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ORIGINAL

COASTAL POLICE OF VIGO. A QUASI-EXPERIMENTAL PILOT STUDY ABOUT CPR AND RESCUE

POLICÍA COSTERA DE VIGO. ESTUDIO PILOTO CUASI-EXPERIMENTAL SOBRE RESCATE Y RCP

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ABSTRACT

Drowning is a leading cause of death worldwide and in Spain. Lifeguards exert vigilance and prevention efforts but their work is seasonal and temporary. In many places the first emergency response when lifeguards are not on duty, depends on the police, which are required rescue skills and cardiopulmonary resuscitation (CPR). The objective of this study is to determine the ability of lifesaving and effect of fatigue on the quality of CPR of a group of ten coastal police whose area of influence is the coast of Vigo. The design was quasi-experimental with two factors (basal pretest / posttest rescue). Cops with basic training could perform fast and safe water rescue 417 ± 54.5 seconds, lactate level was recorded 12.27 ± 2.36 mmol. Induced fatigue during resuce effort had a nevative effect on the quality of compressions in CPR ($p = 0.002$).

KEYWORDS

Cardiopulmonary resuscitation, drowning, rescue, police, fatigue.

RESUMEN

El ahogamiento es una de las principales causas de muerte en el mundo y en España. Los socorristas ejercen una labor de prevención y vigilancia pero su labor es estacional y temporal. En muchos lugares, la primera respuesta a la emergencia, cuando los socorristas no están de servicio, depende de la policía, a la que se le requiere habilidades de rescate y reanimación cardiopulmonar (RCP). El objetivo de este estudio es determinar la capacidad de rescate y efecto de la fatiga sobre la calidad de la RCP de un grupo de diez policías costeros cuya área de influencia es el litoral de Vigo. El diseño fue cuasi-experimental con dos factores (pretest basal/postest rescate). Los policías pudieron realizar el rescate acuático rápido y seguro 417 ± 54,5 seg, a nivel de lactacidema se registró 12,27 ± 2,36 mmol. La fatiga inducida por el rescate afectó negativamente a la calidad de la compresiones en la RCP (p = 0,002).

PALABRAS CLAVE: Reanimación cardiopulmonar, ahogamiento, rescate, policía, fatiga.

1. INTRODUCTION

Drowning is one of leading causes of unintentional death in the world (1). It is particularly tragic in young people under 20 years old (1), and men have a higher prevalence of death by drowning in comparison to women (2). For every drowned person, there are four people receiving care in emergency services for non-fatal drowning (3). The risk of dying from exposure to drowning, compared to a car accident, is 200 times higher (4). 438 people died in Spain in 2012, mostly young and male persons (5).

Lifeguards ensure the safety on the beaches, but their work is seasonal and limited to a geographic area. Not all water areas are monitored and those that are being monitored, are not covered 24 hours per day. When there are no lifeguards, aquatic incidents must be addressed by other professionals such as police or fire fighters as the prognosis of the victim will depend on the amount of water intake (6) so that the speed with which the drowning process is disrupted is crucial. This care extends until emergency medical services (EMS) arrive.

On the beaches patrolled by lifeguards only 0.5% of their interventions required CPR (7) because they carry an important role in prevention. However, in areas without lifeguards, 30% of people rescued by witnesses needed CPR (8).

On many occasions, the police arrives at the place where the incident occurs before the EMS (9), especially in the beach areas where they are present or in inaccessible places. Therefore, it is considered useful to involve the police as first responders in emergency (10,11) even though today, there is no evidence of their ability, their preparation and their activities in the aquatic environment and its competence to perform cardiopulmonary resuscitation (CPR).

If the response to the incident is quick and CPR is early implemented, it could help reduce the collapse in cardiac arrest, thus increasing the probability of survival (12). An early quality CPR also reduces damage to the neurological level (8.13), so the European Resuscitation Council (14) and the American Heart Association (15) promote quality CPR. Hence the importance of instructing and evaluating potential first responders.

Certain standards of fitness and mastery of specific skills (16) are required to become a police officer, however, for access to police public service in Spain no lifeguard or rescue skills are required, although everyone knows how to swim.

If the police officers have no knowledge of rescue and they aren't trained in the aquatic environment, the outcome can be fatal for them and the victim, however, with basic training, they could become enabled to face a water incident and decide whether or not to intervene.

The aim of this pilot study is to test the ability of water rescue and quality of the CPR post-rescue of a police team with responsibilities for water safety.

2. METHODS

2.1. Sample

Ten policemen from Coast and Beaches Unit of the City of Vigo (Spain) comprise the sample of this study. Their participation was voluntary and approved by the Local Police Headquarters. At the time of the investigation, police officers were active, they were destined to Coast and Beaches Unit and they had no previous professional experience in water rescue. Everyone knew how to swim.

2.2. Ethics and consent

This study stems from a joint project between the University of Vigo, Vigo Town Hall and Police Headquarters of the city of Vigo. The research project was approved by the estates involved and it was performed in compliance with the ethical principles of the Helsinki Convention. Each participant has authorized in writing the transfer of data for this study and signed the informed consent.

2.3. Design and implementation of the pilot study

A quasi-experimental design involving 10 police officers from Coast and Beaches Unit of the municipality of Vigo was used. The study was conducted in two phases (pre-test and post-test). They previously received training following basic content for the first responder of professional lifeguard qualification in natural aquatic areas (17), in which rescue and CPR skills were included.

In the first phase, the anthropometric data of the sample were recorded and a test of 5 minutes CPR at baseline was performed (pre-test). In the second phase, the agents conducted a land rescue trip to the shore and water rescue to finish with 5 minutes of CPR (post-test). Thus, it was possible to analyze the difference between the quality of cardiopulmonary resuscitation at rest and under conditions of fatigue. The response time to emergency and rescue lactic effect could also be checked.

2.4. Lifeguard Training and CPR

Police officers who formed the sample received basic training in first aid and CPR techniques before the start of the summer of 2013. During the same year they received a weekly one-hour session from 1 April to late summer. The test was conducted on May 8, 2013, thus receiving 6 training sessions prior to CPR test and rescue. The training is divided as follows; swimming 25% of the time (front crawl and breaststroke), 50% training of rescue techniques (victim control and transfer to dorsal breaststroke) and 25% of the time, CPR practice (with instructor's support). Each session lasted one hour. All training contents corresponded to some of the units of competence of Professional lifeguard qualification in natural aquatic areas (17). The training process was conducted and supervised by the coordinator of lifesaving services of the City of Vigo.

2.5. Pre-test of quality of CPR (basal)

Descriptive and anthropometric variables of the sample were recorded: sex, age, weight, height, body mass index (BMI) and body fat percentage of each participant (Table 1). The Tanita BC-418MA octapolar bioimpedance was used to determine the percentage of body fat.

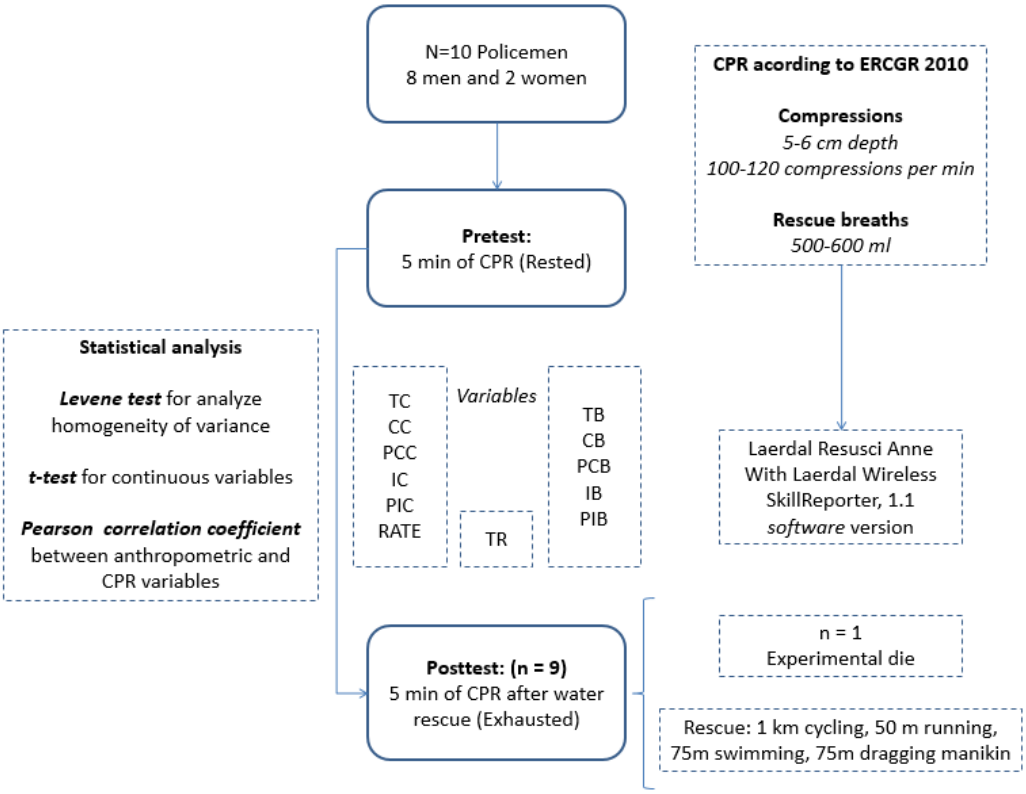
Then, participants executed a basal CPR test for 5 minutes (Figure 1). This test was performed in the gymnasium of the local police in Vigo.

2.6. Life saving post-test and CPR quality (post-rescue)

The post-test consisted of overland movement, water rescue and 5 minutes of CPR. The rescue was divided into 1000 meters cycling, 50 meters of running on the sand, 75 meters of swimming, 75 meters of rescue and 10 meters of dry sand extraction. The police officers were told that they were to perform the rescue with the same intensity that would be used during an actual intervention. At the end of the rescue they should immediately start CPR. The choice of rescue stages was based on the coverage of the police unit and on the previous studies using these distances (18-20). Cycling phase was implemented since it was a regular means of getting around by the police who monitors beach surroundings.

The CPR results (baseline and post-rescue) and the time of the rescue were recorded.

Figure 1. Sequence of research.



TC: Total compressions; CC: Correct Compressions; PCC: Percentage of correct compressions; IC: incorrect compressions; PIC: Percentage of incorrect compressions; TB: Total breaths; CB: Correct breaths; PCB: Percentage of correct breaths; IB: Incorrect breaths; PIB: Percentage of incorrect breaths; TR: Time of Rescue.

2.7. Terms of rescue phase in the post-test

The rescue test was conducted in the Samil Beach - Spain (Latitude: 42°13'13"N, Longitude: 8°46'33"W). The bike ride was along the promenade. As for the water phase, all participants performed the test on the same date, in the middle of the day, under similar conditions: calm sea (value 0 on Douglas Scale), the average ambient temperature of 21° C, the average water temperature 13° C and wind speed not exceeding 4 m • sec-1 (Figure 2). A rescue dummy approved by the International Lifesaving Federation was used as simulated victim.

Figure 2. Response trajectory and post-rescue CPR

2.8. Assessment of quality CPR

Laerdal Resusci Anne dummy with Laerdal Wireless Skillreporter, software version 1.1 was used. This model is able to discriminate between correct and incorrect compressions and ventilations. To assess compressions, four quality indicators are considered: the depth, speed, decompression of the chest and hand position. In the case of rescue breaths, the volume of air breathed is taken into account.

The dummy is programmed in accordance with the guidelines of the European Resuscitation Council 2010: 5-6 cm depth of compressions, 100-120 compressions per minute (speed) and 500-600 ml in rescue breaths. In this study it is understood as a correct compression and ventilation when error has not been made

2.9. Variables

Firstly, general data were recorded: sex, age, height, weight, BMI and fat percentage:

The variables analyzed in the CPR are as follows: total number of chest compressions (TC), correct chest compressions (CC), percentage of correct chest compressions (PCC); bad chest compressions (IC), percentage of incorrect compressions (PIC), medium depth of compression (MDC), medium compression rate (MCR); total rescue breaths (TRB), correct rescue breaths (CRB), percentage of correct rescue breaths (PCB), incorrect rescue breaths (IB), percentage of incorrect rescue breaths (PIB).
During the post-test, times of each rescue segment were recorded.

For analysis of lactacidaemnia Lactate Scout device was used. This lactate meter is used widely in sports science for its reliability, speed and the low blood volume for analytical process (0.5 microliters). Sample collection was performed by an osteopathic physician with expertise in analyses of athletes and swimmers during training and under aseptic conditions necessary for the safety of participants and the validity of the sample.

Basal control sample was taken and then three additional samples were taken as well immediately after finalizing each sector. To save time in the lactic control, police were trained on how to access the collection point and they were informed of every sample taking.

2.10. Statistical analysis

For analysis, SPSS package for Windows, version 20 was used. The following tests were performed: a) test for homogeneity of variance using Levene's statistic; b) for the analysis of continuous variables, the t test was used based on results of the Levene test. CPR quality when fatigued and at rest were compared; c) the Pearson coefficient was used to analyze the correlation between variables related to lactacidaemnia and perceived exertion; d) The variables described the use of measures of central tendency (mean) and dispersion (standard deviation). A significance level of $p < 0.05$ for all analyses was considered.

3. RESULTS

The study initially involved ten police officers belonging to Local police of Vigo with a mean age of 33 ± 3.14 years. One of them could not perform the post-test due to injury. So, finally, the third phase was conducted by nine policemen; seven men and two women. Table 1 shows the anthropometric data of the sample.

Table 1. Anthropometric data of the sample

Variables	**All** (*n*=10)		**Men** (*n*=8)		**Women** (*n*=2)	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Age[a]	33	3,1	33	3,2	31	2,8
Height[b]	181	8,5	183	7,5	173	9,2
Weight[c]	78	11,2	81	8,3	63	9,2
BMI[d]	23,4	1,9	24,0	1,5	20,8	0,9
Fat %	14,7	4,3	13,8	3,9	18,4	5,2
Span[b]	183	9,8	185	10,2	176	2,1

[a] Age in years
[b] Height en cm
[c] Weight in kg
[d] BMI en kg·m^{-2}

All participants were able to complete the aquatic rescue. 100% opted to rescue the victim using the transfer manoeuvre by neck and with a breaststroke kick. This was possible due to stable sea conditions. For the extraction phase of the victim to dry sand, everyone used the grip under the arms of the dummy. There was no difference in time of rescue in relation to sex (men: 418 ± 62.9 s; women: 414.00 ± 4.2, p = 0.877). The average time for police officers during each part of the rescue was (cycling: 164 ± 21.8 s; running in the beach: 13 ± 2.3 s; swimming: 90 ± 28.8 s; dummy rescue 111 ± 32 , 9; dummy extraction: 39 ± 8.1 s) (Table 2).

Tabla 2. Rescue time divided into phases (seconds)

Variables	**All**(*n*=9)		**Men** (*n*=7)		**Women** (*n*=2)	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Cycling	164	21,8	158	21,8	183	2,8
Running	13	2,3	13	1,8	16	1,4
Swimming	90	28,8	92	33,1	85	2,8
Moving the victim through water	111	32,9	119	32,8	82	0,7
Extraction to dry sand	39	8,1	36	6,7	48	3,5
Total time	417	54,5	418	62,9	414	4,2

The physiological response of the rescue was analyzed based on the lactacidaemnia, having a total value at the end of CPR 12.27 ± 2.36 mmol of lactic acid (men: 12.17 ± 2.65 s; women: 12.30 ± 1.56) (Table 3). These data were correlated (Pearson) with perceived exertion assessed by the modified Borg scale (21) and the time of rescue, respectively finding associations *r*-0.70 *p* 0.035 and 0.76 *p*. 0.018.

Table 3. Lactacidaemnia and perceived exertion

Variables	**All** (*n*=9)		**Men** (*n*=7)		**Women** (*n*=2)	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
LaB	1,41	0,48	1,30	0,47	1,8	0,28
LaC	5,94	1,98	6,04	2,24	5,60	0,99
LaE	11,77	2,75	11,07	2,73	14,20	0,84
LaRCP	12,27	2,36	12,17	2,65	12,30	1,56
PSE	8,11	0,60	8,78	0,69	8	0

LaB: basal lactate, LaC: lactate at the end of the cycling phase, LaE: lactate at the end of the extraction of water rescue, LaCPR: lactate at the end of CPR, PSE: Subjective perception of effort according to the modified Borg scale (0-10)

Table 3 presents the CPR data disaggregated by type of test. We observed a decrease in the quality of resuscitation after water rescue. The percentage of correct compressions decreased ($p < 0.001$) and the percentage of incorrect compressions increased ($p < 0.001$). Increased compression rate in the post-test ($p = 0.002$) is shown, where the police officers were fatigued. Consequently, the total number of compressions increases ($p < 0.001$). As far as rescue breaths are concerned, there are significant differences in the total number, which becomes higher after rescue ($p = 0.002$).

There was no difference in the quality of CPR by gender in any of the variables ($p > 0.05$), either at baseline conditions or after the rescue.

Table 4. Univariate analysis for CPR variables associated with difference between entre pre-test y post-test.

CPR variables	CPR pre-test (basal)		CPR post-test (fatigued)		*t*-test	
	Mean	*SD*	*Mean*	*SD*	*t*	*p* *
Compressions						
Total compressions	378	28,3	431	18,8	-4,719[a]	< 0,001
Correct compressions	288	90,3	134	93,7	3,658[a]	0,002
% correct compressions	76,5	23,3	31,3	22,1	4,318[a]	< 0,001
Incorrect compressions	90	94,1	297	101,0	-4,628[a]	< 0,001
% incorrect compressions	22,5	23,5	68,7	22,1	-4,394[a]	< 0,001
Compression depth	52,7	3,3	54,2	7,1	-0,587[b]	0,569
Compression ratio	109	6,8	119	8,4	-3,061[a]	0,002
Rescue ventilations						
Total breaths	24	1,6	27	1,9	-3,363[a]	0,002
Correct breaths	5	4,7	5	3,5	-0,023[a]	0,982
% of correct breaths	21,7	18,2	19,8	12,4	0,257[a]	0,800
Incorrect breaths	19	4,2	22	3,6	-1,605[a]	0,127
% of incorrect breaths	79,9	18,5	80,2	12,4	-0,037[a]	0,971

* Level of significance (p <0.05)
a Equality of assumed variance
b Equality of not assumed variance

4. DISCUSSION

This pilot study sought to evaluate the response of the coastal police of Vigo in a water rescue and posterior CPR after a training program. Police officers from the study, with basic training in first aid, had physical fitness and acquired the technical skills to respond to an aquatic emergency, however, physical fatigue caused a significant decrease in the quality of CPR.

The police officers are trained to respond in their work with diverse physical abilities such as jumping, climbing, lifting, carrying, fighting, or dragging (8), but can also encounter the need for a water rescue, either as a witness or as a first response to a distress call.

All police officers in the sample were able to complete the rescue and return to land with the dummy. However, specific training in rescue is needed, since it requires management of complex skills (16) and pilot situation presented no adverse weather phenomenon. An untrained person could endanger his/her own life, since rescue of drowning has potential risk of injury or death to the rescuer (22).

The police officers performed a trajectory on the bicycle before water rescue. After cycling phase, it took them an average of 253 seconds to perform a rescue. Similar times for similar distances were obtained by professional lifeguards in Sweden, 258 sec (18) and in Spain 294 sec (19). In the study performed by Prieto et al. (23) also with lifeguards, rescue time (only swimming and towing) was 163 seconds. In Claesson et al. (18) and in Prieto et al. (23) the lifeguards did not have to run and move the victim to the dry sand, the test ended at the water phase. Moreover, in Prieto et al. study (23) rescuers swam 55 meters in freshwater aquatic center that simulated waves. Another difference is that neither of them had to perform CPR at the end of the rescue, in order to focus the effort on the aquatic phase. In our study, police officers's times were similar to times obtained by lifeguards cited in scientific studies; it is somewhat paradoxical because the lifeguards, for their specificity, should be faster. These results may be motivated by the inexperience of the police rescue, focusing their best effort in the water phase, regardless of their ability to perform CPR. This would explain the such a poor CPR post-rescue, even lower than the one made by fatigued lifeguards at similar distances (19,20).

At a lactacidaemnia level, police officers in this study had a mean of 12.27 ± 2.36 mmol. of lactic acid concentration in their blood. This indicates a large physiological stress and it has similar values as those obtained in another study with lifeguards (9.5 ± 1.8 mmol.), but at shorter distances (24).

As far as lactacidaemnia level is concerned, police officers in this study obtained a high concentration of lactic acid in blood. This data indicates a large physiological stress and the value obtained is similar to that obtained in another study with lifeguards but at shorter distances (24).

This study, as a novelty, included a phase of the approach to the beach by bike. In many coastal areas, police patrols move around the city by bike. With this, we intended to make the study more realistic.

The total time of the rescue was 7 minutes. The average response time of emergency medical services ranges from 5-8 minutes (25). If the rescue was already done, the EMS could begin CPR without any fatigue, which is ideal for good performance in CPR (20). Still, it should implement a training for a longer duration performance because the response time of the emergency services can reach even up to 20 minutes (26), depending on the location and description of the exact location of the emergency (27). Therefore, it is recommended to capacitate and train police officers and firefighters (9), since they are closer to emergency situations at the beaches than EMS services (12). This could reduce the incidence of deaths by drowning, either by interrupting the process of submersion in water or by initiating CPR early, increasing the chances of survival of a person who suffered a cardiac arrest (8.28 to 30).

After the rescue, we observed a decrease in the quality of CPR. The influence of fatigue during CPR has been studied extensively (8,13), and precisely because of the effect of fatigue; it is recommended to relieve the rescuer every two minutes (14,15). However, few studies have analyzed the performance of CPR if the rescuer has a pre-existing fatigue (19). The standard goal is to implement and maintain a quality CPR, defined by a value equal to or greater than 70% efficiency in compressions and ventilations (31).

Generally, the compressions are the most analyzed variable (13.27 to 30) regardless of whether they are correct or not, and while the worst CPR is the one that is not performed, the fact of doing it wrong, could cause a serious injury (32 33) in case of survival. In our study, the police officers made just 27 correct compressions per minute after the rescue, and this is less than a correct cycle. In the initial test, nearly 60 correct compressions per minute ($p = 0.002$) were performed, representing a decrease in the mean number of correct compressions after the rescue.

As for rescue breaths, the guidelines of the European Resuscitation Council 2010 (14) recommend breathing in a volume of 500-600 ml. In CPR baseline test, they obtained a rate of efficiency lower than 22%, and in the post-rescue test the rate was around 20%. In the scientific literature we find other studies that indicate the complexity of the rescue breaths (13.18 to 20). Adequate artificial ventilation may be difficult to achieve in outpatient cardiac arrest (34). For a better survival chance after drowning, oxygenation is very important. People who are drowning in respiratory arrest usually respond after a few rescue breaths (35) and they should be started as soon as possible (36).

The main contribution of this pilot study is that we analyze for the first time the ability of the police officers to perform a water rescue and CPR with no previous experience and with only a basic training. There are other studies that examine the inclusion of the police in the emergency response to cardiac arrest, but none of them in the field of water rescue and CPR quality. This study shows that a short, specific training can help the police to respond to an aquatic emergency, although fatigue causes them to perform a poor quality CPR, somewhat different than CPR studies performed by lifeguards.

4.1. Limitations of the study

The main limitations of this study were the sample, the complexity of the measured variables, the standardization of the test conditions and labour conciliation of participants. Due to this, 10 police officers participated in this pilot study.

In our study, there were no differences between CPR performed by women and by men but the data are not transferrable as there were only two women in the sample. No correlations between anthropometric, physiological and CPR variables were found. With a larger sample perhaps we could maybe discuss our results with those obtained by Hong et al. They affirmed that men and rescue teams with a BMI ≥ 25 kg • m-2 become fatigued later (29).

There were also no significant differences in time of rescue in comparison to other studies of professional rescuers. It may be due to the fact that the police officers who volunteered for that research had a mastery of aquatic medium; consequently, generalization of mastery of police officers's swimming skills should be taken with caution.

Another limitation is that the situation in fatigue is generated by a simulated rescue. Therefore, it is a controlled position; it does not induce the same level of stress in participants as a real situation. Although in the research design rescue conditions were standardized, in a real situation these conditions are highly variable. Two dummies, one for aquatic rescue phase and another for CPR phase, were used. The goal was to put all participants under the same conditions and thus have the same instrument for recording data, although it is known that a dummy is never completely identical to a real victim.

Any quasi-experimental research and simulation in variable environments has important limitations, but there is no other prospective way for analysis of the object of study.

5. CONCLUSIONS

Coastal police officers of this pilot study, with basic training in life rescue, are able to perform quality CPR at baseline and easy water rescues. Fatigue induced by rescue affects adversely the quality of CPR causing low quality performance.

Police should be trained in CPR and units that work near the shore, should also be receive water rescue training to collaborate with lifeguards. The response of coastal police of Vigo before a water rescue was adequate. This would help reduce the number of deaths from drowning.

REFERENCES

1. Towner E, Scott I. Child injuries in context. Peden M, Oyegbite K, Ozanne J, et al. (Eds.) World report on child injury prevention. Geneva: UNICEF; 2008:1-29.
2. Lozano R, Naghavi M, Foreman K, et al: Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380(9859):2095-128. https://doi.org/10.1016/S0140-6736(12)61728-0
3. Centers for Disease Control and Prevention: Web-based Injury Statistics Query and Reporting System (WISQARS). Atlanta, 2009.
4. Mitchell RJ, WiMitchell RJ, Williamson AM, Olivier J. Estimates of drowning morbidity and mortality adjusted for exposure to risk. Inj Prev 2010;16:261-6. https://doi.org/10.1136/ip.2009.024307
5. Instituto Nacional de Estadística [base de datos en línea]. Madrid: Defunciones según causa de muerte. ; c2014 [actualizada 2014 Ene 31; citada 2014 Jun 06]. Disponible desde: http://www.ine.es/jaxi/menu.do?type=pcaxis&path=/t15/p417&file=inebase&L=0
6. Szpilman D, Bierens J, Handley A, Orlowski P. Drowning. N Engl J Med 2012;366:2102-10. https://doi.org/10.1056/NEJMra1013317
7. Szpilman D. Near-drowning and drowning classification: a proposal to stratify mortality based on the analysis of 1831 cases. Chest 1997;112:660-5. https://doi.org/10.1378/chest.112.3.660
8. Venema AM, Groothoff JW, Bierens JJ. The role of bystanders during rescue and resuscitation of drowning victims. Resuscitation 2010;81:434-9. https://doi.org/10.1016/j.resuscitation.2010.01.005
9. Aguilera-Campos A, Asensio-Lafuente E, Fraga-Sastrías JM. Análisis de la inclusión de la policía en la respuesta de emergencias al paro cardiorrespiratorio extrahospitalario. Salud Publica Mexico 2012;54(1):60-7.
10. Hess EP, White RD. Recurrent ventricular fibrillation in out-ofhospital cardiac arrest after defibrillation by police and firefighters: Implications for automated external defibrillator users. Crit Care Med2004;32(Suppl 5):436-9. https://doi.org/10.1097/01.CCM.0000134258.72142.E5
11. Valenzuela T, Roe D, Nichol G, et al. Outcomes of rapid defibrillation by security officers after cardiac arrest in casinos. N Engl J Med 2000;343:1206-9. https://doi.org/10.1056/NEJM200010263431701
12. Rørtveit S, Meland E. First responder resuscitation teams in a rural Norwegian community: sustainability and self-reports of meaningfulness, stress and mastering. Scand J Traum Resus 2010;18:25. https://doi.org/10.1186/1757-7241-18-25
13. Heidenreich JW, Bonner A, Sanders AB. Rescuer fatigue in the elderly: Standard vs. Hands-only CPR. J Emerg Med 2012, 42(1):88-92. https://doi.org/10.1016/j.jemermed.2010.05.019
14. Koster RW, Baubin MA, Bossaert LL, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 2. Adult basic life support and use of automated external defibrillators. Resuscitation 2010;81(10):1277-92. https://doi.org/10.1016/j.resuscitation.2010.08.009

15. Travers AH, Rea TD, Bobrow BJ, et al. Part 4: CPR Overview: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitacion and Emergency Cardiovascular Care. Circulation 2010;122:s676-84. https://doi.org/10.1161/CIRCULATIONAHA.110.970913
16. Bonneau J, Brown J. Physical ability, fitness and police work. J Clin Forensic Med 1995;2:157-64. https://doi.org/10.1016/1353-1131(95)90085-3
17. Real Decreto 711/2011, de 20 de mayo por el que se establecen tres certificados de profesionalidad de la familia profesional Actividades físicas y deportivas que se incluyen en el Repertorio Nacional de certificados de profesionalidad. Boletín Oficial del Estado, nº138 (10 de junio de 2011).
18. Claesson A, Karlsson T, Thorén A, et al. Delay and performance of cardiopulmonary resuscitation in surf lifeguards after simulated cardiac arrest due to drowning. Am J Emerg Med 2011;29(9):1044-50. https://doi.org/10.1016/j.ajem.2010.06.026
19. Barcala-Furelos R, Abelairas-Gomez C, Romo-Perez V, et al. Effect of physical fatigue on the quality CPR: A water rescue study of lifeguards. Am J Emerg Med 2013;31(3):473-7. https://doi.org/10.1016/j.ajem.2012.09.012
20. Abelairas-Gomez C, Romo-Perez V, Barcala-Furelos R, et al. Efecto de la fatiga física del socorrista en los primeros cuatro minutos de reanimación cardiopulmonar posrescateacuático. Emergencias 2013;25(3):184-90.
21. Borg G. Psychophysical bases of perceived exertion. J. Med. Sci. Sports Exercise 1982;14(5):377-381. https://doi.org/10.1249/00005768-198205000-00012
22. Ducharme MB, Lounsbury DS. Self-rescue swimming in cold water: the latest advice. Appl Physiol Nutr Metab 2007;32(4):799-807. https://doi.org/10.1139/H07-042
23. Prieto JA, Soto Mdel V, Díez VG, et al. Physiological response of beach lifeguards in a rescue simulation with surf. Ergonomics 2010;53(9):1140-50. https://doi.org/10.1080/00140139.2010.502255
24. Abelairas-Gomez C, Palacios-Aguilar J, Costas-Veiga J, Bores-Cerezal A. Physiological analysis of an aquatic rescue: How a rescuer faces a CPR? Resuscitation 2012; 83(1):24. https://doi.org/10.1016/j.resuscitation.2012.08.139
25. Weisfeldt ML, Sitlani CM, Ornato JP, et al. Survival after application of automatic external defibrillators before arrival of the emergency medical system. Evaluation in the resuscitation outcomes consortium population of 21 million. J Am CollCardiol 2010; 55(16):1713-20. https://doi.org/10.1016/j.jacc.2009.11.077
26. Adelborg K, Dalgas C, Grove EL, et al. Mouth to-mouth ventilation is superior to mouth-to-pocket mask and bag-valve-mask ventilation during lifeguard CPR: A randomized study. Resuscitation 2011;82(5):618-22. https://doi.org/10.1016/j.resuscitation.2011.01.009
27. Claesson A, Svensson L, Silfverstolpe J, et al. Characteristics and outcome among patients suffering out-of-hospital cardiac arrest due to

drowning. Resuscitation 2008;76(3):381-7. https://doi.org/10.1016/j.resuscitation.2007.09.003
28. Russo SG, Neumann P, Reinhardt S, et al. Impact of physical fitness and biometric data on the quality of external chest compression: a randomised, crossover trial. BMC Emerg Med 2011;11:20. https://doi.org/10.1186/1471-227X-11-20
29. Hong DY, Park SO, Lee KR, et al. A different rescuer changing strategy between 30:2 cardiopulmonary resuscitation and hands-only cardiopulmonary resuscitation that considers rescuer factors: a randomisedcross-over simulation study with a time-dependent analysis. Resuscitation 2012;83(3):353-9. https://doi.org/10.1016/j.resuscitation.2011.11.006
30. McDonald CH, Heggie J, Jones CM, et al. Rescuer fatigue under the 2010 ERC guidelines, and its effect on cardiopulmonary resuscitation (CPR) performance. Emerg Med J 2012, article in press, doi: 10.1136/emermed-2012-201610. https://doi.org/10.1136/emermed-2012-201610
31. Perkins GD, Colquhoun M, Simons R. Training manikins. Colquhoun M, Handley AJ, Evans TR (Eds.). ABC of resuscitation. London: BMJ Books; 2004:97-101.
32. Van Hoeyweghen RJ, Bossaert LL, Mullie A, et al. Quality and efficiency of bystander CPR. Belgian Cerebral Resuscitation Study Group.Resuscitation 1993;26(1):47-52. https://doi.org/10.1016/0300-9572(93)90162-J
33. White L, Rogers J, Bloomingdale M, et al. Dispatcher-assisted cardiopulmonary resuscitation: risks for patients not in cardiac arrest. Circulation 2010;121(1):91-7. https://doi.org/10.1161/CIRCULATIONAHA.109.872366
34. Hollenberg J, Svensson L, Rosenqvist M: Out-of-hospital cardiac arrest: 10 years of progress in research and treatment. J Intern Med 2013;273(6):572-83. https://doi.org/10.1111/joim.12064
35. Szpilman D, Bierens JJLM, Handley AJ, et al. Drowning.N Engl J Med 2012;366(22):2102-10. https://doi.org/10.1056/NEJMra1013317
36. Soar J, Perkins GD, Abbas G, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 8. Cardiac arrest in special circumstances: Electrolyte abnormalities, poisoning, drowning, accidental hypothermia, hyperthermia, asthma, anaphylaxis, cardiac surgery, trauma, pregnancy, electrocution. Resuscitation 2010;81(10):1400-33. https://doi.org/10.1016/j.resuscitation.2010.08.015

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