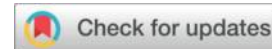




Morphological and Anthropometric Differences Between Elite Male and Female Volleyball Players: A Comparative Systematic Review



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Received: 23/05/2026 ; Accepted: 17/09/2026 ; Published: 16/10/2026

Abstract

Background: Body size and composition are recognised prerequisites of elite volleyball performance, yet male and female profiles are usually reported in separate reviews, preventing direct comparison. Objective: to compare the anthropometric and body-composition profiles of elite male and female volleyball players and to describe how these traits discriminate competitive levels within each sex. Methods: two structured literature reviews (female and male players, 2000-2020) were merged and harmonised under common eligibility criteria restricted to adult elite, professional, national-team and top-division players. Study-level means were extracted and compared descriptively and with Welch tests, and the findings were discussed against recent meta-analytic evidence (2023-2025). Somatotype was extracted for both sexes, with a supplementary search for male data. Results: twenty female and twenty-four male study samples were retained. Elite men were taller (193.6 ± 4.4 vs. 180.6 ± 4.8 cm; difference 13.1 cm) and heavier (87.4 ± 4.8 vs. 71.0 ± 4.0 kg; difference 16.5 kg), and had lower body fat ($11.4 \pm 1.7\%$ vs. $17.4 \pm 3.8\%$; difference 6.1 percentage points). Within each sex, higher-division players tended to be taller and leaner than lower-division players. Somatotype (five samples per sex) showed lower endomorphy (2.4 vs. 3.0) and higher mesomorphy (3.7 vs. 3.0) in men, with similar ectomorphy (3.3 vs. 3.1); men were ectomorphic mesomorphs and women central. Conclusions: elite volleyball demands a tall, lean and muscular morphology in both sexes, but with markedly different reference values. Sex-specific norms should underpin talent identification. Differences in body-fat assessment methods limit direct comparison of adiposity across studies.

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Keywords: volleyball; anthropometry; body composition; somatotype; sex differences; elite athletes; talent identification.

1. Introduction

Volleyball is an intermittent, net-separated team sport in which spiking, blocking and jump serving determine scoring, and these actions depend strongly on standing height, reach and power-to-mass ratio. Some morphological traits are largely genetic, whereas others respond to training and environment; athletes who already possess the required somatic characteristics can refine some of them through training (Papadopoulou et al., 2002). Anthropometric traits therefore remain a core criterion in talent detection and selection.

The morphological profile of players has evolved over time. In Cuban female players, mean height rose from 175.1 to 182.2 cm between 1976 and 2008, fat mass fell from 25% to 22% and somatotype shifted from meso-endomorphic to meso-ectomorphic (Carvajal et al., 2008). In the male game, the same direction of change has been described in the literature.

Recent evidence confirms that sex is a major moderator of body composition in volleyball. A systematic review with meta-analysis of 63 studies and 2,607 players reported pooled body fat of 12.8% in male and 22.8% in female competitive players, with values also depending on the measurement method and on competitive level (Matłosz et al., 2023). Sex-specific associations between morphology and performance have been shown in adolescents as well (Kozłenia et al., 2024; Asfour et al., 2025). However, that meta-analysis addressed body fat only. A side-by-side synthesis of height, body mass, lean mass and level effects in elite male and female players, based on harmonised criteria, is still missing.

The aims of this review were therefore (i) to compare elite male and female volleyball players for height, body mass, body fat, fat-free mass and somatotype; (ii) to examine which traits discriminate competitive levels within each sex; and (iii) to discuss practical implications for talent identification.

2. Methods

2.1. Design and reporting

This is a comparative systematic review reported following PRISMA 2020 where applicable. It was built by merging two previously conducted structured reviews, one on female players and one on male players, covering the period 2000-2020. [Before submission, the authors must add the PRISMA flow diagram with actual counts of records identified, screened, excluded with reasons and included, plus the protocol registration number, if any.]

2.2. Information sources

The original searches used Google Scholar and ResearchGate (female review) and Google Scholar, ResearchGate and PubMed (male review), with keywords related to body composition, somatotype, anthropometric and morphological characteristics, and volleyball. Recent literature (2021-2025) was consulted to contextualise and discuss the findings but was not added to the quantitative synthesis.

2.3. Eligibility criteria

To harmonise the two datasets, studies were retained if they (1) reported adult players of elite level (national team, professional, top-division or international competition), (2) gave means of height and body mass, and (3) were full-text articles in English or Spanish. Junior, school, college and university samples, books, book chapters and congress abstracts were excluded. Samples limited to position-specific values (Sheppard et al., 2009; Marques et al., 2009; Palao et al., 2014) were used in the position analysis only, not in the pooled means.

2.4. Data extraction and synthesis

For each study, the mean of the highest-level group was extracted for height, body mass, body fat percentage (BF%) and fat-free mass (FFM). Standard deviations were not pooled. Study means were summarised as mean $\pm$ SD across studies, and sexes were compared using Welch t-tests and Cohen d as exploratory statistics (unweighted by sample size). Because the unit of analysis is the study and not the athlete, these tests describe between-study variation and should not be interpreted as inferences about individual players. Somatotype components (endomorph, mesomorph, ectomorph) were extracted for both sexes; male data came from a supplementary targeted search (September 2026) that also returned two studies published after 2020, which are flagged and examined in a sensitivity analysis. Somatotype comparisons were descriptive (five samples per sex).

2.5. Risk of bias

[A formal risk-of-bias assessment (for example the JBI checklist for cross-sectional studies or AXIS) has not yet been performed on the retained studies and must be added.]

3. Results

3.1. Characteristics of the included samples

Twenty female and twenty-four male study samples met the harmonised criteria (Tables 1 and 2). Body fat was available in 12 female and 14 male samples, and FFM in only 4 female and 3 male samples, so conclusions about lean mass remain tentative. Somatotype data are presented separately (Tables 6-8).

Table 1. Elite female volleyball players: study-level data (means of the highest-level group)

Study	Sample (n)	Height (cm)	Mass (kg)	BF (%)	FFM (kg)
Gualdi-Russo & Zaccagni, 2001	Italy A1 (129)	178.4	71.2	NA	NA
Papadopoulou, 2003	Greece NT (29)	180.5	72.7	22.4	NA
Papadopoulou et al., 2002	Greece NT (18)	182.5	74.8	NA	NA
Aytek, 2007	Turkey NT (60)	183.2	67.4	15.8	NA
Malousaris et al., 2008	Greece A1 (79)	179.6	71.0	22.7	NA
Marques et al., 2008	Portugal 1st div. (10)	187.0	74.6	NA	NA
Toledo et al., 2008	Brazil NT (11)	182.6	70.9	NA	NA
Carvajal et al., 2008	Cuba (25)	182.2	74.3	22.3	NA
Carvajal et al., 2009	Cuba (43)	180.5	73.6	NA	NA
Dopsaj et al., 2010	Serbia Olympic team (16)	185.4	71.6	14.3	61.2
Zhang, 2010	China elite (100)	183.6	70.5	NA	NA
Malá et al., 2010	Slovakia NT (12)	179.4	67.7	13.7	58.4
Maly et al., 2011	European CL team (12)	182.8	72.9	16.1	61.0
Carvajal et al., 2012	Cuba Olympic (41)	181.6	75.2	NA	NA
Zapolska et al., 2014	Poland professional (17)	180.0	74.3	18.5	NA
Abazi et al., 2017	N. Macedonia 1st league (86)	176.5	68.8	12.8	59.7
Valleser et al., 2018	Philippines elite (36)	168.0	64.0	16.0	NA
Bankovic et al., 2018	Rio 2016 medallists (12)	188.9	75.5	13.4	NA
Selimi et al., 2019	Kosovo Super League (116)	172.2	60.5	NA	NA
Carvalho et al., 2020	Portugal A1, top-ranked (20)	176.3	68.0	21.3	NA

NT: national team; NA: not available; BF: body fat; FFM: fat-free mass.

Table 2. Elite male volleyball players: study-level data (means of the highest-level group)

Study	Sample (n)	Height (cm)	Mass (kg)	BF (%)	FFM (kg)
Gualdi-Russo & Zaccagni, 2001	Italy A1 (107)	193.9	88.4	22.1*	NA
Forthomme et al., 2005	Belgium 1st div. (19)	193.9	89.5	NA	NA
Vilamitjana et al., 2006	Argentina elite (10)	188.2	91.0	11.5	NA
Aytek et al., 2007	Turkey adult (60)	198.3	91.7	9.7	NA
Aouadi et al., 2011	Tunisia 1st div. (33)	186.5	76.9	NA	NA
Borras et al., 2011	Spain NT (13)	191.9	86.9	10.4	NA
Petroski et al., 2013	Brazil NT (12)	197.0	90.3	12.3	NA
Mroczek et al., 2014	Poland league (28)	192.7	85.9	NA	NA
Popovic et al., 2014	Serbia premier league (14)	198.5	92.6	13.6	NA
Alsarraf & Bakr, 2015	Kuwait 1st div.	186.3	75.1	9.5	NA
Sattler et al., 2015	Slovenia 1st/2nd div. (113)	186.9	85.2	10.7	NA
Campos, 2016	World Cup elite	196.0	87.2	NA	NA
Wnorowski & Ciemiński, 2016	WCh 2014, places 1-4 (91)	199.7	87.5	NA	NA
Giannopoulos et al., 2017	Greece A1 (68)	196.8	94.6	14.9	80.2
Stamm et al., 2017	EuroVolley Pool B NTs	200.2	93.4	NA	NA
Toselli & Campa, 2018	Italy Super Lega (39)	195.3	90.5	11.7	79.4
Buvanendiran & Virupaksha, 2018	Elite (20)	188.0	81.0	NA	NA
Campa & Toselli, 2018	Italy Super Lega	194.7	91.0	11.9	80.1
Challoumas & Artemiou, 2018	Cyprus 1st div. (22)	192.0	88.2	12.1	NA
Sánchez-Moreno et al., 2018	Spain 1st div. (12)	189.5	83.4	11.4	NA
Pena et al., 2018	Spain 1st div. (13)	193.2	88.5	7.85	NA
Ateş et al., 2019	Turkey league (12)	195.7	87.5	NA	NA
Sieroń & Kołodyńska, 2019	Nations League teams (73)	200.3	89.7	NA	NA
Bojanic et al., 2020	Montenegro top clubs (43)	191.9	82.5	11.7	NA

** Value reported in the source (22.1%) is physiologically implausible for elite men and was excluded from pooled body-fat statistics pending verification against the original article.*

3.2. Male vs. female comparison

Table 3. Between-study comparison of elite male and female players.

Variables	Female mean $\pm$ SD (k)	Male mean $\pm$ SD (k)	Difference (M – F)	Cohen d	Welch p	Relative difference
Height (cm)	180.6 $\pm$ 4.8 (20)	193.6 $\pm$ 4.4 (24)	+13.1	2.86	< 0.001	+7.3%
Body mass (kg)	71.0 $\pm$ 4.0 (20)	87.4 $\pm$ 4.8 (24)	+16.5	3.69	< 0.001	+23.2%
Body fat (%)	17.4 $\pm$ 3.8 (12)	11.4 $\pm$ 1.7 (14)	–6.1	–2.10	< 0.001	–35%
FFM (kg)	60.1 $\pm$ 1.3 (4)	79.9 $\pm$ 0.4 (3)	+19.8	not computed	not tested	+33%

k: number of study samples. FFM: descriptive only, too few studies for inference. Body fat was measured with different methods (skinfolds, bioimpedance, DXA), which inflates between-study variance.

The two sexes were clearly separated for height and body mass: no female sample reached the mean of the male samples for either variable. The pattern was corroborated in same-league comparisons. In the Italian A1 league, men were 15.5 cm taller and 17.2 kg heavier than women (Gualdi-Russo & Zaccagni, 2001); in Greek A1, the differences were 17.2 cm and 23.6 kg (Malousaris et al., 2008; Giannopoulos et al., 2017).

3.3. Competitive level within each sex

Table 4. Higher vs. lower competitive level within each sex.

Study	Sex	Higher level: height (cm)	Lower level: height (cm)	Body fat (%), higher vs. lower
Malousaris et al., 2008	F	179.6 (A1)	174.7 (A2)	22.7 vs. 24.1
Carvalho et al., 2020	F	176.3 (A1, top-ranked)	168.1 (A2)	21.3 vs. 27.2
Dopsaj et al., 2010	F	185.4 (Olympic team)	180.8 (Super League)	14.3 vs. 17.1
Giannopoulos et al., 2017	M	196.8 (A1)	190.5 (A2)	14.9 vs. 15.6
Campa & Toselli, 2018	M	194.7 (Super Lega)	193.2 (A2)	11.9 vs. 15.5
Alsarraf & Bakr, 2015	M	186.3 (1st div.)	181.1 (2nd div.)	9.5 vs. 13.5

In all six comparisons, higher-level players were taller and had lower body fat. In the Spanish elite league, top-ranked female teams were likewise taller, with higher muscle mass and lower adiposity markers than lower-ranked teams (Martín-Matillas et al., 2014). In male players, FFM also separated levels (80.1 kg in Super Lega vs. 73.9 kg in A2; Campa & Toselli, 2018).

3.4. *Playing position*

Table 5. Position effect in elite male competition (Palao et al., 2014; 2000-2012 Olympic Games and World Championships, n = 1,454)

Position	Height (m)	Body mass (kg)
Middle blocker	2.02 ± 0.05	92.1 ± 7.8
Opposite	1.99 ± 0.06	91.1 ± 7.8
Outsidehitter	1.97 ± 0.05	89.0 ± 7.0
Setter	1.92 ± 0.06	84.8 ± 7.1
Libero	1.86 ± 0.06	81.2 ± 6.6

Female studies show the same gradient: liberos were the smallest players, and centres and opposites the tallest (Malousaris et al., 2008).

3.5. *Somatotype*

Somatotype (Heath-Carter) was extracted for both sexes. Because the original extraction had covered female studies only, a supplementary targeted web search for somatotype data of male players was carried out in September 2026 (academic indexes, PubMed Central and publisher websites; keywords: somatotype, Heath-Carter, male volleyball players, elite), without repeating the full PRISMA screening. Five male samples of adult elite or professional players with numerical values for the three components (Table 6) and five female samples (Table 7) were available. Two male samples (Barajas-Pineda et al., 2021; Đurković et al., 2023) were published after 2020 and therefore lie outside the original 2000-2020 window (marked †); their influence is checked below. Somatotypes were classified with the Heath-Carter 13-category rules, using the classification given by the authors when reported.

Table 6. Elite male volleyball players: somatotype (Heath-Carter), study-level data

Study	Sample (n)	Endomorphy	Mesomorphy	Ectomorphy	Category
Gualdi-Russo & Zaccagni, 2001	Italy A1 (107)	2.1 ± 0.6	4.1 ± 0.8	3.3 ± 0.7	Ectomorphicmesomorph
Giannopoulos et al., 2017	Greece A1 (68)	2.9 ± 0.6	2.2 ± 1.0	3.1 ± 0.9	Endomorph-ectomorph
Campa et al., 2020	Italy A2, professional (88)	2.0 ± 0.7	4.0 ± 1.3	3.2 ± 1.1	Ectomorphicmesomorph
Barajas-Pineda et al., 2021 †	Mexico national team (15)	2.3 ± 0.8	4.0 ± 1.4	3.6 ± 1.5	Mesomorph-ectomorph
Đurković et al., 2023 †	Croatia 1st league (40)*	2.5	4.1	3.3	Ectomorphicmesomorph
Mean ± SD across samples (k = 5)		2.4 ± 0.4	3.7 ± 0.9	3.3 ± 0.2	Ectomorphicmesomorph

*Values are mean ± SD where reported. † Published after the 2000-2020 window (supplementary search). * Mean calculated here as the unweighted mean of the four position means reported by the authors (setters 2.8-3.8-3.4; middle blockers 2.3-3.8-3.6; outside hitters 2.5-4.3-3.1; liberos 2.4-4.6-3.0; 10 players per position); SD not available. Giannopoulos et al. also reported Division A2 (n = 76): 3.2-2.5-2.8. Italy A2 is a professional second division; Gualdi-Russo & Zaccagni (2001) also reported a whole-sample male mean of 2.2-4.2-3.2. [Authors: verify n = 40 for Croatia against the published paper.]*

Table 7. Elite female volleyball players: somatotype (Heath-Carter), study-level data

Study	Sample (n)	Endomorphy	Mesomorphy	Ectomorphy	Category
Gualdi-Russo & Zaccagni, 2001	Italy A1 (129)	2.9 ± 0.8	3.1 ± 1.0	3.0 ± 0.9	Central
Malousaris et al., 2008	Greece A1 + A2 (163; 79 from A1)	3.4	2.7	2.9	Balanced endomorph
Carvajal et al., 2012	Cuba Olympic champions (41)	2.7	3.6	2.9	Balanced mesomorph
Martín-Matillas et al., 2014	Spain top league (148)	3.1 ± 0.7	3.4 ± 0.9	3.1 ± 0.9	Central (balanced-mesomorph tendency)
Rešetar et al., 2020	Croatia Superliga (52)	3.1	2.4	3.6	Endomorphic ectomorph
Mean ± SD across samples (k = 5)		3.0 ± 0.3	3.0 ± 0.5	3.1 ± 0.3	Central

Values are mean ± SD where reported. The value for Malousaris et al. (2008) is the whole-sample mean (A1 + A2); the division-specific means were not available in the abstract.

Category as given by the authors or assigned with the Heath-Carter rules.

Male somatotype. Elite men were, on average, ectomorphic mesomorphs (Table 6): low endomorphy (2.4), high mesomorphy (3.7) and moderate ectomorphy (3.3). Four of the five samples fell in the mesomorphic categories with mesomorphy between 4.0 and 4.1. The exception was the Greek A1 sample, which was endomorph-ectomorph with mesomorphy of only 2.2; the authors themselves noted that their somatotypes were not comparable to those of the Italian and Brazilian national-level players (Giannopoulos et al., 2017). A systematic review of male volleyball somatotype reached a similar conclusion for adults, with the meso-ectomorph profile predominating (Braga & Porto, 2022).

Female somatotype. The female samples differed in category but centred on a balanced profile (mean 3.0-3.0-3.1; Table 7), from balanced endomorph (Greece) to balanced mesomorph (Cuba) and endomorphic ectomorph (Croatia). In the original extraction of female studies, elite players were mostly described as meso-ectomorphic or endomorph-ectomorphic, with higher ectomorphy and lower endomorphy in higher divisions (Gualdi-Russo & Zaccagni, 2001; Malousaris et al., 2008; Carvalho et al., 2020); a balanced-mesomorph tendency was reported in the Spanish league (Martín-Matillas et al., 2014).

Level and position in men. In both male studies that compared divisions, higher-level players were less endomorphic and more ectomorphic: Italian A1 versus A2, 2.1-4.1-3.3 versus 2.3-4.3-3.0 (Gualdi-Russo & Zaccagni, 2001); Greek A1 versus A2, endomorphy 2.9 versus 3.2 ($p < 0.05$) and ectomorphy 3.1 versus 2.8 (Giannopoulos et al., 2017). This is the same direction as reported for women (Gualdi-Russo & Zaccagni, 2001; Malousaris et al., 2008; Nikolaidis et al., 2015). By position, setters were the most mesomorphic and centres the most ectomorphic

in Italian men (setters 2.4-4.5-2.8; centres 2.0-4.0-3.5; Gualdi-Russo & Zaccagni, 2001). Croatian liberos had the highest mesomorphy (4.6) and middle blockers the highest ectomorphy (3.6; Đurković et al., 2023), and the same ordering was found in Italian elite men (Toselli & Campa, 2018).

Table 8. Sex comparison of somatotype in elite volleyball players (M – F, component units)

Comparison	Male (endo-meso-ecto)	Female (endo-meso-ecto)	Difference (M – F)
Italy A1 (same study)	2.1-4.1-3.3	2.9-3.1-3.0	–0.8 / +1.0 / +0.3
Croatia top leagues, all players	2.5-4.1-3.3	3.1-2.4-3.6	–0.6 / +1.7 / –0.3
Setters	2.8-3.8-3.4	3.0-2.7-3.3	–0.2 / +1.1 / +0.1
Middle blockers vs. centres	2.3-3.8-3.6	3.0-1.6-4.5	–0.7 / +2.2 / –0.9
Outside hitters vs. receivers	2.5-4.3-3.1	3.3-2.7-3.5	–0.8 / +1.6 / –0.4
Liberos	2.4-4.6-3.0	3.1-3.3-2.7	–0.7 / +1.3 / +0.3
Greece (Giannopoulos A1 vs. Malousaris A1 + A2)	2.9-2.2-3.1	3.4-2.7-2.9	–0.5 / –0.5 / +0.2
All samples (k = 5 vs. 5)	2.4-3.7-3.3	3.0-3.0-3.1	–0.7 / +0.6 / +0.2
All samples excluding the Greek male sample (k = 4 vs. 5)	2.2-4.1-3.3	3.0-3.0-3.1	–0.8 / +1.0 / +0.2
Male samples published up to 2020 only (k = 3 vs. 5)	2.3-3.4-3.2	3.0-3.0-3.1	–0.7 / +0.4 / +0.1

Differences are in Heath-Carter units. Croatian male values are from Đurković et al. (2023) and female values from Rešetar et al. (2020); Croatian position contrasts pair middle blockers with centres and outside hitters with receivers. The pooled rows are descriptive only: with five samples per sex, no inferential test was applied (as for FFM). Standardised effect sizes (Cohen d, descriptive) were about –2.2 for endomorphy, +0.9 for mesomorphy and +0.8 for ectomorphy.

Sex comparison. Men differed from women mainly in endomorphy and mesomorphy rather than in ectomorphy (Table 8). Across samples, men had lower endomorphy (2.4 vs. 3.0) and higher mesomorphy (3.7 vs. 3.0), while ectomorphy was similar (3.3 vs. 3.1). The same pattern appeared in the two within-country comparisons with consistent methods: Italian A1 (mesomorphy +1.0, endomorphy –0.8) and Croatian top leagues (mesomorphy +1.7, endomorphy –0.6). In Croatia, every position-matched contrast showed higher mesomorphy (+1.1 to +2.2) and lower endomorphy (–0.2 to –0.8) in men. The Greek pair was the exception (mesomorphy –0.5), which is consistent with the atypical Greek male mesomorphy noted above. Excluding that sample, the mesomorphy gap rose to +1.0 and the endomorphy gap to –0.8; restricting the male samples to studies published up to 2020 (k = 3, which still includes the Greek sample) gave a smaller mesomorphy gap (+0.4) but the same direction for all three components.

4. Discussion

The main finding is a consistent and large sex difference in body size and composition among elite volleyball players: men were about 13 cm taller and 16 kg heavier at study level, and about 6 percentage points leaner. The body-fat gap is in line with the pooled estimates of 12.8% for men and 22.8% for women reported in the most recent meta-analysis (Matłosz et al., 2023); our lower female mean (17.4%) mainly reflects the predominance of skinfold and bioimpedance studies in elite samples and the small number of DXA studies, since the meta-analysis found that DXA yields higher values than other methods.

Within each sex, level discriminated players in the same direction: higher-level players were taller and had lower adiposity. The consistent height advantage is consistent with the importance of reach in attack and block, and with selection practices that favour tall athletes. Height is also highly heritable, so it cannot be trained, which makes it a critical early criterion in talent programmes.

Lean mass and low adiposity appear to be shared markers of elite status, but the evidence is thinner for FFM (only seven samples). Recent work in elite female players suggests that fat mass index may be more informative than fat percentage, and that elite players differ in structural dimensions and muscularity rather than in adiposity alone. Among adolescents, the morphology-performance relationship is sex-specific: fat mass impaired change-of-direction and agility in boys but not in girls (Kozłenia et al., 2024), while limb and hand dimensions correlated with serve speed and accuracy in both sexes, with boys outperforming girls in serve speed (Asfour et al., 2025). These findings argue against applying a single morphological standard to both sexes.

Somatotype adds a shape-based dimension to the sex comparison. Elite men were leaner and more muscular in proportion to size (lower endomorphy, higher mesomorphy), whereas ectomorphy, which is derived from the height to cube-root-of-mass ratio, was similar in both sexes, meaning that the greater height of men is accompanied by proportionally greater mass. This fits the body-composition data above (body fat 11.4 vs. 17.4%; FFM 79.9 vs. 60.1 kg). Elite male volleyball players also differ from the endomorphic mesomorph that predominates among male elite athletes across sports, whereas women match the central profile commonly reported for elite women (Martínez-Mireles et al., 2025), suggesting sport-specific selection for low adiposity and linearity in men. The Greek male sample should be interpreted with caution: its low mesomorphy (2.2) contrasts with 4.0-4.1 in the other four samples, and differences in measurement or calculation between laboratories cannot be excluded.

For practitioners, the merged dataset suggests that selection thresholds must be sex-specific. Approximate elite reference values from this review are 181 cm and 71 kg for women, and 194 cm and 87 kg for men, with positional variation of roughly 10 to 16 cm in height between middle blockers and liberos.

4.1. Limitations

First, the analysis is study-level and unweighted, and studies with small samples weigh as much as large ones. Second, the two source reviews were built with slightly different search and inclusion rules, and the merged dataset has not yet been re-screened from scratch under one protocol. Third, body composition was measured with different methods, which limits

comparison of BF%. Fourth, only English and Spanish full texts were considered, and the search ended in 2020; later elite-level studies should be added to update the pooled means. Fifth, risk of bias was not formally appraised, FFM data are too sparse for a sex comparison, and somatotype rests on only five samples per sex, with one male sample (Greece) clearly atypical and two male samples (Mexico, Croatia) coming from outside the 2000-2020 window. Finally, some source values require verification (for example the male body-fat value of 22.1% in the Italian A1 study).

5. Conclusion

Elite volleyball selects tall, lean and muscular athletes in both sexes, but elite men are about 13 cm taller, 16 kg heavier and 6 percentage points leaner than elite women. Competitive level is associated with greater height and lower adiposity in both sexes. In somatotype, men were ectomorphic mesomorphs and women central, the difference lying in lower endomorphy and higher mesomorphy in men rather than in ectomorphy. Talent identification and monitoring programmes should rely on sex-specific reference values, ideally complemented by a consistent body-composition method. Future work should add post-2020 studies, weight studies by sample size and run a formal meta-analysis.

Declarations

[Funding, conflicts of interest, data availability and author contributions to be completed.]

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