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Impact of CPR Training on High School Students and the Role of School Nursing in Madrid- Spain

Gomez de Quero Cordoba Marina*

Department of Nursing, Universitat Rovira, Spain

ABSTRACT

Background: Early CPR initiation is crucial for survival in out-of-hospital events. Adolescents are ideal for CPR education due to their learning capacity. This study evaluated the impact of different CPR training methods on high school students' knowledge.

Methodology: An observational, cross-sectional study using the American Heart Association's validated Basic Life Support questionnaire and a self-developed questionnaire.

Results: Out of 354 valid responses, only 37% passed the CPR test, indicating a general lack of knowledge. Twenty-six percent had no prior training, and most had sporadic practical workshops. About 75.4% believed CPR training should be mandatory, and 88.7% found it useful. Training by Health Professional yielded better results, but differences were not statistically significant.

Conclusions: Students have low CPR knowledge due to insufficient and infrequent training. Practical workshops are more effective than lectures, and healthcare personnel training shows better results.

Keywords: Cardiac arrest, cardiopulmonary resuscitation, health education, academic institutions, high school students, and school nursing.

INTRODUCTION

Cardiac arrest (CA) is defined as the sudden and potentially reversible interruption of the mechanical activity of the heart and spontaneous breathing. It is one of the leading causes of death in developed countries. In Spain, it is estimated that approximately 52,300 cardiac arrests occur each year, of which 30,000 take place outside the hospital setting. These events could be responsible for approximately 46,900 deaths per year, which amounts to an average of 128 deaths daily [1-3].

Most cardiac arrests occur outside of hospitals, which means the time without medical attention increases. Studies published by the European Resuscitation Council (ERC) suggest that the average time it takes for emergency medical services (EMS) to arrive at the scene is approximately 8 minutes, while the time a brain can survive without blood supply and without suffering damage is only 3-5 minutes, decreasing a 10% decrease in the chances of survival for each minute that passes without cardiopulmonary resuscitation (CPR) being performed [2,4].

For this reason, the prompt action of bystanders is one of the most important actions in the treatment of a cardiac arrest. This action will begin with the activation of the chain of survival2,4 Whose steps are: early recognition and calling for help, early CPR by bystanders, early defibrillation, early advanced life support, and post-resuscitation care [2,5].

However, according to the data from the "Cardioprotection Study in Spain" endorsed by the Spanish Heart Foundation, only 30% of Spaniards are capable of performing CPR techniques in the event of a cardiac arrest5. There are very few countries where CPR training is included in the school curriculum. At the European level, some of the countries that stand out are: Denmark, Belgium, France, or Portugal6. In Spain, learning first aid is considered mandatory in primary and secondary education, but it has not yet been implemented in many schools and institutes across the country [6,7].

A recent study conducted by the Cardiopulmonary Resuscitation (CPR) Working Group of the Spanish Society of Cardiology reveals that only 36.2% of students in Spain have received CPR training. This figure is notably lower compared to similar studies conducted in other countries [7]. The WHO supported the

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***Corresponding author:**

Gomez de Quero Cordoba Marina, Department of Nursing, Universitat Rovira, Spain, **Email**: marina.gomezdequero@urv.cat

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"Kids Save Lives" campaign, causing a significant impact on the training in school resuscitation techniques in 2015 [6,8].

It is recommended to teach CPR to schoolchildren from the age of 12, including the use of an AED. The importance of this training for this population group is once again emphasized, as the dissemination of knowledge will be significant, creating a chain of training when children teach their family members and friends. After the Declaration, CPR training for schoolchildren became a legal requirement in six European countries by 2020, while in another 23 countries it was a recommendation [9].

There is still controversy over who is the most suitable figure to provide CPR and first aid training in the school setting. Recent publications issued by the ERC and ILCOR suggest the possibility of teachers taking on this role. However, although the majority of teachers support this training, it is important to note that many of them currently lack the necessary knowledge to teach these techniques. Various studies emphasize the importance of having competent instructors in this field to achieve successful training, noting that the instructor's skill and ability to convey CPR knowledge and practical skills play a crucial role in the effectiveness of the students' learning process [8,10,11].

The school nurse could be the ideal figure to provide CPR training in educational settings. Due to their training and experience, school nurses are equipped to effectively convey knowledge, as, in addition to their theoretical and practical knowledge on the subject, they are professionals familiar with the school environment who understand the specific needs of the students. Their inclusion in the educational team would not only alleviate the burden of responsibilities from teachers and other professionals who provide timely education, such as the community nurse, but would also ensure the continuity of health projects and programs in schools [12-14].

Cardiac arrests represent a significant challenge for public health, with more than three million deaths per year in the out-of-hospital setting worldwide. Starting cardiopulmonary resuscitation early by bystanders can not only increase the chances of survival by two to three times but also help mitigate subsequent consequences, such as brain damage [3].

Studies show that individuals trained in CPR techniques are more willing to intervene in the event of witnessing a cardiac arrest than those who have not received training. The fear of causing harm due to poorly performed CPR and the legal implications are identified as significant barriers for non-professional witnesses to initiate CPR. This can be attributed to a lack of confidence in one's own skills, which suggests that those with some levels of skill are more inclined to act [15-17].

For all these reasons, children and adolescents constitute the target population on which this type of teaching should be based due to characteristics such as their high learning capacity, the large population reach, or the tendency to disseminate the knowledge acquired. Knowledge can be instilled progressively, starting with the recognition of cardiac arrest and the activation of emergency medical services, and gradually advancing towards the application of more complex techniques, such as chest compressions, ventilation, and the use of AEDs. This gradual progression allows students to better assimilate the information and acquire the necessary skills to respond effectively in emergency situations [1,2].

So far, no previous study has been identified that has addressed the analysis of the level of knowledge in CPR and first aid in the selected educational centers. This lack of previous research underscores the relevance and necessity of conducting a study to assess the level of knowledge in these educational contexts. The main objective of this study was to evaluate the impact of different CPR training methods on the knowledge level of high school students.

METHODOLOGY

Dising

Cross-sectional descriptive observational study.

Settings

The research area included the Public Secondary High-school located in Rivas Vaciamadrid. This municipality housed five public high schools: IES Duque de Rivas, IES Europa, IES Julio Pérez, IES Las Lagunas, and IES Antares. The first three centers had the presence of a school nurse. The selected grade was 4th year of ESO since it is the last year of compulsory education.

Poblation

The study population consisted of 4th-year ESO students from the aforementioned institutes. The age of the students ranged between 15 and 16 years, possibly exceeding this range if they had repeated any course. The inclusion criteria were: a) students enrolled from the beginning of the course and b) their willingness to participate. The exclusion criteria were: a) lack of verbal and/or written comprehension of the Spanish language, b) surveys, and c) absence of signed informed consent.

Tamaño Muestral y Estrategia de Muestreo

According to data provided by the Ministry of Education, Science, and Universities of the Community of Madrid [18-22], for the 2024-2025 school year, the spots offered for the 4th year of ESO in the centers selected in this study total 870 vacancies.

El número de plazas ofertadas para 4º ESO en centros académicos en el curso 2024-25 es: IES Las Lagunas 120; IES Julio Pérez 210; IES Europa 180; IES ANTARES 180; IES Duque 180.

Para el cálculo del tamaño muestral se empleó el programa EPIDAT 3.1. For a total population of 870 students, with an expected proportion of 50%, a precision of 5%, and a confidence level of 95%, the required sample size is 267 students.

Studio variables

The variables analyzed in this study were: knowledge about CPR, prior training received, the person who provided the CPR training, the students' perspective, and the centers where the figure of the school nurse was present.

Instrumentos de Recogida de Datos

For data collection, the validated Basic Life Support questionnaire from the American Heart Association (AHA) was administered to all selected students. This questionnaire was validated in Spanish, including transcultural adaptation and verification of its reliability and validity in similar populations, ensuring that the questions are understandable and relevant for Spanish speakers [23].

The authorization from the corresponding association was requested and obtained, thus ensuring the legitimacy in the use of the instrument. This questionnaire is designed to assess knowledge of CPR and first aid in school environments. It consists of 12 questions, each with four answer options, of which only one was correct. Each question awarded one point, with a maximum score of 12. To pass the quiz, it was necessary to score at least 6 points.

Additionally, an ad hoc questionnaire designed by the principal investigator (see supplementary file X) was administered to gather information on prior training in CPR and/or first aid (whether they had received it, how often, and how it was delivered), the person who provided the CPR training, the students' perspective (whether it was useful, if they believe it should be mandatory, their perception of their level of knowledge in CPR), and the presence of the school nurse at the center. This questionnaire was answered by the students during class hours, provided by the principal investigator of the study.

Data Collection

The data collection took place from October to December 2024, thus ensuring a sufficient time frame for the proper administration and gathering of information.

After the study was approved by the management of the educational institutions, the PI established direct contact with the Physical Education teachers. These teachers played a fundamental role in the process, as they were responsible for distributing the questionnaires among the students participating in the study.

Data Analysis

All the data was entered into Excel for subsequent management, ensuring their pseudo-ammonification. Once the database was complete, it was transferred to the SPSS program to conduct the statistical analysis.

Initially, a descriptive analysis of the variables was conducted. The qualitative variables were analyzed using frequencies. With the quantitative variables, an assessment of the normality of their distribution was first carried out using the Kolmogorov Test. The quantitative variables that were normally distributed were described with mean and standard deviation, while those that were not were analyzed with median and interquartile range.

In a second phase, comparisons of variables by study groups were made. To search for associations between qualitative variables, the Pearson Chi-square test was used. To compare quantitative variables, the T-Student Test or the Analysis of Variance (ANOVA) Test was used if the variables were normally distributed, or the Mann-Whitney U Test or Kruskal-Wallis Test if they were not normally distributed. Throughout the study, statistical significance was maintained at a 5% probability level ($p \leq 0.05$).

To improve the understanding and visualization of the data, graphical representations with pie charts and bar charts were used.

RESULTS

Of the five Public Education High Schools contacted for the study, three centers ultimately participated, resulting in a total of 354 valid questionnaires and no missing data in most of the analyzed variables. 97.7% of the participants (n=346) agreed to participate in the study, while 2.3% (n=8) did not. In the following graph, the percentage of students who participated by educational center is shown.

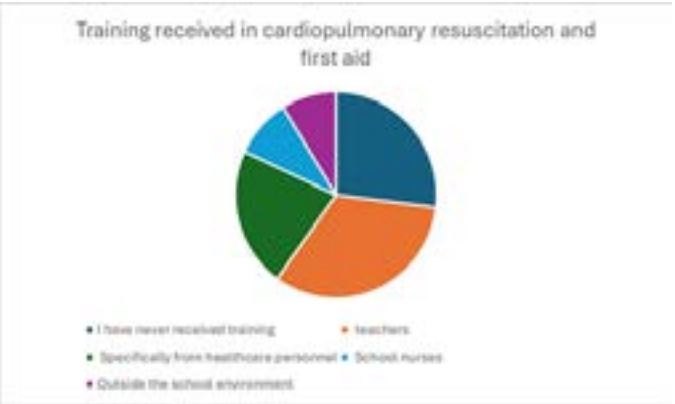
Table 1: Advanced Life Support Questionnaire Results.

	Frequency	Percentage	Percentage valid	Percentage acumulad
0	8	2,3	2,3	2,3
1	2	6	6	2,8
2	15	4,2	4,2	7,1
3	49	13,8	13,8	20,9
4	60	16,9	16,9	37,9
5	89	25,1	25,1	63,0
6	62	17,5	17,5	80,5
7	41	11,6	11,6	92,1
8	23	6,5	6,5	98,6
9	4	1,1	1,1	99,7
10	1	3	3	100,0
Total	354	100,0	100,0	

Table 1 indicates that 131 participants (37%) passed the questionnaire, reaching or exceeding the minimum required score, while 223 participants (63%) did not succeed. These data suggest that a significant majority of the evaluated did not reach a sufficient level of CPR competencies.

Regarding prior CPR training, there is a great diversity in the participants' experience. 26% indicated that they had not received any type of CPR training. On the other hand, 31.9% stated that they had received training provided by teachers in their schools, positioning this group as the largest percentage among those who have accessed some level of education in this field. Additionally, 21.2% of the respondents reported having received training specifically from healthcare personnel in school settings. It is interesting to note that 9% of the participants received training provided by school nurses, which emphasizes the potential role of this staff in first aid education.

Lastly, 8.5% indicated that they had pursued training on their own initiative, outside the school environment [**Figure 1**].



Regarding the frequency with which participants have received CPR training, the data reveals that 44.4% reported having re-

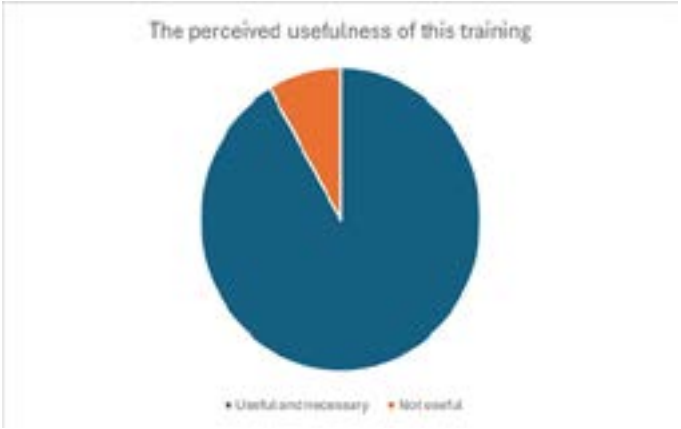
ceived training only once in their lifetime, reflecting the sporadic nature of this training in most cases. 21.8% indicated that this training was provided regularly, at least once a year, and only 9.6% of the participants stated that they had received training two or more times per course [**Figure 2**].

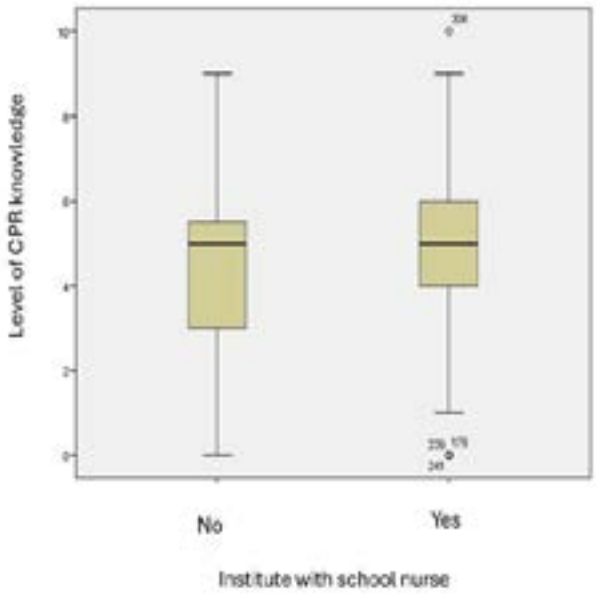
Regarding the methods used to provide CPR training, the data indicates that practical workshops were the most utilized, reaching a 35.9% preference. On the other hand, 29.1% received training through theoretical talks, which could limit information retention due to the lack of a practical component. Finally, 10.2% accessed information through informational material, a modality that, although valuable, may be insufficient without practical complement [**Figure 3**].

El 75.4% expressed their interest in having CPR training included as a mandatory subject in schools and educational centers. Regarding the perceived usefulness of this training, 88.7% of respondents agreed that learning CPR is useful and necessary. On the contrary, 8.2% determined that it is not useful, which could reflect a lack of knowledge or previous experiences [**Figure 4**].

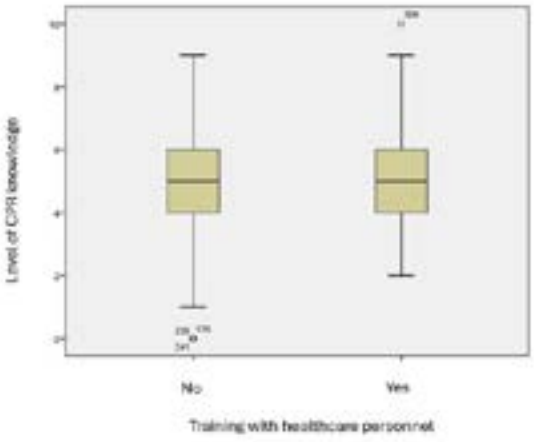
In terms of self-assessment of CPR knowledge, the data show a significant concentration at the "low" and "medium" levels. 43.8% of the participants rated their knowledge as low, while 48.3% considered it medium. Only 5.1% of the respondents stated that they had a high level of knowledge, which highlights a widespread need to improve training in this area.

Participants from IES with a school nurse reported an average of 5.04 (σ = 1.76) points on the AHA knowledge questionnaire, compared to an average of 4.56 (σ = 1.94) for those without access to this resource. Although the difference in means indicates a possible advantage, the statistical analysis did not find a significant difference (p=0.056) [**Figure 5**].





The training provided by healthcare personnel was also subject to comparative analysis. The data show that participants who received training from healthcare personnel had an average score of 5.11 (σ = 1.66) on the knowledge questionnaire, while those who did not have access to this modality had an average score of 4.88 (σ = 1.85). Although the difference is not statistically significant (p=0.27i) [24-37] [**Figure 6**].



DISCUSSION

The findings of this study reveal an insufficient level of cardiopulmonary resuscitation (CPR) knowledge among secondary school students, as 63% did not reach the minimum required score in the questionnaire. This result aligns with previous studies conducted in various regions of Spain, such as Aragón and Galicia, where similarly low levels of CPR competence were documented among students without specific training [38,39]. Moreover, the Spanish Society of Cardiology (SEC) reported that fewer than half of students were able to identify a cardiac arrest, and an even smaller percentage knew the emergency number or how to locate an automated external defibrillator (AED) [40].

A total of 26% of the participating students reported never having received CPR training, and 44.4% had only received it once in their lives, reflecting a clear lack of continuity. The literature is clear on this point: without regular training, CPR knowledge and skills decline rapidly [41,42]. According to the European Resuscitation Council, CPR training should be delivered at least once per year during the school period [2]. In turn, the American Heart Association recommends at least two key training sessions throughout the educational cycle, with periodic repetition [31]. However, in Spain, although the national curriculum includes the mandatory teaching of basic life support [8,19–21], its practical implementation remains inconsistent and highly dependent on the individual commitment of schools or regional educational authorities.

In terms of self-perception, 43.8% of students rated their CPR knowledge as low, and 48.3% as medium. This finding is especially relevant, as a perceived lack of competence can significantly reduce the willingness to act in an emergency situation [31]. International studies have shown that greater training frequency improves both performance and confidence when responding to such events [43,45].

Analysis of the pedagogical approaches confirms that practical workshops were more effective than theoretical talks or informational materials. These results are consistent with previous research that underscores the importance of hands-on learning for consolidating meaningful knowledge in CPR [42,43].

Although statistically significant differences were not found, both training delivered by healthcare professionals and the presence of a school nurse were associated with better questionnaire performance. This suggests that training led by health professionals may have a stronger educational impact, not only due to technical quality, but also due to the authority and confidence conveyed by the instructor [43,45].

The school nurse, in particular, emerges as a strategic figure in health promotion and CPR education. Various studies highlight that their integration within school settings facilitates not only more effective instruction but also the sustained planning of preventive workshops and early interventions [27,44]. Their continued presence in the educational environment promotes close interaction with students and the ability to intervene directly and immediately in emergency situations [44].

In contrast, although teaching staff generally recognize the importance of including CPR training, many report not feeling adequately prepared to deliver it. In the study by Otero-Agra carried out in schools in the Balearic Islands, only 30.7% of teachers agreed that they should take on the role of basic life support instructors [43]. This finding is in line with other studies showing that teachers' perceived lack of training is a barrier to the effective delivery of CPR education in schools [23,25,42].

One of the main limitations of this study is the self-reporting bias, inherent to the questionnaires used, which may lead to an over- or underestimation of actual knowledge due to socially desirable responses or recall errors.

In addition, the cross-sectional nature of the study prevents the analysis of how knowledge evolves over time. The lack of longitudinal follow-up limits the ability to assess the lasting impact of different educational strategies. Another important limitation is the non-participation of all public schools in the selected area. Although the sample was numerically representative, the exclusion of some schools may limit the generalizability of the results. Furthermore, not all contextual variables that could influence outcomes were controlled, such as the level of teacher involvement, availability of educational resources, or the existence of previous first aid programmers within the schools. Finally, although differences in knowledge levels were identified according to the type of training and the instructor, the lack of statistical significance in many comparative analyses may be due to an insufficient sample size to detect small effects, suggesting the need to replicate this study with a larger and more diverse population.

CONCLUSION

This study has shown that the level of CPR knowledge among the evaluated students is insufficient, with 63% of participants failing to achieve the minimum required score on the questionnaire. This finding underscores the urgent need to improve CPR training in educational centers. The variability in prior training experience is notable, as 26% of students have not received any CPR training, while 44.4% have only been trained once in their lifetime. This lack of continuity in CPR education can negatively affect the long-term retention of knowledge and skills.

Teaching methods have shown a significant influence on knowledge acquisition. Practical workshops were the most effective training modality, while theoretical lectures and informational materials were less impactful. This suggests the importance of prioritizing practice-based pedagogical approaches to improve CPR competence.

In comparative terms, students who received training from healthcare personnel achieved better results in the knowledge test compared to those instructed by other means. Similarly, the presence of school nurses showed a possible positive influence on the level of knowledge, although both results were not statistically significant. These findings underscore the importance of strengthening CPR education in schools, ensuring that all students receive regular and practical training.

The implementation of more structured and continuous educational programs, with the participation of trained nurses, such as school nursing staff, could be fundamental in improving CPR competence and optimizing the preparedness of young people for emergency situations. School nurses can play a crucial role in implementing continuous and practical CPR training programs, leveraging their experience and proximity to students. Additionally, including CPR training as a mandatory subject in the school curriculum would ensure that all students receive the necessary training, increasing acceptance and commitment to CPR education.

ETHICAL CONSIDERATION

This study was conducted in accordance with the principles articulated in the Declaration of Helsinki38, as well as in Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on Data Protection 39, ensuring proper coding and data matching. In the minutes of meeting 6/2024 of the CEIM (CEIPSA-2023-PRD-0031), acceptance was obtained.

The processing, communication, and transfer of personal data of all collaborating individuals were in accordance with the provisions of Organic Law 3/2018, of December 5, on the Protection of Personal Data and the guarantee of digital rights. In accordance with the provisions of Article 7 of said legislation, the processing of personal data of a minor can be based on their consent when they are over fourteen years old. Since, for academic reasoWns, all our participants were over fifteen years old, informed consent was provided directly to the student. This consent reflected the minor's will and could be withdrawn at any time without any detriment to him. The confidentiality of the collected information was guaranteed. The anonymity of the participants was respected at all times, and their data was not used for any purposes other than this research.

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None.

CONFLICT OF INTEREST

None.

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