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Australia's awareness of cardiac arrest and rates of CPR training: results from the Heart Foundations' Heart Watch Survey.

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Title: Australia's awareness of cardiac arrest and rates of CPR training: results from the Heart Foundations' Heart Watch Survey.

Running Title: Australian CPR training rates

Abstract

Objective: We aimed to provide the first national estimates of cardiopulmonary (CPR) training and awareness of cardiac arrest.

Design: A retrospective analysis of a national cross-sectional survey was undertaken. Data was collected online from adults in July 2017 as part of the Heart Foundation of Australia HeartWatch survey. We used logistic regression to examine demographic factors associated with CPR training.

Participants: A national cohort was invited to participate in the survey using purposive, non-probability sampling methods with quotas for age, gender and area of residence, in order to reflect the wider Australian population. The final sample consisted of 1076 respondents.

Main outcome measure: To determine an estimation of the prevalence of CPR training at a national level and if training was related to demographic factors.

Results: The majority (76%) of respondents were born in Australia and 51% were female, 41% were aged between 35 and 64 years. Only 16% of respondents could identify the difference between a cardiac arrest and a heart attack. While 56% reported previous CPR training, only 22% were currently trained (within one year). CPR training was associated with younger age (35-54 years) (odds ratio, 1.45, 95% CI, 1.06-2.0), being born in Australia (OR, 1.59, 95% CI 1.17-2.17) and higher levels of education (university, OR, 1.86, 95% CI 1.35-2.57). CPR training increased confidence in respondents ability to perform effective CPR and use a defibrillator. Lack of CPR training was the most common reason why respondents would not provide CPR training to a stranger.

Conclusions: There is a need to improve the community's understanding of cardiac arrest, and to increase awareness and training in CPR. CPR training rates have not changed over the past decades – new initiatives are needed.

Keywords: cardiopulmonary resuscitation, cardiac arrest, education, education surveillance, resuscitation

ARTICLE SUMMARY

Strengths and limitations

- This is the first time a national perspective investigating the awareness of cardiac arrest and cardiopulmonary resuscitation training has been undertaken in Australia.
- A representative group of Australians were represented in this survey using probability sampling methods that included quotas for age, gender and area of residence.
- While the limitations of cross-sectional survey methods include recall bias, our results are consistent with past surveys conducted in Australia.
- Future surveys of this nature require validation of survey questions and could employ mixed methods of using both online and phone surveys to address the challenge of participants using online searches to source survey answers.

INTRODUCTION

Bystander CPR more than doubles the chance of surviving a cardiac arrest[1,2], however the provision of bystander CPR remains low.[3] While there has been improvement in bystander CPR rates with the introduction of dispatcher-assisted CPR instructions during the emergency call[4], a significant proportion still do not feel confident to provide CPR even with instruction.[5]

There is growing evidence of a link between rates of bystander CPR and CPR training. Three studies have now reported communities with higher rates of bystander CPR have high rates of CPR trained residents.[6–8] This most likely occurs because CPR training is significantly associated with increased confidence and willingness to provide CPR.[9,10] Existing data also suggests specific demographics are associated with CPR training, including age, education level, country of birth and occupation.[9–11] There is also a need to examine the impact of socio-economic factors on rates of bystander CPR training, as regions with lower bystander CPR also have lower CPR training rates.[12,13] Therefore, understanding current rates of CPR training in the community is important, and may drive local initiatives.

In Australia, CPR training is currently not mandatory, and state-based surveys[9,14–16] suggest that less than 60% of Australian adults have received CPR training at least once. However, these surveys were conducted in specific regions, and most more than a decade ago. This study aimed to provide the first Australian-wide estimates of CPR training and willingness to learn CPR.

METHODS

This cross-sectional study used data from the Heart Foundations of Australia's "HeartWatch" Survey. This quarterly survey is conducted using a purposive, non-probability sampling method with quotas for age, gender and area of residence, in order to reflect the wider Australian population. Respondents of the survey belong to an online survey panel. In July 2017, 21 questions about CPR

were added to the survey. The CPR questions (Supplementary File) were in three sections: cardiac arrest knowledge; CPR knowledge and experience; and defibrillator knowledge. The Residential postcodes were used to assign deciles of Socio-Economic Indexes for Areas (SEIFA)[17] using 2016 Australian Census data.

The present study was granted an ethics exemption from Monash University Human Research Ethics Committee (Project Number: 12329) as data provided for the research by the Heart Foundation of Australia was de-identified.

Patient and Public Involvement

The public were not invited to comment on the design of this study and were not consulted to develop relevant outcomes or interpret the results. The research group (Australian and New Zealand Prehospital Emergency Care [PEC-ANZ] Centre of Research Excellence) do however have representatives from the pubic on the steering committee who will be consulted about the outcomes and directions of dissemination of this research during regularly scheduled meetings. Results will also be disseminated via Heart Foundation of Australia channels in addition to the research group.

Data analysis

Data were analysed using descriptive statistics with proportions expressed as percentages and tests of association using chi-squared statistic between respondent characteristics and CPR training status. Logistic regression was used to identify respondent characteristics independently associated with CPR training. Characteristics with p-values <0.2 at the univariate level were included in the model. We also conducted a sensitivity analysis in a subsample of respondents excluding those who reported they had previously performed CPR. Free text responses were categorically coded by two health care professionals (Registered Nurse [SC] and Paramedic [DS]), both of whom are experienced

community first aid trainers. Statistical significance was set at $p<0.05$ and analysis was conducted with Stata V15.1.

RESULTS

The survey sample consisted of 1,076 Australian adults. Responses were received from every state and territory in Australia (Table 1). There was a similar proportion of female (n=554, 50.6%) and male (n=532, 49.4%) respondents. The majority were aged between 35 and 64 years (n = 443, 41%), had completed at least 10 years of schooling (n = 968, 90%) and were born in Australia (n= 817, 76%).

< **Table 1. Characteristics of the sample according to cardiopulmonary resuscitation training status >**

Cardiac arrest knowledge

Respondents were asked if they "knew the difference between a cardiac arrest and a heart attack". The majority of respondents stated they were "unsure" (n = 404, 37.6%), followed by "yes" (n = 356, 33.1%), with the remaining responding "no" (n=316, 29.4%). The majority of those responding "yes" had received CPR training (72%). Those who answered "yes" were then asked to describe the difference between the two conditions using free text. Less than half of the "yes" respondents identified the two conditions correctly (n = 174, 48.3%), however 22.2% (n=79) identified the conditions incorrectly or only had the definitions partially correct (n=66, 18.5%). A small proportion (n=37, 10.4%) of yes respondents declared they were unsure once asked for a definition. When coding free text descriptions of the conditions it was noted that several respondents (n=10, 2.8%) had used the exact same wording. This wording was identical to the top result from online search engine Google when pasting the question into a search.

Knowledge of signs of cardiac arrest were variable among respondents. When coding free text responses according to Australian Resuscitation Council criteria (unresponsive and not breathing normally)[18], only 2.9% (n = 32) of respondents answered correctly. However, many respondents described the absence of a pulse ("no heart beat", "heart stops"). When we added absence of a pulse as a correct descriptor of cardiac arrest 14.2% (n = 153) of respondents had the answer coded as correct. Commonly respondents described a cardiac arrest victim as either unconscious or having an absence of breathing (n = 97, 9%). Incorrect answers (n = 684, 63.6%) featured chest pain, shortness of breath, weakness and dizziness. Numerous (11.8%) respondents (n = 127) stated they were unsure of the signs and symptoms.

CPR knowledge, confidence and training preferences

The majority of respondents (n=969, 90.1%) had heard of CPR. Few respondents (n = 95, 8.8%) had previously performed CPR. When respondents were asked what they would do if someone was in cardiac arrest, only 9 (0.8%) respondents correctly identified the chain of survival[19] sequence of calling an ambulance, commencing CPR and applying a defibrillator. These respondents all had prior CPR training within five years. More respondents (n=141, 13%) were able to identify two correct actions (i.e. calling an ambulance, and CPR or defibrillation). A smaller proportion (n = 121, 11.2%) described CPR and or defibrillation but did not mention calling an ambulance. The majority of respondents (n = 536, 49.7%) responded they would call an ambulance, but did not describe any further actions.

In total 55.7% (n = 540) of respondents had undertaken CPR training previously, however a large proportion (42.5%, n = 412) had not, and a small proportion were unsure (n = 17, 1.8%,) or did not answer (n = 107, 9.9%) (Figure 1A). The majority of CPR trained respondents had not been trained in CPR for over 5 years (n = 227, 42%), with only 21.7% (n = 117) classified as being currently trained (within 12 months) as per the Australian guidelines.[20] (Figure 1B).

<Figure 1A and Figure 1B>

CPR training was not associated with any region (state or territory) of residence (Table 2) or socioeconomic status (all deciles p>0.05, data not shown). However, CPR training was associated with age 35-54 years (odds ratio [OR] 1.45, 95% CI 1.06 - 2.00), Australian-born (OR 1.59, 95% CI 1.17 – 2.17), and university (OR 1.86, 95% CI 1.35 – 2.57) and vocational level of education (OR 2.33, 95% CI 1.64 – 3.30) (Table 2). These factors remained significant when restricted to those who had not previously performed CPR. The main barriers to learning CPR included lack of awareness ("never thought about it") (n = 190, 44%), not knowing where to go to learn (n = 91, 21%) and cost (12%).

The relationship between confidence in ability to provide CPR was significantly related to CPR training status, with respondents who stated they were very confident to perform CPR more likely to have CPR training (p<0.001 (Figure 2).

Of those with no prior CPR training, the majority (n = 312, 72.7%) of respondents were willing to learn CPR. The preferred format for CPR training was for group learning, led by a professional provider (n = 237, 76.0%) with a smaller proportion choosing learning via self-instruction (n = 57, 18.3%).

<Table 2. Factors associated with CPR training. >

<Figure 2. Self-rated confidence levels (%) about ability to perform effective CPR in an emergency according to CPR training status.>

Barriers to performing CPR

Only half (n = 530, 49.3%) of respondents stated they would provide CPR to a stranger. The remaining respondents were predominantly unsure (n = 307, 28.5%). In those that responded no (n = 132, 12.3%) the most common response was not being trained in CPR (n = 57, 43.2%) or not feeling confident (n = 26, 19.7%). Fear (n = 9, 6.8%), a physical inability (n = 5, 3.9%), or concern over legalities (n = 5, 3.9%) were other factors mentioned.

Of the respondents who were not CPR trained (n = 412), the majority stated they were willing to learn (n = 312, 75.7%), with only small proportion of respondents stating they were unsure (n = 74, 17.9%) or unwilling (n = 26, 6.3%).

Defibrillator knowledge (confidence, willingness)

The majority of respondents (n = 903, 83.9%) had heard of a defibrillator and of these respondents more than half (n = 633, 58.8%) would be willing to use it. However confidence levels to use a defibrillator were low, with a third (33.9%, n = 215) stating they were not confident. (Table 1, Supplement).

DISCUSSION

In this Australia-wide study, just over half (56%) of the adults reported having ever undertaken CPR training, however only 21% had current (within one year) training. CPR training was associated with younger age (35 – 54 years), being born in Australia and having a higher level of education. The association between these demographics and CPR training are similar to studies conducted in other countries.[9–11] Alarmingly however, this study found a low understanding of cardiac arrest, or being able to identify the actions involved with the chain of survival. There is a large opportunity to increase national training prevalence, as the majority of those who were untrained in CPR are willing to learn and identified that learning in a group class, led by a professional instructor was the preferred learning format.

The prevalence of CPR training in this Australian study are similar to other recent international surveys conducted in the United Kingdom (57%)[10] and the United States of America (65%)[11]. Unlike these countries however, Australia has no national or state-based mandatory training strategy, and there has only been limited attempts to promote awareness of cardiac arrest and CPR via mass-

media (e.g. Shock Verdict https://www.utas.edu.au/shockverdict). These strategies are important to increase cardiac arrest and CPR training knowledge and awareness and should be considered.

In Australia, CPR training is only mandatory for selected professions (i.e. Health care professionals, teachers, childcare workers and fitness instructors)[21]. The effect of workplace training is likely evidenced in our results by the fact younger working ages (35 – 54 years, OR 1.45, 95% CI 1.06 – 2.00) and those who attended both vocational college (OR 2.33, 95% CI 1.64-3.30) and university (OR 1.86, 95% Ci 1.35-2.57) were independently associated with CPR training. Recent evidence from the USA[22] demonstrates that mandatory CPR training in schools is associated with higher levels of individuals who are currently trained in CPR. Mandatory community-level training strategies require cooperation from many parties including federal and state governments and Resuscitation Councils. Nevertheless, these strategies have been successfully implemented elsewhere and they should not be overlooked, as they could ensure a large proportion of the community receive CPR training, at least once in their lifetime.

Our results, as has been identified before[10,23,24], also demonstrate that those with CPR training had higher levels of self-reported confidence to perform CPR and use a defibrillator. Concurrently, the most common barrier to not performing CPR in this study was not being trained. This highlights the importance of CPR training especially given the positive link between levels of training and bystander CPR rates.[6–8] CPR training is consistently related to younger age and higher levels of education both in Australia[9,14] and internationally.[11] Future training initiatives need to consider targeting populations less likely to receive training, particularly those that are older, who are at higher risk of future cardiac events. Along with the International Liaison Committee on Resuscitation[25], we also place value on training high-risk populations, such as households containing a person with heart disease and have success in piloting a targeted training program through cardiac rehabilitation programs.[26]

In addition to training, raising awareness of cardiac arrest and CPR training is essential. A significant proportion of respondents in our study had never thought about CPR training or didn't know where

to go to receive training. A national and co-ordinated campaign to increase public awareness of cardiac arrest and CPR training is warranted given the low rates of knowledge assessed in this study. Highlighting the simplification of CPR through promoting hand-only CPR may encourage more people to render assistance in an emergency and to undertake training. As traditional television, radio and print mass media campaigns are very costly, dissemination of these messages via social media should be investigated.[27] These approaches could be successful now that smartphones and other digital mobile devices are almost ubiquitous in Australia, including among older Australians.[28]

In the modern era, CPR training can be provided in many formats (e.g. with an instructor, via self-instruction, online). The majority of respondents in our study stated they would prefer to learn from an instructor in a class, with a smaller proportion preferring self-instruction. Now that "hands-only" CPR is the preferred teaching method for lay people[18], the simplified algorithm has the benefits of being appropriate for all levels of literacy and education, in addition to decreasing barriers to performing CPR (such as mouth-to-mouth ventilations).

Our study is subject to a number of potential limitations. Firstly, the online survey may be subject to selection bias. Secondly, the survey questions were not formally validated. It is therefore possible that some respondents may not have understood some of the questions or terms such as cardiac arrest. We also acknowledge that survey methodology is subject to recall bias. However, our results are consistent with previous Australian[14,15] and international research.[10,11] Thirdly, the survey was restricted to those who could read and respond in English. Additionally, future online survey's need to be aware that some participants will undertake an online search to answer questions. In our case, we saw ten identical answers to one question and upon further examination determined these had been copied and pasted from the top search result of Google. Future online surveys could supplement responses using other methods such as a phone survey to address this issue.

In conclusion, our data suggest CPR training rates in Australia are unchanged over the past decades, however the majority of untrained respondents were willing to learn. This willingness should be

leveraged through national training and awareness strategies to increase knowledge of cardiac arrest and CPR. Such strategies need to consider targeting training to men, those with lower levels of education and those born overseas.

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Competing interests

All authors have completed the ICMJE uniform disclosure form. No competing interests to declare.

Authors contributions

SC and JB led the data analysis and drafted the paper. DS contributed to data analysis. All authors contributed to critical revisions of the paper.

Data sharing statement

No additional data are available as data are owned by the National Heart Foundation of Australia.

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Table 1. Characteristics of the sample according to cardiopulmonary resuscitation training status

	Overall n = 1076	CPR training status		
		CPR trained n = 540 (55.7%)	Not CPR trained n = 429 (44.3%)	p value
Gender				
Female	544 (50.6%)	292 (54.1%)	210 (48.9%)	0.11
Male	532 (49.4%)	248 (45.9%)	219 (51.1%)	
Age				
18 – 34	114 (10.6%)	154 (28.5%)	135 (31.4%)	0.07
35-44	220 (20.5%)	231 (42.8%)	149 (34.7%)	
45-64	223 (20.7%)	142 (26.3%)	130 (30.3%)	
75+	207 (19.2%)	13 (2.4%)	15 (3.5%)	
Country of birth				
Australia	817 (75.9%)	431 (79.8%)	311 (72.5%)	0.03
Overseas	253 (23.5%)	108 (20.0%)	116 (27.0%)	
Prefer not to answer	6 (0.6%)	1 (0.2%)	2 (0.5%)	

State				
Australian Capital Territory	8 (0.7%)	4 (0.7%)	4 (0.9%)	0.83
New South Wales and	339 (31.5%)	174 (32.2%)	127 (29.6%)	
Northern Territory	4 (0.4%)	2 (0.4%)	2 (0.5%)	
Queensland	218 (20.3%)	111 (20.6%)	92 (21.4%)	
South Australia	85 (7.9%)	43 (8.0%)	33 (7.7%)	
Tasmania	24 (2.2%)	16 (3.0%)	6 (1.4%)	
Victoria	284 (26.4%)	132 (24.4%)	115 (26.8%)	
Western Australia	114 (10.6%)	58 (10.7%)	44 (10.3%)	
Education				
Primary or grade school	3 (0.3%)	1 (0.2%)	2 (0.5%)	<0.001
Some high school	97 (9%)	41 (7.8%)	44 (10.3%)	
High school graduate	193 (17.9%)	75 (13.9%)	104 (24.2%)	
Technical college	302 (28.1%)	179 (33.2%)	102 (23.8%)	
University diploma	332 (30.9%)	161 (29.8%)	133 (31.0%)	
Postgraduate	141 (13.1%)	78 (14.4%)	43 (10.0%)	

Prefer not to answer	8 (0.8%)	5 (0.9%)	2 (0.5%)	
Previously performed emergency CPR	95 (8.8%)	84 (15.5%)	11 (2.6%)	<0.0001

Table 2. Factors associated with CPR training.

	OR (95% CI)	p-value
Females	1.30 (0.99-1.70)	0.05
Age		
18-34	Ref	
35-54	1.45 (1.06-2.00)	0.02
55-74	1.11 (0.78-1.58)	0.55
>75	0.92 (0.42-2.06)	0.85
Australian born	1.59 (1.17-2.17)	0.003
Education		
High school or less	Ref	
Vocational college	2.33 (1.64-3.30)	<0.001
University	1.86 (1.35-2.57)	<0.001

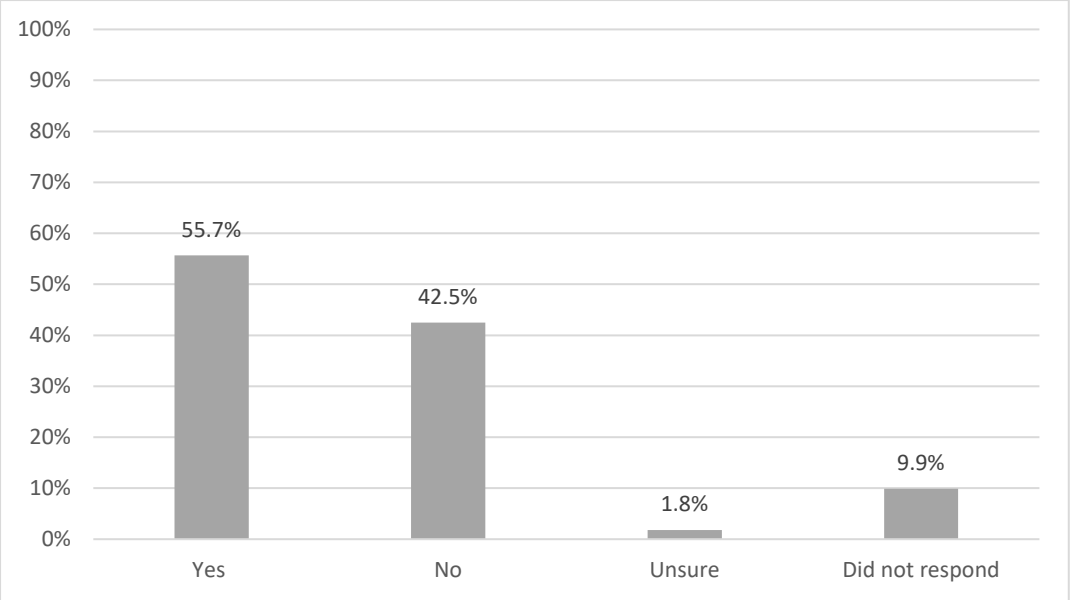

Figure 1A: Proportion of sample who have "ever had" CPR training

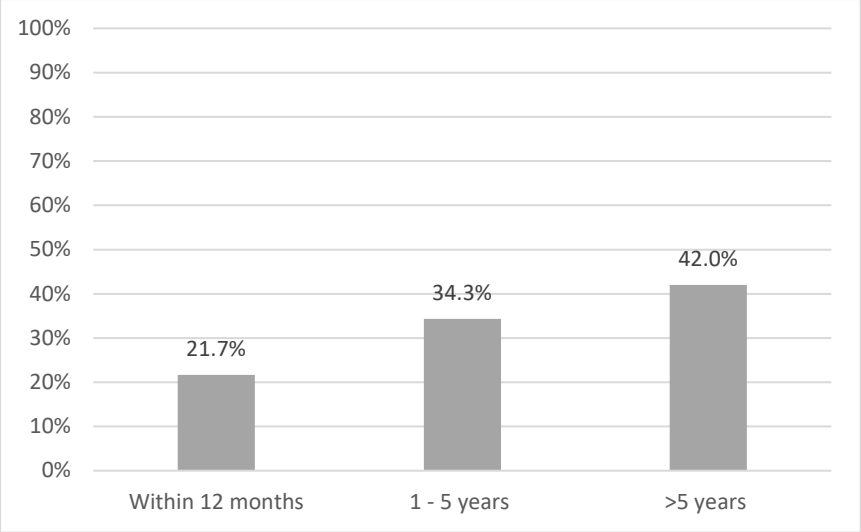

Figure 1B: Of those with CPR training, years since last training completed.

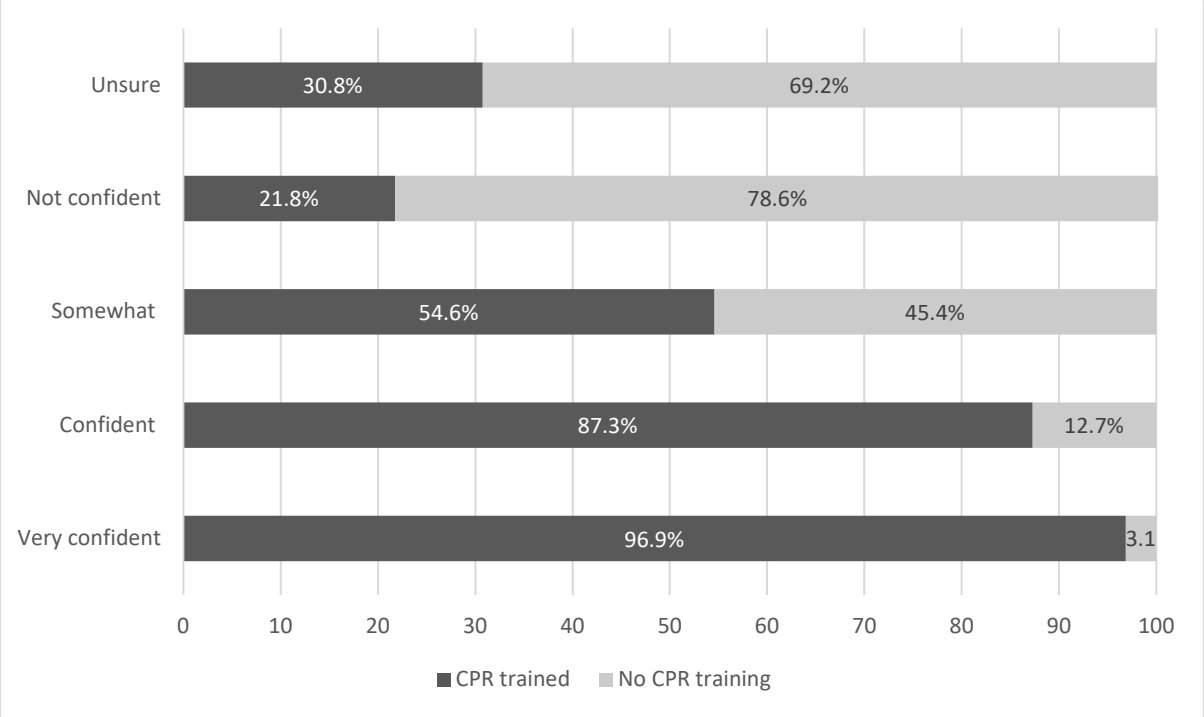

Figure 2. Self-rated confidence levels (%) about ability to perform effective CPR in an emergency

Supplementary 1: CPR specific questions of HeartWatch Survey 2017

1. To begin with could you please confirm your age?
2. What gender are you?
3. Where do you live?
4. What is your postcode?
5. Where you born in Australia or overseas?
6. What is the highest level of schooling you have received?
7. Do you know the difference between a cardiac arrest and a heart attack?
8. How would you describe the difference between a cardiac arrest and a heart attack?
9. What symptoms or signs would you associate with having a cardiac arrest?
10. What do you think you would do if you saw someone in cardiac arrest?
11. Have you ever heard of cardiopulmonary resuscitation, also known as CPR or mouth-to-mouth?
12. What is your understanding of when a person requires CPR?
13. Which of the following reflects how confident you currently feel about your ability to perform effective CPR in an emergency?
14. Have you ever performed CPR in a real-life emergency?
15. Would you intervene and provide CPR to a stranger?
16. Why would you not provide CPR?
17. Would you provide CPR to a family member or someone you know?
18. When a person has a cardiac arrest, CPR can more than double a person's chance of survival. Now knowing this, would you be more likely to provide CPR to a stranger?
19. Have you been trained in CPR?
20. How long ago did you receive the CPR training?

21. Which of these statements best describes your reasons for not receiving CPR training?
22. Would you be willing to learn CPR?
23. Which format of learning CPR would you prefer?
24. Have you ever heard of a defibrillator?
25. Would you be willing to use a defibrillator to help someone in difficulty/in an emergency?
26. Which of the following reflects how confident you currently feel about using a defibrillator in an emergency?
27. Why would you not use a defibrillator to help someone in difficulty/in an emergency?
28. How long do you think someone will survive after a cardiac arrest without CPR or defibrillation?

Supplementary 2: Defibrillator knowledge

	Overall n = 1076	CPR training status	
		CPR trained	Not CPR trained
		n = 540 (55.7%)	n = 429 (44.3%)
Have you ever heard of a defibrillator?			
Yes	903 (83.9%)	511 (94.6%)	392 (91.4%)
No	127 (11.8%)	20 (3.7%)	107 (24.9%)
Unsure	46 (4.3%)	9 (1.7%)	37 (8.6%)
Willingness to use a defibrillator			
Yes	633 (58.8%)	390 (72.2%)	243 (56.6%)
No	73 (6.8%)	27 (5.0%)	46 (10.7%)
Unsure	197 (18.3%)	94 (17.4%)	103 (24.0%)
Self-rated confidence to use a defibrillator			
Very confident	85 (7.9%)	77 (14.3%)	8 (1.9%)
Confident	137 (12.7%)	119 (22.0%)	18 (4.2%)
Somewhat confident	187 (17.4%)	118 (21.9%)	69 (16.1%)
Not confident	215 (20.0%)	73 (13.5%)	142 (33.1%)
Unsure	9 (0.8%)	3 (0.6%)	6 (1.4%)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4 - 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4 – 5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4 - 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	NA
Bias	9	Describe any efforts to address potential sources of bias	*NA*
Study size	10	Explain how the study size was arrived at	NA – secondary analysis
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5 - 6
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5 - 6
		(b) Indicate number of participants with missing data for each variable of interest	5 - 8
Outcome data	15*	Report numbers of outcome events or summary measures	5 - 8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	9 – 11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Australia's awareness of cardiac arrest and rates of CPR training: results from the Heart Foundations' Heart Watch Survey.

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Australia's awareness of cardiac arrest and rates of CPR training: results from the Heart Foundations' Heart Watch Survey.

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Title: Australia's awareness of cardiac arrest and rates of CPR training: results from the Heart Foundations' Heart Watch Survey.

Running Title: Australian CPR training rates

Abstract

Objective: We aimed to provide the first national estimates of cardiopulmonary (CPR) training and awareness of cardiac arrest.

Design: A retrospective analysis of a national cross-sectional survey was undertaken. Data was collected online from adults in July 2017 as part of the Heart Foundation of Australia HeartWatch survey. We used logistic regression to examine demographic factors associated with CPR training.

Participants: A national cohort was invited to participate in the survey using purposive, non-probability sampling methods with quotas for age, gender and area of residence, in order to reflect the wider Australian population. The final sample consisted of 1076 respondents.

Main outcome measure: To determine an estimation of the prevalence of CPR training at a national level and if training was related to demographic factors.

Results: The majority (76%) of respondents were born in Australia and 51% were female, 41% were aged between 35 and 64 years. Only 16% of respondents could identify the difference between a cardiac arrest and a heart attack. While 56% reported previous CPR training, only 22% were currently trained (within one year). CPR training was associated with younger age (35-54 years) (odds ratio (OR), 1.45, 95% confidence interval (CI), 1.06-2.0), being born in Australia (OR, 1.59, 95% CI 1.17-2.17) and higher levels of education (university, OR, 1.86, 95% CI 1.35-2.57). CPR training increased confidence in respondents ability to perform effective CPR and use a defibrillator. Lack of CPR training was the most common reason why respondents would not provide CPR training to a stranger.

Conclusions: There is a need to improve the community's understanding of cardiac arrest, and to increase awareness and training in CPR. CPR training rates have not changed over the past decades – new initiatives are needed.

Keywords: cardiopulmonary resuscitation, cardiac arrest, education, education surveillance, resuscitation

ARTICLE SUMMARY

Strengths and limitations

- This is the first time a national perspective investigating the awareness of cardiac arrest and cardiopulmonary resuscitation training has been undertaken in Australia.
- A representative group of Australians were represented in this survey using probability sampling methods that included quotas for age, gender and area of residence.
- While the limitations of cross-sectional survey methods include recall bias, our results are consistent with past surveys conducted in Australia.
- Future surveys of this nature require validation of survey questions and could employ mixed methods of using both online and phone surveys to address the challenge of participants using online searches to source survey answers.

INTRODUCTION

Bystander CPR more than doubles the chance of surviving a cardiac arrest,[1,2] however the provision of bystander CPR remains low.[3] While there has been improvement in bystander CPR rates with the introduction of dispatcher-assisted CPR instructions during the emergency call,[4] a significant proportion still do not feel confident to provide CPR even with instruction.[5]

There is growing evidence of a link between rates of bystander CPR and CPR training. Three studies have now reported communities with higher rates of bystander CPR have high rates of CPR trained residents.[6–8] This most likely occurs because CPR training is significantly associated with increased confidence and willingness to provide CPR.[9,10] Existing data also suggests specific demographics are associated with CPR training, including age, education level, country of birth and occupation.[9–11] There is also a need to examine the impact of socio-economic factors on rates of bystander CPR training, as regions with lower bystander CPR also have lower CPR training rates.[12,13] Therefore, understanding current rates of CPR training in the community is important, and may drive local initiatives.

In Australia, CPR training is currently not mandatory, and state-based surveys[9,14–16] suggest that less than 60% of Australian adults have received CPR training at least once. However, these surveys were conducted in specific regions, and most more than a decade ago. This study aimed to provide the first Australian-wide estimates of CPR training and willingness to learn CPR.

METHODS

This cross-sectional study used data from the Heart Foundations of Australia's "HeartWatch" Survey. This quarterly survey is conducted using a purposive, non-probability sampling method with quotas for age, gender and area of residence, in order to reflect the characteristics of the wider Australian population. Respondents of the survey belong to an online survey panel. In July 2017, 21 questions

about CPR were added to the survey, generated from previous Australian surveys.[9,14–16] The CPR questions (Supplementary File 1) were in three sections: cardiac arrest knowledge; CPR knowledge and experience; and defibrillator knowledge.

The present study was granted an ethics exemption from Monash University Human Research Ethics Committee (Project Number: 12329) as data provided for the research by the Heart Foundation of Australia was de-identified.

Patient and Public Involvement

The public were not invited to comment on the design of this study and were not consulted to develop relevant outcomes or interpret the results. The research group (Australian and New Zealand Prehospital Emergency Care [PEC-ANZ] Centre of Research Excellence) do however have representatives from the pubic on the steering committee who will be consulted about the outcomes and directions of dissemination of this research during regularly scheduled meetings. Results will also be disseminated via Heart Foundation of Australia channels in addition to the research group.

Data analysis

Data were analysed using descriptive statistics with proportions expressed as percentages and tests of association using chi-squared statistic between respondent characteristics and CPR training status. Logistic regression was used to identify respondent characteristics independently associated with CPR training. Characteristics with p-values <0.2 at the univariate level were included in the model. We also conducted a sensitivity analysis in a subsample of respondents excluding those who reported they had previously performed CPR. Free text responses were categorically coded by two health care professionals (Registered Nurse [SC] and Paramedic [DS]) in parallel, both of whom are experienced community first aid trainers. These authors met several times to compare and discuss

coding frameworks with outstanding disagreements referred to a third author (JB). Statistical significance for quantitative analysis was set at $p<0.05$ and analysis was conducted with Stata V15.1.

RESULTS

The survey sample consisted of 1,076 Australian adults. Responses were received from every state and territory in Australia (Table 1). There was a similar proportion of female (n=554, 50.6%) and male (n=532, 49.4%) respondents. The majority were aged between 35 and 64 years (n = 443, 41%), had completed at least 10 years of schooling (n = 968, 90%) and were born in Australia (n= 817, 76%).

Table 1. Characteristics of the sample according to cardiopulmonary resuscitation training status

	Overall n = 1076	CPR training status		
		CPR trained	Not CPR trained	p value
		n = 540 (55.7%)	n = 429 (44.3%)	
Gender				
Female	544 (50.6%)	292 (54.1%)	210 (48.9%)	0.11
Male	532 (49.4%)	248 (45.9%)	219 (51.1%)	
Age				
18 – 34	114 (10.6%)	154 (28.5%)	135 (31.4%)	0.07
35-44	220 (20.5%)	231 (42.8%)	149 (34.7%)	
45-64	223 (20.7%)	142 (26.3%)	130 (30.3%)	
75+	207 (19.2%)	13 (2.4%)	15 (3.5%)	
Country of birth				
Australia	817 (75.9%)	431 (79.8%)	311 (72.5%)	0.03
Overseas	253 (23.5%)	108 (20.0%)	116 (27.0%)	
Prefer not to answer	6 (0.6%)	1 (0.2%)	2 (0.5%)	

State				
Australian Capital Territory	8 (0.7%)	4 (0.7%)	4 (0.9%)	0.83
New South Wales and	339 (31.5%)	174 (32.2%)	127 (29.6%)	
Northern Territory	4 (0.4%)	2 (0.4%)	2 (0.5%)	
Queensland	218 (20.3%)	111 (20.6%)	92 (21.4%)	
South Australia	85 (7.9%)	43 (8.0%)	33 (7.7%)	
Tasmania	24 (2.2%)	16 (3.0%)	6 (1.4%)	
Victoria	284 (26.4%)	132 (24.4%)	115 (26.8%)	
Western Australia	114 (10.6%)	58 (10.7%)	44 (10.3%)	
Education				
Primary or grade school	3 (0.3%)	1 (0.2%)	2 (0.5%)	<0.001
Some high school	97 (9%)	41 (7.8%)	44 (10.3%)	
High school graduate	193 (17.9%)	75 (13.9%)	104 (24.2%)	
Technical college	302 (28.1%)	179 (33.2%)	102 (23.8%)	
University diploma	332 (30.9%)	161 (29.8%)	133 (31.0%)	
Postgraduate	141 (13.1%)	78 (14.4%)	43 (10.0%)	

Prefer not to answer	8 (0.8%)	5 (0.9%)	2 (0.5%)	
Previously performed emergency CPR	95 (8.8%)	84 (15.5%)	11 (2.6%)	<0.0001

Cardiac arrest knowledge

Respondents were asked if they "knew the difference between a cardiac arrest and a heart attack". The majority of respondents stated they were "unsure" (n = 404, 37.6%), followed by "yes" (n = 356, 33.1%), with the remaining responding "no" (n=316, 29.4%). The majority of those responding "yes" had received CPR training (72%). Those who answered "yes" were then asked to describe the difference between the two conditions using free text. Less than half of the "yes" respondents identified the two conditions correctly (n = 174, 48.3%), however 22.2% (n=79) identified the conditions incorrectly or only had the definitions partially correct (n=66, 18.5%). A small proportion (n=37, 10.4%) of yes respondents declared they were unsure once asked for a definition. When coding free text descriptions of the conditions it was noted that several respondents (n=10, 2.8%) had used the exact same wording. This wording was identical to the top result from online search engine Google when pasting the question into a search.

Knowledge of signs of cardiac arrest were variable among respondents. When coding free text responses according to Australian Resuscitation Council criteria (unresponsive and not breathing normally)[17], only 2.9% (n = 32) of respondents answered correctly. However, many respondents described the absence of a pulse ("no heart beat", "heart stops"), which has been removed within the last decade as a criteria for cardiac arrest in accredited Australian CPR training and from emergency call dispatch CPR instructions.[4] When we added the absence of a pulse as a correct descriptor of cardiac arrest, 14.2% (n = 153) of respondents had the answer coded as correct. Commonly respondents described a cardiac arrest victim as either unconscious or having an absence of breathing (n = 97, 9%). Incorrect answers (n = 684, 63.6%) featured chest pain, shortness of breath, weakness and dizziness. Numerous (11.8%) respondents (n = 127) stated they were unsure of the signs and symptoms.

CPR knowledge, confidence and training preferences

The majority of respondents (n=969, 90.1%) had heard of CPR. Few respondents (n = 95, 8.8%) had previously performed CPR. When respondents were asked what they would do if someone was in cardiac arrest, only 9 (0.8%) respondents correctly identified the chain of survival[18] sequence of calling an ambulance, commencing CPR and applying a defibrillator. These respondents all had prior CPR training within five years. More respondents (n=141, 13%) were able to identify two correct actions (i.e. calling an ambulance, and CPR or defibrillation). A smaller proportion (n = 121, 11.2%) described CPR and or defibrillation but did not mention calling an ambulance. The majority of respondents (n = 536, 49.7%) responded they would call an ambulance, but did not describe any further actions.

In total 55.7% (n = 540) of respondents had undertaken CPR training previously, however a large proportion (42.5%, n = 412) had not, and a small proportion were unsure (n = 17, 1.8%,) or did not answer (n = 107, 9.9%) (Figure 1). The majority of CPR trained respondents had not been trained in CPR for over 5 years (n = 227, 42%), with only 21.7% (n = 117) classified as being currently trained (within 12 months) as per the Australian guidelines.[19] (Figure 2).

<Figure 1: Proportion (%) of sample who have "ever had" cardiopulmonary resuscitation training>

<Figure 2: Of those with cardiopulmonary resuscitation training, years since last training completed

CPR training was not associated with any region (state or territory) of residence (Table 2) or socioeconomic status (all deciles p>0.05, data not shown). However, CPR training was associated with age 35-54 years (odds ratio [OR] 1.45, 95% CI 1.06 - 2.00), Australian-born (OR 1.59, 95% CI 1.17 – 2.17), and university (OR 1.86, 95% CI 1.35 – 2.57) and vocational level of education (OR 2.33, 95% CI 1.64 – 3.30) (Table 2). These factors remained significant when restricted to those who had not previously performed CPR. The main barriers to learning CPR included lack of awareness (“never thought about it”) (n = 190, 44%), not knowing where to go to learn (n = 91, 21%) and cost (12%).

The relationship between confidence in ability to provide CPR was significantly related to CPR training status, with respondents who stated they were very confident to perform CPR more likely to have CPR training ($p<0.001$ (Figure 3).

Of those with no prior CPR training, the majority (n = 312, 72.7%) of respondents were willing to learn CPR. The preferred format for CPR training was for group learning, led by a professional provider (n = 237, 76.0%) with a smaller proportion choosing learning via self-instruction (n = 57, 18.3%).

Table 2. Factors associated with CPR training.

	OR (95% CI)	p-value
Females	1.30 (0.99-1.70)	0.05
Age		
18-34	Ref	
35-54	1.45 (1.06-2.00)	0.02
55-74	1.11 (0.78-1.58)	0.55
>75	0.92 (0.42-2.06)	0.85
Australian born	1.59 (1.17-2.17)	0.003
Education		
High school or less	Ref	
Vocational college	2.33 (1.64-3.30)	<0.001
University	1.86 (1.35-2.57)	<0.001

<Figure 3. Self-rated confidence levels (%) about ability to perform effective CPR in an emergency according to CPR training status.>

Barriers to performing CPR

Only half (n = 530, 49.3%) of respondents stated they would provide CPR to a stranger. The remaining respondents were predominantly unsure (n = 307, 28.5%). In those that responded no (n = 132, 12.3%) the most common response was not being trained in CPR (n = 57, 43.2%) or not feeling confident (n = 26, 19.7%). Fear (n = 9, 6.8%), a physical inability (n = 5, 3.8%), or concern over legalities (n = 5, 3.9%) were other factors mentioned, with only two (1.5%) mentioning fear of infection.

Of the respondents who were not CPR trained (n = 412), the majority stated they were willing to learn (n = 312, 75.7%), with only small proportion of respondents stating they were unsure (n = 74, 17.9%) or unwilling (n = 26, 6.3%).

Defibrillator knowledge (confidence, willingness)

The majority of respondents (n = 903, 83.9%) had heard of a defibrillator and of these respondents more than half (n = 633, 58.8%) would be willing to use it. However confidence levels to use a defibrillator were low, with a third (33.9%, n = 215) stating they were not confident. (Supplementary File 2).

DISCUSSION

In this Australia-wide study, just over half (56%) of the adults reported having ever undertaken CPR training, however only 21% had current (within one year) training. CPR training was associated with younger age (35 – 54 years), being born in Australia and having a higher level of education. The association between these demographics and CPR training are similar to studies conducted in other countries.[9–11] Alarmingly however, this study found a low understanding of cardiac arrest, or being able to identify the actions involved with the chain of survival. There is a large opportunity to

increase national training prevalence, as the majority of those who were untrained in CPR are willing to learn and identified that learning in a group class, led by a professional instructor was the preferred learning format.

The prevalence of CPR training in this Australian study are similar to other recent international surveys conducted in the United Kingdom (57%)[10] and the United States of America (65%).[11] Unlike these countries however, Australia has no national or state-based mandatory training strategy, and there has only been limited attempts to promote awareness of cardiac arrest and CPR via mass-media (e.g. Shock Verdict https://www.utas.edu.au/shockverdict). These strategies are important to increase cardiac arrest and CPR training knowledge and awareness and should be considered.

In Australia, CPR training is only mandatory for selected professions (i.e. Health care professionals, teachers, childcare workers and fitness instructors).[20] The effect of workplace training is likely evidenced in our results by the fact younger working ages (35 – 54 years, OR 1.45, 95% CI 1.06 – 2.00) and those who attended both vocational college (OR 2.33, 95% CI 1.64-3.30) and university (OR 1.86, 95% Ci 1.35-2.57) were independently associated with CPR training. Recent evidence from the USA[21] demonstrates that mandatory CPR training in schools is associated with higher levels of individuals who are currently trained in CPR. Mandatory community-level training strategies require cooperation from many parties including federal and state governments and Resuscitation Councils. Nevertheless, these strategies have been successfully implemented elsewhere and they should not be overlooked, as they could ensure a large proportion of the community receive CPR training, at least once in their lifetime.

Our results, as has been identified before,[10,22,23] also demonstrate that those with CPR training had higher levels of self-reported confidence to perform CPR and use a defibrillator. Concurrently, the most common barrier to not performing CPR in this study was not being trained. This highlights the importance of CPR training especially given the positive link between levels of training and bystander CPR rates.[6–8] CPR training is consistently related to younger age and higher levels of education both

in Australia[9,14] and internationally.[11] Future training initiatives need to consider targeting populations less likely to receive training, particularly those that are older, who are at higher risk of future cardiac events. Along with the International Liaison Committee on Resuscitation,[24] we also place value on training high-risk populations, such as households containing a person with heart disease and have success in piloting a targeted training program through cardiac rehabilitation programs.[25]

In addition to training, raising awareness of cardiac arrest and CPR training is essential. A significant proportion of respondents in our study had never thought about CPR training or didn't know where to go to receive training. A national and co-ordinated campaign to increase public awareness of cardiac arrest and CPR training is warranted given the low rates of knowledge assessed in this study. Highlighting the simplification of CPR through promoting hand-only CPR may encourage more people to render assistance in an emergency and to undertake training. As traditional television, radio and print mass media campaigns are very costly, dissemination of these messages via social media should be investigated.[26] These approaches could be successful now that smartphones and other digital mobile devices are almost ubiquitous in Australia, including among older Australians.[27]

In the modern era, CPR training can be provided in many formats (e.g. with an instructor, via self-instruction, online). The majority of respondents in our study stated they would prefer to learn from an instructor in a class, with a smaller proportion preferring self-instruction. Now that "hands-only" CPR is the preferred teaching method for lay people,[17] the simplified algorithm has the benefits of being appropriate for all levels of literacy and education, in addition to decreasing barriers to performing CPR (such as mouth-to-mouth ventilations).[9,28]

Our study is subject to a number of potential limitations. Firstly, the online survey may be subject to selection bias and the results may only be applicable to those who respond to online surveys. However, the rationale of the sampling method used was to generate a sample which matched the characteristics (ie. age, sex, nationality) of the underlying Australian population. Secondly, the survey questions were not formally validated. It is therefore possible that some respondents may not have

understood some of the questions or terms such as cardiac arrest. We also acknowledge that survey methodology is subject to recall bias. However, our results are consistent with previous Australian[14,15] and international research.[10,11] Thirdly, the survey was restricted to those who could read and respond in English. Additionally, future online survey's need to be aware that some participants will undertake an online search to answer questions. In our case, we saw ten identical answers to one question and upon further examination determined these had been copied and pasted from the top search result of Google. Future online surveys could supplement responses using other methods such as a phone survey to address this issue.

Conclusion

Our data suggest CPR training rates in Australia are unchanged over the past decades, however the majority of untrained respondents were willing to learn. This willingness should be leveraged through national training and awareness strategies to increase knowledge of cardiac arrest and CPR. Such strategies need to consider targeting training to men, those with lower levels of education and those born overseas.

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Competing interests

All authors have completed the ICMJE uniform disclosure form. No competing interests to declare.

Authors contributions

SC and JB led the data analysis and drafted the paper. DS contributed to data analysis. All authors (SC, JB, DS and JF) contributed to critical revisions of the paper.

Data sharing statement

No additional data are available as data are owned by the National Heart Foundation of Australia.

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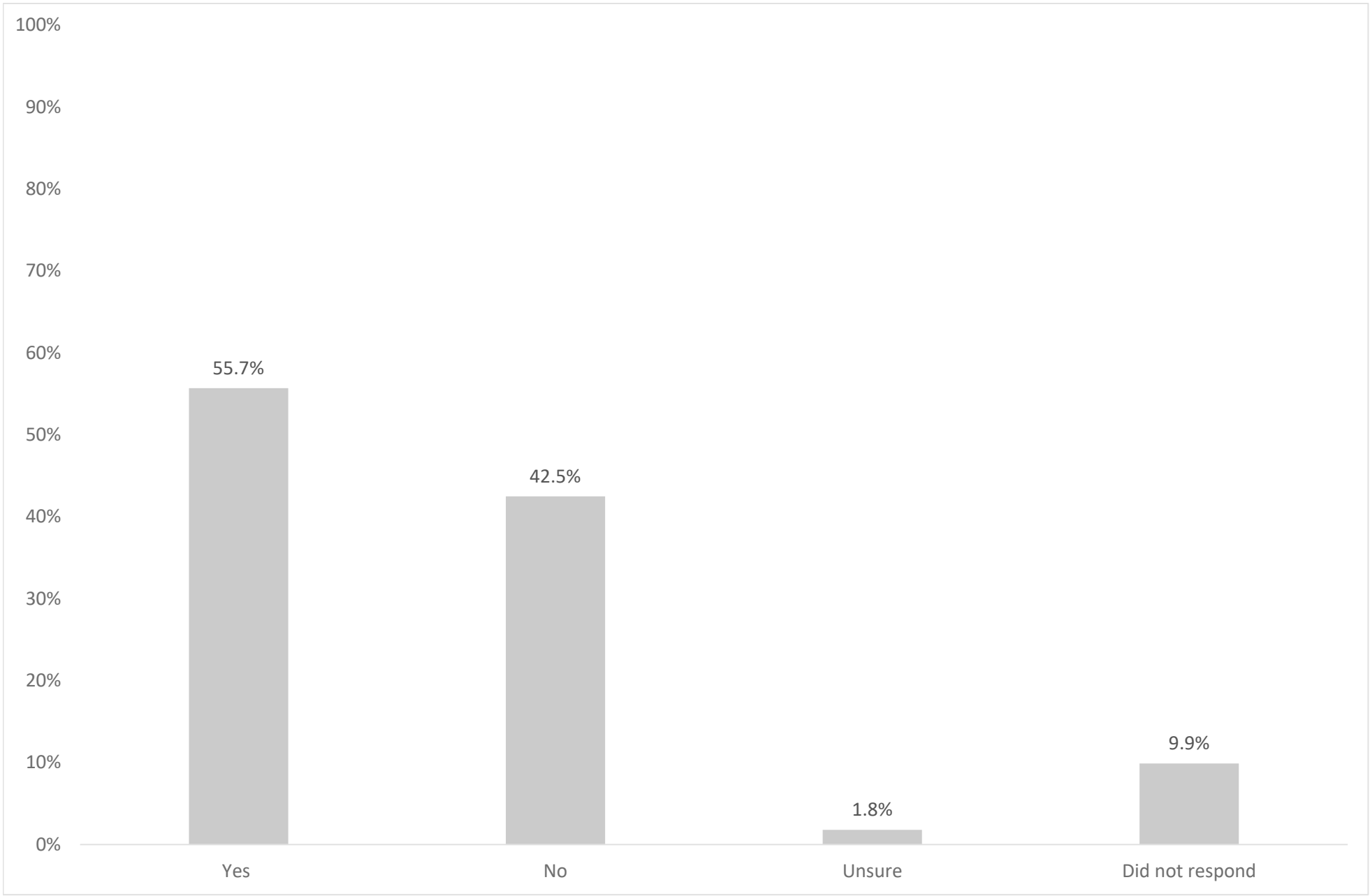
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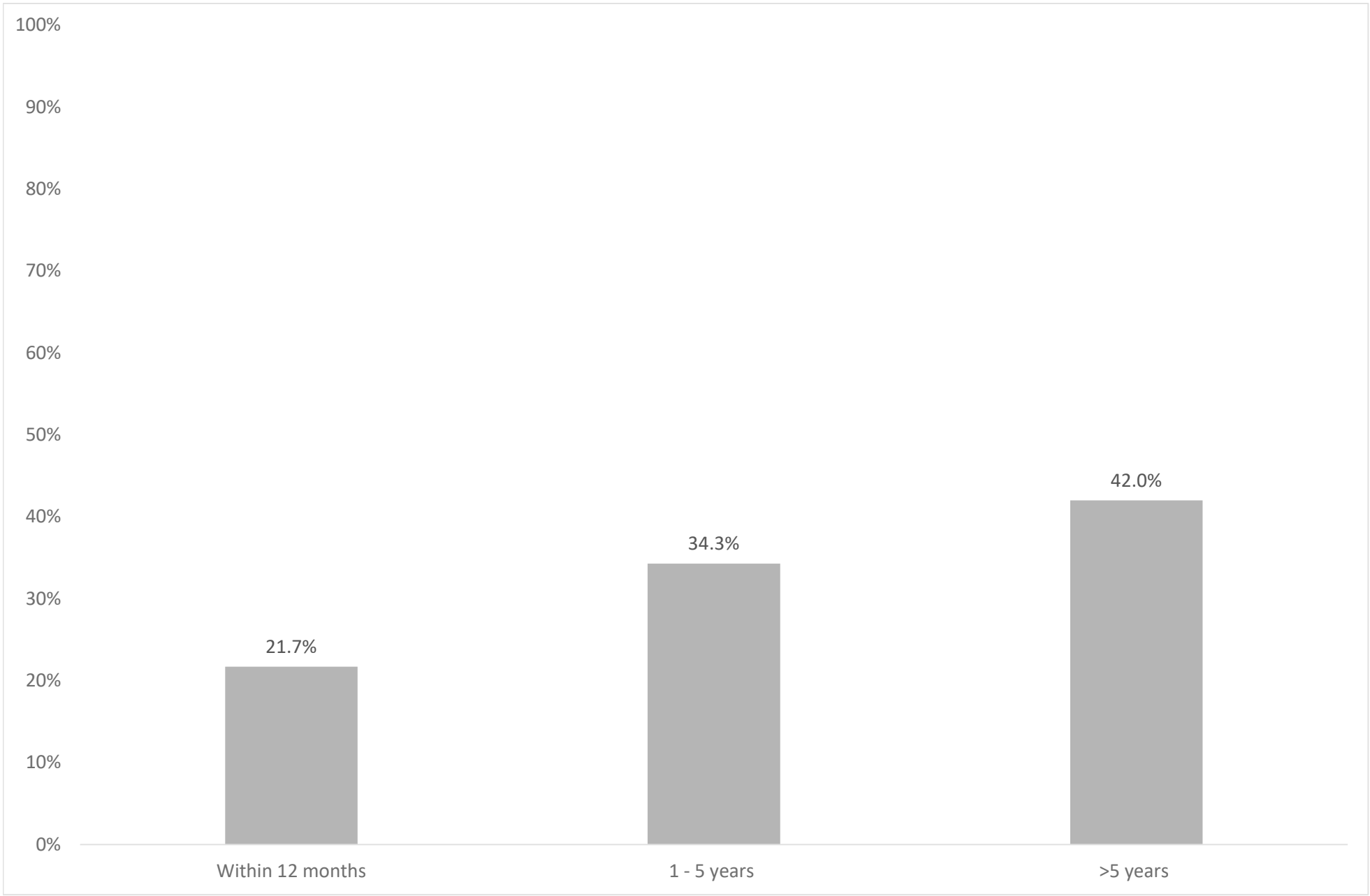
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Within 12 months
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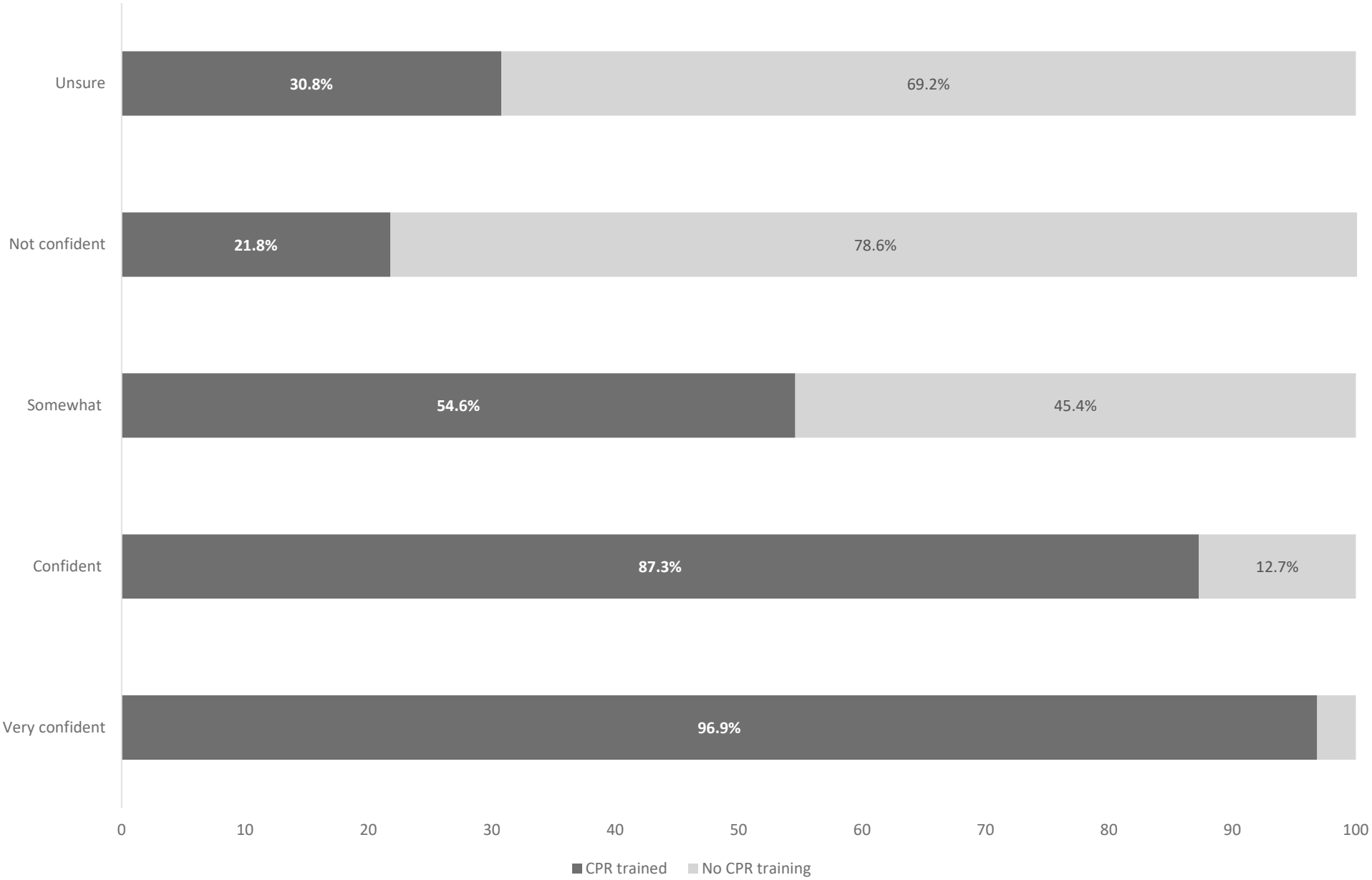
>5 years


Unsure
30.8%
69.2%
Not confident
21.8%
78.6%
Somewhat
54.6%
45.4%
Confident
87.3%
12.7%
Very confident
96.9%
0
10
20
30
40
50
60
70
80
90
100
CPR trained
No CPR training

Supplementary 1: CPR specific questions of HeartWatch Survey 2017

1. To begin with could you please confirm your age?
2. What gender are you?
3. Where do you live?
4. What is your postcode?
5. Where you born in Australia or overseas?
6. What is the highest level of schooling you have received?
7. Do you know the difference between a cardiac arrest and a heart attack?
8. How would you describe the difference between a cardiac arrest and a heart attack?
9. What symptoms or signs would you associate with having a cardiac arrest?
10. What do you think you would do if you saw someone in cardiac arrest?
11. Have you ever heard of cardiopulmonary resuscitation, also known as CPR or mouth-to-mouth?
12. What is your understanding of when a person requires CPR?
13. Which of the following reflects how confident you currently feel about your ability to perform effective CPR in an emergency?
14. Have you ever performed CPR in a real-life emergency?
15. Would you intervene and provide CPR to a stranger?
16. Why would you not provide CPR?
17. Would you provide CPR to a family member or someone you know?
18. When a person has a cardiac arrest, CPR can more than double a person's chance of survival. Now knowing this, would you be more likely to provide CPR to a stranger?
19. Have you been trained in CPR?
20. How long ago did you receive the CPR training?

21. Which of these statements best describes your reasons for not receiving CPR training?
22. Would you be willing to learn CPR?
23. Which format of learning CPR would you prefer?
24. Have you ever heard of a defibrillator?
25. Would you be willing to use a defibrillator to help someone in difficulty/in an emergency?
26. Which of the following reflects how confident you currently feel about using a defibrillator in an emergency?
27. Why would you not use a defibrillator to help someone in difficulty/in an emergency?
28. How long do you think someone will survive after a cardiac arrest without CPR or defibrillation?

Supplementary 2: Defibrillator knowledge

	Overall n = 1076	CPR training status	
		CPR trained	Not CPR trained
		n = 540 (55.7%)	n = 429 (44.3%)
Have you ever heard of a defibrillator?			
Yes	903 (83.9%)	511 (94.6%)	392 (91.4%)
No	127 (11.8%)	20 (3.7%)	107 (24.9%)
Unsure	46 (4.3%)	9 (1.7%)	37 (8.6%)
Willingness to use a defibrillator			
Yes	633 (58.8%)	390 (72.2%)	243 (56.6%)
No	73 (6.8%)	27 (5.0%)	46 (10.7%)
Unsure	197 (18.3%)	94 (17.4%)	103 (24.0%)
Self-rated confidence to use a defibrillator			
Very confident	85 (7.9%)	77 (14.3%)	8 (1.9%)
Confident	137 (12.7%)	119 (22.0%)	18 (4.2%)
Somewhat confident	187 (17.4%)	118 (21.9%)	69 (16.1%)
Not confident	215 (20.0%)	73 (13.5%)	142 (33.1%)
Unsure	9 (0.8%)	3 (0.6%)	6 (1.4%)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4 - 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4 – 5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4 - 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	NA
Bias	9	Describe any efforts to address potential sources of bias	*NA*
Study size	10	Explain how the study size was arrived at	NA – secondary analysis
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	NA
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5 - 6
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5 - 6
		(b) Indicate number of participants with missing data for each variable of interest	5 - 8
Outcome data	15*	Report numbers of outcome events or summary measures	5 - 8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	9 – 11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.