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ORIGINAL ARTICLE

Anthropometric and physical fitness reference values by playing position in a Beninese university volleyball team: A case study

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ABSTRACT

Positional specialisation in volleyball is well documented among elite players, but reference data on West African university-level athletes remain scarce. This case study reports the anthropometric and physical fitness profile, by playing position, of a single Beninese university volleyball team (N = 25: 5 middle blockers, 10 outside hitters/receivers, 6 setters, 4 liberos), and situates these values against selected international reference populations. Given the small, unevenly distributed positional groups, between-position comparisons are reported descriptively, with effect sizes and assumption checks alongside one-way ANOVA, and p values adjusted for multiple comparisons. Height and arm span varied significantly by position and remained robust after correction, with middle blockers tallest and outside hitters/receivers showing the greatest arm span. Body mass index and trunk flexibility also differed in uncorrected analyses but did not survive correction for multiple comparisons; most other variables showed moderate-to-large effect sizes despite non-significant p values, suggesting limited statistical power rather than true equivalence. Rather than generalisable or normative conclusions, these findings offer preliminary, team-specific reference values and a comparative baseline to guide position-specific training and future, larger-scale talent-development research in Beninese university volleyball.

Keywords: performance analysis; case study; volleyball; physical fitness; playing position; athlete profiling.

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INTRODUCTION

Volleyball is one of the most widely practised team sports worldwide. Team composition is organised around four playing positions: middle blocker, outside hitter/receiver, setter, and libero, each with a distinct competitive role defined under current competition regulations (Fédération Internationale de Volleyball, 2025). The sport combines explosive power, displacement speed, coordination, and intermittent endurance, and its tactical and physiological demands vary across these positions (Palao et al., 2014; Sheppard et al., 2009). In countries with established sport-science infrastructure, talent identification and positional orientation can draw on systematic anthropometric and physical profiling (Johnston et al., 2018), allowing coaches to complement technical judgement with objective athlete information.

African volleyball has expanded considerably in recent years, supported by regular continental competition. Studies from several African contexts, including Algeria, Cameroon, and Ethiopia, have examined positional anthropometric and physical characteristics and contributed to a more evidence-informed approach to athlete development (Chachou, 2021; Mbang Bian et al., 2024; Muche et al., 2023). Beninese university volleyball has received comparatively little empirical attention, and positional orientation decisions may therefore rely heavily on coaches' practical experience rather than on local reference data. To our knowledge, no published anthropometric or physical fitness data on Beninese university volleyball players could be identified.

Beyond its immediate practical value for positional orientation, local profiling also speaks to broader talent-development frameworks, which increasingly recognise that athlete development pathways are shaped by the sporting, economic, and institutional environment in which young athletes are embedded, and not solely by selection on fixed physical traits (Johnston et al., 2018). In less professionalised systems, where training specialisation begins later and selection pressure on physical traits is weaker than in fully professionalised systems, the degree of positional physical differentiation may itself be an informative marker of a sporting system's developmental stage, rather than a fixed biological given.

This case study reports the anthropometric and physical fitness profile, by playing position, of the members of a single Beninese university volleyball team, and situates these values against selected international and African reference populations. Given the exhaustive but small single-team sample, the aim was not to test generalisable positional effects, but to establish a first local reference dataset and to describe how it compares with previously published cohorts. The specific objectives were to characterise the anthropometric and physical fitness profile of players within each position, and to provide a preliminary, context-specific comparison with existing international and African data as a baseline for future, larger-scale research.

MATERIAL AND METHODS

Participants

An exhaustive sampling strategy (census) was applied given the restricted size of the target population: all team members meeting the inclusion criteria were enrolled. Inclusion required regular team membership and written informed consent. Players who were absent during testing or who were injured or ill at the time of testing were excluded. The final sample comprised 25 male players (age M = 21.8 years, SD = 1.3 years, range 19–25), distributed across four positions: 5 middle blockers (20.0%), 10 outside hitters/receivers (40.0%), 6 setters (24.0%), and 4 liberos (16.0%).

Measures

Anthropometric measurements included standing height (wall-mounted stadiometer, SECA, France), body mass (Smart Digital Scale EM-19019), arm span (measuring tape, fingertip to fingertip with the arms

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extended horizontally), and standing reach height (floor to fingertip of the dominant arm raised vertically). Body mass index was calculated as body mass in kilograms divided by height in metres squared. Standardised protocols were followed for each measurement, but intra-rater reliability, test-retest reliability, and technical error of measurement were not formally assessed for this study; this is acknowledged as a limitation below.

Physical fitness testing comprised block jump reach height, recorded with a contact mat from a static semi-flexed position without a run-up; spike jump reach height, recorded using the same procedure but preceded by a short run-up; 30-m sprint performance from a static start, hand-timed to the nearest hundredth of a second; T-test agility, involving forward, lateral, and backward displacements between four cones placed 9.14 m and 4.57 m apart; the 20-m multistage shuttle-run test, with the last completed stage converted to running speed in km/h (Léger et al., 1988); and seated sit-and-reach flexibility, recorded in centimetres. Jump-reach values were expressed as absolute touch height (standing reach plus jump displacement). Sprint times were hand-timed rather than electronically timed, which introduces reaction-time error, and the better of two trials was retained for the jump, sprint, and agility tests rather than an average of multiple trials; both choices are discussed as limitations below.

Procedures

Data were collected over two sessions by the research team on the same indoor university volleyball court in Benin, under comparable ambient conditions across sessions; ambient temperature and humidity were not formally recorded. Before each measurement session, participants completed a standardised 10-minute warm-up. Session 1 comprised anthropometric measurements; session 2 comprised the physical fitness test battery, conducted in the same order for all participants. For the jump, sprint, and agility tests, the best of two trials was retained.

Analysis

Data were processed in Microsoft Excel and analysed in Python using the SciPy library (Virtanen et al., 2020). Means and standard deviations were calculated for each variable by playing position. One-way analysis of variance (ANOVA) was used to examine between-position differences for each anthropometric and physical fitness variable, with the significance level set at $\alpha = .05$, alongside eta-squared (η^2) as a measure of effect size and its 90% confidence interval, computed via the noncentral F distribution (Steiger, 2004). Homogeneity of variance was assessed with Levene's test and the normality of ANOVA residuals with the Shapiro–Wilk test; where residuals departed from normality, results were cross-checked with the non-parametric Kruskal–Wallis test. Because 11 comparisons were performed across the full set of anthropometric and physical fitness variables, p values were additionally adjusted for multiple testing using the Benjamini–Hochberg (BH) false discovery rate procedure ($q = .05$), and results are reported both before and after this correction. Because the sample was small, unevenly distributed across positions ($n = 4$–10), and drawn from a single team, these comparisons should be interpreted as descriptive and exploratory rather than confirmatory of generalisable positional effects consistent with the case-study design of this study. Comparison with international reference populations was likewise descriptive rather than inferential.

RESULTS

The sample comprised 25 male university volleyball players (age $M = 21.8$ years, $SD = 1.3$ years) distributed as follows: middle blockers, $n = 5$ (20.0%); outside hitters and receivers, $n = 10$ (40.0%); setters, $n = 6$ (24.0%); liberos, $n = 4$ (16.0%).

Mean sample height was 177.20 cm (*SD* = 6.53 cm), with a clear positional gradient: middle blockers were tallest (*M* = 185.20 cm, *SD* = 8.11 cm), followed by outside hitters/receivers (*M* = 178.30 cm, *SD* = 3.20 cm), setters (*M* = 173.33 cm, *SD* = 2.80 cm), and liberos (*M* = 170.25 cm, *SD* = 2.06 cm), with a significant, large between-position effect ($F(3, 21) = 10.58$, $p < .001$, $\eta^2 = .60$, 90% CI [.28, .70]). Residuals for this variable were consistent with normality (Shapiro–Wilk $p = .165$) and homogeneity of variance (Levene $p = .078$), and the difference remained significant after Benjamini–Hochberg correction for multiple comparisons. Body mass followed a similar pattern but did not reach statistical significance ($F(3, 21) = 2.36$, $p = .100$, $\eta^2 = .25$, 90% CI [.00, .40]); the confidence interval includes zero, so this result is compatible with either a true but undetected positional effect or a true absence of difference, and should not be read as confirming either interpretation. Arm span differed significantly between positions ($F(3, 21) = 5.80$, $p = .005$, $\eta^2 = .45$, 90% CI [.11, .58]), with outside hitters/receivers recording the highest values (*M* = 201.40 cm, *SD* = 6.96 cm), narrowly ahead of middle blockers (*M* = 198.40 cm, *SD* = 19.55 cm); this difference also survived Benjamini–Hochberg correction. Residuals for arm span departed from normality (Shapiro–Wilk $p = .015$), but a non-parametric Kruskal–Wallis test confirmed the difference ($H(3) = 10.97$, $p = .012$), indicating the result is not an artefact of this assumption violation. Standing reach height did not differ significantly ($F(3, 21) = 1.11$, $p = .368$, $\eta^2 = .14$, 90% CI [.00, .28]). Body mass index differed significantly between positions in the uncorrected analysis ($F(3, 21) = 3.87$, $p = .024$, $\eta^2 = .36$, 90% CI [.03, .50]), with liberos recording the highest values (*M* = 23.36 kg/m², *SD* = 1.09 kg/m²), followed by setters, middle blockers, and outside hitters/receivers (*M* = 20.20 kg/m², *SD* = 0.63 kg/m²); residuals departed from normality (Shapiro–Wilk $p < .001$), and although a Kruskal–Wallis test confirmed a significant difference ($H(3) = 11.65$, $p = .009$), this result did not survive Benjamini–Hochberg correction for multiple comparisons and should therefore be treated as more tentative than the height and arm span findings.

Table 1. Anthropometric profile by playing position (mean ± SD) and one-way ANOVA results.

Variable	Middle Blockers (*n* = 5)	Outside Hitters/Receivers (*n* = 10)	Setters (*n* = 6)	Liberos (*n* = 4)	Total (*N* = 25)
Height (cm)	185.20 ± 8.11	178.30 ± 3.20	173.33 ± 2.80	170.25 ± 2.06	177.20 ± 6.53
Body mass (kg)	71.66 ± 7.35	64.25 ± 2.75	66.57 ± 7.23	67.69 ± 1.63	66.84 ± 5.55
Arm span (cm)	198.40 ± 19.55	201.40 ± 6.96	193.00 ± 9.01	175.50 ± 4.20	194.64 ± 13.59
Standing reach height (cm)	244.00 ± 25.02	234.70 ± 14.86	234.17 ± 24.88	220.50 ± 8.23	234.16 ± 19.39
Body mass index (kg/m²)	20.87 ± 1.37	20.20 ± 0.63	22.22 ± 3.12	23.36 ± 1.09	21.32 ± 2.03
Variable	***F***	***p***	**η²**	**Sig. (BH-corrected)**	
Height (cm)	10.58	< .001	.60	Yes	
Body mass (kg)	2.36	.100	.25	No	
Arm span (cm)	5.80	.005	.45	Yes	
Standing reach height (cm)	1.11	.368	.14	No	
Body mass index (kg/m²)	3.87	.024	.36	No	

Note. *p* values adjusted for multiple comparisons across all 11 variables tested (Benjamini–Hochberg procedure, $q = .05$). "Sig. (BH-corrected)" indicates whether the between-position difference remained significant after this correction.

Of the six physical fitness tests, sit-and-reach flexibility showed a significant positional difference in the uncorrected analysis ($F(3, 21) = 3.34$, $p = .039$, $\eta^2 = .32$, 90% CI [.01, .47]): middle blockers were most flexible (*M* = 36.30 cm, *SD* = 6.38 cm), followed by liberos, setters, and outside hitters/receivers (*M* = 28.80 cm, *SD* = 2.82 cm). Like body mass index, this result did not survive Benjamini–Hochberg correction for multiple comparisons and should be treated as tentative. For the remaining five physical fitness variables, effect sizes were mostly moderate to large despite non-significant *p* values, and in each case the 90% confidence interval around η^2 included zero; these results are therefore compatible with an undetected true effect or with a true absence of difference, and should not be read as confirming either. Homogeneity of variance and residual normality were satisfied for all of these variables (Levene $p \geq .077$; Shapiro–Wilk $p \geq .073$), supporting the validity of the ANOVA results for these comparisons. Sprint performance did not reach statistical significance ($F(3, 21) = 2.52$, $p = .086$, $\eta^2 = .26$, 90% CI [.00, .42]); liberos recorded the fastest mean time (*M* = 4.83 s,

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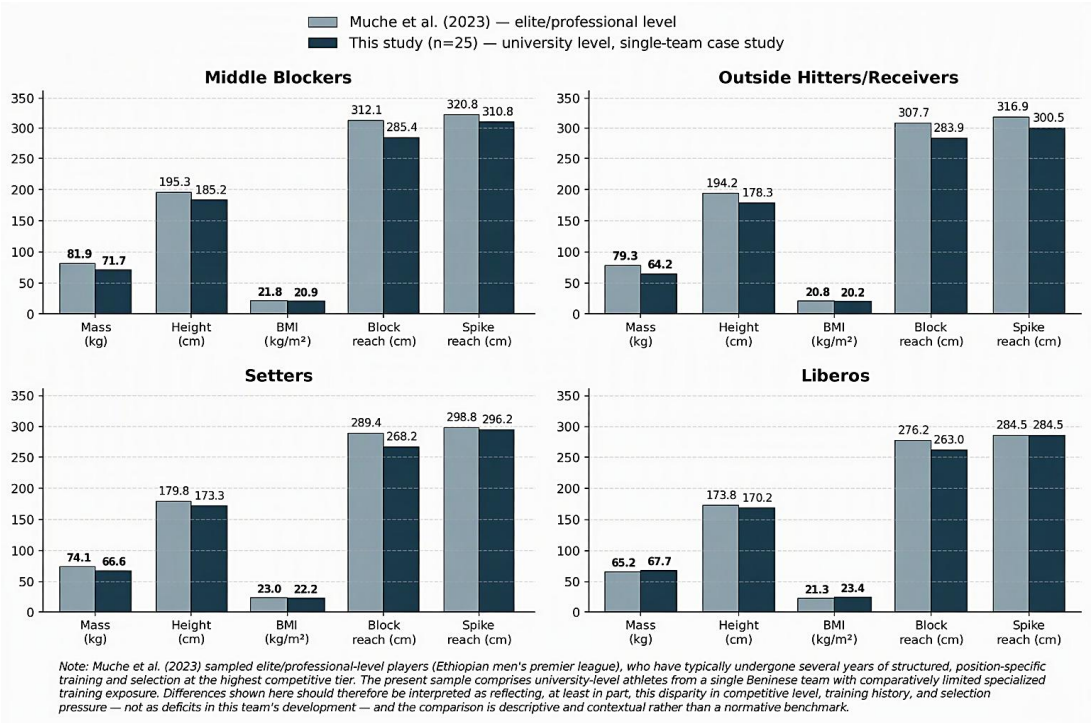
SD = 0.20 s). Shuttle-run speed showed a similarly inconclusive result ($F(3, 21) = 2.16$, $p = .123$, $\eta^2 = .24$, 90% CI [.00, .39]). Block jump reach ($F(3, 21) = 1.42$, $p = .265$, $\eta^2 = .17$, 90% CI [.00, .32]) and spike jump reach ($F(3, 21) = 1.11$, $p = .368$, $\eta^2 = .14$, 90% CI [.00, .28]) were descriptively highest among middle blockers. T-test agility showed the smallest effect and the narrowest, zero-inclusive interval among all variables tested ($F(3, 21) = 0.63$, $p = .603$, $\eta^2 = .08$, 90% CI [.00, .20]), the result most consistent with a true absence of positional difference rather than an underpowered analysis.

Table 2. Physical fitness profile by playing position (mean ± SD) and one-way ANOVA results.

Variable	Middle Blockers (*n* = 5)	Outside Hitters/Receivers (*n* = 10)	Setters (*n* = 6)	Liberos (*n* = 4)	Total (*N* = 25)
Block jump reach (cm)	285.40 ± 22.73	283.90 ± 15.22	268.17 ± 27.78	263.00 ± 27.43	277.08 ± 22.68
Spike jump reach (cm)	310.80 ± 23.90	300.50 ± 19.42	296.17 ± 28.95	284.50 ± 9.71	298.96 ± 22.13
30-m sprint (s)	5.39 ± 0.70	6.51 ± 1.46	5.68 ± 1.09	4.83 ± 0.20	5.82 ± 1.24
T-test agility (s)	8.58 ± 1.03	8.46 ± 1.15	7.77 ± 1.62	7.82 ± 1.30	8.22 ± 1.25
Shuttle-run speed (km/h)	16.20 ± 1.89	14.45 ± 2.03	16.83 ± 2.02	15.75 ± 1.50	15.58 ± 2.07
Sit-and-reach (cm)	36.30 ± 6.38	28.80 ± 2.82	31.25 ± 5.53	34.38 ± 4.92	31.78 ± 5.32
Variable	***F***	***p***	**η^2**	**Sig. (BH-corrected)**	
Block jump reach (cm)	1.42	.265	.17	No	
Spike jump reach (cm)	1.11	.368	.14	No	
30-m sprint (s)	2.52	.086	.26	No	
T-test agility (s)	0.63	.603	.08	No	
Shuttle-run speed (km/h)	2.16	.123	.24	No	
Sit-and-reach (cm)	3.34	.039	.32	No	

Note. *p* values adjusted for multiple comparisons across all 11 variables tested (Benjamini–Hochberg procedure, *q* = .05). "Sig. (BH-corrected)" indicates whether the between-position difference remained significant after this correction.



Note. Muche et al. (2023) sampled elite/professional-level players (Ethiopian men's premier league), who have typically undergone several years of structured, position-specific training and selection at the highest competitive tier. The present sample comprises university-level athletes from a single Beninese team with comparatively limited specialised training exposure. Differences shown here should therefore be interpreted as reflecting, at least in part, this disparity in competitive level, training history, and selection pressure — not as deficits in this team's development — and the comparison is descriptive and contextual rather than a normative benchmark.

Figure 1. Anthropometric and jump-reach profiles by playing position: Beninese university players (present study) compared with Ethiopian premier league players (Muche et al., 2023).

Profiles were compared descriptively with Muche et al. (2023), the reference study providing the most complete set of comparable anthropometric and jump-reach variables across the four playing positions.

DISCUSSION

This study provides the first local reference profile of anthropometric and physical fitness characteristics by playing position for male university volleyball players in Benin. Two broad patterns emerge: a coherent, literature-consistent positional hierarchy for height and arm span, both of which remained significant after correction for multiple comparisons, and largely inconclusive results for most physical fitness variables reflecting limited statistical power in this small single-team sample rather than genuine positional equivalence. Body mass index and trunk flexibility also differed significantly in uncorrected analyses, but these findings did not survive adjustment for multiple comparisons and should be regarded as tentative rather than confirmed.

Mean height and arm span values observed in this sample were broadly comparable to those reported in previous volleyball cohorts, including junior elite English players (Duncan et al., 2006), professional Portuguese players (Marques et al., 2009), and elite Italian players (Gualdi-Russo & Zaccagni, 2001), supporting the consistency of the stature-related positional hierarchy observed here with the broader international literature.

These findings also bear on broader questions of athlete-development context. The present single-team sample cannot test this directly, but it is plausible that the strength of positional physical differentiation itself varies with a sporting system's degree of professionalisation: later specialisation, smaller athlete pools, and less structured position-specific training in developing systems such as Beninese university volleyball may narrow physical differences between positions relative to fully professionalised systems, where years of selection and specialised training accentuate them. Framed this way, the present dataset is not only a set of reference values but also a potential starting point for comparative work on how developmental context shapes positional specialisation.

Body mass followed a similar but statistically non-significant trend ($\eta^2 = .25$, 90% CI [.00, .40]); because this interval spans zero, the data are compatible with either a true, undetected positional difference or with no difference at all, and this result should not be used to argue for one interpretation over the other. The point estimate is broadly consistent with Sheppard et al. (2009), who reported heavier middle blockers among national-team players, but also with Duncan et al. (2006) and Milić et al. (2017), who found no significant inter-positional differences in body mass in junior or youth cohorts. In the present sample, liberos, despite their shorter stature, showed intermediate body mass ($M = 67.69$ kg, $SD = 1.63$ kg), exceeding that of outside hitters/receivers; this finding should be interpreted cautiously because the libero subgroup comprised only four players.

Arm span showed a different ranking from height, with outside hitters/receivers recording the highest values despite middle blockers being taller. This pattern may indicate a favourable reach-to-height profile, but the present cross-sectional data do not allow a causal interpretation or a conclusion that these players compensate for stature through wingspan. Body mass index was highest among liberos, a pattern not corroborated by Muche et al. (2023) or Mbang Bian et al. (2024); combined with its sensitivity to correction for multiple comparisons, this suggests body mass index may be a less stable discriminator of positional specialisation in university and non-professional populations and warrants replication before being treated as a reliable positional marker.

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Of the six physical fitness tests, sit-and-reach flexibility showed the only nominally significant positional difference, though this result did not survive correction for multiple comparisons and should be treated with corresponding caution. For the remaining variables, effect sizes were mostly moderate to large despite non-significant *p* values, suggesting the present design was underpowered to detect true positional differences rather than demonstrating their absence with the exception of T-test agility, whose small effect size ($\eta^2 = .08$) is more consistent with genuine positional equivalence. It is worth noting that large effect sizes paired with non-significant *p* values are also compatible with ordinary sampling variability in small groups, and should not, on their own, be read as confirming a true effect; the present underpowering interpretation remains a plausible but unconfirmed explanation, consistent with the assumption checks reported above rather than with a formal power analysis. Similar patterns have been reported in younger or less specialised volleyball populations, in which anthropometric variables may differentiate positions more consistently than physical-performance measures (Duncan et al., 2006; Milić et al., 2017). However, the present design cannot establish whether positional differentiation in physical fitness emerges with competitive expertise or position-specific training; this possibility requires longitudinal or larger multi-team studies, ideally powered a priori to detect the moderate-to-large effects observed here.

Middle blockers recorded the highest jump-reach values, consistent with previous evidence that net-position players tend to show greater jumping performance than setters and liberos (Sattler et al., 2015). Sheppard et al. (2009) reported substantially higher jump-reach values for national-team middle blockers than those observed here, a difference that may reflect competitive level, training exposure, measurement protocol, or sample characteristics. Jiang et al. (2024) further indicate that jump performance is influenced by lower-limb muscle structure as well as stature. These comparisons should therefore be regarded as contextual rather than as direct normative comparisons.

Sit-and-reach flexibility was the only physical fitness variable showing a nominally significant positional difference. Middle blockers showed the highest mean value, which contrasts with the common expectation that net players are primarily characterised by power and reach. Duncan et al. (2006) reported a comparable flexibility value for English middle blockers using the same test, but given that this finding did not survive correction for multiple comparisons, the evidence remains insufficient to establish flexibility as a structural characteristic of the position. Differences in positional taxonomy and the small subgroup sizes in the present study further limit this interpretation.

Beyond their reference value, these data have practical uses that extend past simple positional orientation. Coaches could use the height and arm span distributions reported here as a first benchmark when discussing positional fit with incoming players for example, flagging when a prospective middle blocker's measurements fall well outside the range observed in this team, and prompting a conversation about complementary skill development or an alternative position rather than a rigid assignment based on stature alone. Because the present design is cross-sectional, it cannot determine whether these profiles are stable over a playing career; repeated testing of the same individuals across seasons would allow these reference values to support longitudinal monitoring of growth and training adaptation, rather than serving only as a one-off snapshot. More broadly, generating this kind of baseline data in a context where sport-science evidence remains scarce contributes, modestly, to narrowing the wider imbalance in athlete-profiling evidence between well-resourced and under-resourced sporting systems, and may encourage comparable data collection by neighbouring volleyball federations.

The study has several limitations. First, the sample was small, particularly for liberos ($n = 4$), which limits statistical power and the stability of between-position comparisons; several non-significant results showed

moderate-to-large effect sizes, consistent with a power limitation rather than true absence of effect, though this interpretation remains plausible rather than confirmed in the absence of a formal power analysis. Second, participants came from a single institution and one university team, limiting generalisability to other Beninese or African volleyball populations; the values reported here describe this team specifically and should not be interpreted as normative standards for Beninese university volleyball more broadly. Third, the cross-sectional design does not allow evaluation of changes over time or causal relationships between playing position, training exposure, and physical characteristics. Fourth, match-performance indicators and training-load data were not collected. Fifth, measurement reliability (intra-rater or test-retest reliability, technical error of measurement) was not formally assessed, and calibration procedures were not systematically documented; because several between-position differences were numerically modest, part of the observed variability could reflect measurement error rather than true biological variation. Sixth, sprint performance was recorded by hand-timing, introducing reaction-time error relative to electronic timing, and the better of two trials was retained rather than an average of multiple trials, which may inflate point estimates relative to a more conservative scoring approach. Finally, although ANOVA assumptions were checked and *p* values were adjusted for multiple comparisons, the small subgroup sizes and the number of variables tested mean that several comparisons remain statistically fragile and should be treated as hypothesis-generating rather than confirmatory. Comparison with published reference populations was similarly descriptive because protocols, competitive levels, and participant characteristics were not necessarily identical.

CONCLUSIONS

This case study provides a preliminary, team-specific reference profile of anthropometric and physical fitness characteristics by playing position for the members of one male university volleyball team in Benin. Significant, large-effect between-position differences were observed for height and arm span, both of which remained robust after correction for multiple comparisons, with middle blockers showing the greatest height and liberos the shortest stature. Body mass index and trunk flexibility also differed significantly in uncorrected analyses but did not survive this correction and should be treated as tentative rather than confirmed. Among the remaining physical fitness measures, most showed inconclusive results with moderate-to-large effect sizes, more consistent with limited statistical power than with true positional equivalence. Comparisons with selected international reference populations suggest broadly similar anthropometric patterns but should be read as contextual rather than normative, and the values reported here describe this team specifically rather than Beninese university volleyball as a whole. Rather than generalisable conclusions, these findings offer a first local reference dataset and generate hypotheses including about how athlete-development context may shape the degree of positional physical differentiation to guide larger, adequately powered multi-team studies of positional specialisation in Beninese volleyball.

AUTHOR CONTRIBUTIONS

All authors meet the established criteria for authorship. Contributions are reported according to the CRediT taxonomy as follows:

Conceptualisation: Farelle Hazoumè. Methodology: Farelle Hazoumè. Formal analysis: Farelle Hazoumè. Investigation: Farelle Hazoumè. Data curation: Farelle Hazoumè. Writing original draft: Farelle Hazoumè. Writing review & editing: Wilfrid Kpèdétin Dieu-Donné Agbodjogbe. Supervision: Wilfrid Kpèdétin Dieu-Donné Agbodjogbe (supervision); Bernardin Gnansounou (co-supervision).

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All authors have critically reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

ETHICS DECLARATION

The experiments described in this study comply with the current laws of Benin, the country in which they were performed.

AI USE DISCLOSURE

In accordance with current publishing ethics and transparency recommendations, artificial intelligence (AI) tools were used during the revision stage to assist with language editing and reference formatting. No AI tools were used in the generation of scientific content, including the study design, data collection, analysis, interpretation of results, or the formulation of conclusions. The authors retain full responsibility for the content of the manuscript and confirm its originality, integrity, and accuracy.

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