

Factors influencing the willingness to perform bystander cardiopulmonary resuscitation on the workplace: a study from North-Eastern Italy

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Summary. *Background:* Early bystander cardiopulmonary resuscitation (CPR) improves the chances of successful resuscitation and survival. However, few data are available regarding the willingness to perform CPR among First Aid Attendants on the Workplace (FAAWs) in Italy. The present study was performed in order to identify current attitudes of Italian FAAWs towards CPR. *Methods:* Between February and June 2017, FAAWs from the Autonomous Province of Trento were asked about their willingness to perform CPR through a structured questionnaire assessing their knowledge about CPR, and the reasons for hesitancy. A cumulative knowledge score (KS) was eventually calculated. *Results:* A total of 123 FAAWs (male 57.7%, mean age 45.2 years \pm 10.1) completed the questionnaire. About 1/3 of participants (32.5%) had previously performed First Aid procedures. Overall, 77.2% exhibited willingness to perform CPR, and such attitude was more frequently reported by subjects younger than 40 years (29.5% vs. 10.7% in older subjects; $p=0.045$), perceiving First Aid training as useful (98.9% vs. 84.7%, $p=0.002$), and exhibiting a better knowledge of CPR (KS \geq 75%: 47.4% vs. 15.3%). The reasons for the unwillingness were inadequate knowledge and doubt regarding whether they could perform the techniques effectively. Eventually, KS was identified as the main predictor for willingness to perform CPR (OR 4.450, 95%CI 1.442-14.350). *Conclusions:* Willingness to perform CPR was seemingly high, and knowledge of CPR techniques was its main predictor. These findings emphasize the importance for an accurate CPR training, as well as for the surveillance of the quality of qualification courses. (www.actabiomedica.it)

Key words: cardiac arrest, cardiopulmonary resuscitation (CPR), workplace

Introduction

Sudden out-of-hospital cardiac arrest (OHCA) is an important global health problem with approximately 420,000 cases in USA and 275,000 in Europe, annually (1-4): despite marked improvements in the pre-hospital emergency care system, only a minority of patients survive to hospital discharge, with estimates

of 400,000 to 450,000 deaths per year (1, 3-4). Three are the critical determinants of survival in the event of OHCA (1-6): the rapid activation of the emergency medical system, the initiation of cardiopulmonary resuscitation (CPR) by bystanders, and on-site defibrillation (2, 7-8). In particular, an effectively performed bystander CPR may increase eventual survival two- to fourfold (2, 8-11): because of this positive impact on

health outcomes, CPR is globally taught to First Aid Attendants on the Workplace (FAAWs), with a significant consumption of time and resources (3, 5, 8-9, 10, 12). Although the frequency of immediate bystander CPR in certain countries may peak 70%, it generally remains inadequate, even in recent years, also in the workplaces (3-4, 13), and many studies have identified the perceived risks of infectious diseases (i.e. potential HIV transmission etc.), as well as general hygienic concerns regarding mouth-to-mouth ventilation, and the fear of legal liability, among the main barriers towards CPR performance (4, 6). Moreover, an increasing base of evidence suggests that a significant share of trained people may ultimately hesitate to perform CPR in case of OHCA (3-4, 6, 12-14). However, little is known about the factors that make FAAWs more or less willing to engage in CPR on the workplace (12, 14).

Italian regulation (Legislative Decree No. 81/2008; Ministerial Decree 388/03) requires the employers to designate and train workers as FAAWs, and organize facilities in the workplaces, irrespective of size and risk profile of parent company. Formation courses (12 or 16 hours, depending on the company risk profile, with 4-6 hours retraining every three years) statutorily include CPR training with hands-on practice on the manikin (15). However, both quality and actual effectiveness of First Aid's system in the workplace have been questioned (16).

This study was therefore designed to investigate the attitudes, barriers and facilitators towards performing CPR in a sample of Italian FAAWs, in order to assess whether individual characteristics may be associated or not with the willingness to perform bystander resuscitation.

Methods

1. Study design, target population and ethical consideration

The present investigation was performed as a questionnaire-based cross-sectional study in the Autonomous Province of Trento (APT). APT is located in the Italy's North East, covers a total area of 6,214 km² (2,399 sq. mi) and has a population of 538,604

habitants (2016 intercensal estimate), with a total workforce of 227,247 subjects. According to available labor force statistics, around 43.5% of total employees work in firms having less than 10 employees, that represent 90.0% of all companies residing in the APT (17-18).

The Operative Unit of Prevention, Health and Safety in the Workplace (UOPSAL in APT) of the Provincial Agency for Health Services (APSS: the name of the Local Health Unit for the whole APT) represents the local governmental structure for the management of prevention in the workplace. As stated by the National Basic Health Care Levels (in Italian: *Livelli Essenziali di Assistenza*, or LEA), every year, a sample of 5% of all enterprises operating in the territory of a Local Health Unit should receive a workplace inspection by technicians and/or occupational physicians from UOPSAL and analogous services. Between February and June 2017, a random sample of 16 enterprises was identified among the assessed companies, eventually including a total of 5,110 workers, 2.2% of total provincial workforce. During the planned inspection of workplaces, UOPSAL personnel identified all workers with a FAAW qualification, collecting the year of their initial training course on CPR, and the date of the last retraining. A written report was then signed by UOPSAL personnel and employer's representatives in order to end the formal inspection of the worksites.

All active FAAWs identified during the inspection were eligible to participate to the present study, being contacted by UOPSAL personnel only after the conclusion of the formal assessment of the workplace. They were informed that participation was voluntary, that all collected information would be handled anonymously and confidentially, and that the questionnaires would be gathered only from subjects expressing preliminary consent for study participation. Moreover, as the inspection was formally concluded, their refusal to participate would have no consequences on the parent company.

Participants were then guaranteed that they could withdraw from the survey in any time, by simply not delivering the questionnaire at the end of the course session. As the questionnaire was strictly anonymous, it is implausible that individual participants could be

identified based on the presented material, and ultimately this study caused no plausible harm or stigma to participating individuals. As the study design assured an adequate protection of participants, and neither included clinical data about patients nor configured itself as a clinical trial, a preliminary evaluation by the Ethical Committee of the APSS was not statutorily required.

2. Questionnaire

The instrument used was a specifically designed structured questionnaire, that was developed in January 2017 from an extensive review of the literature about CPR knowledge and skill retention. It included a total of 26 multiple-choice items that had been used in previous studies on knowledge and attitudes towards CPR and First Aid, then adapted to our specific target population and design, and took about 7 to 10 minutes to complete.

Eventually, it comprised the following three sections:

(1) *Information about the interviewee.* Retrieved data included: gender, age, education level, birthplace (i.e. Italian-born people, IBP vs. Foreign-born people, FBP).

(2) *CPR knowledge and skills.* Firstly, subjects received a general knowledge test, containing a total of 8 true-false statements such as “*Before performing external cardiac massage, the victim should be placed face up on a firm surface, such as the floor or the ground*” (true), covering some typical misconceptions on CPR. The participants were then asked to identify where to place the palm of the hands on the thorax in order to start CPR by drawing a circle on a picture representing a male human chest (correct answer: centre of the chest, lower part of the victim’s sternum). Participants were then requested to identify the appropriate depth (around 5 cm) and rate (100 to 120 min⁻¹) of chest compressions, and the recommended ratio of chest compressions to breaths. As 2015 European Resuscitation Council guidelines for bystander CPR primarily recommend a 30:2 ratio, and identifies as appropriate in adults a continuous chest compression with a rate of 100 rounds per minute, both answers were retained as correct (19–20). A cumulative Knowledge Score was then calcu-

lated as follows: when the FAAWs correctly answered, +1 was added to a sum score, whereas a wrong indication or a missing answer added 0 to the sum score. The Knowledge Score was eventually normalized to per cent values (min 0.0% - max 100%).

(3) *Attitudes and practices.* Participants were initially asked whether they had ever performed First Aid procedures, both in general and on the workplace, and specifically whether they had previously executed at least one CPR procedure. FAAWs were then asked whether they would actually perform a CPR in case of a suspected OHCA on the workplace, through a 5-point Likert scale (i.e. *strongly agree, agree, neutral, disagree, strongly disagree*) or rather would avoid it or hesitate, explaining.

Test-retested reliability of questionnaire items was preventively assessed by having twelve non-medically trained persons reviewing the questionnaires prior to the survey at two different points in time. A correlation coefficient was calculated to compare the two sets of responses: items having a coefficient >0.80 were interpreted as consistent, and were therefore included in the questionnaire. All questionnaire items other than age were binary or categorical variables. All questions were self-reported, and not externally validated.

The delivering and gathering of questionnaires were performed by hand at the workplace by a trained health and safety technician, and questionnaires lacking basic information about the interviewee were excluded from the study.

3. Data analysis

Data entry was performed and compared by two independent researchers to ensure correct entries. Unclear responses were reviewed by the primary investigator to determine which answer was assumed as “correct”. Questionnaires lacking basic information about the interviewee were excluded from the study. Internal consistency of the Knowledge sections was measured by Cronbach’s alpha (21–22).

Continuous variables were expressed as mean \pm standard deviation (SD) and were preliminarily tested for normal distribution. Categorical variables were reported as per cent values and univariate confrontation between proportion were initially evaluated through

Chi-squared test in order to examine correlated of self-assessed willingness to perform bystander CPR, dichotomized as “*strongly agree / agree*” vs. “*neutral/ disagree/strongly disagree*”, with demographic data and individual factors, including: age (dichotomized as <40 vs. ≥40 years), gender, migration background (Italian-Born people vs. Foreign-Born people), education level (≤8 years vs. >8 years of formal education), time since last (≤1 year vs. >1 year or more) and first (≤3 years vs. >3 years or more) CPR training, number of previous training courses (only initial training vs. at least 1 re-training), experience of emergency situations, in general and on the workplace, experience on CPR (any vs. never), Knowledge Score (dichotomized as ≤75% vs. >75%) and attitude towards CPR training and the perceived need for further formation on CPR (“*somehow agree*” vs. “*somehow disagree*”).

Variables with p-value less than 0.05 were then included in a logistic regression model to determine the factors associated with willingness to attempt bystander CPR. The results were expressed as multivariate Odds Ratios (mOR) and 95% confidence intervals (CI). Significance level for all analyses was set for $p < 0.05$. All calculations were performed in SPSS 24 (IBM Corp. Armonk, NY).

Results

Demographics

A total of 144 FAAWs were identified, with a ratio with untrained workers of 1:8.4 (range: min 1:41, max 1:3.7), and all received the questionnaire. Eventually, 123 of them completed and returned the questionnaire, with a participation rate of 85.4%. The main characteristics of the respondents are shown in Table 1.

The majority of participants were of Italian origin (87.8%), and male sex (57.7%). Mean age was 45.2 ± 10.1 years, similar in males and females (46.0 ± 9.2 years vs. 44.2 ± 11.2 years, $p = 0.354$). All participants had completed at least the primary education requirements (5+ 3 years of formal education), and the majority of them (94, 76.4%) had achieved secondary education level (13 years) or higher. Around half of the

participants reported that they had received First Aid training during the last year (47.2%), and the majority of them had the initial training 4 years or more before the survey (in mean, 6.7 ± 5.2 years). The majority of the participants recalled 2 retrainings or more (56.9%).

A total of 40 participants (32.5%) had actually performed at least one First Aid procedure: 13 of them (10.6%) reported a workplace-related intervention, whereas 8 participants recalled that they had specifically performed a CPR (6.5%).

Knowledge

Cronbach's alpha for the General Knowledge test was 0.796. After per cent normalization, Knowledge Score was estimated in $68.9\% \pm 15.6$, and 38.9% of the participants had a score $\geq 75.0\%$. As shown in Table 2, the majority of the participants were aware that out of hospital heart arrest is possible in all age group (94.3%), that the external cardiac massage is an emergency life-support procedure only aimed to maintain heart to pump blood until medical help arrives (97.6%), that it should be sustained until medical help arrives (95.9%), that before performing external cardiac massage, the victim should be placed face up on a firm surface, such as the floor or the ground (95.1%), and that before starting cardiac massage, the bystander should ascertain whether the victim is breathing (91.9%). On the contrary, less than half of participant correctly stated that CPR in adults may be performed through continuous chest compressions without mouth-to-mouth resuscitation (49.6%), that the efficiency of the external cardiac massage in restoring autonomous heart pump is limited (47.2%), and that the external cardiac massage may be discontinued when the rescuer is physically exhausted (36.6%).

Regarding the CPR technical skills, 63.4% of participants correctly identified the centre of the chest, lower part of the victim's sternum, as the reference point for external cardiac massage (Figure 1), and 65.9% appropriately recalled a depth of around 5 cm for chest compressions. In this regard, half of respondents correctly identified an optimal compression rate of 100 to 120 min^{-1} (52.0%), whereas around a third of participants identified an inappropriately slower rate of 60 to 80 min^{-1} (32.5%), and 80.5% identified 30:2

Table 1. Demographics of 123 First Aid attendants from the Autonomous Province of Trento participating to the study (2017).

		Total
Age (years)	mean \pm SD	45.2 \pm 10.1
<30	No. (%)	11 (8.9%)
30- 39	No. (%)	20 (16.3%)
40- 49	No. (%)	45 (36.6%)
\geq 50	No. (%)	47 (38.2%)
Sex		
Males	No. (%)	71 (57.7%)
Females	No. (%)	52 (42.3%)
Migration Background		
No (Italian Born People)	No. (%)	108 (87.8%)
Yes (Foreign Born People)	No. (%)	15 (12.2%)
Education level		
Primary School (up to 8 years of formal education)	No. (%)	29 (23.6%)
High School (9 to 13 years of formal education)	No. (%)	72 (58.5%)
University or higher	No. (%)	22 (17.9%)
Time since the LAST First Aid formation course		
<1 year	No. (%)	58 (47.2%)
1 to 2 years	No. (%)	38 (30.9%)
2 to 3 years	No. (%)	16 (13.0%)
>3 years	No. (%)	11 (8.9%)
Time since the INITIAL First Aid formation course (years)	mean \pm S.D.	6.7 \pm 5.2
\leq 3 years	No. (%)	45 (36.6%)
4 or more	No. (%)	78 (63.4%)
No. of previous training courses	median (range)	3 (1 to 9)
Only initial training	No. (%)	24 (19.5%)
1 retraining	No. (%)	29 (23.6%)
2 retrainings or more	No. (%)	70 (56.9%)
Previously performed First Aid procedures		
Yes	No. (%)	40 (32.5%)
No	No. (%)	83 (67.5%)
Previously performed First Aid procedures on the workplace		
Yes	No. (%)	13 (10.6%)
No	No. (%)	110 (89.4%)
Previously performed CPR procedures		
Yes	No. (%)	8 (6.5%)
No	No. (%)	115 (93.5%)
Self-assessed attitude towards CPR on the workplace		
Strongly agree - Agree	No. (%)	95 (77.2%)
Neutral - Disagree - Strongly disagree	No. (%)	28 (22.8%)
Perception of First Aid courses as useful		
Strongly agree - Agree	No. (%)	118 (95.9%)
Neutral - Disagree - Strongly disagree	No. (%)	5 (4.1%)
Perceived need for further formation on CPR		
Strongly agree - Agree	No. (%)	89 (72.4%)
Neutral - Disagree - Strongly disagree	No. (%)	34 (27.6%)

Table 2. Knowledge test: response distribution of items proposed to 123 First Aid attendants from the Autonomous Province of Trento participating in the survey

	Correct answer	No. of Correct answers (%)
<i>External cardiac massage is an emergency life-support procedure only aimed to maintain heart to pump blood until medical help arrives.</i>	True	120 (97.6%)
<i>Before performing external cardiac massage, the victim should be placed face up on a firm surface, such as the floor or the ground.</i>	True	117 (95.1%)
<i>Before starting cardiac massage, the bystander should ascertain whether the victim is breathing.</i>	True	113 (91.9%)
<i>External cardiac massage should be sustained until medical help arrives.</i>	True	118 (95.9%)
<i>In adults, cardiopulmonary resuscitation may be performed through continuous chest compressions without mouth-to-mouth resuscitation.</i>	True	61 (49.6%)
<i>External cardiac massage is highly efficient in restoring autonomous heart pump (as shown in movies).</i>	False	58 (47.2%)
<i>External cardiac massage may be discontinued whether the rescuer is physically exhausted.</i>	True	45 (36.6%)
<i>Out of hospital heart arrest is possible in all age groups.</i>	True	116 (94.3%)
At your knowledge, appropriate rate of external chest compressions should be		
100 to 120 min ⁻¹	True	64 (52.0%)
60 to 80 min ⁻¹	False	40 (32.5%)
80 to 100 min ⁻¹	False	13 (10.6%)
> 120 min ⁻¹	False	6 (4.9%)
Appropriate ratio of chest compression : breaths should be		
30 chest compressions : 2 breaths		99 (80.5%)
Continuous chest compressions (approximately 100 min ⁻¹)		31 (25.2%)
Appropriate depth of chest compression should be		
Around 5 cm	True	81 (65.9%)
6 cm or more	False	38 (30.9%)
Less than 5 cm	False	4 (3.3%)

as the optimal chest compression : breath ratio. On the contrary, only 25.2% of participants acknowledged a continuous chest compression rate of 100 min⁻¹ as appropriate when performed by a bystander.

Attitudes and practices

Regarding the attitude towards First Aid training and CPR, the majority of participants agreed or strongly agreed in recognizing First Aid training courses as useful (95.9%), perceiving the need for further training in CPR (72.4%). Overall, 77.2% of participants agreed or strongly agreed that in case of necessity they would perform CPR on the workplace. Among the hesitant subjects (Figure 2), the majority of them (53.6%) feared that they would be unable to

perform it correctly, whereas 21.4% reported that, as fearing infections associated with mouth-to-mouth respiration, they would perform only continuous chest compressions, and 17.9% would avoid any intervention fearing that they might cause some damage to the victim. Eventually, only 1 respondent (3.6%) claimed that because of the fear of infections as well as fearing legal consequence he would avoid any contact with victim, including heart massage. Similarly, 1 participant (3.6%) reported that he would avoid CPR because of personal/religious/ethical reasons.

Univariate analysis

As shown in Table 3, subjects exhibiting a favourable attitude towards performing CPR were sig-

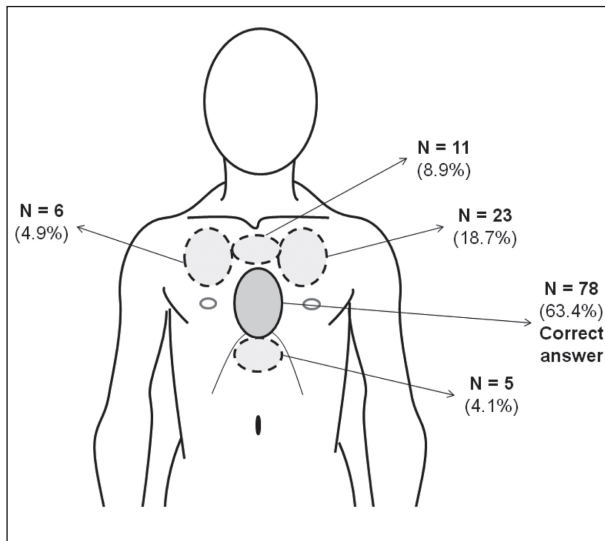


Figure 1. Identification by First Aid attendants participating to the study of the body site where to perform external cardiac massage (correct answer: centre of the chest, lower part of the victim's sternum)

nificantly younger than those somehow against (44.4 years \pm 10.5 vs. 48.1 years \pm 7.8, $p=0.048$), and in particular age group <40 year-old was associated with a significantly more favourable attitude (29.5% vs. 10.7%, $p=0.045$). Contrariwise, no significant differences regarding CPR attitude were identified by sex, migration background, formal education, but also time since first and last training course, as well as the number of retraining received by First Aid attendants (all comparisons, $p>0.05$). Also individual factors such as having previously performed First Aid and CPR procedures and the perceived need for further training on CPR had no significant effects. Eventually, participants exhibiting a better attitude towards First Aid training courses (98.9% vs. 85.7%, $p=0.002$) and in particular a Knowledge Score $\geq 75\%$ (47.4% vs. 15.3%, $p=0.002$) were associated with a more favourable attitude towards performing CPR.

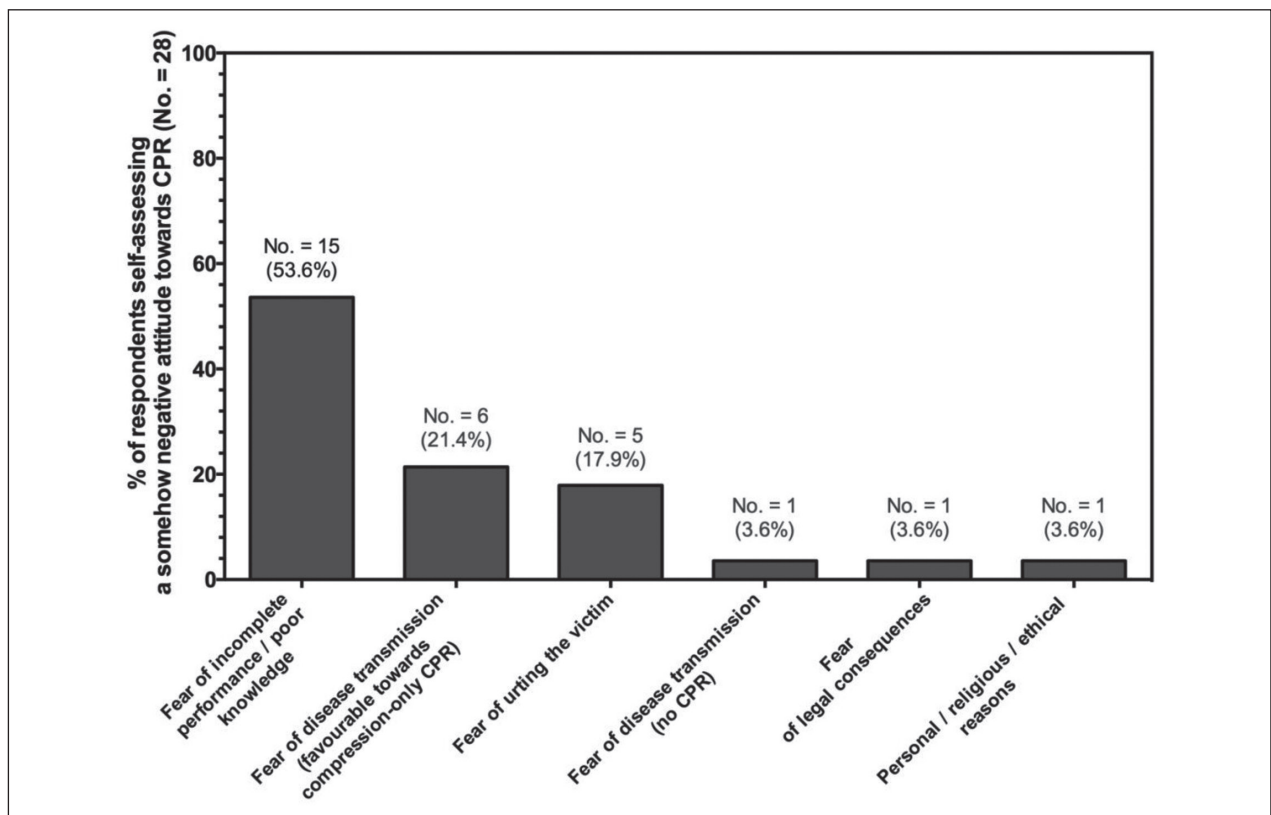


Figure 2. Reasons recalled by 28 First Aid attendants participating to this survey to avoid / partially avoid cardiopulmonary resuscitation (CPR) on the workplace

Table 3. Association of self-assessed attitude towards cardiopulmonary resuscitation (CPR) on the workplace with main demographic factors of 123 First Aid attendants from the Autonomous Province of Trento.

		Self-assessed attitude towards CPR on the workplace		
		Positive (No. = 28, 22.8%)	Negative (No. = 95, 77.2%)	P value
Age (years)				
	mean \pm SD	44.4 \pm 10.5	48.1 \pm 7.8	0.048
< 40	No. (%)	28 (29.5%)	3 (10.7%)	0.045
\geq 40	No. (%)	67 (70.5%)	25 (89.3%)	
Sex				
Males	No. (%)	57 (60.0%)	14 (50.0%)	0.347
Females	No. (%)	38 (40.0%)	14 (50.0%)	
Migration Background				
No (Italian Born People)	No. (%)	83 (87.4%)	25 (89.3%)	0.785
Yes (Foreign Born People)	No. (%)	12 (12.6%)	3 (10.7%)	
Education level				
9 years of formal education or more	No. (%)	73 (76.8%)	21 (75.0%)	0.840
\leq 8 years of formal education	No. (%)	22 (23.2%)	7 (25.0%)	
Time since the LAST First Aid formation course				
1 year or more	No. (%)	47 (49.5%)	11 (39.3%)	0.343
Up to 1 year	No. (%)	48 (50.5%)	17 (60.7%)	
Time since the INITIAL First Aid formation course (years)				
	mean \pm SD	6.5 \pm 5.2	7.3 \pm 5.3	0.473
\leq 3 years	No. (%)	36 (37.9%)	9 (32.1%)	0.579
4 or more	No. (%)	59 (62.1%)	19 (67.9%)	
No. of previous training courses				
	Median (range)	3 (1 to 9)	3.5 (1 to 7)	0.289
At least 1 retraining	No. (%)	76 (80.0%)	23 (82.1%)	0.801
Only initial training	No. (%)	19 (20.0%)	5 (17.9%)	
Previously performed First Aid procedures				
Yes	No. (%)	32 (33.7%)	8 (28.6%)	0.612
No	No. (%)	63 (66.3%)	20 (71.4%)	
Previously performed First Aid procedures on the workplace				
Yes	No. (%)	9 (9.5%)	4 (14.3%)	0.467
No	No. (%)	86 (90.5%)	24 (85.7%)	
Previously performed CPR procedures				
Yes	No. (%)	6 (6.3%)	2 (7.1%)	0.876
No	No. (%)	89 (93.7%)	26 (92.9%)	
Perception of First Aid courses as useful				
Strongly agree – Agree	No. (%)	94 (98.9%)	24 (85.7%)	0.002
Neutral – Disagree – Strongly disagree	No. (%)	1 (1.1%)	4 (14.3%)	
Perceived need for further formation on CPR				
Strongly agree – Agree	No. (%)	69 (72.6%)	20 (71.4%)	0.900
Neutral – Disagree – Strongly disagree	No. (%)	26 (27.4%)	8 (28.6%)	
Knowledge Score (%)				
	mean \pm SD	71.0 \pm 15.0	61.5 \pm 15.5	0.004
\geq 75%	No. (%)	45 (47.4%)	4 (15.3%)	0.002
< 75%	No. (%)	50 (52.6%)	24 (85.7%)	

Table 4. Multivariate Odds ratios (mOR) and 95% confidence intervals (95%CI) from a binary logistic regression analysis of 123 First Aid attendants from the Autonomous Province of Trento to perform bystander cardiopulmonary resuscitation (CPR) on their demographic variables

	mOR	95%CI		P value
		Lower limit	Upper limit	
<i>Age < 40 years</i>	1.363	0.543	3.432	0.510
<i>Perception of First Aid courses as useful</i>	9.924	0.970	89.057	0.053
<i>Knowledge Score >75%</i>	4.450	1.442	14.350	0.010

Multivariate analysis

The binary regression analysis model eventually included age ≤ 40 years, perception of First Aid courses as useful and knowledge score $\geq 75\%$ as independent variables. As shown in Table 4, only knowledge score was associated with a significant effect on the outcome variable attitude towards performing CPR on the workplace (mOR 4.450 95%CI 1.442-14.350), $p=0.010$).

Discussion

Strategies promoting FAAWs training in the workplace aim to create safer workplaces and disseminating CPR skills among the general population (19-25), but there is increasing concern regarding the actual FAAWs' willingness to perform CPR and the quality of their performances (5, 15-16, 23-29). At the moment, Italian law enforces no statutory requirement regarding the ratio of FAAWs to those not trained, but in our sample it was well higher than that usually recommended (i.e. 1:8.4 vs. 1:25 to 1:50 depending on the extent of workplace occupational health and safety risk) (12-15). This very high ratio is consistent with the reportedly favourable attitude of employers towards CPR education (24, 26), similarly stressing how time- and resource-consuming training and retraining may be for the parent companies (27-28). Consequently, it is essential that FAAWs would actually perform CPR procedures in case of suspected OHCA.

In our sample, 77.2% of participants exhibited a somehow favourable attitude towards performing CPR on the workplace, and such results are consistent

with available European data, suggesting a willingness rate ranging 40 to 70% (1-2, 4, 11, 13, 29). Regarding the reported barriers, most of them concerned the perceived insufficient technical skills, including the fear of causing some harms to the victims: interestingly enough, such concerns are globally raising despite the more recent guidelines have been designed in order to simplify the bystander approach towards CPR (3-4, 10, 15, 19, 23, 30-37). On the contrary, a factor usually identified among main barriers for CPR performance, i.e. the fear of infectious disease, was identified by a relatively low share of participants. Even though 21.4% of the participants reported to fear disease transmission during the CPR manoeuvre, they would not avoid the performance, rather performing a continuous chest compression CPR, whereas only 1 participant (3.6%) would totally elude CPR manoeuvre. Even though previous studies have suggested that continuous chest compression CPR may improve the willingness in laypeople fearing potential disease transmission during mouth-to-mouth resuscitation (33), our results significantly differ from studies conducted elsewhere, both in the general population and on the workplaces (38). For example, 30 to 80% of the American lay public were at least moderately concerned about disease transmission (35, 39), as were over 90% of lay rescuers in Sweden (1), 50 to 70% in Japanese healthcare workers (37), and 46% in Norway (10). In contrast, around only 18% of Australian residents (38), 16% of Chinese medical students (40), 5 to 6% of Japanese teachers and high school students (41), and only 1.8 of Chinese (32) and 0.7% of South Korean lay public (13) found disease to be a barrier to CPR. This heterogeneity could be partially explained through the varying rates of infectious diseases in these countries and subsequent risk percep-

tion by participants (38). In addition, some variations may be due to the different methodologies employed in these studies, i.e. open questions vs. forced-choice questions as the present one (10, 13, 30, 38, 41).

In our survey, factors usually associated with the intention of providing bystander CPR including previous experience, male gender and prior education (13) were eventually unrelated with willingness to perform CPR. Such results may be primarily explained by means of the relatively high level of knowledge and skill retention exhibited by participants. Not only mean Knowledge Score was high (i.e. $68.9\% \pm 15.6$), but more than a third of the participants (38.9%) achieved a score $\geq 75.0\%$: also focusing on the single items, the majority of participants exhibited relatively good or even very good knowledge of the technical skills required by CPR. In this regards, some uncertainties about the usage of continuous chest compression CPR were expected: latest guidelines recommending 100 chest compressions per minute by lay persons had achieved a difficult and conflicting recognition by international scientific authorities, with an ultimately incomplete dissemination among general population (5). Moreover, a better Knowledge Score was significantly associated with the self-referred willingness to perform CPR, being the only one significant facilitator after multivariate analysis (OR 4.450, 95%CI 1.442-14.350).

This seemingly high knowledge and skills retention was somehow unexpected as the majority of the participants (52.8%) had performed last training more than 1 year before the survey, and a many CPR skills are usually forgotten after certification, with a rapid decline between two to six months after the course (6, 8). Even though most of skill retention studies have been performed in general population rather than in the occupational settings (6), there is some evidence that 6 months post-training the share of participants able to perform a safe and effective CPR technique may be largely below 10% (8, 42), with a further decline in the first 5 years (8). Whilst optimal intervals are not known, evidence suggests that frequent “low dose” retraining may be beneficial (26): as around 80% of the respondents had performed at least 1 retraining, that presumptively contributed to improve both knowledge and skill retention among participants.

Eventually, several limitations of this study have to be addressed. First at all, behavioural intentions have been defined as predictors of actual behaviour (43), but specific circumstances may allow for some discrepancies (13). For instance, people may forget that even an ill-performed CPR cannot cause further harm to a person otherwise fated die because of the cardiac arrest, as uniformly fatal if not treated within minutes, that in some jurisdictions there is a law protecting against legal actions ensuing from helping with good intentions (i.e. the Good Samaritan Law; in Italy art. 54 of the Criminal Code or “*On the Necessity*”), and that concerns on the potential transmission of infectious diseases on potential rescuers have found no base of evidence in available data (43-44). Consequently, it is possible that personal pressures may ultimately restrain bystanders from performing CPR. Again, because of the study design we cannot rule out that our data might have been affected by a significant *social desirability bias*, with participants overrating their actual willingness to perform CPR (45).

Second, our study was unable to assess some factors that have been strongly associated with better knowledge and attitude towards CPR, such as the competencies of the instructor, the class size, the time spent in participants’ assessment, and the individual actual manikin practice time (6, 8). American Heart Association, American Red Cross CPR courses, but also CPR teaching unit of First Aid qualification courses as defined by Italian Law usually require the presence of a qualified instructor, being generally taught in a classroom setting, and taking approximately 4 hours to complete (46). They attempt to convey large amounts of information and impart considerable skills with a limited amount of practice time, but some studies have also suggested that traditional instructor-based learning does not provide the students with a solid platform to retain their practical and theoretical knowledge. However, as effective and less costly means of delivering CPR training such as the peer-led resuscitation training, individualized audiotape or videotape coached self-practice, are not allowed by current Italian laws, such remarks should be rather interpreted as limits to the international generalizability of our results (8, 26, 47).

In conclusion, our study identified a seemingly high willingness to perform CPR in cases of OHCA

among FFAWs from Northern Italy. A better knowledge of CPR was a significant determinant towards the performance of bystander CPR, supporting the usefulness of the training as currently defined by Italian Law (i.e. initial training, followed by periodic retrain every three years, including manikin CPR practice). As many of the barriers identified among participants reporting a negative attitude towards CPR, as well as the lack of confidence and knowledge towards compression only CPR, may be associated with inappropriate knowledge of CPR technique and skills, our results collectively emphasize the importance of constantly improving quality of training courses in order to increase FFAWs' confidence and willingness towards intervention. On the other hand, as qualification and periodic requalification of well-trained FFAWs are both time and resource-consuming, our results indirectly suggest the social relevance of further assessment on the actual content and quality of CPR training courses.

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References

1. Gräsner J-T, Lefering R, Koster RW, Masterson S, Böttiger BW, Herlitz J, et al. EuReCa ONE—27 Nations, ONE Europe, ONE Registry: A prospective one month analysis of out-of-hospital cardiac arrest outcomes in 27 countries in Europe. *Resuscitation* 2016;105:188–195
2. Hasselqvist-Ax I, Riva G, Herlitz J, Rosenqvist M, Holtenberg J, Nordberg P, et al. Early Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest. *N Eng J Med* 2015;372:2307–2315
3. Kuramoto N, Morimoto T, Kubota Y, Maeda Y, Seki S, Takada K, et al. Public perception of and willingness to perform bystander CPR in Japan. *Resuscitation* 2008;79:475–481
4. Swor R, Khan I, Domeier R, Honeycutt L, Chu K, Compton S. CPR Training and CPR Performance: Do CPR-trained Bystanders Perform CPR? *Acad Emerg Med* 2006;13:596–601
5. Anderson GS, Gaetz M, Statz C. CPR Skill Retention of First Aid Attendants within the Workplace. *Prehosp Disaster med* 2012;27:312–318
6. Eisenburger P, Safar P. Life supporting first aid training of the public—review and recommendations. *Resuscitation* 1999;41:3–18
7. Anderson GS, Gaetz M, Masse J. First aid skill retention of first responders within the workplace. *Scand J Trauma Resusc Emerg Med* 2011;19:11
8. Parnell MM, Larsen PD. Poor quality teaching in lay person CPR courses. *Resuscitation* 2007;73:271–278
9. Gallagher EJ, Lombardi G, Gennis P. Effectiveness of bystander cardiopulmonary resuscitation and survival following out-of-hospital cardiac arrest. *JAMA* 1995;274:1922–1925
10. Kanstad BK, Nilsen SA, Fredriksen K. CPR knowledge and attitude to performing bystander CPR among secondary students in Norway. *Resuscitation* 2011;82:1053–1059
11. Kragholm K, Wissenberg M, Mortensen RN, Hansen SM, Malta Hansen C, Thorsteinsson K, et al. Bystander Efforts and 1-Year Outcomes in Out-of-Hospital Cardiac Arrest. *N Eng J Med* 2017;376:1737–1747
12. Lingard H: The effect of first aid training on Australian construction workers' occupational health and safety motivation and risk control behavior. *J Saf Res* 2002;33:209–230
13. Lee MJ, Hwang SO, Cha KC, Cho GC, Yang HJ, Rho TH. Influence of nationwide policy on citizens' awareness and willingness to perform bystander cardiopulmonary resuscitation. *Resuscitation* 2013;84:889–894.
13. Sacco A, Ciavarella M, Trevisan A, Monteforte G, De Santis A. [Educational and training issues in occupational first aid: the requisites for the teachers of the workers responsible for first aid]. *Med Lav* 2005;96:403–408 (Article in Italian)
14. Höglund S. Farmers' Health and Safety Programs in Sweden. *Am J Ind Med* 1990; 18 (4): 371–378
16. Papaleo B, Cangiano G, Calicchia S, Marcellini L, Cola-

- giacomo C, Pera A. [The organization and management of First Aid in the workplace: critical issues and innovations to be introduced]. *G Ital Med Lav Erg* 2012;34:71-75 (Article in Italian)
17. Agnolin C, Ioriatti C, Pontalti M, Venturelli MB: IFP experiences in Trentino, Italy. *Acta Hort* 2000;525:45-50
 18. The Organization for economic Co-operation and development (OECD). Report: Local Job Creation: How Employment and Training Agencies can Help - Labour Agency of the Autonomous Province of Trento (2012). Available on: <http://www.oecd.org/cfe/leed/Report%20Local%20Job%20Creation%20Labour%20Agency%20Trento%20Italy.pdf> (last access: June 13th, 2017).
 19. Perkins GD, Handley AJ, Koster RW, Castrén M, Smyth MA, Olasveengen T, et al: European Resuscitation Council Guidelines for Resuscitation 2015: Section 2. Adult basic life support and automated external defibrillation. *Resuscitation* 2015;95:81-99
 19. Strömsöe A, Andersson B, Ekström L, Herlitz J, Axelsson A, Göransson KE, et al. Education in cardiopulmonary resuscitation in Sweden and its clinical consequences. *Resuscitation* 2010;81:211-216
 20. Zideman DA, De Buck EDJ, Singletary EM, Cassan P, Chalkias AF, Evans TR, et al. European Resuscitation Council Guidelines for Resuscitation 2015 Section 9. First aid. *Resuscitation* 2015; 95:278-287
 21. Riccò M, Cattani S, Casagrande F, Gualerzi G, Signorelli C. Knowledge, attitudes, beliefs and practices of occupational physicians towards vaccinations of health care workers: A cross sectional pilot study in north-eastern Italy. *Int J Occup Med Environ Health* 2017;30:775-790
 22. Riccò M, Vezzosi L, Gualerzi G, Signorelli C. Knowledge, attitudes and practices (KAP) towards vaccinations in the school settings: an explorative survey. *J Prev Med Hyg.* 2017;58:266-278.
 23. Sim MS, Jo IJ, Song HG. Basic cardiac life support education for non-medical hospital employees. *Emerg Med J* 2009;26:327-330
 24. Roppolo LP, Saunders T, Pepe PE, Idris AH. Layperson training for cardiopulmonary resuscitation: when less is better. *Curr Opin Crit Care* 2007;13:256-260
 25. Hatzakis KD, Kritsotakis EI, Angelaki HP, Tzanoudaki IK, Androulaki ZD. First Aid Knowledge among Industry Workers in Greece. *Ind Health* 2005;43:327-332
 26. Greif R, Lockey AS, Conaghan P, Lippert A, De Vries W, Monsieurs KG, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 10. Education and implementation of resuscitation. *Resuscitation* 2015;95:288-301
 27. Manzoli L, Sotgiu G, Magnavita N, Durando P, National Working Group on Occupational Hygiene of the Italian Society of Hygiene, Preventive Medicine and Public Health (SIIt). Evidence-based approach for continuous improvement of occupational health. *Epidemiol Prev* 2015;39:S81-S85
 28. Signorelli C, Riccò M, Odone A. The Italian National Health Service expenditure on workplace prevention and safety (2006-2013): a national-level analysis. *Ann Ig* 2016;28:313-318
 29. Calicchia S, Cangiano G, Papaleo B. [First aid and defibrillation in the workplace: a helpful decision for the public]. *G Ital Med Lav Erg* 2012;34(S3):193-195 (Article in Italian).
 30. Axelsson Å, Thorén A, Holmberg S, Herlitz J. Attitudes of trained Swedish lay rescuers toward CPR performance in an emergency. A survey of 1012 recently trained CPR rescuers. *Resuscitation* 2000;44:27-36
 31. Breckwoldt J, Lingemann C, Wagner P: Resuscitation training for lay persons in first aid courses. *Anaesthetist* 2015;65:22-29
 32. Chen M, Wang Y, Li X, Hou L, Wang Y, Liu J, et al. Public Knowledge and Attitudes towards Bystander Cardiopulmonary Resuscitation in China. *Biomed Res Int* 2017;2017:3250485
 33. Cheskes L, Morrison LJ, Beaton D, Parsons J, Dainty KN. Are Canadians more willing to provide chest-compression-only cardiopulmonary resuscitation (CPR)?—a nation-wide public survey. *CJEM* 2016;18:253-263
 34. Delavar MA, Gholami G, Ahmadi L, Moshtaghian R. Knowledge, attitude and practices of relief workers regarding first aid measures. *J Pak Med Assoc* 2012;62:218-221
 35. Locke CJ, Berg RA, Sanders AB, Davis MF, Milander MM, Kern KB, et al. Bystander cardiopulmonary resuscitation. Concerns about mouth to mouth contact. *Arch Intern Med* 1995;155:938-943
 36. Sasson C, Haukoos JS, Ben-Youssef L, Ramirez L, Bull S, Eigel B et al. Barriers to Calling 911 and Learning and Performing Cardiopulmonary Resuscitation for Residents of Primarily Latino, High-Risk Neighborhoods in Denver, Colorado. *Ann Emerg Med* 2015;65:545-552
 37. Taniguchi T, Sato K, Fujita T, Takamura M. Attitudes to Bystander Cardiopulmonary Resuscitation in Japan in 2010. *Circ J* 2012;76:1130-1135
 38. Johnston TC, Clarck MJ, Dingle GA, FitzGerald G. Factors influencing Queenslanders' willingness to perform bystander cardiopulmonary resuscitation. *Resuscitation* 2003;56:67-75
 39. Shams A, Raad M, Chams N, Chams S, Bachir R, El Sayed MJ. Community involvement in out of hospital cardiac arrest: A cross-sectional study assessing cardiopulmonary resuscitation awareness and barriers among the Lebanese youth. *Medicine (Baltimore)* 2016;95:e5091
 40. Lu C, Jin Y, Meng F, Wang Y, Shi X1, Ma W, et al: An exploration of attitudes toward bystander cardiopulmonary resuscitation in university students in Tianjin, China: A survey. *Int Emerg Nurs* 2016;24:28-34
 41. Shibata K, Taniguchi T, Yoshida M, Yamamoto K. Obstacles to bystander cardiopulmonary resuscitation in Japan. *Resuscitation* 2000;44:187-193
 42. Chamberlain D, Smith A, Colquhoun M, Handley AJ, Kern KB, Woollard M. Randomised controlled trials of staged teaching for basic life support 2. Comparison of CPR performance and skill retention using either staged instruc-

- tion or conventional training. *Resuscitation* 2001;50:27-37
43. Vaillancourt C, Charette M, Kasaboski A, Brehaut JC, Osmond M, Wells GA, et al: Barriers and facilitators to CPR knowledge transfer in an older population most likely to witness cardiac arrest: a theory-informed interview approach. *Emerg Med J* 2014;31:700-705
44. Vaillancourt C, Kasaboski A, Charette M, Islam R, Osmond M, Wells GA, et al: Barriers and facilitators to CPR training and performing CPR in an older population most likely to witness cardiac arrest: A national survey. *Resuscitation* 2013;84:1747-1752
45. King MF, Bruner GC. Social desirability bias: A neglected aspect of validity testing. *Psychol Mark* 2000;17:79-103.
46. Todd KH, Heron SL, Thompson M, Dennis R, O'Connor J, Kellermann AL.: Simple CPR: A Randomized, Controlled Trial of Video Self-Instructional Cardiopulmonary Resuscitation Training in an African American Church Congregation. *Ann Emerg Med* 1999;34:730-737
47. Lynch B, Einspruch EL, Nichol G, Becker LB, Aufderheide TP, Idris A. Effectiveness of a 30-min CPR self-instruction program for lay responders: a controlled randomized study. *Resuscitation* 2005;67:31-43

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