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The Effect of an 8-week Functional Training Approach on Strength, Flexibility and Swimming Performance of Young Male Swimmers*

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REVIEW

Abstract

This study aimed to examine the effects of an 8-week functional training program on swimming performance, muscular strength, and flexibility in young male swimmers. A total of 14 swimmers aged 14–16 years, who were regular members of the Pamukkale University swimming team, participated in the study. The program was designed to evaluate the impact of functional training on biomotor development, focusing on specific swimming and physical performance outputs. To assess the outcomes, participants completed a series of tests both before and after the intervention. These tests included 50 m, 100 m, and 1000 m freestyle swimming performance assessments, as well as measurements of muscular strength and flexibility. Anthropometric data, including body weight and height, were recorded at both stages to monitor any physical changes that could influence the results. The primary goal was to determine whether functional training could lead to measurable improvements in these variables over the 8-week period. The statistical analysis of the data was conducted using paired t-tests to identify significant differences between pre- and post-intervention results. The findings showed a statistically significant increase in muscular strength among participants following the functional training program. This suggests that the program was effective in enhancing the swimmers' overall muscular strength. However, no significant improvements were observed in the swimming performance metrics (50 m, 100 m, and 1000 m freestyle times) or flexibility levels. Despite the progress in strength, the lack of improvement in swimming times and flexibility indicates that the functional training program may have limited direct effects on these parameters within the given timeframe. These results highlight an important point: while functional training appears to be a valuable tool for increasing muscular strength, its ability to directly influence swimming performance and flexibility might require either a longer intervention period or a more specialized training approach. The findings suggest that the improvements in strength could potentially contribute indirectly to swimming performance and flexibility over a more extended duration or through targeted adaptations in training regimens. In conclusion, the study underscores the potential of functional training to support muscle development in young male swimmers. Although direct enhancements in swimming performance and flexibility were not observed in the 8-week program, the gains in muscular strength may have longer-term benefits for these areas. Further research is recommended to explore the effects of functional training in more detail, particularly through longer interventions or programs tailored to address specific aspects of swimming performance and flexibility. This study provides a foundation for understanding how functional training can be integrated into the athletic development of young swimmers, emphasizing the need for a comprehensive approach to training.

Keywords: Training, Swimming, Strength, Flexibility

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8 Haftalık Fonksiyonel Antrenman Yaklaşımının Genç Erkek Yüzücülerin Kuvvet, Esneklik ve Yüzme Performansına Etkisi

Özet

Bu çalışma, 8 haftalık bir fonksiyonel antrenman programının 14-16 yaş arasındaki genç erkek yüzücülerde yüzme performansı, kas kuvveti ve esneklik üzerindeki etkilerini araştırmayı amaçlamıştır. Araştırmaya, Pamukkale Üniversitesi yüzme takımında düzenli olarak antrenman yapan 14 sporcu gönüllü olarak katılmıştır. Çalışma kapsamında, katılımcıların biyomotor gelişimlerini değerlendirmek amacıyla belirli performans ve fiziksel ölçümler yapılmıştır. Bu ölçümler, 50 m, 100 m ve 1000 m serbest stil yüzme performans testlerini, esneklik değerlendirmelerini ve kas kuvveti ölçümlerini içermektedir. Antrenman programının etkisini belirlemek için katılımcılardan hem antrenmanlar öncesinde hem de sonrasında bu testleri tamamlamaları istenmiştir. Ek olarak, antropometrik ölçümler (boy ve kilo) de kaydedilerek, olası fiziksel değişiklikler izlenmiştir. Fonksiyonel antrenman programı, yüzücülerin kuvvet, esneklik ve yüzme performansı üzerindeki gelişimlerini anlamak için yapılandırılmıştır. Verilerin istatistiksel analizi, ölçüm öncesi ve sonrası sonuçlar arasında anlamlı farklılıklar olup olmadığını belirlemek için t-test kullanılarak gerçekleştirilmiştir. Analiz sonuçlarına göre, fonksiyonel antrenman süreci sonunda katılımcıların kas kuvvetinde istatistiksel olarak anlamlı bir artış gözlemlenmiştir. Bu durum, programın kas kuvveti geliştirme üzerindeki etkisinin olumlu olduğunu göstermektedir. Ancak, yüzme performansı (50 m, 100 m ve 1000 m süreleri) veya esneklik düzeylerinde anlamlı bir değişiklik tespit edilmemiştir. Bu bulgu, fonksiyonel antrenmanın doğrudan yüzme performansı ve esneklik üzerindeki etkilerinin 8 haftalık bir süre içinde sınırlı olduğunu ortaya koymaktadır. Elde edilen sonuçlar, fonksiyonel antrenmanın özellikle kas kuvveti gelişimi açısından genç yüzücüler için faydalı olabileceğini göstermektedir. Bununla birlikte, bu tür bir programın yüzme performansı ve esneklik gibi diğer önemli ölçütlere doğrudan etkileri, daha uzun süreli ya da daha hedefe yönelik antrenman programları ile daha kapsamlı bir şekilde değerlendirilmelidir. Kas kuvvetinde kaydedilen artışlar, bu parametrelerin dolaylı olarak geliştirilmesine katkı sağlayabilir. Ancak, bu tür dolaylı etkilerin anlamlı bir şekilde ortaya çıkabilmesi için, fonksiyonel antrenmanın süresinin uzatılması ya da daha spesifik antrenman protokollerine dahil edilmesi gerekebilir. Sonuç olarak, bu çalışma, fonksiyonel antrenmanın genç erkek yüzücülerde kas gelişimini destekleme potansiyelini vurgulamaktadır. Bununla birlikte, doğrudan yüzme performansı ve esneklik iyileştirmeleri sağlamak için mevcut 8 haftalık süre yeterli görünmemektedir. Artan kuvvetin yüzme performansına ve esnekliğe dolaylı katkılar sağlayıp sağlamadığını belirlemek için daha uzun vadeli ve hedefe yönelik çalışmalar yapılması gereklidir. Bu çalışma, fonksiyonel antrenmanın genç yüzücülerde atletik gelişim programlarına eklenmesi konusunda önemli bilgiler sağlamaktadır.

Anahtar kelimeler: Antrenman, Yüzme, Güç, Esneklik

Introduction

Functional movement plays a critical role in the development of athletic competence. To maintain optimal performance and support daily physical activities, it is essential that the movements we execute are both energy-efficient and conducive to long-term health and safety. Functional movement is characterized by the seamless integration of both athletic performance components and the requirements of daily life. These components include motor skills such as velocity, strength, flexibility, endurance, and coordination, as well as fundamental movement patterns like rotation, pushing, pulling, and other dynamic actions that underpin efficient movement execution (Cook et al., 2014). However, when human motion is confined to a single axis or overly localized muscle groups, movement functionality may be compromised, resulting in challenges during athletic or everyday activities (Boyle, 2004; Cook, 2003; Cook et al., 2014). This discordance can lead to inefficiencies, injuries, or compensatory movement patterns, particularly when harmony among muscle groups is lacking (Boyle, 2004).

The benefits of exercise are widely acknowledged, encompassing improved physical fitness, health, and overall quality of life. Exercise, defined as regular and planned physical activities aimed at maintaining or enhancing physical fitness, systematically targets various fitness elements such as flexibility, strength, and endurance (Özer, 2013). Functional training, as a contemporary and versatile approach within the fitness domain, builds on these principles by focusing on the synergistic development of multiple muscle groups. Unlike traditional training modalities, functional training incorporates dynamic, multi-joint, and movement-specific exercises that simulate real-life activities, fostering improved strength, mobility, and coordination. Due to its comprehensive nature, functional training has been embraced by various professional groups, including military personnel, marines, and athletes across diverse sports disciplines (Haddock et al., 2016).

The athletic performance and overall quality of life of athletes are often negatively affected by repetitive overload, exercise monotony, or an excessive focus on specific muscle groups. These practices can lead to imbalances within the kinetic chain, increasing the risk of injuries and potentially shortening athletic careers (Cook et al., 2010). Functional training addresses these risks by emphasizing the coordinated interaction of multiple body segments. It trains not only individual muscles but also movement patterns, fostering a balanced and integrated approach to physical development (Mountainite et al., 2015). Exercises are designed to resemble daily movements and sporting activities, enhancing balance, stability, mobility, and strength while minimizing the likelihood of dysfunctions within the kinetic chain (Knispelytė, 2018).

Functional training's emphasis on interconnected, dynamic movements is supported by recent empirical findings. For instance, a 2018 study conducted in Portugal demonstrated the significant impact of functional training on the athletic performance of competitive swimmers. Male swimmers who supplemented their aquatic training with functional exercises performed twice weekly over 6–8 weeks achieved measurable improvements in starts and turns. The training, which included 1–6 sets of 1–10 repetitions, resulted in statistically significant gains in leg and chest muscle strength, as well as flexibility (Amaro et al., 2019). These results highlight the short-term effectiveness of functional training in enhancing specific physical parameters crucial for athletic performance (Beltz et al., 2019).

Athletic training often begins during childhood, emphasizing the importance of early and systematic development of physical fitness and foundational motor skills. The increasing prevalence of young athletes participating in competitive sports has heightened the need for evidence-based training protocols that prioritize both physical and cognitive development (Cochrane et al., 2015; Lima-Borges et al., 2018). Functional training offers a unique advantage in this context by facilitating comprehensive physical development. By targeting coordinated movements involving the entire kinetic chain, functional training supports efficient force transfer, whether from the ground to the arms or vice versa. This coordination requires the harmonious contraction of agonist, antagonist, and synergist muscles, with any disruption in this sequence representing a weak link that can compromise overall performance (Cook et al., 2010).

Ongoing advancements in technology and sports science continue to refine training methodologies, enabling athletes to achieve higher levels of performance and set new records. The application of scientifically validated training approaches, including functional training, is crucial for athletes competing at national and international levels. Functional training's focus on enhancing movement quality, balance, and stability aligns well with the evolving demands of modern sports. For instance, research by Behm and colleagues (2020) emphasizes the growing role of neuromuscular coordination in athletic success, further underscoring the value of functional training in preparing athletes for the rigors of high-level competition.

Despite its increasing popularity, the existing literature on the specific effects of functional training on flexibility, muscle strength, and performance—particularly in swimming—remains limited. To address this gap, the present study systematically investigates the impact of functional training on these key variables in young male swimmers. By evaluating potential short- and long-term benefits, the findings are expected to inform evidence-based practices for coaches and athletes. Ultimately, this work aims to broaden our understanding of how functional training can optimize athletic performance while promoting overall well-being. Specifically, it is hypothesized that the group undergoing functional training will exhibit improvements in strength, flexibility, and swimming performance.

Material And Method

Participants

14 healthy male athletes aged 14-16 years (average age: 15.0±1.19 years, height: 164.704±0.12 cm, weight: 54.47±4.37 kg, body mass: 52.63±11.13 kg), who have been training regularly for a minimum of 6 years and have been consistently engaged in strength training for at least 2 years, participated voluntarily in the study. The study was started with 16 athletes, but 2 athletes were injured during training and therefore excluded. The study was completed with 14 athletes. Only participants with no history of musculoskeletal injuries or other health complications were eligible for inclusion in the study.

Procedures

To determine maximal strength measurements, participants performed the butterfly, biceps curl, triceps pushdown, lat pulldown, leg extension, and upright row exercises using Technogym® equipment (Technogym S.p.A., Italy) at the fitness center 7 days prior to the start of the training program. *Warm-up protocol:* In accordance with Koenig et al. (2019), participants followed a concise dynamic warm-up before each strength training session to enhance neuromuscular readiness and reduce injury risk. They began with 3–5 minutes of light cardiovascular exercise (e.g., cycling or jogging) to elevate core temperature, followed by dynamic joint movements (e.g., arm swings, shoulder rotations, trunk twists) to progressively activate the upper body. Scapular activation exercises (e.g., scapular push-ups, prone “Y” lifts) were then performed to specifically prepare the shoulder girdle. Lastly, short-duration dynamic stretching (10–15 seconds per muscle group) targeted overall mobility without compromising subsequent strength performance. *One-repetition maximum (1RM) Protocol:* Participants first performed a low-intensity dynamic warm-up (approximately 40–50% of their estimated 1RM for 5–10 repetitions), followed by incremental load attempts (1–2 repetitions at ~80–90% of the estimated maximum after a 2–3 minute rest), and finally progressed to maximum attempts with 2–5 minute rest intervals, recording the last successfully lifted weight (i.e., the final load completed with proper form) as the 1RM (Baechle et al., 2008). After a 24-hour rest period, the first day began with measuring participants’ height and body weight. Subsequently, their flexibility was assessed using the sit-and-reach test conducted in the gym. After another 24-hour interval, the second day involved evaluating swimming performances over 50 meters, 100 meters, and 1000 meters. Before each swimming performance, participants performed a 5-minute dryland warm-up followed by a 15-minute in-water warm-up at an Olympic swimming pool. All these measurements were repeated after 8 weeks of functional training. The functional training program consisted of 7 exercises performed 3 days per week for 8 weeks. During the first 6 weeks, participants completed 3 sets per exercise, increasing to 4 sets in the 7th and 8th weeks. The number of repetitions and exercise durations varied depending on the movement, with rest intervals of 1–1.5 minutes between sets. Each session began with a 10-minute warm-up that included stretching exercises, followed by the main workout and a cooldown phase, lasting 75 minutes in total.

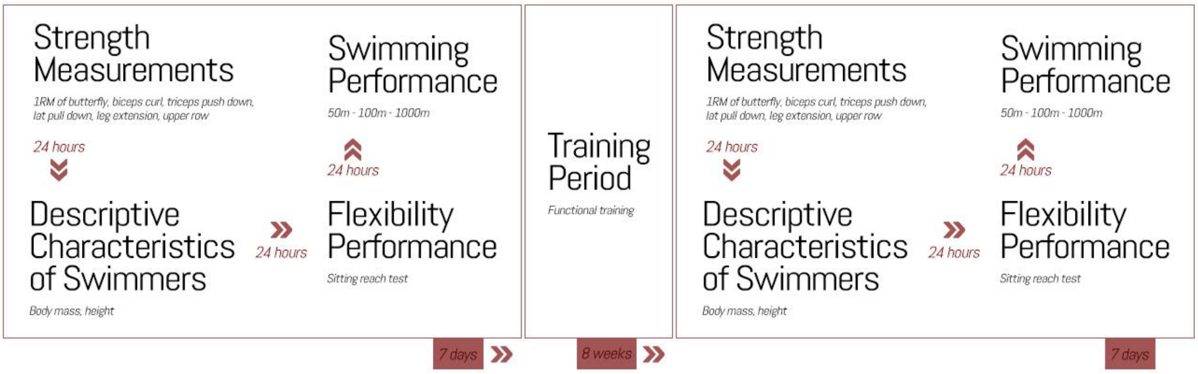
The exercises included in the functional training program are detailed in Table 1, and the study design is illustrated in Figure 1.

Table 1. Functional Training Interventions

		Sets x rep (1-6th week)	Sets x rep (7-8th week)	Rest between sets	Rest between rep
1	Back Pull Over	3 sets x 25 rep	4 sets x 25 rep	3 min	1 min
2	Trx Swim Start	3 sets x 10 rep	4 sets x 10 rep	3 min	1 min
3	Front Pull Over	3 sets x 25 rep	4 sets x 25 rep	3 min	1 min
4	Hex Bar B Stance Dead Lift	3 sets x 12 rep (70% of 1RM)	4 sets x 10 rep (80% of 1RM)	3 min	1 min
5	One Arm Slam with Medicine Ball	3 sets x 10 rep (2 kg medicine ball)	4 sets x 10 rep (3 kg medicine ball)	3 min	1 min
6	Kicking on Exercise Ball	3 sets x 30 s	4 sets x 30 s	3 min	1 min
7	Streamline on Exercise Ball	3 sets x 45 s	4 sets x 45 s	3,5 min	1,5 min

Rep: repetition - Min: minutes - s: second - Kg: Kilogram

Figure 1. Study Design



Data Analysis

All statistical analyses were conducted using IBM SPSS Statistics 23.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation, whereas categorical variables are presented as frequencies and percentages. The normality of the data distribution was confirmed using the Kolmogorov Smirnov test. Paired Sample T-test was used to determine differences intra-group. Before using parametric tests, the assumption of normality was verified using the Shapiro-Wilk test ($p<0.05$). The significance level was set at $p<0.05$.

Results

Table 2. Pre-post Tests

Variables	Test Time		t	p	Test Time		t	p
	Pre-Test	Post Test			Relative Pre-Test	Relative Post-Test		
Biceps Curl (kg)	17.51±5,34	20.31±5.41	-9.001	**0.000***	0.38±0.05	0.37±0.06	-10.688	**0.000***
Triceps Push Down (kg)	20±6.81	21.87±6.78	-3.077	**0.020***	0.37±0.06	0.4±0.05	-2.366	**0.050***
Lat Pull Down (kg)	53.71±18.2	56.84±17.57	-3.416	**0.011***	0.99±0.17	1.05±0.13	-2.505	**0.041***
Butterfly (kg)	41.2±14.52	45.99±14.4	-4.255	**0.004***	0.76±0.13	0.84±0.11	-3.632	**0.008***
Upper Row (kg)	38.1±9.61	41.22±9.63	-3.989	**0.005***	0.72±0.03	0.77±0.02	-2.560	**0.038***
Leg Extension (kg)	50.66±19.84	56.87±21	-7.638	**0.000***	0.93±0.23	1.04±0.23	-7.585	**0.000***
50m. swimming (s)	30.51±1.86	30.2±1.83	0.953	0.372				
100m. swimming (s)	66.49±4	64.32±4.63	1.957	0.091				
1000m. swimming (s)	768.33±51.82	752.81±44.41	2.075	0.077				
Sitting reach (cm)	29.71±4.04	30.78±5.31	-2.273	0.057				

*: $p < 0.05$
Kg: Kilogram - s: second - cm: Centimeters

A statistically significant improvement was observed in the biceps curl, triceps pushdown, lat pulldown, butterfly, upright row, and leg extension tests when comparing the pre- and post-test results of the group ($p < 0.05$). However, while numerical increases were noted in 50-meter, 100-meter, and 1000-meter swimming performances, as well as in flexibility, these changes did not reach statistical significance ($p > 0.05$).

Discussion

The increase in strength observed in children participating in sports activities is primarily attributed to the enhancement of muscle mass through exercise. Additionally, improved intermuscular coordination plays a significant role in strength development (Muratlı et al., 2007). Consequently, coordinative exercises incorporated alongside strength training further contribute to strength gains (Işıldak, 2013). In the present study, changes in arm, leg, back, and chest strength were assessed, revealing increases across all strength parameters. These findings demonstrated a statistically significant difference between the pre- and post-test mean scores for arm, leg, back, and chest strength. However, a contrasting study reported no statistically significant differences in strength values between pre- and post-test averages across all groups (Selçuk, 2012).

Functional exercises represent a highly effective training method for enhancing overall fitness. To sustain physical activities and optimize athletic performance in daily life, the movements we perform must be both energy-efficient and conducive to long-term health. Achieving this requires addressing the dual demands of athletic performance and everyday functionality. These demands encompass motor skills such as endurance, strength, speed, flexibility, and coordination, which are integral to fundamental human movements like pulling, pushing, carrying, lifting, twisting, and transitioning between levels (Cook et al., 2010; Boyle, 2004).

Muratlı (2007) highlighted in his study that the strength development of children at the end of school age is constrained by the natural progression occurring between the ages of 7 and 18. He further emphasized that club-based training during this period can lead to significant improvements in strength. Based on these findings, it is suggested that incorporating additional functional training within this age range could have a positive impact on strength development.

Shaikh and Mondal (2012) observed in their study on 8-week functional training that such training significantly improved strength parameters. Similarly, Ülker (2019), in his research examining the effects of functional training on body composition and strength parameters, reported that functional training had a positive impact on strength development. These findings align with and support the results of the present study.

Faigenbaum et al. (2002) conducted a study aimed at enhancing strength development in children through resistance training. They implemented a program consisting of 12 stations with 10–15 repetitions per exercise, performed in a single set, targeting children aged 7–12 years. Their findings indicated that resistance training, conducted once or twice per week, effectively improved strength in this age group. Consistent with the findings of the current study, Faigenbaum et al.'s results underscore the potential for developing muscle strength at a young age.

In the present study, developmental changes in the 50 m, 100 m, and 1000 m swimming performances of participants were evaluated. Although numerical improvements were observed in all three swimming distances, these changes did not reach statistical significance.

Selçuk (2012) emphasized the importance of both endurance and sprint ability for athletes competing in 25m and 50m swimming events. He reported that the 50m swimming performance of the experimental group, which improved strength through theraband training (47.30±5.46 to 43.94±5.53 seconds), was superior to that of the control group, which focused solely on swimming practice (49.26±5.15 to 48.17±4.97 seconds). These findings suggest that theraband training contributes not only to strength development but also to sprint performance. However, in the present study, the functional training approach designed to enhance strength development did not result in a statistically significant improvement in the pre- and post-test values for 50m and 100m swimming performance.

Flexibility is a crucial movement characteristic across nearly all sports. In the present study, while numerical improvements in flexibility were observed among the participants, the functional training exercises targeting flexibility did not yield statistically significant changes. Muratlı (2007) emphasized the importance of developing flexibility from an early age, noting that flexibility becomes increasingly challenging to improve as individuals grow older.

Loss of flexibility is one of the most prevalent physical challenges during adolescence. Rapid bone growth, coupled with the inability of muscles to keep pace with this development, can occasionally result in knee pain. Regular stretching exercises are therefore crucial for maintaining flexibility and preventing such issues in adolescents (Baltacı & Baltacı, 2008).

The literature highlights conflicting findings regarding the relationship between swimming participation and flexibility development. Many studies have reported no significant association between swimming and improvements in flexibility (Dawson et al., 2002; Cook et al., 2010; Zülkadiroğlu, 1995; Berg et al., 1995). These findings are consistent with the results of the present study.

In contrast to the findings of this study, there are studies in the literature indicating significant improvements in flexibility through physical activity programs conducted with children. Saygın et al. (2005) reported that children engaged in sports demonstrated superior flexibility compared to their non-active peers. Similarly, Yenal et al. (1999) identified a significant relationship between sports participation and flexibility development in children aged 10–11 years. The discrepancy between these studies and the present study may stem from variations in the type or intensity of flexibility training applied.

Conclusions

The 8-week functional training program applied to young male swimmers was found to have a positive impact on strength performance; however, its effects on flexibility and swimming performance did not reach statistical significance. Despite this, the test results indicated numerical improvements in both flexibility and swimming performance. This training approach is believed to offer valuable insights for swimming coaches and sports scientists working with this age group, contributing to both the developmental needs of young athletes and the enhancement of their performance in training.

Information on Ethics Committee Permission

Committee Name: Pamukkale University Non-Interventional Clinical Research Ethics Committee

Date: 20.03.2024

Issue/Decision Number: E-60116787-020-507069

All subjects and their parents were informed about the research procedures, requirements, potential benefits, and risks before providing written informed consent.

Limitations

A key limitation of this study is the lack of existing research specifically examining the effects of a functional training program on strength, flexibility, and swimming performance in young male swimmers. The paucity of comparable investigations in the literature makes it difficult to situate the present findings within broader evidence base or directly align them with the outcomes of previous studies. In turn, this constrains the extent to which the results can be generalized beyond the immediate context of this research. Future studies with larger sample sizes, varying training protocols, and longer intervention periods are needed to validate and expand upon these initial findings. Establishing a more robust body of literature would not only facilitate meaningful cross-study comparisons but also guide practitioners in optimizing functional training programs for enhanced athletic development in this specific population.

Practical Applications

It may be beneficial for athletes to increase the intensity and frequency of sprint exercises, as these can lead to greater improvements in overall athletic performance. Engaging in functional training that targets explosive strength also holds promise for enhancing power and competitive outcomes. In the context of flexibility, regularly incorporating multiple flexibility-oriented exercises (rather than just one) into the training regimen could result in more substantial gains in range of motion, injury prevention, and overall athletic efficiency.

Coaches could consider structuring training programs in a way that includes a higher number of sprint sessions, with progressively increasing intensity and frequency. They might also integrate various explosive strength and flexibility exercises, as a broader range of targeted activities is more likely to yield notable improvements in performance. Extending the training program's duration and increasing the volume (e.g., additional sets, repetitions, or sessions) may be warranted to observe significant improvements and to achieve stronger statistical validity.

Swimmers, specifically, can benefit from focusing on increasing the intensity of sprint training and complementing it with functional training to develop explosive strength. By doing so, they may see marked improvements in speed and power in the water. Incorporating more than one flexibility exercise in each training session could help prevent injuries and improve stroke mechanics, ultimately supporting better overall performance.

From a reader's perspective, the findings of this study emphasize the importance of sprint-focused and functional training in developing strength, power, and flexibility for young athletes.

Longer intervention periods with carefully planned increases in training volume appear necessary for detecting substantial enhancements in performance and establishing more robust evidence. In turn, these insights may inform evidence-based strategies for future research and practice aimed at optimizing youth athletic development.

Authors' contributions: The author collected the data, created the study design, analyzed the data, revised the article, and interpreted the results. The author has approved the final version of the manuscript.

Conflict of interest declaration: No potential conflict of interest was reported by the author.

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