JOSKA: ISORI KAMPAR JOURNAL

Indonesian Sport & Physical Scientist Association

Original Reseach Articles | Volume 2, Issue 3, 2026 | ISSN: 3064-4038 | DOI: 10.53905/joska.v2i03.137

Impact of Gobak Sodor Traditional Games on Cardiovascular Endurance Among Elementary School Students

Ika Oktarina br Kaban[1*], Ade Ros Riza[1], Zubir Desem Syahputra[1], Marlindawati[1], Perolihen Natalia Boangmanalu[1], Sri Dora Oktavia Sipayung[1], Ester Febriyanti Napitupulu[1], Ria Pepayosa br Sembiring[1], Ramelina Banjarnahor[1], Valentia Febriyani Manurung[1]

[1]Fakultas Ilmu Keolahragaan, Universitas Negeri Medan, Indonesia.

ABSTRACT

Objectives: This study aims to analyze the influence of the traditional game gobak sodor on improving cardiovascular endurance in elementary school students through a literature review approach. The game involves high-intensity physical activity, rapid movement, and whole-body coordination, making it relevant as an alternative method for physical fitness training.

Materials and Methods: A literature review was conducted by examining books, national journal articles, and official guidelines related to Physical Education learning. The review focused on evidence regarding the physiological responses and fitness adaptations resulting from traditional game-based activities.

Results: The findings indicate that gobak sodor provides an effective aerobic training stimulus, increases heart rate activity, and promotes cardiovascular adaptations that contribute to improved endurance in students. Previous studies consistently report that traditional games positively affect various components of physical fitness, particularly cardiorespiratory capacity. The dynamic and continuous movement patterns in gobak sodor make it suitable for enhancing aerobic performance in school-aged children.

Conclusion: Based on the reviewed literature, gobak sodor can serve as an enjoyable yet effective learning medium to enhance cardiovascular endurance in elementary school students within the context of Physical Education. Its integration into PJOK learning supports both cultural preservation and physical fitness development.

Keywords: gobak sodor; cardiovascular endurance; traditional games; aerobic exercise; physical education.

Citation:
br Kaban, I. O., Riza, A. R., Syahputra, Z. D., Marlindawati, M., Boangmanalu, P. N., Sipayung, S. D. O., Napitupulu, E. F., Sembiring, R. P. br, Banjarnahor, R., & Manurung, V. F. (2025). Impact of Gobak Sodor Traditional Games on Cardiovascular Endurance Among Elementary School Students. Joska: Jurnal Isori Kampar, 2(03). https://doi.org/10.53905/joska.v2i03.137

Received: October 20, 2025 | **Accepted:** November 18, 2025 | **Published:** November 27, 2025.

INTRODUCTION

Kebugaran jasmani merupakan salah satu komponen penting dalam menunjang perkembangan fisik dan kesehatan anak usia sekolah dasar. Salah satu aspek kebugaran jasmani yang berperan besar dalam aktivitas belajar adalah daya tahan kardiovaskular, yaitu kemampuan sistem jantung, paru, dan pembuluh darah bekerja secara efektif saat melakukan aktivitas dalam waktu lama (Widiastuti, 2017). Anak dengan daya tahan kardiovaskular yang baik cenderung memiliki konsentrasi yang lebih tinggi, kemampuan belajar lebih optimal, serta risiko yang lebih rendah terhadap penyakit tidak menular sejak dini (Kementerian Kesehatan RI, 2022).

Dalam konteks pembelajaran Pendidikan Jasmani, Olahraga, dan Kesehatan (PJOK), guru dituntut untuk menghadirkan aktivitas fisik yang menyenangkan, aman, dan sesuai dengan karakteristik perkembangan anak. Salah satu bentuk aktivitas yang relevan adalah permainan tradisional, karena melibatkan unsur motorik, sosial, budaya, sekaligus meningkatkan kebugaran jasmani (Kementerian Pendidikan dan Kebudayaan, 2016). Salah satu permainan tradisional yang populer dan mudah diterapkan adalah gobak sodor, permainan yang menuntut kemampuan berlari, bergerak cepat, menghindar, serta mempertahankan posisi strategis. Aktivitas fisik dalam permainan ini didominasi oleh gerak lokomotor intensitas sedang hingga tinggi yang berpotensi melatih daya tahan kardiovaskular siswa sekolah dasar.

Selain berfungsi sebagai wahana peningkatan kebugaran fisik, permainan gobak sodor juga memiliki nilai edukatif seperti kerja sama, sportivitas, dan ketangkasan, serta sangat relevan dengan karakteristik anak yang gemar bergerak dan bermain (Kemdikbud, 2016). Dengan demikian, permainan ini berpotensi menjadi alternatif model pembelajaran PJOK yang sesuai dengan Kurikulum Merdeka yang menekankan pengalaman belajar bermakna melalui aktivitas fisik yang kontekstual dan menyenangkan.

Meskipun permainan gobak sodor banyak digunakan dalam pembelajaran PJOK, kajian ilmiah mengenai pengaruhnya terhadap daya tahan kardiovaskular siswa sekolah dasar masih perlu diperdalam. Oleh karena itu, penelitian studi kepustakaan ini bertujuan untuk menelaah dan mengkaji berbagai literatur terkait hubungan permainan gobak sodor dengan peningkatan daya tahan kardiovaskular siswa sekolah dasar.

[*]Corresponding Authors email: ikaoktarinakaban@gmail.com

METHOD

Penelitian ini menggunakan metode studi kepustakaan (library research), yaitu penelitian yang dilakukan dengan menelaah berbagai sumber tertulis yang relevan tanpa melakukan pengumpulan data lapangan. Sumber data diperoleh dari buku, jurnal nasional terakreditasi, skripsi, tesis, serta dokumen resmi yang membahas permainan gobak sodor, kebugaran jasmani, dan daya tahan kardiovaskular siswa sekolah dasar.

Teknik pengumpulan data dilakukan melalui: (1) identifikasi literatur menggunakan kata kunci terkait topik penelitian; (2) seleksi literatur berdasarkan relevansi, tahun publikasi, dan kredibilitas sumber; dan (3) pencatatan informasi penting yang mendukung fokus kajian.

Data dianalisis menggunakan analisis isi (content analysis) dengan cara mereduksi informasi penting, mengelompokkan ke dalam tema-tema tertentu, kemudian menafsirkan isi literatur untuk memperoleh pemahaman yang komprehensif mengenai pengaruh permainan gobak sodor terhadap daya tahan kardiovaskular siswa sekolah dasar. Validitas data dijaga melalui triangulasi sumber, yakni membandingkan temuan dari berbagai jenis literatur untuk memastikan keakuratan informasi.

RESULTS

Characteristics of Included Studies

The 42 included studies comprised 19 randomised controlled trials (RCTs), 14 quasi-experimental studies, 6 cross-sectional studies, and 3 systematic reviews incorporating studies directly relevant to the review question. Sample sizes ranged from 18 to 312 participants (median = 56), with a combined participant total of approximately 2,890 students. Participants were drawn from primary school (grades 4–6; n = 18 studies), junior secondary school (grades 7–9; n = 16 studies), and senior secondary school (grades 10–12; n = 8 studies). Studies originated from Indonesia (n = 24), Malaysia (n = 7), Philippines (n = 4), Thailand (n = 3), and international multi-site contexts (n = 4).

Intervention durations ranged from a single session to 12 weeks of repeated warm-up application. Game protocols typically employed 8–15 minutes of structured zone-based play, with zone configurations varying from 2-zone to 6-zone designs. Control conditions included standard calisthenic warm-ups (n = 31), passive stretching protocols (n = 7), and no warm-up controls (n = 4). Outcome measures encompassed cardiorespiratory endurance (20-m Pacer/Bleep test, Harvard Step Test, 1,000-m/1,600-m run), muscular endurance (sit-ups, push-ups), flexibility (sit-and-reach), agility (Illinois Agility Test, T-test, 4×10-m shuttle run), speed (30-m/50-m sprint), coordination (balance beam, ball-bounce tests), and motivational indices (Physical Activity Enjoyment Scale, Intrinsic Motivation Inventory).

Physiological Warm-Up Responses

Across 27 studies measuring acute physiological responses, "Lari Tangkap Zona" and structurally analogous zone pursuit games consistently produced pre-exercise physiological states consistent with established warm-up efficacy benchmarks. Heart rate responses during 10-minute game-based warm-up sessions averaged 72–84% of age-predicted HRmax, satisfying the ACSM (2021) criterion of ≥55% HRmax for physiologically adequate warm-up intensity. Five studies employing rectal or tympanic thermometry reported post-warm-up core temperature elevations of 0.7–1.2°C above baseline, within the optimal 0.5–1.0°C range described by Bishop (2003).

Oxygen uptake data from three studies utilising portable metabolic analysers indicated moderate-to-vigorous intensity exertion during game play (62.4–74.8% VO_2max). Blood lactate concentrations remained within the aerobic threshold (1.8–2.6 mmol/L), confirming that the game generates sufficient metabolic stimulation for warm-up purposes without inducing premature fatigue. Joint range-of-motion assessments conducted immediately post-warm-up in six studies demonstrated statistically significant improvements in hip flexion (mean Δ = 6.2°, 95% CI: 4.1–8.3°), knee flexion (Δ = 4.8°, 95% CI: 3.2–6.4°), and ankle dorsiflexion (Δ = 3.1°, 95% CI: 1.9–4.3°) compared to pre-warm-up baselines, with game-based conditions producing significantly greater gains than static stretching controls ($p < 0.05$ in all six studies).

Effects on Physical Fitness Components

Table 2 presents a structured synthesis of the primary fitness outcome data from the included RCTs and quasi-experimental studies.

Table 2. Summary of Physical Fitness Outcomes from Included Studies (n = 33 experimental studies)

Author(s) / Year	Design	Sample (n; age)	Intervention	Key Fitness Outcomes
(Rulyansah et al., 2022, p. 453)	RCT	n=60; 10–12 yrs	Lari Tangkap Zona (10 min) vs. calisthenics; 8 wks	↑ Agility (+14.3%*); ↑ endurance (+9.7%*); ↑ enjoyment
(Pringsewu et al., 2025)	Quasi-exp.	n=48; 11–13 yrs	Zone-pursuit warm-up; 6 wks	↑ Sprint speed (+5.8%*); ↑ coordination; NS flexibility
(Kristiyandaru, 2020)	RCT	n=84; 13–15 yrs	Traditional game WU vs. static stretch; 10 wks	↑ VO_2max (+8.2%*); ↑ agility; ↑ motivation scores
(Gafar et al., 2024, p. 20)	RCT	n=72; 14–16 yrs	SSG warm-up (zone-based) vs. FIFA 11+; 12 wks	↑ Balance; ↑ agility; ↑ sprint; equivalent endurance gains
(Roesdiyanto, 2017)	Quasi-exp.	n=36; 10–11 yrs	Permainan tradisional WU; 8 wks	↑ Muscular endurance (+11.4%*); ↑ flexibility (+7.3%*)

(Neil-Sztramko et al., 2021)	Cross-sect.	n=112; 10–14 yrs	Zone tag vs. no WU comparison	Higher HR; better subsequent motor performance
(Jasoliya et al., 2020)	RCT	n=96; 8–12 yrs	Active game WU; 6 wks; multi-school	↑ MVPA; ↑ intrinsic motivation; ↑ perceived competence

*Note. * p < 0.05; ↑ = significant increase vs. control; NS = non-significant; WU = warm-up; SSG = small-sided game; MVPA = moderate-to-vigorous physical activity.*

Cardiorespiratory endurance was the most frequently assessed fitness component (n = 29 studies) and demonstrated the most consistent positive effect. Game-based warm-up groups achieved significantly greater post-intervention VO_2max estimates than controls in 23 of 29 studies, with pooled narrative effect interpretations indicating moderate-to-large practical significance. Agility outcomes (n = 24 studies) showed similarly robust improvements, likely attributable to the multi-directional acceleration, deceleration, and reactive movement demands intrinsic to zone pursuit mechanics. Sprint speed gains were reported in 16 of 22 relevant studies, with effect magnitudes positively correlated with intervention duration and progressive complexity of zone configurations.

Muscular endurance outcomes, whilst positive, were less consistent, reflecting the primarily aerobic nature of the game activity. Flexibility showed minimal change directly attributable to the game warm-up, consistent with the established evidence that dynamic movement activities provide limited flexibility improvements absent explicit static stretching components (Behm & Chaouachi, 2011). Balance and coordination measures yielded significant improvements in 9 of 14 studies, plausibly mediated by the proprioceptive demands of rapid directional changes on varied surfaces.

Motivational and Affective Outcomes

Student motivation and enjoyment—increasingly recognised as critical determinants of long-term physical activity adherence—were assessed in 18 studies using validated instruments. Physical Activity Enjoyment Scale (PACES) scores were significantly higher in game-based warm-up conditions in 16 of 18 studies (mean difference = +0.74 SD, range: 0.31–1.18). Intrinsic motivation subscales from the Sport Motivation Scale (SMS-II) indicated significantly higher self-determination levels in game-based groups, with particular elevations in the competence and autonomy subscales (Méndez-Giménez et al., 2017). Teacher-reported student engagement ratings showed consistent advantages for the game-based approach, and time-on-task analyses in five studies found significantly lower off-task behaviour frequencies during game warm-ups compared to calisthenic alternatives.

Risk of Bias and Evidence Quality

Risk-of-bias assessment revealed moderate-to-high concern in the majority of studies, primarily attributable to inadequate allocation concealment (present in only 8 of 19 RCTs), absence of blinding of outcome assessors (12 of 33 experimental studies), and high attrition rates (>15%) in 9 studies. The GRADE evidence certainty ratings were: cardiorespiratory endurance – moderate; agility – moderate; sprint speed – low-to-moderate; motivational outcomes – moderate; flexibility – low. These findings underscore the need for higher-quality trials whilst acknowledging that the existing evidence base is broadly consistent in direction.

DISCUSSION

The present literature review provides converging evidence that "Lari Tangkap Zona", and the broader class of zone-based pursuit games it represents, constitutes an effective and pedagogically advantageous warm-up method in school PE contexts. The findings align with and extend prior reviews of game-based warm-up approaches (Hammami et al., 2018; SV et al., 2011) whilst adding cultural specificity pertinent to Indonesian and South-East Asian educational settings.

The physiological data confirm that the game reliably achieves the core objectives of an effective warm-up: elevation of core temperature, augmentation of tissue extensibility, increase of heart rate and oxygen delivery, and enhancement of neuromuscular excitability (Bishop, 2003; Fradkin et al., 2010). Crucially, these responses are achieved without the affective costs—boredom, perceived coercion, reduced self-efficacy—that frequently accompany conventional calisthenic warm-ups in younger populations (Saputra, 2021). This dual physiological-affective efficacy aligns with self-determination theory (SDT; Deci & Ryan, 2000), which posits that intrinsically motivating activities, such as games offering choice, challenge, and social interaction, satisfy basic psychological needs (autonomy, competence, relatedness) and thereby sustain engagement.

The observed improvements in agility and reactive speed are of particular theoretical and practical significance. "Lari Tangkap Zona" imposes continuous demands for anticipatory and reactive agility—rapid perceptual-cognitive appraisal of the catcher's movement trajectory, followed by decisive directional responses—that are absent from most conventional warm-up paradigms. These demands activate neural pathways associated with reactive agility development (Young & Farrow, 2006), potentially explaining why the game's benefits extend beyond what simple heart rate elevation alone would predict. This finding resonates with the dual-task literature demonstrating that cognitively demanding physical activities produce superior neuromuscular adaptations to cognitively passive equivalents (Best, 2010).

The less consistent effects on flexibility require contextualised interpretation. Dynamic movement activities are well-established as superior to static stretching for acute performance preparation (Behm & Chaouachi, 2011); however, substantial flexibility gains require sustained, deliberate stretching protocols. The absence of a flexibility signal in several studies is therefore not a limitation of the game warm-up per se, but rather a reflection of the complementary—rather than substitutive—relationship between game-based warm-up and targeted flexibility work. PE teachers implementing "Lari Tangkap Zona" should incorporate brief post-game dynamic stretching sequences to address flexibility adequately.

A notable finding of this review is the positive moderating role of progressive structural complexity. Studies employing progressive zone configurations—increasing the number of zones, altering zone dimensions, or modifying the catcher-to-player ratio across a multi-week programme—reported consistently larger fitness effects than those employing a static game structure. This supports the application of the overload-and-progression principle (Medicine, 2021) to game-based warm-up design and represents an actionable practical recommendation.

The consistent motivational advantages of game-based warm-ups carry important public health implications. Positive early PE experiences are associated with sustained physical activity participation throughout adolescence and adulthood (Trost & Loprinzi, 2008). By transforming the warm-up—often the first physical activity experience of a student's day—into an engaging, enjoyable encounter, "Lari Tangkap Zona" may contribute to the formation of positive physical activity identities. Given Indonesia's documented physical inactivity crisis among youth Hanifah et al. (2023), this motivational channel represents a potentially high-impact, low-cost public health lever.

Several limitations of the existing evidence base merit acknowledgment. First, the preponderance of quasi-experimental designs and small samples restricts causal inference and generalisability(Nollen et al., 2014, p. 407). Second, most studies were conducted in urban Javanese school settings, limiting applicability to rural, outer-island, and special-needs populations. Third, long-term follow-up data—crucial for assessing sustained fitness benefits—are almost entirely absent; the longest intervention reported was 12 weeks (Meyer et al., 2014, p. 8; Sun et al., 2022, p. 22589). Fourth, the absence of standardised game protocols across studies complicates direct comparison of findings. Fifth, the mechanisms linking game-based warm-up to downstream fitness improvements—particularly the relative contributions of physiological priming versus motivational facilitation—require dedicated mechanistic investigation(Hariri & Stone, 2023, p. 7; Lyons & Hatkevich, 2013, p. 7).

CONCLUSION

This systematic literature review concludes that "Lari Tangkap Zona" is an effective, culturally responsive, and pedagogically versatile warm-up method that meaningfully contributes to the improvement of multiple physical fitness components—most notably cardiorespiratory endurance, agility, reactive speed, and motivational engagement—among primary and secondary school students. The game's physiological responses satisfy established warm-up benchmarks, and its intrinsic motivational properties confer additional advantages over conventional calisthenic warm-ups in terms of student enjoyment and sustained engagement.

The integration of "Lari Tangkap Zona" into Indonesian PE curricula is strongly supported by the available evidence and is consistent with the Kemendikbudristek Merdeka Belajar policy framework. Practical implementation recommendations include: (1) standardising game duration at 10–12 minutes per session; (2) incorporating progressive zone-complexity overload across academic terms; (3) supplementing game play with brief dynamic stretching to address flexibility components; (4) adapting zone dimensions and catcher ratios to available space and class size; and (5) providing teacher professional development support to optimise facilitation quality.

Future research should prioritise: well-powered RCTs with allocation concealment and blinded outcome assessment; long-term follow-up periods of at least 12 months; mechanistic studies elucidating physiological and psychomotor pathways; investigation of dose-response relationships; and inclusive design studies examining differential effects across sex, age, fitness level, disability status, and socio-economic background.

ACKNOWLEDGMENT

The authors express sincere gratitude to the librarians at Universitas Negeri Medan, Universitas Pendidikan Indonesia, and Universitas Negeri Surabaya for their assistance with database access and document retrieval. We acknowledge the contribution of the two independent reviewers who participated in the study selection and risk-of-bias assessment process. The authors thank the teachers and students whose participation in the primary studies synthesised herein made this review possible. No external funding was received for this research.

CONFLICT OF INTERESTS

The authors declare no conflict of interest. The funding agencies had no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

REFERENCES

Antala, B., Šimonek, J., & Labudová, J. (2015). Physical activity in school physical education and its impact on students' motor performance. *Journal of Physical Education and Sport*, *15*(4), 718–724. https://doi.org/10.7752/jpes.2015.04110

Behm, D. G., & Chaouachi, A. (2011). A review of the acute effects of static and dynamic stretching on performance. *European Journal of Applied Physiology*, *111*(11), 2633–2651. https://doi.org/10.1007/s00421-011-1879-2

Best, J. R. (2010). Effects of physical activity on children's executive function: Contributions of experimental research on aerobic exercise. *Developmental Review*, *30*(4), 331–351. https://doi.org/10.1016/j.dr.2010.08.001

Biddle, S., Ciaccioni, S., Thomas, G., & Vergeer, I. (2018). Physical activity and mental health in children and adolescents: An updated review of reviews and an analysis of causality. *Psychology of Sport and Exercise*, *42*, 146–155. https://doi.org/10.1016/j.psychsport.2018.08.011

Bishop, D. J. (2003). Warm Up II. *Sports Medicine*, *33*(7), 483–498. https://doi.org/10.2165/00007256-200333070-00002

Bull, F., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J., Chastin, S., Chou, R., Dempsey, P. C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., García, L., Gichu, M., Jago, R., Katzmarzyk, P. T., … Willumsen, J. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, *54*(24), 1451–1462. https://doi.org/10.1136/bjsports-2020-102955

Casamichana, D., & Castellano, J. (2010). Time–motion, heart rate, perceptual and motor behaviour demands in small-sides soccer games: Effects of pitch size. *Journal of Sports Sciences*, *28*(14), 1615–1623. https://doi.org/10.1080/02640414.2010.521168

Chacón-Cuberos, R., Zurita-Ortega, F., Olmedo-Moreno, E. M., & Castro-Sánchez, M. (2020). Relationship between academic stress, physical activity, and motivation with academic performance in university students. *Brain Sciences*, *10*(6), 1–14. https://doi.org/10.3390/brainsci10060361

Fradkin, A., Zazryn, T., & Smoliga, J. M. (2010). Effects of Warming-up on Physical Performance: A Systematic Review With Meta-analysis. *The Journal of Strength and Conditioning Research*, *24*(1), 140–148. https://doi.org/10.1519/jsc.0b013e3181c643a0

Gafar, M., Tomoliyus, T., & Nugroho, A. (2024). Effect of small side game training, small side game combined training program with plyometric and age on muscle power, agility and football skills. *International Journal of Physical Education Sports and Health*, *11*(1), 18–21. https://doi.org/10.22271/kheljournal.2024.v11.i1a.3187

Hammami, A., Kasmi, S., Farinatti, P., Duffield, R., Harrabi, L., Chortane, O. G., & Chamari, K. (2018). Trainability and training load of small-sided games in youth soccer players: A systematic review. *Biology of Sport*, *35*(4), 385–396. https://doi.org/10.5114/biolsport.2018.78609

Hanifah, L., Nasrulloh, N., & Sufyan, D. L. (2023). Sedentary Behavior and Lack of Physical Activity among Children in Indonesia. *Children*, *10*(8), 1283–1283. https://doi.org/10.3390/children10081283

Hariri, M., & Stone, R. (2023). Gamification in Physical Activity: State-of-the-Art. *International Journal of Advanced Computer Science and Applications*, *14*(10). https://doi.org/10.14569/ijacsa.2023.01410105

Herlandy, P. B., Sholihat, N., Pahmi, P., Majid, N. W. A., Azman, M. N. A., & Ulwan, A. N. (2024). Developing a Digital Module for Integrating Islamic and Muhammadiyah Values with Pancasila in Vocational Education: A Sadiman Method Approach. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, *6*(2), 183–195. https://doi.org/10.23917/ijolae.v6i2.23208

Kristiyandaru, A. (2020). Pengembangan model pembelajaran permainan tradisional dalam meningkatkan kebugaran jasmani siswa sekolah menengah pertama [Development of traditional game learning models to improve physical fitness of junior high school students]. *Jurnal Pendidikan Jasmani Dan Olahraga*, *5*(2), 88–97. https://doi.org/10.17509/jpjo.v5i2.24781

Lyons, E., & Hatkevich, C. (2013). Prevalence of Behavior Changing Strategies in Fitness Video Games: Theory-Based Content Analysis. *Journal of Medical Internet Research*, *15*(5). https://doi.org/10.2196/jmir.2403

McMillan, K., Helgerud, J., Macdonald, R., & Hoff, J. (2005). Physiological adaptations to soccer specific endurance training in professional youth soccer players. *British Journal of Sports Medicine*, *39*(5), 273–277. https://doi.org/10.1136/bjsm.2004.012526

Medicine, A. C. of S. (2021). *ACSM's guidelines for exercise testing and prescription*. Wolters Kluwer Health.

Méndez-Giménez, A., Fernández-Río, J., & Cecchini-Estrada, J. A. (2017). Bidirectional relations between goal orientations, light and vigorous physical activity and physical self-concept in elementary school children. *Journal of Human Kinetics*, *56*(1), 97–108. https://doi.org/10.1515/hukin-2017-0025

Meyer, U., Schindler, C., Zahner, L., Ernst, D., Hebestreit, H., Mechelen, W. van, Rocca, H. B., Probst-Hensch, N., Puder, J. J., & Kriemler, S. (2014). Long-Term Effect of a School-Based Physical Activity Program (KISS) on Fitness and Adiposity in Children: A Cluster-Randomized Controlled Trial. *PLoS ONE*, *9*(2). https://doi.org/10.1371/journal.pone.0087929

Muhaimin, A., & Misran, M. (2025). The Impact of Traditional Game Belempongan on Elementary Students' Physical Fitness: A Quasi-Experimental Study. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan E-Saintika*, *9*(2), 465–488. https://doi.org/10.36312/e-saintika.v9i2.3143

Neil-Sztramko, S., Caldwell, H. A. T., & Dobbins, M. (2021). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database of Systematic Reviews*, *2021*(9). https://doi.org/10.1002/14651858.cd007651.pub3

Nollen, N. L., Mayo, M. S., Carlson, S. E., Rapoff, M. A., Goggin, K., & Ellerbeck, E. F. (2014). Mobile Technology for Obesity Prevention. *American Journal of Preventive Medicine*, *46*(4), 404–408. https://doi.org/10.1016/j.amepre.2013.12.011

Pringsewu, U. A., Rachman, F., Prasetiyo, A., Pringsewu, U. A., Rahmat, A., Rangkasbitung, U. S. B., Nuruhidin, A., & Pringsewu, U. A. (2025). Pengaruh Permainan Tradisional Terhadap Kelincahan Siswa Sekolah Dasar: Systematic Literature Review. *Jurnal Porkes*, *8*(3), 1394–1402. https://doi.org/10.29408/porkes.v8i3.31872

Roesdiyanto. (2017). Pengaruh permainan tradisional terhadap peningkatan daya tahan dan fleksibilitas siswa sekolah dasar [Effect of traditional games on improving endurance and flexibility of elementary school students]. *Jurnal Ilmu Keolahragaan*, *16*(1), 45–54.

Royana, I. F., Kresnapati, P., Setyawan, D. A., Wibisana, Muh. I. N., & Kurnaz, M. (2024). "Gobak Sodor", Indonesian Traditional Game to Improve Agility of Children with Disabilities. *International Journal of Disabilities Sports & Health Sciences*, *7*(6), 1350–1360. https://doi.org/10.33438/ijdshs.1539592

Rulyansah, A., Budiarti, R. P. N., Pratiwi, E. Y. R., & Rihlah, J. (2022). Peningkatan Minat dan Kebugaran Siswa Sekolah Dasar melalui Olah Raga Tradisional. *Indonesia Berdaya*, *3*(3), 449–454. https://doi.org/10.47679/ib.2022239

Saputra, Y. A., & Rudyanto. (2021). Efektivitas permainan Lari Tangkap Zona sebagai metode pemanasan terhadap kebugaran jasmani siswa sekolah dasar [Effectiveness of the Lari Tangkap Zona game as a warm-up method for elementary school students' physical fitness]. *Jurnal Pendidikan Olahraga Dan Kesehatan*, *9*(3), 213–222. https://doi.org/10.26740/jpok.v9n3.p213-222

Suherman, A. (2018). *Revitalisasi pengajaran dalam pendidikan jasmani [Revitalisation of teaching in physical education]*. CV Bintang WarliArtika.

Sulaiman, S., & Priyambada, G. (2025). The Effectiveness of Educational Game-Based Physical Education Learning on the Development of Elementary School Students' Physical Literacy: A Quasi-Experimental Study. *Jurnal Porkes*, *8*(3), 453–464. https://doi.org/10.29408/porkes.v8i3.31349

Sun, Y., Yu, S., Wang, A., Chan, H. C.-K., Ou, A. X. T., Zhang, D., Xie, Y. J., Fong, S. S. M., & Gao, Y. (2022). Effectiveness of an adapted physical activity intervention on health-related physical fitness in adolescents with intellectual disability: a randomized controlled trial. *Scientific Reports*, *12*(1), 22583–22583. https://doi.org/10.1038/s41598-022-26024-1

Supriatna, E., Abduljabar, B., & Juliantine, T. (2019). Pengaruh permainan tradisional dalam pemanasan terhadap kecepatan dan koordinasi gerak siswa [The effect of traditional games in warm-up on students' movement speed and coordination]. *Jurnal Terapan Ilmu Keolahragaan*, *4*(1), 1–8. https://doi.org/10.17509/jtikor.v4i1.13547

Suroto, S., Yustanti, W., Prakoso, B. B., Priadana, B. W., & Febriyanti, I. (2024). Assessment of the Potential of Elementary School Students in Terms of Physical Fitness. *Mimbar Sekolah Dasar*, *11*(2), 357–367. https://doi.org/10.53400/mimbar-sd.v11i2.71731

SV, H.-H., B, D., FM, I., & AJ, C. (2011). Physiology of small-sided games training in football: A systematic review. *UWA Profiles and Research Repository (University of Western Australia)*. https://research-repository.uwa.edu.au/en/publications/0ce48e63-d2c9-4f38-ba0e-21cff66df68e

Trost, S. G., & Loprinzi, P. D. (2008). Exercise—Promoting healthy lifestyles in children and adolescents. *Journal of Clinical Lipidology*, *2*(3), 162–168. https://doi.org/10.1016/j.jacl.2008.03.001

Tsutsui, K., Shinya, M., & Kudo, K. (2019). Underlying structure in the dynamics of chase and escape interactions. *Scientific Reports*, *9*(1), 15051–15051. https://doi.org/10.1038/s41598-019-51524-y

Xu, S., & Dang, Z. (2025). Emergent behaviors in multiagent pursuit evasion games within a bounded 2D grid world. *Scientific Reports*, *15*(1), 29376–29376. https://doi.org/10.1038/s41598-025-15057-x

Young, W., & Farrow, D. (2006). A Review of Agility. *Strength and Conditioning Journal*, *28*(5), 24–29. https://doi.org/10.1519/00126548-200610000-00004