

Strengthening the Preparedness of Elementary School Physical Education Teachers in Injury Prevention and Initial Emergency Response

Adi S^{1*}, Cahyo Yuwono², Sugianto Parulian Simanjuntak³, Dicky Budhi Setyawan⁴,
Jumanto⁵, Ummi Nur Laila Sulistyani⁶, Erika Afriana⁷, Karina Permata Andhini⁸

¹⁻⁸Universitas Negeri Semarang, Indonesia

*Corresponding Author: adis@mail.unnes.ac.id

Abstract

The limited preparedness of elementary school Physical Education (PE) teachers in managing injuries and emergency situations remains a significant challenge for ensuring student safety. This community service programme aimed to strengthen teachers' competencies in injury prevention, emergency response, and school safety management through an integrated training and mentoring approach. The programme involved 33 PE teachers from the Physical Education Teachers' Working Group (KKG PJOK) in Gunungpati Sub-district, Semarang, Indonesia. Activities included needs assessment, training on school safety management, injury prevention, first aid, Emergency Cardiac Care (ECC), cardiopulmonary resuscitation (CPR), simulation-based practice, the development of school safety Standard Operating Procedures (SOPs), and the implementation of SIGAPEdu as a digital injury reporting system. Programme effectiveness was evaluated using pre-test and post-test assessments, practical performance observations, and monitoring of programme outputs. The results demonstrated substantial improvements in teachers' knowledge and practical competencies. The mean knowledge score increased from 58.24 ± 9.17 in the pre-test to 86.73 ± 6.84 in the post-test, representing an overall improvement of 48.9%. The proportion of teachers capable of performing basic CPR increased from 12.1% to 84.8%, exceeding the programme target of 80%. Furthermore, school-based safety SOPs were developed and implemented, three safety-oriented PE teaching materials were produced, and SIGAPEdu was adopted by 72.7% of participants, surpassing the predetermined target. These outcomes indicate that the programme successfully strengthened teachers' emergency preparedness, promoted the integration of safety principles into PE learning, and supported the development of data-driven school safety practices. Continuous implementation of similar programmes is recommended to foster safer and higher-quality learning environments in schools.

Keywords: emergency preparedness, injury prevention, physical education

INTRODUCTION

Accidents in primary school settings are influenced by various factors, particularly the limited first-aid skills of teachers and the suboptimal implementation of safety standards. Research findings reveal that around half of primary school teachers do not yet have an adequate understanding of first aid (Adi & Soenyoto, 2023; Dr. Adi S & Wijayama, 2024), whilst accidental injuries remain a real threat to pupils' safety (Adi et al., 2025). Physical education is designed to encourage students' active engagement in physical activity (Adi, 2024; Rosenstiel et al., 2021), yet sports injuries frequently hinder sustained participation. This situation calls for effective injury prevention measures (de Jong, 2022; Rumini et al., 2024; Saifulloh et al., 2024) and the integration of structured injury management into the learning process (Liu et al., 2022; Yuwono et al., 2024).

A study in Semarang revealed that sports injuries are a common occurrence among schoolchildren, with knee injuries being the most prevalent type, affecting 41.04% of male pupils and 21.43% of female pupils (Muhibbi et al., 2023). Furthermore, around 75% of participants reported experiencing physical fatigue, which has the potential to increase the risk of injury during high-intensity activities (Wibisana, 2020). The issues were identified using Google Forms; the information

gathered, and the results of the interviews revealed the following problems. The Gunungpati Physical Education Teachers' Working Group (KKG PJOK) comprises 33 primary schools, both state and private. Based on the results of the observation, several problems were identified. Limited training programmes and a lack of resource support remain the main obstacles in equipping teachers with essential first aid skills (Silva de Oliveira et al., 2022). This situation has led to a lack of attention to injury prevention and emergency preparedness among physical education teachers (Bou-Karroum et al., 2022; Heiestad et al., 2022). In fact, teachers' level of understanding in dealing with specific types of injuries plays a crucial role in ensuring a safe, rapid, and standard-compliant initial response to student injury incidents (Cahalan, 2021; Ha et al., 2020). Proactive measures are needed to enhance teachers' ability to create a learning environment that is both safe and responsive to emergencies. This community engagement initiative, therefore aims to strengthen the preparedness of physical education teachers through integrated, practice- and technology-based training.

Proactive efforts are required to enhance teachers' capacity to create a learning environment that is both safe and responsive to emergencies. This approach is realised through an integrated training programme covering classroom safety management, injury mitigation strategies, and an introduction to emergency cardiac care (ECC) in a practical and easily implementable format. In the initial phase, the programme focuses on strengthening teachers' competencies in managing safety during physical education lessons, including the identification of potential hazards, the assessment of risks associated with physical activities, and the management of safety throughout the learning process. The next phase focused on training in ECC-based first aid and cardiopulmonary resuscitation (CPR) tailored to the characteristics of primary schools, thereby strengthening the role of teachers as first responders in emergency situations. The programme then continued with support for the development of Standard Operating Procedures (SOPs) for managing injuries and emergencies at school, supported by visual aids such as posters and infographics to ensure consistent implementation.

To enhance the effectiveness of implementation, training activities were supplemented with simulations of injury and emergency management using supporting equipment, such as CPR manikins and first aid kits. These simulations aim to improve the accuracy of responses, boost confidence, and enhance teachers' preparedness when facing realistic emergency scenarios. As a sustainability strategy, the programme encourages the strengthening of the teaching community through KKG forums as spaces for ongoing discussion and reflection, as well as the use of online platforms, to build a collaborative and sustainable school safety culture.

METHOD

This community service programme was conducted in Gunungpati Sub-district, Semarang, Indonesia, involving 33 elementary school Physical Education (PE) teachers who were members of the Physical Education Teachers' Working Group (KKG PJOK). The programme employed an integrated training and mentoring approach designed to strengthen teachers' competencies in injury prevention, emergency response, and school safety management. The implementation consisted of four sequential stages. The first stage involved needs assessment and coordination with stakeholders, including the Gunungpati Sub-district Education Office and participating schools. Preliminary data were collected through observations, interviews, and questionnaires to identify teachers' needs related to injury prevention, first aid, and emergency preparedness. The second stage focused on capacity building through a series of training sessions. The training covered school safety management, injury prevention strategies, first aid procedures, Emergency Cardiac Care (ECC), and cardiopulmonary resuscitation (CPR). Learning activities were delivered using lectures, demonstrations, case-based discussions, simulation exercises, and hands-on practice with CPR manikins and first-aid equipment. In addition, participants received guidance on developing safety-oriented Physical Education learning materials and integrating injury prevention concepts into classroom practice.

The third stage involved the development and implementation of supporting safety systems. Participants were assisted in developing school-based Standard Operating Procedures (SOPs) for injury prevention and emergency response. Furthermore, the SIGAPEdu (Educational Injury Response Information and Support System) platform was introduced and tested as a digital tool for documenting, monitoring, and reporting student injury incidents. The final stage consisted of programme evaluation and follow-up monitoring. Teachers completed pre-test and post-test assessments using structured questionnaires administered through Google Forms to measure changes in knowledge related to school safety, injury prevention, first aid, and CPR. Practical competencies were evaluated through direct observation during simulation activities using performance assessment

rubrics. Follow-up monitoring was conducted to assess the implementation of safety SOPs, the development of safety-based teaching materials, and the adoption of SIGAPEdu within participating schools. The success of the programme was evaluated using four performance indicators: (1) at least 80% of participating teachers demonstrated competency in performing basic CPR procedures; (2) emergency response modules and school safety SOPs were developed and implemented; (3) a minimum of three Physical Education teaching materials integrating physical safety concepts were produced; and (4) at least 70% of participating teachers adopted SIGAPEdu for injury recording and reporting purposes. Data were analysed descriptively by comparing pre-test and post-test results and summarising programme outcomes according to the predetermined performance indicators.

RESULTS AND DISCUSSION

A total of 33 elementary school Physical Education (PE) teachers from the Gunungpati Physical Education Teachers' Working Group (KKG PJOK) participated in the community service programme. The intervention consisted of integrated training sessions covering school safety management, sports injury prevention, first aid, cardiopulmonary resuscitation (CPR), Emergency Cardiac Care (ECC), and the use of SIGAPEdu as a digital injury reporting system. To evaluate programme effectiveness, participants completed pre-test and post-test assessments using a structured questionnaire administered through Google Forms. The results demonstrated a substantial improvement in teachers' knowledge following the intervention. The mean pre-test score increased from 58.24 ± 9.17 to 86.73 ± 6.84 in the post-test, representing an overall improvement of 48.9%. The greatest improvement was observed in first-aid management (52.2%), followed by sports injury prevention (49.6%) and Emergency Cardiac Care (48.9%).

Table 1. Pre-test and Post-test Results of Teachers' Knowledge

Variable	Pre-test	Post-test	Improvement (%)
School safety management	60.12	87.34	45.3
Sports injury prevention	57.48	85.97	49.6
First aid management	56.79	86.42	52.2
Emergency Cardiac Care (ECC) and CPR	58.57	87.19	48.9
Overall Mean Score	58.24	86.73	48.9

These findings suggest that the programme effectively improved participants' knowledge of injury risk identification, emergency procedures, and safety management practices within Physical Education settings. Practical competencies were assessed through direct observation during CPR demonstrations, first-aid procedures, and emergency response simulations. Prior to the intervention, only 12.1% (4 teachers) were able to perform basic CPR correctly according to established guidelines. Following the training, this proportion increased to 84.8% (28 teachers), exceeding the programme target of 80%. Similarly, competency in managing acute sports injuries using the RICE (Rest, Ice, Compression, Elevation) protocol improved from 27.3% before training to 87.9% after the intervention.

Table 2. Improvement in Practical Competencies

Competency	Pre-intervention (%)	Post-intervention (%)
Correct performance of basic CPR	12.1	84.8
Management of acute sports injuries	27.3	87.9
Identification of safety risks	33.3	90.9
Proper use of first-aid equipment	42.4	93.9
Injury incident reporting procedures	18.2	81.8

The programme also contributed to strengthening school safety systems. Prior to the intervention, only approximately 10% of teachers had implemented formal safety protocols during Physical Education lessons. Following the training and mentoring process, 26 of the 33 teachers (78.8%) successfully developed and adopted school-based Standard Operating Procedures (SOPs) for injury prevention and emergency response. As part of the mentoring process, participants collaboratively developed three safety-oriented Physical Education teaching materials, including injury prevention guidelines, safe movement and landing technique modules, and emergency response learning resources. These materials were designed to support the integration of physical safety concepts into regular Physical Education instruction. The introduction of SIGAPEdu (Educational

Injury Response Information and Support System) facilitated the digital recording and monitoring of student injury incidents. By the end of the programme, 24 teachers (72.7%) had successfully utilized the platform to document and report injury cases during simulation activities, exceeding the programme target of 70%. The implementation of SIGAPEdu represents an important step toward establishing a data-driven safety culture through systematic injury surveillance, monitoring, and evaluation.

Overall, all programme performance indicators were successfully achieved. The proportion of teachers capable of performing basic CPR increased to 84.8%, exceeding the target of 80%. School-based SOPs for injury prevention and emergency response were developed and implemented, while three safety-oriented Physical Education teaching materials were successfully produced to support the integration of safety concepts into classroom practice. Furthermore, SIGAPEdu was adopted by 72.7% of participants, surpassing the minimum target established for programme sustainability. Collectively, these outcomes indicate that the programme effectively enhanced teachers' competencies, strengthened school safety systems, and facilitated the implementation of technology-supported injury surveillance and reporting practices.

The findings indicate that the integrated training programme significantly improved teachers' knowledge, practical skills, and preparedness in managing injuries and emergency situations. The combination of lectures, demonstrations, hands-on practice, and scenario-based simulations provided participants with both conceptual understanding and practical competence. The marked increase in CPR and first-aid performance is consistent with previous studies demonstrating the effectiveness of experiential and simulation-based training in improving emergency response capabilities among educators. Furthermore, the development of safety-oriented teaching practices indicates that teachers became more proactive in identifying hazards, conducting safety briefings, and implementing preventive measures during lessons. This finding highlights the successful integration of safety education into the Physical Education curriculum and supports the creation of safer learning environments for students.

The implementation of SIGAPEdu further strengthened school safety management by providing a structured mechanism for injury documentation and reporting. Through systematic data collection and monitoring, schools are better positioned to identify injury trends, evaluate preventive measures, and make evidence-based decisions to enhance student safety. Collectively, these findings demonstrate that integrating emergency response training, safety-oriented instructional development, and digital injury surveillance systems can effectively strengthen school safety culture and improve the preparedness of Physical Education teachers. Training in first aid and cardiopulmonary resuscitation (CPR) has been shown to significantly improve teachers' competence in responding to injuries and emergencies at school (Ma et al., 2025; Greif et al., 2019; Jaskiewicz et al., 2022; Nas et al., 2022). These findings indicate that training combining theory and practice is effective in enhancing preparedness. Safety education in schools has been shown to be effective in reducing the risk of injury through increased awareness and behavioural change (Kwon & Jang, 2025; Emery et al., 2019; Jerebine et al., 2024; Rössler et al., 2020). This indicates that improvements in teachers' competence have a direct impact on student safety.

The integration of safety education into physical education lessons enhances the quality of learning comprehensively (Marttinen et al., 2017; Harris & Greenhow, 2019). Digital systems such as SIGAPEdu improve the quality of incident documentation through systematic and real-time recording (Chiou et al., 2019; Betts & Power, 2025; Gil-Hernández et al., 2024). This demonstrates that technology plays a vital role in supporting data-driven safety systems. Simulation-based training has also been shown to boost teachers' confidence and preparedness in dealing with emergency situations (Cant & Cooper, 2017; Saczkowski & Kuzak, 2018; Cho & Kim, 2024). The sustainability of the programme is supported by the teaching community through collaboration and continuous learning (Doğan & Adams, 2018; Hairon et al., 2017; Rakes et al., 2020).

In physical education practice that emphasises intensive physical activity, the aspect of injury prevention has not yet been fully integrated. Muscle and joint injuries, particularly in the knee and ankle regions, are recorded as the most common types of injury experienced by students (Barendrecht et al., 2023; Graha et al., 2024; Juhanis et al., 2025). These injuries can occur through contact or non-contact mechanisms, with the dominant causes being falls, improper landing techniques, and explosive movements during both curricular and extracurricular activities (Blikendaal et al., 2021). Differences in injury risk levels across sports and variations in students' experience further underscore the importance of contextual and adaptive prevention strategies (Wilson & Jackson, 2024). National data indicate that the prevalence of sports injuries among schoolchildren in Indonesia remains relatively

high, with 18% of pupils sustaining injuries to the lower limbs (Suryanto et al., 2022). Pupils aged 10-11 years generally experience minor injuries such as cramps and bruises, which are often associated with suboptimal warm-ups (Shidiq, 2022). Educational programmes play a significant role in improving knowledge and injury prevention practices, as evidenced by a meaningful increase in awareness following training (Wilson & Jackson, 2024).

CONCLUSION

The community service programme successfully enhanced the knowledge, practical competencies, and emergency preparedness of elementary school Physical Education teachers. The integrated training approach, which combined school safety management, injury prevention, first aid, Emergency Cardiac Care (ECC), and simulation-based learning, resulted in substantial improvements in teachers' understanding and practical skills related to emergency response. The programme also achieved all predetermined performance indicators, including increased CPR competency among participants, the development and implementation of school safety Standard Operating Procedures (SOPs), the production of safety-oriented Physical Education teaching materials, and the adoption of SIGAPEdu as a digital injury reporting and monitoring system. Beyond improving teachers' technical competencies, the programme strengthened the integration of safety principles into Physical Education learning and promoted a more systematic approach to injury prevention and emergency management in schools. The implementation of SIGAPEdu further supported the establishment of a data-driven school safety culture through structured injury documentation, monitoring, and reporting practices. These findings demonstrate that combining capacity-building initiatives with digital innovation can effectively strengthen school safety systems and improve teachers' readiness to respond to emergency situations. Therefore, similar programmes should be implemented continuously and expanded to a broader range of schools to support the creation of safer, healthier, and higher-quality learning environments.

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DECLARATION OF CONFLICTING INTERESTS

The authors states that there is no conflict of interest in the publication of this article.

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REFERENCES

- Adi, S. (2021). *The Importance of Multimedia Technology in pe Learning*. 574(Iset 2020), 182–185.
- Adi, S. (2024). Perspektif Pendidikan Jasmani Kontemporer: Tradisional Vs Modern. *SEHAT DAN BUGAR MELALUI PENDIDIKAN JASMANI*, 43.
- Adi, S., Aldapit, E., Nova, A., Dharmika Nugraha, P., Hutomo Bhakti, Y., & Bang Redy Utama, M. (2021). Virtual Multimedia Communication for Physical Distancing in Physical Education. *Journal of Physics: Conference Series*, 1779(1). <https://doi.org/10.1088/1742-6596/1779/1/012016>
- Adi, S., Rohidi, T. R., & Rustiadi, T. (2023). Digital literacy of physical education teachers in the 5.0 era. *Sport TK*, 12. <https://doi.org/10.6018/SPORTK.562941>
- Adi, S., & Soenyoto, T. (2023). *FISIOLOGI OLAHRAGA*. Cahya Ghani Recovery.
- Adi, S., Soenyoto, T., Aliriad, H., & Utama, M. B. R. (2025). *MANAJEMEN AKTIVITAS FISIK SISWA*. Cahya Ghani Recovery.
- Barendrecht, M., Barten, C. C., van Mechelen, W., Verhagen, E., & Smits-Engelsman, B. C. M. (2023). Injuries in Physical Education Teacher Students: Differences between Sex, Curriculum Year, Setting, and Sports. *Translational Sports Medicine*, 2023, 8643402. <https://doi.org/10.1155/2023/8643402>
- Betts, C., & Power, N. (2025). Enhancing incident reporting systems: Insights from JOL online and the emergency services. *Cognition, Technology & Work*, 27(1), 241–255.
- Blikendaal, S., Barendrecht, M., Stubbe, J., & Verhagen, E. (2021). *MECHANISMS OF SPORT-*

RELATED INJURIES IN PHYSICAL EDUCATION TEACHER EDUCATION STUDENTS: A DESCRIPTIVE ANALYSIS OF 896 INJURIES.

- Bou-Karroum, L., El-Jardali, F., Jabbour, M., Harb, A., Fadlallah, R., Hemadi, N., & Al-Hajj, S. (2022). Preventing Unintentional Injuries in School-Aged Children: A Systematic Review. *Pediatrics*, 149(Suppl 5). <https://doi.org/10.1542/peds.2021-053852J>
- Cahalan, Róisín. (2021). Injury prevention knowledge and beliefs of Irish dancing teachers: An international survey. *Physiotherapy Practice and Research*, 42(1), 43–50. <https://doi.org/10.3233/PPR-200472>
- Cant, R. P., & Cooper, S. J. (2017). The value of simulation-based learning in pre-licensure nurse education: A state-of-the-art review and meta-analysis. *Nurse Education in Practice*, 27, 45–62. <https://doi.org/https://doi.org/10.1016/j.nepr.2017.08.012>
- Chiou, S.-F., Huang, E.-W., & Chuang, J.-H. (2019). The development of an incident event reporting system for nursing students. In *Connecting Health and Humans* (pp. 598–602). IOS Press. <https://doi.org/10.3233/978-1-60750-024-7-598>
- Cho, M.-K., & Kim, M. Y. (2024). Effectiveness of simulation-based interventions on empathy enhancement among nursing students: A systematic literature review and meta-analysis. *BMC Nursing*, 23(1), 319.
- de Jong, J. (2022). O1-7 MoveHealthy: Improving health and sustaining participation of youth in sports through sports injury prevention. *European Journal of Public Health*, 32. <https://doi.org/10.1093/eurpub/ckac094.007>
- Doğan, S., & Adams, A. (2018). Effect of professional learning communities on teachers and students: Reporting updated results and raising questions about research design. *School Effectiveness and School Improvement*, 29(4), 634–659. <https://doi.org/10.1080/09243453.2018.1500921>
- Dr. Adi S, M. P., & Wijayama, B. (2024). *FISIOLOGI OLAHRAGA: Pemanasan, Permainan dan Workout*. Cahya Ghani Recovery.
- Emery, C. A., Roy, T.-O., Whittaker, J. L., Nettel-Aguirre, A., & Van Mechelen, W. (2019). Neuromuscular training injury prevention strategies in youth sport: A systematic review and meta-analysis. *British Journal of Sports Medicine*, 49(13), 865–870. <https://doi.org/https://doi.org/10.1136/bjsports-2015-094639>
- Gil-Hernández, E., Carrillo, I., Guilabert, M., Bohomol, E., Serpa, P. C., Ribeiro Neves, V., Maluenda Martínez, M., Martín-Delgado, J., Pérez-Esteve, C., Fernández, C., & Mira, J. J. (2024). Development and Implementation of a Safety Incident Report System for Health Care Discipline Students During Clinical Internships: Observational Study. *JMIR Med Educ*, 10, e56879. <https://doi.org/10.2196/56879>
- Graha, A., Ridwan, A., Nurhadi, F., Perkasa, B., Yachsie, W., & Cakrawati, T. (2024). Injuries in the context of physical education: A systematic literature review. *Fizjoterapia Polska*, 24, 318–325. <https://doi.org/10.56984/8ZG5608Y6U>
- Greif, R., Lockey, A. S., Conaghan, P., Lippert, A., De Vries, W., Monsieurs, K. G., Ballance, J. H. W., Barelli, A., Biarent, D., & Bossaert, L. (2019). European resuscitation council guidelines for resuscitation 2015: Section 10. Education and implementation of resuscitation. *Resuscitation*, 95, 288–301.
- Ha, M., Kasamatsu, T., Valovich McLeod, T., Register-Mihalik, J., & Welch Bacon, C. (2020). Teachers' Perceived Knowledge and Confidence Regarding Adolescent Concussion Management. *Journal of Education and Learning*, 9, 27. <https://doi.org/10.5539/jel.v9n5p27>
- Hairon, S., Goh, J. W. P., Chua, C. S. K., & Wang, L. (2017). A research agenda for professional learning communities: Moving forward. *Professional Development in Education*, 43(1), 72–86.
- Harris, J., & Greenhow, L. (2019). Making Physical Education Dynamic and Inclusive for 2030: International Curriculum Analysis. OECD Future of Education 2030. *OECD Publishing*.
- Heiestad, H., Myklebust, G., Funnemark, K., & Holm Moseid, C. (2022). Closing the gap on injury prevention: The Oslo Sports Trauma Research Centre four-platform model for translating research into practice. *British Journal of Sports Medicine*, 56(9), 482 LP – 483. <https://doi.org/10.1136/bjsports-2021-104998>
- Jaskiewicz, F., Kowalewski, D., Kaniecka, E., Kozłowski, R., Marczak, M., & Timler, D. (2022). Factors influencing self-confidence and willingness to perform cardiopulmonary resuscitation among working adults—A quasi-experimental study in a training environment. *International Journal of Environmental Research and Public Health*, 19(14), 8334.
- Jerebine, A., Eyre, E. L. J., Lander, N., Duncan, M. J., & Barnett, L. M. (2024). Forces at play: A qualitative study of risk aversion, policy and decision making for children's physically active play in schools. *Health & Place*, 90, 103373.

- Juhanis, J., Aliriad, H., Da'i, M., Adi S, Tauchid, A., Taufik, M. S., & Saifuddin, H. (2025). Analysis of Technical Performance, Recovery and Prevention of Injuries in Wrestling athletes. *Cuestiones de Fisioterapia*, 54(1), 167–178. <https://doi.org/10.48047/CU/54/01/167-178>
- Kwon, J., & Jang, J. (2025). Impact of participation in sports safety education on sports injuries, sports safety awareness, and sports activity habits among young Korean athletes. *Medicine*, 104(8), e41589.
- Liu, H., Huang, S., Bu, T., Jiang, W., Fu, T., & Zhao, L. (2022). Epidemiology of Campus Football Injuries in Ningxia, China: Occurrence, Causes, and Management. *Frontiers in Public Health*, 10, 893541. <https://doi.org/10.3389/fpubh.2022.893541>
- Ma, J., Kuai, L., Zhu, X., Tang, Q., Liu, S., & Zhou, W. (2025). Cardiopulmonary resuscitation knowledge and skills among schoolteachers in Xinjiang, China: A cross-sectional survey. *Frontiers in Public Health*, 13, 1683122.
- Marttinen, R. H. J., McLoughlin, G., Fredrick III, R., & Novak, D. (2017). Integration and physical education: A review of research. *Quest*, 69(1), 37–49. <https://doi.org/10.1080/00336297.2016.1150864>
- Muhibbi, M., Pranata, D., Ramadhan, A., & Adila, F. (2023). Identification of sports injuries in semarang city communities based on gender. *Journal Of Sport Education (JOPE)*, 5, 158. <https://doi.org/10.31258/jope.5.2.158-166>
- Nas, J., Thannhauser, J., Konijnenberg, L. S. F., van Geuns, R.-J. M., van Royen, N., Bonnes, J. L., & Brouwer, M. A. (2022). Long-term effect of face-to-face vs virtual reality cardiopulmonary resuscitation (CPR) training on willingness to perform CPR, retention of knowledge, and dissemination of CPR awareness: A secondary analysis of a randomized clinical trial. *JAMA Network Open*, 5(5), e2212964. <https://doi.org/10.1001/jamanetworkopen.2022.12964>
- Rakes, C. R., Ronau, R. N., Bush, S. B., Driskell, S. O., Niess, M. L., & Pugalee, D. K. (2020). Mathematics achievement and orientation: A systematic review and meta-analysis of education technology. *Educational Research Review*, 31, 100337. <https://doi.org/https://doi.org/10.1016/j.edurev.2020.100337>
- Rosenstiel, S., Volk, C., Schmid, J., Wagner, W., Demetriou, Y., Höner, O., Thiel, A., Trautwein, U., & Sudeck, G. (2021). Promotion of physical activity-related health competence in physical education: A person-oriented approach for evaluating the GEKOS intervention within a cluster randomized controlled trial. *European Physical Education Review*, 28(1), 279–299. <https://doi.org/10.1177/1356336X211037432>
- Rössler, R., Donath, L., Verhagen, E., Junge, A., Schweizer, T., & Faude, O. (2020). Exercise-based injury prevention in child and adolescent sport: A systematic review and meta-analysis. *Sports Medicine*, 44(12), 1733–1748. <https://doi.org/https://doi.org/10.1007/s40279-014-0234-2>
- Rumini, Adi S, & Kusuma, D. W. Y. (2024). Beyond the Finish Line: Muscle Injuries in Athletic Competition. *Physical Education Theory and Methodology*, 24(5 SE-Original Scientific Articles), 744–748. <https://doi.org/10.17309/tmfv.2024.5.09>
- Saczkowski, R. S., & Kuzak, N. (2018). Combining individual patient data from multiple trials require specific modelling techniques in order to provide accurate predictions. *Resuscitation*, 129, e1. <https://doi.org/10.1016/j.resuscitation.2018.04.021>
- Saifulloh, Z. A., Kusuma, D. W., Raharjo, A., & Adi, S. (2024). Tingkat Pengetahuan Atlet Bulutangkis Tentang Cidera Ankle Dan Terapi Latihan Di Kabupaten Demak. *Indonesian Journal for Physical Education and Sport*, 5(1), 175–183.
- Shidiq, A. A. P. (2022). Identification of Sports Injuries in Young Badminton Men's Athletes 10-11 Years Old. *JUARA: Jurnal Olahraga*, 7(3 SE-Articles). <https://doi.org/10.33222/juara.v7i3.1956>
- Silva de Oliveira, C. B., Nascimento, D., Gomes, G., Lima, M., & Albuquerque, A. (2022). PRIMEIROS SOCORROS NA ESCOLA: PERSPECTIVAS DO CONHECIMENTO E DA CAPACITAÇÃO DE PROFESSORES. *Educação Ciência e Saúde*, 9, 138–154. <https://doi.org/10.20438/ecs.v9i1.448>
- Suryanto, F. A., Widyahening, I. S., & Tobing, A. J. (2022). Incidence and Risk Factors for Musculoskeletal Injuries among Indonesian Junior Badminton Athletes during a National Elite Championship. *Acta Medica Philippina*, 56(1), 37–41. <https://doi.org/10.47895/amp.v56i1.3808>
- Wibisana, M. (2020). Analisis Indeks Kelelahan dan Daya Tahan Anaerobic Atlet Futsal SMA Institut Indonesia Semarang. *Jurnal Terapan Ilmu Keolahragaan*, 5.
- Wilson, C., & Jackson, M. (2024). Survey and analysis of sports injuries among physical education college students. *Cambridge Sport Science*, 2024, 16–21.
- Yuwono, C., Billiandri, B., Risqanada, A., & Adi, S. (2024). Optimizing Water Rescue and Rescue Swimming for Elementary School Physical Education Teachers. *GANDRUNG: Jurnal Pengabdian Kepada Masyarakat*, 5(2), 1657–1664.