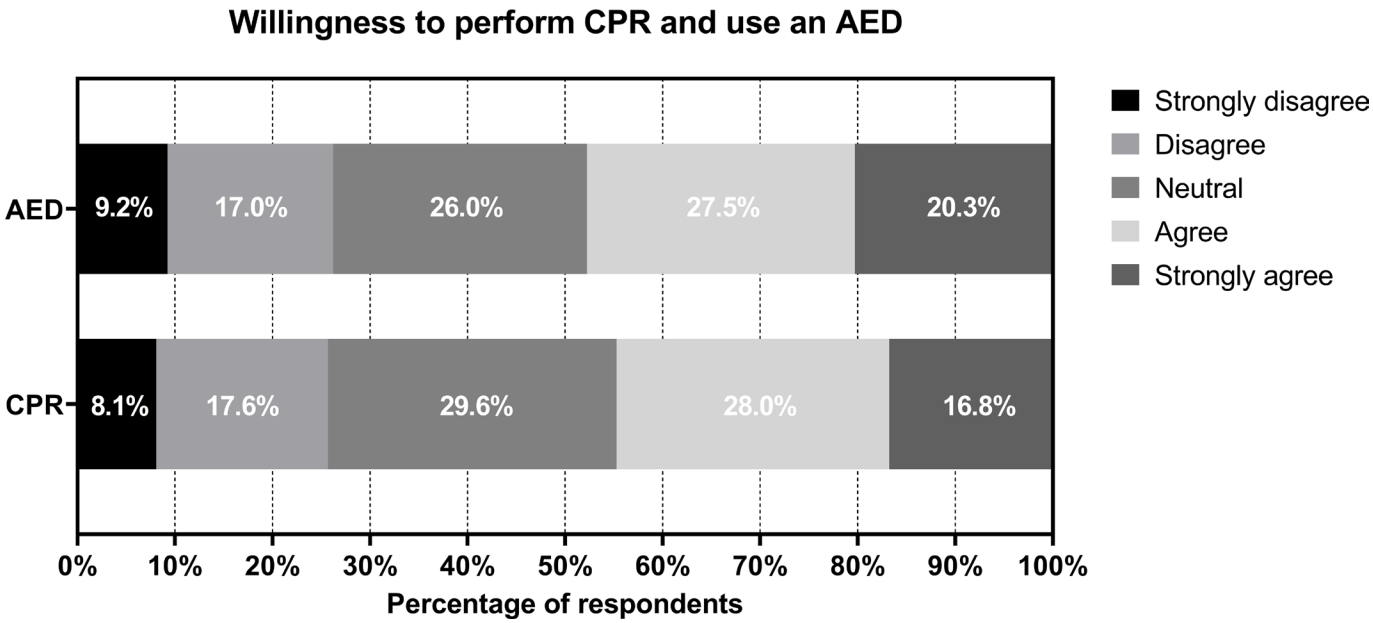

Figure 1 Willingness to perform CPR and use an AED (n=1449). Figures were constructed using GraphPad Prism V.9 (GraphPad Software, San Diego, USA). Top row: willingness to use an AED. Bottom row: willingness to perform CPR. Less than half of the respondents were willing to perform CPR and use an AED while more than a quarter of respondents did not willing to do so. AED, automated external defibrillator; CPR, cardiopulmonary resuscitation.

resuscitation. Higher monthly income was associated with a higher willingness to use AED, which could be attributed to higher awareness of technology and social awareness.[10]

Knowledge was not a significant predictor of either willingness to perform CPR or use an AED, although knowledge is crucial for one to perform CPR and use an AED correctly. A previous study revealed that only 29%

Table 3 Multiple ordinal regression of willingness to perform CPR and use AED

		OR_{adj} (95% CI)	
Categorical predictors	**N**	**Perform CPR**	**Use AED**
Age (years)			
15–17	101	1	
18–25	430	0.63 (0.42 to 0.94)*	
26–40	492	0.92 (0.62 to 1.37)	
41–64	384	0.82 (0.54 to 1.24)	NS
Monthly income (US$)			
<15 001	460		1
15 001–30 000	358		1.34 (1.03 to 1.73)*
30 001–45 000	259		1.50 (1.13 to 2.00)**
45 001–60 000	139		1.36 (0.96 to 1.94)
>60 000	191	NS	1.75 (1.27 to 2.41)***
		OR_{adj} (95% CI)	
Continuous predictors	**Mean**	**Perform CPR**	**Use AED**
Attitude	3.35	1.57 (1.27 to 1.95)***	2.26 (1.83 to 2.79)***
Subjective norms	2.65	1.93 (1.64 to 2.28)***	1.79 (1.52 to 2.10)***
Perceived behavioural control	2.13	2.53 (2.23 to 2.88)***	2.60 (2.30 to 2.93)***
Barriers	1.55	0.77 (0.66 to 0.91)**	NS

*P<0.05, **p<0.01, ***p<0.001.
AED, automated external defibrillator; CPR, cardiopulmonary resuscitation; NS, not significant;

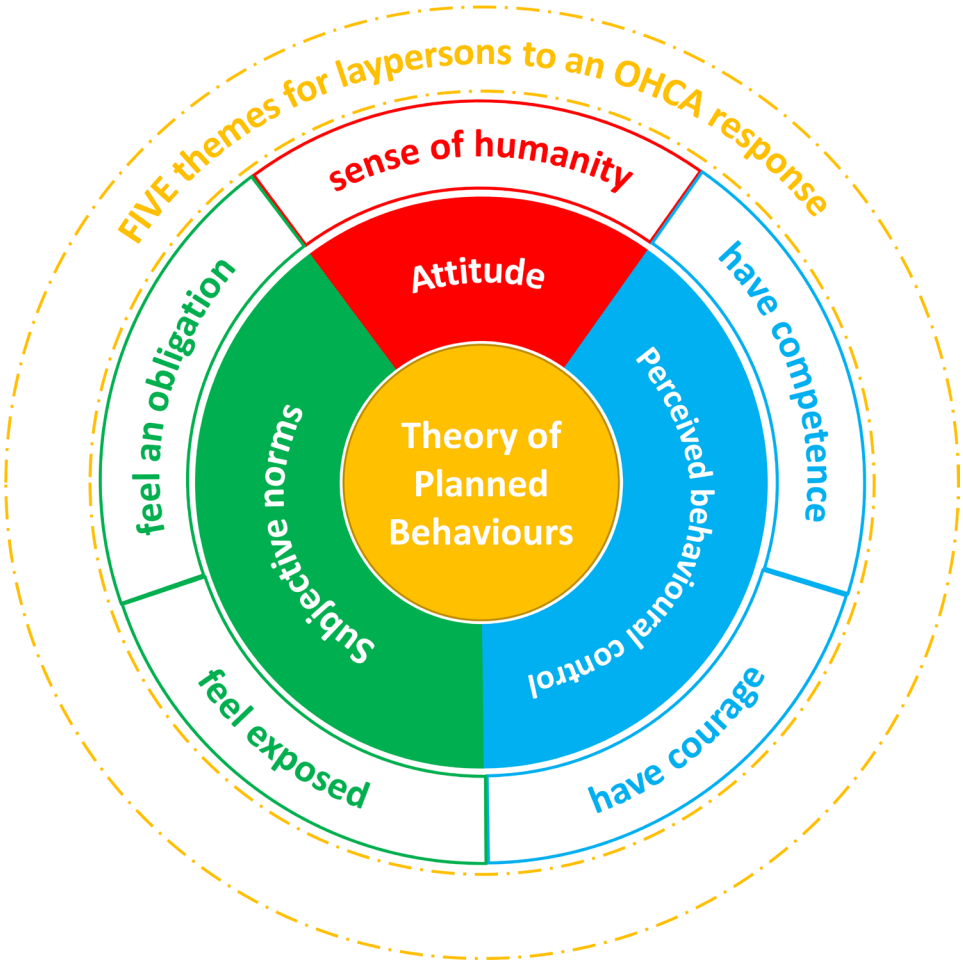

Figure 2 TPB determinants and themes for laypersons to an OHCA response.[13] Attitude (red), subjective norms (green) and perceived behavioural control (blue) are the TPB determinants presented at the centre. The themes for laypersons to an OHCA response were presented at the outer ring using the corresponding colours of the TPB determinants, which create vivid objectives to promote BLS in the community. BLS, basic life support; OHCA, out-of-hospital cardiac arrest; TPB, theory of planned behaviour.

of participants who had just completed the BLS training were willing to offer CPR, suggesting that knowing how to perform CPR does not necessarily translate into willingness.[7] Promotors of BLS should be alert to this potential 'know-do' gap of performing CPR and using an AED among the general public and address the determinants of intention through behavioural framework during the training.

All three TPB determinants were associated with willingness to perform CPR and use an AED. A positive attitude believing in the desired outcomes of performing BLS and an obligation to save others' lives would favour the behaviour.[8] Subjective norms refer to one's perceived expectations from their significant others and the community.[8] If society had a high expectation of one to perform CPR and use an AED, the individual would have a higher willingness to do so.[11] Perceived behavioural control is the perceived ease or difficulty of performing a behaviour.[8] People who have higher perceived behavioural control towards CPR and AED, not limited to their actual capability but also prompts and support from the surroundings, would be more willing to perform BLS.

A recent scientific statement from the AHA advocated an 'intention-focused model for bystanders' to boost the bystander CPR rate, which incorporated the TPB into the framework.[12] This echoed our study and guided BLS promoters to enhance public willingness to perform bystander BLS using an intention-based approach by addressing the TPB determinants. Moreover, an earlier study summarised five themes for laypersons to participate in resuscitation to an OHCA, including 'have competence', 'have courage', 'feel exposed', 'feel an obligation' and 'sense of humanity'.[13] These indeed complement the TPB determinants, providing more concrete objectives to address laypersons' needs during resuscitation attempts, as illustrated in figure 2.

Other than BLS training, there were numerous strategies to enhance the public willingness to perform CPR and use an AED in an OHCA crisis. For instance, the local postdispatch advice system was updated to include OHCA to guide bystanders performing CPR and using an AED by standard scripts,[14] which could boost the perceived behavioural control towards CPR and AED use. A Korean study has revealed that among those OHCA victims who

received bystander CPR, 79.0% of the bystanders were prompted by the dispatcher's advice.[15]

The enactment of the Good Samaritan Law could promote bystander resuscitation by addressing subjective norms and reinforcing the culture of helping others in the community. It is in force around the globe, including China, the UK, Ireland and the USA, yet, not in HK.[16] Indeed, a local study revealed that laymen showed support for the enactment of the law as it addresses their need to be protected from legal liability, which was recognised as a significant barrier for them in OHCA resuscitation.[9 17 18]

Innovative solutions have been developed to facilitate resuscitation in OHCA. For example, a mobile application alerting surrounding users of crises nearby was available.[19] In Singapore, taxi and private drivers were equipped with first aid training and put AEDs on their vehicles under the 'AED-on-Wheels' programme.[20] The application will alert nearby drivers to potential OHCA, bringing the AED and recruiting trained lay rescuers to the scene. In HK, even though there are more publicly available AEDs, innovative ideas to help laymen actively search for an AED and perform resuscitation are still wanted.

There were several limitations in this study. First, convenience sampling could result in a biased sample and limited representativeness of the HK community. An overestimated willingness to perform BLS was probable as a higher proportion of healthcare professionals and those who have previously trained with bystander resuscitation were sampled. Second, the online survey was limited to those who have internet access, which could neglect those from lower socio-economic status. Third, around 200 responses had substantial missing data, with willingness unanswered, which were excluded from the analysis. These may represent a group of respondents who were less interested in this topic or failed to complete the questionnaires as they were unfamiliar with online survey technologies. Lastly, our study analysed willingness to undertake CPR and AED use collectively. However, different components of bystander resuscitation may be associated with variations in psychological constructs, which were not addressed in our current analysis and warranted further investigation.

CONCLUSIONS

A low willingness to perform CPR and use an AED in an OHCA in the local community was revealed. All TPB determinants were significant predictors of willingness, but the knowledge was not. Although sampling biases were probable, this is the first study investigating local public willingness to perform BLS using the TPB framework, which concurred with the AHA's 'intention-focused model for the bystanders' approach. Incorporating the TPB framework into community education would address the 'know-do' gap and enhance the community's willingness to perform CPR and use an AED.

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Contributors VCWT conceptualised the research design, had access to the data, conducted analysis and wrote the original draft, including reviewing, editing and finalising for publication. AWLK accepts full responsibility for the overall content of this study. AWLK supervised and contributed to conception and design of the work, and substantively revised the manuscript for publication.

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Patient consent for publication Not applicable.

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