

# **SPORTS ANTHROPOLOGICAL AND SOMATOTYPICAL COMPARISON BETWEEN HIGHER CLASS MALE AND FEMALE BADMINTON AND TENNIS PLAYERS**

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## **ABSTRACT**

The present study was to clarify whether there are sports anthropometric differences due to the different requirement profiles in tennis and badminton. 80 athletes (20 female and 20 male badminton players and 20 female and 20 male tennis players) were examined. Both badminton players and tennis players were from the second or third division. Anthropometric data and computed constitutional and somatotypical parameters in this work correspond to international standards.

The male badminton (tennis) players are characterized by the triplet combination 3.4 – 3.3 – 3.4 (3.4 – 3.2 – 3.8) in the somatochart of Parnell, by the triplet combination 2.3 – 3.2 – 2.7 (2.3 – 3.2 – 3.1) in the Heath & Carter somatochart.

In the present study, the women's badminton average somatotype resulted by Parnell (Heath & Carter) of 4.1 – 3.3 – 2.8 (3.7 – 3.1 – 2.0), with the tennis ladies of 4.2 – 2.8 – 3.5 (3.5 – 2.6 – 2.9).

In summary it can be said that the male and female badminton players compared with the tennis players were smaller and had shorter arms and shorter legs (but longer lower legs) and a longer torso. In addition, the body of badminton players appeared strong and robust, and the calf muscles seemed more pronounced.

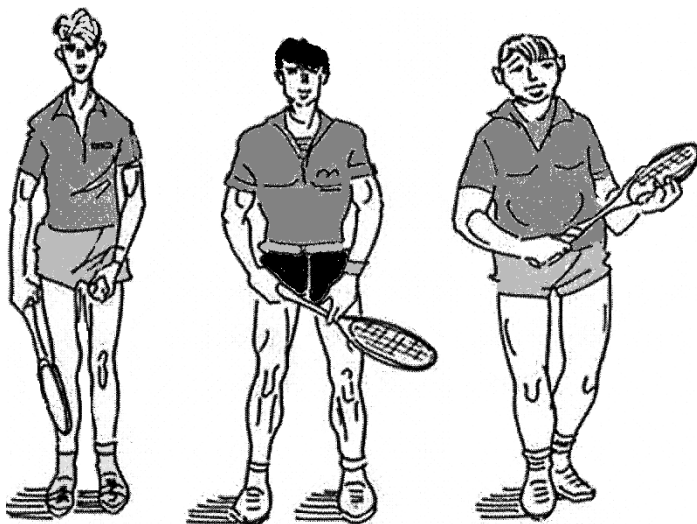
Tennis players possessed significantly thicker and larger humeri and feet. In the somatotypology the picture is that of the tall, ectomorphic tennis player is compared to the smaller, but more robust badminton player.

*Keywords: sports anthropological investigation, somatotypical investigation, badminton and tennis players*

## INTRODUCTION

It is often claimed that badminton is the fastest racquet sport. Although badminton holds the record for the fastest initial speed of a racket sports projectile, the shuttlecock decelerates substantially faster than other projectiles such as tennis balls. While players of badminton or tennis often claim that their sport is the more physically demanding, such comparisons are difficult to make objectively because of the differing demands of the games. No formal study currently exists evaluating the physical condition of the players, their demands during game play and the sports anthropological differences.

The present study was to clarify whether due to the similarities between the two sports there is also a similar type of constitution in tennis players and badminton players, or whether there are sports anthropometric differences due to the different requirement profiles.



**Figure 1.**  
Leptosom, Athletic  
and Pyknic Tennis  
Players (according  
to Pöttinger and  
Mensing 1986)

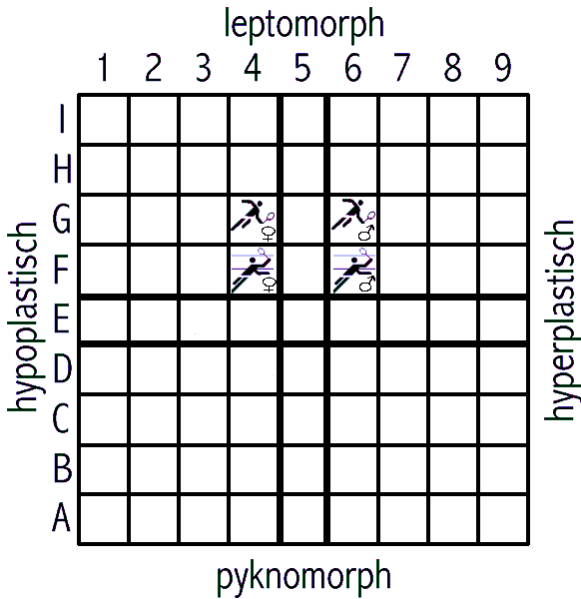
## PARTICIPANTS AND METHODS

In this study 80 athletes (20 female and 20 male badminton players and 20 female and 20 male tennis players) were examined. Both badminton players and tennis players were from the second or third division. Each proband participated voluntarily and the data were used anonymously. Anthropometric data and computed constitutional and somatotypical parameters in this work correspond to international standards (Conrad 1963, Heath & Carter 1967+1990, Knussmann 1996, Martin&Knussmann 1988, Raschka 2006,

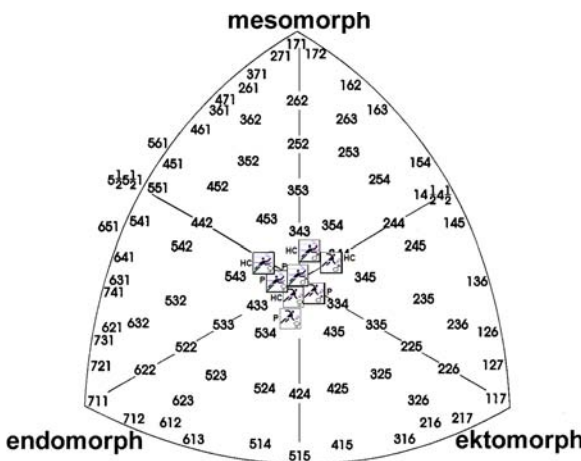
Tittel&Wutscherk 1972). The analysis of differences was tested by Anova, correlations were tested by the Pearson correlation coefficients.

**RESULTS**

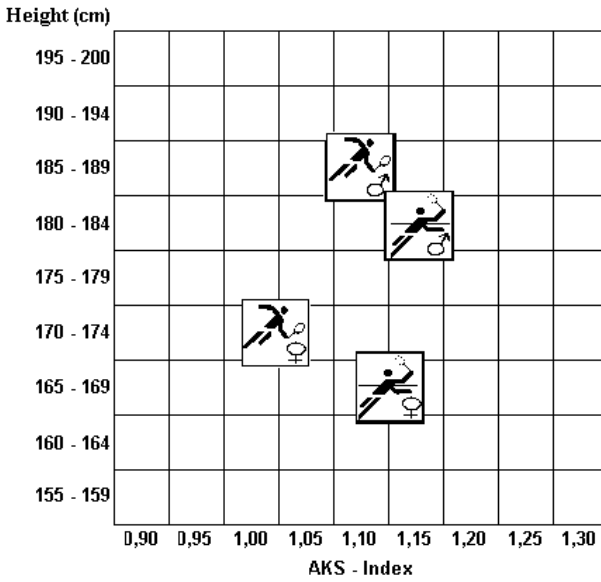
The distribution of constitutional types after Conrad and Tittel & Wutscherk (1972) and the somatypes after Parnell and Heath & Carter are summarized in Figures 2–4.



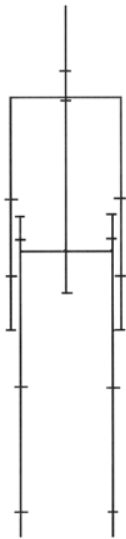
**Figure 2:** Male and female average constitutional types of tennis and badminton players in the chessboard pattern graphic after Conrad



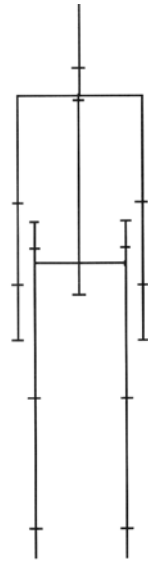
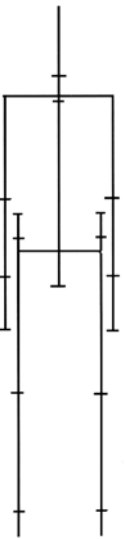
**Figure 3:** Male and female average somatypes of badminton and tennis players after Heath & Carter (HC) and Parnell (P) in the somatochart.



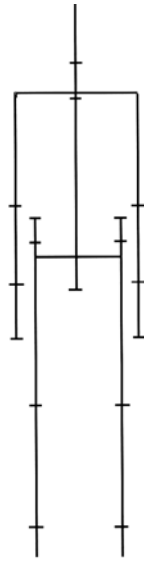
**Figure 4.** Male and female tennis and badminton players in the diagram after Tittel & Wutscherk (1972).



**Figure 5.** Proportion figures of female badminton (left) and tennis players (right).



**Figure 6.** Proportion figures of male badminton (left) and tennis players (right).



**Table 1.** Sports anthropometric parameters of male and female badminton and tennis players

Parameter	Badminton		Tennis		p
	Men	Women	Men	Women	
Age (years)	22.7±3.8	24.0±2.4	22.8±3.3	21.1±4-3	n.s.
Height (Vertex; cm)	182.0±4.6	168.1±5.8	184.8±4.8	170.1±4.2	< 0.05
Gnathion (cm)	160.3±4.5	147.5±4.9	163.3±4.3	148.1±4.0	n.s.
Suprasternale (cm)	148.5±4.0	137.1±5.3	150.5±4.2	137.8±3.5	n.s.
Acromiale (cm)	151.3±3.6	139.0±5.3	153.9±4.7	141.3±3.9	< 0.05
Radiale (cm)	117.0±3.1	107.3±4.3	118.0±4.5	109.2±3.8	n.s.
Stylian (cm)	90.1±2.7	83.8±3.7	91.7±4.0	84.7±3.3	n.s.
Dactylian (cm)	71.6±2.6	66.8±3.1	72.8±3.6	67.9±3.1	n.s.
Iliocristale (cm)	110.0±3.4	101.5±4.4	111.6±4.2	102.2±3.3	n.s.
Iliospinale (cm)	101.8±3.5	93.8±4.3	104.1±4.2	95.4±3.0	< 0.05
Trochanterion (cm)	92.6±3.5	85.0±4.2	94.8±4.7	87.6±2.9	< 0.01
Tibiale (cm)	51.9±2.2	47.1±2.4	50.6±1.9	45.9±2.6	< 0.05
Sphyrion (cm)	9.1±0.9	8.2±0.7	9.3±0.8	8.3±0.7	n.s.
Sitting height (cm)	95.9±2.5	89.9±3.3	95.7±3.2	89.8±2.5	n.s.
Arm span (cm)	184.8±5.8	168.0±6.2	188.1±6.0	171.0±5.3	< 0.05
Shoulder width (cm)	39.2±1.4	33.7±1.5	38.8±1.7	33.9±1.6	n.s.
Chest width (cm)	31.0±1.6	28.0±1.7	30.3±1.8	27.3±1.5	<0.05
Chest depth (cm)	20.8±2.3	17.8±1.0	19.7±1.6	17.3±1.7	<0.05
Pelvis width (cm)	28.0±1.2	27.8±1.5	27.8±1.4	26.6±1.1	<0.05
Epiphysis width Femur (cm)	8.9±0.4	8.4±0.4	9.0±0.6	8.3±0.5	n.s.
Ankle breadth	7.7±0.4	6.8±0.3	7.6±0.4	6.6±0.5	n.s.
Epiphysis width Humerus (cm)	6.3±0.4	5.6±0.3	6.7±0.4	5.8±0.3	<0.001
Hand breadth (cm)	7.9±0.4	7.1±0.4	8.1±0.4	7.2±0.4	n.s.
Neck circumference (cm)	38.1±1.8	33.4±1.6	38.1±1.6	32.6±1.5	n.s.
Chest circumference (respiratory centre, cm)	96.1±4.3	87.1±4.3	95.5±5.2	85.4±3.4	n.s.
Chest circumference in inspiration (cm)	101.7±4.6	93.1±4.1	101.2±4.7	90.7±3.8	n.s.
Chest circumference in expiration (cm)	92.7±4.3	84.7±3.9	92.2±5.2	83.5±3.6	n.s.
Waist circumference (cm)	81.6±3.8	73.5±3.6	79.8±4.0	69.6±3.7	<0.001
Pelvis circumference (cm)	90.1±4.1	87.4±4.6	90.6±4.6	85.1±3.2	n.s.
Upper arm circumference in flexion (cm), left side	31.8±2.1	27.6±1.9	31.9±3.0	27.2±1.8	n.s.
Upper arm circumf. flex. (cm), non-dominant side	31.6±1.9	27.6±1.9	31.9±3.0	27.2±1.8	n.s.

	Badminton		Tennis		p
Upper arm circumf. in flexion (cm), right side	32.8±1.9	28.9±1.9	33.0±3.0	28.2±1.9	n.s.
Upper arm circumf. flex. (cm), dominant side	32.9±1.9	28.9±1.9	33.0±3.0	28.2±1.9	n.s.
Upper arm circumference extension (cm), left side	28.4±2.1	26.3±1.7	29.0±2.7	25.4±1.9	n.s.
Upper arm circumference extension(cm),right side	29.2±1.8	26.8±1.8	29.8±2.7	25.9±2.0	n.s.
Forearm circumference maximum (cm), left side	27.0±1.4	23.6±1.1	27.0±1.8	23.7±1.2	n.s.
Forearm circumf. max. (cm), non-dominant side	26.8±1.2	23.6±1.1	26.9±1.8	23.7±1.2	n.s.
Forearm circumference maximum (cm) right side	28.1±1.2	25.2±1.2	28.6±1.8	25.0±1.4	n.s.
Forearm circumf. maximum (cm), dominant side	28.2±1.2	25.2±1.2	28.6±1.7	25.1±1.3	n.s.
Forearm circumference minimum (cm)	16.9±0.7	15.2±0.5	17.0±0.6	15.2±0.6	n.s.
Hand circumference (cm)	20.9±0.9	18.7±0.8	21.4±1.2	18.7±0.8	n.s.
Thigh circumference (cm)	52.3±3.0	52.1±2.7	52.4±3.0	51.1±2.9	n.s.
Calf circumference (cm)	37.9±1.6	37.4±1.6	37.4±2.0	35.9±3.1	<0.05
Lower leg circumference minimum (cm)	23.8±1.1	23.0±1.1	24.9±1.4	22.3±1.1	n.s.
Morphological facial height (cm)	11.6±0.8	10.8±0.6	11.8±0.7	11.0±0.5	n.s.
Zygomatic breadth (cm)	12.3±0.6	11.9±0.5	12.6±0.4	11.8±0.5	n.s.
Foot length (cm)	26.0±0.9	24.0±1.0	26.9±0.8	24.2±0.7	<0.01
Foot width (cm)	10.7±0.5	9.7±0.7	10.5±0.7	10.0±0.8	n.s.
Subscapular skinfold (mm)	9.4±2.0	11.1±3.0	9.7±1.9	11.3±2.9	n.s.
Triceps skinfold (mm)	7.4±2.0	11.4±2.2	7.3±2.8	12.0±3.2	n.s.
Forearm skinfold (mm)	4.2±0.6	4.2±0.6	4.1±0.4	4.2±0.7	n.s.
Suprailiac skinfold (mm)	8.1±2.2	13.2±4.7	8.4±2.7	11.0±3.2	n.s.
Thigh skinfold (mm)	7.1±2.2	12.3±3.3	6.8±2.0	11.4±3.1	n.s.
Calf skinfold (mm)	7.9±2.3	14.2±3.4	7.8±2.7	13.7±3.4	n.s.
Body fat percentage (calipermetry; %)	10.8±1.9	18.9±2.1	11.1±2.2	18.3±2.0	n.s.
Body fat percentage (BIA; %)	21.7±4.0	33.0±4.0	20.6±4.5	28.7±4.8	<0.01
Plastik-Index after Conrad	86.9±3.0	76.0±3.0	87.1±3.9	76.2±2.9	n.s.
Metrik-Index after Conrad	-0.6±0.4	-0.7±0.3	-1.0±0.3	-1.0±0.4	<0.001
Pyknomorphy after Knußmann	-2.2±1.7	-1.0±1.2	-2.7±1.0	-1.6±1.2	<0.05
Makrosomia after Knußmann	3.8±1.3	3.9±1.4	4.3±1.6	4.2±1.4	n.s.
Endomorphy after Parnell	3.4±0.6	4.1±0.8	3.4±0.7	4.2±0.6	n.s.
Mesomorphy after Parnell	3.3±1.0	3.3±0.7	3.2±1.0	2.8±1.2	n.s.

	Badminton		Tennis		p
Ectomorphy after Parnell	3.4±0.8	2.8±0.9	3.8±0.8	3.5±1.0	<0.01
Endomorphy after Heath&Carter	2.3±0.6	3.7±0.8	2.3±0.6	3.5±0.7	n.s.
Mesomorphy after Heath&Carter	3.2±0.9	3.1±0.8	3.2±0.9	2.6±1.1	n.s.
Ectomorphy after Heath&Carter	2.7±0.8	2.0±0.8	3.1±0.8	2.9±1.0	<0.001
Body weight (kg)	77.5±5.9	65.5±6.6	78.1±8.5	62.1±6.3	n.s.
BMI (kg/m <sup>2</sup> )	23.4±1.6	23.2±1.9	22.8±1.8	21.5±1.9	<0.01
Pelidisi-Index (kg/cm)	95.7±2.9	96.6±2.9	96.2±3.5	95.0±3.6	n.s.

## DISCUSSION

Unlike Klingler and Biener (1986) who examined players from lower leagues, in the present study, a larger body height of male and female tennis players was found compared to badminton. WEBER described in 1987 with his measurements for tennis players (183.3 cm) and badminton players (181.4 cm) similar results.

The importance of the body height in tennis is reflected in the results of Copley (1980): The pros were with an average size of 182.8 cm much larger than the amateurs with 178.5 cm. In the study of Pallulat (1984) top tennis players were on average 170.5 cm tall.

After Stockhausen (1999) the body length in women's tennis seems to determine more clearly the performance than in men's tennis.

The body heights in badminton (men and women) are essentially in agreement with the results for the Czech national team, which was investigated by Heller and Koudelkova (2003).

Concerning the measurements of the widths in the present study, we found a significantly lower arm span of badminton players compared to the tennis players.

The larger calf circumferences of the badminton players are a sign of more pronounced calf muscles.

Also, the foot of the tennis players was significantly longer than for the badminton players.

Calipermetrically there was no significant difference between the sports.

The male badminton (tennis) players are characterized by the triplet combination 3.4 – 3.3 – 3.4 (3.4 – 3.2 – 3.8) in the somatochart of Parnell, by the

triplet combination 2.3 – 3.2 – 2.7 (2.3 – 3.2 – 3.1) in the Heath & Carter somatochart.

Withers et al. found in 1986 at South Australian male (female) badminton players a mean somatotype of 2.5 – 4.6 – 3.2 (4.1 – 4.4 – 2.5).

COPLEY describes in 1980 for the tennis players of the South Africa Open the somatotypes of 2.2 – 4.6 – 3.0 for the professionals and 2.2 – 4.3 – 3.2 for the amateurs.

In the present study, the women's badminton average somatotype resulted by Parnell (Heath & Carter) of 4.1 – 3.3 – 2.8 (3.7 – 3.1 – 2.0), with the tennis ladies of 4.2 – 2.8 – 3.5 (3.5 – 2.6 – 2.9). Copley (1980) described in South African women's tennis average somatotypes of 3.1 – 3.9 – 2.6 for professionals and 2.6 – 3.2 – 3.6 for amateurs.

In summary it can be said that the male and the female badminton players compared with the tennis players were smaller and had shorter arms and shorter legs (but longer lower legs) and a longer torso. In addition, the body of badminton players appeared strong and robust, and the calf muscles seemed more pronounced.

Tennis players possessed significantly thicker and larger humeri and feet. In the somatotypology the picture is that of the tall, ectomorphic tennis player compared to the smaller, but more robust badminton player.

## REFERENCES

1. Conrad K. (1963). *Der Konstitutionstypus*. Berlin. Springer Verlag
2. Copley B. B. (1980). *An anthropometric, somatotypical and physiological study of tennis players with special reference to the effects of training*. PhD Thesis. University of the Witwaterstrand, Johannesburg.
3. Copley B. B. (1980). *A morphological and physiological study of tennis players with special reference to the effects of training*. *South African Journal for Research in Sports, Physical Education and Recreation* 3, 33–44.
4. Heath B. H., Carter L. J. E. (1967). *A modified somatotype method*. *Am J Phys Anthropol* 27, 57–74.
5. Heath B. H., Carter L. J. E. (1990). *Somatotyping-development and applications*. *Cambridge Studies in Biological Anthropology*. Great Britain. Redwood Press.
6. Heller J., Koudelkova M. (2003). *Physiological profiles of elite male and female badminton players*. *Kinanthropologica* 39, 63–75.
7. Klingler K., Biener K. (1986). *Zur Sportmedizin des Badminton*. *Österreichisches Journal für Sportmedizin* 16, 24–32.



8. Knußmann R. (1996). *Vergleichende Biologie des Menschen*. Lehrbuch der Anthropologie. Stuttgart. Gustav Fischer Verlag.
9. Kretschmer E. (1921). *Körperbau und Charakter*. Berlin. Springer Verlag.
10. Martin R. & Knussmann R. (1988). *Anthropologie*. Handbuch. Band I. Stuttgart. Fischer Verlag.
11. Pallulat D. M. A. (1984). *Physiques of female professional tennis players*. MA Thesis. San Diego State University.
12. Parnell R. W. (1954) Somatotyping by physical anthropometry. *Am J Phys Anthropol* 12, 209–239.
13. Pöttinger P., Mensing E. (1986). *Tennissport*. Handbuch für Lehre, Training und Spiel. Böblingen: Central-Druck Verlagsgesellschaft.
14. Raschka C. (2006). *Sportanthropologie*. Köln. Sportverlag Strauß.
15. Stockhausen W. (1999). *Besondere sportmedizinische Aspekte im Nachwuchsbereich*. In: Hölting N., Mester J. (Eds.). *Belastung und Regeneration im Tennis*. 7. Symposium des Ausschusses für Sportwissenschaft des DTB vom 13.–14.11.1998 in Göttingen. p 39–51. Hamburg. Czwalina Verlag.
16. Tittel K., Wutscherk H. (1972). *Sportanthropometrie*. Leipzig. Barth.
17. Weber K. (1987). *Der Tennissport aus internistisch-sportmedizinischer Sicht*. Band 20: *Schriften der Deutschen Sporthochschule Köln*. Sankt Augustin. Hans Richarz Verlag.
18. Withers R. T., Whittingham N. O., Norton K. I. (1987). Relative Body Fat and anthropometric prediction of body density of female athletes. *European Journal of Applied Physiology* 56 (2), 169–180.
19. Withers R. T., Craig N. P., Bourdon P. C. (1987). Relative Body Fat and anthropometric prediction of body density of male athletes. *European Journal of Applied Physiology* 56 (2), 191–200.

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