

## The Effectiveness of Traditional Tug of War Game in Improving Arm Muscle Strength of Elementary School Students at SD Telkom Makassar

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### ABSTRACT

This study aimed to determine the effectiveness of the traditional tug of war game in improving arm muscle strength among elementary school students at SD Telkom Makassar. A quasi-experimental research design with pretest-posttest control group was employed, involving 60 students divided into experimental and control groups of 30 students each. The experimental group participated in tug of war activities twice weekly for eight weeks, while the control group engaged in conventional physical education exercises. Arm muscle strength was measured using a hand dynamometer before and after the intervention period. The results demonstrated that the experimental group showed a significant increase in arm muscle strength with a mean difference of 8.73 kg ( $p < 0.001$ ), while the control group exhibited a minimal improvement of 1.54 kg. The effect size analysis revealed a large Cohen's  $d$  value of 1.24, indicating substantial practical significance. These findings suggest that traditional tug of war games are an effective and engaging approach to enhance arm muscle strength in elementary school children, offering an alternative method to conventional physical education programs. [The study concludes that integration of traditional games into school physical education curriculum can provide both physical benefits and cultural preservation.

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- A. Conception and design of the study;
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## INTRODUCTION

Physical fitness is a fundamental component of overall health and development in children, particularly during the elementary school years when growth patterns and motor skill development are most critical (Mazzardo et al., 2024). The World Health Organization emphasizes that children and adolescents aged 5-17 years should engage in at least 60 minutes of moderate-to-vigorous intensity physical activity daily to maintain optimal physical and mental health (Movia et al., 2022). Among the various components of physical fitness, muscular strength represents an essential indicator of overall physical capability and is associated with numerous health benefits including improved metabolic function, better postural control, and enhanced athletic performance.

In the context of Indonesian education, physical education (PE) programs have been recognized as crucial platforms for promoting physical activity and fitness development among school-aged children. However, contemporary physical education approaches in many schools often emphasize modern sports and structured exercise programs, potentially neglecting the value of traditional games and cultural heritage activities (Ali Muhaimin et al., 2024). Traditional games, such as tarik tambang (tug of war), represent culturally significant activities that have been practiced for generations across various Indonesian communities and serve as important bearers of cultural identity and social cohesion. These traditional games are not only accessible and economical in terms of equipment and resources required, but they also promote collaborative learning, social bonding, and psychological well-being among participants.

The tug of war game specifically requires bilateral coordination, sustained muscular effort, and involves multiple muscle groups, particularly those of the upper extremities. From a biomechanical perspective, the pulling action during tug of war engages the muscles of the forearm, upper arm, shoulder, and back regions, thereby providing a comprehensive training stimulus for arm muscle development (Cayero et al., 2021). Despite the apparent potential benefits of this traditional game for physical development, there is limited empirical evidence in the Indonesian research context regarding its specific effects on arm muscle strength among elementary school-aged children. This gap in the literature motivated the current investigation.

The significance of this research extends beyond academic interest. First, it provides empirical evidence for the effectiveness of traditional games in achieving specific physical fitness outcomes, thereby contributing to the body of knowledge on culturally appropriate physical education approaches. Second, it addresses the practical concerns of physical education practitioners seeking alternative or complementary methods to enhance student fitness within resource-limited school environments. Third, the findings may inform curriculum development and policy decisions regarding the integration of traditional games into formal school physical education programs (Dwi Fathihah, 2024). Finally, this study contributes to the preservation and valorization of Indonesian cultural heritage by demonstrating the educational and health benefits of traditional games in contemporary school settings.

The primary objective of this study was to investigate the effectiveness of tug of war as a traditional game intervention in improving arm muscle strength among elementary school students at SD Telkom Makassar compared to conventional physical education activities. Specifically, this research sought to address the following research questions: What are the differences in arm muscle strength improvements between students who participate in tug of war activities and those who engage in conventional physical education exercises? What is the magnitude of the effect of traditional tug of war games on arm muscle strength development in this population?

## METHODS

This research employed a quasi-experimental research design with a pretest-posttest control group approach to examine the effectiveness of tug of war intervention on arm muscle strength. The study was conducted at SD Telkom Makassar over an eight-week period from March to May 2023. The population consisted of all fourth-grade students (approximately 120 students) enrolled at the school during the academic year 2022-2023. Using purposive sampling technique, 60 students were selected and randomly assigned to two groups: 30 students in the experimental group and 30 students in the control group. The inclusion criteria were: students aged 9-11 years, physically able to participate in physical activities, free from injuries or medical conditions that would prevent participation, and having parental consent. Students with existing musculoskeletal injuries, chronic health conditions affecting physical performance, or those taking medications that could influence muscular strength were excluded from the study.

The independent variable in this study was the type of physical activity intervention, while the dependent variable was arm muscle strength measured in kilograms of force. The experimental group participated in tug of war activities structured as part of their physical education curriculum, conducted twice weekly for 60 minutes per session (total duration: 8 weeks). Each session consisted of a 10-minute warm-up including general dynamic stretching exercises, 40 minutes of tug of war activities involving variations in rope pulling techniques, team formations, and competitive and cooperative game formats, and 10 minutes of cool-down with static stretching and relaxation exercises. The control group continued their standard physical education program consisting of conventional exercises including basic aerobic activities, general strength training exercises, flexibility work, and traditional sports skill instruction, also delivered twice weekly for 60 minutes per session.

Arm muscle strength was measured using a mechanical hand dynamometer calibrated according to manufacturer specifications before the study commenced. Measurements were taken in a standardized manner with participants standing in an upright posture, arm held at waist level, wrist in neutral position, and participants instructed to exert maximum voluntary contraction for approximately 3-5 seconds. Three trials were conducted for each hand with one-minute rest intervals between trials, and the maximum value recorded for each hand was used in the analysis. Measurements were performed at baseline (week 0) prior to any intervention and at the conclusion of the eight-week intervention period. All measurements were conducted by trained research assistants who were blinded to group assignment.

Data were analyzed using SPSS version 26.0 statistical software. Descriptive statistics including means, standard deviations, and frequency distributions were calculated to characterize the sample. Prior to hypothesis testing, the Shapiro-Wilk test was performed to assess normality of the data distribution, and Levene's test was conducted to examine the homogeneity of variance assumption. Given that the data satisfied assumptions for parametric tests, independent samples t-tests were

conducted to compare baseline characteristics between groups and to examine post-intervention differences in arm muscle strength between the experimental and control groups. Within-group changes from pretest to posttest were examined using paired samples t-tests. The magnitude of intervention effects was determined through calculation of Cohen's d effect size, with interpretation following conventional standards: 0.2-0.49 (small), 0.5-0.79 (medium), and  $\geq 0.80$  (large). A significance level of  $\alpha = 0.05$  was established for all statistical tests. The study received ethical approval from the school administration and informed consent was obtained from all parents or guardians prior to student participation.

## RESULTS AND DISCUSSION

The baseline characteristics of both groups are presented in descriptive detail. The experimental group consisted of 30 students with a mean age of  $10.2 \pm 0.8$  years, comprising 16 males and 14 females. The control group also included 30 students with a mean age of  $10.1 \pm 0.7$  years, with 17 males and 13 females. No statistically significant differences were observed between groups at baseline in terms of age ( $t = 0.54$ ,  $p = 0.591$ ), gender distribution ( $\chi^2 = 0.07$ ,  $p = 0.791$ ), or initial arm muscle strength measurements ( $t = 0.32$ ,  $p = 0.751$ ), confirming adequate randomization and group comparability prior to the intervention.

The pretest measurements revealed that the experimental group had a mean arm muscle strength of  $12.84 \pm 2.31$  kg, while the control group demonstrated a mean of  $12.76 \pm 2.18$  kg. These baseline values were comparable and did not differ significantly between groups. Following the eight-week intervention period, the experimental group demonstrated a mean arm muscle strength of  $21.57 \pm 2.89$  kg, representing an increase of 8.73 kg from baseline. In contrast, the control group's posttest measurement yielded a mean of  $14.30 \pm 2.56$  kg, indicating an increase of only 1.54 kg. The paired samples t-test revealed that both groups showed statistically significant within-group improvements from pretest to posttest (experimental group:  $t = 19.84$ ,  $p < 0.001$ ; control group:  $t = 4.67$ ,  $p < 0.001$ ). However, the magnitude of improvement in the experimental group was substantially greater than in the control group.

The independent samples t-test comparing post-intervention arm muscle strength between groups revealed a highly significant difference ( $t = 11.23$ ,  $p < 0.001$ ), with the experimental group demonstrating considerably superior arm muscle strength compared to the control group. The mean difference of 7.27 kg (95% CI: 5.89-8.65 kg) represented a clinically meaningful improvement. The calculation of Cohen's d effect size yielded a value of 1.24, indicating a large effect size that substantially exceeded conventional thresholds and demonstrated substantial practical significance of the intervention. These results collectively demonstrated that the tug of war intervention produced markedly greater improvements in arm muscle strength compared to conventional physical education activities.

The findings of this study provide compelling empirical evidence for the effectiveness of traditional tug of war games in promoting arm muscle strength

development among elementary school children. The substantial improvement observed in the experimental group, evidenced by both statistical significance and large effect size, can be understood through multiple biomechanical and physiological mechanisms. The tug of war activity involves sustained isometric and dynamic muscle contractions of the upper extremities, particularly engaging the forearm flexors, extensors, biceps, triceps, deltoids, and various back musculature (Salazar, 2022). This comprehensive muscular recruitment pattern provides a potent stimulus for neuromuscular adaptation and strength development consistent with established principles of strength training.

From a physiological perspective, the repeated pulling actions and sustained effort required during tug of war activities create mechanical tension within muscle fibers, leading to microtrauma and subsequent adaptive responses including protein synthesis and enlargement of muscle fiber cross-sectional area (Parker, 2024). The competitive and cooperative nature of the game also promotes sustained intensity of effort through psychological motivation, potentially enhancing the training stimulus compared to more passive or less engaging conventional exercises. Furthermore, the natural variability in resistance and dynamic nature of the game may provide superior proprioceptive feedback and neural adaptations compared to resistance training with fixed implements.

The modest but statistically significant improvement observed in the control group receiving conventional physical education (1.54 kg increase) likely reflects the natural developmental progression and baseline physical activity engagement typical of elementary school children. However, the substantially greater improvement in the experimental group clearly demonstrates the added value of the structured tug of war intervention. This finding is consistent with prior research on traditional games and physical activity in school settings, though direct comparative studies are limited in the Indonesian context (Zulnadila, 2025).

Several pedagogical advantages of traditional tug of war games warrant consideration in the interpretation of these findings. First, the game requires minimal equipment and financial investment, making it highly accessible in resource-limited school environments common throughout Indonesia. Second, the inherent collaborative structure of the game promotes positive social interactions, teamwork, and peer support, potentially enhancing student motivation and engagement compared to individualized conventional exercises. Third, participation in culturally significant traditional games may enhance psychological well-being and sense of cultural identity among students (Ashar et al., 2024). Fourth, the game is easily adapted to accommodate various skill levels and can be modified to adjust difficulty and training intensity as students develop.

The substantial effect size observed in this study (Cohen's  $d = 1.24$ ) exceeds typical effect sizes reported in many physical education intervention studies, suggesting that the tug of war intervention represents a particularly effective approach for this population (Bibić et al., 2025). This finding challenges any potential dismissal of traditional games as inferior to contemporary physical training methods and provides evidence for their complementary or even superior role in school physical education

programs. The eight-week duration of the intervention appears sufficient to produce meaningful physiological adaptations, suggesting that sustainable implementation in school curricula is feasible and practical.

However, several factors warrant consideration in interpreting and generalizing these findings. The study was conducted with a single elementary school in Makassar, which may limit generalizability to other geographic regions and educational contexts within Indonesia and beyond. The measurement of arm muscle strength was limited to hand grip strength as assessed by dynamometry; assessment of other upper extremity strength components or comprehensive fitness profiles was not conducted. The study did not include long-term follow-up assessments to determine the persistence of strength gains after intervention cessation. Additionally, potential confounding variables such as nutrition, sleep quality, and physical activity outside the school setting were not systematically controlled or measured.

Future research should address these limitations through larger-scale studies involving multiple schools across various regions, longer intervention periods, extended follow-up assessments, measurement of additional strength components, and careful documentation of potential confounding variables. Investigation of mechanisms underlying the superior effectiveness of traditional games compared to conventional exercise approaches would also contribute valuable insights. Furthermore, examination of whether the social, cultural, and psychological benefits of traditional games translate into improved overall wellness and academic outcomes beyond physical fitness would strengthen the justification for their integration into school curricula. Research examining long-term adherence and sustainability of traditional game-based physical education programs would also be valuable for informing educational policy and practice (Wulansari et al., 2025).

## CONCLUSION

This study demonstrates that traditional tug of war games are significantly more effective than conventional physical education activities in improving arm muscle strength among elementary school students at SD Telkom Makassar. The experimental group achieved an 8.73 kg increase in arm muscle strength over eight weeks compared to only 1.54 kg in the control group, with the intervention producing a large effect size ( $d = 1.24$ ). These findings provide robust empirical evidence supporting the effectiveness of culturally traditional games as legitimate and valuable components of school physical education programming.

Based on these findings, we recommend that school administrators and physical education curriculum developers consider integrating traditional games such as tug of war into regular physical education programming to enhance student fitness outcomes. The accessibility, cultural significance, and demonstrated effectiveness of these games make them particularly suitable for implementation in Indonesian school settings. Physical education instructors should receive professional development training to



effectively incorporate traditional games with appropriate progression, safety measures, and adaptations for diverse student populations. Research-based physical education programs that deliberately combine traditional games with modern pedagogical approaches may represent an optimal strategy for promoting both fitness development and cultural preservation. Further research involving multiple schools and extended intervention periods is recommended to confirm and extend these findings across broader populations and geographic contexts. Additionally, investigation of mechanisms linking traditional game participation with broader health, academic, and psychosocial outcomes would strengthen the evidence base for policy changes at regional and national levels.

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## REFERENCES

- Ali Muhaimin, Johansyah Lubis, & Fahmy Fachrezzy. (2024). The Impact of Traditional Games on Physical Fitness and Well-being of Literature Review. *South Eastern European Journal of Public Health*, 536–544. <https://doi.org/10.70135/seejph.vi.1751>
- Ashar, Sitti Mania, Misykat malik Ibrahim, St. Syamsudduha, Sadaruddin, & Anita Candra Dewi. (2024). The Impact of Traditional Games on Social-Emotional Development: A Comprehensive Review of Existing Research. *Journal of Learning and Development Studies*, 4(2), 39–51. <https://doi.org/10.32996/jlds.2024.4.2.5>
- Bibić, E., Stupar, D., Mitrović, N., Zoretić, D., & Trajković, N. (2025). Effects of High-Intensity Interval Training with Change of Direction Versus Small-Sided Games on Physical Fitness in School-Aged Children. *Children*, 12(9), 1124. <https://doi.org/10.3390/children12091124>
- Cayero, R., Rocandio, V., Calleja-González, J., & Martínez de Aldama, I. (2021). *Analysis of Tug of War Competition. A Narrative Complete Review*. <https://doi.org/10.20944/preprints202101.0630.v1>
- Dwi Fathihah, M. (2024). Menjaga Tradisi, Mengasah Motorik: Dampak Positif Permainan Tradisional pada Siswa Sekolah Dasar. *SAKALIMA: Pilar Pemberdayaan Masyarakat Pendidikan*, 1(1), 37–49. <https://doi.org/10.70211/sakalima.v1i1.109>
- Mazzardo, O., Weis, B. M., Sampaio, A. A., de Lima, D. F., de Souza, D. C., & Furtado, O. (2024). Associations Between Fundamental Motor Skill Domains and Physical Fitness Components in 5-11-Year-Old Children. *Perceptual and Motor Skills*, 131(6), 2103–2124. <https://doi.org/10.1177/00315125241284785>

- Movia, M., Macher, S., Antony, G., Zeuschner, V., Wamprechtsamer, G., delle Grazie, J., Simi, H., & Fuchs-Neuhold, B. (2022). Health Impact Assessment (HIA) of a Daily Physical Activity Unit in Schools: Focus on Children and Adolescents in Austria Up to the 8th Grade. *International Journal of Environmental Research and Public Health*, 19(11), 6428. <https://doi.org/10.3390/ijerph19116428>
- Parker, B. L. (2024). *eLife assessment: A novel imaging method (FIM-ID) reveals that myofibrillogenesis plays a major role in the mechanically induced growth of skeletal muscle*. <https://doi.org/10.7554/eLife.92674.3.sa0>
- Salazar, L. (2022). *Relative Isometric and Dynamic Endurance Curves for Different Muscle Groups of the Upper Extremities*. [Louisiana State University and Agricultural & Mechanical College]. [https://doi.org/10.31390/gradschool\\_disstheses.4540](https://doi.org/10.31390/gradschool_disstheses.4540)
- Wulansari, D. A., Hermawan, H., Riyadi, M. B., Nazareta, P. I., & Rozi, F. (2025). Permainan Tradisional Dalam Pendidikan Jasmani: A Systematic Literature Review. *Afeksi: Jurnal Penelitian dan Evaluasi Pendidikan*, 6(6), 1339–1357. <https://doi.org/10.59698/afeksi.v6i6.622>
- Zulnadila, Z. (2025). Traditional games for physical fitness in primary school students: A systematic review in Indonesia. *Tanjungpura Journal of Coaching Research*, 3(1), 76–86. <https://doi.org/10.26418/tajor.v3i2.89690>