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Anthropometric and physical characteristics of youth soccer in Timor-Leste: A multi-dimensional analysis of male players in a developing country

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ABSTRACT: The objective of this study was to analyze the growth, maturation, and physical characteristics of youth soccer players in Timor-Leste. Anthropometric and physical data were collected from 217 Under-15, Under-13, Under-11, and Under-9 male soccer players from five clubs. The anthropometric parameters included height, sitting height, and body mass. These allowed calculations of maturity offset, peak-height velocity (PHV), and body mass index (BMI). The Yo-Yo Intermittent Endurance Test (Level 1), Shuttle Sprint and Dribble Tests, Horizontal Jump Test, and Slalom Sprint and Dribble Tests were recorded to make physical assessments. Results showed youth soccer in Timor-Leste presented with lower values of anthropometric and physical parameters compared to more developed countries. Under-9 soccer players were predicted an age at PHV earlier than the other age-categories ($p < 0.001$). There were no significant differences in BMI between age-categories. Regarding physical assessments, Under-11 performed better on the Slalom Sprint and Dribble Tests compared to Under-13 ($p < 0.001$). This investigation offers the first insights into the maturational, anthropometric, and athletic qualities of youth soccer players from Timor-Leste. It hopes to provide impetus for researchers to work with other developing countries in this field to breed more generalizable findings, and so, support the implementation of developmental programs.

KEY WORDS Growth, Maturation, Development, Maturity Offset, Peak-Height Velocity.

INTRODUCTION

Training for youth soccer players should not simply be a scaled-down version of adult practices, as children and adolescents grow and develop at varying rates [1]. While it is true that organized youth sports can be highly structured and competitive environments shaped largely by adult perspectives, it is crucial to consider the distinct differences between youths and adults in terms of training needs [2]. This approach ensures that the training is tailored to the specific requirements of young athletes. For instance, since children perceive exertion differently than adults, their training programs require more careful supervision and thoughtful planning, potentially integrating insights from previous experiences and professional practices in a way that addresses the unique developmental stages of youth athletes [3]. Another factor is the effect that physical maturation has on children's technical development due to, for example, the ever-changing state of strength, power, endurance, and recovery [4]. As a result, many young people fail to reach their potential due to lack of stimuli and practice during earlier ages, thus the correct training program plays a crucial role in the development of youth players [1,5]. Indeed, creating and adopting appropriate training regimes reaffirm benefits of sustained physical activity on the health of individuals, regardless of age, that have long been known and promoted [2].

To implement appropriate training programs, practitioners need to understand that children and adolescents undergo an interaction of three distinct processes: growth, maturation, and development. Malina et al. (2007) [5] suggest that these three processes interact with each other and occur simultaneously influencing self-esteem, body image and the perception of competences, as well as the acquired skills and behaviors related to sport. It is imperative, therefore, that the coach or teacher considers the stage and evolution of each of these processes. Particularly, puberty is a phase characterized by an acceleration of growth that affects most of the body dimensions, is universal in nature, established for a period of about two years, and reaches a maximum value (peak-height velocity, PHV) to then decelerate [5,6]. This is followed by the attainment of a period of stability that involves all tissues and body dimensions [7]. The PHV is a characteristic of the beginning of the pubertal peak, during which boys tend to gain fat mass on the trunk, while it decreases on the limbs [8]. A stabilization or a slight increase in fat mass is also observed in boys during PHV, and a marked increase in fat-free mass, due to the substantial increase in muscle and bone mass [5]. Body mass, fat-free mass, and muscle mass show growth velocity peaks, occurring a few months after the PHV [5]. Hence, it is important to recognize the soccer specific outcomes that are affected during puberty, especially when considering specific regions and the factors that also affect physical growth and sport development in later life [9,10].

The pubertal period is then marked by important physiological changes, with direct consequences for the prescription of the young person's training process [11]. According to Figueiredo et al. (2009) [11], the ability of a young person to perform aerobic exercise rises with age, as VO2max develops from middle childhood to 12 years of age, with boys presenting slightly higher values than girls. Also, anaerobic performance increases with the growth process, being dependent on body size [5,12]. This increase in anaerobic performance is not only due to quantitative factors (i.e., increase in muscle and body mass), but also to qualitative factors of the muscle, the activation of motor units and the consequent improvement of neurological aspects linked to motor coordination, or hormonal changes [1]. Young players tend to be advanced in maturation as well as being taller and heavier in comparison with their peers [7]. Coelho-e-Silva et al. (2010) [13] found significant differences in terms of anthropometry, general and specific physiological fitness, and skills between Portuguese young soccer players and non-players. Further, young soccer players tend to have a balance between height and body mass up to the age of 14 or 15, and in the final growth phase, body mass tends to be greater than height due to the higher amount of fat-free mass in relation to the general population [7,13,14].

A wide range of existing evidence about the functional abilities of young soccer players makes it difficult to gather studies that coincide with the methodology of the present work [4,7]. However, there is a consensus that all functional capacities tend to improve with the increasing age of youth soccer players, especially between aged 12 and 14 years [3,14–16]. Coincidingly, Belton et al. (2014) [10] suggested the importance of training specific fundamental movement skills in sport-specific scenarios in post-primary education. Despite soccer being considered the most popular sport in the world, there are few studies at an international level on the knowledge and functional characteristics of young players at the association [7], and particularly, in least developed countries [14], that allows to have an impact on the development of the game [16]. Coaches and key stakeholders need to understand aspects related to the physiology, psychology, and tactical-technical actions of the game to progress and develop young soccer players [7] While understanding the multi-disciplinary challenges young soccer players experience to develop and the number of talent development models that describe the various stages that athletes may go through to reach an elite level, it is paramount that differentiation between territories, demographics, and nations must be specific to their relevant identity [8].

Nowhere is this more salient than in Timor-Leste, and to date and the author's best knowledge, there are no studies that shed light on this issue. It is, therefore, fundamental to know the aspects related to training and competition information to which young people are subject from an early age. The objective of this study was then to evaluate the state of growth and physical fitness of young Timorese soccer players (Under-9, Under-11, Under-13, and Under-15). The aim was to characterize youth soccer in Timor-Leste, for the first time, considering the anthropometric, aerobic performance, anaerobic performance, lower limb strength, and agility parameters. Considering people from Asia are generally smaller in stature and underweight [14], it is expected that young Timorese soccer players to be of reduced height and body mass, and with lower physical ability, than their peers from other western countries [1,5-7,9,13]. Also, it is presumed that older age categories will present better scores in all physical tests performed, due to their advanced maturity and game knowledge, compared to their younger peers [2,3,12,14].

METHODS

Participants

Two hundred and seventeen male soccer players (Under-15 (U15): 55 players, age: 14.40 ± 0.59 years old; Under-13 (U13): 87 players, age:12.80 ± 0.54 years old; Under-11 (U11): 38 players, age: 11.02 ± 0.58 years old; Under-9 (U9): 37 players, age: 8.20.80 ± 0.80 years old) from five soccer academies in Timor-Leste participated in this study. All players engaged in two weekly 90-minute training sessions plus one game on weekends and competed at a regional standard level on a clay soccer pitch. Players had approximately 38 weeks of training per season. Head coaches possessed the Asian Soccer Confederation B or C licenses. Informed consent was gained from the coaches, parents, and players as well as gatekeeper consent from the clubs before the study began. The experimental protocol and investigation were approved by the local Institutional Research Ethics Committee and performed according to the Helsinki Declaration's ethical standards. Data was collected in Timor-Leste, a less developed Southeast Asian country, and recognized as part of a PhD project to characterize the soccer participants in this specific socio-cultural environment.

Data Collection

The evaluation of the young Timorese soccer players occurred in a single moment, in each of the different five clubs (totaling five days of data collection, one day exclusively in a single site). The following data was collected: 1) Anthropometric parameters, following the protocol proposed by The International Society for the Advancement of Kinanthropometry (ISAK) [11]; 2) Aerobic Performance assessment, using the yo-yo intermittent endurance test, level 1 [12]; 3) Anaerobic Performance assessment, using the Shuttle Sprint and Dribble Tests [2]; 4) Lower Limb Strength evaluation, using the Horizontal Jump Test [17]; and 5) Agility assessment using the Slalom Sprint and Dribble Tests [18] (Figure 1). Data was collected on the second training session of an in-season regular microcycle, three days after the match. An experienced researcher, possessing a PhD, collected the data, supported by two more assistant researchers. The team head coach and a voluntary teacher were present during data collection, to allow translation of any necessary information, from Portuguese to Tetum, in case some of the players could not understand instructions, and to organize equipment and areas effectively.

Procedures

The first data collected were the anthropometric parameters, to be able to observe individuals in a normal physical state. Following this, agility and strength of lower limbs were assessed with tests that do not create physical fatigue. Finally, the participants completed an anaerobic performance assessment, and after active recovery, an aerobic performance assessment. During the time between the performance of different tests, it was proposed that players executed lower limbs stretches to allow active recovery. The data collection date depended on the availability of the clubs and was previously agreed with the respective coaches and stakeholders. Despite this, all data collection occurred during the same month in the middle of the season.

Anthropometric assessments

The anthropometric assessment followed the protocol proposed by The International Society for the Advancement of Kinanthropometry (ISAK) [15], taking the values of the following variables: height and sitting height (Seca 213 Stadiometer), and body mass (Seca 813 electronic scale). Based on these measurements, it was possible to estimate maturity offset ((0.0002708 x (height - sitting height) x (sitting height)) - ((0.001663 x age) x (height - sitting height)) + (0.007216 x (age) x (sitting height)) + (0.02292 x (body mass) / (height)) - 9.236) [19], age at PHV (age – maturity offset) [20], and determine body mass index (BMI = body mass / height2) [4].

Physical assessments

The aerobic performance assessment was performed using the Yo-Yo Intermittent Endurance Test, Level 1 [12], which requires the completion of 40-meter courses (2x20) within the cadence of a sound signal that establishes the running speed, with a 5-second recovery after each 40-meter run. The objective was to complete the maximum number of courses, presenting the result in total meters travelled.

The anaerobic performance assessment was performed using the Shuttle Sprint and Dribble Tests [2], which consists of performing three maximum sprints of 30 meters, with and without the ball, with three 180° direction changes. Each participant had the opportunity to perform it twice, counting the best of the two attempts.

The lower limb strength assessment was performed using the Horizontal Jump Test [17], in which each participant was instructed to jump as far as possible, starting from a static position, with free use of hands, measuring the distance from the starting line to the heel of the foot closest to this same line. Each participant was able to perform three jumps, later counting the best of all.

The agility assessment was performed using the Slalom Sprint and Dribble Test [18], which consisted of performing a maximum sprint in slalom, and a maximum sprint in slalom dribbling the ball, in a space of 30-meters, using twelve cones arranged in a zig-zag pattern. Each participant had the opportunity to perform it twice, counting the best of the two attempts.

Due to the lack of resources available in Timor-Leste, all physical performance data was collected by three experienced researchers, supported by two other voluntary individuals (soccer head coach and teacher), using a stopwatch to measure speed times, and a tape measure and cones to measure distances. Particularly for the anaerobic performance and agility assessment, all measurements were collected by each of the three researchers, to then use the mean values of each attempt [21].

Statistical Analysis

The statistical analysis was conducted using the Jamovi Project (version 2.5, Sydney, Australia). Due to the objective of this investigation being to characterize a population, a descriptive analysis was completed and is presented as means and standard deviations (Mean ± SD), and range (minimum and maximum values) (Table 1). Normality and homoscedasticity were assessed with Shapiro-Wilk and Levene's tests, respectively. One way analysis of variance (ANOVA) test was used to assess differences between age categories and TukeyHSD post hoc tests were used to analyze pairwise comparisons. Eta squared ($\eta 2$) (0.01 = small, 0.06 = medium, 0.14 = large) and Cohen's d (d) (0.20 = small, 0.50 = medium, 0.80 = large) were used to calculate effect sizes [22]. Statistical significance was set at $p < 0.05$.

Table 1. Descriptive analysis with Mean ± SD, and range (minimum – maximum) for the anthropometric parameters and physical assessment.

Variables	Under-15 (N=55)	Under-13 (N=87)	Under-11 (N=38)	Under-9 (N=37)
Anthropometric Parameters				
Age	14.40 ± 0.59 (13.67 - 16.15)	12.80 ± 0.54 (11.74 - 13.77)	11.02 ± 0.58 (9.73 - 11.76)	8.20 ± 0.80 (6.88 - 9.70)
Height (cm)	153.94 ± 9.01 (131.00 - 174.00)	142.93 ± 9.16 (127.00 - 168.00)	130.49 ± 5.57 (119.00 - 149.00)	114.92 ± 8.40 (98.00 - 134.00)
Body Mass (kg)	40.19 ± 7.18 (24.40 - 56.70)	33.33 ± 8.08 (23.00 - 55.60)	26.76 ± 4.30 (19.70 - 40.00)	21.21 ± 4.17 (14.10 - 32.30)
Maturity Offset	-1.80 ± 0.90 (-3.89 - 0.12)	-3.06 ± 0.65 (-4.39 - -0.86)	-4.30 ± 0.87 (-8.61 - -2.93)	-5.72 ± 0.52 (-6.95 - -4.60)
Age at PHV (y)	16.19 ± 0.72 (14.82 - 17.83)	15.86 ± 0.59 (13.78 - 17.46)	15.32 ± 0.87 (14.23 - 19.89)	13.92 ± 0.55 (12.85 - 15.82)
Body Mass Index (a.u.)	16.86 ± 1.99 (12.78 - 22.35)	16.19 ± 2.93 (10.69 - 26.63)	15.63 ± 1.60 (13.02 - 20.14)	15.95 ± 1.78 (12.31 - 21.70)
Physical Assessment				
Yo-Yo Intermittent Endurance Test, Level 1 (m)	924.36 ± 296.66 (320.00 - 1640.00)	718.62 ± 245.79 (200.00 - 1440.00)	618.95 ± 190.01 (160.00 - 1040.00)	505.95 ± 262.42 (240.00 - 1280.00)
Shuttle Sprint Test (sec)	9.93 ± 0.73 (8.40 - 11.10)	10.22 ± 0.69 (8.70 - 12.27)	10.74 ± 0.55 (9.43 - 12.20)	11.07 ± 1.59 (8.70 - 15.03)
Shuttle Dribble Test (sec)	13.21 ± 1.41 (10.87 - 16±60)	13.70 ± 1.38 (10.37 - 17.10)	14.20 ± 1.31 (10.37 - 18.37)	15.23 ± 2.11 (11.63 - 21.07)
Horizontal Jump Test (cm)	194.11 ± 19.17 (148.00 - 239.00)	166.92 ± 17.45 (120.00 - 210.00)	150.34 ± 16.25 (113.00 - 188.00)	119.59 ± 16.51 (92.00 - 160.00)
Slalom Sprint Test (sec)	19.11 ± 1.45 (16.10 - 22.62)	19.23 ± 1.55 (16.20 - 22.60)	19.22 ± 1.48 (16.40 - 22.74)	21.50 ± 2.52 (18.20 - 29.60)
Slalom Dribble Test (sec)	29.08 ± 3.62 (20.90 - 37.20)	29.42 ± 3.72 (23.40 - 42.18)	29.17 ± 2.93 (24.60 - 34.80)	37.23 ± 6.49 (31.40 - 55.80)

N - Number of participants; m - meters; cm - centimeters; sec – seconds; kg – kilograms; y – years; a.u. – arbitrary units.

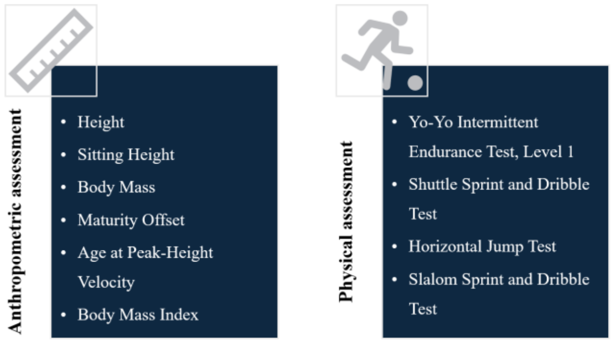

Figure 1. Anthropometric and physical assessments.

STATISTICAL RESULTS

Anthropometric assessments

Height (F (3, 213) = 172.61, p < 0.001, η2 = 0.71) and body mass (F (3, 213) = 66.24, p < 0.001, η2 = 0.48) both increased with age. Regarding maturity offset, none of the age-categories had achieved PHV yet (F (3, 213) = 224.38, p < 0.001, η2 = 0.76). Estimated age at PHV decreased with throughout age categories (F (3, 213) = 92.89, p < 0.001, η2 = 0.57). The oldest age category presented with higher scores for BMI (F (3, 213) = 2.37, p = 0.072, η2 = 0.03). Anthropometric post hoc comparisons are displayed in Table 2.

Table 2. Anthropometric *post hoc* comparisons

Age category		MD	*t*	*p*	Cohen's *d*
Height (cm)					
U9	U11	-15.57	-7.89	< .001	-1.82
	U13	-28.01	-16.70	< .001	-3.28
	U15	-39.02	-21.48	< .001	-4.57
U11	U13	-12.44	-7.49	< .001	-1.46
	U15	-23.45	-13.01	< .001	-2.74
U13	U15	-11.01	-7.48	< .001	-1.29
Body Mass (kg)					
U9	U11	-5.55	-3.53	0.003	-0.82
	U13	-12.12	-9.08	< .001	-1.78
	U15	-18.99	-13.13	< .001	-2.79
U11	U13	-6.57	-4.97	< .001	-0.97
	U15	-13.44	-9.36	< .001	-1.98
U13	U15	-6.86	-5.86	< .001	-1.01
Maturity Offset					
U9	U11	-1.41	-8.12	< .001	-1.87
	U13	-2.65	-17.98	< .001	-3.53
	U15	-3.91	-24.50	< .001	-5.21
U11	U13	-1.24	-8.51	< .001	-1.65
	U15	-2.51	-15.81	< .001	-3.33
U13	U15	-1.26	-9.75	< .001	-1.68
Age at Peak-Height Velocity (y)					
U9	U11	-1.40	-8.87	< .001	-2.05
	U13	-1.93	-14.38	< .001	-2.82
	U15	-2.27	-15.61	< .001	-3.32
U11	U13	-0.53	-3.98	< .001	-0.77
	U15	-0.87	-6.02	< .001	-1.27
U13	U15	-0.34	-2.88	0.023	-0.50
Body Mass Index (a.u.)					
U9	U11	0.31	0.58	0.939	0.13
	U13	-0.25	-0.54	0.948	-0.11
	U15	-0.93	-1.85	0.253	-0.39
U11	U13	-0.57	-1.23	0.605	-0.24
	U15	-1.24	-2.50	0.063	-0.53
U13	U15	-0.68	-1.66	0.345	-0.29

MD - mean difference; cm - centimeters; kg – kilograms; y – years; a.u. – arbitrary units.

Physical assessments

Distance covered in the Yo-Yo Intermittent Endurance Test Level 1 increased throughout age categories (F (3, 213) = 22.18, p < 0.001, η2 = 0.24). Older age categories outperformed their younger peers on the Shuttle Sprint (F (3, 213) = 14.58, p < 0.001, η2 = 0.17) and Dribble Sprint (F (3, 213) = 13.67, p < 0.001, η2 = 0.16) Tests. Likewise, distance increased with age on the Horizontal Jump Test (F (3, 213) = 138.52, p < 0.001, η2 = 0.66). U11, U13, and U15 players recorded negligible differences for both the Slalom Sprint (F (3, 213) = 18.15, p < 0.001, η2 = 0.20) and Dribble (F (3, 213) = 36.50, p < 0.001, η2 = 0.34) Tests. All three older categories were faster than the U9s for both tests. Physical post hoc comparisons are displayed in Table 3.

Table 3. Physical *post hoc* comparisons

Age category		MD	*t*	*p*	Cohen's *d*
Yo-Yo Intermittent Endurance Test, Level 1 (m)					
U9	U11	-113.00	-1.91	0.228	-0.44
	U13	-212.67	-4.22	< .001	-0.83
	U15	-418.42	-7.67	< .001	-1.63
U11	U13	-99.67	-2.00	0.192	-0.39
	U15	-305.42	-5.64	< .001	-1.19
U13	U15	-205.74	-4.66	< .001	-0.80
Shuttle Sprint Test (sec)					

U9	U11	0.32	1.52	0.430	0.35
	U13	0.84	4.74	< .001	0.93
	U15	1.14	5.90	< .001	1.26
U11	U13	0.53	2.98	0.017	0.58
	U15	0.82	4.29	< .001	0.91
U13	U15	0.30	1.89	0.235	0.33
Shuttle Dribble Test (sec)					
U9	U11	1.02	2.88	0.023	0.66
	U13	1.52	5.02	< .001	0.99
	U15	2.01	6.14	< .001	1.30
U11	U13	0.49	1.65	0.352	0.32
	U15	0.99	3.03	0.014	0.64
U13	U15	0.49	1.85	0.253	0.32
Horizontal Jump Test (cm)					
U9	U11	-30.75	-7.52	< .001	-1.74
	U13	-47.32	-13.61	< .001	-2.67
	U15	-74.51	-19.79	< .001	-4.21
U11	U13	-16.58	-4.81	< .001	-0.94
	U15	-43.77	-11.71	< .001	-2.47
U13	U15	-27.19	-8.91	< .001	-1.54
Slalom Sprint Test (sec)					
U9	U11	2.28	5.67	< .001	1.31
	U13	2.27	6.66	< .001	1.31
	U15	2.40	6.48	< .001	1.38
U11	U13	0.00	-0.01	1	0.00
	U15	0.12	0.32	0.988	0.07
U13	U15	0.12	0.41	0.977	0.07
Slalom Dribble Test (sec)					
U9	U11	8.06	8.26	< .001	1.91
	U13	7.82	9.43	< .001	1.85
	U15	8.16	9.08	< .001	1.93
U11	U13	-0.25	-0.30	0.991	-0.06
	U15	0.09	0.11	1	0.02
U13	U15	0.34	0.47	0.966	0.08

MD - mean difference; m - meters; cm - centimeters; sec – seconds.

DISCUSSION

The objective of this study was to evaluate anthropometric and physical characteristics of male Timorese soccer players at academy level. As expected, height and body mass increased incrementally with age across the categories, with all of them presenting an underweight classification on BMI. It was also observed that none of the age categories had reached PHV at the time of the study. Notably, U9 players were predicted to reach PHV (13.92 ± 0.55) at the youngest age. For all the physical assessments, as expected, U15s performed better compared to younger age-categories. Interestingly, however, there were small differences depicted between U15s, U13s and U11s for the Slalom Sprint and Dribble Tests. Indeed, U11s (19.22 ± 1.48 and 29.17 ± 2.93) performed somewhat better than U13s (19.23 ± 1.55 and 29.42 ± 3.72).
Timorese soccer players presented lower values for all anthropometric parameters compared to studies from Europe, Middle East, or Africa. Also, based on BMI results, all age categories were categorized as underweight. These differences in stature and body mass are more than 10cm and 10kgs when compared to Portuguese [15], Qatari [7], and Tunisian [23] players, and more than 15cm and 15kgs when compared to Dutch [2,18], respectively. The variation in body size associated with individual differences in the state of maturity is, on average, especially marked on boys aged between 13 and 15 years: greater size, speed, strength, and power may allow a competitive advantage for players who are older or more advanced in their maturity state [24]. Young Timorese players, particularly in older age-categories, are smaller and leaner than their peers from other demographics. They may be then at a disadvantage when performing in international matches, not building the confidence necessary to excel in the future, but particularly, not being able to develop soccer in a standard that can feed the senior national team [25].

This may be a result of socio-cultural constraints, as Timor-Leste was only recently recognized, and it is still a developing nation (https://timor-leste.gov.tl). Older players may then not have the same education and sporting opportunities as their younger peers, particularly in cities away from the capital [26]. Supporting this interpretation, it was noteworthy that none of the age categories had reached PHV at the time of the study and a lower age at PHV was observed for U9s (13.92 ± 0.55) compared to U15s (16.19 ± 0.72). This may reflect the increase in opportunities in the education system but also more resources available for younger players [14]. Therefore, younger individuals may have been promoted with stimulus that allowed them to develop their systems to a higher standard than their older peers [25].

For the physical tests, Timorese soccer players recorded lower scores compared to individuals from Europe, in line with results from Wong & Wong (2009) [14]. Particularly, for the aerobic assessment, U15s and U13s performed less than half distance of the Portuguese [12] and Italian [9] players, and less than 20cm for the horizontal jump test compared with their Greek peers [4]. When evaluating age-categories, U15 players covered greater distances or jumped furthest than younger ages. Considering U15 players still had not reached puberty, coaches should continue to develop VO2max as the cardiovascular system can be improved prior PHV. Drills with accelerations, decelerations, and breaks should also be prescribed, such as small-sided games (SSGs) with 3v3 to 5v5 in areas of around 30x25-metres [27]. Also, specifically for these players, they can be used alongside their teammates in game scenarios of numerical inferiority (4v2 or 4v6), as playing at a disadvantage stimulates the anaerobic system [28]. This is supported by Hill-Haas et al. (2009) [27] due to the increased acute and long-term physical development of athletes following a program of SSGs, and by Wong & Wong (2009) [14] in relation to their training recommendations when compared Chinese and Tunisian players. Further literature highlights the multifaceted benefits of SSGs, including their effectiveness in enhancing physical fitness parameters such as agility, speed, and muscular endurance [29]. Adjusting the format and rules of SSGs allows for targeted development of specific anthropometric and technical skills, making them particularly suitable for addressing the developmental needs of varying age groups [27,28,29].

Regarding skill-based evaluation, results showed that Timorese players outperformed on the anaerobic and agility assessments compared to their Dutch peers [2,18]. However, it was interesting to observe that U11s performed the Slalom Sprint and Dribble Tests faster than U13s. Players in this older age group may struggle with technical skills as they near their PHV, when rapid physical changes occur. During this time, they often experiment with different skills and adapt techniques through coping strategies to manage these changes. [20]. These changes in physical properties could then provide an impetus for players to perform other skills such as dribbling with the ball past defenders, rather than passing more frequently at a younger age [24].

The ability to run and dribble is essential for soccer performance, and previous research has shown that the best players are distinguished by their performance at high speed [2,18]. This issue has led many coaches to opt for the development of dribbling, and running at speed while controlling the ball, recognized as a central component in the development of young players [2,18]. Therefore, coaches should be patient and adapt training tasks with less decision-making so players can easily perform the different skills (e.g., SSGs in numerical superiority); the more confident the players are, the more challenges should start being in place (e.g., SSGs in equal number or in numerical inferiority) [28,29]. It should also be noted that young players mature at different rates both from a physical and technical perspective. Research from the European academy system suggests that the biological status rather than chronological age may provide a clearer indication of young players physical development [24]. Whilst the slalom sprint and dribble tests provide a broad overview of combined physical and technical performance, it is difficult to assess which component predominates.

Despite the important insights that this research can present to youth development in soccer, some limitations should be acknowledged. First, this study examines a specific population, and therefore, cannot be generalized to other countries and cultures. For instance, it is important to acknowledge that the formula used to measure PHV was validated with young participants from North America and are often designed for Caucasian athletes [19]. Consequently, there is a need to carefully compare players' estimated age at PHV between different countries. More studies are required to evaluate replicability of the formula to these demographics, and the viable comparison with other people, or the need to create a new one.

Also, although the PHV can be calculated to within ±1 year with 95% confidence intervals [19], the results should be considered as an estimation, particularly for the U9s and U11s. These individuals still did not start the puberty phase, consequently, making it harder to predict who is late or early mature. In the future, it is encouraged to consider alternative methods for estimating maturity in youth (e.g., skeletal age assessment, Tanner stages, or biological age assessment), especially when working with athletes across such a broad age range.

Regarding data collection for anaerobic and agility assessments, whilst the use of stopwatches for this study provides a feasible measure to collect group data [21], it should be acknowledged that these have limitations when compared to photoelectric cells when capturing a high degree of precision. However, it should also be understood that such equipment (such as alternative methods for estimating maturity offset) is not readily available in developing countries in comparison to more developed countries and should not be seen as a restraining factor. In addition, the surface type used during physical tests, particularly those that require changing of direction (COD), should be considered since the surface used in the current study was clay. Although considerations were made by the researchers for the loose clay surface material, there remained the potential for players to 'slip'. However, it is also acknowledged that players in the region regularly play on this type of surface, therefore the surface seemed appropriate and realistic. Future comparative studies of this type involving rapid COD, should consider how best to standardize the surface, reducing the likelihood of players slipping.

Future studies should focus on understanding the evolution of this specific population, by replicating the tests in the next ten and twenty years and analyzing the evolution of youth academy soccer players in Timor-Leste. Also, it would be interesting to replicate the same tests in other countries, both in the same continent and others, as it appears accurate that the optimal age of player performance may not be uniform across every league, as soccer is practiced differently in every nation [25,30].

These investigations may support the creation of a long-term athletic development plan (like that used as part of the Premier League Elite Player Performance Plan, England) in Timor-Leste, that would aim at improving soccer as other countries whilst maintaining the unique context of the region. While developing a bespoke development plan capable of supporting young Timorese soccer players may not immediately address the difficulties in achieving a professional career [30], this investigation can inform future strategies to support players development.

CONCLUSION

The young male soccer player from Timor-Leste is generally small and lean. All the age-categories analyzed also still did not achieve their mature state, and therefore, they are still aiming to achieve PHV. Interestingly, the youngest age-category analyzed (U9) have a younger predicted age at PHV than their peers. Still, all age categories analyzed presented an underweight category for BMI. From a physical perspective, most of the tests showed a better performance from older ages, when compared to their younger peers. The implication of these social constraints for coaches at the academy level in Timor-Leste is that training tasks, such as SSGs, should prioritize the development of creativity and decision-making. In this way, the players in these developing countries may overcome the difficulty of their late maturity status and mature perception-action coupling that allows them to discover other skills from their body composition. To this end, isolated practices without interference should be replaced by enriched environments where players are constantly being constrained by the task, in cooperation and opposition scenarios, utilizing unbalanced situations when necessary to afford creativity, to be identical as those observed in match play. Moreover, the adoption of SSGs should also be highlighted for their substantial impact on improving physical fitness attributes, including aerobic capacity, agility, and technical skills which are crucial for the holistic development of youth players. These adaptations are essential, especially considering the physical profiles of Timorese players as described and can aid significantly in their physical and technical maturation. Finally, younger ages seem to start being better equipped with skill-related practices, as their scores on the agility tests are slightly better than their older peers, suggesting progress in the development of youth soccer players in Timor-Leste.

DISCLOSURE STATEMENT

The authors report there are no competing interests to declare.

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