

THE EFFECTIVENESS OF INTERVAL TRAINING INTERVENTION ON THE MAXIMUM ACCELERATION OF THE 100 METER SPRINT IN THE DEVELOPMENT OF STUDENT ATHLETES

Abdul Rahman¹, Maria Herlinda Dos Santos², Khalid Rijaluddin³, Andi Ogo Darminto⁴, Asrul⁵

Universitas Muhammadiyah Bone^{1,2,3,4,5}
mariaherlinda@unimbone.ac.id

Abstract

The ability of the 100-meter sprint requires explosiveness and maximum speed that is often not ideally achieved by adolescent runners due to the application of less specific training methods. This study aims to evaluate the effectiveness of interval training protocol interventions on the maximum acceleration of the 100-meter sprint in the development of student athletes. A quantitative experimental approach with a one-group pretest-posttest design was applied in this study. A total of 20 male student-athletes were selected through purposive sampling techniques as study subjects. The intervention in the form of a structured interval training program was given for four weeks which included 12 comprehensive training sessions. Speed performance was measured using a standard 100-meter running test instrument, both before and after the intervention. Data were statistically analyzed using the Shapiro-Wilk normality test and the paired-sample t-test. The results revealed a significant decrease in average travel time from 22.68 seconds in the pre-test stage to 19.96 seconds in the post-test. The difference in time acceleration of 2.72 seconds was supported by the results of inferential statistical tests that showed high significance ($p < 0.001$). In conclusion, the interval training method has been proven to have a positive and crucial impact in boosting the speed of 100-meter sprint acceleration. As a practical implication, physical education teachers and sports coaches are recommended to adopt this interval training protocol to manifest physiological adaptation and optimize the speed capacity of intermediate runners. ($t = 16,670p < 0,001$)

Keywords: Interval Training; Sprint Speed; 100 Meter Run; Athletic Performance; Student Athlete.

Submitted : 17th of June 2026

Accepted : 31th of July 2026

Published : 31th of July 2026

Correspondence Author: Maria Herlinda Dos Santos, Universitas Muhammadiyah Bone, Indonesia.

E-Mail: mariaherlinda@unimbone.ac.id

DOI <http://dx.doi.org/10.31851/hon.v9i2.22640>



Jurnal Laman Olahraga Nusantara licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](https://creativecommons.org/licenses/by-sa/4.0/)

INTRODUCTION

Physical, Sports, and Health Education plays a strategic role that goes beyond the dimensions of mechanical physical activity, but rather acts as a catalyst in the holistic development of students' personal capacity and academic competence (Mutmainna & Hardi, 2025). In the scientific hierarchy of sports, athletics is classified as the mother of sport because the number of walking, running, jumping,

and throwing forms the ontogenetic foundation for all human motor skills (Fajar & Kurniawan, 2021). Comprehensive mastery of athletic biomechanics not only optimizes basic movement efficiency, but also facilitates the transition of achievement to other specific sports that relies on high-level parameters of speed, explosiveness, and neuromuscular coordination (Yang et al., 2021).

Within the athletic cluster, the number of 100-meter sprints is globally recognized as the pinnacle parameter of human anaerobic performance. Maximum performance in short-distance running requires the exploitation of acceleration speed, leg muscle explosiveness, and central nervous system reactivity accumulated in a very limited duration of time (Harsono, 2021). In contrast to endurance sports, explosive movements in sprints rely heavily on the dominance of the pure adenosine triphosphate-phosphocreatine (ATP-PC) energy system in the early phases of running. Physiological adaptation to this number requires the engineering of exercises with supra-maximum intensity so that the body is able to instantly regenerate energy and maximize mechanical power output before the glycolysis system takes over (Archacki et al., 2024).

Although the theoretical foundation for speed development is well established, the reality of sports coaching at the grassroots level, especially in the secondary school environment, is still faced with systemic performance deficits. In South Sulawesi Province, the physical fitness index in the student-age demographic is still mostly distributed in the "adequate" category, with the most essential weaknesses detected in the explosive power and speed reactivity components (Ramadhan, 2023). This degradation in the quality of physical condition is directly correlated with the absence of periodization of training programs based on scientific prescriptions at the extracurricular level in educational institutions.

This stagnation of physical coaching is even more crucial when contextualized with the regional demographic and education landscape. Referring to indicators from the Central Statistics Agency (BPS) of Bone Regency in 2023, the average length of school duration for residents only touches 7.54 years,

manifesting a significant disparity when compared to the national average which is at the level of 8.77 years (Central Statistics Agency of Bone Regency, 2023). These sociocultural and infrastructure conditions have implications for the inhibition of progressive human resource development, including in designing a regeneration system for student athletes. For comparison, similar stagnation was previously recorded in the neighboring district, Sinjai, during the 2018 South Sulawesi Regional Sports Week (PORDA), where the exploitation of athletics medals has not reached its maximum point due to the asymmetry between school coaching methods and the demands of pure achievement sports performance (South Sulawesi XVI Porda, 2018).

This biological and structural deficit was confirmed absolutely through clinical empirical observations in a specialized group, namely the extracurricular running club at SMA Negeri 4 Bone. Preliminary diagnostic data revealed a striking anomaly in the performance of the 100-meter run among 20 male student-athletes. Only 35% of students managed to break through the competitive threshold with a time record of 12.0-13.0 seconds, while the absolute dominance was in 65% of the population who were categorized as "lacking" due to exceeding 13 seconds, with an extreme deficit of 15.4 seconds. This delay in travel time over short distances represents a failure of neuromuscular adaptation, a low rate of force development (RFD), and inefficient recruitment of fast-twitch muscle fibers, which cumulatively indicates the malpractice of the training load design that has been applied.

Intervening in such a specific speed crisis, biomechanical modification and anaerobic capacity expansion can only be initiated through the application of specific training methods that trigger extreme metabolic adaptation. Interval training (or specifically Sprint Interval Training / SIT) emerges as the most superior training protocol because it is designed through a combination architecture of maximum intensity working phases (100-110% $\dot{V}O_{2max}$ /MAS) and precisely calibrated recovery breaks (Coates et al., 2022). Manipulation of load ratios and

measured breaks in interval training has been shown to reduce central nervous system stress but in parallel force functional hypertrophy of leg muscles and increased resistance to metabolic acidosis (Harsono, 2021). This exercise not only stimulates linear adaptation, but also triggers a surge in lower extremity power which contributes absolutely to the multiple of the athlete's step frequency (Nugraha, 2023).

The effectiveness of interval training interventions has solid empirical justification in the global and national literature discourse. Clinical experiments by Hall, Thompson, and Morris (2023) prove that interval training prescriptions trigger molecular adaptations that result in improved speed performance and anaerobic capacity in young athletes. At the local dimension, Ariningsih, Suratmin, and Kusuma (2021) legitimized that the interval load ranges of 60–100 meters and 110–150 meters are linearly correlated with 100-meter acceleration escalation in high school students. The synthesis of these findings is further validated by Mugiarti, Muhtarom, and Agustan (2023) who affirm that the interval method is able to correct biomechanical deficits and significantly increase running speed output in the middle school population.

Although the literature base on interval training has been consolidated, a systematic narrative review reveals a fundamental research gap that demands further experimental investigation. The majority of previous studies have designed interval training interventions with long macro cycles, i.e. between 8 and 12 weeks, to obtain significant physiological adaptations (Abassi et al., 2023). Although a recent study from Michailidis et al. (2023) has tested a short 4-week microcycle at a speed of 10 to 30 meters in adolescent football athletes, its impact purely on the acceleration of full-distance running (100 meters) in the context of school extracurricular clubs with a high frequency of intensive training (three times a week) has not been comprehensively mapped.

Articulating this scientific gap, this study was conducted to explore and evaluate the effectiveness of a four-week structural interval training protocol

intervention on the acceleration of 100-meter running speed in student athletes. This study aims to validate whether the ratio of short cycle load (microcycle) is precise enough in modifying the physiological system and energy mechanics of adolescent runners. These experimental findings are anticipated to formulate a new theoretical construct for school-based coaching discourse, as well as provide evidence-based guidelines for physical educators and coaches in navigating sports coaching to break the stagnation of high school-age athletes' achievement.

METHOD

This study adopts a quantitative approach through experimental methods to evaluate the impact of interventions in a measurable and objective manner. The research design implemented is a one-group pretest-posttest design, a structure that facilitates the comparison of running speed performance in the same group of subjects before and after receiving special treatment. The implementation of observation and intervention is centered on the field running track facility of SMA Negeri 4 Bone, an institution that has a regular athletic extracurricular coaching program.

The target population in this study included all students under the auspices of SMA Negeri 4 Bone running club. Sample withdrawal was carried out through purposive sampling techniques, where participants were selected based on a series of specific inclusion criteria to maintain homogeneous physical conditions. These criteria required participants to be active members, in excellent physical health, willing to comply with the full intervention schedule, and provide voluntary consent as research subjects. Through the screening, 20 male students were determined as a representative sample in this experiment.

The main instrument operated to extract performance data is the 100-meter sprint test. This instrument is justified as having very strong content validity, considering that its mileage and motion mechanics represent the anaerobic running speed variables with precision. In order to secure the reliability of the measurement

results, the test process is calibrated through the application of strictly standardized procedures. The standardization includes the use of the same running trajectory for all subjects, the provision of uniform cue instructions, and the recording of time in seconds using a digital stopwatch by a single consistent tester to minimize instrument bias.

The data collection procedure was systematically and gradually, beginning with the fulfillment of ethical considerations in the form of obtaining official permits from the authorities of SMA Negeri 4 Bone. The empirical data collection phase was carried out through direct observation of instruments twice, namely in the initial stage (pre-test) and the final stage (post-test). Between the two phases of measurement, the researcher injected treatment in the form of a structured interval training program that lasted for four weeks. This program was designed with a frequency of three meetings per week, so that the subjects completed a total of 12 progressive training sessions before being re-evaluated for their travel time achievements.

The overall numerical data collected from the running time test was then comprehensively processed using descriptive and inferential statistical analysis frameworks. Descriptive analysis was projected to calculate the distribution of mean values, standard deviations, score variances, and extreme time differences from each athlete's achievement. In the inferential dimension, the data distribution prerequisite test was carried out using the Shapiro-Wilk normality technique, considering the number of subject populations that were below the threshold of 50 respondents. Once the validated data met the normality assumptions, hypothesis testing was executed using the Paired Sample t-Test comparison method to determine the significance of the treatment impact. The entire analytical computation process was completed with the help of IBM SPSS Statistics software version 27 for Windows.

RESULTS

Descriptive statistical analysis evaluated the performance parameters of the 100-meter running time before and after the interval training protocol intervention.

The computational results demonstrated a consistent reduction in travel time in all study subjects, representing an escalation of running speed. The average sprint travel time in the pre-test phase was recorded as 22.68 seconds with a standard deviation of 4.06. Post-intervention, the average travel time in the post-test shrank sharply to 19.96 seconds with a smaller standard deviation of 3.50. This decrease in the standard deviation number indicates that the distribution of athletes' speed abilities becomes more homogeneous and even after receiving a structured training program. Overall, this intervention triggered an acceleration in the achievement of an average time of 2.72 seconds. The range of individual speed increases varies in each sample, with the smallest reduction in travel time recorded at 1.76 seconds, while the maximum performance reduction is 4.10 seconds.

Table 1. Descriptive Statistical Analysis of 100 Meter Sprint Performance (N = 20)

Measurement Variables		Minimum (Seconds)	Maximum (Seconds)	Red (Seconds)	Standard Deviation
Pre-Test Time	Travel	15,08	28,20	22,68	4,06
Post-Test Time	Travel	12,75	24,70	19,96	3,50

Testing of the assumption of data normality was performed using the Shapiro-Wilk technique before the inferential stage was executed. This prerequisite calculation resulted in a significance probability (Sig.) of 0.131 for the pre-test data distribution and 0.233 for the post-test data distribution. Both probability values exceeded the error tolerance threshold ($p > 0.05$), which confirmed that the travel time data was normally distributed and statistically feasible to be tested using parametric procedures. The main hypothesis test was then implemented through the Paired Sample t-Test to detect the significance of performance differentiation between measurement phases. This comparative analysis resulted in a t-calculated statistical value of 16.670 with a degree of freedom (df) of 19. The value of two-tailed significance was empirically detected at the level of 0.000 ($p < 0.001$).

Table 2. Inferential Test Results of Paired Sample t-Test

Phase Test	Comparison	t-Calculate value	df	Sig. (2-tailed)	Statistical Results	
<i>Pre-Test – Post-Test</i>		16,670	19	0,000	H ₀ rejected,	H ₁ accepted

The rejection of the null hypothesis (H₀) and the acceptance of the alternative hypothesis (H₁) confirmed the statistical significance of the experimental treatment. These quantitative findings solidly prove that the implemented interval training protocol had very significant positive implications for the acceleration escalation and improvement of the 100-meter run time in the evaluated student athletes.

DISCUSSION

These experimental findings validate the hypothesis that interval training protocol interventions significantly restructure the 100-meter running acceleration capacity in the mid-level student athlete population. This performance improvement is manifested because interval training engineers physiological stress in a controlled manner through high-intensity running repetitions separated by a tightly calibrated recovery phase. Mechanically, the acute physiological adaptation due to fluctuating loading facilitates the optimization of motor unit recruitment, increases the capacity of leg muscles to extract kinetic forces, and polishes the efficiency of the anaerobic metabolic system (especially the ATP-PC pathway) that dominates the energy supply in sprint numbers. The progressive overload mechanism urges the central nervous system and muscle tissue to adapt, resulting in a substantial escalation of the athlete's explosive energy during the drive and speed maintenance phases.

A critical comparison of ten global and regional literature reinforces the theoretical supremacy of this intervention. In the neurophysiological domain, these results resonate strongly with Hall, Thompson, and Morris (2023) who prove that exposure to interval sprints boosts anaerobic capacity without triggering premature depletion of the nervous system. This is in line with the findings of Yang et al. (2025) who affirm that repetitive sprinting training triggers controlled neuromuscular stress that dramatically optimizes anaerobic power output. On

metabolic efficiency parameters, the study of Clemente et al. (2021) and Arslan et al. (2022) validated that interval interventions with specific work-rest ratios were shown to expand anaerobic threshold capacity, allowing athletes to replicate maximum speed on running reps without excess acidosis. In the realm of biomechanics, this study confirms Nugraha's (2023) postulate that the explosion of leg muscle power due to interval work ratios is directly correlated with the escalation of frequency and stride length. This biomechanical argument is empirically strengthened by Darch et al. (2022) who prove that adequate inter-sprint recovery scheduling crucially prevents the kinematic degradation of joints that often impair runner technique due to residual fatigue.

Furthermore, the efficacy of intervals in the demographics of beginner learners is closely aligned with the research of Ariningsih, Suratmin, and Kusuma (2021) and Mugiarti, Muhtarom, and Agustan (2023) which verified that the deficit of beginner travel time can be aggressively reduced through interval loading. On the dimension of coaching architecture, these findings expand the conceptual framework of Bompa and Buzzichelli (2020) who mandate that the adaptation of anaerobic speed structurally is highly dependent on progressive variations in load, frequency, and volume of exercise. Finally, the study of Zhang et al. (2024) and the study of Rogers et al. (2024) legitimize the importance of the manipulation of the duration of recovery time confirmed in this research, where a rational active rest break is able to reduce the rate of blood lactate accumulation, so that the consistency of the athlete's explosive strength is maintained along the 100-meter course.

The theoretical implications of this experiment demand a reconstruction of the theory of microcycle periodization. These findings challenge the conventional coaching paradigm that often mandates a long duration of 8 to 12 weeks to trigger neuromuscular adaptation in athletes. The empirical data of this research definitively prove that a dense adaptation cycle of 4 weeks (12 sessions) with

precise manipulation of work intervals is very adequate to evaluate the physiology of adolescent runners in the school extracurricular environment.

In practice, the interval prescription in this research provides a validated intervention blueprint for physical educators and grassroots sports coaches. Interval training is positioned as the most measurable and efficient training guideline to exploit students' sprint talents without the need for heavy equipment. At the policy level, the escalation of student athletic achievement demands structural interventions; the education office and school managers are recommended to reorganize the procurement policy of track facilities according to specifications. At the same time, regional sports curriculum development authorities can adopt interval training protocols into district athletic talent guidance modules so that regeneration programs are standardized based on sports science-based interventions, rather than a trial-and-error approach.

CONCLUSION

This study conclusively proves that interval training interventions have a positive, very significant, and effective effect on increasing the acceleration of the 100-meter run in student athletes. The application of the microcycle for four weeks resulted in a reduction in average travel time of 2.72 seconds ($p < 0.001$), which confirms the occurrence of functional adaptations to the anaerobic energy system and neuromuscular recruitment of participants.

As a theoretical and practical contribution, this research provides empirical evidence that modification of interval training loads with short macro duration (four weeks) is sufficient to calibrate the explosiveness of the limbs and break the stagnation of the running speed of novice learners. This approach offers a blueprint for training periodization that is highly efficient and applicable for physical education teachers and extracurricular coaches in facilitating the achievement of student achievement in educational institutions with limited infrastructure.

Despite presenting solid findings, this study has a number of methodological limitations. The use of a one-group pretest-posttest design without the existence of a control group (comparator group) limits the study's capacity to isolate external

confounding variables absolutely. In addition, the constellation of samples involving only 20 male athletes from one school limits the generalization of these findings to female athletes and more heterogeneous geographic demographics.

To overcome these limitations, further research is recommended to adopt an experimental design of Randomized Controlled Trials (RCTs) involving specific control groups. Future investigations also urge to expand the scope of cross-gender samples, compare the efficacy of interval training with plyometric methods, and integrate biochemical instruments (such as blood lactate level measurements) to dissect athletes' metabolic responses on a cellular basis during interventions.

REFERENCES

- Abassi, S., et al. (2023). Physiological and performance adaptations to high-intensity interval training in youth athletes: A systematic review. *Journal of Sports Medicine and Physical Fitness*, 63(4), 512-522.
- Ahmad, M., & Prasetyo, M. (2023). Analisis teknik sprint terhadap hasil kecepatan lari 100 meter pada atlet pelajar. *Jurnal Pendidikan Olahraga dan Kesehatan*, 11(2), 5-12.
- Archacki, P., et al. (2024). Bioenergetics and metabolic demands of short-distance sprint running: A physiological perspective. *Journal of Sports Sciences and Medicine*, 23(1), 45-53.
- Ariningsih, D., Suratmin, S., & Kusuma, I. J. (2021). Pengaruh latihan interval anaerobik terhadap kecepatan lari 100 meter siswa SMA. *Jurnal Pendidikan Jasmani Olahraga*, 10(2), 123-131.
- Arslan, E., Kilit, B., Clemente, F. M., Murawska-Ciałowicz, E., & Soylu, Y. (2022). Effects of short-term sprint interval training on physical and physiological responses in young athletes. *Journal of Sports Sciences*, 40(6), 652-660.
- Badan Pusat Statistik Kabupaten Bone. (2023). *Statistik daerah Kabupaten Bone 2023*. BPS Kabupaten Bone.
- Bompa, T. O., & Buzzichelli, C. (2020). *Periodization: Theory and methodology of training* (6th ed.). Human Kinetics.
- Clemente, F. M., Ramirez-Campillo, R., & Sarmiento, H. (2021). High-intensity interval training in youth athletes: A systematic review and meta-analysis. *Sports Medicine*, 51(3), 525-545.

- Coates, A. M., Joyner, M. J., Little, J. P., Jones, A. M., & Gibala, M. J. (2022). A perspective on high-intensity interval training for performance and health. *Sports Medicine*, 52(1), 85-96.
- Darch, J., Nassis, G. P., & Rumpf, M. C. (2022). Biomechanical and metabolic adaptations to repeated sprint training in adolescent sprinters. *European Journal of Applied Physiology*, 122(4), 981-992.
- Fajar, A., & Kurniawan, D. (2021). Pendidikan jasmani dan olahraga dalam pembentukan karakter peserta didik. *Jurnal Pendidikan Jasmani Indonesia*, 17(1), 12-20.
- Gibala, M. J. (2021). An update on interval training for performance and health. *Journal of Applied Physiology*, 137(3), 453-460.
- Hall, E. C., Thompson, K., & Morris, J. G. (2023). Effects of sprint interval training on anaerobic performance and sprint speed in young athletes. *Journal of Strength and Conditioning Research*, 37(4), 890-898.
- Harsono. (2021). *Kepelatihan olahraga: Teori dan metodologi*. Remaja Rosdakarya.
- Michailidis, Y., Tabouris, A., & Metaxas, T. (2023). Effects of a 4-week short sprint interval training on explosive performance in youth soccer players. *International Journal of Sports Physiology and Performance*, 18(2), 201-209.
- Mugiarti, S., Muhtarom, A., & Agustan, M. (2023). Pengaruh metode interval training terhadap kecepatan lari siswa SMA. *Jurnal Keolahragaan*, 11(1), 45-53.
- Mutmainna, A., & Hardi, A. A. (2025). Implementasi kurikulum merdeka pada pembelajaran pendidikan jasmani, olahraga, dan kesehatan. *Jurnal Pendidikan Jasmani*, 15(1), 10-18.
- Nugraha, R. A. (2023). Pengaruh latihan interval terhadap kekuatan otot tungkai dan kecepatan lari siswa sekolah menengah. *Jurnal Pendidikan Jasmani Indonesia*, 19(2), 98-105.
- Porda Sulawesi Selatan XVI. (2018). *Laporan hasil pertandingan PORDA XVI*. KONI Sulawesi Selatan.
- Prayoga, H. D. (2023). *Dasar kepelatihan olahraga*. Zahir Publishing.
- Ramadhan, A. (2023). Tingkat kebugaran mahasiswa pendidikan olahraga di Makassar. *Jurnal Aktivitas Jasmani*, 8(1), 15-22.
- Rogers, D. K., Spencer, M., & Dawson, B. (2024). Work-to-rest ratio manipulation in sprint interval training: Effects on metabolic byproducts and power output. *Journal of Science and Medicine in Sport*, 27(1), 112-118.

Abdul Rahman, Maria Herlinda Dos Santos, Khalid Rijaluddin, Andi Ogo Darminto, Asrul, (2026)

The Effectiveness of Interval Training Intervention on The Maximum Acceleration of The 100 Meter Sprint in The Development of Student Athletes



Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu
Palembang South Sumatera

email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: <http://www.univpgri-palembang.ac.id>

-
- Yang, H., Ma, Z., & Chen, Y. (2021). Neuromuscular adaptations and kinematic determinants in sprint running performance. *Journal of Human Kinetics*, 79(1), 115-124.
- Yang, H., Ma, Z., & Chen, Y. (2025). Neuromuscular adaptations to microcycle sprint interval training in youth sprinters. *Frontiers in Physiology*, 16, 882314.
- Zhang, W., Li, J., & Wang, X. (2024). The impact of active recovery on blood lactate clearance and subsequent sprint performance. *Research Quarterly for Exercise and Sport*, 95(2), 345-353.