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Original Research

Assessment of Automated External Defibrillators and Cardiopulmonary Resuscitation Training in Lebanese Schools

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ABSTRACT

Introduction: Sudden cardiac arrest accounts for 5% to 10% of deaths among children. Survival following out-of-hospital cardiac arrest depends on quick recognition, early cardiopulmonary resuscitation (CPR) and defibrillation. In Lebanon, the survival rate of children following such arrests is low (16.7%). Consequently, this study assesses availability of automated external defibrillators (AED) and CPR/AED training in Lebanese schools.

Methods: This is a cross-sectional phone-based survey study conducted using a randomized sample of 175 private, private-free and public schools - representative of all of the country regions.

Results: Among surveyed schools, 99 responded with a complete participation (56.6% response rate). Most surveyed schools were public. In 28% of schools, at least one individual underwent CPR or/and AED training, and only 2 schools had an AED. Four schools reported a history of SCA, 3 of them were confirmed dead, and those 4 schools did not have an AED. The main perceived barriers for not having an AED included lack of recommendations and regulations implementing such programs at schools (24.7%), no previous cardiac arrest cases at the school (22.7%) and absence of support from authorities (21.6%). Moreover, 86.9% of participant schools were interested in CPR/AED training and 89% found it essential.

Conclusion: The results of the study suggest that Lebanese schools are affected by the lack of sufficient legislations and requirements for SCA. This calls for promotion of basic life support training, as well as large-scale evaluation for emergency preparedness.

Keywords: emergency preparedness plan, pediatric emergency, resuscitation, sudden cardiac arrest

INTRODUCTION

Sudden cardiac arrest (SCA) is responsible for 5% to 10% of all deaths among 5 to 19 years old children.[1] SCA is also considered the major cause of exercise related death in young athletes, accounting for 75% of all mortalities during sports activities.[2] Undetected structural heart diseases and electrophysiologic disorders are the most common causes of SCA in young patients including cardiomyopathies, myocarditis, and primary arrhythmogenic disorders.[3] Young athletes carrying these cardiac disorders do not show symptoms or warning signs and go undetected until the cardiac event occurs; therefore, early cardiovascular screening and medical emergency preparedness planning are crucial for patients' survival.[4]

Survival following out-of-hospital cardiac arrest (OHCA) relies on quick recognition, prompt CPR and access to early defibrillation.[5] Drezner et al (2013) showed that US schools enrolled in AED program had a high survival rate of 85% if the arrest was witnessed, and if the student received fast CPR and defibrillation.[6] Survival rates were significantly higher if the school had an on-site AED and a ready emergency plan. As a matter of fact, it is reported that children with SCA are more responsive to CPR and immediate defibrillation with more favourable outcomes compared to adults.[1] Given that public

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access defibrillation improves OHCA outcomes, the American Heart Association's (AHA) guidelines for emergency response planning in schools recommend the availability and accessibility (within 3 minutes from collapse to shock) to an AED.[7,8]

Several factors lead to low usage of AED and subsequently low OHCA survival rates. A systematic review demonstrated that the major barriers for not using AEDs include lack of knowledge on how to find an AED and use it, lack of training, unwillingness to use it due to fear of causing harm or incorrect use. Other barriers include inability to buy an AED or to Similar findings were demonstrated in other studies in the Arab region.[9-11]

Outcomes are also negatively affected in low-and middle-income countries (LMIC) mainly due to lack of CPR training.[12] In Lebanon, survival rate of young children post-OHCA was only 16.7%. The reasons behind this low survival rate were attributed to late EMS arrival, low performance of CPR and rare use of AED.[13] Furthermore, little is known in Lebanese schools about the medical emergency response planning, specifically AED availability, accessibility to and use of AEDs or CPR training. Consequently, the purpose of this study was to assess the availability and accessibility of AEDs and CPR training in Lebanese public, private and private-free schools.

MATERIALS & METHODS

Study Design and Settings

This was a cross-sectional, observational survey study conducted at a regional academic institution. Data collection was performed between June 2019 and November 2019. A Lebanese school index for the years 2015-2016 was obtained from the official directory of the Lebanon Center for Educational Research and Development (CERD).[14] The school index included the names of all public and private schools, their addresses, phone numbers, working/operating time, as well as the number of students and employees. To ensure that schools from all areas of Lebanon and from both the private and public sectors are represented, schools were stratified by provinces and sector. Using an online randomization software (Research Randomizer)[15,16], a randomized sample of 175 schools was selected while ensuring that all provinces and both sectors were represented equally, from a list of 9584 schools in Lebanon available through the Ministry of Education.[17] The sample size was calculated accounting for a 20% non-response rate.

Data Collection

The research team called schools during weekdays, introduced the study and obtained oral consent for participation from interested parties. To note, the interviews were conducted with the directors or principals at the school to ensure that the data is reliable. In case of no response, the researcher would try again the following week for up to three attempts. The data collection tool included school information, demographics, sections on CPR readiness, AED availability and accessibility, prior history of on-site cardiac events, and interest in receiving training. The American University of Beirut's Institutional Review Board (IRB) ethical approval was obtained prior to the launch of the study.

Statistical Analysis

All data was cleaned and managed using IBM SPSS 25 (IBM Corp, Armonk, NY). Categorical variables were presented in frequencies and percentages, while continuous variables were summarized in the form of means ± standard

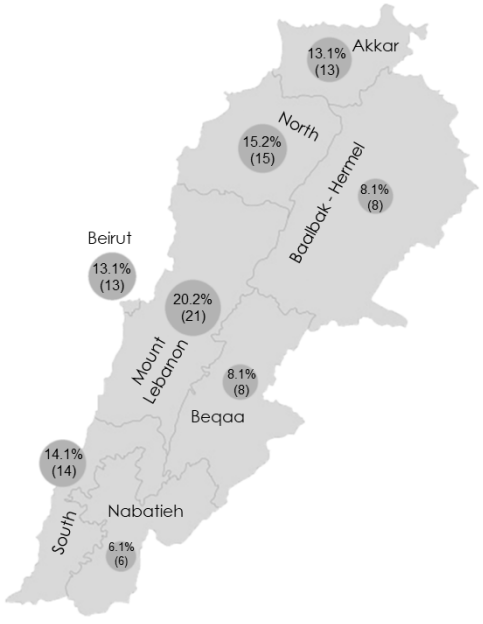

Figure 1 Distribution of schools in the 8 Lebanese governorates

Table 1 Characteristics of respondent schools

Schools Characteristics (N=99)		Frequency (percentage)
Schools	Private	18 (18.2)
	Private free	16 (16.2)
	Public	65 (65.7)
Governorate	Akkar	13 (13.1)
	Baalback-Hermel	8 (8.1)
	Beirut	15 (15.2)
	Beqaa	8 (8.1)
	Mount Lebanon	20 (20.2)
	Nabatiyeh	6 (6.1)
	North Lebanon	15 (15.2)
	South Lebanon	14 (14.1)
Availability of registered nurse		17 (17.2)
Availability of doctor		2 (2.0)
History of arrest at school		4 (4.0)
History of training		28 (28.3)
Staff Training (N=28)		
Training*	Supervisors and teachers	21 (75.0)
	Students	11 (39.3)
	Nurses	4 (14.3)
	Principal	4 (14.3)
	Sports Coaches	4 (14.3)
	Security	1 (3.6)
Availability of trained individuals at all time		7 (25.0)
Organized the training	Red Cross	10 (35.7)
	Medical organizations	5 (17.9)
	Civil Defence	2 (7.1)
	School doctors/teachers	2 (7.1)
	Ministry of health	1 (3.6)
	Physician	1 (3.6)
	Others/unknown	7 (25.0)

**One or more options may apply - percentage total more than 100*

deviations. Chi-square and Fisher's exact tests as well as non/parametric tests were used to evaluate differences and flag associations between variables.

RESULTS

Schools Characteristics

Of the 175 randomly selected schools, 99 completed the survey (56.6% response rate). Responding schools had between 28 and 1700

students (mean of 423 ± 350), and number of employees ranged between 4 and 220 (mean of 46.2 ± 39.5). Out of the respondent schools, 65.7% were public schools and 34.3% were private ones; the latter were, in turn, divided into 18.2% and 16.2% private and free private schools, respectively. Involved schools were mostly based in Mount Lebanon (20.2%), followed by the Beirut (15.2%), North Lebanon (15.2%), South Lebanon (14.1%), Akkar (13.1%), Baalback-Hermel (8.1%), Beqaa (8%) and Nabatiyeh (6.1%) (Figure 1).

Emergency Preparedness Plan

Training Prevalence

Out of the 99 surveyed schools, 28 had at least one CPR-trained individual at their facility (training with/without AED). Among the schools with trained individuals, supervisors and teachers accounted for a majority of trained personnel (75%), and few schools trained students, principals, sport coaches, and security guards. Of the participant schools, only 17.2% and 2% had an on-site nurse and doctor, respectively. However, nurses were only present in private schools, especially in schools with a large number of students (p=0.02, CI: [-0.453; -0.10116]) irrelevant of the location of the school (p>0.05). Moreover, out of the participating schools, only 7 (7.1%) schools had at least one trained personnel available at all time. Usually, those training programs were organized by the red-cross or medical organizations (Table 1).

AED Prevalence and Use in SCA

Of schools surveyed, only 2 had AEDs available on campus which were never used due to the absence of SCA events (Table 2). In the past 10 years, 4 out of the 99 schools (4.0%) reported a SCA incident

Table 2 AED distribution and training characteristics in Lebanese schools

AED Availability and Barriers		Frequency (percentage)
AED availability on school property (N=99)		2 (2.0)
Reasons for not having an AED* (n=97)	Lack of recommendations and law to implement an AED program	24 (24.7)
	No cardiac incidence in the past	22 (22.7)
	Ministry should provide us with AED	21 (21.6)
	Lack of funding/money to adopt an AED program	16 (16.5)
	Lack of AED training programs around us	13 (13.4)
	Lack of knowledge of its presence	11 (11.3)
	The school is close to the hospital/ healthcare center	11 (11.3)
	No healthcare professionals/ clinic at school	8 (8.2)
	The students are young and don't have heart diseases	7 (7.2)
	Isolated village/ low SES village/ Negligence towards public schools	5 (5.2)
	We have a doctor/pharmacy	3 (3.1)
	Schools are not hospitals	2 (2.1)
	Not a priority/ not interested	4 (4.1)
Interest in Future Preparedness Plan (N=99)		
School is interested in a training program?		86 (86.9)
Thinks that CPR training should be for all schools ?		88 (88.9)
Do you Thinks that AED use should be public?		88 (88.9)

**One or more options may apply - percentage total more than 100*

on campus, 3 resulted in death and the fourth had an unknown outcome. None of those 4 schools had an AED or AED/CPR training (Table 1).

Top reasons for not having an AED at the other 97 schools include: lack of clear local recommendations and laws for AED programs (24.7%) and no previous SCA occurrence (22.7%) as well as lack of support from the ministry of education (21.6%) and absence of funding (16.5%) (Table 2).

Interest in Future Medical Emergency Preparedness Plan

Of the surveyed schools, the majority were interested in a CPR and AED training program (86.9%), and 89% of school confirmed that CPR training should be mandatory in all schools and that AEDs should be publicly available (Table 2).

DISCUSSION

This is the first study to assess a segment of emergency preparedness plan related to sudden cardiac arrests in Lebanon, a low middle income country. The research focused two essential elements for SCA response which are AED availability/use and CPR training in public and private schools across Lebanon. Our study findings highlighted the low prevalence of CPR or AED training in schools, with only 7 schools having available trained personnel always present on-site. Furthermore, only 2 of the surveyed schools had one AED each which were never used due to the non-occurrence of SCA incidents. In addition, the majority of schools were interested in CPR and AED training and emphasized that it should be publicly available and mandatory in all schools.

Emergency preparedness plans in schools include, but are not limited to, training staff and students in first aid and CPR as well as implementing AED programs.[18] AHA emphasized on early bystander chest compression and use of AED, for the reason that if it is done within 3 to 5 minutes after the collapse it might lead to a 49% to 85% survival rate.[4,19,20] In Lebanon, these structural elements are unavailable, few schools had a nurse/physician, trained individual or an available AED in their premises. An important point to mention is that public schools in Lebanon have implemented the "health advisor" program; this consists of appointing a teacher in charge of health-related issues at the school. This teacher receives introductory training on basic health aspects to mainly take care of health issues until professional help arrives.[17] However, this advisor remains essentially a teacher and not a healthcare professional; additionally, there is no national accredited training in CPR and AED as part of the health advisory program.[17]

Compared to developed countries, Lebanese schools lack structural elements of emergency preparedness plan for cardiac arrest. In Lebanon, out of the 99 schools, only 2 schools had an AED and 28 schools had at least one trained personnel. On the other hand, in Japan 90% of the schools provided a basic life support training for teachers, and all the schools installed at least one AED in their facilities leading to a significant improvement in the 30-day survival rate of SCA from 38 % (in 2005) to 57% (in 2015).[21] In the UK, Salciccioli et al (2017) indicated that 56% of London schools provided training programmes and 28% of them had an implemented AED.[22]

The main barriers for implementing a public preparedness plan in LMIC were related to the financial burden, absence of public awareness, cultural barrier and lack of infrastructure for emergency medical services (EMS).[23,24] Some of these barriers apply in Lebanon. In this study, the major reported barriers for not implementing an AED program and training included lack of national recommendations or regulations to implement AED programs in Lebanese schools, no previous occurrence of SCA, unavailable supply of AED from the government/ministry and paucity of funding. These results suggest that there is a significant need for national public health campaigns to provide funding for AEDs, trainings to school staff and students.

Moreover, international recommendations by medical and sports association urge pre-participation cardiovascular screening of young athletes with ECG.[25-27] Such measures have been implemented in developed countries like Japan, where all school children go through an ECG screening in the first, seventh and tenth grades.[28] In Italy the national screening program, which included ECG, significantly decreased sudden cardiac death in young athletes.[29] In Lebanon, there have been some efforts by non-governmental organizations in Lebanon to provide basic training and screening (ECG) for young school athletes.[30]

Therefore, national policies and awareness campaigns targeting ECG screening in young children is crucial in mitigating cardiac death in young athletes and students.

Even though most school administrators agreed that AED/CPR trainings should be available in all schools, there were 7 school officials who were not interested in implementing an emergency preparedness plan since "young children are not at risk of having heart disease". This misperception emphasizes the need to increase awareness and training programs in all schools especially in small schools more so in communities with low socioeconomical status population. Therefore, enhancements should take place in Lebanese schools through national policies and programs to ensure CPR/AED training and certification for administrative personnel, nurses, teachers, as well as students. Additionally, implementing such policies will also ensure the availability of trained individuals at all time on school grounds which could save children and adults working or visiting the schools from potential SCA[6,7,31], especially that three individuals who had a SCA in the participant schools passed away.

Lebanon still lacks national EMS guidelines, national deployment of AEDs (specially in high risk areas such as schools) as well as national policies and legal framework on CPR for OHCA patients.[30]

Limitations of this study include a relatively small sample size due to low response rate. Selection bias was minimized by randomly selecting schools across different regions in Lebanon. The collected data was also not verified by site visits and findings may differ if actual audits of preparedness plans were conducted. A recent initiative was launched in Lebanon to improve cardiac arrest survival by drafting a "Good Samaritan" law and initiating AED deployment programs in public places and in schools in Lebanon.[30] This initiative might affect future assessments of AED/CPR availability and training in schools. Despite these limitations, this study is also the largest to date to assess Lebanese schools and its findings can be generalized to other schools in Lebanon.

CONCLUSION

The results of the present study suggest that Lebanese schools lack emergency preparedness policies, especially for sudden cardiac arrests, although schools' administrators are interested in CPR/AED trainings and programs. The main reasons behind it appeared to be lack of funding and regulations; therefore, further evaluation may be needed to assess other public sectors preparedness to OHCA and other emergencies. Eventually, this may call for new public policies focusing on implementing accredited CPR and AED trainings to staff and students in all Lebanese schools and allocation of resources for promoting the availability of public AEDs.

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