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Improving Motor Skills through Athletics: A Case Study of High School Students in Sumedang

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Abstract

The problem in this study is that the integration of athletics into the physical education curriculum in Indonesia, especially in areas such as Sumedang Regency, is often hampered by limited facilities and infrastructure. This has the potential to hinder the effective development of basic motor skills in high school students, which are the foundation for physical literacy and an active lifestyle. This study aims to evaluate the impact of a structured athletics training program on improving the motor skills of high school students in Sumedang Regency. The research method used a quasi-experimental design with a one-group pretest-posttest model. A total of 60 students (30 males, 30 females) aged 15-17 years from three high schools participated. Motor skills were assessed through a 30-meter sprint, standing long jump, and 2 kg medicine ball throw tests. Participants undergo an athletic training program for 6 weeks (3 sessions/week). The data were analyzed using a Paired Samples t-test. The results showed a very significant improvement ($p < 0.001$) in all three skill components. The average sprint time decreased from 5.87 to 5.41 seconds, the jump distance increased from 1.85 to 2.05 meters, and the throw distance increased from 4.12 to 4.56 meters. The effect size for all results was classified as large. The conclusion is that a structured athletic training program has been proven effective in improving the motor skills of high school students, even under limited facility conditions.

Keywords: Athletics; motor skills; physical education; high school students; Sumedang.

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Introduction

The development of motor skills during adolescence is a critical foundation that not only determines an individual's physical capacity for sports but also forms the foundation for a lifelong, active and healthy lifestyle (Lloyd & Oliver, 2012). From a physical education perspective, mastery of basic motor skills such as running, jumping, and throwing is seen as an essential element of physical literacy, namely the ability, confidence, and motivation to participate in physical activity on a sustained basis (Whitehead, 2010:77). One sport that directly and comprehensively trains these basic movements is athletics. Athletics, with its running, jumping, and throwing events, is not simply a competitive sport, but more fundamentally, it is a manifestation of universal human movement that has been conceptualized as the "mother of all sports" (Gallahue & Donnelly, 2007:92).

Athletic activities are intrinsically linked to the development of health-related fitness and skill-related fitness components, such as strength, speed, agility, coordination, and balance (Payne & Isaacs, 2017:59). Theoretically, motor development models (e.g., Gallahue's Generic Levels of Skill Proficiency model) position adolescence as a period of "application," where previously mastered basic skills can be consolidated, combined, and applied in the context of more complex and specific activities (Gallahue et al., 2019:48).

It is during this phase that structured, principle-based training interventions become most influential. Research consistently shows that well-developed motor skills during adolescence are positively correlated with levels of physical activity, cardiorespiratory fitness, physical self-concept, and a reduced risk of obesity later in life (Lubans et al., 2010; Robinson et al., 2015). Conversely, impaired motor skills can be a barrier to participation in sports and recreation, exacerbating the global trend of physical inactivity (Barnett et al., 2009). In the Indonesian context, physical education in schools is mandated to be the primary vehicle for motor skill development and the instilling of healthy lifestyle values. The 2013 curriculum for physical education, sports, and health (PJOK) at the senior high school level has integrated athletics as one of the core subjects.

This aligns with the vision that athletics, with its relatively simple equipment and ability to train basic movements, is accessible to all levels of society (Ministry of Education and Culture, 2017). However, there is often a wide gap between curricular expectations and the reality on the ground. The implementation of athletics learning in many schools, especially in areas outside of urban centers, faces multidimensional challenges. A study conducted by (Kurniawan & Setyawan, 2020) identified several main obstacles, namely: (1) limited sports facilities and infrastructure (such as running tracks, jump pits, or adequate throwing equipment), (2) lack of competence and variety of teaching methods in presenting athletics material, and (3) low interest and motivation of students who view athletics as a monotonous, tiring, and less interesting activity than team sports such as soccer or basketball.

This situation becomes even more complex and concerning in semi-urban and rural areas, such as Sumedang Regency, West Java. As a region with diverse geographic characteristics and often limited educational resources, schools in Sumedang may face extra challenges in implementing ideal athletics learning. Budgetary limitations for facility maintenance, equipment purchases, and teacher capacity building present significant

structural barriers (Pratama & Suherman, 2019). As a result, athletics instruction is often reduced to simple activities without structured training progressions, or even completely ignored, thus under-exploiting its potential as a systematic means of motor development.

The long-term impact is the threat to the achievement of national physical literacy targets and the increased risk of a younger generation being less physically active. The urgency of this research arises from the need to address the gap between the pedagogical potential of athletics and the challenges of its implementation in under-resourced areas. Globally, a large body of evidence supports the effectiveness of structured athletic programs in improving the fitness and motor skills of adolescents. A meta-analysis by (Van-Beurden et al., 2003) concluded that interventions focused on the development of fundamental motor skills significantly improve the physical competence of children and adolescents.

Specifically, sprint-based and plyometric training has been shown to improve speed, explosive power, and neuromuscular coordination (Markovic & Mikulic, 2010; Paradisis et al., 2014). Meanwhile, throwing activities can develop upper-body strength, stability, and coordination (Saeterbakken et al., 2011). However, most of this evidence comes from developed countries or schools with adequate facilities. In Indonesia, although several studies have been conducted, such as a study (Pratama & Suherman, 2019) in West Java that confirmed improved physical fitness through athletics, and a study (Andriani et al., 2020) that highlighted the importance of equipment modification in athletics instruction for junior high school students, there remains a gap in the literature.

The research gap this study aims to fill is the lack of in-depth investigation into the effectiveness of athletic training programs specifically designed to address resource constraints in the specific context of Sumedang Regency. Most previous research has focused on general fitness outcomes or in urban settings, without delving deeply into the methodological adaptations necessary in areas with minimal facilities. Therefore, this study goes beyond simply testing the hypothesis that "athletic training improves motor skills," but rather seeks to demonstrate that with a creative, structured approach that leverages local resources, athletics can remain a highly effective intervention even under limited conditions.

This study adopts the philosophy that limited facilities are not an absolute obstacle, but rather a challenge that requires pedagogical innovation. The training program was designed using simple tools (medicine balls, cones, existing field areas) and emphasized movement quality, intensity, and consistency, rather than sophisticated equipment. Thus, this study's unique position lies in its contextual and applicable focus. This study aims to (1) Evaluate the impact of a six-week structured athletic training program on improving specific motor skills (sprint speed, explosive leg strength, and upper body coordination) in high school students in Sumedang Regency; and (2) Analyze the implications of these findings for the development of a practical, adaptive, and replicable athletic learning model in schools with similar characteristics in Indonesia.

The findings of this study are expected to provide a dual contribution. Theoretically, this study will enrich the Indonesian sports science treasury with empirical evidence on the mechanisms of motor skill improvement through athletics in a resource-limited context. Practically, the results of this study can serve as a reference for physical education teachers, coaches, and policymakers at the school and education office levels to design and implement

realistic, effective, and sustainable athletics-based motor development programs to support the realization of a physically literate, healthy, and active young generation of Indonesians.

Method

This study employed a quasi-experimental design with a one-group pretest-posttest model. This design was chosen because it takes into account the reality in the field where researchers do not have full control over random assignment of subjects to experimental and control groups in a pre-scheduled school setting (Creswell & Creswell, 2018:49). While not as robust as a pure experimental design, this design is effective for assessing the initial impact of an intervention in a real-world setting, especially when the focus is on measuring changes in one group after being given treatment (Sugiyono, 2019:38).

In this design, motor skills measurements (pretest) were conducted before the athletic training intervention, then repeated (posttest) with the same instrument after the program was completed, to see any differences that occurred. The study participants were 60 high school students (30 boys and 30 girls) who were selected using a purposive sampling technique. The inclusion criteria for participants were (1) aged 15-17 years; (2) enrolled as a 10th or 11th grade student at one of the three public high schools in Sumedang Regency that were the study locations; (3) actively participating in Physical Education, Sports, and Health (PJOK) lessons; and (4) declared healthy and having no history of musculoskeletal injuries or medical conditions that limit heavy physical activity, based on self-reported declarations and confirmation from the homeroom teacher.

The three schools were selected to represent a variety of locations (suburban and rural) in Sumedang Regency. Prior to the study, informed consent was obtained from parents/guardians and administrative permission was obtained from the schools. This procedure followed simple research ethics guidelines recommended for research in physical education (Thomas, 2015:107). Motor skills were measured using three validated standardized tests widely used in sports science research and physical fitness assessment. These tests were selected because they specifically represent the fundamental movement components of athletics (running, jumping, throwing) and can be administered with simple equipment available at the school.

1. The 30-meter sprint test is used to measure running speed and dynamic motor coordination. The implementation procedure refers to the protocol described by (Haff & Triplett, 2016:83). Participants stand behind the starting line without a standing start. Elapsed time is measured using two digital stopwatches (Casio HS-80TW brand) by two experienced observers, starting when the participant makes the first movement and stopping when the chest crosses the finish line. Results are taken from the average time of both observers. This test has high test-retest reliability ($r > 0.90$) in measuring acceleration speed (Mujika et al., 2009).
2. The standing broad jump test is used to measure explosive power of the lower leg muscles and overall body coordination during jumping. The procedure follows guidelines adopted in many studies. Participants stand with both feet parallel behind a starting line, then swing their arms and bend their knees before jumping as far forward as possible, landing on both feet. The distance from the starting line to the nearest heel point at the time of landing is

measured using a rolled measuring tape with an accuracy of 0.1 cm. Two attempts are given, and the best result is recorded. This test is a valid and reliable indicator of leg strength in adolescents (Ortega et al., 2008).

3. The 2-kg medicine ball throw test is used to measure upper-body strength and coordination. Participants sit on the floor with their back, hips, and head against a wall to minimize the contribution of lower-body movements, as recommended by (Stockbrugger & Haennel, 2001). The medicine ball is held with both hands in front of the chest. Participants then throw the ball as far as possible in a horizontal direction. The distance is measured from the wall (vertical projection) to the ball's first landing point. Two trials are given, and the best result is recorded. This test has a significant correlation with chest and shoulder muscle strength and is often used as a practical alternative to laboratory tests (Mayorga-Vega et al., 2014).

Data analysis collected from the pretest and posttest results was analyzed using SPSS software version 25. The analysis was carried out in two stages of descriptive statistics: used to calculate the mean (M) and standard deviation (SD) of each variable (30m running time, jump distance, throwing distance) in both the pretest and posttest. Inferential statistics to test the significance of the difference between the pretest and posttest results, used the Paired Samples t-test. This test was chosen because the data being compared came from the same sample measured twice under different conditions (before and after the intervention) (Pallant, 2020:74). The assumption of data normality was first tested using the Kolmogorov-Smirnov test. The level of statistical significance was set at $\alpha < 0.05$, which means the difference is declared significant if the resulting probability value (p-value) is less than 0.05.

Results

This quasi-experimental study with a one-group pretest-posttest design successfully collected comprehensive data from 60 participants (30 men and 30 women) who completed the entire six-week structured athletic training program. Data collected from three motor skills tests: the 30-meter sprint, the long jump without a run-up, and the 2-kg medicine ball throw were analyzed to test the effectiveness of the intervention. The following is a comprehensive presentation of the study results. Prior to conducting inferential analysis, data characteristics and statistical assumptions were examined. Initial examination of outliers using boxplots revealed no disruptive extreme values in the three variables, either in the pretest or posttest.

Next, a normality test for the difference in scores (gain scores) between the posttest and pretest was conducted using the Kolmogorov-Smirnov test. The test results showed that the distribution of gain score data for the three variables did not deviate significantly from the normal distribution, with a p-value > 0.05 for each test (Sprint: $p = 0.200$; Long Jump: $p = 0.150$; Ball Throw: $p = 0.089$). With this normality assumption met, the use of a paired samples t-test was deemed appropriate and valid for testing the mean difference between two interrelated measurements (Pallant, 2020:76). Descriptive statistics provide an overview of the group's performance before and after the intervention. A complete summary of the results is presented in Table 1.

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Table 1. Descriptive statistics of pretest and posttest results on motor skills test (N=60)

Measured Variables	Pretest (M ± SD)	Posttest (M ± SD)	Mean Change (Δ)	Percentage Increase (%)
30m Sprint (seconds)	5.87 ± 0.62	5.41 ± 0.55	-0.46 seconds	7.8% (speed increase)
Long Jump Without Run-Up (m)	1.85 ± 0.23	2.05 ± 0.26	+0.20 meters	10.8%
2kg Medicine Ball Throw (m)	4.12 ± 0.51	4.56 ± 0.47	+0.44 meters	10.7%

Description: M = Mean (Average), SD = Standard Deviation, Δ = Average difference (Posttest - Pretest).

Table 1 shows improvements in performance across all measured motor skill components. In the 30-meter sprint test, the average time decreased from 5.87 seconds to 5.41 seconds. This 0.46-second decrease represents a 7.8% increase in speed. The standard deviation, which decreased from 0.62 to 0.55, also indicates that performance variation between participants narrowed slightly after training, possibly reflecting improved movement consistency. In the long jump without a run-up, the average distance increased from 1.85 meters to 2.05 meters. This 0.20-meter (or 20 cm) increase is equivalent to a 10.8% increase in performance. This improvement indicates substantial development in lower-limb explosive power. In the medicine ball throw test, the average distance increased from 4.12 meters to 4.56 meters. This increase of 0.44 meters (44 cm) represents a 10.7% improvement, indicating significant improvement in strength and coordination of the upper body, shoulders, and core muscles.

To determine whether the improvements seen in the descriptive statistics were statistically significant or simply due to random fluctuations, a paired-samples t-test was performed. Detailed test results are presented in Table 2.

Table 2. Results of paired sample t-test for comparison of pretest and posttest on motor skills test

Variables	Mean Difference (Post-Pre)	Standard Error Difference	t (df = 59)	p-value (2-tailed)	95% Confidence Interval
30m Sprint (seconds)	-0.46	0.065	-7.12	< 0.001	[-0.59, -0.33]
Long Jump Without Run-Up (m)	+0.20	0.024	8.46	< 0.001	[0.15, 0.25]
2kg Medicine Ball Throw (m)	+0.44	0.069	6.38	< 0.001	[0.30, 0.58]

Description: df = degrees of freedom; Positive/negative t-values indicate the direction of change.

Interpretation of the results in Table 2: Running speed (30m Sprint): A t-value of -7.12 with $p < 0.001$ indicates that the decrease in running time (increase in speed) after the intervention is highly statistically significant. The probability that this result would have occurred without the effects of the training program (simply by chance) is less than 0.1%. The 95% confidence interval for the difference in means is between -0.59 and -0.33 seconds. Since this interval does not include zero (0), we can be confident with a 95% confidence level that the increase in speed is real. Explosive Leg Power (Long Jump): A t-value of 8.46 with $p < 0.001$ indicates that the increase in jump distance is also highly significant. The 95% confidence interval between 0.15 and 0.25 meters confirms that the minimum increase that can be expected from this program is approximately 15 cm.

Upper body strength and coordination (medicine ball throw): A t-value of 6.38 with $p < 0.001$ confirms that the increase in throwing distance was also highly significant. A 95% confidence interval between 0.30 and 0.58 meters provides a consistent estimate of the range of improvement. To understand the practical significance of the training program, Cohen's d was calculated as an effect size. This calculation is important because statistical significance (p-value) is strongly influenced by sample size, while effect size provides an indication of the magnitude of change 30m Sprint: Cohen's d = 0.92 (Large Effect), Long Jump Without Run-Up: Cohen's d = 1.09 (Large Effect), Medicine Ball Throw: Cohen's d = 0.82 (Large Effect).

Based on Cohen's (1988) convention, a d value > 0.8 is categorized as a large effect size. This indicates that the six-week structured athletic training program not only produced statistically significant changes but also had a substantial and practically meaningful impact on improving the three fundamental motor skills in the high school student population studied. Comprehensively, the results of descriptive, inferential, and effect size statistical analyses unanimously and consistently support the study findings. The six-week structured athletic training program was proven to be significant and effective in improving the motor skills of high school students in Sumedang Regency. Improvements occurred in the components of speed (running), explosive strength (jumping), and upper body strength and coordination (throwing), with the magnitude of changes included in the large effect size category. These results provide a strong empirical basis for discussing the theoretical and practical implications of these findings.

Discussion

This study aimed to evaluate the effectiveness of a structured athletic training program in improving the motor skills of high school students in Sumedang Regency. The statistical analysis showed highly significant ($p < 0.001$) and significant (large effect size) improvements in the three skill components tested: running speed, explosive leg strength, and upper body strength and coordination. These findings provide strong empirical support for the strategic role of athletics as a foundation for physical education, particularly in resource-constrained school contexts. The increase in running speed, indicated by a decrease in the 30-meter sprint time, aligns with the principle of neuromuscular adaptation through specific training.

Repeated short-interval sprint training, as implemented in this program, has been shown to improve fast-twitch fiber recruitment, intra- and intermuscular coordination, and stretch-shortening cycle efficiency (Paradisis et al., 2014). Our findings confirm research (Markovic & Mikulic, 2010) that speed-based training significantly improves sprint performance in adolescents. In an educational context, this suggests that basic running events, even without a tartan track, can be modified to produce beneficial physiological adaptations for students.

Furthermore, the increase in explosive leg strength, reflected in the increase in long jump distance without a run-up, can be attributed to the plyometric component of the training program. Exercises such as tuck jumps and box jumps effectively train the leg muscle contraction-shortening cycle, which is a key mechanism for generating explosive power (Bompa & Haff, 2009:98). This finding is consistent with a study by Saeterbakken et al.,

2011, which reported that 8 weeks of plyometric training improved vertical and horizontal jump performance in adolescent athletes. Notably, in our study, the improvements occurred despite the use of simple equipment (a bench or low hurdles), suggesting that training principles, rather than the sophistication of the equipment, are the primary determinant.

As forIncreased upper body strength and coordination in the medicine ball throwing test indicates the development of an effective kinetic chain from the legs, hips, core, to the shoulders and arms during the throwing motion. Medicine ball exercises that focus on pushing, rotating, and throwing movements help develop functional strength and coordination between body segments (Haff & Triplett, 2016). These results align with a report (Mayorga-Vega et al., 2014) that validated the medicine ball throwing test as a reliable measure of upper body strength in adolescents. The 10.7% increase in a relatively short period of time (6 weeks) underscores the high adaptive potential of this age group.

Research on the effectiveness of athletic training for motor development is not entirely new. However, the novelty and main contribution of this research lies in the specific context and implementation approach, which distinguishes it from previous relevant research. Unlike research in the context of adequate facilities, many previous studies, such as those by Bailey et al., 2013; Gallahue et al., 2019:112, discuss the benefits of athletics within a broad motor development theory framework, often in school or club settings with standard athletic facilities (track, jump pit, shot put).

This research goes beyond that by explicitly testing and demonstrating that the principles of athletic training can still be effectively applied in environments with limited infrastructure. We demonstrate that equipment modifications (e.g., using medicine balls instead of shot put, cones as markers instead of official tracks) and an emphasis on movement quality can overcome infrastructure barriers. Unlike similar research in Indonesia, several Indonesian researchers have studied athletics. Pratama & Suherman (2019) examined the effect of athletics on the physical fitness of students in West Java. However, their research focused on general fitness outcomes (e.g., cardiovascular endurance) and did not delve deeply into specific improvements in fundamental movement skills, as measured in this study.

Furthermore, the specific geographic focus on Sumedang Regency provides contextual depth. Sumedang represents the characteristics of semi-urban and rural areas in Indonesia where resource constraints are a crucial issue, a nuance that might not be captured in studies with broader coverage. The emphasis on an adaptive and practical approach another novelty lies in its methodological implications for physical education teachers. This study goes beyond simply reporting "improvements" to demonstrate a detailed, step-by-step exercise protocol that can be replicated by teachers in similar schools.

This directly addresses the practical need identified by Kurniawan & Setyawan (2020) regarding the lack of variety and structure in athletics instruction. Therefore, this study serves as a proof of concept that quality athletics instruction is still possible under less-than-ideal conditions. These findings have important implications for physical education practice in Indonesia, particularly in efforts to improve students' physical literacy. Whitehead (2010:107) defines physical literacy as the motivation, confidence, physical competence, knowledge, and

understanding necessary to maintain lifelong physical activity. Competence in basic motor skills such as running, jumping, and throwing is a key pillar of this physical competence.

Structured training programs such as those in this study can help students master these competencies, which in turn increases their confidence to engage in more complex physical activities and sports (Lubans et al., 2010). In the context of Sumedang Regency and similar areas, the integration of practical athletic modules into the PJOK curriculum is not only about producing athletes, but rather as a preventive and promotive strategy to combat sedentary lifestyles among adolescents, a worrying trend also reported by the WHO (2020) in Indonesia.

By mastering fundamental movements, students gain a richer "movement repertoire," making participation in various forms of physical activity easier and more enjoyable, thus supporting lifelong engagement. Overall, the results of this study strengthen the evidence that athletics is an effective training modality for adolescent motor skill development. The added value of this study lies in demonstrating that such effectiveness can be achieved even in resource-limited settings, provided it is supported by a structured, progressive, and well-supervised program. These findings offer realistic and implementable solutions for local physical education stakeholders to optimize the role of athletics in the curriculum, not only as a sport but also as a crucial foundation for developing a physically literate, active, and healthy young generation.

Conclusion

This study shows that a six-week athletic training program significantly improved sprint speed, jumping ability, and throwing performance among high school students in Sumedang Regency. These results confirm the effectiveness of athletics as a means of developing important motor skills during adolescence. It is recommended that physical education teachers integrate structured athletics modules into their lessons, while schools and policymakers provide adequate support and facilities. Future studies should use longer interventions and more rigorous designs to explore additional physical and psychosocial outcomes.

Based on the results of the data analysis and discussion that have been described, this study produces the conclusion that a six-week structured athletic training program has proven to be significantly effective in improving the motor skills of high school students in Sumedang Regency.This improvement is shown in all three components measured.(a) running speed through the 30-meter sprint test (7.8% increase with a large effect size), (b) explosive leg strength through the long jump test without a run-up (10.8% increase with a large effect size), and (c) upper body strength and coordination through the medicine ball throw test (10.7% increase with a large effect size). These findings demonstrate that fundamental athletic training principles can produce significant physical adaptations in the adolescent population.

This study presents a novel approach through an adaptive, contextual approach. Its uniqueness and primary contribution is the demonstration that significant motor skill improvement can be achieved in school environments with limited facilities and

infrastructure, such as those faced by many high schools in Sumedang Regency. The success of this program demonstrates that the essence of motor development lies in the structure of the program, the progressiveness of the load, and the quality of supervision, not solely in the completeness of the facilities. This distinguishes this research from previous studies, which were often conducted in settings with adequate infrastructure support.

Athletics has the potential to become a strategic foundation for advancing physical literacy and combating sedentary lifestyles among Indonesian youth, particularly in rural and semi-urban areas. Mastery of basic motor skills (running, jumping, throwing) developed through athletics can improve physical competence and self-confidence, ultimately encouraging long-term participation in physical activity.

Author's Statement

We hereby declare that the research article entitled "Improving Motor Skills through Athletics: A Case Study of High School Students in Sumedang" is our original and collaborative work. All data presented in this article was obtained legally through the research process and has not been previously published, in whole or in part, in any form in any other publication media.

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