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Determining anthropometry related with Fencing using social data mining

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This paper presents a study to determine the size and direction of changes in anthropometric characteristics between two female teams of players Fencing belonging to the Juarez City University and Université Quebecoise Au Montreal, considering assess differences in anthropometric parameters, body fat, body mass index (BMI) and body density induced by sport−specific morphological optimization (adaptation). The survey included a total of 160 male Fencing players, all members of University teams of Fencing. The sample from Juarez City consisted of 95 players (71.9% of target population) aged between 18 and 30 years, and the sample from Montreal included 65 players (50% of target population) aged between 19 and 29 years. The variables of influence, in the Fencing to be considered for the development of this study have been described and measured under standard conditions by procedures established by the International Biological Program. They measured 23 anthropometric variables influence reflecting basic human body characteristic described by skeletal bone lengths (total leg length, total arm length, hand length, foot length, and height), breadths (hand at proximal phalanges, foot in metatarsal area, biacromial, biliocristal, biepicondylar femur, biepicondylar humerus, and radio−ulnar wrist breadth), girths (chest, arm, forearm, thigh, and calf girth), skinfold thickness as a measure of subcutaneous adiposity (triceps, subscapular, axillary, calf, and abdominal skinfold thickness), and mass. Additionally, estimates of body mass index (BMI), body density, and percentage of body fat were calculated from the primary measures to reveal possible trends in adiposity measures and the human body.

Key words: Anthropometrics, social data mining, and influencing variables in fencing.

INTRODUCTION

Fencing is a tactical sport, a sport game with an aerobic-anaerobic character. Variations in body size due to environmental influences are much larger than those resulting from genetic differences (Johnston, 1995). A trend of increasing body size and faster growth rate has been noted in industrialized countries since the middle of the 19th century, especially in the first half of 20th century (Tanner, 1966; Ljung BO, 1974). This positive secular trend has largely been attributed to improving living conditions, nutrition, and control of infections (Van Wieringen, 1978; Hauspie, 1997). The secular trend of increased stature observed during the last century amounted to 1.3 cm per decade by the end of childhood, 1.9 cm in mid-adolescence, and 0.6 cm at young adult age (Meredith, 1976). Different effects of sport activities (sport training) on growth and development have been summarized in different publications and textbooks (Borms, 1984; Malina, 1991). The athlete's anthropometric dimensions, reflecting body shape, proportionally, and composition (Carter, 1970, 1984), plays a significant role in

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determining the potential for success in sport (Battinelli, 1990). Distinctive anthropometric characteristics come about by natural selection of successful athletes over successive generations and/or by an adaptation on the training demands within the present generation. The "final" body shape and composition in a given sport results from a phenomenon called "sport morphological optimization" (Norton, 2001) which is the process whereby the physical demands of a sport lead to selection of body types best suited to that sport. Actually the distinctive top athlete anthropometric characteristics are the result of the selection of successful athletes from a number of successive generations. The body shapes are peculiar feature in some sports, such as the silhouette of a shot putter in athletics differs from the silhouette of an artistic gymnast hence body proportionality profiles can lead us to an optimization for certain sports morphological study. The morphological optimization, are features that allow the athlete to react more efficiently to the demands for sports performance. In this study, we can identify some of the features that comprise morphological optimization in fencing.

A number of differences in players' body morphology and composition (Lozovina, 1986; Vujovič, 1986) due to the environmental changes in general, and changes within the game of Fencing itself (Pavičić, 1991; Lozovina, 2003) could be expected. The idea is to present that adaptation to a specific sport, is determined by adaptation to sport and especially for a set of anthropometric characteristics that directly affect the performance of the athlete.

METHODS

The sample consisted of 160 male Fencing players from two samples. Anthropometric measures of 95 players (71.9% of the target population) were taken in Juarez City (Skermmes team), and of 65 players in Montreal. The age range of the first sample at the time of measurement was 18 to 30 years (mean ± standard deviation, SD, 21.1± 4.0 years), and the age range of the second sample (50% of the target population) was 19 to 29 years (mean ± SD, 21.8 ± 3.8 years). All participants were clinically healthy without morphological aberrations. The only inclusion criterion was participation in at least one University team in the year of measurement. There was no overlap between the two groups.

Trained and qualified investigators performed all the measurements, using standardized procedures recommended by the International Biological Program (Weiner, 1969). A medical balance was used with a precision of 0.1 kg, Martin anthrop meter with a precision of 0.1 mm, small sliding caliper with accuracy of 1 mm^2, and synthetic length measuring tape with accuracy of 1 mm. Anthropometric status of subjects was determined on the basis of 23 anthropometric measures. Katch and McArdle (1973) formulae were used to estimate the body fat percentage on the basis of measurements performed.

Data for each sample were presented as mean ± standard deviation (SD). Analysis of variance was used to test the differences between the two generations. Differences were also calculated as z-scores (z^2). Measures of the two samples were rescaled according to the formula: $z_2 = (r_2 - x_1) / sd_1$, where r_2 was the result of Montreal and x_1 and sd_1 were mean ± SD for Juarez people. SPSS statistical software, Ver. 11.0 was used for all statistical analyses.

The two samples significantly differed in almost all anthropometric measures and indices (Table 1 and Figure 1) except chest girth, arm girth, mass, foot length, and foot breadth. Comparison of length measures between the samples, that is the leg length, arm length, and height, showed statistically significant positive trends. The only exception was the hand length, where a significant decrease in the mean value was observed. Breadth measures, including biiliocristal breadth, biepicondylar femur, biepicondylar humerus, and wrist breadth, significantly decreased. Only the biacromial breadth increased in the second sample. The measures of soft tissues, such as girths and skinfolds, generally decreased. There were significant decreases in forearm girth, thigh girth, and calf girth. Although these measurements were mildly decreased in the first group compared to the second, it reached statistical significance, but was not clinically prominent. Body mass index (BMI) and estimated body fat percentage decreased significantly, whereas body density increased while the mean height significantly increased, body mass remained statistically unchanged. This study considered the most appropriate measures for the three tests that have the fencing: saber, sword and foil.

RESULTS AND DISCUSSION

Our study showed that body morphology and composition of Fencing players significantly is different in Juarez City and Montreal. The players has longer limbs, and smaller breadth and girth of most anthropometric parameters measured. Their bodies were taller but more slender with wider shoulders and thinner waist. It seems that a change in the body composition of Fencing players has been accompanied by changes in the body shape. Body adiposity estimate, based on the skin folds, was significantly lower. In the second sample, estimated percentage of body fat and BMI was lower, and body density higher. Since there was no difference in the body mass between the two samples, it seems that the same body mass was achieved by the increase in the muscle and bone mass on account of less dense body fat, which decreased, all this characteristics has influence on the genetics of the societies. Table 1 shows the anthropometric measurements of athletes from a sport similar to Fencing (water polo) which requires precise hand and arm strength.

These differences may be explained by the changes in Fencing and changes in environmental conditions. The playing rules of the game over the World were subject to several changes. The variants of sport with less time to realize a "escaramuza". Accordingly, there are less physical contacts between opponent players during the practice the ratio of vertical to horizontal posture to attack changed in favor to the horizontal one, and there are more contact points (Lozovina, 2003). Consequently, the volume and intensity of the training also considerably increased.

The significantly shorter hand length in Juarez City in comparison with Montreal was most probably the consequence of the changes in playing conditions and

Table 1. Analysis of variance of differences in 26 anthropometric measures, body mass index (BMI), body density, and body fat between Male Fencing players of two different samples.

	Anthropometric measures (mean ± SD, range) of water polo players in the year				
Parameter (mm)	Juarez City (n = 95)	Montenegro (n = 65)	d*	F (ratio)	p
Leg length	1,056.3 ± 41.8 (967-1,168)	1,073.3 ± 38.4 (986-1,177)	-16.98	6.801	0.010
Total arm length	802.9 ± 30.9 (704-884)	831.5 ± 34.5 (748-907)	-28.59	30.077	0.001
Hand length	200.3 ± 8.9 (172-227)	186.2 ± 8.1 (167-204)	14.14	104.847	0.001
Foot length	280.5 ± 11.0 (258-312)	280.3 ± 10.6 (251-296)	0.24	0.19	0.890
Height	1,858.6 ± 52.7 (1,741-2,000)	1,895.9 ± 50.2 (1,789-2,018)	-37.31	0.131	0.001
Hand breadth (proximal phalanges)	81.9 ± 5.6 (69-96)	84.1 ± 4.1 (76-93)	-2.16	7.066	0.009
Foot breadth (metatarsalis)	102.8 ± 6.2 (87-118)	101.3 ± 5.3 (91-115)	1.53	2.681	0.104
Biacromial bredth	420.6 ± 19.5 (372-468)	437.3 ± 13.3 (401-462)	-16.70	36.174	0.001
Biiliocristal bredth	297.1 ± 14.9 (265-353)	285.2 ± 15.8 (256-330)	11.91	23.408	0.001
Biepycondilar femur	99.3 ± 5.2 (90-115)	96.5 ± 4.5 (88-108)	2.80	12.428	0.001
Biepycondilar humerus	73.1 ± 3.4 (65-80)	65.7 ± 5.8 (54-79)	7.38	101.413	0.001
Wrist breadth (radio-ulnar)	60.6 ± 2.8 (53-68)	58.1 ± 2.6 (51-63)	2.48	31.925	0.001
Chest girth	1,030.5 ± 45.5 (932-1,154)	1,039.4 ± 51.1 (942-1,156)	-8.88	1.330	0.251
Arm girth (relaxed)	328.3 ± 20.8 (282-385)	324.9 ± 17.3 (293-381)	3.34	1.138	0.288
Forearm girth	282.1 ± 11.4 (256-312)	273.4 ± 12.3 (241-300)	8.67	20.861	0.001
Thigh girth	601.3 ± 28.3 (533-682)	565.0 ± 26.2 (507-631)	36.29	67.589	0.001
Calf girth	389.1 ± 15.9 (354-431)	375.7 ± 14.2 (341-413)	13.43	30.018	0.001
Triceps skinfold	9.3 ± 2.8 (4.8-19.3)	8.2 ± 2.7 (4.35-16.52)	1.10	6.219	0.014
Subscapular skinfold	11.0 ± 3.2 (7.2-22.8)	9.0 ± 2.3 (6.28-16.70)	2.02	19.426	0.001
Axilar skinfold	9.1 ± 3.7 (4.3-20.3)	7.3 ± 2.8 (4.38-20.87)	1.78	11.030	0.001
Calf skinfold	8.0 ± 2.2 (3.8-14.8)	10.6 ± 3.1 (5.78-20.20)	-2.60	38.834	0.001
Abdominal skinfold	13.4 ± 5.6 (5.5-27.5)	10.6 ± 4.5 (5.22-29.60)	2.87	12.026	0.001
Mass (kg)	85.2 ± 7.3 (65.6-107.2)	85.9 ± 6.9 (73.0-104.0)	-0.74	0.419	0.518
Body mass index (BMI)	24.7 ± 1.7 (20.0-30.1)	23.9 ± 1.4 (21.31-28.91)	0.76	8.798	0.003
Body density (against water)	1.07 ± 0.01 (1.06-1.1)	1.08 ± 0.01 (1.06-1.08)	0.0038	13.781	0.001
Body fat (%)	11.1 ± 3.0 (6.9-19.2)	9.4 ± 2.4 (6.4-17.5)	-1.65	13.693	0.001

rules of the game. Changes in rules of the game which is more competitive promoted the use of technologically improved spades, sables and florets allowing it to retain its stable characteristic for the full duration of the game. Conversely, in Juarez City played the game with different accessories; consequently, the characteristics changed during the course of the game as it became heavier. It seems that shorter hand in the Fencing players measured in Juarez City was a disadvantage for better manipulation and control of the arms.

The secular changes, that is a more rapid growth and development, higher mean stature, and body mass have been noticeable in Developed countries and elsewhere for more than a century. Coefficients of increase in the stature per decade (cm/decade) differ among countries, from 0.3 in Norway and Sweden to 1.9 in Slovenia (6). The average secular trend coefficient for Europe is 1.2 cm/decade.

Thus, the lack of differences in body mass and a greater than expected increment in height imply some other sources of variation besides the already established population secular trend. Due to similar training histories and psychological attributes, traits other than anthropometric characteristics contributing to success, such as skill level and physical fitness, will tend to optimize similarities among athletes. Given the possibilities of influencing body shape and body composition, it is obvious that anthropometric characteristics are of para- mount importance for the selection and success of new players. The observed trend can be only partially explained by a population secular trend. It is at least a twofold dynamic problem. The question on the one side is what makes a successful athlete, and on the other, how the training process and selection pressure, taken together, transform or change body characteristics. Besides a secular trend, which is obviously present in any given population (Meredith, 1976; Hauspie, 1997) athletes are additionally influenced by the training and selection dynamics (Borms, 1984; Malina, 1991). The characteristic

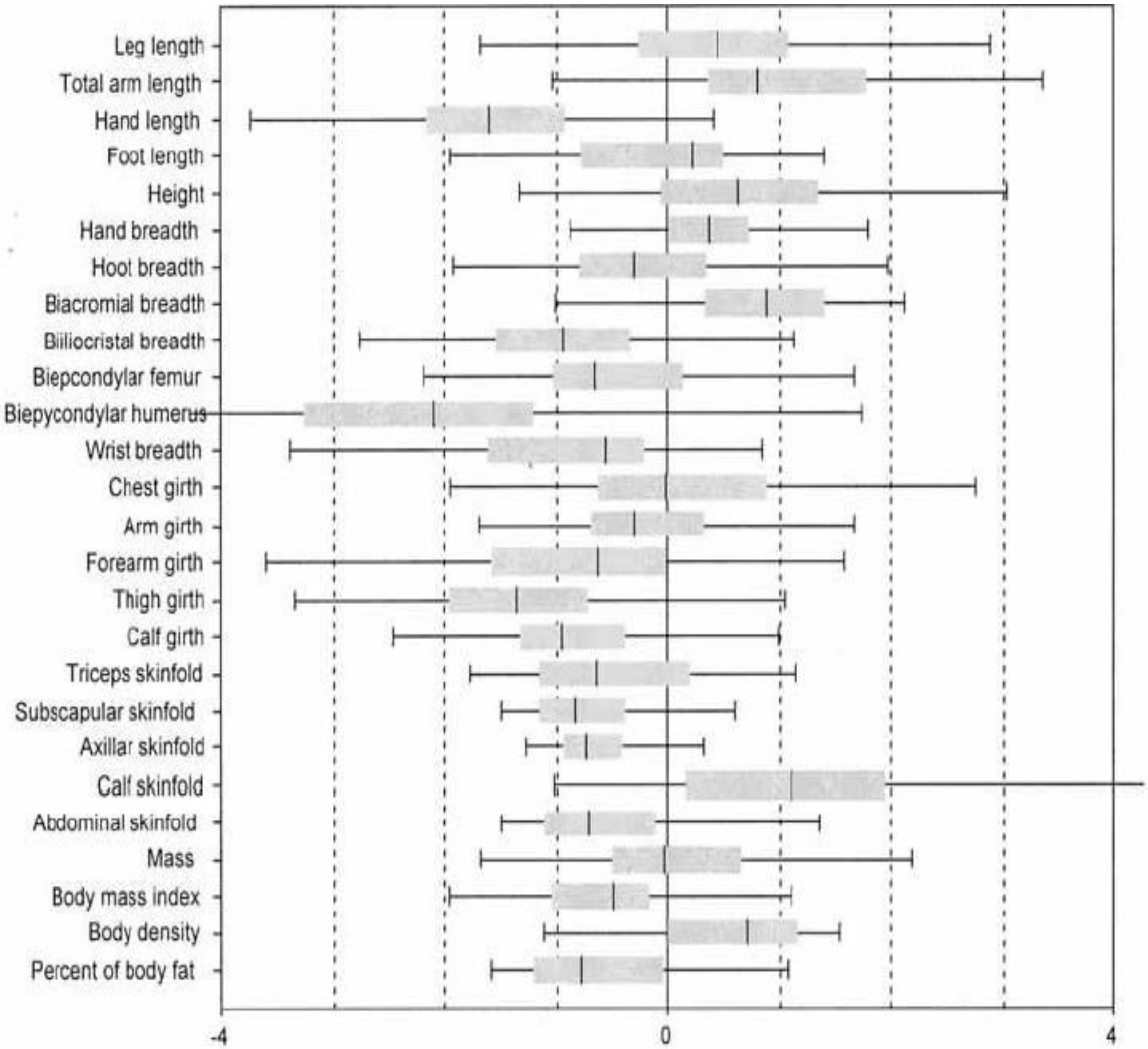

Figure 1. Differences in 26 anthropometric variables, body mass index (BMI), body density, and percent of body fat between two samples of male Fencing players. The cross-sectional study was based on two measurement point. Box-plot of measures at the 2nd measurement point is rescaled as z-scores to the 1st sample. Full line in the box –arithmetic mean, box- 2 standard deviation, whiskers –minimum and maximum. Zero on the x-axis denotes the mean of all 26 anthropometric variables, with up to 4 standard deviations (-4 to 4).

body shape and composition of successful elite athletes, in the long run, are the result of the selection process of ever changing competitive conditions in sport. Fencing players have been under pressures from intensive training and selection procedures over a number of years. Hence, the sport morphological adaptation (Norton, 2001) must be taken into account. Regarding the types of adaptation that have occurred, it is evident from the results in our study that the body mass of Fencing players is in the category of "absolute sports morphological optimization", whereas their height is in "open upper end optimization" (Norton, 2001).

The limitation of our study was that the anthropometric measurements were performed only twice. Therefore, possible extrapolations or anticipations of trends have to be made with utmost caution. Secular trends in anthropometry are the result of cross-sectional studies of populations. Furthermore, secular trend analysis and identification in particular population of athletes is additionally limited by the fact that the same athletes are usually the constituents of two societies. The comparative anthropometric was performed at two different times, but this is not significant enough that were made during the same year.

Comparison between anthropometric measures of the two samples of Fencing players revealed a positive trend in body skeletal measures and negative trend in body adiposity measures. Most noteworthy differences (d) were an increase in height (d = 37.3 mm, $p \leq 0.001$), decrease in estimated body fat (d = -1.65%, $p \leq 0.001$) accompanied by higher body density (d = 0.001, $p \leq 0.001$), with no significant difference in body mass (d = -2.74 kg, p = 0.518).

CONCLUSIONS

Our study may, nevertheless, provide a good insight into the anthropometric changes in Fencing players. We used multiple anthropometric variables, rarely covered to such an extent in other similar studies. Because of the range of anthropometric measures in this study, the sample is unique and may be a challenge for further investigation of the population secular trend and sport morphological optimization phenomena, with special consideration given to their possible interaction. We believe that successful prediction of future athletes' body shape and form should be sought also in the domain of complex systems theory (Forrester, 1968).

Anthropometric characteristics of Fencing players have changed over the two analyzed samples. Body shape changed in terms of greater height and more elongated limbs, with thinner waist and broader shoulders. Body mass remained is very different. Muscle-to-fat mass ratio increased in the first sample. The observed changes may be a consequence of population secular trend and sport morphological adaptation (optimization).

Although individuals in a society are very different, in this study, we determined the best way to determine if a specific set of individuals may be eligible for Fencing anthropometrically. From the results obtained by comparing the people of Montreal and Montenegro, it can therefore be concluded that they are similar with respect to Ciudad Juarez, food, lifestyle and other factors of modernity.

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