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Transformation of Physical Training, Parental Support, and Resilience in Enhancing the Performance of Swimming Athletes in South Sulawesi

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ABSTRACT

This study aimed to analyze the influence of physical training and parental support on swimming athlete performance in South Sulawesi, with resilience positioned as a mediating variable. The study employed a cross-sectional quantitative design involving 100 competitive swimming athletes aged 15–30 years. Participants were recruited from 10 swimming clubs affiliated with the South Sulawesi Provincial Board of the Indonesian Swimming Association (PRSI), representing athletes from 17 regencies and cities across the province. Purposive sampling was used to select athletes who actively participated in training programs and competitive swimming events. Data were collected using structured Likert-type survey instruments and analyzed using Structural Equation Modeling (SEM). The results showed that physical training and parental support had significant positive effects on swimming performance. Physical training improved performance through structured and science-based training principles, while parental support strengthened the athlete motivation and competitive stability through emotional and instrumental involvement. Resilience also significantly influenced performance and mediated the relationship between the predictor variables and athletic achievement. These findings indicate that swimming performance is shaped by the interaction of physiological preparation, social support, and psychological adaptability.

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INTRODUCTION

Athletic achievement in the competitive swimming represents a critical indicator of the effectiveness of regional sport development systems. However, performance outcomes do not always improve proportionally with the intensity of training programs. In South Sulawesi, swimming performance has demonstrated fluctuating trends over time. For example, the *Sulsel Maju II* squad successfully qualified four athletes for the 19th National Sports Week (PON XIX) in the individual medley and butterfly events (Kadir, 2015). In contrast, the overall performance of the South Sulawesi contingent ranked 12th out of 34 provinces at the 2016 National Sports Week (Nasri, 2019), highlighting persistent inconsistencies in athlete performance within the regional development system.

Physical training is widely acknowledged as a primary determinant of swimming performance, as the sport requires the integration of strength, endurance, speed, flexibility, and technical efficiency (S. Liu et al., 2025; Shi et al., 2025; Yang et al., 2025). Previous research has demonstrated that well-structured strength and conditioning programs significantly enhance race performance and movement efficiency in competitive swimmers (Cavaggioni et al., 2024; Z. Wang et al., 2025). Furthermore, the dry-land training, such as resistance exercises and core stability trainings, has been shown to improve propulsive force and optimize streamline body position in the water (Ji et al., 2021; Khiyami et al., 2022). These findings emphasize that the quality, specificity, and structure of physical training programs are essential for maximizing swimming performance.

Despite the importance of physiological preparation, athletic performance cannot be fully explained by physical factors alone. Competitive athletes are frequently exposed to psychological pressures, including performance anxiety, high expectations, and fear of failure (Gorskova et al., 2025; Mabweazara et al., 2017). In this context, social support plays a crucial role in maintaining psychological stability and sustaining motivation (Kuok et al., 2022; Shang & Yang, 2021; Shi et al., 2025). In particular, parental support has been identified as a key contributor to the athlete self-confidence, intrinsic motivation, and long-term commitment to trainings (Astiti et al., 2023; Kramers et al., 2023). Therefore, the family environment represents an important contextual factor in an athlete development.

Another significant determinant of sport performance is psychological resilience, defined as an individual capacity to adapt positively to stress, adversity, and the demands of competitive environments (Li et al., 2025; Mei et al., 2025; Stoyanova et al., 2025). Empirical evidence suggests that resilience enhances performance consistency, emotional regulation, and competitive readiness (López-Hernández et al., 2025; Predoiu et al., 2025; Uzzell et al., 2024; Z. Wang, Wang, et al., 2025). Thus, resilience can be conceptualized as a critical psychological resource that supports optimal athletic performance, particularly in high-pressure competitive settings.

Although previous studies have extensively examined the physiological determinants of swimming performance (Price et al., 2024; Ruiz-Navarro et al., 2025), research that integrates physical, psychological, and social dimensions remains limited. Most existing studies focus predominantly on anthropometric, biomechanical, or physiological variables, often neglecting the simultaneous influence of psychosocial factors (Morais et al., 2021; Numanovich & Abbosxonovich, 2020; Reinebo et al., 2024). Consequently, the combined and interactive effects of physical training, parental support, and resilience on swimming

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performance have not been comprehensively explored. This gap highlights the need for a multidimensional approach to better understand the determinants of athlete achievement.

Therefore, this study aimed to examine the influence of physical training, parental support, and psychological resilience on the performance of competitive swimmers in South Sulawesi. Unlike prior research that predominantly emphasized physiological aspects, this study integrated physical, psychological, and social variables within a unified analytical framework. By employing Structural Equation Modeling (SEM), this research sought to provide a more comprehensive understanding of the determinants of swimming performance and to contribute to the development of more holistic and evidence-based athlete training strategies.

METHODS

This study employed a quantitative explanatory approach with a cross-sectional design to examine the relationships between physical training, parental support, resilience, and swimming performance. A cross-sectional design was selected because data were collected at a single point in time, enabling the analysis of relationships among variables without experimental manipulations.

In the proposed model, physical training and parental support were specified as exogenous variables, swimming performance as the endogenous variable, and resilience as a mediating variable. Structural Equation Modeling (SEM) was applied as the primary analytical technique, as it allows simultaneous estimation of multiple relationships and the assessment of mediating effects within a unified structural framework.

Participants

The population of this study consisted of all active swimming athletes in South Sulawesi Province who were registered in official swimming clubs and regularly participated in training programs and competitions. From this population, 100 athletes were selected as research participants based on specific inclusion criteria. The criteria included athletes who had trained actively for at least one year, were aged 15 to 30 years, and had recorded achievements in swimming competitions at regional or higher levels.

The participants were recruited from 10 swimming clubs affiliated with the Indonesian Swimming Association (PRSI) South Sulawesi Provincial Board, representing athletes from 17 regencies and cities across the province. This distribution was intended to ensure that the sample adequately reflected the diversity of training environments and competitive swimming athletes in South Sulawesi.

The sampling technique used in this study was purposive sampling, which involved selecting participants based on specific characteristics relevant to the research objectives. This technique was applied to ensure that the selected athletes had sufficient experience in structured training, received family support, and were actively involved in competitive swimming events related to performance achievement.

Sampling Procedures

The purposive sampling technique was applied in accordance with specified participant qualifications, including active swimming athletes with a minimum of one year of continuous training experience, having an official registration with a recognized swimming club, and having a verified record of competitive performance. Eligible athletes were contacted through the coordination with coaches and club managements. All approached athletes agreed to participate, yielding full participation (100%).

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The data were gathered from swimming clubs and affiliated training facilities throughout South Sulawesi within a three- to four-month timeframe. The involvement in the study was entirely voluntary and participants did not receive any monetary compensation. Ahead of questionnaire distributions, the research team clarified the aims of the investigation and additionally stressed the strict confidentiality of the gathered data. A written consent was obtained from each respondent, while additional approval from parents or legal guardians was required for participants below 18 years old. The study protocol received ethical clearance from the appropriate academic authority in line with recognized guidelines for social and sport science research.

Statistical power considerations were addressed by ensuring that the sample size met recommended criteria for Structural Equation Modeling (SEM), which generally requires a minimum of five to ten observations per estimated parameter to achieve stable and reliable model estimation.

Materials and Apparatus

Data were collected using a standardized survey instrument employing a five-point Likert scale, with response options ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire items for each construct were developed based on theoretical frameworks and empirical findings reported in previous studies to ensure conceptual relevance to the variables examined.

The physical training variable (X1) was measured based on the conceptual framework proposed by Amara et al. (2021). Parental support (X2) was measured based on the theoretical perspective described by Gao et al. (2023). Resilience (Z) was evaluated based on the conceptual framework discussed by D'Agostino & Munroe-Chandler (2025). Swimming performance (Y) was measured based on the theoretical framework presented by Price et al. (2024).

Prior to data collection, the questionnaire items were formulated according to these theoretical constructs and subsequently reviewed by experts in sport science to ensure content validity and clarity of the measurement indicators.

Instrument testing demonstrated satisfactory psychometric properties. All constructs exhibited strong internal consistency, with Composite Reliability (CR) values exceeding 0.80 and Cronbach's Alpha coefficients above 0.84. In addition, Average Variance Extracted (AVE) values were greater than 0.60, indicating adequate convergent validity. Data were collected using questionnaires distributed through Google Forms to facilitate efficient data collection and statistical analysis.

Procedures

The independent variables in this study were physical training and parental support. Resilience functioned as the mediating variable, while swimming performance served as the dependent variable. As a non-experimental study, participants were not assigned to experimental or control groups.

The research procedure began with the coordination of meetings involving club administrators and coaches to schedule data collection sessions. The researcher was present during the questionnaire administration to provide standardized instructions and to ensure that participants completed the instrument independently without discussions. Athletes were instructed to respond honestly based on their experiences during trainings and competitions. The average completion time ranged from 20 to 30 minutes.

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Performance data were obtained from official club records and documented competition results. Throughout the process, the researcher acted solely as a facilitator and supervisor, without influencing participant responses.

Design or Data Analysis

Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS software, which is appropriate for predictive analysis and complex mediation models.

The analysis followed a two-stage approach:

1. Measurement Model Evaluation (Outer Model)
   Indicator reliability was assessed through outer loadings, while internal consistency reliability was evaluated using Composite Reliability and Cronbach's Alpha. Convergent validity was determined based on Average Variance Extracted (AVE), applying established threshold criteria.
2. Structural Model Evaluation (Inner Model)
   Path coefficients were estimated to examine the hypothesized relationships among variables. Statistical significance was tested using a bootstrapping procedure to obtain t-values and p-values. The explanatory power of the model was evaluated using the coefficient of determination (R^2) for endogenous variables.

The mediating effect of resilience was assessed by examining indirect effects within the structural model, allowing for simultaneous evaluation of both direct and indirect relationships.

RESULTS

This section presents the empirical findings on the effects of physical training and parental support on swimming performance in South Sulawesi, with resilience examined as a mediating variable. Data analysis was carried out through appropriate quantitative procedures in order to evaluate simultaneous and mediated relationships among study variables. The results highlight the contribution of each factor and confirm the role of resilience as a psychological mechanism that strengthens athletic performance.

Table 1. Respondent Demographics

Demographic Items	Frequency	Percentage (%)
Gender		
Male	61	61.0
Female	39	39.0
Age		
Under 20 years old	39	39.0
21–25 years old	56	56.0
26–30 years old	7	7.0
Swimming Achievement Level		
Provincial Level	87	87.0
National Level	13	13.0

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Based on Table 1, the sample was predominantly composed of male athletes, totaling 61 individuals (61.0%), while female athletes accounted for 39 participants (39.0%). In terms of age distribution, the majority were between 21–25 years old (56.0%), followed by those under 20 years (39.0%), and a smaller proportion aged 26–30 years (7.0%). Regarding the competitive level, most athletes competed at the provincial level (87.0%), whereas 13.0% had reached the national level.

Table 2. Measurement Model Evaluation (Outer Model)

Construct	Indicator	Outer Loading	Cronbach's Alpha	Composite Reliability	AVE
Physical Training	PT1	0,758	0.849	0.891	0.622
	PT2	0,773			
	PT3	0,767			
	PT4	0,763			
	PT5	0,876			
Parental Support	PS1	0,726	0.845	0.889	0.617
	PS2	0,741			
	PS3	0,749			
	PS4	0,868			
	PS5	0,834			
Resilience	RS1	0,820	0.862	0.900	0.645
	RS2	0,851			
	RS3	0,754			
	RS4	0,775			
	RS5	0,810			
Athlete Performance	AP1	0,718	0.840	0.886	0.611
	AP2	0,810			
	AP3	0,825			
	AP4	0,818			
	AP5	0,728			

Table 2 presents the results of the measurement model evaluation. Indicator reliability was assessed through outer loading values, all of which exceeded the recommended threshold of 0.70. Internal consistency reliability was examined using Cronbach's Alpha and Composite Reliability. The results show that all constructs achieved Cronbach's Alpha values above 0.80 and Composite Reliability values exceeding 0.85. Convergent validity was evaluated through the Average Variance Extracted (AVE). All constructs demonstrated AVE values above the recommended threshold of 0.50. Overall, these findings indicate that the measurement model demonstrates adequate reliability and convergent validity, supporting the suitability of the constructs for subsequent structural model analysis.

Table 3. Discriminant Validity (HTMT Criterion)

Construct	PT	PS	R	AP
PT	–			
PS	0.726	–		
R	0.610	0.502	–	
AP	0.555	0.414	0.583	–

Note: PT= Physical Training, PS= Parental Support, R= Resilience, AP= Athlete Performance

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Table 3 presents the results of discriminant validity testing using the Heterotrait–Monotrait Ratio (HTMT). The findings show that all HTMT values among the constructs are below the recommended threshold of 0.90, indicating that each construct in the model is empirically distinct from the others. Therefore, the discriminant validity requirement of the measurement model has been satisfied, and the model is considered appropriate for further structural model analysis.

Table 4. Structural Model Results

Relationship	Path Coefficient (β)	p-value	Decision
Physical Training → Athlete Performance	0.382	0.000	Supported
Parental Support → Athlete Performance	0.472	0.003	Supported
Physical Training → Resilience	0.289	0.000	Supported
Parental Support → Resilience	0.652	0.000	Supported
Resilience → Athlete Performance	0.154	0.001	Supported

Note: p-value < 0.05

Based on Table 4, which presents the structural model results obtained from the bootstrapping procedure. The results show that physical training has a positive and significant effect on athlete performance ($\beta = 0.382$, $p < 0.05$). Parental support also significantly influences athlete performance ($\beta = 0.472$, $p < 0.05$).

Furthermore, physical training significantly affects resilience ($\beta = 0.289$, $p < 0.05$). Similarly, parental support has a positive and significant influence on resilience ($\beta = 0.652$, $p < 0.05$). Finally, resilience significantly contributes to athlete performance ($\beta = 0.154$, $p < 0.05$). Overall, all proposed hypotheses are supported, indicating that both physical and psychological factors contribute significantly to athlete performance.

DISCUSSION

The findings demonstrate that swimming performance is shaped by the combined interaction of physical, psychological, and social determinants. Rather than functioning independently, physical training, parental support, and resilience operate as interconnected components that collectively influence athlete performance outcomes. This result suggests that achievement in time-based sports such as swimming cannot be fully explained by physiological preparation alone. Instead, performance emerges from the integration of training intensity, psychological adaptability, and supportive social environments. Within the context of swimming development in South Sulawesi, these findings highlight the importance of adopting a multidimensional approach to athlete development rather than relying on single-factor performance models.

The results confirm that physical training significantly enhances swimming performance. This outcome aligns with Cano-Cuartero et al. (2025) who demonstrated that scientifically periodized training could improve technical efficiency and aerobic capacity among competitive swimmers. Similarly, S. Liu et al. (2025) showed that systematic control of training intensity and program variation contributed to improvements in personal best times. From a physiological perspective, adaptations such as increased VO_2max, muscular strength, and stroke efficiency remain central determinants of swimming performance (de Haan et al., 2024; Pla et al., 2024; Trindade et al., 2024). These findings reinforce the argument that

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training programs must be structured and evidence-based to generate optimal performance outcomes.

Parental support was also found to significantly influence swimming performance. This finding supports previous studies highlighting the importance of the social environment in athlete development. Kim & Kim (2025) as well as Jiang et al. (2025) emphasized that emotional encouragement and practical assistance from family members enhance athlete intrinsic motivation. Coutinho et al. (2025) further indicated that parental engagement contributed to performance stability during competitive events. In swimming, which typically involves intensive training routines and demanding competition schedules, family support functions as a key mechanism for emotional regulation and psychological stability (López-Hernández et al., 2025; Uzzell et al., 2024). These findings indicate that athletic success cannot be separated from the social ecosystem that sustains it.

A particularly salient result of this study is the role of resilience in shaping swimming performance. This outcome is consistent with Stoyanova et al. (2025) who reported that resilient athletes exhibit stronger psychological regulation during competition. Similarly, Örencik et al. (2024) identified resilience as a protective factor against competitive stress. In sports where performance outcomes are strictly determined by time measurements, the ability to recover from setbacks and maintain psychological stability becomes a distinguishing characteristic of elite athletes (Brat et al., 2025; Kesler et al., 2026). Consequently, psychological resilience represents a critical determinant in explaining variations in competitive performance.

The present study further demonstrates that physical training and parental support contribute positively to the development of resilience. Exposure to progressively challenging training loads can strengthen athlete psychological endurance, as suggested by S. Wang & Liu (2025). At the same time, supportive family environments reinforce athlete confidence and optimism when facing competitive challenges (L. Liu et al., 2025; Tao & Yu, 2025). These findings indicate that resilience operates as a mediating psychological mechanism linking external conditions to performance outcomes. In other words, both training environments and social support systems indirectly shape performance through their influence on athlete adaptive capacity.

From a theoretical perspective, the findings contribute to the understanding of athletic performance as a multidimensional phenomenon. Previous studies often examined physiological training variables or psychological characteristics separately, which limited the ability to explain how these factors interact in real sporting contexts (Coutinho et al., 2025; Stoyanova et al., 2025). The present study extends existing sport performance frameworks by demonstrating that physical preparation, social support, and psychological resilience operate simultaneously within a structural model. This integrative perspective supports a system-based view of athlete development in which performance outcomes emerge from the dynamic interaction of multiple determinants rather than from isolated factors.

The results also provide several practical insights for improving athlete development systems. For coaches, the findings emphasize that training programs should not focus exclusively on physical conditioning. Instead, training environments should incorporate psychological skill development aimed at strengthening resilience and coping strategies during competition. Integrating mental training, reflective performance evaluation, and stress management techniques within regular practice sessions may help athletes maintain performance stability under pressure. For sport organizations and swimming federations, the findings highlight the importance of strengthening family engagement within athlete

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development programs. Educational initiatives that help parents understand training demands, competition stress, and appropriate forms of support may enhance athlete motivation and psychological well-being. Establishing collaborative communication between coaches, athletes, and parents may therefore create a more supportive developmental environment.

This study also offers a novel contribution by empirically demonstrating the simultaneous interaction between physical training, parental support, and resilience in explaining swimming performance within a structural modeling framework. While previous research has tended to examine physiological or psychological determinants independently, the present findings reveal how these factors operate together within a multidimensional system that shapes athletic achievement. By positioning resilience as a mediating mechanism connecting physical preparation and social support with performance outcomes, the study provides a more comprehensive explanation of how competitive success develops among swimming athletes.

Despite these contributions, several limitations should be acknowledged. The cross-sectional design restricts the ability to establish causal relationships between the variables examined. Future studies are therefore encouraged to employ longitudinal or experimental designs to better understand how resilience and performance evolve across different stages of athlete development. Additionally, incorporating moderating variables such as competitive experience, competition intensity, or coaching quality may provide deeper insight into the mechanisms influencing swimming performance.

CONCLUSION

In conclusion, the findings of this study demonstrate that swimming performance in South Sulawesi is significantly influenced by both physical training and parental support. Athletes who engage in structured, systematic, and continuous training programs tend to achieve higher performance outcomes. Furthermore, parental support plays a critical role in sustaining athlete motivation and psychological well-being, thereby contributing to performance enhancement.

Importantly, resilience was found to function as a significant mediating variable, strengthening the relationships between physical training, parental support, and swimming performance. This finding highlights that athletic achievement is not solely determined by physical and technical factors but is also shaped by psychological and social dimensions.

These results underscore the importance of adopting a holistic approach to athlete development by integrating physical training with psychosocial support systems. Therefore, effective collaboration among coaches, parents, and athletes is essential to foster a comprehensive and sustainable framework for swimming development.

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AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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