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MUSCLE TORQUE TOPOGRAPHY IN FEMALE BASKETBALL PLAYERS

K.Buśko
Dept. of Physiology, Academy of Physical Education, Warsaw, Poland

The aim of the study was to determine maximal isometric muscle torques and their topography for 11 principal muscle groups in cadet (n=22), junior (n=50) and elite senior (n=70), female basketball players. No significant between-group differences were found in the topography of muscle torques. The values of most muscle torques were significantly correlated with body mass (r ranging from -0.103 to 0.774), especially in cadets and juniors. ***(Biol.Sport 15:45-49, 1998)***

Key words: Muscle torques - Basketball - Females

Introduction

Changes in the values of muscle torques may be indicative of the applied training loads being effective. Torque values, especially those for flexors and extensors of upper limbs and trunk (in static conditions), may also be applied to sport selection [3]. In an extended assessment of fitness, also other mechanical variables are useful; these include maximal power output under isokinetic conditions [10] and maximal power output in jumps performed on a dynamometric platform [2].

Muscle torques for individual muscle groups may be expressed in relation to their total sum [1,6]. This enabled ranking of relative torque values for various sports [5], so muscle torque topography may prove sport-specific. It was, however, much less apparent in case of junior athletes [8]. The aim of this study was to determine the muscle torque topography in female basketball players differing in experience.

Material and Methods

The participants of the study were 22 cadets, 50 juniors and 70 elite basketball senior players. Their age, body height and mass, and training experience are presented in Table 1.

Muscle torques of flexors and extensors of 11 muscle groups (elbow, shoulder, hip, knee, trunk, ankle) were measured in static conditions. Only the dominant limb was considered.

Elbow flexors and extensors were examined in upright position, the arm resting on a support. Shoulder angle was 90°, the forearm perpendicular to the arm, the trunk stabilised and supported.

Reprint requests to: Dr Krzysztof Buśko, Dept. of Physiology, Academy of Physical Education, Marymoncka 34, 01-813 Warsaw 45, Poland

Shoulder flexors and extensors were examined in upright position, the angle being 0°. The trunk was stabilised by the subject who was holding fast the stand with her non-dominant hand and the chest was pressed to the stand frame by the assistant.

Flexors and extensors of the knee and trunk were examined in sitting position. The hip and knee angles were 90°. The subject was stabilised with belts crossing the anterior superior iliac spine and distal part of thighs. The arms rested against the chest.

Table 1
Basic characteristics of group - mean values and standard deviation (±SD)

Variable	Cadets (n=22)	Juniors (n=50)	Seniors (n=70)
Age (years)	15.1±0.7	16.8±1.4	21.1±2.9
Body mass (kg)	68.2±8.4	67.8±7.9$^{\#}$	70.9±6.2
Body height (cm)	178.6±7.3	178.3±7.7$^{\#}$	181.4±6.4
Training experience (years)	4.0±1.6	5.2±2.2*	8.9±2.9**$^{\#\#}$

Significantly different from the respective value in cadets (* P<0.05; ** P<0.01);
Significantly different from the respective value in seniors ($^{\#}$ P<0.05; $^{\#\#}$ P<0.01).

Hip extensors were examined in supine position forward. Hip angle was 90°. The subject stabilised her trunk by gripping the stand. Hip flexors were examined in supine position backwards. Hip angle was 90°. The subject was gripping the stand and pressed her pelvis against the support.

Foot flexors were examined in sitting position, the examined limb being bent in knee and hip joints at 90°. The subject was gripping the seat and the lower limb was stabilised by a steel band around the knee.

Maximal force measurement error was 10 N and that of length - 1 cm, which amounted to an overall relative error of 4 - 8%, depending on the muscle group.

The data were analysed by applying ANOVA, followed by the C-test of Cochran and Cox or Student's t-test. The level of P≤0.05 was considered significant.

Results

Absolute values of muscle torques are presented in Table 2. Senior athletes exhibited highest torques of elbow, shoulder, hip and ankle flexors, elbow extensors and of the sum of torques. However, when related to body mass, significant differences (P<0.05) were found between cadets, juniors and seniors for the hip flexors (1.71, 1.78 and 1.92 $N \cdot m \cdot kg^{-1}$, respec-

tively). Regarding the percent torque topography (Table 3), senior athletes differed significantly ($P<0.01$) from the two other groups only in the hip flexors (7.6%). Cadets had significantly ($P<0.05$) lower value for shoulder flexors compared with the two other groups.

Coefficients of correlations between muscle torques and body mass are presented in Table 3. They were of moderate magnitude (from -0.103 to 0.650) and highest in the cadet group. In seniors they were much lower and the number of significant coefficients was also lowest. Interestingly, the correlation of the sum of muscle torques with body mass was significantly higher ($P<0.01$) in cadets than in senior athletes ($r=0.774$ and 0.384, respectively).

Table 2
Mean values (±SD) of muscle torques [Nm] and their sums in cadets, juniors and senior female basketball players

Muscle group	Cadets (n=22)	Juniors (n=50)	Seniors (n=70)
Elbow F	50.4±7.4	52.5±8.46	55.3±7.5**
E	33.9±5.3	32.7±6.2	36.4±7.3 ##
Shoulder F	63.8±12.0	68.6±16.1	73.0±12.8**
E	60.4±11.5	63.2±14.1	67.1±12.6*
Hip F	116.9±25.6	119.8±23.1##	135.3±28.4**
E	345.4±77.8	351.1±65.3	349.1±69.5
Knee F	119.4±31.1	111.9±22.5	115.4±24.3
E	187.4±33.1	168.1±39.8*#	184.4±38.6
Ankle F	156.3±42.5	145.3±36.2#	162.3±36.1
Trunk F	193.5±41.2	185.0±27.6	182.1±38.2
E	428.6±86.7	393.6±81.4	423.8±98.5
Σ	1755.6±227.1	1715.7±249.2	1784.0±229.5

F - Flexors; E - Extensors;
Significantly different from the respective value in cadets (* $P<0.05$; ** $P<0.01$);
Significantly different from the respective value in seniors (# $P<0.05$; ## $P<0.01$).

Discussion

Many authors reported data concerning muscle force and muscle torques [1,3,6], as well as the topography of torques of individual muscle groups related to their sum [1,6]. Junior and senior rowers exhibited a similar topography [6] and also in this study the similarity of topographies in cadet, junior and senior basketball female players was quite high.

Table 3
Percent muscle topography (means ±SD) and coefficients of correlation between absolute values of torques and body mass in female basketball players

	Percent topography			Correlation coefficients		
Muscle group	Cadets (n=22)	Juniors (n=50)	Seniors (n=70)	Cadets (n=22)	Juniors (n=50)	Seniors (n=70)
Elbow F	2.9±2.0	3.1±0.4	3.1±0.5	0.574	0.650	0.383
E	2.0±0.4	1.9±0.4	2.1±0.5	-0.048	0.279	-0.103
Shoulder F	3.6±0.5	4.0±0.8*	4.1±0.8*	0.513	0.348	0.159
E	3.4±0.5	3.7±0.7	3.8±0.8*	0.635	0.462	0.346
Hip F	6.7±1.4	7.0±1.1	7.6±1.3**	0.490	0.404	0.177
E	19.6±3.3	20.5±3.1	19.5±2.8	0.512	0.417	0.138
Knee F	6.8±1.3	6.6±1.2	6.5±1.1	0.451	0.193	0.296
E	10.8±2.3	9.8±1.5	10.3±1.8	0.164	0.510	0.284
Ankle F	8.9±2.2	8.5±1.9	9.1±1.7	0.565	0.516	0.397
Trunk F	11.0±1.4	10.9±1.8	10.3±2.0	0.592	0.214	0.180
E	24.3±3.1	23.0±3.9	23.6±3.7	0.440	0.246	0.259
Σ	100	100	100	0.774***[#]	0.628***	0.384***

The sum of muscle torques was reported [5] to be highly correlated with body mass in senior male basketball players (r=0.778). Similar correlations were found in this study for cadet and junior female players (r=0.774 and 0.628, respectively), the former being significantly higher than in seniors (r=0.384). A difference between junior and senior athletes was reported also for male rowers (r=0.707 and 0.455, respectively) [6]. A lower correlation was reported for the sum of torques of 8 muscle groups in untrained students [1] and the correlations between muscle torques of shoulder extensors or hip flexors and body mass were low and non-significant. The lack of significant correlations between muscle torques of shoulder flexors, hip flexors and extensors and trunk flexors, observed in this study in senior players, despite the existence of such correlations in younger ones, could be the result of a disproportionately increasing muscle strength with respect to body mass.

It can be concluded that muscle topography in female basketball players was quite stable, irrespectively of their training experience, although the latter negatively affected the relation between static muscle torques and body mass.

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