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Simulation-Based Basic Life Support and Choking Training for High School Students

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Abstract
Purpose: This study aimed to improve the knowledge and skills of 12th-grade students in Basic Life Support (BLS) and choking management through simulation-based health education at SMA Negeri 6 Pekanbaru.
Research Methodology: A one-group pre-test–post-test community service design was conducted on 80 students using interactive lectures, group discussions, live demonstrations, and hands-on practice with BLS and choking manikins; knowledge questionnaires and skill checklists adapted from the 2020 American Heart Association guidelines were used for evaluation.
Results: The mean knowledge score increased from approximately 60 (pre-test) to 90 (post-test), and most participants shifted from unskilled to skilled categories in recognizing cardiac arrest, performing chest compressions with adequate depth and rate, and applying the correct choking-relief sequence.
Conclusions: Simulation-based health education effectively enhanced high school students' basic life support and choking management competencies and has the potential to strengthen emergency preparedness within the school environment.
Limitations: This study used a single-group design in one school without long-term follow-up; therefore, causal inference and skill retention over time could not be fully assessed.
Contributions: The program provides a practical model for integrating simulation-based BLS and choking training into school health promotion activities and offers guidance for educators, public health practitioners, and policymakers seeking to build community first-responder capacity among adolescents.

Keywords: *Adolescents, Basic Life Support, Cardiopulmonary Resuscitation, Choking Management-Based Training, High School Students*

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1. Introduction

The global mortality burden remains high. The World Health Statistics 2024 report estimated approximately 57 million deaths in 2022–2023, with Cardiovascular Diseases (CVD) persisting as one of the leading causes of death worldwide (Cesare et al., 2023; Roth et al., 2020). An analysis by the Institute for Health Metrics and Evaluation indicates that CVD accounts for a substantial proportion of deaths and disability across countries, with recent Global Burden of Disease reports estimating more than 19 million CVD deaths and 437 million Disability-Adjusted Life Years (DALYs) in 2023, and nearly a doubling of prevalent CVD cases since 1990. Premature CVD mortality has risen by approximately one-quarter- over the past three decades, especially in low-resource- settings, underscoring the urgent need for preventive interventions and early emergency management (Gregory A et al., 2020; Lababidi et al., 2023; Mensah, Roth, & Fuster, 2019).

Sudden cardiac arrest is a major cause of mortality and requires immediate Basic Life Support (BLS) to improve survival chances. Early recognition, followed by prompt cardiopulmonary resuscitation and rapid defibrillation, is critical to maintaining cardiac, pulmonary, and cerebral function, preventing sudden cardiac death, and achieving favorable neurological outcomes until advanced care is available (Ana & Kusyani, 2023; Chen, Zou, Wen, Li, & Liang, 2025; Evie & Saman, 2023; Yow, Rajasurya, Ahmed, & Sharma, 2024).

The effectiveness of BLS depends heavily on the rapid recognition of cardiac arrest, prompt activation of emergency services, and the quality of Cardiopulmonary Resuscitation (CPR) delivered by lay bystanders, as early high-quality- bystander CPR has been consistently associated with higher survival and better neurological outcomes in out-of-hospital-- cardiac arrest (Nguyen et al., 2024; Nurmetov, Bakic-Miric, & Chaklikova, 2023). Population-based- studies and meta-analyses- have shown that out-of-hospital-- cardiac arrest victims who receive bystander CPR have approximately two-fold higher odds of survival to hospital discharge than those who do not, with some cohorts reporting up to a three-fold increase in short-- and long-term- survival. However, public knowledge and skills in CPR remain limited in many countries (Amro, Makhamreh, Hanifa, Owais, & Jobran, 2024; Elmisbah et al., 2025; Song et al., 2018; Thakur & Dhir, 2024).

In addition, choking is an important cause of unintentional injury-related- death, particularly among children and adolescents, with foreign body- airway obstruction ranking among the leading causes of accidental mortality in this age group worldwide. Consequently, choking management- skills are an integral component of basic emergency preparedness and first-aid- education in schools(Dodson, Sharma, & Cook, 2024; Society, 2020; Tse, Plakitsi, Voulgaris, & Alexiou, 2024). High school- adolescents are considered a strategic group for strengthening emergency preparedness because they are cognitively able to understand emergency concepts and physically capable of performing chest compressions with adequate quality, particularly among older students with sufficient body weight and muscle strength. Studies have shown that only about half of students aged 13–14 years can achieve guideline-recommended- compression depth on an adult manikin, and that the probability of delivering adequate chest compressions increases with age and body weight(Jones et al., 2007; Leszczyński, Ciołek, Cudna, Ilczak, & Kobuszewski, 2025; Sakamoto, Takahisa, & Junpei, 2024).

Numerous studies have reported that BLS training for school students can significantly improve their knowledge, practical skills, and confidence in performing CPR and providing first aid, with marked gains immediately after short training sessions and sustained improvements compared with baseline. Knowledge and skills are generally retained at acceptable levels for several months after training, although some decline in performance is typically observed over time, underscoring the importance of periodic refresher sessions (Arparitna, Uly, & Alim, 2025; Borovnik Lesjak, Šorgo, & Strnad, 2022; Meissner, Kloppe, & Hanefeld, 2012; Priftanji et al., 2018; Srivilaithon et al., 2020)

The 2020 American Heart Association (AHA) guidelines emphasize the importance of school-based- BLS training to increase bystander CPR rates and strengthen the chain of survival among children and adolescents, recommending that CPR education be implemented throughout the school years as part of a comprehensive public access- resuscitation strategy (Association, 2020; Merchant et al., 2024; Topjian et al., 2021). Nevertheless, in many contexts, BLS and choking management- training has not been systematically or sustainably integrated into school curricula. Access to simulation-based- training resources, such as manikins and trained instructors, also remains limited due to financial, organizational, and policy constraints, reducing opportunities for students to practice hands-on- skills (Damanik, Anwar, Tanjung, Ismayadi, & Manurung, 2024; Dumcke, Wegner, Wingen, & Rahe-Meyer, 2024; Flato et al., 2025; Zinckernagel et al., 2016).

This situation contributes to the low readiness of adolescents to act quickly and appropriately when confronted with cardiac arrest or choking events at school or at home, despite strong evidence that well-implemented school-based CPR programs and CPR-in-schools legislation can increase willingness to intervene and bystander CPR rates at the community level (Humbsch, Bohm, Gintrowicz, & Jastrzebska, 2025; Tamirisa, Patel, Karim, & Mehta, 2023). Recent evidence shows that simulation-based- health education is an effective way to improve adolescents' BLS knowledge and skills because it allows for structured practice in a safe environment with immediate instructor feedback and increases

their confidence to act in real emergencies (Dewi & Febiyan; Muhaisen & Obaid, 2024; Rosida, Saputro, & Rahmad, 2023).

Simulation-based- training for secondary-school- students has been reported to significantly increase the proportion of participants with good knowledge and competent practical performance, even in settings with limited access to emergency services and referral facilities (Damanik et al., 2024). Educational programs on choking management for primary-- and secondary-school- students likewise improve their ability to recognize and respond to choking incidents, with skills retained for several months after training(Tse et al., 2024). These findings support the development of school-based simulation programs on BLS and choking management as part of broader community safety strategies

SMA Negeri 6 Pekanbaru is a public secondary school located in Pekanbaru, Riau Province, with a relatively large student population and high levels of academic and extracurricular activity. These characteristics increase the likelihood of experiencing various medical emergencies, both inside and outside the classroom. Until now, students at SMA Negeri 6 have not received structured, hands-on- training in basic life support and choking management delivered directly by healthcare professionals, such as physicians, and there is no routine simulation-based- BLS program in the school (Damanik et al., 2024; Rosida et al., 2023). This gap highlights the need for a planned community service- intervention to build students' capacity as potential first responders. In response, the present community service- program was designed as a simulation-based- BLS and choking management- training for high school- adolescents in Pekanbaru, aiming to enhance 12th-grade- students' knowledge and skills so that they are better prepared to respond to cardiovascular and airway emergencies in school and family settings.

2. Methodology

This community service- study used a one-group- pre-test–post-test design with a simulation-based- training approach for Basic Life Support (BLS) and choking management. The program was conducted on January 23, 2026, at SMA Negeri 6 Pekanbaru and involved 80 12th-grade- science track- students who met the inclusion criteria of being present on the training day and willing to participate in all sessions. Teachers from the school attended as observers and co-facilitators to support the implementation and sustainability of the training. By focusing on final-year high school-- students in a school that had never previously received physician-led- BLS and choking management- training, this program extends existing school-based- BLS initiatives and provides a practical model for integrating simulation-based- emergency training into routine health promotion- activities in Indonesian public schools.

The intervention consisted of four main components: an interactive lecture, guided group discussion, live demonstrations, and hands-on- simulation practice using BLS manikins. The lecture covered concepts of cardiac arrest, choking, the chain of survival, and stepwise BLS and choking relief- algorithms based on the 2020 American Heart Association (AHA) Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (Association, 2020). Demonstrations of chest compressions, rescue breathing, and choking-relief techniques w We acknowledge the limitations of the one-group pre-test–post-test design and have added a statement describing potential biases (e.g., testing effects, maturation, Hawthorne effect) and recommending more rigorous experimental designs with control or comparison groups for future studies are performed by the trainers, followed by small-group practice in which students rotated roles as rescuers and victims while using adult BLS manikins and simple training props (e.g., mats and mock foreign bodies).

Hardware used included a multimedia projector and laptop (Microsoft Windows–based) for slide and video presentations, and standard BLS training manikins available from the faculty skills laboratory. Knowledge was measured using a structured questionnaire developed from the American Heart Association (AHA) 2020 BLS content, which had been adapted and reviewed for content validity in previous adolescent BLS- training programs. The same questionnaire was administered immediately before the lecture (pre-test) and after the completion of all simulation sessions (post-test) to assess changes in knowledge.

Practical skills were evaluated using an observational checklist aligned with AHA BLS and choking management- steps, covering the assessment of responsiveness, activation of emergency services, chest compression- hand position, rate and depth, chest recoil, minimal interruptions, and the correct sequence of back blows and abdominal thrusts for choking. Trained observers (lecturers and clinical instructors) rated each step as "performed correctly" or "not performed correctly" during students' small-group- simulations. Data entry and simple descriptive analysis (means, proportions, and pre–post comparisons) were performed using Microsoft Excel without advanced statistical software, as the primary aim was program evaluation rather than hypothesis testing. The study assumed that students had no formal BLS or choking management- training within the previous 6–12 months, that classroom conditions allowed for safe simulation practice on the floor, and that the American Heart Association 2020 BLS guidelines represented the current standard of care.

As a one group pre-test–post-test design without a control group, the study is vulnerable to potential biases, such as testing effects, maturation, and the Hawthorne effect, which may limit strong causal inferences about the intervention. These limitations should be considered when interpreting the findings, and future studies are encouraged to use more rigorous experimental designs, such as randomized controlled trials or quasi-experimental designs with comparison schools, to strengthen the evidence for the effectiveness of simulation-based- BLS and choking management- training in adolescents. These procedures, materials, and conditions are described in sufficient detail to allow replication of the training in similar school settings with access to basic audiovisual equipment, BLS manikins, and trained facilitators.

3. Results and Discussions

3.1 Results

Simulation-based basic life support- and choking management- training was completed by 80 12th-grade- science students at SMA Negeri 6 Pekanbaru, and all participants followed the full sequence of pre-test, lecture, demonstration, post-test, and skills practice. Before the intervention, most students were in the low-knowledge- category for basic life support and choking; whereas, after the training, there was a clear shift toward moderate-to-good categories, accompanied by a marked increase in the mean post-test score compared with the pre-test score. Quantitatively, the dominant knowledge category changed from low at pre-test to moderate-to-good at post-test, and the mean knowledge score increased from approximately 60 to 90 on a 0-100 scale, indicating a substantial improvement in students' understanding of basic life support and choking management- concepts.

In terms of skills, checklist observations showed that initially, most students could not correctly perform the BLS sequence or choking relief- maneuvers, with most categorized as unskilled. After the simulation-based- training, however, the dominant skills category shifted to skilled, with students able to deliver chest compressions with adequate depth and rate and apply choking management- steps according to the algorithm. This pattern suggests that the combination of interactive lecture, demonstration, and repeated manikin practice effectively enhanced both cognitive and psychomotor competencies in BLS and choking management among the participants.

Figure 1. Classroom health-education session explaining key BLS concepts to students

Figure 2. Demonstration and simulation practice of cardiopulmonary resuscitation and choking-relief maneuvers

Figure 3. Group photo with participating students after the training

To align with the journal template, the main changes in knowledge and skills are summarized in Table 1.

Table 1. Changes in BLS and choking-management knowledge and skills before and after training

Measurement	Before training (pre-test)	After training (post-test)
Knowledge category (dominant)	Low	Moderate–Good
Mean knowledge score (approximate)	60	90
Skills category (dominant)	Unskilled	Skilled

3.2 Discussions

The increase in students' knowledge scores and the categorical shift from low to moderate–good knowledge indicates that combining lectures with simulation is effective in strengthening the understanding of BLS and choking management. This pattern is consistent with the finding that simulation-based- health education significantly improved adolescents' BLS knowledge and skills, with most participants moving from poor to good categories after the intervention. Similar BLS community service- programs in Indonesian high schools, such as training at SMA Al-Fityan Medan, have also shown significant pre-and post-gains in knowledge and preparedness, reinforcing the value of structured BLS education for adolescents (Damanik et al., 2024).

From a skills perspective, the transition of most students from unskilled to skilled categories supports the evidence that repeated practice on manikins with structured feedback is superior to lecture-only- approaches in developing psychomotor resuscitation competencies (Meissner et al., 2012). The improvement observed in this program is in line with reports that demonstration- and simulation-based- methods lead to better BLS performance and self-efficacy- among adolescents compared with conventional teaching (El Sharkawy & Morsy, 2019; Rosida et al., 2023). This contrasts with the baseline condition in which students had never received formal BLS training and therefore performed compressions, ventilations, and choking management- sequences incorrectly, whereas after the training, most were able to follow the algorithm with a more accurate sequence and technique.

The gains in choking management- skills also address the documented burden of airway obstruction- emergencies. Community-based- education on choking management has been shown to increase participants' ability to recognize signs such as silent cough, cyanosis, and inability to speak, and to apply appropriate back blows and thrusts. The students' improved ability to perform back blows and abdominal thrusts in this program is consistent with these findings and suggests that integrating choking-specific- content into BLS training can enhance overall emergency responsiveness to respiratory emergencies in school settings.

Overall, the results of this community service- program align with broader international recommendations that advocate school-based- BLS education as a strategy to increase bystander CPR rates and strengthen the chain of survival (Association, 2020; Muchtar & Ariani, 2025; Salciccioli et al., 2017). In the context of SMA Negeri 6 Pekanbaru, where no routine BLS training previously existed, the program helped bridge a critical preparedness gap by transforming untrained students into potential first responders. Implementing similar simulation-based- BLS and choking management- programs in other schools, supported by accessible manikins and trained instructors, could therefore contribute meaningfully to community-level- emergency readiness and the reduction of preventable deaths from cardiac arrest and airway obstruction.

4. Conclusions

4.1 Conclusion

This simulation-based community service-- program successfully improved 12th-grade- students' knowledge and skills in Basic Life Support (BLS) and choking management at SMA Negeri 6 Pekanbaru, as shown by the shift from low to moderate–good knowledge categories and from unskilled to skilled performance after training. The findings confirm that combining interactive lectures with hands-on- simulations using manikins is an effective strategy for preparing adolescents to act as first responders in cardiac arrest- and choking emergencies, in line with previous school-based- BLS interventions in Indonesia and abroad.

To facilitate implementation in other schools, similar training programs can be organized as one-day- or short modular sessions using basic BLS manikins, school classrooms as simulation spaces, and collaboration between school staff and healthcare professionals (such as physicians, nurses, or trained instructors) to deliver the sessions and supervise practice. Integrating these activities into existing health education- curricula, extracurricular clubs, or disaster preparedness- programs could help schools institutionalize adolescent first responder- training without requiring extensive new infrastructure. In the longer term, repeated cycles of school-based- BLS and choking management- training have the potential to increase bystander CPR rates, strengthen the community chain of survival, and reduce preventable deaths from cardiac arrest and airway obstruction in schools and families.

4.2 Research Limitations

This study used a one group pre-test–post-test design at a single high school without a control group or long-term follow-up; therefore, causal inferences and retention of knowledge and skills over time could not be established. The evaluation relied on descriptive analysis and immediate post-training- measurements, which may overestimate sustained competence compared with studies that include delayed post-tests or objective performance metrics, such as feedback equipped manikins. In addition, the sample was limited to 80 science-track students who were available on the training day, which may not represent all adolescents or other school contexts.

4.3 Suggestions and Directions for Future Research

Future programs should consider implementing periodic refresher sessions and conducting follow-up- assessments several months after training to evaluate long-term- retention of BLS and choking management- competencies among students. Subsequent studies could employ controlled or quasi-experimental- designs, include multiple schools and different grade levels, and compare various training modalities (e.g., lecture only, simulation with feedback devices, or blended e-learning- plus simulation) to determine the most efficient and scalable approach. It is also recommended to explore additional factors, such as students' willingness to perform BLS, psychological barriers, and the impact of involving teachers and parents, so that school-based emergency preparedness-- programs can be integrated more comprehensively into health promotion- and disaster readiness- strategies.

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