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Are There Differences in Body Dimensions Among Children from Matings at Different Exogamic Levels?

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A B S T R A C T

The aim of this study was to investigate if there are differences in body dimensions among children from matings of different levels of exogamy. The cross-sectional sample consisted of 285 children, 136 males and 149 females, 6 to 10 years old, attending elementary schools in Tortolì, a town in east-central Sardinia. The children were divided into four groups according to the level of exogamy. One of them included the children of parents born in the same Sardinian village is highly endogamous. For each sex, the Kruskal-Wallis test revealed no significant differences among the four groups of children for the 35 anthropometric variables considered, with the exception of head circumference in the male sample. In particular, there were no significant differences among the four groups of children for some anthropometric variables that are considered to be indirect indicators of nutritional status: sum of skinfolds, waist/hip ratio, body mass index, total upper arm area, upper arm muscle area, upper arm fat area. We conclude that Sardinian children from mariages of different levels of exogamy do not differ in body dimensions if they have similar nutritional conditions.

Introduction

The question of whether the offspring of exogamic human matings have larger body dimensions than their same-sex peers born in endogamic matings has long been debated. Indeed, while some authors report the occurrence of this phenomenon[1–14], others maintain that it does not exist[15–18].

Larger body dimensions in the offspring of exogamic matings than in those of endogamic matings have been attributed to a heterosis effect[1,4–6,8,11–13]. The

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term »heterosis« was initially used in botany and zoology to indicate the increased development and vigor (as well as higher fitness) of the offspring of crosses between individuals of different varieties of the same species with respect to the parental types.

Recent studies of animals[19–20] and plants[21–22] have also maintained the existence of heterosis.

Dahlberg in 1942[23] was the first to propose the hypothesis of heterosis, or hybrid vigor, as one of the non-environmental factors influencing positive secular trends.

Heterosis would be due to heterozygosity, and would be manifested with particular intensity following the breakdown of breeding isolates. This has occurred in Europe mainly since the end of World War I and is characterized by higher social and demographic mobility with a consequent increase of exogamy and a decrease of endogamy and consanguinity.

In this study, to evaluate if there are statistically significant anthropometric differences among urban children from east-central Sardinia of different exogamic levels, we classified the different levels of exogamy of the parents on the basis of their origin in terms of historical-geographical zones, a subdivision of the Sardinian territory dating from the »Giudicato« period (IX-XIII century AD) but which is still valid today[24]. In addition to a specific historical characterization and strong geographical connotation, the historical-geographical zones also present heterogeneity for various biological markers[25–28].

The historical-geographical background

Between the IX and XIII century AD, Sardinia was divided into 4 autonomous administrative areas (»giudicati«): Arborea, Cagliari, Gallura and Torres or Logudoro. The Judge (»Judike«) was the supreme military and civil authority of the respective giudicato (»rennu« or »logu«); he held supreme political, judicial, administrative and military power. Until the XII century, he was elected for a limited period from among the representatives of the most important families, although the office subsequently became hereditary. The Judge governed and legislated with the assistance of an assembly (»corona de logu«) composed of the representatives of the inhabited centers (»villas«) within the giudicato. Each giudicato was divided into small territorial districts (»curatorias«), each including several »villas«; they in turn were administered by a »majore« named annually by the Judge or by the »curatore« – royal officer who superintended the administrative activities and the execution of justice in the »curatoria« in the name of the Judge. This type of governmental system remained unchanged until the fall of the respective giudicati: the giudicato of Cagliari ended in 1256, that of Torres or Logudoro in 1259, that of Gallura in 1296, while the giudicato of Arborea lasted until 1410. In the Giudicato period, the only historical period in which the Sardinian people have enjoyed administrative and political independence, the island was divided into about sixty small territorial districts (»curatorias«) according to both the physical and human environment. During the Aragonese-Catalan (1323–1478), Spanish (1478–1714), Austrian (1714–1720) and Piedmontese (1720–1861) dominations, the island was dismembered into numerous fiefs which did not correspond at all to the geographical conformation of the territory or the needs of the population. Therefore, with the disappearance of the political and administrative form of the territory in vigor during the Giudicato period, not only was the concept of many natural regions lost (especially of the geographically less characterized ones), but the choronymy that identified them also fell into disuse. Among the regional names of the smaller territorial districts of the Giudicato period, some have survived and now cover areas belonging to other »curatorias«, some have changed name, while others have continued to indicate the same areas. Currently, about thirty names are in common use, identifying the same number of historical-geographical zones of Sardinia, i.e. those best characterized by geographical factors[24].

Subjects and Methods

Subjects

The cross-sectional sample used in this study is composed of 285 children, 136 males and 149 females, 6 to 10 years old; they were all apparently healthy, without evident physical defects or malformations, unrelated, the children of non-consanguineous parents, and attending elementary schools in the town of Tortolí (they represent about 50% of the town's 6 to 10 year-old school population). The subjects were measured in the 1995–1996 scholastic year.

Tortolí, situated in the historical-geographical zone of Ogliastra, east-central Sardinia, had 9657 inhabitants on December 31 1996, and has been classified as an urban typology by the Italian National Institute of Statistics[29].

Anthropometry

The following anthropometric variables were measured on each subject by one of the authors (E. Cau), according to Martin and Saller[30]: weight, stature, sitting height, biacromial breadth, chest depth, bicristal breadth, humerus and femur breadths on the right side, chest circumference, waist circumference, hip circumference, arm and medial calf circumferences on the right side, maximum head length and head breadth, bizygomatic breadth, morphological face height, cephalic circumference, and estimated lower limb length (the difference between stature and sitting height). The biceps, triceps, subscapular, suprailiac and medial calf skinfolds were measured on the right side with a Lange caliper to the nearest 0.1 mm, according to Zaveleta and Malina[31]. The skinfold data were log transformed.

The following indices were also calculated: relative sitting height (sitting height/stature), cephalic (max. head breadth/max. head length), facial (total facial height/bizygomatic breadth).

Since anthropometric data of children of different ages were pooled per sex, anthropometric measurements were transformed into z-scores, using as reference data those of 500 boys and 500 girls aged 6–10 years attending elementary schools in Cagliari (the principal city of Sardinia) sampled in the 1997–98 and 1998–99 school years. The males and females of Tortolì and of the reference sample were grouped into whole-year age cohorts, e.g. 6.00–6.99, and so on. The z-score of a measurement is obtained as $z_i = [(x_i - m) / s]$, x_i being the observed value of a subject of a given decimal age, and m and s, respectively, the mean and standard deviation of that measurement in the coeval reference sample of the same sex.

Anthropometric indicators of nutritional status

For an evaluation of the nutritional status of the children, we calculated the following derived anthropometric variables: sum of two trunk skinfolds (subscapular and suprailiac), sum of three limb skinfolds (biceps, triceps and medial calf), sum of biceps, triceps, subscapular, suprailiac and medial calf skinfolds, waist to hip ratio (W/H), body mass index (BMI), total upper arm area (TUA), upper arm muscle area (UMA) and upper arm fat area (UFA), using the formulae[32–35]:

$$BMI = weight\ (kg) / stature^2\ (m);$$

$$TUA = [C^2 / (4\pi)];$$

$$UMA = \{[C-(Ts\ \pi)]^2 / (4\ \pi)\};$$

$$UFA = (TUA - UMA),$$

where C is the circumference of the right upper arm and Ts is the right triceps skinfold thickness.

The derived anthropometric variables are considered good indicators of nutritional status. In fact, BMI is considered a good indicator of adiposity in children, and therefore reflects energy reserves[36–40], as do the sum of two trunk skinfolds (subscapular and suprailiac), the sum of three limb skinfolds (biceps, triceps, and medial calf)[41], the sum of biceps, triceps, subscapular, suprailiac and medial calf skinfolds[33,39,42–44], W/H[45] and UFA[33–35,43,46]. TUA[33] and UMA[33–35,43–44,46–47] are also considered good indicators of nutritional status; in particular UMA is an indicator of body muscle and hence of body protein, and therefore reflects protein and energy reserves.

Social and demographic characteristics

The sample of children was divided into four categories on the basis of a gradient of the exogamy of their parents:

I. Subjects whose parents were born in and native to villages in different historical-geographical zones of different Sardinian giudicati;
II. Subjects whose parents were born in and native to villages in different historical-geographical zones of the same Sardinian giudicato;
III. Subjects whose parents were born in and native to different villages in the same historical-geographical zone of Sardinia;
IV. Subjects whose parents were born in and native to the same Sardinian village, and thus properly endogamic.

The variables used to assess possible demographic and social differences were the father's age, mother's age, sibship size, birth order, socioeconomic status, and maternal schooling. These data were obtained by means of questionnaires filled in by the parents.

The father's and mother's calendar ages were transformed into decimal ages as recommended by Eveleth and Tanner[48].

Social class was determined according to the classification of occupation which uses a three-point scale: 1, 2 professional and managerial; 3 skilled, both manual and non-manual; 4, 5 semi-skilled and unskilled[16].

The maternal schooling was also divided into a three-point scale: 1, 2 degree and high school diploma; 3 middle school diploma; 4, 5 elementary school diploma and less than elementary school diploma.

Statistical methods

To evaluate if the anthropometric and demographic variables differed significantly among the four levels of exogamy (subdivided by sex), we used the Kruskal -Wallis test; as a post-hoc procedure the Mann-Whitney test with the Bonferroni method for multiple comparisons at a prefixed level of a = 0.05 was adopted[49]. To test for significant differences in the social characteristics among the four levels of exogamy, we employed the G-test (log likelihood ratio test).

The Kruskal-Wallis and Mann-Whitney tests were performed with the Statistica Version 4.0 program and the G-test was performed with the Excel program.

Results

Table 1 reports the mean values and standard deviations of the demographic variables in the four groups differing in the level of exogamy. It is interesting that level IV, i.e. properly endogamic, has the

TABLE 1
DESCRIPTIVE STATISTICS OF DEMOGRAPHIC CHARACTERISTICS AND H VALUES (KRUSKAL-WALLIS' TEST)

	Level of exogamy									
	I		II		III		IV		K.W.	
Variables	X	SD	X	SD	X	SD	X	SD	H	p
Father's age	31.94	6.07	35.25	6.74	32.79	5.97	34.55	7.17	11.303	0.010
Mother's age	28.41	5.46	31.55	6.32	28.20	4.81	29.15	5.91	10.375	0.016
Sibship size	2.24	0.86	2.00	0.75	2.41	1.38	2.61	1.16	9.391	0.025
Birth order	1.71	0.87	1.66	0.81	1.80	1.29	1.95	1.10	2.143	0.543

highest mean value for sibship size and birth order, while for father's age and mother's age, the highest mean is that of level II, i.e. children whose parents were born in villages in different historical-geographical zones of the same Sardinian giudicato. The Kruskal-Wallis test revealed significant differences among the four groups of children for father's age, mother's age and sibship size, while birth order was not significantly different. The Mann-Whitney test, with the Bonferroni method for multiple comparisons at a prefixed level of a = 0.05, indicated significant differences between levels II and I for father's age, between levels II and III and levels II and I for mother's age, and between levels IV and II for sibship size.

Table 2 reports the absolute frequencies for all four levels of exogamy of both socioeconomic status and maternal schooling. Level IV, i.e. properly endogamic, exhibits the smallest percentages in the two highest classes (1, 2 professional and managerial) for both socioeconomic status (15.63%) and maternal schooling (26.56%). Level II shows the reverse situation: in the two highest classes, there are frequencies of 52.27% for socioeconomic status and 59.09% for maternal schooling. The G-test revealed a significant difference in the distribution of the frequencies among the four levels of exogamy, both for socioeconomic status and for maternal schooling.

TABLE 2
ABSOLUTE FREQUENCIES OF THE SOCIOECONOMIC CHARACTERISTICS AND THE G-TEST VALUES

Level of exogamy	Socioeconomic status			
	1–2	3	4–5	Total
I	32	38	38	108
II	23	11	10	44
III	15	17	37	69
IV	10	20	34	64
	G-test=24.433; df= 6; p<0.001			
	Maternal schooling			
	1–2	3	4–5	Total
I	51	46	11	108
II	26	13	5	44
III	21	38	10	69
IV	17	39	8	64
	G-test=17.240; df= 6; p<0.01			

Tables 3 and 4 report, respectively for males and females, the original means and standard deviations of the anthropometric variables of the children in the four levels of exogamy.

Table 5 shows the H-values from the Kruskal-Wallis test applied to the standardized variables. For females, there were no significant differences among the four groups differing in the level of exogamy for the 35 anthropometric variables, while for males only 1 of the 35 variables (head circumference) was significantly different (p = 0.042). Among the four

TABLE 3
MEAN VALUES AND STANDARD DEVIATIONS OF THE ANTHROPOMETRIC VARIABLES FOR CHILDREN (MALES) FROM TORTOLÍ

Variables	Exogamic level							
	I N=57		II N=19		III N=36		IV N=24	
	X	SD	X	SD	X	SD	X	SD
Weight (kg)	27.46	5.25	27.45	5.60	25.86	4.81	27.77	5.13
Stature (cm)	129.68	7.72	128.86	9.09	127.11	7.39	129.16	8.27
Sitting height (cm)	69.36	3.91	69.89	4.77	68.41	3.99	69.34	3.81
Estim. lower limb length (cm)	59.71	4.52	58.97	4.85	58.71	4.18	59. 28	5.06
Biacromial breadth (cm)	28.95	2.09	29.28	1.66	28.49	1.62	28.76	2.06
Bicristal breadth (cm)	20.58	1.85	20.92	1.47	20.39	1.19	20.80	1.13
Chest depth (cm)	14.25	0.88	14.18	1.08	14.03	0.91	14.11	0.78
Humerus breadth (cm)	5.18	0.33	5.15	0.42	5.07	0.35	5.20	0.40
Femur breadth (cm)	7.85	0.52	7.94	0.53	7.74	0.47	7.91	0.43
Chest circumference (cm)	63.56	4.62	63.89	4.82	62.85	4.40	64.45	4.87
Waist circumference (cm)	58.11	4.66	59.33	4.42	57.97	4.84	59.40	4.31
Hip circumference (cm)	69.70	5.75	70.92	5.80	68.11	5.72	70.79	5.80
Arm circumference (cm)	19.02	1.84	19.13	2.25	18.56	2.25	19.15	2.13
Calf circumference (cm)	27.15	2.28	27.02	1.89	26.32	2.45	27.24	2.68
log Biceps (mm)	0.65	0.14	0.69	0.19	0.62	0.20	0.65	0.17
log Triceps (mm)	0.98	0.15	1.00	0.16	0.94	0.17	0.98	0.16
log Subscapular (mm)	0.76	0.13	0.76	0.13	0.74	0.15	0.76	0.16
log Suprailiac (mm)	0.84	0.22	0.83	0.21	0.79	0.25	0.85	0.28
log Calf (mm)	0.98	0.18	0.98	0.20	0.93	0.21	1.00	0.21
Cephalic circumference (cm)	52.54	1.19	53.06	1.70	52.53	1.43	53.23	1.60
Head length (cm)	18.03	0.64	18.32	0.67	18.06	0.56	18.28	0.82
Head breadth (cm)	14.11	0.55	14.30	0.37	14.20	0.59	14.40	0.59
Bizygomatic breadth (cm)	11.81	0.52	11.80	0.58	11.67	0.60	11.85	0.58
Morph. face height (cm)	10.78	0.55	10.95	0.65	10.88	0.55	10.99	0.56
Relative sitting height	53.76	1.39	54.26	1.28	53.74	1.38	53.73	1.47
Cephalic index	78.36	3.90	78.18	3.53	78.70	4.02	78.94	4.82
Facial index	91.35	4.88	92.98	7.13	93.32	0.50	92.83	5.38
$\sum$ log 2 trunk skinfolds (mm)	1.38	0.15	1.10	0.17	1.07	0.20	1.11	0.22
$\sum$ log 3 limb skinfolds (mm)	1.11	0.17	1.39	0.17	1.34	0.18	1.38	0.17
$\sum$ log skinfolds (mm)	1.57	0.15	1.57	0.17	1.53	0.19	1.57	0.19
W/H	83.49	4.15	83.75	2.75	85.27	4.97	84.06	3.69
BMI	16.37	2.06	16.41	2.02	15.99	2.16	16.52	1.90
TUA (cm^2)	29.05	5.73	29.51	7.24	27.82	7.01	29.60	7.04
UMA (cm^2)	20.14	3.02	20.02	3.64	19.46	3.36	20.41	3.63
UFA (cm^2)	8.90	3.71	9.49	2.75	8.36	4.68	9.20	4.43

TABLE 4
MEAN VALUES AND STANDARD DEVIATIONS OF THE ANTHROPOMETRIC VARIABLES FOR CHILDREN (FEMALES) FROM TORTOLÍ

Variables	Exogamic level							
	I N=51		II N=25		III N=33		IV N=40	
	X	SD	X	SD	X	SD	X	SD
Weight (kg)	27.43	7.06	26.14	5.33	26.65	6.84	27.73	5.89
Stature (cm)	128.54	9.79	125.98	8.98	127.12	11.19	129.01	7.88
Sitting height (cm)	69.95	4.66	67.31	4.70	68.29	5.61	69.25	4.38
Estim. lower limb length (cm)	59.59	6.00	58.67	4.86	58.82	6.19	59.76	4.26
Biacromial breadth (cm)	28.46	2.15	28.25	1.98	28.19	2.57	28.86	1.95
Bicristal breadth (cm)	20.91	1.75	20. 92	1.81	20.73	2.18	20.98	1.44
Chest depth (cm)	14.19	1.24	13.66	1.21	13.86	1.15	13.95	1.27
Humerus breadth (cm)	4.96	0.46	4.85	0.43	4.86	0.45	4.98	0.39
Femur breadth (cm)	7.60	0.54	7.49	0.51	7.49	0.64	7.57	0.55
Chest circumference (cm)	63.21	6.00	62.05	5.18	62.56	6.15	64.10	6.43
Waist circumference (cm)	57.20	4.98	57.22	4.07	57.09	4.72	57.63	5.24
Hip circumference (cm)	70.94	6.71	69.82	5.54	69.85	7.70	71.61	6.30
Arm circumference (cm)	19.06	2.22	19.05	2.20	18.92	2.37	19.89	1.99
Calf circumference (cm)	27.89	4.53	27.06	2.28	26.48	2.81	27.69	2.59
log Biceps (mm)	0.74	0.17	0.72	0.17	0.74	0.20	0.77	0.15
log Triceps (mm)	1.07	0.14	1.06	0.13	1.06	0.16	1.10	0.14
log Subscapular (mm)	0.83	0.17	0.79	0.11	0.85	0.18	0.88	0.20
log Suprailiac (mm)	0.91	0.24	0.87	0.21	0.89	0.19	0.96	0.22
log Calf (mm)	1.08	0.17	1.02	0.14	1.07	0.19	1.11	0.18
Cephalic circumference (cm)	52.40	1.49	52.69	1.85	52.02	1.61	51.71	4.51
Head length (cm)	17.83	0.70	17.92	0.73	17.66	0.66	17.80	0.48
Head breadth (cm)	13.91	0.47	13.94	0.57	13.95	0.49	13.95	0.53
Bizygomatic breadth (cm)	11.43	0.47	11.55	0.46	11.57	0.45	11. 57	0.60
Morph. face height (cm)	10.79	0.53	10.66	0.55	10.62	0.61	10.66	0.57
Relative sitting height	53.70	1.91	53.45	1.36	53.77	1.54	53.68	1.42
Cephalic index	78.13	4.11	77.92	4.26	79.10	3.59	78.43	3.98
Facial index	94.52	5.21	92.32	4.87	91.78	4.46	92.19	4.87
∑ log 2 trunk skinfolds (mm)	1.18	0.20	1.14	0.16	1.18	0.17	1.23	0.20
∑ log 3 limb skinfolds (mm)	1.47	0.15	1.44	0.13	1.46	0.17	1.51	0.15
∑ log skinfolds (mm)	1.65	0.16	1.62	0.13	1.65	0.17	1.69	0.16
W/H	80.78	3.84	82.13	4.91	82.03	4.41	80.55	3.66
BMI	16.33	2.16	16.35	1.85	16.29	2.40	16.49	2.03
TUA (cm^2)	29.30	6.80	29.26	6.93	28.91	7.44	31.80	6.54
UMA (cm^2)	18.47	31.29	18.81	3.86	18.25	3.46	19.54	2.90
UFA (cm^2)	10.82	4.42	10.44	3.86	10.65	5.13	12.26	5.01

TABLE 5
THE KRUSKAL-WALLIS TEST FOR CHILDREN (MALES) FROM TORTOLÍ

Variables	Kruskal-Wallis test	
	H	p
Weight	2.997	0.392
Stature	1.353	0.717
Sitting height	2.394	0.495
Estim. lower limb length	1.142	0.767
Biacromial breadth	3.018	0.389
Bicristal breadth	2.455	0.484
Chest depth	1.249	0.741
Humerus breadth	2.375	0.498
Femur breadth	2.769	0.429
Chest circumference	2.287	0.515
Waist circumference	3.749	0.289
Hip circumference	4.970	0.174
Arm circumference	1.806	0.614
Calf circumference	3.300	0.348
log Biceps	4.063	0.255
log Triceps	2.080	0.556
log Subscapular	1.819	0.611
log Suprailiac	1.832	0.608
log Calf	3.110	0.375
Cephalic circumference	8.190	0.042
Head length	7.120	0.068
Head breadth	4.285	0.232
Bizygomatic breadth	2.050	0.562
Morph. face height	3.549	0.315
Relative sitting height	1.953	0.582
Cephalic index	0.158	0.984
Facial index	3.404	0.333
∑ log 2 trunk skinfolds	2.316	0.509
∑ log 3 limb skinfolds	3.278	0.351
∑ log skinfolds	3.004	0.391
W/H	4.617	0.202
BMI	2.054	0.561
TUA	1.806	0.614
UMA	1.655	0.647
UFA	2.328	0.507

TABLE 6
THE KRUSKAL-WALLIS TEST FOR CHILDREN (FEMALES) FROM TORTOLÍ

Variables	Kruskal-Wallis test	
	H	p
Weight	1.806	0.614
Stature	2.898	0.408
Sitting height	4.194	0.241
Estim. lower limb length	1.778	0.620
Biacromial breadth	2.823	0.420
Bicristal breadth	4.423	0.219
Chest depth	4.752	0.191
Humerus breadth	2.128	0.546
Femur breadth	1.428	0.699
Chest circumference	2.031	0.566
Waist circumference	0.283	0.963
Hip circumference	3.252	0.354
Arm circumference	5.160	0.161
Calf circumference	5.708	0.127
log Biceps	2.484	0.478
log Triceps	3.065	0.382
log Subscapular	4.295	0.231
log Suprailiac	2.930	0.403
log Calf	5.144	0.162
Cephalic circumference	1.562	0.668
Head length	2.187	0.535
Head breadth	0.189	0.979
Bizygomatic breadth	3.265	0.353
Morph. face height	3.192	0.363
Relative sitting height	0.826	0.843
Cephalic index	1.435	0.697
Facial index	6.982	0.073
∑ log 2 trunk skinfolds	3.664	0.300
∑ log 3 limb skinfolds	4.313	0.230
∑ log skinfolds	4.241	0.237
W/H	2.668	0.446
BMI	0.821	0.845
TUA	5.160	0.161
UMA	3.203	0.361
UFA	4.177	0.243

groups differing by the exogamy level, the highest mean was presented by level IV (53.23 cm), i.e. subjects whose parents were born in and native to the same Sardinian village (and thus properly endogamic), while level III had the lowest mean (52.53 cm), with a very similar value to that of level I (52.54 cm).

Discussion

In studies of adult males born in the Canton Ticino region of Switzerland, divided into non-migrants (Swiss residents) and migrants (California residents), and people originating from Ticino and born in California (each of the three groups subdivided into exogamic and endogamic offspring), Hulse[1,5,12] concluded that there were no significant differences between migrants and non-migrants (sedentes), while the offspring of exogamic matings were taller, heavier, less brachycephalic and had narrower faces than the offspring of endogamic matings. Hulse[1,5,12] attributed these characteristics of the exogamic offspring to heterosis. Instead, there were no significant differences between the two groups for shoulder breadth, chest depth and nasal dimensions. These findings were consistent for young, middle-aged, and elderly Ticino people, among sedentes, migrants, and California-born[5,12].

Schreider[4] and Billy[6] studied samples of adults from small areas, respectively males of the Polish village of Kuznica and males and females of the Savoy region (France). They reported greater stature in the offspring of exogamic matings than in those of endogamic matings, and they hypothesized the action of heterosis to explain the difference.

In a study of elementary school children of the Canary Islands, Schwidetzky[9] found substantially higher values of some body dimensions (especially stature) in the offspring of exogamic matings than in those of endogamic matings.

Nikityuk and Filippov[8], using a sample of 4 to 7 year-old children from a small geographical area (Verkhovtsevo town and the surrounding villages in the Dniepropetrovsk region, Ukraine), reported that the intensity of the growth processes was lower in the children of endogamic matings than in those of exogamic ones (slight exogamy).

Schreider[3,4], who used a sample of French children from 7 to 14 years old, reported that the heterotic effect is particularly evident overall for girls after the beginning of puberty.

Other authors[2,50,51] believe that what is attributed to heterosis, i.e. greater body dimensions in offspring of exogamic matings than in those of endogamic matings, is largely due to geographical and socio-familial factors.

Wolanski[10], wrote that »when the breeding radius of parents is too great the children are shorter than those from a group with moderately long radius«. Wolanski[10,11] also reported that when there is a large genetic difference or great genetic similarity between mates, there will be similar harm to the offspring.

Crognier[52] found in the African adult population of Sara Madijngay, a dry tropical biotope in Chad, that the exogamic offspring (both males and females) were squatter and physically less adapted to the environment than the endogamic offspring. He explained the hybrid vigor that the exogamy would present, maintaining »their better resistance to the adaptive stresses«[52].

Therefore, some authors have denied the existence of heterosis[15,16,53–56] while others have hypothesized the occurrence of a heterotic effect, especially as one of the possible factors determining positive secular changes[10,11,57–61].

The present study used the Kruskal -Wallis test to compare 35 anthropometric variables among four groups of children (subdivided by sex) with different exogamic levels. For both males and females, there were no significant anthropometric differences among the offspring of parents with different levels of exogamy, with the exception of head circumference in males. However, with a two-

-tailed probability test based on binomial expansion[17], finding one significant difference in 70 comparisons is a random event. In fact, setting a significance level of a = 0.01, for one event in 70, one obtains a non-significant probability of p = 0.505; moreover, for one event in 35, one obtains a non-significant probability of p = 0.297.

It should be emphasized that there were no significant differences among the four groups in the anthropometric variables considered as indicators of nutritional status: sum of the log of two trunk skinfolds (subscapular and suprailiac), sum of the log of three limb skinfolds (biceps, triceps and medial calf), sum of the log of all five skinfolds, W/H, BMI, TUA, UMA, UFA.

Therefore, the finding of no significant anthropometric differences among urban Sardinian children of different levels of exogamy supports the hypothesis that the offspring of exogamic matings do not differ in body and cranio-facial dimensions from those of endogamic marriages, at least when the nutritional status is generally similar.

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POSTOJE LI RAZLIKE U TJELESNIM DIMENZIJAMA IZMEĐU DJECE KOJA POTJEČU IZ BRAKOVA RAZLIČITOG STUPNJA EGZOGAMIJE?

S A Ž E T A K

Cilj je ove studije bio ispitati postoje li razlike u tjelesnim dimenzijama između djece iz brakova različitog stupnja egzogamije. U ovoj transverzalnoj studiji sudjelovalo je 285 djece (136 dječaka i 149 djevojčica), učenika osnovne škola u Tortoli, gradu u istočnom dijelu središnje Sardinije. Uzorak je podijeljen prema stupnju egzogamije na 4 skupine, pri čemu je četvrta skupina uključivala visoko endogamnu djecu, odnosno onu čija su oba roditelja rođena u istom gradu na Sardiniji. Za svaki spol, Kruskal-Wallis test pokazao je kako nema značajne razlike između četiri skupine za 35 razmatranih antropometrijskih varijabli, s izuzetkom opsega glave u dječaka. Također, nije bilo značajne razlike između četiri skupine djece za neke antropometrijske varijable koje se smatraju indikatorima prehrambenog statusa: zbroj kožnih nabora, omjer obujma struk/bokovi, indeks tjelesne mase (BMI), ukupna površina nadlaktice, površina mišićnog tkiva nadlaktice, površina masnog tkiva nadlaktice. Autori zaključuju kako Sardinijska djeca različitog stupnja egzogamije ako imaju slične prehrambene uvjete tada se ne razlikuju u dimenzijama tijela.