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Postural variables in girls practicing volleyball

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Summary

Study aim: To assess body posture of young female volleyball players in relation to their untrained mates.
Material and methods: A group of 42 volleyball players and another of 43 untrained girls, all aged 13 – 16 years were studied with respect to their body posture indices by using computer posturography. Spinal angles and curvatures were measured, and asymmetry and body posture type were assessed. Body height and mass, BMI and body fat content (by bioimpedance technique) were determined.
Results: As compared with untrained girls, the volleyball players were more slender, the positions of shoulders and pelvis being more symmetrical, and shoulder blades and waist triangles were more asymmetrical. Volleyball players were predominantly kyphotic, their lumbar lordosis was flattened and head protruded, especially in those having longer training experience.
Conclusions: The observed asymmetries brought about by unilateral training loads and progressing thoracic kyphosis call for applying corrective and/or yoga exercises to adolescent female volleyball players.

Key words: Body posture – Physical development – Female volleyball players – Training

Introduction

The degree of physical activity is related to that of somatic development and, thus, to the postural development. Sport exercises, often asymmetric or performed under high loads and aimed at shaping specific skills, may lead to postural disorders especially when applied to very young subjects [16]. In many sports, including team games, disproportional body mass and muscle strength, spine statics disorders and/or trunk asymmetries are often noted; these may result from non-uniform loads applied to the spine and/or sport-specific unilateral muscle work [1,8,18].

Since the sport-specific asymmetric work combined with an existing body asymmetry may bring about postural disorders [18], posture monitoring ought to become an important element of training and selection. The aim of this study was thus to assess body posture of young female volleyball players in relation to their untrained mates.

Material and Methods

Two groups of girls aged 13 – 16 years were studied: volleyball players (Voll.; n = 42) and untrained ones (Contr.; n = 43), all attending the same school in a Silesian town, their social and living conditions being alike. Volleyball players trained 2 – 3 h daily, 5 days a week, their training experience amounting to 3 – 5 years; all but one were right-handed. Postural disorders were previously detected in 2 younger and 7 older volleyball players, and in 7 younger and 10 older control girls. No ailments which might induce postural disorders were reported.

Body height was measured using a posturometer (1 mm accuracy), body mass – using a medical electronic balance (0.1 kg accuracy). Percentile values for body height, body mass and BMI reference percentile graphs for Warsaw children [14] were used with an accuracy of 6 months of age.

Body posture (in backward position) was assessed by a device employing the Mora projection technique (MORA 4, CQ Elektronik System, Poland) and very short exposition (5 s). Spinous processes (C_7-S_1), anterior superior iliac spines (M_1, M_2) and inferior scapular angles were marked prior to the recording. The following variables were recorded in the frontal and transversal planes:
– Trunk angle (TA), i.e. that between the C_7-S_1 line and vertical axis;
– Deviations (mm) of spinous processes from the straight line (SPD);

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– Symmetry of shoulders (mm; SS);
– Symmetry of shoulder blades (mm): horizontal (HSB), vertical (VSB) and *versus* spine (SSB);
– Symmetry of waist triangles (mm): horizontal (HWT) and vertical (VWT);
– Pelvic alignment (mm), which includes pelvic deflection in frontal position (PA) and pelvic torsion in the transversal plane (PT).

Asymmetries up to 5 mm were considered none, between 5 and 10 mm – as negligible, above 10 mm as marked. The following measurements were recorded in the sagittal plane:
– Trunk tilt angle (TTA), i.e. that between the C_7-S_1 line and vertical axis;
– Deviation of the upper thoracic spine (α angle);
– Deviation of the thoraco-lumbar spine (β angle);
– Deviation of the lumbo-sacral spine (γ angle).

Spinal angles and other criteria [21] served to classify subjects into postural types: kyphotic (K), lordotic (L) and balanced (B), each containing 3 subcategories – slight ($_1$), medium ($_2$) and pronounced ($_3$) curvatures. Next, 4 postural categories were established: optimal (R_1), good (R_2, K_1, L_1), defective (K_2, L_2) and abnormal (R_3, K_3, L_3). In addition to the computer-aided assessment, the alignement of head, shoulders, abdomen (in the sagittal plane), chest arch and alignment of knees were point-rated [10].

Homogeneity of variances of every variable was verified by Snedecor's F-test. For variables with homogenous variances ANOVA with the *post-hoc* Student's *t*-test was used, otherwise the Cochran-Cox's test was applied [11], the level of p≤0.05 being considered significant.

Results

The percentile distribution of body height, body mass and BMI in volleyball players and untrained girls is shown in Fig. 1. As expected, high girls predominated in the Voll. group: the percentages of the short (below Percentile 25) or high (above Percentile 75) subjects significantly (p<0.01 and 0.05, respectively) differed from the expected ones. In the Contr. group, significantly (p<0.05) fewer tall girls were noted. Regarding BMI, significantly (p<0.05) less underweight or overweight volleyball players than those of normal weight were noted; no deviations from the expected percentages were noted in the untrained girls.

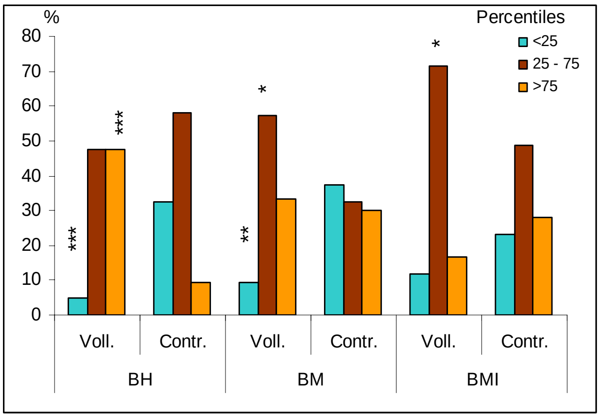

Fig. 1. Percentages of volleyball players (Voll.; n = 42) and untrained girls (Contr.; n = 43) aged 13 – 16 years in various percentile categories of body height (BH), body mass (BM) or BMI

Significantly different from the respective percentage in the control group: * p<0.05; ** p<0.01; *** p<0.001

Table 1. Mean values (±SD) of body posture indices in girls practicing volleyball (V) and in untrained ones (C)

Age / Group / Variable	13 – 14 years		15 – 16 years	
	Voll. (n = 21)	Contr. (n = 21)	Voll. (n = 21)	Contr. (n = 22)
TA (deg)	1.01 ± 0.71	0.97 ± 0.78	1.04 ± 0.55	1.13 ± 0.95
SPD (mm)	3.59 ± 1.99	4.22 ± 2.14	4.63 ± 2.67	4.63 ± 2.36
PA (mm)	3.39 ± 2.55	2.88 ± 2.25	2.52 ± 2.47	2.59 ± 2.31
HWT (mm)	15.2 ± 9.8	10.7 ± 7.1	13.2 ± 10.4	13.0 ± 8.3
VWT (mm)	14.4 ± 10.4*	8.3 ± 6.5	15.5 ± 8.4	11.6 ± 10.0
HSB (mm)	7.23 ± 6.88	5.66 ± 5.11	7.77 ± 7.32	7.17 ± 4.84
SSB (mm)	6.03 ± 4.2	5.17 ± 3.71	8.97 ± 6.14 °	6.75 ± 5.26
SS (mm)	7.28 ± 6.69	5.16 ± 4.24	4.64 ± 4.45*	8.13 ± 5.73
PT (mm)	7.18 ± 3.5	6.74 ± 3.7	7.6 ± 5.3	9.84 ± 5.91
VSB (mm)	12.7 ± 6.3	9.2 ± 5.1	12.4 ± 7.9	13.7 ± 8.7

Legend: TA - Trunk angle; SPD - Deviations (mm) of spinous processes from the straight line; PA - Pelvic angle in frontal position; HWT - Horizontal symmetry of waist triangles (mm); VWT - Vertical symmetry of waist triangles (mm); HSB - Horizontal symmetry of shoulder blades (mm); SSB - Symmetry of shoulder blades (mm) vs. spine; SS - Symmetry of shoulders (mm); PT - Pelvic angle in transversal plane; VSB – Vertical symmetry of shoulder blades (mm); * Significantly (p<0.05) different from the control group; ° Tendency (p=0.08) to differ from younger players; All mean values significantly (p<0.01 – 0.001) differed from the expected zero value

Table 2. Mean values (±SD) of spinal angles in the sagittal plane in girls practicing volleyball (V) and in untrained ones (C)

Age Group / Variable	13 – 14 years		15 – 16 years	
	Voll. (n = 21)	Contr. (n = 21)	Voll. (n = 21)	Contr. (n = 22)
TTA (deg)	2.96 ± 2.53	3.20 ± 2.21	3.31 ± 1.95	3.17 ± 1.46
α–Angle (deg)	12.9 ± 4.7	13.7 ± 4.5	13.9 ± 4.6	14.6 ± 2.5
β-Angle (deg)	14.3 ± 2.2	15.3 ± 3.1	15.7 ± 2.3*	13.9 ± 2.7
γ-Angle (deg)	13.7 ± 6.8	15.3 ± 5.9	9.8 ± 5.8*	15.5 ± 7.4
Kyphosis (α+β)	27.2 ± 5.0	29.0 ± 6.0	29.6 ± 5.9	28.5 ± 4.2
Lordosis (β+ γ)	28.0 ± 6.6	30.5 ± 6.2	25.5 ± 6.9	29.3 ± 8.3

Legend: TTA - Trunk tilt angle; * Significantly ($p<0.05$) different from the control group; ° Nearly significantly ($p=0.06$) different from younger players; All mean TTA values significantly ($p<0.001$) differed from the expected zero value

Postural characteristics of the studied girls are shown in Tables 1 and 2 and in Figs. 2 and 3. The expected value for all variables from Table 1 and for TTA was zero; all mean values significantly ($p<0.01 – 0.001$) differed from the expected one, the majority of all subjects displaying some left-sided spine deflection (TA) and some forward bend (TTA). The vertical asymmetry of waist triangles (VWT) was significantly ($p<0.05$, by two-way ANOVA) higher in volleyball players than in untrained girls and the shoulder asymmetry (SS) was significantly ($p<0.05$) lower in older Voll. group than in the respective control one.

No significant differences between groups or age categories were found for the α angle and for kyphosis. Older volleyball players had significantly ($p<0.05$; significant group×age interaction) greater β angle than the respective control subgroup; the Voll. group had significantly ($p<0.05$; by two-way ANOVA) lower values of γ angle and of lordosis compared with the Contr. group (Table 2).

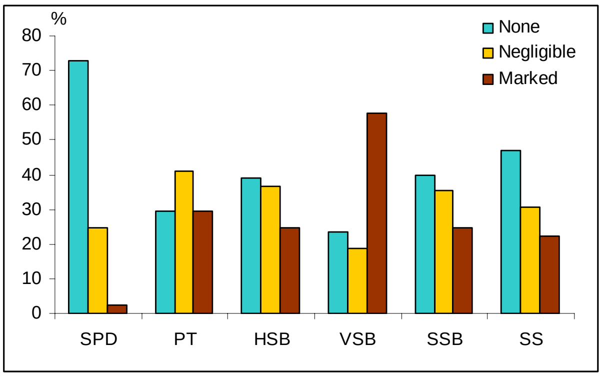

Fig. 1. Percentages of all subjects classified into 3 categories of asymmetry in postural variables (n = 85)

When the asymmetries were classified into 3 categories (none, negligible, marked), no significant differences between groups or age categories were found, therefore the frequencies of asymmetry categories were computed for all subjects combined and presented in Fig. 1. The highest frequency of good symmetry was found for SPD (over 70% of subjects); highest percentage of subjects showing marked vertical asymmetry was found for shoulder blades (VSB; nearly 60% of subjects).

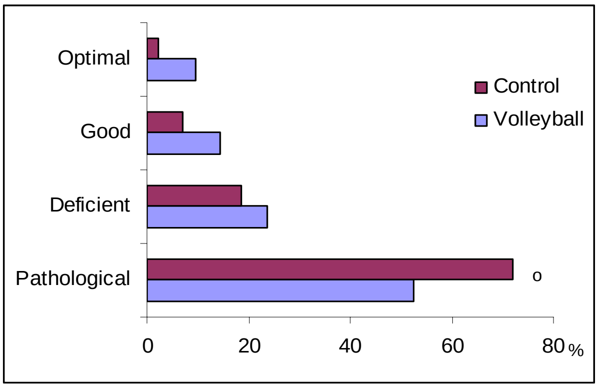

Fig. 2. Percentages of girls from the control (n = 43) and volleyball (n = 42) groups, aged 13 – 16 years, classified according to the quality of body posture

° Tendency towards a between-group difference ($p<0.10$)

Furthermore, the subjects were classified into 4 postural categories. Only a small percentage of all girls exhibited optimal or good body posture, while over 70% of untrained girls and over 50% of volleyball players were classified as having pathological posture; that difference tended to be significant ($p<0.10$) as shown in Fig. 2. No age- or group-related differences were noted in the frequencies of the kyphotic, lordotic or balanced posture types; they were fairly evenly distributed (31, 34 and 35%, respectively). Visual assessment of body posture revealed that about 30% of all girls had good posture, over 30% had protruding head, 15% - shoulders and about 25% - abdomen.

Discussion

Like in other reports [15,17], body height of volleyball players was above average for age. Their engagement in sport activity was associated with very good weight-height proportions; BMI values of most of them was in the percentile range 25 – 75 which is essential for a right body posture, especially the anterior-posterior spine profile [6]. The relations between motor activities and maintenance of appropriate body mass is well documented [2,9,12]. On the other hand, excessive physical activities, especially asymmetrical ones, like fencing, rowing, throws etc., may bring about postural disorders [18]. Volleyball is not considered to depend much on asymmetrical training loads but it seemed interesting to clarify possible effects of such training on body posture of adolescent girls.

Trunk asymmetry was reported in students engaged in competitive sports, especially in sprinters, middle-distance runners, combat sports and team games; in that latter case, negligible asymmetry (5 – 10 mm) was found for the course of spinous processes and a marked one (above 10 mm) for waist triangles [8]. Trunk asymmetry was markedly expressed in Brazilian elite handball players, especially in those having long training experience [23]. In this study, mostly negligible deviations of spinous processes were observed in about 30% of both volleyball players and untrained girls. Sport training based on asymmetrical loads of extremities may thus lead to postural disorders; asymmetry in the frontal plane was twice lower in swimmers than in control subjects, the asymmetries of shoulders, shoulder blades or hips being not observed [4]. According to Starosta [18], asymmetry of upper extremities may induce contralateral scolioses, pelvic asymmetry and lowering of one shoulder. This explains the dominance of left-sided deflections of spinous processes in the mostly right-handed population. In a large cohort of over 10 000 children aged 7 – 15 years, studied by the same technique as in this study, a very high incidence (89%) of postural disorders was shown; this included left-sided scolioses (23.8%) and rounded back (17.3%). Comparable results were obtained in this study.

Kyphotic posture tended to be more and the lordotic one less frequent in volleyball players than in untrained subjects (kyphotic: 36 and 26%, lordotic: 31 and 40%, respectively; $p<0.10$). Similar results were reported for 70 male volleyball players aged 18 – 34 years [19]; the authors attributed that finding to the typical of volleyball posture consisting of forward bend with rounded back, the arms and shoulders protruding. Similar posture was also observed in hockey players [5] and in young swimmers [4].

Spine curvatures in the sagittal plane are affected by the kind of motor activity and its intensity [1,7], the lumbar lordosis and thoracic kyphosis being interrelated [20]. The augmented α-angle, common in volleyball players, may be related to their protruding head [22]. Some authors point to the effect of body height on spinal angles; namely, chest kyphosis may be augmented in tall people [3]. High, positive correlations with body height were reported for α and γ angles and a negative one for β angle [13]. However, Willner and Johnson [20] did not confirm the relation between the magnitude of lumbar lordosis and body height. The sagittal spine profile may be also affected by volleyball training since the α angle was nearly significantly greater and the γ angle – smaller in volleyball players with longer training experience than in their mates of shorter experience, despite their tall stature. Regarding the overall quality of body posture, the frequencies of optimal and good ones (26 and 67%, respectively) were reported to be markedly higher in judoists than in volleyball players [24]; the author presumed that high muscle mass and strength, typical of combat sports, may be essential in correcting postural disorders.

Summing up, volleyball training may affect body posture of adolescent girls. However, the sagittal spine profile is determined also by individual features – genetic, psychomotor, functional, habitual, etc. Yet, the asymmetrical training loads and the seemingly progressing thoracic kyphosis in young female volleyball players may call for corrective or e.g. yoga exercises.

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