Effectiveness of Simulation-Based Health Education on Adolescents' Basic Life Support Knowledge and Skills

Lale Wisnu Andrayani[1], Chandra Irawan[1], Hadi Kusuma Atmaja[1], Yellin Agustintia[1]

[1] Politeknik Kesehatan Kementerian Kesehatan Mataram, Mataram, Indonesia

ABSTRACT

Introduction: Sudden cardiac arrest is a medical emergency that requires immediate intervention in the form of Basic Life Support (BLS). Adolescent knowledge and skills in performing BLS are crucial, especially in areas with limited access to emergency services. This research to assess the effect of simulation-based health education on adolescents' knowledge and skills in performing BLS at Junior High School.

Methods: This study used a pre-experimental design with a One-Group Pretest-Posttest approach. A total of 52 students were randomly selected using simple random sampling. Data were collected through questionnaires and skills checklists, and analyzed using the Wilcoxon Signed Rank Test. In this study, the independent variable is the simulation-based health education provided to adolescents, which serves as the intervention aimed at improving their preparedness in emergency situations. The dependent variables are the adolescents' knowledge and skills in performing Basic Life Support (BLS).

Results: Prior to the intervention, all participants (100%) had low knowledge and skills in BLS. After the intervention, 83% of participants had good knowledge, and 56% were skilled in performing BLS. Statistical analysis revealed a significant improvement in both knowledge and skills (p=0.000).

Conclusion: Simulation-based health education significantly improved adolescents' knowledge and skills in BLS. Future research is recommended to involve larger and more diverse populations, such as students from different educational levels (elementary, high school, or university) or adolescents from rural and urban areas, to compare the effectiveness of simulation-based health education across settings.

1. INTRODUCTION

Cardiac arrest is a life-threatening emergency that requires immediate intervention in the form of Basic Life Support (BLS). The success of BLS is highly time-dependent, with the "golden hour" emphasizing that the first few minutes, particularly within 4–6 minutes after cardiac arrest to prevent irreversible brain damage and increase survival chances (Takei et al., 2024). Early recognition, emergency activation, and immediate cardiopulmonary resuscitation form the foundation of the survival chain (Nolan & Hassager, 2021). In Indonesia, especially in remote areas, there remains a significant gap in access to timely medical services, which makes the role of laypersons, including adolescents, crucial in providing early BLS interventions (Pranata et al., 2020). Unfortunately, public understanding and skills in performing BLS are still limited, resulting in many cases where life-saving actions cannot be carried out when urgently needed. This highlights the importance of strengthening community-based health education and practical

training, particularly among school-aged populations, to improve preparedness and response during cardiac arrest and other medical emergencies (Saha et al., 2023).

Based on data from the World Health Organization (WHO) in 2024, there were 57.03 million deaths recorded globally. Among these, around 35,000 to 50,000 were caused by accidents and natural disasters, with the leading underlying factors being respiratory and cardiac arrest (Syahferi Anwar et al., 2024). In Indonesia, statistics from the Institute for Health Metrics and Evaluation (IHME) reported a mortality rate of 251.09 per 100,000 population due to cardiac arrest in 2023. This figure reflects an increase of 1.25% compared to the previous year, which recorded 247.99 deaths per 100,000 population (Sholikhah et al., 2024). Due to the high incidence of cardiac arrest in Indonesia, there is a need for prompt and appropriate intervention by laypersons who possess the knowledge and skills of Basic Life Support (BLS), including junior high school adolescents (Rosida et al., 2023). The role of junior high school adolescents in handling cardiac arrest cases is highly significant, as they can provide the immediate assistance needed to prevent more severe injury or even death in individuals experiencing sudden cardiac arrest. At this age, adolescents are capable of understanding basic health concepts and applying simple, structured emergency procedures when provided with appropriate training and education (Olivia et al., 2023). When a cardiac arrest occurs, every second is critical, and the presence of bystanders who are able to perform Basic Life Support (BLS) can greatly influence the outcome (Nolan & Hassager, 2021). Adolescents, particularly those in junior high school, often spend a considerable amount of time in social and community environments such as schools, sports fields, and public spaces where emergencies may occur. Their ability to recognize the signs of cardiac arrest, call for emergency assistance, and initiate life-saving interventions such as chest compressions or airway management can make the difference between life and death (Chilappa et al., 2021). Furthermore, empowering adolescents with these skills not only enhances community preparedness but also builds a culture of health awareness and responsibility from a young age. In the context of limited access to immediate medical services, especially in rural or resource-constrained areas, the involvement of adolescents becomes even more critical, as they may be the first responders before professional help arrives. Therefore, equipping junior high school students with the knowledge and practical skills of BLS is an essential step toward improving survival rates in cardiac arrest cases and fostering a generation that is better prepared to respond effectively in emergency situations (Unnikrishnan & Stanly, 2022).

One effective way to improve knowledge and skills in Basic Life Support (BLS) is through the use of simulation-based learning, which has several distinct advantages over traditional teaching methods (Atmaja et al., 2023). Simulation provides learners with the opportunity to practice in a safe, controlled environment that closely replicates real-life emergency scenarios without posing any risk to actual patients. By engaging in hands-on practice, students are able to strengthen their cognitive understanding of BLS procedures while simultaneously developing the psychomotor skills required to perform critical tasks such as chest compressions, rescue breathing, and airway management. This experiential approach not only enhances technical competence but also helps to build confidence, reduce anxiety, and improve readiness to act in real emergencies (Daniel & Daniel, 2020). Furthermore, simulation-based training allows for immediate feedback and correction from instructors, enabling participants to identify mistakes and refine their performance in real time. Another advantage of simulation is its ability to engage learners actively, making the educational process more interactive, memorable, and effective compared to passive learning methods such as lectures or reading materials (Mohebi et al., 2018). Research has consistently shown that simulation-based education is superior in improving both short-term and long-term retention of emergency care skills, including BLS, and is particularly effective among adolescents who benefit from practical, experiential learning approaches. Thus, incorporating simulation into health education programs represents a highly valuable strategy for strengthening knowledge, developing skills, and ultimately improving preparedness in life-threatening situations such as cardiac arrest.

2. METHODS

Study Design

This study employed a One-Group Pretest-Posttest design with a quantitative approach to measure changes in students' knowledge and skills before and after the simulation-based health education intervention. The research was conducted from April to May 2024 at SMPN 3 Lingsar, Lombok Barat.

Population, Samples, and Sampling

The inclusion criteria for respondents in this study were adolescents aged 12–15 years who were actively enrolled at SMPN 3 Lingsar during the research period. Participants had not received any formal Basic Life Support (BLS) training within the past 6–12 months, were able to communicate in Indonesian and follow instructions, and had obtained both parental or guardian consent as well as their own assent. In addition, they were required to be available throughout all stages of the study, including the pretest, simulation sessions, and posttest assessments. The exclusion criteria included students who did not provide assent or whose parents did not provide consent, those who were absent during the

intervention or posttest leading to incomplete data, and students with medical conditions that contraindicated participation in CPR practice, such as recent musculoskeletal injuries, cardiopulmonary disease, or chest surgery. Adolescents with documented cognitive or learning impairments that hindered participation, those who had completed advanced BLS or first-aid certification within the last 6–12 months, or students who transferred or withdrew before study completion were also excluded.The population consisted of 110 students from SMPN 3 Lingsar. A total of 52 students were randomly selected using simple random sampling, with inclusion criteria: students in good health and willing to participate in the training.

Instruments

In this study, two instruments were utilized to measure the outcomes of the intervention. The first was a Knowledge Questionnaire, which assessed students' understanding of Basic Life Support (BLS) both before and after the simulation-based health education. The questionnaire consisted of structured questions adapted from standardized BLS training guidelines developed by the American Heart Association (AHA, 2020), covering essential aspects such as recognizing cardiac arrest, steps of CPR, airway management, and the importance of contacting emergency services. The second instrument was a Skills Checklist, designed to evaluate the participants' practical abilities in performing BLS procedures. This checklist was based on the performance standards outlined in the AHA 2020 Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, and included specific steps such as assessing responsiveness, calling for help, initiating chest compressions with correct depth and rate, delivering rescue breaths, and managing airway obstruction

Procedure

The health education intervention was delivered using a simulation-based learning approach that combined visual demonstration and practical application. The session began with the provision of theoretical material through video demonstrations, which clearly illustrated each step of Basic Life Support (BLS), including the sequence of assessing a victim, ensuring scene safety, performing cardiopulmonary resuscitation (CPR), managing airway obstruction, and contacting emergency services. After watching the video, students were given the opportunity to observe a live demonstration by the facilitator to reinforce the key concepts and correct techniques.

Following this, participants engaged in guided hands-on practice using medical mannequin to simulate real-life scenarios. Each student practiced chest compressions, rescue breaths, and the procedure for relieving choking under the supervision of trained instructors. Immediate feedback and correction were provided to ensure accuracy in technique and to build confidence. The practice was conducted in small groups to maximize individual participation and allow closer supervision.

Data Analysis

The Wilcoxon Signed Rank Test was used to compare pretest and posttest results for knowledge and skills. A significance level of $p < 0.05$ was considered significant. Data analysis was performed using SPSS version 25.

Ethical Clearence

This study obtained ethical clearance from the Health Research Ethics Committee, ensuring that all research procedures were conducted in accordance with ethical principles and the protection of participants' rights. Anonymity and confidentiality of participants were strictly maintained, and the principle of non-maleficence was upheld by ensuring that the intervention posed no harm to the respondents. Autonomy was respected by providing both students and their parents/guardians with clear information about the study, and informed consent was obtained prior to participation.

3. RESULTS

A total of 52 students participated in the study, with the majority being male (62%) and the rest

Table 1. Respondents Characteristics based on Age and Gender

Characteristics	(f)	(%)
Age		
12 years	10	19,2
13 years	18	34,6
14 years	16	30,8
15 years	8	15,4
Gender		
Male	32	62
Female	20	38

Table 2. Knowledge Distribution Before and After Intervention

Knowledge Category	Before Intervention (f)	After Intervention (f)	Percentage Increase (%)
Good	0	43	83
Fair	0	9	17
Poor	52	0	0

Table 3. Skills Distribution Before and After Intervention

Skills Category	Before Intervention (f)	After Intervention (f)	Percentage Increase (%)
Skilled	0	29	56
Moderate	0	23	44
Unskilled	52	0	0

female (38%). The average age of the participants was 13.5 years. Before the intervention, all participants had poor knowledge of BLS (100%). After the simulation, 83% of students showed a significant increase in knowledge, reaching the good category, while 17% achieved the fair category. The skills assessment revealed that before the intervention, none of the participants were skilled in performing BLS. However, after the simulation-based training, 56% of students were deemed skilled, while 44% were moderately skilled. The Wilcoxon Signed Rank Test showed a significant improvement in knowledge ($Z = -6.123$; $p = 0.000$) and skills ($Z = -5.432$; $p = 0.000$) following the simulation, indicating that the intervention was effective in enhancing both variables.

4. DISCUSSION

The results of this study demonstrate that simulation-based health education effectively improves adolescents' knowledge and skills in BLS. These findings are consistent with prior studies by Maria et al. (2024) which highlighted that there was an increase in knowledge, attitudes and skills regarding essential life support from BLS training to adolescents. This is because students were given theoretical instruction on how to perform Basic Life Support (BLS) during the safety stage, accompanied by training sessions designed to enhance their practical skills. According to research form Syahferi Anwar et al. (2024) the BLS training significantly improved students' knowledge and skills in Basic Life Support (BLS). Before the training, most students had only basic or limited understanding, but afterwards they showed a much stronger grasp of BLS concepts and techniques. Their practical abilities also improved, as observed in their increased confidence and accuracy when performing BLS procedures. Feedback and post-training surveys further confirmed that students gained greater awareness and understanding of when and how to apply BLS, demonstrating the effectiveness of the training.

Prior to the intervention, all students had low knowledge and skills, indicating that they had not received adequate training. After participating in the simulation, the majority of students showed significant improvement in practical BLS skills. This suggests that simulation allows participants to practice in a realistic yet safe environment, thereby boosting their confidence in handling emergency situations. Research consistently demonstrates that simulation-based learning provides superior outcomes in enhancing Basic Life Support (BLS) knowledge and skills compared to conventional teaching approaches. In line with Atmaja et al. (2023) that the use of educational simulation significantly improved nursing students' BLS performance. Similarly, Maria et al. (2024) found that medical students who engaged in simulated practice performed better and demonstrated higher retention levels than those who received only theoretical

instruction. Daniel & Daniel (2020) also highlighted the effectiveness of simulation by showing notable improvements in both knowledge and practical skills among fire and rescue personnel following simulation-based BLS training using mannequin equipped with feedback devices. Furthermore, a systematic review by Abuejheisheh et al., (2023), which analyzed 11 randomized controlled trials, reinforced the superiority of blended learning strategies that incorporate simulation over traditional face-to-face teaching, especially in terms of long-term knowledge retention and skill mastery. These findings align with the results of the present study, which similarly demonstrated that simulation through demonstration was effective in improving adolescents' understanding and performance of BLS (Bakhtavar et al., 2021; Hansen et al., 2020). In the context of junior high school students, demonstration is particularly effective because adolescents at this stage are in a developmental phase where learning through observation, imitation, and direct experience is highly impactful. The visual and practical nature of demonstration helps them translate abstract theoretical concepts into concrete actions, while repeated practice builds both confidence and competence. From the author's perspective, demonstration also reduces anxiety by providing a clear model to follow, enabling students to feel more capable and motivated to apply BLS techniques in real-life emergency situations.

Junior high school adolescents who possess the knowledge and skills of Basic Life Support (BLS) can play a vital role in saving lives and providing immediate assistance to victims of cardiac arrest. At the scene of an emergency, especially in environments where access to medical professionals or emergency services may be delayed, the ability of adolescents to recognize the signs of cardiac arrest and perform timely interventions such as calling for help, administering chest compressions, and managing the airway can make the difference between life and death. In line with research from Juariah & Purwaningsih (2022) that BLS training produces significant improvements in adolescents' knowledge and skills before and after training interventions. Their preparedness not only increases the chances of survival for the victim but also reduces the risk of severe complications caused by delayed treatment (Boné et al., 2023; Hasegawa & Hanaki, 2023). Moreover, empowering adolescents with BLS competence fosters a sense of responsibility, confidence, and readiness to act in critical situations, making them valuable first responders within their school and community settings. In this way, adolescents are not merely passive bystanders but can actively contribute to improving outcomes in cases of cardiac arrest by delivering essential, life-saving care (Schroeder et al., 2023). This suggests that demonstration-based simulation not only strengthens cognitive understanding but also fosters the psychomotor readiness needed for effective emergency response among adolescents. The success

of this training can be replicated in other schools, particularly in areas with limited access to emergency medical services. By training students in BLS, they are more likely to provide life-saving first aid in cases of sudden cardiac arrest before professional medical help arrives.

5. CONCLUSION

Simulation-based health education has been proven to significantly improve adolescents' knowledge and skills in performing Basic Life Support (BLS). This method is recommended to be integrated into school curricula to enhance emergency preparedness and equip adolescents with life-saving skills in cases of sudden cardiac arrest. Future research is recommended to involve larger and more diverse populations, such as students from different educational levels (elementary, high school, or university) or adolescents from rural and urban areas, to compare the effectiveness of simulation-based health education across settings.

REFERENCE

Abuejheisheh, A. J., Alshraideh, J. A., Amro, N., Bani Hani, S., & Darawad, M. W. (2023). Effectiveness of blended learning basic life support module on knowledge and skills: A systematic review of randomized controlled trials. *Heliyon*, *9*(11), e21680. https://doi.org/10.1016/j.heliyon.2023.e21680

Atmaja, H. K., Ningsih, M. U., Luthfia, E., Hasbi, M., & Pranata, S. (2023). Effective Simulation Methods Improve Student Skills in Performing Basic Life Support. *Journal of Health Sciences*, *16*(02), 149–156. https://doi.org/10.33086/jhs.v16i02.3788

Bakhtavar, H. E., Allahyari, R., Heidari, M., & Rahmani, F. (2021). Effect of Basic Life Support Training on Knowledge and Performance of High School students. *Journal of Research in Clinical Medicine*. https://doi.org/DOI:10.34172/jrcm.2021.040

Boné, M. A., Loureiro, M. J., & Bonito, J. (2023). Quality Learning in Basic Life Support in Portuguese Basic Education School: A Cross-Sectional Study with 10th Grade Students. *Societies*, *13*(6). https://doi.org/10.3390/soc13060147

Chilappa, R., Waxman, M. J., & M.D., M. (2021). Knowledge in High School Students M EDIC I NE. *Kansas Journal of Medicine*, 38–41.

Daniel, R., & Daniel, E. A. (2020). Impact of simulation-based training on basic life support in improving the knowledge and skills of fire and rescue services personnel. *National Journal of Physiology, Pharmacy and Pharmacology*, *10*, 478–483. https://doi.org/10.5455/njppp.2020.10.03075202030032020

Hansen, C., Bang, C., Rasmussen, S. E., Nebsbjerg, M. A., Lauridsen, K. G., Bomholt, K. B., Krogh, K., &

Løfgren, B. (2020). Basic life support training: Demonstration versus lecture - A randomised controlled trial. *The American Journal of Emergency Medicine*. https://doi.org/DOI:10.1016/j.ajem.2019.06.008

Hasegawa, Y., & Hanaki, K. (2023). Factors Related to Young People's Willingness to Perform Basic Life Support. *Yonago Acta Medica*, *66*(1), 120–128. https://doi.org/10.33160/yam.2023.02.014

Juariah, J., & Purwaningsih, I. (2022). The Effect of Basic Life Support Training on the Knowledge and Skills of Adolescents. *KnE Life Sciences*, *2022*, 421–426. https://doi.org/10.18502/kls.v7i2.10336

Maria, I., Wardhani School of Nursing, A., Tinggi Ilmu Kesehatan Intan Martapura, S., & Samadi No, J. (2024). *Empowering Youth: the Impact of Basic Life Support (Bls) Training on Knowledge, Skills, and Attitude Development in Adolescents*. *6*(December), 33–40. https://doi.org/10.37287/ijghr.v6iS6.4172.

Mohebi, S., Parham, M., Sharifirad, G., & Gharlipour, Z. (2018). *Social Support and Self - Care Behavior Study*. *January*, 1–6. https://doi.org/10.4103/jehp.jehp

Nolan, J. P., & Hassager, C. (2021). Out-of-hospital cardiac arrest. *The ESC Textbook of Intensive and Acute Cardiovascular Care*. https://doi.org/DOI:10.1093/MED/9780198849346.003.0009

Olivia, N., Syafrinanda, V., Waruwu, W. A. K., Sibarani, H. J., & Hasyim, P. H. (2023). Junior High School Training for Basic Life Support At Bakti 2 Private Scool Medan. *EJOIN : Jurnal Pengabdian Masyarakat*, *1*(4), 182–187. https://doi.org/10.55681/ejoin.v1i4.680

Pranata, R., Wiharja, W., Fatah, A., Yamin, M., & Lukito, A. A. (2020). General population's eagerness and knowledge regarding basic life support: A community based study in Jakarta, Indonesia. *Clinical Epidemiology and Global Health*, *8*, 567–569. https://doi.org/10.1016/j.cegh.2019.12.004

Rosida, N. A., Saputro, S. D., & Rahmad, M. N. (2023). Simulation of Basic Life Support (BLS) Training in Improving Self-Efficacy of Cardiac Arrest First Aid in Adolescents Home Mental Revolution WCS. *Jurnal Kreativitas Pengabdian Kepada Masyarakat (PKM)*, *6*(11), 4437–4448. https://doi.org/10.33024/jkpm.v6i11.11939

Saha, M., Chowdhury, D., Banerjee, P., Ray, S., & Paul, K. K. (2023). A comparative study of efficacy and effects on intraocular pressure following treatment with topical loteprednol vernal keratoconjunctivitis. *MRIMS Journal of Health Sciences*, *Aug*, 1–5. https://doi.org/10.4103/mjhs.mjhs

Schroeder, D. C., Semeraro, F., Greif, R., Bray, J. E., Morley, P. T., Parr, M., Nakagawa, N. K., Iwami, T., Finke, S.-R., Hansen, C. M., Lockey, A. S., del

Rios, M., Bhanji, F., Sasson, C., Schexnayder, S. M., Scquizzato, T., Wetsch, W. A., & Böttiger, B. W. (2023). KIDS SAVE LIVES: Basic Life Support Education for Schoolchildren: A Narrative Review and Scientific Statement From the International Liaison Committee on Resuscitation. *Circulation*, *147*, 1854–1868. https://doi.org/DOI:10.1161/CIR.0000000000 001128

Sholikhah, A. S., Susilo, C., & Hamid, M. A. (2024). Pengaruh Pendidikan Kesehatan Resusitasi Jantung Paru Terhadap Kemampuan Penangan Pre Hospital Korban Henti Jantung Pada Karangtaruna Di Kecamatan Balung. *ASSYIFA : Jurnal Ilmu Kesehatan*, *2*(2), 250–255. https://doi.org/10.62085/ajk.v2i2.69

Syahferi Anwar, Tanjung, D., Damanik, B. N., Sianturi, M. I. B., Lubis, I. A. P., & Padang, A. (2024). Education Of Knowledge And Basic Life Support Training For Teenage Students. *Jurnal Pengabdian Masyarakat Sapangambei Manoktok Hitei*, *4*(2), 155–160. https://doi.org/10.36985/nc678661

Takei, Y., Toyama, G., Takahashi, T., & Omatsu, K. (2024). Optimal duration and timing of basic-life-support-only intervention for patients with out-of-hospital cardiac arrest. *Scientific Reports*, *14*(1), 1–9. https://doi.org/10.1038/s41598-024-56487-3

Unnikrishnan, R., & Stanly, S. (2022). Basic Life Support Skills for high school students pre and post-cardiopulmonary resuscitation training-An interventional study. *Indian Journal of Respiratory Care*, *6*(1), 786–790. https://doi.org/10.5005/jp-journals-11010-06109