Navarro-Patón, R.; Freire-Tellado, M.; Mateos-Lorenzo, J.; Basanta-Camiño, S.; Rodríguez-López, A.; Lago-Ballesteros, J. (2020) Sports Activities with Musical Support: A New Way to Learn Cardiopulmonary Resuscitation? Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 20 (78) pp. 243-255 Http://cdeporte.rediris.es/revista/revista78/artactividades1154.htm
**DOI:** http://doi.org/10.15366/rimcafd2020.78.004

# ORIGINAL

# SPORTS ACTIVITIES WITH MUSICAL SUPPORT: A NEW WAY TO LEARN CARDIOPULMONARY RESUSCITATION?

# ACTIVIDADES DEPORTIVAS CON SOPORTE MUSICAL: ¿UNA NUEVA FORMA DE APRENDER REANIMACIÓN CARDIOPULMONAR?

**Navarro-Patón, R.[1]; Freire-Tellado, M.[2]; Mateos-Lorenzo, J.[3]; Basanta-Camiño, S.[4]; Rodríguez-López, A.[5]; Lago-Ballesteros, J.[6]**

[1] Faculty of Teacher Training, Universidad de Santiago de Compostela (Spain) ruben.navarro.paton@usc.es
[2] Emergency Medical Service Fundación Pública Urgencias Sanitarias 061 Lugo (Spain) miguel.freire.tellado@sergas.es
[3] Cantabrian Health Service 061 Santander (Spain). Javier.mateos.lorenzo@sergas.es
[4] Faculty of Teacher Training, Universidad de Santiago de Compostela (Spain) s.basanta@usc.es
[5] Santo Domingo Clinic. Lugo (Spain). andrearodriguezlo91@gmail.com
[6] Faculty of Teacher Training, Universidad de Santiago de Compostela (Spain) joaquin.lago@usc.es

**Spanish-English translator:** Miguel Freire-Tellado miguel.freire.tellado@sergas.es

**CODIGOS UNESCO / UNESCO Code:** 3212 Salud pública / Public Health
**Clasificación Consejo de Europa / Council of Europe classification:** 5 Didáctica y metodología / Didactics and methodology

**Recibido** 30 de junio de 2018 **Received** June 30, 2018
**Aceptado** 1 de octubre de 2018 **Accepted** October 1, 2018

## ABSTRACT

The aim of the study was to analyse the feasibility of teaching CPR in sports activities with musical support in order to assess if this new methodology of CPR training is as effective as a traditional CPR course. 84 university students with no knowledge of CPR participated. They were distributed in two groups randomly. The first one received an experimental fitness dance class CPR course and the other was given a traditional training CPR course. The following

parameters were obtained: fitness dance class group vs traditional CPR course: Average compression depth (41,64 vs 42,92; p= 0,446), Chest Recoil (65,47% vs 72,47%; p=0,423), average compression rate (102.50 vs 138.53; p<0.001), total number of compressions (202.50 vs 277.95; p< 0.001). The two training methods achieved similar results, so CPR teaching in sports activities with musical support can be a new training method.

**KEYWORDS**: Sports activities, cardiopulmonary resuscitation courses, cardiac arrest, teaching CPR, hands-only CPR.

## RESUMEN

El objetivo del estudio fue analizar la viabilidad de enseñar RCP en actividades deportivas con apoyo musical y evaluar si este nuevo enfoque iguala los resultados de un curso tradicional de reanimación cardiopulmonar (RCP). Participaron 84 estudiantes universitarias sin conocimientos de RCP distribuidas en dos grupos de forma aleatoria. El primero recibió formación de RCP sólo manos integradas en una clase de aeróbic y el otro recibió un curso de RCP de manera convencional. Los resultados en la clase coreografiada comparados con el curso tradicional fueron: Profundidad media de compresiones (41,64 vs 42,92; p= 0,446), re-expansión correcta (65,47% vs 72,47%; p=0,423), frecuencia de compresiones en un minuto (102,50 vs 138,53; p<0,001), compresiones totales (202,50 vs 277,95; p< 0,001). Los dos métodos formativos alcanzaron resultados similares por lo que la introducción de la enseñanza de RCP en actividades deportivas puede ser un nuevo método formativo.

**PALABRAS CLAVE:** Actividades deportivas, cursos de reanimación cardiopulmonar, parada cardiorrespiratoria, enseñanza de RCP, compresiones contínuas.

## INTRODUCTION

Sudden out-of-hospital cardiac arrest (OHCA) is one of the most frequent causes of death and morbidity in the industrialized nations (1-5). Immediate recognition of the situation, prompt initiation of bystander CPR and early defibrillation (6-9) are essential to improve the victim's outcome, hence doubling or quadrupling the chance of survival (6,10-13).

The rate of bystander CPR varies greatly among communities, from 10% to 65% (14) and the impact of citizen CPR training (14) according to the current international CPR guidelines (6) has been limited because of the difficulties in reaching 100% of the population.

Due to the difficulty in guaranteeing training 100% of the population in CPR, the World Health Organization (WHO) endorsed the "Kids Save Lives" Statement in 2015 (15) a joint statement from the European Resuscitation Council (ERC), the International Liaison Committee on Resuscitation (ILCOR) and the main societies related to resuscitation and patient safety. This statement

recommends two hours of CPR training annually from the age of 12 in all schools worldwide based on the fact that the highest bystander CPR rates are found in some Scandinavian countries where CPR education in schools has been mandatory for decades. (Hands that help-training children is training for life). They even recommend that the children be encouraged to train friends and family over the two weeks following the course (15-17) to try to increase the percentage of bystander CPR in the adult population.

However, in spite of the statement´s recommendation, it is difficult to reach a high percentage of the population and for the CPR skills learned in childhood to be maintained. CPR skills decay within 3 to 6 months after initial training (18), which highlights the importance of periodically refreshing CPR skills (18-21). Frequent training improves CPR skills, responder confidence and willingness to perform CPR (18). This is particularly important in the elderly population who are most likely to witness OHCA at home and who may not be trained and strong enough to correctly apply these skills. This is why new teaching methods and initiatives are needed (16,17,22-27).

According to the 2014 Eurobarometer survey on sport and physical activity (28) a 41% (22% to 70%) of the European Union population exercise at least once a week whereas 17% seldom exercise. Sports related activities, fitness classes, dance fitness classes, (dance workout, dance exercise classes, Pilates) are highly practised worldwide. Those who do these activities regularly attend classes and do physical exercise over a period of years. CPR skills, especially chest compressions, and sport activities with musical support are both physical activities , they both consist of a sequence of steps and abilities and competeces and both are based in the repetition of rhythmic patterns: if CPR skills could be integrated and taught in these sports classes as a part of their routine, it would be possible not only to reach a greater percentage of the population but also to periodically refresh (18) these psychomotor skills with regular training. Even in these classes, like Pilates, the training could be specifically designed to improve the strength needed to deliver chest compressions in the elderly people (20,29,30).

The aim of the study was to analyse the feasibility of teaching CPR in sports activities with musical support and to assess if this new approach equalises the results of a traditional cardiopulmonary resuscitation course (CPR).

## METHODS

### *Study Design*

In a quasi-experimental study, students from the Faculty of Teacher Training at the University of Santiago de Compostela, Lugo that had received no prior CPR training and had never participated in fitness classes were simple randomly assigned to two groups according to gender and their number on the class list. Because the small number of male participants finally only females participated in the study. The first group received an experimental fitness dance class CPR course (FDC) and the other was given a traditional training CPR course (TTC).

Those individuals who had received previous training were excluded. The teaching experiences were based on a chest compressions-only CPR course according to current guidelines (6). After both courses a CPR skill evaluation was conducted to evaluate skills acquisition and then the performance results were compared. Automated corrective chest compressions feedback manikins (32) could not be used due to the lack of resources. Each participant received verbal explanations and signed an informed consent form. Before the beginning of the study, ethics approval was solicited from the Ethical Committee of the University of Santiago de Compostela (Spain) respecting the ethical principles of the Helsinki Convention.

### *Fitness dance class CPR course (FDC)*

This process activity included three weekly (Thursdays) 30-minute classes divided into 3 ten-minute cycles of 5 minutes of fitness activity (warming-up phase), 20 minutes of the main part phase, 3 minutes of fitness-like dance related CPR choreography, 2 minutes including victim evaluation and call for help, and 2 minutes of chest compression-only CPR carried out to the beat of Staying Alive (100 beats per minute to reinforce chest compressions frequency) (see Figure 1). The class ended up in a five-minute cool down and streching. The specific time devoted to CPR was 12 minutes per class. A mixture of Laerdal (Norway) manikins, Little Anne, Resusci Anne and Mini Anne were used. These classes were designed and taught by a PE teacher Basic Life Support CPR instructor.

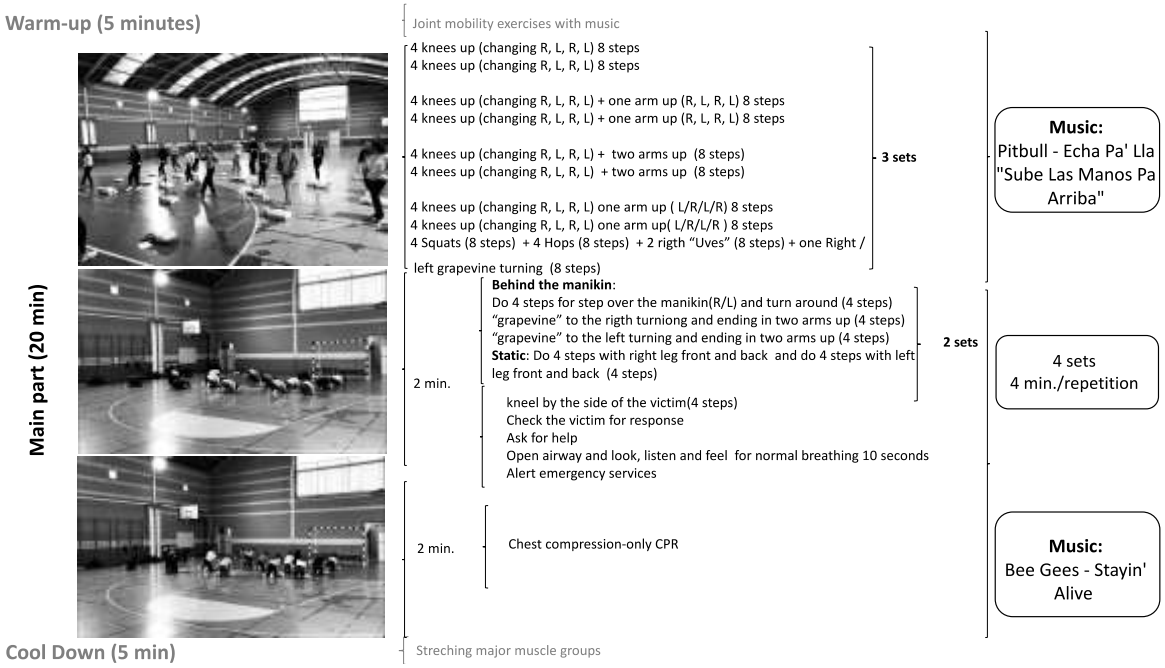


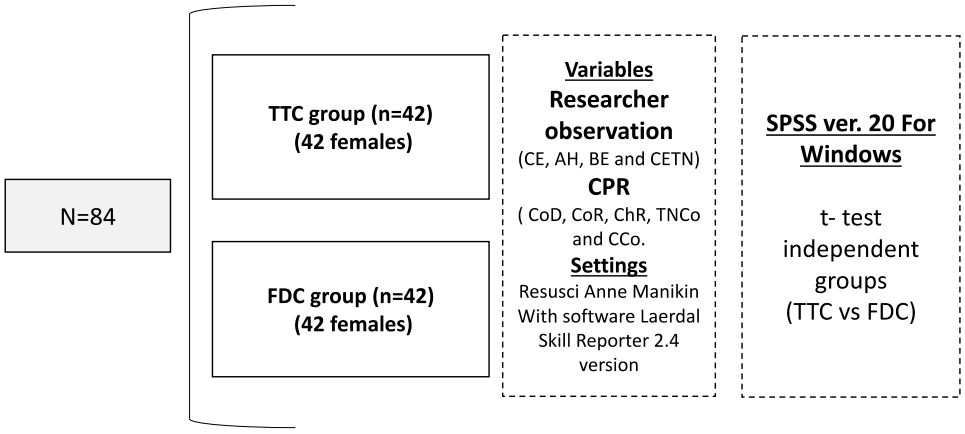

**Figure 1.** Fitness dance class CPR course in motion.

### *Traditional training CPR course (TTC)*

A standard 70-minute, chest compression-only CPR instructor-led course was given to the students in this group by EMS staff, following the structure and instructor-to-pupil ratio recommended by the European Resuscitation Guidelines (18). The length of the course was chosen to coincide with that of the whole fitness course. The theoretical part with audiovisual support (power point) included the chain of survival, recognition of cardiac arrest (check the victim for a response, open the airway head-tilt and chin-lift, look, listen and feel for normal breathing) call for help, chest compressions, and lasted 20 minutes. The practical part included a cardiac arrest simulation that lasted 16 minutes and was attended by two participants that changed positions every two minutes, but first they had to follow every step in cardiac arrest identification. Automated corrective chest compressions feedback manikins could not be used due to the lack of resources.

### *CPR skill evaluation*

A week after the third session of the FDC and immediately after receiving the TTC, a two-minutes chest compression-only CPR skill evaluation was conducted. The CPR manikin used for performance and data gathering was the Laerdal Resusci Anne manikin with Skill reporter software version 2.4; Laerdal medical AS, Norway. A summary of the study design is presented in Figure 2.




**NOTE:** Traditional training CPR course = TTC; Fitness dance class CPR course = FDC; Consciousness evaluation = CE; Ask for help =AH; Breathing evaluation = BE; = CETN: Compression depth = CoD; Compression rate = CoR; Chest recoil percentage = ChR; Total number of compressions = TNCo; and Percentage of correct compressions = Cco.

**Figure 2.** Flow chart

## Data Collection

The information collected in the questionnaire included the participants' gender, age, height, weight and BMI. The researcher observations (Table 1) were

written down on an observation form with dichotomous responses (Yes-No or Correct-Incorrect) and were evaluated in the fitness dance class (FDC) and in the traditional training course (TTC). The manikin program collected average compression depth (CoD), compression rate (CoR), chest recoil percentage (ChR), total number of compressions (TNCo), percentage of correct compressions (CCo) and compression rate (CoR).

### Data analysis

Continuous variables were summarized by the mean and standard deviation (SD) and the two CPR teaching methods were then compared. The significance of difference was set at the $p<.05$ level with the corresponding 95% confidence interval (95%CI). The Kolmogorov-Smirnov test was used to assess normal distribution of the data. The Student's t-test for independent samples was conducted to see whether there was a significant difference between CPR parameters. Pearson's Chi-squared test was used to evaluate the differences between groups about researcher observations. All the data was processed using the SPSS version 20 statistical package for MS Windows (SPSS Inc., IBM, USA).

## RESULTS

The experimental group consisted of a randomized sample of 84 females with a mean age of 20.66 (SD= 1.68): 42 subjects in the fitness dance class group and the same number in the traditional training course group.

### Researcher observations

The observed results can be seen in Table 1. Statistically significant differences were found between both training programs in: Consciousness evaluation ($p = 0.029$); Ask for help ($p = 0.004$); Breathing evaluation ($p= 0.029$) and Call emergency number ($p = 0.002$).

**Table 1.** Results for the descriptive analysis of the variables analyzed. Researcher´s observations.

| | | Training Programs | |
|---|---|---|---|
| | | **FDC (n=42)** | **TTC (n=42)** |
| Consciousness evaluation | No | 0 (0.0%) | 4 (9.53%) |
| | Yes | 42 (100.0 %) | 38 (90.47 %) |
| Ask for help | No | 0 (0.0 %) | 6 (14.29%) |
| | Yes | 42 (100.0 %) | 36 (85.71%) |
| Breathing evaluation | Incorrect | 0 (0.0%) | 4 (9.53%) |
| | Correct | 42 (100.0%) | 38 (90.47 %) |
| Call emergency telephone number | No | 0 (0.0%) | 7 (16.67%) |
| | Yes | 42 (100.0%) | 35 (83.33%) |

**FDC:** Fitness Dance Class CPR course; **TTC:** Traditional Training Course. **n:** Number of subjects.

### Manikin CPR parameters collected

The Manikin`s parameters after training programs can be seen in Table 2.

**Table 2.** Results for the descriptive analysis of the sample segregated according to the training process and comparison of means collected by the manikin programme.

| | FDC (n=42) | | TTC (n=42) | | t-test |
|---|---|---|---|---|---|
| Variable | ***M*** | ***SD*** | ***M*** | ***SD*** | ***p*** |
| **Age** | 20.42 | 1.30 | 20.97 | 1.77 | 0.827 |
| **Height (m)** | 1.63 | 0.05 | 1.66 | 0.08 | 0.172 |
| **Weight (Kg)** | 59.88 | 9.54 | 60.44 | 1087 | 0.821 |
| **BMI (Kg/m$^2$)** | 22.30 | 3.24 | 21.75 | 2.52 | 0.458 |
| **Compression depth (mm)** | 41.64 | 8.55 | 42.92 | 6.71 | 0.446 |
| **Chest recoil percentage (%)** | 65.47 | 40.68 | 72.47 | 39.00 | 0.423 |
| **Compression rate** | 102.50 | 10.68 | 138.53 | 12.51 | < 0.001 |
| **Total number of compressions (2 min)** | 202.50 | 38.33 | 277.97 | 24.49 | <0.001 |

**M**: Mean; **SD**: Standard Deviation; **FDC:** Fitness Dance Class CPR course; **TTC:** Traditional Training Course; **n:** Number of subjects.

Statistically significant differences were found in the following parameters from among the two CPR training groups: Compression depth: FDC (M=102.50, SD=10.68); TTC (M=138,53, SD=12.51), ($t_{(82)}$= -14.19, p<0.001; r=.84); Total number of compressions: FDC(M=202.50, SD=38,33; TTC (M=277.97, SD=24.49) ($t_{(82)}$= -10.75, p<0.001; r=.76).

No statistically significant differences were found in compression depth: FDC=41.64, TTC=42.92 (p=0.446); chest recoil percentage (FDC=65.47, TTC=72.47 (p=0.423).

## DISCUSSION

This study shows that the teaching of CPR incorporated into sports classes is feasible, and the learning of CPR skills in the short-term is promising, although only a small percentage of the participants, mostly young females, reached the parameters recommended by current guidelines. When the FDC short-term experience was compared to a TTC in a group of similar characteristics and with an equivalent duration, the results were similar, even though an inferiority margin would be expected due to the newness of the teaching model.

The strong point of the study is the innovation of the idea of being able to integrate CPR in sports activities that could reach a large part of the population practising sports, and being able not only to learn but also to continuously refresh skills. However, the design of FDC was new and probably not sufficiently-well tested: the sample was limited and only short-term results were evaluated.

No similar studies integrating CPR into sports activities (Sports CPR) have been found to make a direct comparison. Although the experience was designed for long-term skills acquisition, the results shown in the study are short-term. For this reason and, due to the heterogeneous results of published studies (32), it is difficult to establish firm conclusions when comparing Sports CPR to other teaching approaches (16,17,22-27,31). Sports CPR shares with video self-instruction (33) the possibility for the participant to carry out periodical training sessions and the theoretical advantage of traditional courses (33), where a teacher is present to ensure that those taking part learn the correct techniques. In addition, the use of music at 100 bits per minute improves the compression ratio per minute by acting as a metronome as in other studies (34).

The modest results of both groups could be explained by the prevalence of females with low mean height (35) and BMI (less than 25) (36), and because the study was designed to include participants without any previous experience in both fitness and CPR, and they had to acquire both skills. Previous to the study PE teachers taught sports CPR to two small groups of trained participants (PILATES and circuit training) with better results, probably due to the better physical condition and the previous knowledge of sports abilities that made the CPR skills the only ones to learn.

Sports CPR shares with video self-instruction (31) the possibility for the participant to carry out periodic training sessions and the theoretical advantage of traditional courses (31) where a teacher is present to ensure that those taking part learn the correct techniques.

The teaching of CPR in sports activities allows for a large percentage of the adult population to be trained and allows for the continued maintenance of skills, and for them to be updated according to future guidelines, following the physical activity practice data of the 2014 Eurobarometer survey on sport and physical activity (28). It can be adapted to the needs of different age groups, can be used to train beginners or to refresh skills previously attained (e.g. a traditional CPR course), and allows for the continued maintenance of skills, and for them to be updated according to future guidelines. From a sports point of view, promoting CPR in sports would lead to a change in the way society consider CPR, which would no longer be a healthcare skill, but become an integral part of sports education and healthy habits. To guarantee scientific support of CPR knowledge and skills, training in sports CPR should be led by the current scientific CPR-related societies in collaboration with sports organizations.

However, this study only shows the short-term results of one single experience. More studies are needed to evaluate the long-term results and to better know how to introduce these skills into different sports activities.

The main limitations which were found in the study are that the participants were evaluated by practicing the skills acquired on a manikin in a simulated situation, so their abilities in a real situation of resuscitation are unknown. The sample was limited, and only short-term results have been evaluated. These classes were designed and taught by a PE teacher Basic Life Support CPR

instructor and they were intended to be the initial phase of a long term experience, a monthly class during the following 6 months and then a refresher class every 3-6 months (18). The length of the traditional training CPR course was chosen to coincide with that of the whole fitness course, but less than 50% of the time in the Fitness course was devoted to CPR.

## CONCLUSIONS

Teaching CPR in sports classes (FDC) is feasible, and the learning of CPR skills in the short-term is promising and similar to the traditional CPR course, although only a small percentage of the participants reached the parameters recommended by the guidelines. A long-term follow-up of these groups should be carried out to evaluate the progress of the participants.

## REFERENCES


1. Gräsner JT, Lefering R, Koster RW, Masterson S, Böttiger BW, Herlitz J, Wnent J, Tjelmeland IB, Ortiz FR, Maurer H, Baubin M, Mols P, Hadžibegović I, Ioannides M, Škulec R, Wissenberg M, Salo A, Hubert H, Nikolaou NI, Lóczi G, Svavarsdóttir H, Semeraro F, Wright PJ, Clarens C, Pijls R, Cebula G, Correia VG, Cimpoesu D, Raffay V, Trenkler S, Markota A, Strömsöe A, Burkart R, Perkins GD, Bossaert LL; EuReCa ONE Collaborators. 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: 188-95 DOI: https://doi.org/10.1016/j.resuscitation.2016.06.004
2. Mozaffarian D, Benjamin EJ, Go AS, et al; for the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2016 update: a report from the American Heart Association. Circulation 2016; 133(4): e38-e360.
3. Berdowski J, Berg RA, Tijssen JG, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review of 67 prospective studies. Resuscitation 2010; 81: 1479-87. DOI: http://dx.doi.org/10.1016/j.resuscitation.2010.08.006
4. Grasner JT, Herlitz J, Koster RW, Rosell-Ortiz F, Stamatakis L, Bossaert L. Quality management in resuscitation – towards a European cardiac arrest registry (EuReCa). Resuscitation 2011; 82: 989–94. DOI: http://dx.doi.org/10.1016/j.resuscitation.2011.02.047
5.Grasner JT, Bossaert L. Epidemiology and management of cardiac arrest: what registries are revealing. Best Practice & Research Clinical Anaesthesiology 2013; 27: 293–306. DOI: http://dx.doi.org/10.1016/j.bpa.2013.07.008
6. Perkins GD, Handley AJ, Koster RW, Castrén M, Smyth MA, Olasveengen T, Monsieurs KG, Raffay V, Grasner J-T, Wenzel V, Ristagno G, Soar J, on behalf of tehAdult basic life support and automated external defibrillation section Collaborators. European Resuscitation Council Guidelines for Resuscitation 2015: Section 2. Adult basic life support and automated external defibrillation. Resuscitation 2015; 95: 81-99.
7. Hasselqvist-Ax I, Riva G, Herlitz J, et al. Early cardiopulmonary resuscitation in out-of-hospital cardiac arrest. New England Journal Medicine 2015; 372: 2307-15. DOI: 10.1056/NEJMoa1405796
8. Svensson L, Bohm K, Castren M, et al. Compression-only CPR or standard CPR in out-of-hospital cardiac arrest. New England Journal Medicine 2010; 363: 434-42. DOI: 10.1056/NEJMoa0908991
9. Hupfl M, Selig HF, Nagele P. Chest-compression-only versus standard cardiopulmonary resuscitation: a meta-analysis. The Lancet 2010; 376: 1552-7, DOI: http://dx.doi.org/10.1016/S0140-6736(10)61454-7
10. Weisfeldt ML, Becker LB. Resuscitation after cardiac arrest: a 3-phase time-sensitive model. Journal of the American Medical Association 2002; 288: 3035-8. DOI: 10.1001/jama.288.23.3035
11. Waalewijn RA, Tijssen JG, Koster RW. Bystander initiated actions in out-of-hospital cardiopulmonary resuscitation: results from the Amsterdam

Resuscitation Study (ARRESUST). Resuscitation 2001; 50: 273-9. DOI: http://dx.doi.org/10.1016/S0300-9572(01)00354-9

12. Valenzuela TD, Roe DJ, Cretin S, Spaite DW, Larsen MP. Estimating effectiveness of cardiac arrest interventions: a logistic regression survival model. Circulation 1997; 96: 3308-13. In: http://circ.ahajournals.org/content/96/10/3308.long
13. Holmberg M, Holmberg S, Herlitz J. Factors modifying the effect of bystander cardiopulmonary resuscitation on survival in out-of-hospital cardiac arrest patients in Sweden. European Heart Journal 2001; 22: 511-9. DOI: https://doi.org/10.1053/euhj.2000.2421
14. Anderson ML, Cox M, Al-Khatib SM, Nichol G. Rates of Cardiopulmonary Resuscitation Training in the United States. Journal of the American Medical Association. 2014; 174(2): 194-201. DOI: 10.1001/jamainternmed.2013.11320
15. Kids save lifes-ERC position statement on school children education in CPR. "Hands that help-training children is training for life". Resuscitation 2016; 105: A1-A3. DOI: 10.1016/j.resuscitation.2016.06.005
16. Lorem T, Steen PA, Wik Lars. High school students as ambassadors of CPR-A model for reaching the most appropriate target population? Resuscitation 2010; 81: 78-81. DOI: 10.1016/j.resuscitation.2009.09.030
17. Stroobans J, Monsieurs KG, Devriendt B, Dreezen C, Vets P, Mols P. Schoolchildren as BLS instructors for relatives and friends: Impact on attitude towards bystander CPR. Resuscitation 2014; 85: 1769-74. DOI: 10.1016/j.resuscitation.2014.10.013
18. Greif R, Lockey AS, Conaghan P, Lippert A, De Vries W, Monsieurs KG, on behalf of the Education and implementation of resuscitation section Collaborators. European Resuscitation Council Guidelines for Resuscitation 2015. Section 10. Education and implementation of resuscitation. Resuscitation 2015; 95: 288-301. DOI: 10.1016/j.resuscitation.2015.07.032
19. Niles D, Sutton RM, Donoghue A, Kalsi MS, Roberts K, Boyle L, Nishisaki A, Arbogast KB, Helfaer M, Nadkarni V. "Rolling Refreshers": A novel approach to maintain CPR psychomotor skill competence. Resuscitation 2009; 80: 909-12. DOI: https://doi.org/10.1016/j.resuscitation.2009.04.021
20. Ro YS, Shin SD, Song KJ, Hong SO, Kim YT, Cho SI. Bystander cardiopulmonary resuscitation training experience and self-efficacy of age and gender group: a nationwide community survey. American Journal of Emergency Medicine. 2016; 34(8): 1331-37. DOI: https://doi.org/10.1016/j.ajem.2015.12.001
21. Kurosawa H, Ikeyama T, Achuff P, Perkel M, Watson C, Monachino AM, Remy D, Deutsch E, Buchanan N, Anderson J, Berg RA, et al. A Randomized Control Trial of In Situ Pediatric Advanced Life Support Recertification ("Pediatric Advanced Life Support Reconstructed") Compared With Standard Pediatric Advanced Life Support Recertification for ICU Frontline Providers. Critical Care Medicine 2014; 42(3): 610-20. DOI: 10.1097/CCM.0000000000000024
22. Chang MP, Gent LM, Sweet M, Potts J, Ahtone J. A novel educational outreach approach to teach Hands-Only Cardiopulmonary Resuscitation

to the public. Resuscitation 2017; 116: 22-26. DOI: 10.1016/j.resuscitation.2017.04.028

23. Krogh LQ, Bjornshave K, Vestergaard LD, Sharma MB, Rasmussen SE, Nielsen HV. E-learning in pediatric basic life support: A randomized controlled non-inferiority study. Resuscitation 2015; 90: 7-12. DOI: 10.1016/j.resuscitation.2015.01.030
24. Semeraro F, Frisoli A, Loconsole C, Mastronicola N, Stroppa F, Ristagno G. Kids (learn how to) save lives in the school with the serious game Relive. Resuscitation 2017; 116: 27-32. DOI: https://doi.org/10.1016/j.resuscitation.2017.04.038
25. Ikeda DJ, Buckler DG, Li J, et al. Dissemination of CPR video self-instruction materials to secondary trainees: results from a hospital-based CPR education trial. Resuscitation 2016; 100: 45-50. DOI: https://doi.org/10.1016/j.resuscitation.2015.12.016
26. Panchal AR, Meziab O, Stolz U, et al. The impact of ultra-brief chest compression-only CPR video training on responsiveness, compression rate, and hands-off time interval among bystanders in a shopping mall. Resuscitation 2014; 85: 1287-90. DOI: https://doi.org/10.1016/j.resuscitation.2014.06.013
27. Del Ríos M, Aldeen A, Campbell T, Demertsidis E, Heinert S, Sinchi J et al. Save a life at the ballpark; 10-min spectator training achieves proficiency in cardiac arrest response. Resuscitation 2015; 87: 21-5. DOI: https://doi.org/10.1016/j.resuscitation.2014.10.023
28. European Commision [Internet]. Eurobarometer survey on sport and physical activity. Recuperado de: http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_412_en.pdf
29. 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; 84:1747-52. DOI: https://doi.org/10.1016/j.resuscitation.2013.08.001
30. 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. Emergency Medical Journal 2014; 31 700-5. DOI: http://dx.doi.org/10.1136/emermed-2012-202192
31. Hsieh MJ, Bhanji F, Chiang WC, Yang CW, Chien KL, Ma MHH. Comparing the effect of self-instruction with that of traditional instruction in basic life support courses-A systematic review. Resuscitation 2016; 108: 8-19. DOI: https://doi.org/10.1016/j.resuscitation.2016.08.021
32. Navarro-Patón R, Freire-Tellado M, Basanta-Camiño S, Barcala-Furelos R, Arufe-Giraldez V, Rodríguez-Fernández JE; Efecto de 3 métodos de enseñanza en soporte vital básico en futuros maestros de Educación Primaria. Un diseño cuasi experimental. Medicina intensiva *2018; 42: 207-15.* DOI: https://doi.org/10.1016/j.medin.2017.06.005
33. Holmberg M, Holmberg S, Herlitz J, Gardelov B. Survival after cardiac arrest outside hospital in Sweden. Swedish Cardiac Arrest Registry.

Resuscitation 1998; 36:29-36. DOI: http://dx.doi.org/10.1016/S0300-9572(97)00089-0

34. González-Martinez E, Gómez-López L, Gomar C, López-Gutierrez A, Fábregas N, Valero R et al. Eficacia para una aplicación para móviles metrónomo sonoro y el metrónomo mental musical ¨la macarena¨ para mejorar la calidad de las compresiones torácicas. Revista de la Fundación Educación Médica 2017; 20 (2): S57-S58.
35. Russo SG, Neumann P, Reinhardt S, Timmermann A, Nikas A, Quin- tel M, et al. Impact of physical fitness and biometric data on the quality of external chest compression: A randomised, crossover trial. BMC Emergency Medicine. 2011; 11:20. DOI: https://doi.org/10.1186/1471-227X-11-20
36. korning M, Beckers SK, Brokmann JCh, Rötger D, Bergrath S, Veiser T, et al. New visual feedback device improves performance of chest compressions by professionals in simulated cardiac arrest. Resuscitation. 2010; 81:53-8. DOI: https://doi.org/10.1016/j.resuscitation.2009.10.005

**Total references / Número de citas totales:** 36 (100%)
**Journal's own references / Número de citas propias de la revista:** 0 (0 %)