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PROPORTIONALITY CHARACTERISTICS OF FEMALE ATHLETES

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A persistent challenge in human biology is to identify individual differences and to find group characteristics. For this reason the study of internationally elite athletes is particularly attractive. Specific performance criteria makes them easily identified. They are highly select and much of the preparation leading to international competition has been optimized.

For perhaps social-cultural reasons, scant attention has been paid to physique characteristics of females in general, however, noteable contributions have been made and precedent established in the works of Rott (1926), Bach (1927), Arnold (1930), Škerlj (1938, 1959, 1960), Heath (1952), Félice (1958), Heath and Carter (1967), Eiben (1965, 1969, 1970, 1972), Grimm (1966), De Woskin (1967), Félice and Vassal (1968), Moeschler (1968), Novak (1970), Harrison and Marshall (1970), Wilmore and Behnke (1970), Meredith (1971), Garrett and Kennedy (1972), Clauser *et al.* (1972).

There has also been scattered studies reporting anthropometric data on female athletes, although only two comprehensive reports on internationally select female athletes are available. These emanate from the 1966 European Women's Track and Field Championships reported by Eiben (1972) and the 1968 Mexico Olympic Games reported by de Garay, Levine and Carter (1974).

Both these studies provide basic descriptive data, however, further analyses are possible. Of particular interest is the proportionality characteristics of athletes in different events compared to non-athletes viewed with reference to a single *unisex phantom* proposed as a *universal human model.*

Essentially, the unisex phantom proposed by Ross and Wilson (1974) is a metaphorical model derived from both sexes as shown in Fig. 1 and described in Table 1 by over eighty length, girth, breadth, and skinfold values and standard deviations based on male-female size-adjusted averages appropriate for an unisex model with an arbitrary 170.18 centimeters height, 64.58 kilograms body weight and an 18.78 per cent body fat. While the stratagem is perhaps unique in proposing an unisex phantom as a single human reference, there is historical precedent for other concepts. The phantom was constructed from a collation of the world literature on anthropometry assembled by Garrett and Kennedy (1972), reference male and female data by Behnke and Wilmore (1974), Wilmore and Behnke (1969, 1970) and female data by Clauser et al. (1972), using criteria for an „universal human" in much the same way Polyklitos (5th Cent. B. C.) assembled his *Doryphorus* or „*spear-bearer*", Fig. 2, from selected body parts from various subjects he conceived of as representing „ideal male" body form.

Table 1

Phantom specifications, body measurements
1. táblázat. A fantom testméretei

Measurements — *Testméretek*	$\bar{x}$	s
SPECIFICATIONS *SPECIFIKÁCIÓS MÉRETEK*		
Stature *Testmagasság* cm	170.18	6.29
Weight *Testsúly* kg	64.58	8.60
Lean body weight *Sovány testsúly* kg	52.45	6.14
Fat weight *Testzsír* kg	12.13	3.25
Percent fat *Zsírszázalék*	18.78	5.20
Density *Testsűrűség* g/cc	1.056	0.0111
Residual volume *Residuális volumen* l	1.053	0.265
H in / $\sqrt[3]{\text{W lb}}$	12.83	
H cm / $\sqrt[3]{\text{W kg}}$	42.41	
($\sqrt[3]{\text{W kg}}$ / H cm) · 10^3	23.58	
PHANTOM HEIGHTS (projected) *A FANTOM MAGASSÁGMÉRETEI* (cm)		
Vertex (Stature) *Termet*	170.18	6.29
Gnathion *Állcsúcsmagasság*	148.81	5.65
Suprasternal *Szegymagasság*	138.31	5.46
Infrasternal *Infrasternális magasság*	119.50	4.96
Symphysion *Symphysismagasság*	87.05	4.35
Acromial *Vállmagasság*	139.37	5.45
Radial *Könyökmagasság*	107.25	5.36
Stylion *Csuklómagasság*	82.68	4.13
Dactylion *Ujjmagasság*	63.83	3.38
Iliospinale *Csípőtövismagasság*	96.32	4.81
Trochanteric *Tompormagasság*	87.90	4.40
Tibial (lateral or medial) *Térdmagasság*	46.98	2.68
Sphyrion (fibular) *Külső bokamagasság*	7.10	0.85
Sphyrion (tibial) *Belső bokamagasság*	8.01	0.96
Cervical *Cervicalis magasság*	144.15	5.58
Gluteal arch *A gluteális redő magassága*	89.59	4.48
Sitting height *Ülőmagasság*	90.78	4.54
PHANTOM LENGTHS (direct and derived) *A FANTOM HOSSZMÉRETEI* (cm)		
Head height *Egész fejmagasság* (vertex-gnathion)	21.27	1.02
Neck *Nyakhossz* (gnathion-suprasternale)	9.48	1.71
Trunk *Elülső törzsfalhossz* (suprasternale-symphysion)	51.26	2.56
Back *Háthossz* (cervicale-gluteal arch)	56.83	2.84
Upper extremity *A felső végtag hossza* (acromiale-dactylion)	75.95	3.64
Upper extremity—Hand *Felsővégtaghossz a kéz nélkül* (acromiale-stylion)	57.10	2.74
Upper arm *Felkarhossz* (acromiale-radiale)	32.53	1.77
Forearm *Alkarhossz* (radiale-stylion)	24.57	1.37
Hand *Kézhossz* (stylion-dactylion)	18.85	0.85
Lower extremity—Foot *Alsóvégtaghossz a láb nélkül* (iliospinale-t. sphyrion)	82.91	4.14
Thigh *Combhossz* (trochanterion-tibiale lat.)	40.92	2.52
Tibia *Alszárhossz* (tibiale med.-t. sphyrion)	38.97	2.22
Lower leg *Külső alszárhossz* (tibiale lat.-f. sphyrion)	39.88	2.27
Foot *A lábfej hossza* (akropodion-pterion)	25.50	1.16

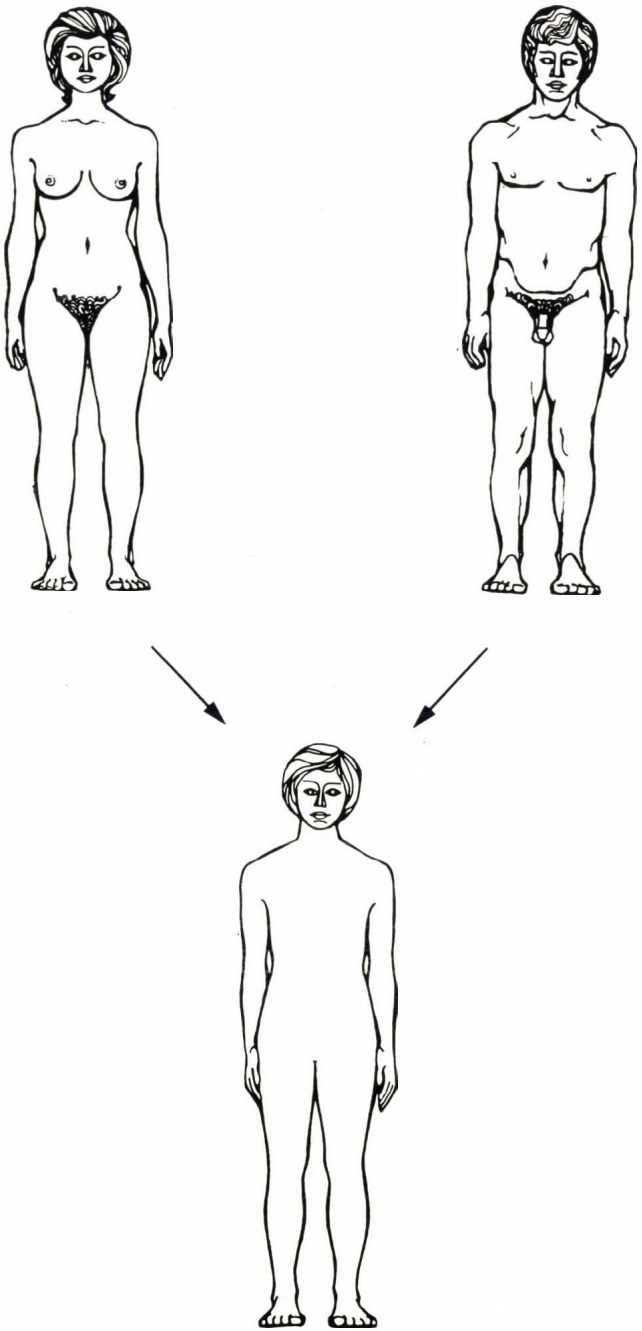

Fig. 1. A bilaterally symmetrical unisex phantom derived from heightadjusted male and female data.

1. ábra. A férfi és női testméret-adatokból létrehozott kétoldali szimmetriát mutató unisex fantom.

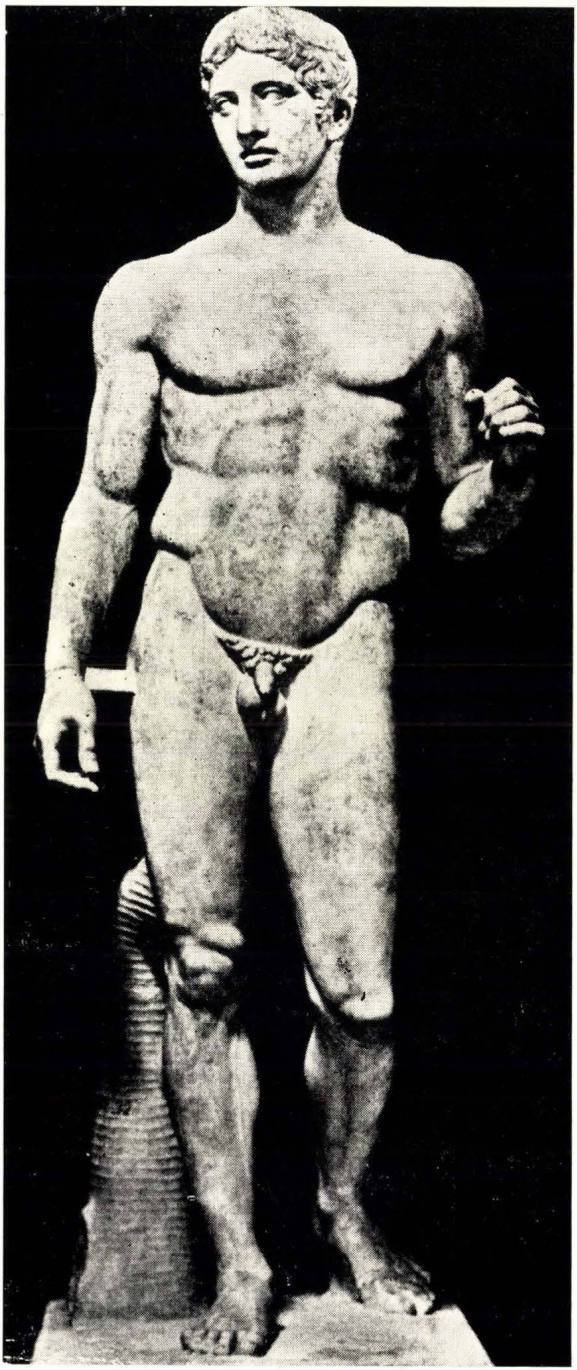

Fig. 2. Polyklitos (5 Cent. B. C.) Doryphorus or spearbearer model of „ideal" male physique.
2. ábra. Polykleitos (i.e. 5. sz.) Doryphorosa vagy Dárdavivője, az „ideális" férfi testalkat modellje.

Table 1 (continued) — *1. táblázat folytatása*

Measurements — *Testméretek*	$\bar{x}$	
PHANTOM GIRTHS *A FANTOM KERÜLETMÉRETEI* (cm)		
Head *Fejkerület*	56.00	1.44
Neck *Nyakkerület*	34.91	1.73
Shoulders *Vállkerület*	104.86	6.23
Chest *Mellkaskerület* (mesosternale)	87.86	5.18
Abdominal 1 (waist) *Derékkerület*	71.91	4.45
Abdominal 2 (umbilical) *Haskerület*	79.06	6.95
Abdominal AV (mean 1 2) *Átlagos haskerület*	75.48	5.74
Hips *Tomporkerület*	94.67	5.58
Thigh *Combkerület*	55.82	4.23
Knee *Térdkerület*	36.04	2.17
Calf (standing) *Alszárkerület (álló helyzetben)*	35.25	2.30
Ankle *Bokakerület*	21.71	1.33
Arm (flexed) *Felkarkerület (behajlítva)*	29.41	2.37
Arm (extended) *Felkarkerület (nyújtva)*	26.89	2.33
Forearm *Alkarkerület*	25.13	1.41
Wrist (distal styloids) *Csuklókerület*	16.35	0.72
PHANTOM BREADTH *A FANTOM SZÉLESSÉGI MÉRETEI* (cm)		
Bi-acromial *Vállszélesség*	38.04	1.92
Bi-deltoid *Deltaszélesség*	43.50	2.40
Transverse mesosternal *Mellkasszélesség*	27.92	1.74
Bi-iliocristal *Cristaszélesség*	28.84	1.75
Bi-trochanteric *Tomporszélesség*	32.66	1.80
Chest depth (A-P) *Mellkasmélység*	17.50	1.38
Bi-epicondylar humerus *Humerus condylusszélessége*	6.48	0.35
Wrist (max. stylion-ulnare) *Csuklószélesség*	5.21	0.28
Hand (distal II—V. metacarpals) *Kézszélesség*	8.28	0.50
Bi-epicondylar femur *Femur condylusszélessége*	9.52	0.48
Transverse tibia *A tibia szélessége*	9.12	0.47
Bi-malleolare *Bokaszélesség*	6.68	0.36
Transverse foot *A lábfej szélessége*	9.61	0.60
Foot (distal I—V. metatarsals) *A lábfej max. szélessége*	10.34	0.65
PHANTOM SKINFOLDS *A FANTOM BŐRREDŐVASTAGSÁG ÉRTÉKEI* (mm)		
Triceps *A tricepsen*	15.4	4.47
Subscapular Rd *A lapocka alatt Rd*	17.2	5.07
Subscapular Lv *A lapocka alatt Lv*	17.5	5.17
Chest *A mellen*	11.8	3.27
Biceps *A bicepsen*	8.0	2.00
Suprailiac *A csípő fölött*	15.4	4.47
Abdominal *A köldök mellett*	25.4	7.78
Iliac crest *A csípőn*	22.4	6.80
Front thigh *A comb elülső felszínén*	27.0	8.33
Rear thigh (f) *A combon*	31.1	9.69
Medial calf *Az alszár belső felszínén*	16.0	4.67

PHANTOM INDEX VALUES *A FANTOM INDEXÉRTÉKEI*

Cormac index
Rel. ülőmagasság

$$\frac{SH}{L} \cdot 100 = 52.5 \quad \text{medium trunk}$$

Skeletal index (MANOUVRIER)
Skeletális index

$$\frac{100(L-SH)}{SH} = 91.0 \quad \text{sub-macroskèle}$$

Table 1 (continued) — *1. táblázat folytatása*

Anterior trunk height index *Rel. elülső törzsfalhossz*	$\frac{100\ (Su\text{-}Sy)}{L} = 30.1$ long trunk
Biacromial index *Rel. vállszélesség*	$\frac{100\ BA}{L} = 22.4$ medium
Bicristal index *Rel. cristaszélesség*	$\frac{100\ BC}{L} = 16.9$ medium
Acromio-iliac index *Törzsszélességi index*	$\frac{100\ BC}{BA} = 75.8$ rectangular
Bitrochanteric index *Rel. tomporszélesség*	$\frac{100\ BT}{L} = 19.2$ medium
Chest girth index *Rel. mellkaskerület*	$\frac{100\ C}{L} = 51.6$ medium
Upper extremity index *Rel. felsővégtaghossz*	$\frac{100\ UE}{L} = 44.6$ short
Upper arm index *Rel. felkarhossz*	$\frac{100\ A}{L} = 19.1$ medium
Forearm index *Rel. alkarhossz*	$\frac{100\ F}{L} = 14.4$ short
Brachia-antibrachial index *Felkar-alkar index*	$\frac{100\ F}{UA} = 75.6$ short
Hand width index *Kézszélességi index*	$\frac{100\ HW}{HL} = 43.9$ medium
Leg length index *Rel. alsóvégtaghossz*	$\frac{100\ Is}{L} = 55.6$ medium
Trochanter index *Rel. trochantermagasság*	$\frac{100\ Tr}{L} = 51.7$ medium
Symphysis index *Rel. Symphysismagasság*	$\frac{100\ Sy}{L} = 51.1$ medium
Thigh length index *Rel. combhossz*	$\frac{100\ Is\text{-}Tm}{L} = 29.0$ medium
Lower leg length index *Rel. alszárhossz*	$\frac{100\ T}{L} = 22.9$ medium
Foot size index *Lábindex*	$\frac{100\ FW}{FL} = 40.5$ medium

The Polyklitian anthropometric canon was a mimetic model. The artists determined proportionality by comparison with the spearbearer model. The modern phantom is used by expressing obtained measurements by application of the following general formula:

$$z = \frac{1}{s}\left[l\left(\frac{170.18}{h}\right)^{d} - p\right]$$

where

z is a proportionality standard score,
s is a prescribed standard deviation for a given item for the phantom,
l is any obtained measurement on a subject for a given item,
170.18 is the phantom height constant,
h is the subject's obtained height,
d is a dimensional constant based on geometrical considerations:
d = 1 for all lengths, breadths, girths, and skinfold thickness;
d = 2 for areas and static strength measures which are related to the area of cross section of muscle tissue; and
d = 3 for weights and volumes of total body or any body part.
p is the prescribed value for the given item for the phantom.

Subjects

The data for viewing proportionality characteristics of female athletes was assembled and reported by EIBEN (1972). His samples consisted of 125 women athletes in nine events of the 1966 European Track and Field Championship, 139 female physical education majors and 179 female teachers' college students.

Method

Mean values reported by EIBEN (1972), for each of nine events for the athletes, and the physical education and teachers' college groups were substituted in the above formula to obtain proportionality z-values.

The analysis for this paper was based on mean values of 26 direct measures which were obtained on all athletic sub-groups and both physical education majors and teachers' college samples. Measurements not common to all groups or those which were derived by calculation from the direct measurements were delimited.

Results

A total of 286 z-values obtained from the 26 items for each of the 11 groups by the phantom formula were displayed on the first line for each designated item as shown in Table 2. These values describe how proportionally similar the obtained values were to phantom values. An obtained value of 0.00 indicates the mean value for the particular group was proportionally the same as the phantom. Positive values indicate the prototype was proportionally greater and negative values proportionally smaller than the phantom.

Table 2

Phantom z-values for female track and field athletes (Data: EIBEN 1972)
2. táblázat. Az atlétanők z-értékei

1 SPR	2 HRD	3 MDR	4 LJ	5 HJ	6 SP	7 DIS	8 JAV	9 PEN	10 PEM	11 TCS*
1. Suprasternal height *Szegymagasság*										
0.17	0.18	0.27	0.22	0.36	0.30	0.37	0.35	0.28	0.12	0.14
0.03	0.04	0.13	0.08	0.22	0.16	0.23	0.20	0.14	−0.02	
2. Shoulder height *Vállmagasság*										
0.06	0.06	0.15	0.07	0.25	0.20	0.14	0.14	0.27	−0.02	−0.07
0.12	0.13	0.22	0.14	0.32	0.27	0.21	0.21	0.34	0.05	
3. Height of radiale *Könyökmagasság*										
0.36	0.28	0.40	0.18	0.25	0.59	0.28	0.35	0.37	0.22	0.24
0.13	0.04	0.16	−0.06	0.02	0.35	0.04	0.11	0.13	−0.02	
4. Height of stylion *Csuklómagasság*										
0.43	0.39	0.49	0.22	0.51	0.57	0.32	0.64	0.44	0.34	0.18
0.25	0.21	0.31	0.04	0.33	0.39	0.14	0.46	0.26	0.16	
5. Height of dactylion *Ujjmagasság*										
0.51	0.42	0.38	0.32	0.55	0.52	0.25	0.58	0.40	0.31	0.38
0.14	0.05	0.00	−0.05	0.17	0.15	−0.12	0.20	0.03	−0.07	
6. Anterior superior iliac *Csípőtövismagasság*										
−0.22	−0.36	−0.21	−0.05	0.00	−0.08	−0.19	0.02	−0.04	−0.27	−0.31
0.09	−0.04	0.10	0.26	0.31	0.23	0.12	0.34	0.27	0.04	
7. Height of tibiale *Térdmagasság*										
0.05	0.27	0.23	0.73	0.32	−0.31	0.24	0.21	0.27	−0.15	−0.36
0.41	0.63	0.59	1.09	0.69	0.05	0.60	0.57	0.63	0.22	
8. Height of sphyrion *Bokamagasság*										
0.40	0.38	0.15	0.11	0.36	−0.07	−0.12	0.42	0.43	0.30	0.65
−0.26	−0.28	−0.05	−0.55	−0.30	−0.73	−0.78	−0.23	−0.22	−0.35	
9. Span *Karöltő*										
−0.12	−0.19	0.04	0.08	−0.08	0.39	0.73	0.08	0.13	0.10	−0.12
−0.00	−0.07	0.16	0.20	0.04	0.51	0.84	0.19	0.25	0.22	
10. Sitting height *Ülőmagasság*										
−0.21	−0.24	−0.29	−0.47	−0.55	−0.08	−0.13	0.09	−0.43	−0.20	−0.16
−0.05	−0.08	−0.12	−0.31	−0.39	0.09	0.03	0.26	−0.27	−0.04	

*SPR. sprinters — vágtázók, HRD hurdlers — gátfutók, MDR middle-distance runners — középtávfutók, LJ long jumpers — távolugrók, HJ high jumpers — magasugrók, SP shot putters — súlylökők, DIS discus throwers — diszkoszvetők, JAV javelin throwers — gerelyhajítók, PEN pentathlonists — ötpróbázók, PEM physical education majors — TF-hallgatónők, TCS teachers' college students — tanítóképzős lányok.

Table 2 (continued) — *2. tá blázat folytatása*

1 SPR	2 HRD	3 MDR	4 LJ	5 HJ	6 SP	7 DIS	8 JAV	9 PEN	10 PEM	11 TCS
11. Biacromial diameter *Vállszélesség*										
0.73	0.95	0.44	0.60	0.29	1.42	1.40	1.13	0.72	0.68	0.49
0.24	0.46	−0.06	0.11	−0.20	0.93	0.91	0.63	0.23	0.18	
12. Bideltoid width *Deltaszélesség*										
−0.45	−0.29	−0.54	−0.52	−0.78	1.25	1.07	0.29	−0.19	−0.08	−0.17
−0.28	−0.12	−0.37	−0.35	0.61	1.42	1.55	0.46	−0.02	0.09	
13. Chest breadth *Mellkasszélesség*										
−0.76	−0.44	−0.44	−0.92	−0.77	1.10	0.76	0.44	−0.54	−0.24	0.07
−0.83	−0.51	−0.51	−0.99	−0.84	1.03	0.69	0.37	−0.61	−0.31	
14. Chest depth *Mellkasmélység*										
0.58	0.45	1.11	0.58	0.40	2.08	1.75	1.50	0.68	0.95	1.08
−0.50	−0.62	0.03	−0.50	−0.68	1.00	0.67	0.42	−0.40	−0.13	
15. Bitrochanter width *Tomporszélesség*										
0.19	0.23	0.20	0.64	0.22	1.65	2.02	0.95	0.18	0.56	1.71
−1.52	−1.47	−1.50	−1.07	−1.49	−0.05	0.31	−0.76	−1.52	−1.15	
16. Chest quiet *Mellkaskerület*										
−0.20	0.15	0.36	0.02	−0.06	1.89	1.66	1.46	0.26	0.22	−0.21
−0.41	−0.06	0.14	−0.19	−0.27	1.67	1.45	1.25	0.05	0.01	
17. Abdomen circumference *Haskerület*										
−1.02	−0.99	−0.90	−1.09	−1.08	0.36	0.47	−0.12	−0.68	−0.53	0.99
−2.01	−1.99	−1.89	−2.08	−2.08	−0.63	−0.52	−1.11	−1.67	−1.52	
18. Trochanter circumference *Tomporkerület*										
−0.60	−0.49	−0.62	−0.77	−0.69	0.90	0.20	0.23	−0.34	−0.45	0.72
−1.32	−1.21	−1.34	−1.49	−1.41	0.18	−0.52	−0.49	−1.06	−1.17	
19. Upper arm relaxed *Felkarkerület (nyújtva)*										
−0.94	−0.45	−0.98	−1.17	−0.99	1.45	1.05	0.20	−0.43	−0.18	−0.71
−0.22	0.26	−0.27	−0.46	−0.28	2.17	1.77	0.91	0.28	0.53	
20. Upper arm contracted *Felkarkerület (behajlítva)*										
−1.30	−0.73	−1.34	−1.54	−1.34	1.14	0.83	−0.15	−0.68	−0.76	−1.14
−0.15	0.41	−0.19	−0.40	−0.20	2.29	1.97	1.00	0.46	0.39	

Table 2 (continued) — *2. táblázat folytatása*

1 SPR	2 HRD	3 MDR	4 LJ	5 HJ	6 SP	7 DIS	8 JAV	9 PEN	10 PEM	11 TCS
21. Forearm circumference *Alkarkerület*										
−1.47	−1.16	−1.66	−1.76	−1.53	0.76	0.67	−0.14	−0.55	−0.35	−1.34
−0.12	0.19	−0.31	−0.41	−0.19	2.11	2.01	1.20	0.80	0.99	
22. Wrist circumference *Csuklókerület*										
−1.39	−0.87	−1.36	−1.61	−1.39	0.76	0.43	−0.05	−0.89	−0.12	−0.76
−0.63	−0.11	−0.60	−0.86	−0.64	1.52	1.18	0.71	−0.13	0.64	
23. Thigh circumference *Combkerület*										
−0.19	0.24	−0.44	−0.17	−0.32	2.07	1.20	1.04	0.17	0.14	0.08
−0.27	0.15	−0.52	−0.26	−0.40	1.99	1.11	0.95	0.09	0.05	
24. Calf circumference *Alkarkerület*										
0.22	0.66	−0.19	−0.07	−0.28	1.72	1.19	1.00	0.28	0.38	−0.38
0.61	1.04	0.20	0.31	0.10	2.10	1.58	1.39	0.66	0.76	
25. Ankle circumference *Bokakerület*										
−0.05	0.11	−0.05	−0.11	−0.34	1.31	1.83	1.06	0.50	0.64	0.56
−0.61	−0.45	−0.60	−0.66	−0.90	0.75	1.27	0.51	−0.06	0.08	
26. Weight *Testsúly*										
−0.25	−0.09	−0.36	−0.40	−0.39	1.76	1.22	0.74	0.03	0.01	0.38
−0.64	−0.47	−0.74	−0.78	−0.77	1.38	0.83	0.36	−0.36	−0.37	

A second display of 260 z-values are shown on the second line for each athletic sub-group and that of the physical education majors. These values were obtained by subtracting the teachers' college z-values for each item from the other group items on the first line and showing the difference directly underneath. This provides for a direct comparison of proportional differences between the athletic and physical education majors prototypes with an arbitrary designated control or normal female prototype.

For example, in viewing proportional body weight, as shown by item 26 in Table 2, the first line showed the sprinters, hurdlers, middle distance runners, long jumpers, and high jumpers to be proportionally lighter than the phantom as indicated by negative z-values, whereas, the shot putters, discus, and javelin throwers, pentathlon athletes, physical education majors, and teachers' college students were proportionally heavier. However, when the athletic and physical education majors groups were compared to the teachers' college control group as shown on the second line, only the shot putters, discus, and javelin throwers were proportionally heavier than the female prototype.

Other comparisons may be made directly from the tables or inferred from computer-generated graphs in Fig. 3 which shows the position of the z-values

for each group by an „x" mark and the range values by a vertical bar. The distance from each mark to the zero level represents the proportional difference from the phantom. The distance from each mark to the horizontal line drawn at the level of the teachers' college z-value indicates the proportional difference from the female prototype.

It is also possible to compare individual z-values or group mean values by a proportionality profile as illustrated by group mean values for shot putters, discus throwers, and long jumpers as shown in Fig. 4.

In viewing proportional lengths, the three event prototypes were similar approximating phantom values. However, an interesting exception was item 7, tibial height. By contrast, the long jumpers had a z-value of 0,73 compared to the shot putters value of −0.31. Thus in tibial height, the long jumpers were a whole standard deviation longer than the shot putters. This difference invites a biomechanical evaluation and further exploration of proportional thigh and shank lengths in jumpers.

In absolute values, EIBEN's data showed the discus throwers to be the tallest and most highly developed of the women athletes. However, in proportional terms, as indicated by item 26, the shot putters were heavier and larger in the breadth and girth measurements except for items 9 and 15, span and bitrochanter width. For discus throwers this laterality suggests a biomechanical advantage.

As anticipated, in an event where the athlete projects her own body rather than imparts force to an inanimate object, the long jumper was proportionally lighter than the shot putter and discus thrower and had smaller proportional breadths and girths, particularly in the upper arm and thigh.

It is beyond the scope of this paper to suggest possible implication of the effect of proportionality differences on performance. Obviously, many factors go into the emergence of a champion. Our concern is that some of the heretofore subjective observations about human proportionality characteristics be quantified and hypothesized differences be viewed objectively. Herein, we suggest an unisex phantom may be an appropriate stratagem.

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*

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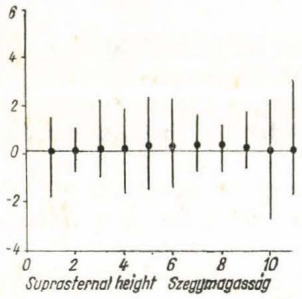
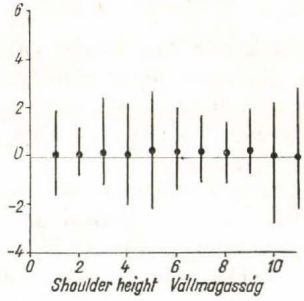
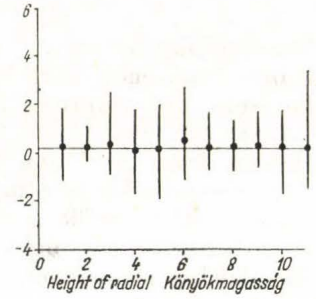
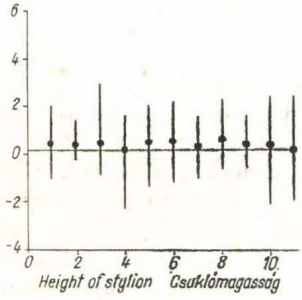
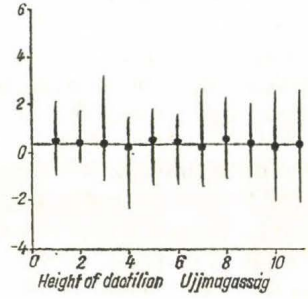
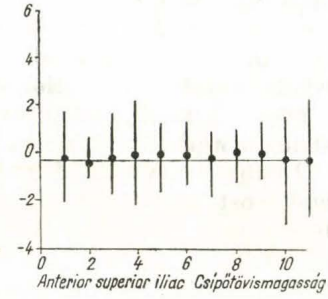

Suprasternal height Szegymagasság

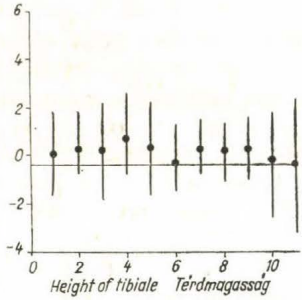

Shoulder height Vállmagasság

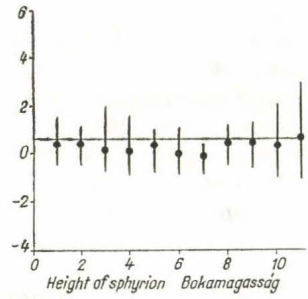

Height of radial Könyökmagasság

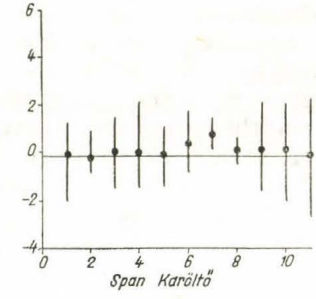

Height of stylion Csuklómagasság

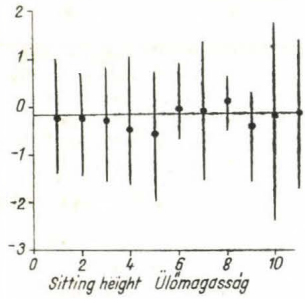

Height of dactilion Ujjmagasság

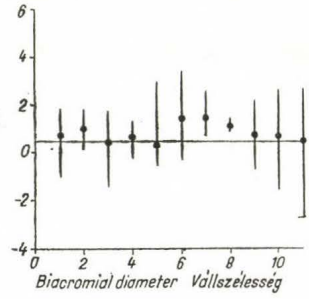

Anterior superior iliac Csípőtövismagasság

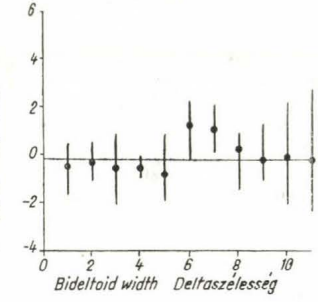

Height of tibiale Térdmagasság

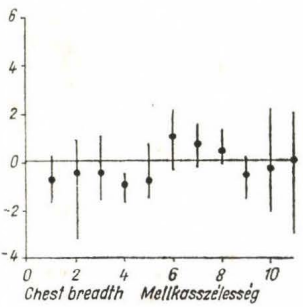

Height of sphyrion Bokamagasság

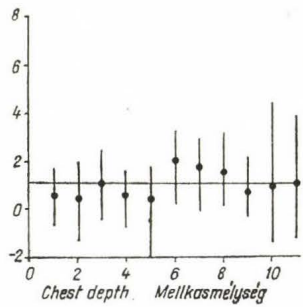

Span Karöltő

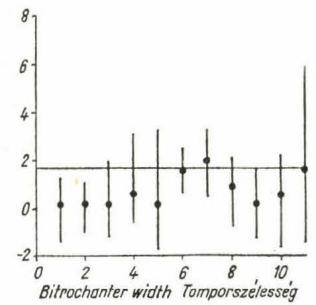

Sitting height Ülőmagasság


Biacromial diameter Vállszélesség


Bideltoid width Deltaszélesség


Chest breadth Mellkasszélesség


Chest depth Mellkasmélység


Bitrochanter width Tomporszélesség

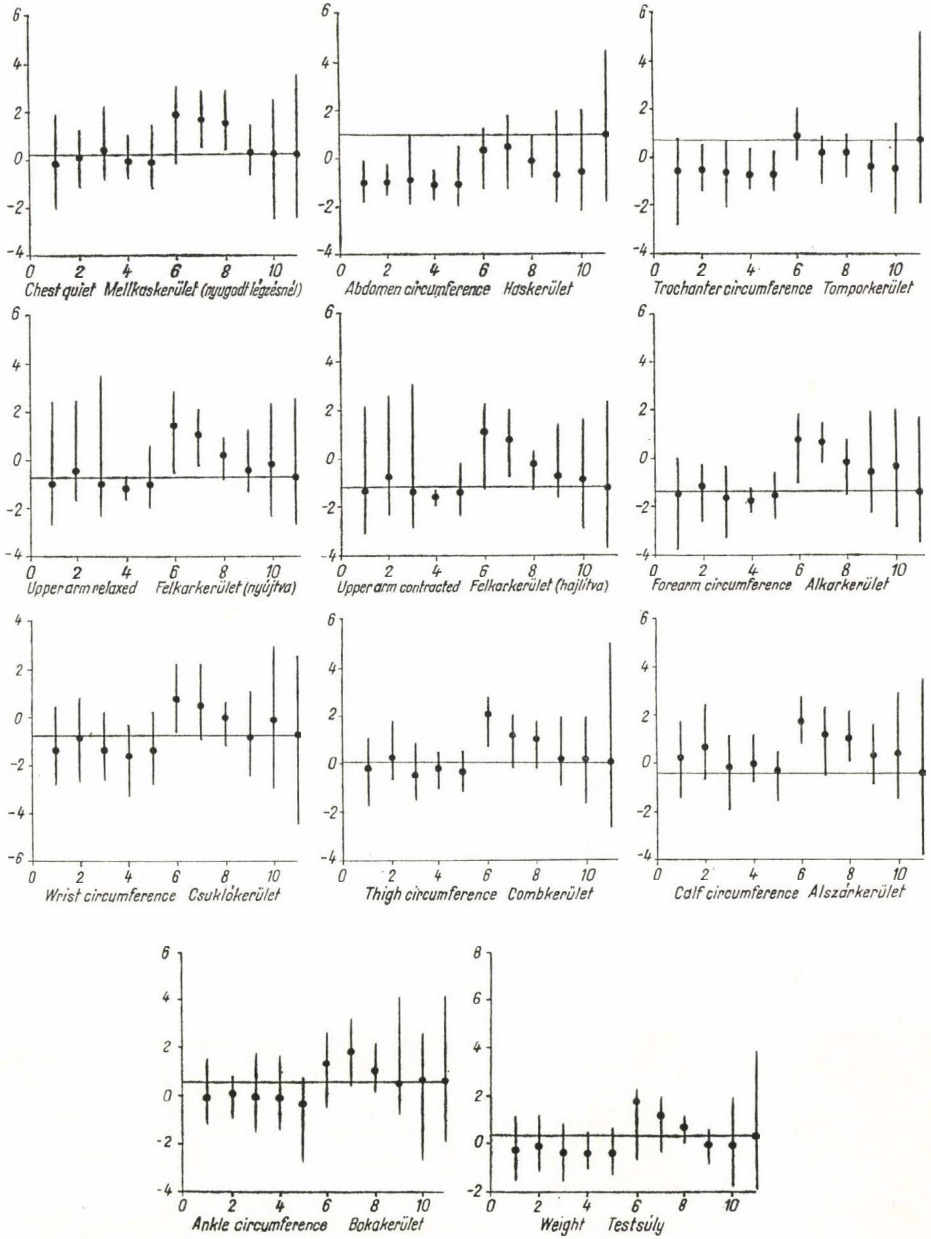


Fig. 3. **Computer-generated graphs showing position of z-values means and ranges for nine athletic subgroups, physical education majors and teachers' college students representing a female prototype.**

***3. ábra.* A számítógép által kirajzolt grafikonok bemutatják a kilenc atlétanő-alcsoport, a TF-hallgatónők és a tanítóképzős leányok mint női prototípus z-értékeit és variációs-terjedelmeit.**

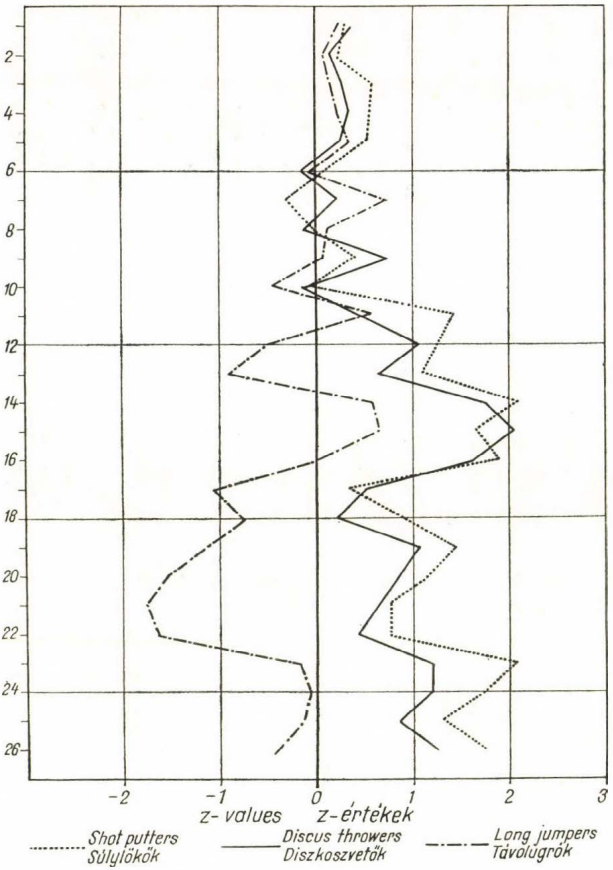


Fig. 4. Proportionality profiles for shot putter, discus thrower, and long jumper prototypes.
4. ábra. A súlylökők, diszkoszvetők és távolugrók proporcionális profilja.

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ATLÉTANŐK PROPORCIONÁLIS JELLEMZŐI

Írta: EIBEN O. G.—ROSS, W. D.—CHRISTENSEN, W.—FAULKNER, R. A.

(Összefoglalás)

A szerzők az idevonatkozó legfontosabb irodalmi adatok ismeretében és az idézett nagy elemszámú minták adatait felhasználva, átvették ROSS és WILSON (1974) unisex fantomját mint univerzális humán modellt (1. ábra és 1. táblázat), és ehhez hasonlították az EIBEN (1972) által vizsgált európai atlétanők kilenc alcsoportjának és magyar főiskolai hallgatónők két alcsoportjának proporciós jellemzőit. A tanulmányban megadott képlet szerint *z*-transzformációt végeztek. E *z*-értékekkel írják le, hogy az egyes alcsoportok testalkata mennyire hasonló vagy különböző a fantom értékeihez képest (3. ábra és 2. táblázat). Példaképpen a súlylökők, a diszkoszvetők és a távolugrók proporcionális jellemzését részletezik (4. ábra).

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