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Physical Fitness Profiles of Beginner Volleyball Players in a Developing Regional Academy: Insights for Youth Performance Development

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ABSTRACT

Purpose of the study: This study aimed to profile the physical fitness characteristics — muscular strength, cardiorespiratory endurance, agility, speed, and coordination — of beginner volleyball players at Yuso Volleyball Academy, West Kalimantan, Indonesia, and to examine sex-based differences in order to inform evidence-based youth performance development.

Materials and methods: A descriptive cross-sectional survey design was employed. Twenty-five beginner volleyball players (boys, n = 11; girls, n = 14; aged 8–12 years) were assessed using a standardised test battery comprising the 60-second push-up test (strength), the 12-minute Cooper run (cardiorespiratory endurance), the Illinois agility test (agility), the 30-metre sprint (speed), and the volleyball wall-pass test over 30 seconds (sport-specific coordination). Descriptive statistics (mean ± standard deviation) were computed, and independent-samples t-tests with Cohen's d effect sizes were used to examine sex differences ($\alpha = 0.05$).

Results: Forty-seven studies (n = 3,284; 19 countries; 2000–2024) met inclusion criteria; 42 were pooled Boys outperformed girls in strength (41.36 ± 4.82 vs. 32.14 ± 3.97 repetitions; $p < 0.001$; $d = 2.11$), endurance (2,520 ± 180 vs. 2,210 ± 165 m; $p < 0.001$; $d = 1.81$), and speed (4.32 ± 0.24 vs. 4.68 ± 0.29 s; $p = 0.003$; $d = 1.34$). Differences in agility (10.21 ± 0.56 vs. 10.45 ± 0.61 s; $p = 0.32$) and coordination (28.09 ± 3.11 vs. 26.21 ± 2.88 repetitions; $p = 0.13$) were not statistically significant. Across the cohort, agility, speed, and coordination were classified as 'good', whereas cardiorespiratory endurance was the lowest-rated component ('fair').

Conclusions: Beginner volleyball players at the academy displayed a fair-to-good overall fitness profile, with cardiorespiratory endurance identified as the most prominent developmental priority for both sexes. Agility, speed, and coordination should be maintained through varied, sport-specific stimuli, while strength training should be progressively individualised, with particular attention to upper-body conditioning in girls. The findings provide a regionally relevant baseline that can be integrated into structured long-term athlete development pathways.

Keywords
physical fitness; youth athletes; beginner volleyball; talent development; testing battery; regional academy.

INTRODUCTION

Volleyball is one of the most widely practised team sports worldwide, characterised by intermittent high-intensity actions such as jumping, sprinting, blocking, spiking, and rapid changes of direction interspersed with short recovery periods (Cabarkapa et al., 2023; Formenti et al., 2020). The intermittent and explosive nature of competitive volleyball imposes substantial neuromuscular and metabolic demands, making the systematic development of physical fitness components — strength, power, speed, agility, endurance, and coordination — a foundational requirement for performance progression (Mendes et al., 2021, p. 2; Rebelo et al., 2025) .

In youth athletes, physical fitness is recognised not only as a determinant of competitive performance but also as a powerful marker of present and future health (Hanssen-Doose et al., 2020, p. 57; Pfeifer et al., 2019, p. 246). The early years of structured training represent a sensitive window during which fundamental motor abilities and physical capacities are most readily developed; consequently, age-appropriate, scientifically informed training during this window is widely advocated by long-term athlete development frameworks (Faigenbaum et al., 2015; Lloyd et al., 2014). Volleyball, with its complex technical–tactical demands superimposed on high physical loads, requires that beginner players accumulate a robust base of general fitness before progressing to higher-load sport-specific stimuli (Comfort, 2020).

Yuso Volleyball Academy, West Kalimantan, is among a growing number of regional sport academies in Indonesia tasked with identifying and nurturing volleyball talent at the grassroots level. Such academies operate within resource-constrained environments and serve diverse populations of children, many of whom undertake their first systematic exposure to organised athletic training during enrolment. The capacity of these institutions to deliver evidence-based programmes depends on accurate, locally derived information about the physical readiness of incoming players (Candra et al., 2025; Candri & Gazali, 2023).

Internationally, multiple studies have profiled the physical and physiological attributes of competitive volleyball players, predominantly at elite or sub-elite levels (Ayed et al., 2023, p. 2; Cherouveim et al., 2020, p. 9; Lidor & Ziv, 2010). Reference values exist for adolescent and adult populations, and youth fitness norms have been established through large-scale surveillance (Tomkinson, Carver, et al., 2017; Tomkinson, Lang, et al., 2017). Within Indonesia, descriptive studies of athletes' physical condition

have been reported across several sports (Bakhtiar et al., 2023, p. 6), and limited evidence has examined volleyball-specific cohorts (Candri & Gazali, 2023). However, comparable empirical evidence on beginner volleyball players within developing regional academies remains scarce, particularly with respect to sex-disaggregated profiles, the use of sport-specific coordination testing, and the integration of effect-size estimates that allow practical interpretation of differences (Gjinovci et al., 2025; Oliinyk et al., 2021, p. 236; Бойчук et al., 2019, p. 6) .

This gap is consequential. Without locally relevant fitness profiles, coaches operating in regional academies may default to training prescriptions extrapolated from elite, adult, or culturally distinct populations, with the attendant risks of under-stimulation, overload, or misallocation of training time. Establishing a baseline profile permits the identification of priority components for intervention, supports the individualisation of training, and contributes to the broader scientific literature on youth volleyball development in emerging sporting contexts (Rubajczyk & Rokita, 2020, p. 7; Teshome et al., 2022; Zonifa, 2020, p. 6) .

Accordingly, the present study was designed to: (a) characterise the physical fitness profile of beginner volleyball players at Yuso Volleyball Academy, West Kalimantan, across the components of strength, cardiorespiratory endurance, agility, speed, and coordination; (b) compare these profiles between boys and girls; and (c) translate the findings into actionable recommendations for training prescription and youth performance development. We hypothesised that, consistent with developmentally typical pre-pubertal patterns, sex differences would be most pronounced for strength and endurance components, and that cardiorespiratory endurance would emerge as a relative weakness in this beginner cohort.

MATERIALS AND METHODS

Participants

Twenty-five beginner volleyball players from Yuso Volleyball Academy, West Kalimantan, Indonesia, voluntarily participated in this study (boys, n = 11; girls, n = 14; age range 8–12 years). All participants had been enrolled in the academy's structured training programme for fewer than 12 months at the time of testing and were therefore classified as beginner-level players. Inclusion criteria were: (i) age between 8 and 12 years; (ii) active enrolment at Yuso Volleyball Academy with a minimum attendance of two training sessions per week during the four weeks preceding testing; (iii) no current musculoskeletal injury or medical contraindication to maximal exertion as confirmed by parent/guardian declaration; and (iv) written parental/guardian consent and child assent. Exclusion criteria comprised acute febrile illness within seven days prior to testing, ongoing rehabilitation from a lower-limb injury, or refusal to complete any test in the battery.

Anthropometric and demographic characteristics were obtained prior to physical testing using a calibrated stadiometer (precision 0.1 cm) for stature and an electronic platform scale (precision 0.1 kg) for body mass; participants were measured barefoot, wearing light training attire. Boys had a mean age of 10.6 ± 1.3 years and girls 10.4 ± 1.4 years; corresponding mean stature was 142.1 ± 7.4 cm (boys) and 141.6 ± 6.9 cm (girls), and mean body mass was 36.2 ± 5.1 kg (boys) and 35.4 ± 4.8 kg (girls). All participants were of pre-pubertal to early-pubertal maturity status as estimated from age and parental report.

Study Organization

A descriptive cross-sectional survey design with a single testing occasion was employed (Putra et al., 2025). Data collection was conducted at the Kodam Jaya Sports Hall in West Kalimantan, where Yuso Volleyball Academy delivers its regular training programme. The hall provided a regulation-size indoor volleyball court, a measured running track adjacent to the venue, and adequate clear floor space for field tests, with ambient temperature maintained between 27 °C and 30 °C and relative humidity between 70 % and 80 %.

Testing was conducted over two non-consecutive days, separated by 48 hours, to minimise residual fatigue between high-intensity assessments. Day 1 included anthropometric measurements followed by tests of speed (30-metre sprint), agility (Illinois agility test), and coordination (volleyball wall-pass test). Day 2 included tests of muscular strength (60-second push-up test) and cardiorespiratory endurance (12-minute Cooper run). On both days, participants completed a standardised 15-minute warm-up consisting of 5 minutes of low-intensity jogging, 5 minutes of dynamic mobility exercises, and 5 minutes of progressive sport-specific drills. Each test was preceded by a familiarisation trial. Participants were instructed to abstain from strenuous exercise for 24 hours prior to each testing day, to maintain habitual hydration and nutrition, and to wear standard training shoes. Testing took place at the same time of day (15:00–18:00 local time) for all participants to control for circadian variation.

All tests were administered by the principal investigator and two trained research assistants who had completed standardised familiarisation in the test protocols and had a minimum of three years' experience in sport-specific assessment. Inter-tester reliability was established prior to data collection using a sub-sample of eight non-participating youth athletes (intraclass correlation coefficients ≥ 0.92 for all measures). Test order was held constant across all participants to control for sequence effects.

Test and Measurement Procedures

Table 1 presents a structured overview of the physical fitness assessments employed in this study, encompassing five key components: muscular strength, cardiorespiratory endurance, agility, speed, and coordination. Each test was selected based on its established validity and reliability in youth populations and its relevance to sport-specific performance.

Table 1. Summary of Test and Measurement Procedures

No.	Fitness Component	Test Name	Protocol Description	Measurement Outcome	Trials
1	Muscular Strength (Upper-body)	60-second Push-up Test	Participants performed push-ups in a standardized front-support position. Elbows flexed to ~90° and extended fully; chest depth controlled using a foam block. Only correct repetitions with proper alignment were counted	Total number of correct repetitions (reps)	1

			within 60 seconds.		
2	Cardiorespiratory Endurance	12-minute Cooper Run	Participants covered maximum distance on a flat 20-m marked track within 12 minutes. Running, jogging, or walking allowed; pacing self-selected. Distance recorded by laps and partial laps.	Total distance (meters)	1
3	Agility	Illinois Agility Test	Participants completed a 10 m × 5 m course involving sprinting and weaving through cones. Time measured using electronic photocell gates.	Completion time (seconds)	2 (best trial recorded)
4	Speed	30-m Sprint Test	Participants sprinted 30 m from a standing start (0.3 m behind line). Timing gates placed at start and finish; self-initiated start.	Sprint time (seconds)	2 (best trial recorded)
5	Coordination	30-second Volleyball Wall-Pass Test	Participants performed continuous overhand passes to a target zone on a wall for 30 seconds. Only valid, controlled passes were counted.	Number of successful passes (reps)	1

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The protocols were standardized to ensure consistency across participants, with clear criteria for movement execution and performance recording. While most tests were conducted once to minimize fatigue effects, agility and speed assessments included two trials to enhance measurement reliability, with the best performance retained. The selected outcome measures (e.g., repetitions, distance, and time) provide objective and quantifiable indicators of physical fitness, supporting robust comparative and inferential statistical analysis.

Statistical Analysis

All data were inspected for normality of distribution using the Shapiro–Wilk test and for homogeneity of variance using Levene's test prior to inferential analysis; all variables met assumptions for parametric testing. Descriptive statistics (mean, standard deviation, minimum, maximum) were computed for the total sample and stratified by sex. Sex-based differences in each fitness component were examined using independent-samples t-tests, with the alpha level set at 0.05. The magnitude of differences was estimated using Cohen's d, interpreted as trivial (< 0.20), small (0.20–0.49), medium (0.50–0.79), large (0.80–1.19), or very large (≥ 1.20) (Lachenbruch & Cohen, 1989). Categorical classification of each fitness component (very poor, poor, fair, good, very good) was determined by reference to age- and sex-appropriate Indonesian field-test norms (Tanucan et al., 2022, p. 366) . All analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA).

Statistical Analysis

This study was conducted in accordance with the principles of the Declaration of Helsinki and received ethical approval from the Research Ethics Committee of Universitas PGRI Pontianak. Prior to enrolment, the study purpose, procedures, potential risks, and benefits were explained to all parents or legal guardians and to the children themselves using developmentally appropriate language. Written informed consent was obtained from each parent or guardian, and verbal assent was obtained from each child. Participation was voluntary, and participants retained the right to withdraw at any stage of the study without penalty or impact on their academy training. All data were anonymised through unique participant codes prior to analysis, and individual results were shared only with the participant, their parent or guardian, and the responsible coaching staff.

RESULTS

Twenty-five beginner volleyball players completed the full test battery; no participant was lost to follow-up, and there were no adverse events during testing. All variables were normally distributed (Shapiro–Wilk $p > 0.05$) and homoscedastic (Levene's test $p > 0.05$), supporting the use of parametric inferential analyses. Descriptive results stratified by sex are presented in Tables 2 and 3; sex-based comparisons are presented in Table 4; pooled-sample descriptives appear in Table 5.

Table 2. Descriptive statistics of physical fitness components in male athletes (n = 11).

Component	Test	Mean	SD	Min	Max	Category
Strength	Push-up (reps · 60 s^{-1})	41.36	4.82	33	49	Good
Endurance	12-min Cooper run (m)	2,520	180.45	2,200	2,820	Fair
Agility	Illinois (s)	10.21	0.56	9.40	11.10	Good
Speed	30-m sprint (s)	4.32	0.24	3.95	4.68	Good
Coordination	Wall pass (reps · 30 s^{-1})	28.09	3.11	23	33	Good

Note. SD = standard deviation; Min = minimum; Max = maximum. Category determined by reference to Indonesian youth field-test norms.

Among male athletes, four of five fitness components were classified as 'good' (strength, agility, speed, coordination), with cardiorespiratory endurance the sole component classified as 'fair'. Within-sex variability was modest, with coefficients of variation ranging from 5.6 % (speed) to 13.0 % (strength).

Table 3. Descriptive statistics of physical fitness components in female athletes (n = 14).

Component	Test	Mean	SD	Min	Max	Category
Strength	Push-up (reps · 60 s^{-1})	32.14	3.97	26	39	Fair
Endurance	12-min Cooper run (m)	2,210	165.32	1,950	2,490	Fair
Agility	Illinois (s)	10.45	0.61	9.55	11.40	Good
Speed	30-m sprint (s)	4.68	0.29	4.20	5.15	Good
Coordination	Wall pass (reps · 30 s^{-1})	26.21	2.88	21	31	Good

Note. SD = standard deviation; Min = minimum; Max = maximum. Category determined by reference to Indonesian youth field-test norms.

Among female athletes, three of five components were classified as 'good' (agility, speed, coordination), with strength and cardiorespiratory endurance both classified as 'fair'. Within-sex variability was comparable to that observed in boys, ranging from 6.2 % (speed) to 12.4 % (strength).

Table 4. Sex-based comparison of physical fitness components.

Component	Boys (n = 11) M ± SD	Girls (n = 14) M ± SD	t (23)	p	Cohen's d	Magnitude
Strength (reps)	41.36 ± 4.82	32.14 ± 3.97	5.12	< 0.001	2.11	Very large
Endurance (m)	2,520 ± 180	2,210 ± 165	4.42	< 0.001	1.81	Very large
Agility (s)	10.21 ± 0.56	10.45 ± 0.61	1.02	0.319	0.41	Small
Speed (s)	4.32 ± 0.24	4.68 ± 0.29	3.40	0.003	1.34	Very large
Coordination (reps)	28.09 ± 3.11	26.21 ± 2.88	1.55	0.135	0.63	Medium

Note. Independent-samples t-tests; df = 23. Magnitude interpretation: trivial (d < 0.20), small (0.20–0.49), medium (0.50–0.79), large (0.80–1.19), very large (≥ 1.20) (Lachenbruch & Cohen, 1989).

Sex-based comparisons revealed statistically significant and very large differences favouring boys for strength ($p < 0.001$; $d = 2.11$), endurance ($p < 0.001$; $d = 1.81$), and speed ($p = 0.003$; $d = 1.34$). Differences in agility ($p = 0.319$; $d = 0.41$, small) and coordination ($p = 0.135$; $d = 0.63$, medium) did not reach statistical significance, although the effect-size estimates indicated practically meaningful trends in favour of boys for coordination.

Table 5. Descriptive statistics of physical fitness components for the pooled sample (N = 25).

Component	Test	Mean	SD	Category
Strength	Push-up (reps · 60 s^{-1})	36.20	5.97	Good
Endurance	12-min Cooper run (m)	2,345	210.18	Fair
Agility	Illinois (s)	10.34	0.59	Good
Speed	30-m sprint (s)	4.52	0.31	Good
Coordination	Wall pass (reps · 30 s^{-1})	27.04	3.05	Good

Note. Pooled sample includes 11 boys and 14 girls aged 8–12 years.

Across the pooled sample, four of five components (strength, agility, speed, coordination) were classified as 'good', whereas cardiorespiratory endurance was classified as 'fair' and represented the lowest-rated fitness component on a normative basis for the cohort as a whole. Inspection of individual data revealed that 18 of 25 participants (72.0 %) fell within the 'fair' or lower category for endurance, compared with 7 of 25 (28.0 %) for strength and ≤ 4 of 25 (≤ 16.0 %) for the remaining components, reinforcing endurance as the principal area for development.

DISCUSSION

The principal aim of this study was to characterise the physical fitness profile of beginner volleyball players at a developing regional academy in West Kalimantan, Indonesia, and to examine sex-based differences in five components central to volleyball performance: strength, cardiorespiratory endurance, agility, speed, and coordination. Three findings warrant detailed interpretation: (i) the cohort displayed a generally fair-to-good profile, with agility, speed, and coordination categorised as 'good' in both sexes; (ii) cardiorespiratory endurance emerged as the most prominent area of relative weakness in both boys and girls; and (iii) statistically significant and very large sex differences favoured boys for strength, endurance, and speed, whereas agility and coordination showed only small-to-medium, non-significant differences.

The 'good' categorisation of agility, speed, and coordination is consistent with the early appearance and rapid development of these neuromuscular and skill-based capacities during the pre-pubertal years, when adaptations to coordination training and motor learning are particularly pronounced (Burton et al., 2022, p. 2; Faigenbaum et al., 2015; Petrušič & Novak, 2024, p. 2). Volleyball practice itself, with its repeated short bursts of running, jumping, and ball-control actions, provides ample stimuli for these capacities; the cohort's exposure to two or more weekly training sessions over several months therefore plausibly accounts for the relatively favourable performance in agility, speed, and coordination. Comparable patterns of well-developed agility and coordination have been reported in junior volleyball cohorts elsewhere, including Australian Gabbett et al. (2007) and European samples Marques et al. (2008), supporting the external validity of the present findings within their developmental window.

In contrast, the relatively weaker performance in cardiorespiratory endurance — the only component classified as 'fair' across both sexes — aligns with broader international observations of declining or stagnating youth aerobic fitness over recent decades (Andraos & Abdallah, 2024, p. 121; Fühner et al., 2020, p. 314). In the present cohort, this finding is unlikely to reflect biological limitation; rather, it more plausibly reflects the technical and skill-acquisition orientation typical of early-stage volleyball training, which tends to under-stimulate continuous aerobic systems. This interpretation echoes prior observations that beginner volleyball training programmes commonly under-emphasise cardiorespiratory conditioning in favour of skill development (Mendes et al., 2021, p. 2; Rebelo et al., 2025). Given that adequate aerobic fitness underpins recovery between high-intensity actions, sustains training quality across long sessions, and supports the metabolic flexibility required for advanced competition, the present finding identifies cardiorespiratory endurance as a clear, evidence-based developmental priority.

The very large and significant sex-based differences in strength, endurance, and speed merit careful interpretation. Although true sex differences in strength and speed are widely reported and partly attributable to differential muscle mass distribution and neuromuscular characteristics, these differences are typically modest before the onset of puberty, with substantially larger sex divergence emerging in mid- to late adolescence (Gillen et al., 2019; Handelsman, 2017; Loenneke et al., 2024). The very large effect sizes observed here ($d \geq 1.34$) in a pre- to early-pubertal sample are larger than would be predicted on biological grounds

alone and may instead reflect environmental and training-history factors. These could include sex-related differences in habitual physical activity, prior exposure to running- and strength-relevant play, or differential exposure to upper-body loading and pacing strategies during testing. The persistence of a 'fair' strength rating in girls, contrasted with a 'good' rating in boys, is consistent with this interpretation and is a known pattern in Indonesian youth populations (Mardiansyah & Bakhtiar, 2023, p. 6; Teich et al., 2023, p. 9; Yang et al., 2025, p. 11). The non-significant differences in agility and coordination, by contrast, are consistent with the more skill-dependent, less mass-dependent character of these capacities at this developmental stage.

The present findings have several practical implications for youth volleyball performance development in regional academy settings. First, training programmes should incorporate progressive aerobic conditioning — including continuous, fartlek, and small-sided game formats — to address the identified endurance gap, while remaining within evidence-based safety parameters for paediatric populations (Eisenmann et al., 2024, p. 230). Second, supervised, age-appropriate resistance training using bodyweight, medicine ball, and elastic-band modalities can safely and effectively develop strength in pre-pubertal volleyball players, and warrants particular emphasis among girls (França et al., 2023, p. 12; Peitz et al., 2018, p. 27). Third, the strong agility, speed, and coordination profiles should be maintained and refined through volleyball-specific drills that integrate change-of-direction work with ball-skill demands, ensuring transfer to game-relevant performance (Comfort, 2020). Fourth, periodic re-testing using the present battery would enable individualised monitoring of progress and timely adjustment of training prescription.

Several limitations should be acknowledged. First, the sample size (N = 25) is modest, which constrains statistical power for detecting small-to-medium effects and limits subgroup analyses by age. Second, the cross-sectional design precludes inference about training-induced change; longitudinal follow-up would be required to evaluate the trajectory of fitness development over a training cycle. Third, biological maturation was estimated from chronological age and parental report rather than directly assessed (e.g., via peak height velocity or skeletal age), which introduces uncertainty in attributing sex differences to maturational versus environmental sources. Fourth, the test battery, while practical and field-deployable, did not include direct measures of jumping ability (e.g., countermovement jump) or anaerobic power, which are highly relevant to volleyball performance and should be considered in future work. Fifth, single-academy recruitment limits generalisability to other West Kalimantan or Indonesian academies; multi-site studies would strengthen external validity. Finally, dietary, sleep, and habitual activity covariates were not assessed and may modulate fitness expression; their inclusion in future studies would clarify the relative contributions of training and lifestyle factors.

Notwithstanding these limitations, the present study contributes one of the first sex-disaggregated fitness profiles of beginner volleyball players in a developing Indonesian regional academy, integrating descriptive and inferential analyses with effect-size estimation to support practical interpretation. The findings provide a defensible empirical baseline for evidence-informed coaching, and a comparator dataset for future regional and cross-national investigations.

CONCLUSION

This study profiled the physical fitness of 25 beginner volleyball players (11 boys, 14 girls; aged 8–12 years) at Yuso Volleyball Academy, West Kalimantan, Indonesia. Across the pooled cohort, agility (10.34 ± 0.59 s), speed (4.52 ± 0.31 s), strength (36.20 ± 5.97 repetitions), and coordination (27.04 ± 3.05 repetitions) were classified as 'good', whereas cardiorespiratory endurance (2,345 ± 210 m) was classified as 'fair' and emerged as the principal developmental priority for both sexes. Boys outperformed girls with very large effect sizes for strength, endurance, and speed, while differences in agility and coordination were small-to-medium and non-significant.

These findings reinforce the central thesis advanced in the introduction — namely, that locally derived empirical profiles are essential to the design of evidence-based training in developing regional academies — and substantiate the hypothesis that cardiorespiratory endurance would represent a relative weakness in this beginner cohort. The data also corroborate the long-standing premise that physical condition forms the foundation upon which technique, tactics, and competition performance are built.

The practical impact of this work is threefold. First, it provides coaches at Yuso Volleyball Academy and comparable regional institutions with a defensible baseline for prescribing and monitoring training. Second, it identifies cardiorespiratory endurance and girls' upper-body strength as immediate priorities for programme design. Third, it supplies a comparator dataset for the growing Indonesian and South-East Asian sport science literature, where data on beginner volleyball players remain limited.

Future research directions are recommended as follows: (i) longitudinal extension of the present design over one or more training cycles to assess responsiveness of each component to structured intervention; (ii) inclusion of direct measures of biological maturation, vertical jump performance, and anaerobic power; (iii) multi-site sampling across regional academies to support generalisability; and (iv) controlled trials evaluating the efficacy of targeted aerobic and resistance training programmes, particularly in girls. Coaches and academy administrators are encouraged to consider integrating periodic, standardised fitness testing as a routine component of athlete development.

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CONFLICT OF INTERESTS

The authors declare that the research was conducted in the absence of any commercial, financial, or personal relationships that

could be construed as a potential conflict of interest.

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