

Development of an endurance training model in athletic performance: a case study on long distance running in Indonesia

Desarrollo de un modelo de entrenamiento de resistencia en el rendimiento deportivo: un estudio de caso sobre carreras de larga distancia en Indonesia

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Abstract. This research aims to create innovative and effective endurance training materials tailored for long-distance runners aged 15-18. Utilizing the research and development (RnD) approach with the Borg and Gall model, the study incorporates feedback from expert validators and athletes along with their coaches from Sorong, West Papua. The research procedure encompasses ten stages, starting with problem identification and culminating in the implementation of the final product, involving 80 athletes. These stages include initial analysis, planning, initial product development, preliminary field testing, primary product revision, main field testing, operational product revision, operational field testing, final product revision, and dissemination and implementation. The involvement of both experts and practitioners ensures the training materials are theoretically sound and practically applicable. Data analysis was conducted using SPSS version 21, employing a normality test, a homogeneity test, and a paired-sample t-test to ensure the reliability and validity of the findings. The normality test confirmed the data followed a normal distribution, while the homogeneity test ensured the sample groups were comparable. The paired-sample t-test results indicated the newly developed book-based endurance training model significantly enhanced athletes' performance (p-value 0.000), showing a more substantial improvement in training outcomes compared to conventional methods (p-value 0.014). This improvement is attributed to the structured and comprehensive nature of the training materials, which include interactive elements and technology integration, making the training process more engaging and effective for young athletes. In conclusion, adopting interactive and technology-based training models can significantly aid in developing endurance skills in young long-distance runners, addressing specific needs and optimizing their training regimen.

Keywords: Athletics, Endurance Training, Exercise Media, Physical Education

Resumen. Esta investigación tiene como objetivo crear materiales innovadores y efectivos de entrenamiento de resistencia adaptados para corredores de larga distancia de entre 15 y 18 años. Utilizando el enfoque de investigación y desarrollo (I+D) con el modelo de Borg y Gall, el estudio incorpora comentarios de validadores expertos y atletas junto con sus entrenadores de Sorong, Papúa Occidental. El procedimiento de investigación abarca diez etapas, comenzando con la identificación del problema y culminando en la implementación del producto final, involucrando a 80 atletas. Estas etapas incluyen análisis inicial, planificación, desarrollo inicial del producto, pruebas preliminares de campo, revisión del producto primario, pruebas principales de campo, revisión del producto operativo, pruebas operativas de campo, revisión final del producto y difusión e implementación. La participación de expertos y practicantes asegura que los materiales de entrenamiento sean teóricamente sólidos y prácticamente aplicables. El análisis de datos se realizó utilizando SPSS versión 21, empleando una prueba de normalidad, una prueba de homogeneidad y una prueba t de muestras pareadas para garantizar la fiabilidad y validez de los resultados. La prueba de normalidad confirmó que los datos seguían una distribución normal, mientras que la prueba de homogeneidad aseguró que los grupos de muestra eran comparables. Los resultados de la prueba t de muestras pareadas indicaron que el modelo de entrenamiento de resistencia basado en libros desarrollado mejoró significativamente el rendimiento de los atletas (valor p 0.000), mostrando una mejora más sustancial en los resultados del entrenamiento en comparación con los métodos convencionales (valor p 0.014). Esta mejora se atribuye a la naturaleza estructurada y completa de los materiales de entrenamiento, que incluyen elementos interactivos e integración tecnológica, haciendo que el proceso de entrenamiento sea más atractivo y efectivo para los jóvenes atletas. En conclusión, la adopción de modelos de entrenamiento interactivos y basados en tecnología puede ayudar significativamente en el desarrollo de habilidades de resistencia en jóvenes corredores de larga distancia, abordando necesidades específicas y optimizando su régimen de entrenamiento.

Palabras clave: Atletismo, Entrenamiento de Resistencia, Medios de Ejercicio, Educación Física

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Introduction

Sport plays a vital role in human life, both in terms of physical and mental health and in terms of achievements that can bring a country's good name at the international level (Dai and Menhas, 2020; Baena-Morales *et al.*, 2021; Habyarimana, Tugirumukiza and Zhou, 2022). Through sports, a country can build its global reputation, which in turn increases national pride. Every country strives to improve its sporting achievements as a form of national dignity, including Indonesia. Among the various sports that exist, athletics occupies a special position as one of the oldest and most basic branches, covering basic movements such as walking,

running, jumping, and throwing that have been known since ancient times (Sina and Pelariyanto, 2020; Yani and Sina, 2022; Wardhani and Arifin, 2024).

Athletics is not only about sport, but also about character building and the spirit of competition (Dohsten, Barker-Ruchti and Lindgren, 2020; Woolway *et al.*, 2021). It has been part of the Olympic Games since ancient times and consists of running, jumping, throwing and walking events (Yani and Hasri, 2020). Each of these events plays an important role in building the physical and mental qualities of athletes. For example, running, which covers various distances such as short, middle and long distance running, requires a combination of speed, strength and endurance. In

the context of modern sports, running, especially long-distance running, is one of the most popular and competed in various events, including long-distance running such as 5,000 meters.

Long-distance running requires high aerobic stamina and endurance (Casado *et al.*, 2022; Davison *et al.*, 2022). Athletes competing in this event must be able to run continuously for at least 5 kilometers, and often up to longer distances such as 10,000 meters or a marathon. To succeed in this competition, an athlete must have excellent physical fitness, especially in terms of cardiovascular endurance. An intensive and continuous training process is necessary to achieve this physical condition. In addition to the physical aspect, long-distance running training also emphasizes the importance of the mental aspect, as a runner must be able to manage fatigue and still maintain high performance throughout the race (Paula, Elena and Daniel, 2021; Vijay *et al.*, 2024).

One of the key factors in successful long-distance running is VO₂max, which is the body's maximum capacity to use oxygen during intense activity (Santisteban *et al.*, 2022; Staff *et al.*, 2023). In addition, economical running speed and effective recovery are also important elements that must be considered. A good training program should be able to improve all these aspects gradually and sustainably. Various training methods such as interval training, fartlek training, and tempo training have been proven effective in improving endurance and long-distance running performance. Interval training, for example, involves repetition of high-intensity training sessions followed by a recovery period. The aim is to increase athletes' VO₂max capacity, so they can run faster and longer. Fartlek training, on the other hand, combines alternating fast and slow running without strict intervals, helping in improving speed and endurance simultaneously. Meanwhile, tempo training is performed at a pace slightly lower than racing speed, aiming to increase lactate threshold, allowing athletes to run faster without tiring quickly (King *et al.*, 2022).

Research has also shown the importance of periodization in endurance training programs (Clemente-Suárez *et al.*, 2021; Casado, González-Mohino, *et al.*, 2022; González-Ravé *et al.*, 2022). Periodization involves the systematic adjustment of training intensity and volume to avoid fatigue and injury and ensure peak performance occurs at key competition times. The phases in this periodization include the base phase, building phase, peak phase and recovery phase, each with a different focus and purpose. In the foundation phase, for example, the focus is on building a base of endurance and strength. In the building phase, training is more intensive to improve specific performance. The peak phase aims to prepare athletes for the main competition in the best physical and mental condition possible, while the recovery phase gives the body time to recover and repair itself after intense training (Sumartiningsih *et al.*, 2022; Susanto *et al.*, 2023).

Overall, long-distance running is not just about physical strength but also about the right training strategies. This sport

not only builds physical fitness but also character and a high spirit of competition in achieving the highest performance. In this context, the development of endurance training models becomes a crucial aspect that cannot be overlooked. With the right approach, supported by science, Indonesian long-distance runners can continue to develop and achieve remarkable accomplishments on the international stage.

Achievements in long-distance running in Indonesia have shown significant development in recent years. This can be seen from the achievements of Indonesian athletes in various international competitions such as the SEA Games and National Sports Week (PON). However, challenges remain, especially in terms of improving the development of young athletes to ensure the continuity of achievements in the future. Therefore, the role of the coach becomes very important in developing an effective training program that suits the needs of each athlete. This program should include various aspects such as volume, intensity, and frequency of training, as well as an individualized approach to maximize the athlete's potential in competition (Schoenfeld *et al.*, 2021; Ruddock *et al.*, 2021; Prieto-González and Sedlacek, 2022).

Although endurance training has become an integral part of athletic training programs, many coaches and athletes still face complex challenges that hinder the achievement of optimal performance. One of the main problems is the lack of in-depth understanding of the basic principles of endurance training and how to apply them effectively in various conditions of individual athletes. In addition, limited facilities and resources are often a significant obstacle. Many training programs still use conventional methods that are not integrated with the latest developments in science and technology, thus unable to accommodate the specific needs of each athlete.

Lack of knowledge and ability to perform proper training periodization is also a problem that cannot be ignored (Buckner *et al.*, 2020; Kirk *et al.*, 2021; González-Badillo *et al.*, 2022). Without proper periodization, athletes are likely to experience chronic fatigue and not reach peak performance at the right time. In addition, many coaches find it difficult to adjust training programs for the various phases of training, from the basic phase to the peak and recovery phase, which should be tailored to the competition cycle and the athlete's physical condition.

In the Indonesian context, this problem becomes more complex with limited infrastructure and government support that is still not optimal in supporting athletic development. This condition makes many talented young athletes not get the appropriate training and potentially experience stagnation or decreased performance over time.

Therefore, a new and more comprehensive endurance training model is needed, which is not only based on scientific principles but also able to integrate the latest technology and consider physiological, psychological and nutritional aspects holistically. This training model must be able to overcome various existing problems and provide clear and structured guidance for coaches and athletes in achieving peak performance in a sustainable and safe manner.

Materials and Methods

The purpose of this research is to develop effective and innovative endurance training media. The research method used in this study is the research and development (RnD) method. This approach was chosen because it allows researchers to design, develop, and evaluate exercise media in a systematic and structured way. By using the RnD approach and the Borg and Gall stage model, the research is expected to produce endurance training media that is innovative and effective, and meets the needs and challenges faced by athletes in improving their performance in long-distance running.

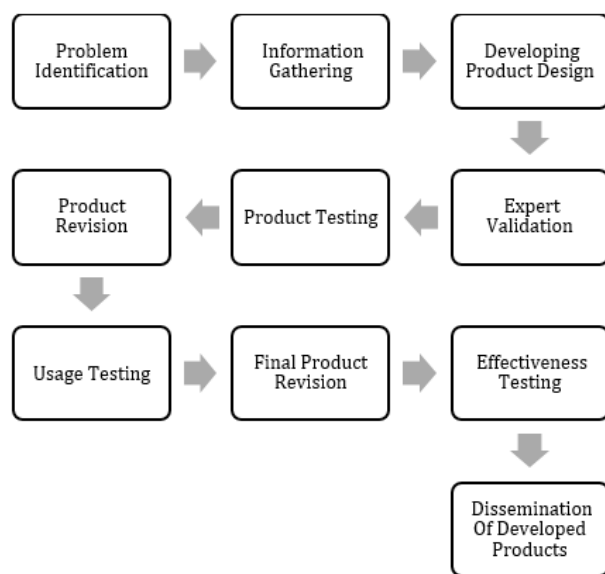


Figure 1. Research Flow

Participant

The study involved two main groups. First, the validator group consists of two experts: a material expert and a media expert, who are carefully selected based on competency criteria in their respective fields. They will provide valuable insights and assessments for the development of the manipulative motion learning media. The second group consisted of 15 to 18 years old running athletes in Sorong West Papua and coaches.

Procedure

This research procedure consists of ten stages that are structured in detail. The first stage began with a preliminary study that included problem identification and needs analysis, followed by information gathering through field observations. The second stage involved planning which included the preparation of an endurance training model development design. The third stage focused on developing the initial product in the form of an endurance training model design. The fourth stage involved an initial field trial using 10 subjects. The fifth and sixth stages are the main product revision based on the evaluation of the initial field trial results, followed by the main product field test on a larger scale with 50 research

subjects. The seventh and eighth stages are operational product revisions based on expert evaluation and field trials in accordance with the research objectives. The ninth stage is the final product revision to get perfect results. The tenth stage is the dissemination and implementation of effective final products using 80 samples.

Statistical Analysis

The measurement data were processed and analyzed using statistical methods with the aid of Statistical Product and Service Solutions (SPSS) software version 21. The data analysis using SPSS included: the normality test, which utilized the Kolmogorov-Smirnov test with a significance level of 5% or 0.05, and the homogeneity test, which employed Levene's Test with a significance level of 5% or 0.05. The statistical technique used to determine the effect of each variable was the Paired Sample t-test.

Result

Planning Stage

The first stage began with Research and Information Collecting. The initial step of this research successfully identified a number of problems and needs in developing an endurance training model for athletic athletes aged 15-18 years. Through the analysis of the current conditions, it was found that there was a significant gap between the endurance training needs at that age and the availability of effective training models. Evaluation of existing training models shows that many of them do not fully meet the needs of developing athletes at that age optimally. In addition, some of the existing training models lack interactivity and are not engaging enough for young athletes, which may reduce their motivation for training. The identification of these shortcomings includes the need for more innovative and engaging training models, which can increase athlete engagement and support the optimal development of their endurance capabilities. The results of this study emphasize the need to develop a more effective endurance training model that is in accordance with the characteristics and needs of athletic athletes aged 15-18 years.

The literature review conducted succeeded in providing an in-depth understanding of the theory and best practices in the development of endurance training models for athletic athletes aged 15-18 years. Through the review of various literature sources such as journal articles, textbooks, and other relevant academic sources, a strong basis was obtained for designing innovative and effective training models. The literature reviewed demonstrated the importance of using book-based training models to improve engagement and coaching outcomes for young athletes. In addition, information was gathered from various sources through direct observation of young athletes in schools and sports clubs to gain an in-depth understanding of the current state of endurance training. Questionnaires and interviews were also conducted with 15 research subjects consisting of athletes, coaches, and physical education experts, to explore their views, experiences, and

needs regarding the ideal endurance training model for young athletes. These findings emphasize the importance of developing an endurance training model that is in accordance with the characteristics and needs of athletic athletes aged 15-18 years.

The second stage is Planning. Based on the information that has been collected, the next step is to design a plan for developing a book-based endurance training model. This plan includes a development strategy that focuses on overcoming the shortcomings identified, as well as considering the results of the literature review that has been carried out. The specifications of the exercise model were also clearly defined, including the features that would be integrated in this innovative exercise model. The book-based endurance training model was designed to include appropriate use of technology, including the use of interactive media and the integration of multimedia content that could significantly enhance the learning experience of young athletes.

Development Stage

The first stage of development was to create an initial draft or prototype of the book-based endurance training model by adding relevant image references. This prototype included the initial design of the exercise structure, interactivity, and content planned to be included in the final exercise model.

After completing the development of the book-based endurance training model, the product was assessed by media experts and material experts. The evaluation results from media experts (91.25%) and material experts (87.50%) showed that the developed exercise model received a very good category rating. Media experts appreciated the attractive design and the use of technology that can enrich the training experience of young athletes. Meanwhile, the material experts recognized that the training content delivered through this model was relevant and in-depth, in accordance with the needs of coaching athletes at the age of 15-18 years according to the physical education curriculum standards.

The results of the field trial involving 10 young athletes showed that the book-based endurance training model succeeded in increasing athletes' motivation in their training. Positive feedback from trial participants indicated that the model provided a more enjoyable and engaging learning experience due to the interactive design and technology used. In addition, coaches reported increased athlete engagement in training sessions, which contributed positively to the development of their endurance skills.

Based on feedback from the field trial, the addition of relevant image references was considered to further enrich the athletes' training experience, by providing a more comprehensive visualization of the movements. This feedback will be implemented in future developments to ensure the training model remains relevant and effective in supporting the development of young athletes in schools and sports clubs.

Feedback from the field trial suggests that the addition of relevant image references in a book-based endurance training model can have a significant positive impact on the athlete's

training experience. This provides encouragement to integrate images more strategically in the development of this training model, with the hope of maximizing the potential for effective coaching in formal and non-formal education environments.

Evaluation Stage

A wide-scale trial was conducted involving 50 athletes aged 15-18 years (87.50%) and 3 coaches (98.21%), which produced very satisfactory results. Feedback received from trial participants indicated an overall positive response to the developed book-based endurance training model. Athletes reported increased motivation and engagement during training sessions, highlighting the clarity of instructions and interactivity provided by the model. Coaches also observed an increase in athletes' understanding of endurance training techniques, as well as the ease of integrating the model into the daily training program at the sports club. In all aspects of testing, only positive feedback was generated, indicating that the training model was effective in supporting the development of young athletes and achieved good acceptance from end users.

This study examined the effectiveness of the book-based endurance training model in improving athletes' training outcomes through a series of statistical tests with a sample size of 80 athletes. Group A used the book-based endurance training model, while Group B used conventional training methods. The normality test results showed that the data was normally distributed, while the variance homogeneity test showed similar results. The paired-sample t-test showed that the significant improvement in training results between pre-test and post-test was greater in Group A than Group B, confirming that the use of a book-based endurance training model is effective in improving athletes' skills in endurance training at sports clubs.

Table 1.
Normality Test

No	Group	N	Asym. Sig (p-value)	Note
1	Pretest Group A	40	.590	Normal
2	Posttest Group A	40	.229	Normal
3	Pretest Group B	40	.439	Normal
4	Posttest Group B	40	.385	Normal

The results presented in Table 1 indicate that the normality tests for all groups yielded p-values greater than the significance level of 0.05. Specifically, the p-values for the Pretest Group A, Posttest Group A, Pretest Group B, and Posttest Group B are 0.590, 0.229, 0.439, and 0.385, respectively. Since all p-values are above 0.05, we can conclude that the data for each group are normally distributed.

Table 2.
Homogeneity Test

No.	Group	N	Asym. Sig (p-value)	Note
1	Pretest Group A B	80	.587	Homogen
2	Posttest Group A B	80	.845	Homogen

The results presented in Table 2 indicate that the homogeneity tests for both the Pretest and Posttest groups (combined Group A and Group B) yielded p-values greater than

the significance level of 0.05, at 0.587 and 0.845, respectively. Therefore, we conclude that the data for each combined group are homogeneous, indicating similar variances between the groups.

Table 3.
Paired Sample T-Test

No	Group	t	Asym. Sig (p-value)
1	Posttest – Pretest Group A	4.465	0.000
2	Posttest – Pretest Group B	2.561	0.014

The data from Table 3 shows that both groups showed significant improvement in exercise outcomes. However, Group A, which used the book-based endurance training model, showed a more significant improvement compared to Group B, which used the conventional training method. This finding suggests that the book-based endurance training model can be more effective in improving athletes' skills compared to traditional training methods.

Discussion

In the first stage of the research, data and information were collected to identify problems and needs in developing an endurance training model for athletic athletes aged 15-18 years. The results of the analysis showed a significant gap between the need for endurance training at that age and the availability of effective training models. Many existing training models do not fully meet the needs of coaching athletes aged 15-18 years optimally. The lack of interactivity and attractiveness in existing training models is also a factor that reduces athlete motivation in undergoing training (Westmattelmann *et al.*, 2021; Vasudevan and Ford, 2022; Tušak *et al.*, 2022). This research emphasizes the importance of developing more innovative and engaging endurance training models, which can increase athlete engagement and support the development of their endurance capabilities optimally.

The literature review provided an in-depth understanding of theory and best practice in the development of an endurance training model for 15-18 year old track and field athletes. The literature reviewed demonstrated the importance of using book-based training models to improve engagement and coaching outcomes for young athletes (Marini, Setiakarnawijaya and Moch. Asmawi, 2023; Febriani *et al.*, 2023; Hasibuan *et al.*, 2024). Additional information was gathered through direct observation of young athletes in schools and sports clubs as well as through questionnaires and interviews with 15 research subjects consisting of athletes, coaches and physical education experts. The findings emphasize the importance of developing an endurance training model that suits the characteristics and needs of athletic athletes aged 15-18 years (Festiawan *et al.*, 2024; Ketut Yoda *et al.*, 2024). The development stage begins with the creation of an initial draft or prototype of a book-based endurance training model that includes the initial design of the exercise structure, and content. This prototype was then evaluated by media experts and material experts. The evaluation results showed that the developed exercise model received excellent

ratings, with media experts appreciating the attractive design and use of technology that enriches the training experience of young athletes, and material experts recognizing the relevance and depth of exercise content in accordance with physical education curriculum standards. The results showed that the developed training model received very good ratings from media experts and material experts and has the potential to improve the quality of training and learning for young athletes (Koopmann *et al.*, 2020; Varghese, Ruparell and LaBella, 2022; Jayanthi *et al.*, 2022).

A field trial with 10 young athletes showed that the book-based endurance training model successfully increased athletes' motivation and engagement in their training. The engaging design used provided a more fun and interesting learning experience (Almulla, 2020; Laine and Lindberg, 2020; Saputra and Kania, 2022). Coaches also reported increased athlete engagement in training sessions, which contributed positively to the development of their endurance skills. Feedback from the field trial indicated that the addition of relevant image references could enrich the athletes' training experience by providing a more comprehensive visualization of movements. This will be implemented in future developments to ensure the training model remains relevant and effective in supporting the development of young athletes in schools and sports clubs.

The wide-scale trial involving 50 athletes aged 15-18 years and 3 coaches produced very satisfactory results. The feedback received indicated an overall positive response to the developed book-based endurance training model. Athletes reported increased motivation and engagement during training sessions, with clarity of instruction and interactivity provided by the model. Coaches also observed improved athlete understanding of endurance training techniques and ease of integrating the model into their daily training program at the sports club. The success of the wide-scale trial resulted in a positive user impact (Luczak *et al.*, 2020; Carreres-Ponsoda *et al.*, 2021).

This study tested the effectiveness of a book-based endurance training model in improving athletes' training results through a series of statistical tests with 80 athletes as samples. Normality test results showed that the data was normally distributed, while the homogeneity of variance test showed similar results. The paired-sample t-test showed a significant improvement in training results between pre-test and post-test, with a greater improvement in the group using the book-based endurance training model compared to the group using the conventional training method. These findings suggest that the use of book-based exercises in endurance training is more effective in improving athletes' skills compared to traditional training methods. Similar research has also examined that book-based training improves training outcomes (Leo Sukma and Taroreh, 2022; Alamsyah and Taroreh, 2022). One of the limitations of this study is the relatively small sample size, particularly in the early field trials, which involved only 10 athletes, potentially limiting the generalizability of the findings to a broader population. Additionally, the short duration of the

trials makes it difficult to assess the long-term impact of the book-based endurance training model on athletes' endurance development. Further research with a longer testing period is needed to evaluate its long-term effectiveness. Moreover, while the study primarily focused on physical endurance, it did not deeply explore psychological factors such as motivation, concentration, and mental pressure during training, which could also significantly impact the athletes' performance.

Conclusion

This study successfully developed an innovative and interactive book-based endurance training model for 15-18 year old athletic athletes in Indonesia. Through the stages of planning, development, and evaluation, this study found that the training model developed was able to significantly improve athletes' motivation, engagement, and training results compared to conventional training methods. Evaluations from media and material experts and field trials showed that the model received excellent ratings in terms of design, content relevance, and ability to enrich young athletes' training experience. The study also emphasized the importance of identifying and addressing the shortcomings of existing training models, as well as the importance of integrating technology and interactive elements to enhance athlete engagement. The book-based endurance training model succeeded in providing a more enjoyable and engaging learning experience, and supported the optimal development of athletes' endurance capabilities.

For future research, it is recommended that the development of this book-based endurance training model be continued by adding more image references and richer multimedia content. More comprehensive visualization of movements can help athletes understand and apply training techniques better. In addition, further research could test the effectiveness of this training model in a wider context, including various sports clubs and schools in various regions in Indonesia. This is important to ensure that this model can be adapted and applied effectively in various situations and conditions. It is also recommended to conduct a long-term evaluation of the use of this training model to see the sustained impact on athlete performance. This research could include analyzing athletes' endurance development over a longer period of time as well as the impact of the training model on competition performance.

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References

- Alamsyah, I. D. and Taroreh, B. S. (2022) 'Book Development of Volley Ball Passing Variations in the Special Preparation Period for Volley Ball Teachers and Coaches in Palembang', *Kinestetik : Jurnal Ilmiah Pendidikan Jasmani*, 6(4), pp. 798–805. doi: 10.33369/jk.v6i4.25665.
- Almulla, M. A. (2020) 'The Effectiveness of the Project-Based Learning (PBL) Approach as a Way to Engage Students in Learning', *SAGE Open*, 10(3). doi: 10.1177/2158244020938702.
- Baena-Morales, S. et al. (2021) 'Sustainable development goals and physical education. A proposal for practice-based models', *International Journal of Environmental Research and Public Health*, 18(4), pp. 1–18. doi: 10.3390/ijerph18042129.
- Buckner, S. L. et al. (2020) 'The Basics of Training for Muscle Size and Strength: A Brief Review on the Theory', *Medicine and Science in Sports and Exercise*, 52(3), pp. 645–653. doi: 10.1249/MSS.0000000000002171.
- Carreres-Ponsoda, F. et al. (2021) 'Effects of a Teaching Personal and Social Responsibility Model Intervention in Competitive Youth Sport', *Frontiers in Psychology*, 12(March). doi: 10.3389/fpsyg.2021.624018.
- Casado, A., Tuimil, J. L., et al. (2022) 'Maximum aerobic speed, maximum oxygen consumption, and running spatiotemporal parameters during an incremental test among middle- and long-distance runners and endurance non-running athletes', *PeerJ*, 10. doi: 10.7717/peerj.14035.
- Casado, A., González-Mohino, F., et al. (2022) 'Training Periodization, Methods, Intensity Distribution, and Volume in Highly Trained and Elite Distance Runners: A Systematic Review', *International Journal of Sports Physiology and Performance*, 17(6), pp. 820–833. doi: 10.1123/ijsp.2021-0435.
- Clemente-Suárez, V. J. et al. (2021) 'The effect of periodization on training program adherence', *International Journal of Environmental Research and Public Health*, 18(24). doi: 10.3390/ijerph182412973.
- Dai, J. and Menhas, R. (2020) 'Sustainable development goals, sports and physical activity: The localization of health-related sustainable development goals through sports in China: A narrative review', *Risk Management and Healthcare Policy*, 13, pp. 1419–1430. doi: 10.2147/RMHP.S257844.
- Davison, R. C. R. et al. (2022) 'Sport and Exercise Physiology Testing Guidelines: Volume I – Sport Testing', *Sport and Exercise Physiology Testing Guidelines: Volume I – Sport Testing*, I, pp. 159–168. doi: 10.4324/9781003045281.
- Dohsten, J., Barker-Ruchti, N. and Lindgren, E. C. (2020) 'Caring as sustainable coaching in elite athletics: benefits and challenges', *Sports Coaching Review*, 9(1), pp. 48–70. doi: 10.1080/21640629.2018.1558896.
- Febriani, W. et al. (2023) 'Development of an E-Book-Based Flexibility Training Model for Karate', *International Journal of Multidisciplinary Research and Analysis*, 06(06), pp. 2429–2433. doi: 10.47191/ijmra/v6-i6-11.

- Festiwawan, R. *et al.* (2024) 'The Hybrid Learning System With Project Based Learning: Can It Increase Creative Thinking Skill and Learning Motivation in Physical Education Learning?', *Retos*, 56, pp. 1009–1015. doi: 10.47197/retos.v56.105047.
- González-Badillo, J. J. *et al.* (2022) 'Toward a New Paradigm in Resistance Training by Means of Velocity Monitoring: A Critical and Challenging Narrative', *Sports Medicine - Open*, 8(1). doi: 10.1186/s40798-022-00513-z.
- González-Ravé, J. M. *et al.* (2022) 'Reverse Periodization for Improving Sports Performance: A Systematic Review', *Sports Medicine - Open*, 8(1). doi: 10.1186/s40798-022-00445-8.
- Habyarimana, J. de D., Tugirumukiza, E. and Zhou, K. (2022) 'Physical Education and Sports: A Backbone of the Entire Community in the Twenty-First Century', *International Journal of Environmental Research and Public Health*, 19(12). doi: 10.3390/ijerph19127296.
- Hasibuan, S. *et al.* (2024) 'Development of Flip Book-Based Learning Media for Sports Physiology in Physical Education Students at University', *AL-ISHLAH: Jurnal Pendidikan*, 16, pp. 1361–1373. doi: 10.35445/alishlah.v16i2.4053.
- Jayanthi, N. *et al.* (2022) 'Developmental Training Model for the Sport Specialized Youth Athlete: A Dynamic Strategy for Individualizing Load-Response During Maturation', *Sports Health*, 14(1), pp. 142–153. doi: 10.1177/19417381211056088.
- Ketut Yoda, I. *et al.* (2024) 'Effectiveness of Motor Learning Model Based on Local Wisdom in Improving Fundamental Skills', *Retos*, 57, pp. 881–886. doi: 10.47197/retos.v57.106807.
- King, A. J. *et al.* (2022) 'Short-Term Very High Carbohydrate Diet and Gut-Training Have Minor Effects on Gastrointestinal Status and Performance in Highly Trained Endurance Athletes', *Nutrients*, 14(9). doi: 10.3390/nu14091929.
- Kirk, C. *et al.* (2021) 'Quantification of training load distribution in mixed martial arts athletes: A lack of periodisation and load management', *PLoS ONE*, 16(5 May 2021). doi: 10.1371/journal.pone.0251266.
- Koopmann, T. *et al.* (2020) 'Assessing Technical Skills in Talented Youth Athletes: A Systematic Review', *Sports Medicine*, 50(9), pp. 1593–1611. doi: 10.1007/s40279-020-01299-4.
- Laine, T. H. and Lindberg, R. S. N. (2020) 'Designing Engaging Games for Education: A Systematic Literature Review on Game Motivators and Design Principles', *IEEE Transactions on Learning Technologies*, 13(4), pp. 804–821. doi: 10.1109/TLT.2020.3018503.
- Leo Sukma and Taroreh, B. S. (2022) 'Book Development of Volleyball Smash Exercises Variations for Volleyball Coaches in Palembang', *Kinestetik : Jurnal Ilmiah Pendidikan Jasmani*, 6(4), pp. 806–813. doi: 10.33369/jk.v6i4.25664.
- Luczak, T. *et al.* (2020) 'State-of-the-art review of athletic wearable technology: What 113 strength and conditioning coaches and athletic trainers from the USA said about technology in sports', *International Journal of Sports Science and Coaching*, 15(1), pp. 26–40. doi: 10.1177/1747954119885244.
- Marini, M., Setiakarnawijaya, Y. and Moch. Asmawi (2023) 'E-Book Based Hammer Throwing Training Model at the Age of 13-15 Years DKI Jakarta Province', *Kinestetik : Jurnal Ilmiah Pendidikan Jasmani*, 7(4), pp. 1054–1063. doi: 10.33369/jk.v7i4.30789.
- Paula, I., Elena, S. and Daniel, G. (2021) 'Strengths and Weaknesses Aspects in Marathon Runners Training.', *Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health*, 21(2), pp. 325–330.
- Prieto-González, P. and Sedlacek, J. (2022) 'Effects of Running-Specific Strength Training, Endurance Training, and Concurrent Training on Recreational Endurance Athletes' Performance and Selected Anthropometric Parameters', *International Journal of Environmental Research and Public Health*, 19(17), pp. 1–17. doi: 10.3390/ijerph191710773.
- Ruddock, A. *et al.* (2021) 'High-intensity conditioning for combat athletes: Practical recommendations', *Applied Sciences (Switzerland)*, 11(22). doi: 10.3390/app112210658.
- Santisteban, K. J. *et al.* (2022) 'Sex Differences in VO₂max and the Impact on Endurance-Exercise Performance', *International Journal of Environmental Research and Public Health*, 19(9). doi: 10.3390/ijerph19094946.
- Saputra, D. and Kania, R. (2022) 'Designing User Interface of a Mobile Learning Application by Using a Design Thinking Approach: A Case Study on UNI Course', *Journal of Marketing Innovation (JMI)*, 2(2), pp. 14–32. doi: 10.35313/jmi.v2i2.36.
- Schoenfeld, B. *et al.* (2021) 'Resistance Training Recommendations to Maximize Muscle Hypertrophy in an Athletic Population: Position Stand of the IUSCA', *International Journal of Strength and Conditioning*, 1(1), pp. 1–30. doi: 10.47206/ijsc.v1i1.81.
- Sina, I. and Pelariyanto, E. (2020) 'Pengaruh Latihan Skipping Terhadap Hasil Loncat Katak Pada Siswa Sekolah Dasar', *Physical Activity Journal (PAJU)*. Available at: <https://jos.unsoed.ac.id/index.php/paju/article/view/2471>.
- Staff, H. C. *et al.* (2023) 'Long-Term Development of Training Characteristics and Performance-Determining Factors in Elite/International and World-Class Endurance Athletes: A Scoping Review', *Sports Medicine*, 53(8), pp. 1595–1607. doi: 10.1007/s40279-023-01850-z.
- Sumartiningsih, S. *et al.* (2022) 'The FIFA 11+ for kids warm-up program improved balance and leg muscle strength in children (9–12 years old)', *Journal of Physical Education and Sport*, 22(12), pp. 3122–3127. doi: 10.7752/jpes.2022.12395.
- Susanto, E. *et al.* (2023) 'Talent Identification Predicting in Athletics: A Case Study in Indonesia', *Annals of Applied Sport Science*, 11(1), pp. 1–11. doi: 10.52547/aassjournal.1102.

- Tušak, Matej *et al.* (2022) 'Dynamic Interactive Model of Sport Motivation', *International Journal of Environmental Research and Public Health*, 19(7). doi: 10.3390/ijerph19074202.
- Varghese, M., Ruparell, S. and LaBella, C. (2022) 'Youth Athlete Development Models: A Narrative Review', *Sports Health*, 14(1), pp. 20–29. doi: 10.1177/19417381211055396.
- Vasudevan, A. and Ford, E. (2022) 'Motivational Factors and Barriers Towards Initiating and Maintaining Strength Training in Women: a Systematic Review and Meta-synthesis', *Prevention Science*, 23(4), pp. 674–695. doi: 10.1007/s11121-021-01328-2.
- Vijay, S. A. *et al.* (2024) 'Lactate threshold training to improve longdistance running performance: A narrative review', *Montenegrin Journal of Sports Science and Medicine*, 20(1), pp. 19–29. doi: 10.26773/mjssm.240303.
- Wardhani, R. and Arifin, Z. (2024) 'Analysis of Front Roll Movement In Gymnastics: An Inquiry Approach Among Physical Education Students', *Physical Activity Journal (PAJU)*. Available at: <https://jos.unsoed.ac.id/index.php/paju/article/view/11839>.
- Westmattelmann, D. *et al.* (2021) 'Apart we ride together: The motivations behind users of mixed-reality sports', *Journal of Business Research*, 134(May), pp. 316–328. doi: 10.1016/j.jbusres.2021.05.044.
- Woolway, T. *et al.* (2021) 'One Does Not Fit All: European Study Shows Significant Differences in Value-Priorities in Clean Sport', *Frontiers in Sports and Active Living*, 3(May), pp. 1–12. doi: 10.3389/fspor.2021.662542.
- Yani, A. and Hasri, R. (2020) 'Hubungan Panjang Tungkai Dengan Kecepatan Lari 60 Meter Siswa Sekolah Dasar', *Physical Activity Journal (PAJU)*. Available at: <https://jurnalonline.unsoed.ac.id/index.php/paju/article/view/2423>.
- Yani, A. and Sina, I. (2022) 'Pengaruh Latihan Fundamental Movement Skills (FMS) pada Anak dengan Gangguan Koordinasi Perkembangan (Dyspraxia)', *Physical Activity Journal (PAJU)*. Available at: <https://jos.unsoed.ac.id/index.php/paju/article/view/6940>.

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