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Trabajo Original

Pediatría

Somatotypes of schoolchildren from Chile: higher endomorphic components among adolescent girls

El somatotipo de escolares chilenos: altos componentes endomórficos en mujeres adolescentes

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Abstract

Objective: this investigation describes the somatotype components and somatotype as a whole in Chilean children and adolescents.

Methods: a cross-sectional study was conducted in Valparaiso, Chile. The somatotypes of 1,409 schoolchildren (747 males) aged 6 to 18 years were assessed using the Heath-Carter anthropometric method. Comparative category analyses (endomorph, mesomorph, and ectomorph) were performed using t-tests. To analyze whole somatotypes along two and three dimensions, the somatotype dispersion mean (SDM) and somatotype attitudinal mean (SAM), respectively, were used in addition to a somatochart representation.

Results: the somatotype of the male sample showed a marked mesomorph-endomorph biotype (4.9-4.8-2.1), whereas that for the female sample showed a mesomorphic endomorph classification (5.8-4.3-1.8). The samples differed significantly by sex, with an increased endomorphic component observed in females aged 13 to 18 years old. These sex differences were primarily evident in adolescents with high somatotype values in two or three dimensions (SDM ≥ 3.0; SAM ≥ 1.2), indicating high between-group dispersion. The somatocharts showed displacement of the endomorphic components for both sexes, particularly females.

Conclusions: the results provide strong evidence that biotype changes have increased, primarily in terms of relative adiposity (i.e., the endomorphic component) and predominantly in adolescent girls.

Key words:

Somatotype. Adiposity. Biotype. Endomorph. Female adolescent.

Resumen

Objetivo: esta investigación tiene por objetivo describir los componentes del somatotipo en niños y adolescentes chilenos.

Métodos: se realizó un estudio transversal en la región de Valparaíso, Chile. Se evaluó el somatotipo de 1.409 escolares (747 hombres) de 6 a 18 años de edad utilizando el método antropométrico de Heath-Carter. Los análisis comparativos por componentes (endomorfía, mesomorfía y ectomorfía) fueron realizados mediante pruebas t. Para analizar el somatotipo como un todo se realizó el cálculo en dos y tres dimensiones, se utilizaron la distancia de dispersión del somatotipo medio (DSM) y la dispersión morfogénica media (DMM) respectivamente, además de una representación en la somatocarta.

Resultados: el somatotipo de la muestra masculina mostró un marcado biotipo mesomorfo-endomorfo (4,9-4,8-2,1), mientras que el de la muestra femenina mostró una clasificación meso-endomórfica (5,8-4,3-1,8). Las muestras difirieron significativamente según sexo, con un elevado componente endomórfico observado en mujeres de 13 a 18 años de edad. Estas diferencias en adolescentes por sexo también fueron observadas en el análisis del somatotipo en dos y tres dimensiones (DSM ≥ 3,0, DMM ≥ 1,2), lo que indica una alta dispersión entre grupos. Además, las somatocartas mostraron un desplazamiento hacia componentes endomórficos para ambos sexos, principalmente en mujeres.

Conclusiones: los resultados proporcionan una fuerte evidencia de que los cambios en los biotipos han aumentado, principalmente en términos de adiposidad relativa (componente endomórfico) y predominantemente en adolescentes mujeres.

Palabras clave:

Somatotipo. Adiposidad. Biotipo. Endomorfía. Adolecentes mujeres.

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INTRODUCTION

In recent decades, trends of overweight and obesity have been identified in most of the population worldwide, particularly among youth (1-4). A rapid increase in overweight children has been reported in most Latin American countries (5), and Chile is no exception (6,7).

Governments and researchers have focused on a variety of nutritional variables to overcome these issues. The most commonly used variables in Chile are size, weight, and body mass index (BMI). There are even technical standards in the country issued by the Nutrition Unit of the Ministry of Health (8). However, certain aspects of body composition are undervalued, particularly somatotype, even though studies throughout the world have shown that these factors are highly valuable in contributing to the understanding of diet, growth, development, physical exercise, physical self-concept, and disease in different age groups (9-14).

Somatotype corresponds to the estimation of body shape and composition, and it is expressed with three numeric values that correspond to the endomorphic, mesomorphic, and ectomorphic components, providing information on relative adiposity, musculoskeletal development, and relative linearity, respectively, thus providing the morphological characteristics of individuals as a whole (15). Several methods are used for calculating the somatotype; the Heath-Carter anthropometric method is the most commonly used method (12,15,16).

Somatotype is highly correlated with the physical condition and body composition of athletes and with the identification of their physical characteristics (9, 17) and health-related risk factors (18). In addition, several researchers have acknowledged the value of somatotypological characteristics in developing and maturing populations, as well as their sexual dimorphism (10,11,14,18-20).

In Chile, somatotype studies are scarce, and they have been primarily performed by a group from Valparaíso, Temuco, and the Metropolitan Region (12). Recent studies have shown higher scores in the adolescent endomorphic component (14,18,19). In this sense, somatotype has helped characterize specific populations of children. Therefore, this investigation describes the somatotype components and somatotype as a whole in youth from Valparaiso, Chile, and contrasts them with previous Chilean somatotype data obtained using the same methodology.

METHODS

PARTICIPANTS

This study applied a cross-sectional study design. The population included students from Primary and Secondary Education levels (6 to 18 years old) from public, subsidized private, and private schools. The participants came from the cities of Valparaíso, Viña del Mar, and Concón, Region of Valparaiso, Chile. The following selection criteria were applied: students enrolled in the school systems of the previously mentioned cities (i.e., Primary, scientific-humanist, commercial, industrial, and technical educational programs), with informed consent provided by their parents or guardians. Adult schools or special schools (e.g., schools for children with motor, sensory, and/or mental disorders), individuals with illnesses (as reported by the parent or guardian) that affected their body composition, students outside the age range of the study, and pregnant students were excluded. To calculate the number of schoolchildren to be included in the study in order to guarantee a representative sample of the Valparaíso region, Chile (n = 185,896 according to data from the Ministry of Education of Chile), obesity (by BMI) was selected as the variable with greatest variance for this age group (21.2%; 21). Sampling was performed with 95% reliability and a 3% sample error. The minimum established sample size was n = 888. Thus, to guarantee the representativeness of each age group, the final sample included 1,409 schoolchildren (male 47.05%; female 52.95%).

ANTHROPOMETRICAL SOMATOTYPE

The Heath-Carter method was used to evaluate the anthropometric somatotype. This method comprises ten variables: height; body mass, four skinfolds (triceps, subscapular, supraspinal, and medial calf); two bone breadths (biepicondylar humeral and femoral); and two limb girths (arm flexed and maximum tensed [at maximum] and maximum perimeter of the calf) (15). All training and measurements were performed following the recommendations of the International Society for the Advancement of Kinanthropometry (22).

Evaluations were performed with the students standing in bare feet and wearing light clothes. All measurements were performed three times, by the first author, with the median value used as the final result.

This study was performed in the morning at the educational institutions, between 2011 and 2012. Anthropometric measurements were taken on the right side of the body.

EQUIPMENT

Body mass was measured with precision scales (Seca® 813, Hamburg, Germany) with a sensitivity of 100 g. Height was registered using a stadiometer (Seca® 217, Hamburg, Germany) with a sensitivity of 0.1 cm. Breadths were taken with a flexible and inextensible metric tape (model W606PM-Lufkin®, Houston, TX, USA). Girths were evaluated using a small sliding caliper Campbell 10, and skinfolds were measured with a Slim Guide caliper (both from the anthropometrical Gaucho pro kit with Rosscraft® license).

ETHICAL ASPECTS

The process of anthropometric assessments was orally explained to and authorized by the guardians, educational establishments, and each child. Informed consent was signed by the parents/legal guardians, school education directors, or the students themselves. This consent (for adolescents aged 14 to 18) and assent (referring to a simplified and compressible text for children aged six to 13) was approved by the Ethics Committee of the Pontificia Universidad Católica de Valparaíso, Chile, in accordance with the policies outlined by the Declaration of Helsinki.

STATISTICAL ANALYSIS

Both descriptive and inferential statistics were applied, and the assumptions of normality (via the Shapiro-Wilk test) and homoscedasticity (i.e., equal variance) for continuous variables were confirmed. Significant differences in somatotype components between the male and female schoolchildren of 2012 were evaluated using Student's t-test.

Estimation of somatotype comprised the following factors: a) mean somatotype; b) a calculation of the three components of the somatotype (endomorphic, mesomorphic, and ectomorphic); c) somatotype dispersion mean (SDM), which is the average distance of individual somatotypes over a two-dimensional somatotype mean (this is a measure of dispersion; this distance is statistically significant at $p < 0.05$, when SDM is equal to or greater than 2 [23]); and d) the somatotype attitudinal mean (SAM), which is the average of the distance of the somatotypes from the mean in three dimensions. A small SAM indicates a tight cluster around the somatotype mean, whereas a large SAM indicates a wide scatter. A higher SAM value corresponds to lower group homogeneity. For this study, SAM was defined as high (SAM ≥ 1.0), moderate (SAM between 0.80 and 0.99), and low (SAM ≤ 0.79) (24). The somatochart representation was used to present the studied samples. For the somatotype categories, the categories proposed by Carter (13 categories; 15) and the description ratings of each component (low, 1-2.5; moderate, 3-5; high, 5.5-7; and extremely high, > 7.5) were used (15). Statistical calculations were performed using STATA version 12.0, and $p < 0.05$ was considered as significant.

RESULTS

Table I shows the anthropometric characteristics of height, mass, and somatotype means (endomorphic, ectomorphic, and mesomorphic components, SDM, and SAM) for male and female samples. The height and mass analyses indicated significant differences between males and females, primarily in the adolescent group. Male adolescents were taller than their female counterparts (at 13-18 years old). An exception was observed at ten years old, when girls were taller than boys. An analysis of the somatotype components found differences among adolescents (i.e., 13- to 18-year-olds): females demonstrated significantly higher endomorphic values than males. The mesomorphy values of males were higher than those of females, and significant differences were observed at 9-15 and 17 years old. The SDM was high (all values over 2.0) for all male and female adolescents, indicating large differences in both 11-year-olds and 13- to 18-year-olds. Differences in the SAM were observed among 13- and 18-year-olds (Table I). The SAM showed heterogeneity across sex.

The mesomorphic endomorph category predominated in the male and female samples (males: 36.20%, females: 64.48%) (Table II), followed by endomorphic mesomorph category in males (20.81%) and mesomorph-endomorph category in females (7.91%). Mesomorphic endomorph category prevailed among male children (39.09%). Among male adolescents, endomorphic mesomorph was the predominant category (28.93%), closely followed by mesomorphic endomorph category (27.04%). Among female children and adolescents, mesomorphic endomorph category predominated, but was greater among adolescents (73.87%) than in children (58.61%).

Figure 1 shows the somatochart with the mean somatoplots by age and sex across the assessed samples. The somatocharts showed the displacement of the endomorphic components for both sexes, particularly females.

DISCUSSION

Over time, the somatotype of Chilean youth has changed from mesomorphic category to the endomorphic category, particularly in females (10). Compared to the latest study in Temuco, Chile, a foothill area (in southern Chile), an endomorphic trend was observed at 15 years old, with a numerical value of 5.6 (18); this component was exceeded by females of the same age during the 2009-2010 period (6.64; 10).

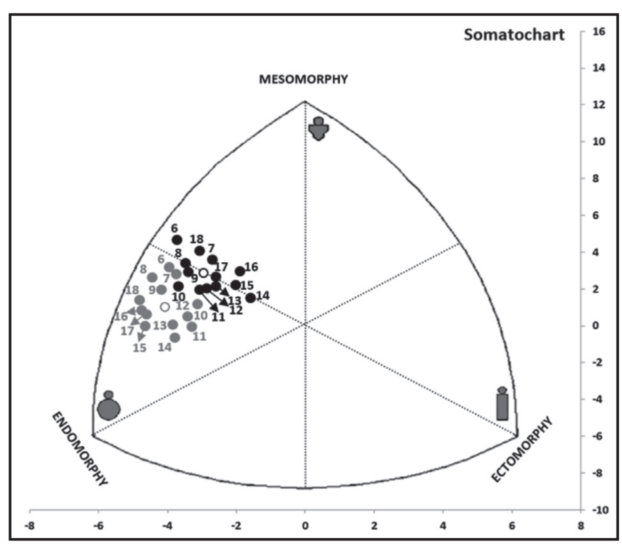

Figure 1.

Comparative distribution of mean somatopoints for Chilean children and adolescents by age and sex. The male sample is represented with black circles, and the female sample is represented with gray circles. The total group of mean somatotype in males is represented with black circles and a white center (4.91-4.82-2.06; n = 663). The female total sample is represented with a gray circle with a white center (5.83-4.26-1.76; n = 746).

Table I. Differences in somatotype components between male and female schoolchildren samples (n = 1,409) from Valparaíso, Chile, 2011-2012

Male							Female							
Age	n	Height (m)	Mass (kg)	Endo	Meso	Ecto	n	Height (m)	Mass (kg)	Endo	Meso	Ecto	SDM	SAM
6	43	1.2 ± 0.53	27.39 ± 6.15	4.86 ± 2.29	5.34 ± 1.22	1.12 ± 0.93	30	1.21 ± 0.51	27.22 ± 5.40	5.20 ± 2.18	4.81 ± 1.02	1.24 ± 1.03	1.57	0.64
7	38	1.2 ± 0.43	29.23 ± 4.89	4.35 ± 2.04	4.81 ± 1.03	1.65 ± 1.02	62	1.25 ± 0.49	30.02 ± 6.23	5.19 ± 2.04	4.72 ± 1.03	1.44 ± 1.13	1.99	0.87
8	61	1.31 ± 0.60	33.94 ± 7.64	5.08 ± 2.54	5.05 ± 1.36	1.60 ± 1.28	28	1.30 ± 0.58	33.74 ± 7.21	5.84 ± 2.04	4.93 ± 0.80	1.39 ± 0.99	1.86	0.80
9	63	1.36 ± 0.69	37.17 ± 9.26	5.22 ± 2.66	4.98 ± 1.32	1.81 ± 1.31	65	1.38 ± 0.96	38.74 ± 9.22	5.71 ± 1.94	4.60 ± 1.38	1.54 ± 1.19	1.64	0.68
10	59	1.43 ± 0.60	42.86 ± 10.06	5.62 ± 2.66	4.86 ± 1.34	1.93 ± 1.52	78	1.41 ± 0.61*	39.26 ± 8.49*	5.25 ± 1.89	4.27 ± 1.07†	2.12 ± 1.35	1.39	0.72
11	65	1.48 ± 0.79	46.06 ± 12.43	5.25± 2.56	4.70 ± 1.29	2.18 ± 1.52	49	1.48 ± 0.68	45.01 ± 9.15	5.52 ± 1.97	3.84 ± 1.09†	2.22 ± 1.26	2.07*	0.90
12	68	1.53 ± 0.68	49.47 ± 10.01	5.19 ± 2.43	4.77 ± 1.22	2.31 ± 1.57	44	1.53 ± 0.65	50.02 ± 10.55	5.60 ± 1.91	4.15 ± 1.37*	2.19 ± 1.50	1.78	0.75
13	58	1.59 ± 0.73	55.45 ± 11.51	4.93 ± 2.25	4.70 ± 1.37	2.32 ± 1.46	45	1.55 ± 0.54†	52.76 ± 9.60	5.86 ± 1.56*	3.96 ± 1.25†	2.01 ± 1.34	3.00*	1.23
14	49	1.66 ± 0.67	60.54 ± 12.41	4.32 ± 2.04	4.28 ± 1.28	2.71 ± 1.43	58	1.58 ± 0.59†	54.77 ± 7.02†	5.85 ± 1.44†	3.63 ± 1.04†	2.06 ± 1.14	4.36*	1.78
15	50	1.70 ± 0.58	65.50 ± 10.40	4.47 ± 1.95	4.57 ± 1.38	2.44 ± 1.34	103	1.59 ± 0.53†	58.84 ± 10.60†	6.35 ± 1.88†	4.03 ± 1.35*	1.71 ± 1.14	5.04*	2.09
16	51	1.72 ± 0.69	69.25 ± 13.23	4.28 ± 2.03	4.80 ± 1.74	2.37 ± 1.42	65	1.58 ± 0.59†	60.11 ± 12.20†	6.28 ± 1.75†	4.32 ± 1.58	1.52 ± 1.09*	5.37*	2.23
17	38	1.72 ± 0.77	70.11 ± 11.50	4.82 ± 2.27	4.86 ± 1.32	2.22 ± 1.47	88	1.58 ± 0.65†	58.96 ± 10.74†	6.22± 1.77†	4.23 ± 1.33*	1.63 ± 1.30	4.02*	1.65
18	20	1.70 ± 0.56	72.41 ± 10.57	4.75 ± 2.24	5.26 ± 0.67	1.67 ± 1.29	31	1.57 ± 0.53†	60.46 ± 13.70†	6.34 ± 2.00†	4.64 ± 1.37	1.53 ± 1.42	4.03*	1.71
Mean	663	1.50 ± 0.18	49.31 ± 17.45	4.91± 2.37	4.82 ± 1.33	2.06 ± 1.43	746	1.48 ± 0.14*	48.51 ± 14.62	5.83 ± 1.89*	4.26 ± 1.29*	1.76 ± 1.26*	2.74*	1.12

*Endo: endomorphy; Meso: mesomorphy; Ecto: ectomorphy; SDD: somatotype dispersion mean (two dimensions analysis); SAM: somatotype attitudinal mean (three dimensions analysis). *p < 0.05; †p < 0.01.*

Table II. Distribution of 13 somatotype categories at school-age Chilean children and adolescents from Valparaíso, Chile for sex (n = 1,409), 2011-2012

Category somatotype	Total sample	Male (n = 663)	Female (n = 746)
Balanced endomorph	2.56 (36)	1.51 (10)	3.49 (26)
Mesomorphic endomorph	*51.17 (721)*	*36.20 (240)*	*64.48 (481)*
Mesomorph-endomorph	8.87 (125)	9.95 (66)	7.91 (59)
Endomorphic mesomorph	13.70 (193)	20.81 (138)	7.37 (55)
Balanced mesomorph	3.90 (55)	6.94 (46)	1.21 (9)
Ectomorphic mesomorph	3.69 (52)	7.09 (47)	0.67 (5)
Mesomorph-ectomorph	1.56 (22)	1.96 (13)	1.21 (9)
Mesomorphic ectomorph	4.33 (61)	8.45 (56)	0.67 (5)
Balanced ectomorph	1.63 (23)	1.21 (8)	2.01 (15)
Endomorphic ectomorph	2.48 (35)	2.56 (17)	2.41 (18)
Endomorph-ectomorph	1.14 (16)	0.60 (4)	1.61 (12)
Ectomorphic endomorph	3.05 (43)	0.60 (4)	5.23 (39)
Central	1.92 (27)	2.11 (14)	1.74 (13)
Male	**Total sample**	**Children**	**Adolescents**
Balanced endomorph	1.51 (10)	1.59 (8)	1.26 (2)
Mesomorphic endomorph	*36.20 (240)*	*39.09 (197)*	27.04 (43)
Mesomorph-endomorph	9.95 (66)	9.92 (50)	10.06 (16)
Endomorphic mesomorph	20.81 (138)	18.25 (92)	*28.93 (46)*
Balanced mesomorph	6.94 (46)	7.14 (36)	6.29 (10)
Ectomorphic mesomorph	7.09 (47)	7.54 (38)	5.66 (9)
Mesomorph-ectomorph	1.96 (13)	1.79 (9)	2.52 (4)
Mesomorphic ectomorph	8.45 (56)	8.53 (43)	8.18 (13)
Balanced ectomorph	1.21 (8)	0.99 (5)	1.89 (3)
Endomorphic ectomorph	2.56 (17)	2.58 (13)	2.52 (4)
Endomorph-ectomorph	0.60 (4)	0.20 (1)	1.89 (3)
Ectomorphic endomorph	0.60 (4)	0.40 (2)	1.26 (2)
Central	2.11 (14)	1.98 (10)	2.52 (4)
Female	**Total sample**	**Children**	**Adolescents**
Balanced endomorph	3.49 (26)	3.05 (14)	4.18 (12)
Mesomorphic endomorph	*64.48 (481)*	*58.61 (269)*	*73.87 (212)*
Mesomorph-endomorph	7.91 (59)	9.59 (44)	5.23 (15)
Endomorphic mesomorph	7.37 (55)	9.80 (45)	3.48 (10)
Balanced mesomorph	1.21 (9)	1.74 (8)	0.35 (1)
Ectomorphic mesomorph	0.67 (5)	1.09 (5)	0.00 (0)
Mesomorph-ectomorph	1.21 (9)	1.96 (5)	0.00 (0)
Mesomorphic ectomorph	0.67 (5)	0.87 (4)	0.35 (1)
Balanced ectomorph	2.01 (15)	2.61 (12)	1.05 (3)
Endomorphic ectomorph	2.41 (18)	2.61 (12)	2.09 (6)
Endomorph-ectomorph	1.61 (12)	1.31 (6)	2.09 (6)
Ectomorphic endomorph	5.23 (39)	4.14 (19)	6.97 (20)
Central	1.74 (13)	2.61 (12)	0.35 (1)

Values are expressed as percentage and (frequency). Higher values are shown in italics.

The latter value remained relatively stable in the present study (6.35), which suggests that the predominantly endomorphic biotype of the female population is maintained in that condition. In males, a mesomorphic biotype at 15 years old has been observed in the population of Temuco (4.8; 18), in contrast to the present study, where males are less mesomorphic at the same age (4.47).

Silva et al. (2008) recorded the somatotypes of overweight and obese students 16 to 18 years of age (7.4-4.0-0.6 males, 8.1-4.1-0.4 females) in the city of Temuco, Chile (25). The highest endomorphic values were recorded at the age of 16 for men and 17 for women, thus confirming a high adiposity in adolescents, an aspect that coincides with our study, in which high endomorphy values were recorded in females between ages 15 and 17. Conversely, in males, high values were reported from an early age for the endomorphic component. Despite these high endomorphic component values in males, the highest values are recorded during childhood (5.62 at age 10), which indicates that from childhood, males have a high load of adiposity that remains during adolescence, thus contributing to the development of overweight and obese adults in addition to associated health consequences.

For the third somatotype component, ectomorphism, both males and females reported low values, indicating the large volumes and rounded shapes that are typical of people with increased relative adiposity (15).

Tables III and IV show the comparative somatotypes across the SDM and SAM of the male and female samples from 1996, in which Almagià et al. (1996) evaluated a large sample from Valparaíso and reported three somatotype components by sex, and the data from the present study. Males from the 1996 sample showed a predominant mesomorphic shape at all ages, and the ectomorphic component was more dominant than the endomorphic component (ectomorphic mesomorph). The dominant mesomorphic shape was classified as a "balanced mesomorph" at six to nine years old, as a "mesomorphic ectomorph" at ten to 12 years old, as an "ectomorphic mesomorph" at 13 to 14 years old, and as an "ectomorphic mesomorph" at 15 to 18 years old. Females predominantly showed a mesomorphic shape at all ages in 1996, except at eleven years old, when an ectomorphic shape was more common. However, this exception did not exceed one unit; thus, they shared similar mesomorphic components. When classifying using the Heath-Carter criteria, the 1996 female sample primarily showed a balanced mesomorph profile (7-10 and 12 years old) and was classified as "central" at 13 and 14 years old. Mesomorphic and endomorphic shapes (i.e., mesomorph-endomorph) predominate at the beginning of adolescence (15 to 18 years old). Elevated SDM and SAM values were observed for both study periods and sexes (all scores were over 2.0 and 1.0, respectively), indicating a high dispersion of scores. Our analysis by sex revealed a high dispersion (two- and three-dimensional analyses), which is similar to the comparative work performed among adolescents from Valparaíso, Chile from 1985 to 2010 (10). In addition, figures 2 and 3 show the comparative somatochart with the mean somatoplots by age and sex. These somatocharts show displacement toward the endomorphic shape for both sexes. The 1996 female sample (26) is located in the middle of the somatochart; conversely, the females of the present study showed a marked displacement toward an endomorphic shape. These results show that adolescents experienced an important biotype change over time, particularly adolescent females with an increased endomorphic component.

Table III. Comparative differences in somatotype components between male schoolchildren samples of 1996 and the present study from Valparaíso, Chile

	1996 (n = 518)				Present study (n = 663)					
Age	**n**	**Endomorphy**	**Mesomorphy**	**Ectomorphy**	**n**	**Endomorphy**	**Mesomorphy**	**Ectomorphy**	**SDM**	**SAM**
6	12	1.48 ± 0.35	4.54 ± 0.54	1.84 ± 1.22	43	4.86 ± 2.29	5.34 ± 1.22	1.12 ± 0.93	7.17	3.54
7	32	2.07 ± 0.34	4.51 ± 0.54	2.21 ± 1.16	38	4.35 ± 2.04	4.81 ± 1.03	1.65 ± 1.02	5.05	2.37
8	32	2.00 ± 0.35	4.18 ± 0.50	2.57 ± 1.19	61	5.08 ± 2.54	5.05 ± 1.36	1.60 ± 1.28	7.03	3.35
9	34	2.08 ± 0.35	4.25 ± 0.50	2.38 ± 1.09	63	5.22 ± 2.66	4.98 ± 1.32	1.81 ± 1.31	6.52	3.27
10	30	2.03 ± 0.28	4.30 ± 0.50	2.75 ± 1.03	59	5.62 ± 2.66	4.86 ± 1.34	1.93 ± 1.52	7.82	3.73
11	32	1.82 ± 0.25	3.94 ± 0.50	3.20 ± 0.86	65	5.25± 2.56	4.70 ± 1.29	2.18 ± 1.52	7.76	3.66
12	32	1.80 ± 0.24	4.24 ± 0.52	3.37 ± 1.03	68	5.19 ± 2.43	4.77 ± 1.22	2.31 ± 1.57	7.82	3.60
13	25	1.79 ± 0.23	3.87 ± 0.63	3.38 ± 1.10	58	4.93 ± 2.25	4.70 ± 1.37	2.32 ± 1.46	7.28	3.41
14	8	1.68 ± 0.23	4.06 ± 0.71	3.83 ± 1.16	49	4.32 ± 2.04	4.28 ± 1.28	2.71 ± 1.43	6.60	2.87
15	19	2.45 ± 0.25	4.34 ± 0.69	3.41 ± 1.16	50	4.47 ± 1.95	4.57 ± 1.38	2.44 ± 1.34	5.22	2.26
16	95	2.43 ± 0.24	4.68 ± 0.64	3.23 ± 1.20	51	4.28 ± 2.03	4.80 ± 1.74	2.37 ± 1.42	4.76	2.05
17	113	2.34 ± 0.23	4.43 ± 0.64	3.35 ± 1.20	38	4.82 ± 2.27	4.86 ± 1.32	2.22 ± 1.47	6.27	2.76
18	54	2.33 ± 0.95	4.49 ± 0.74	3.20 ± 1.24	20	4.75 ± 2.24	5.26 ± 0.67	1.67 ± 1.29	6.87	2.96

SDM: somatotype dispersion mean (two dimensions analysis); SAM: somatotype attitudinal mean (three dimensions analysis).

Table IV. Comparative differences in somatotype components between female schoolchildren samples of 1996 and the present study from Valparaíso, Chile

	1996 (n = 460)				Present study (n = 746)					
Age	n	Endomorphy	Mesomorphy	Ectomorphy	n	Endomorphy	Mesomorphy	Ectomorphy	SDM	SAM
6	12	2.31 ± 0.88	4.28 ± 0.95	2.39 ± 1.65	30	5.20 ± 2.18	4.81 ± 1.02	1.24 ± 1.03	7.03	3.16
7	42	2.29 ± 1.00	4.11 ± 0.86	2.32 ± 1.34	62	5.19 ± 2.04	4.72 ± 1.03	1.44 ± 1.13	6.60	3.09
8	30	2.13 ± 0.86	3.89 ± 0.74	2.51 ± 1.13	28	5.84 ± 2.04	4.93 ± 0.80	1.39 ± 0.99	8.38	4.01
9	35	2.36 ± 1.12	3.77 ± 0.97	2.27 ± 1.21	65	5.72 ± 1.97	4.43 ± 1.48	1.69 ± 1.68	7.13	3.53
10	23	2.89 ± 0.98	3.79 ± 1.05	2.63 ± 0.99	78	5.25 ± 1.89	4.27 ± 1.07	2.12 ± 1.35	5.05	2.46
11	21	2.03 ± 0.81	3.01 ± 1.03	3.75 ± 1.53	49	5.52 ± 1.97	3.84 ± 1.09	2.22 ± 1.26	8.70	3.90
12	39	2.48 ± 1.18	3.68 ± 1.46	2.86 ± 1.48	44	5.60 ± 1.91	4.15 ± 1.37	2.19 ± 1.50	6.74	3.23
13	23	2.65 ± 0.97	3.48 ± 0.97	3.03 ± 1.53	45	5.86 ± 1.56	3.96 ± 1.25	2.01 ± 1.34	7.43	3.40
14	11	2.72 ± 1.25	2.89 ± 0.86	2.54 ± 1.28	58	5.85 ± 1.44	3.63 ± 1.04	2.06 ± 1.14	6.36	3.25
15	21	4.45 ± 0.99	4.79 ± 1.19	2.11 ± 1.18	103	6.35 ± 1.88	4.03 ± 1.35	1.71 ± 1.14	5.00	2.09
16	71	4.54 ± 1.44	4.78 ± 1.37	2.10 ± 1.14	65	6.28 ± 1.75	4.32 ± 1.58	1.52 ± 1.09	4.52	1.89
17	81	4.45 ± 1.24	4.87 ± 1.23	1.91 ± 1.00	88	6.22± 1.77	4.23 ± 1.33	1.63 ± 1.30	4.50	1.91
18	51	4.71 ± 1.37	4.79 ± 1.38	1.89 ± 1.18	31	6.34 ± 2.00	4.64 ± 1.37	1.53 ± 1.42	3.79	1.68

SDM: somatotype dispersion mean (two dimensions analysis); SAM: somatotype attitudinal mean (three dimensions analysis).

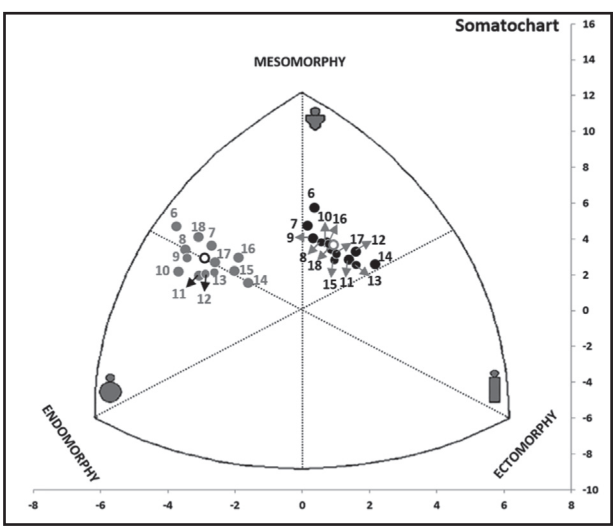

Figure 2.

Comparative distribution of the mean somatopoints in Chilean male children and adolescents by year and age (6 to 18 years old). The 1996 sample is represented by black circles (n = 518) and the 2012 sample is represented by gray circles (n = 663).

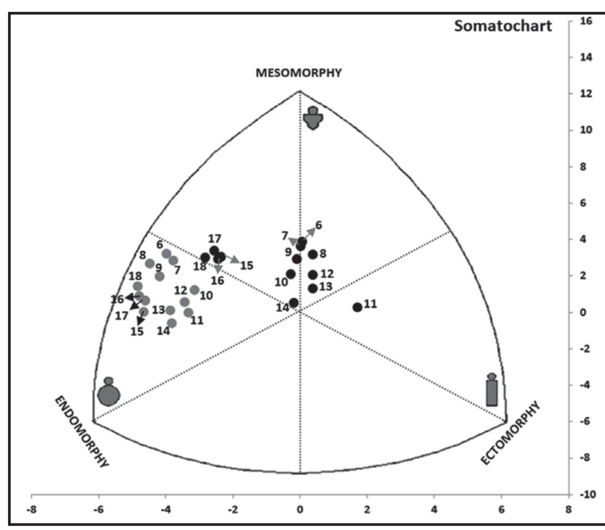

Figure 3.

Comparative distribution of the mean somatopoints in Chilean female children and adolescents by year and age (6 to 18 years old). The 1996 sample is represented by black circles (n = 460) and the 2012 sample is represented by gray circles (n = 746).

In this study, increased sex differences in endomorphy were observed in women compared with men; conversely, males had a higher mesomorphic component than females. However, both sexes moved toward endomorphy. This change toward an increased endomorphy (higher in girls than in boys) has been observed over time in several populations in Chile (10,14,18,19,25-27). The change in males moved the relative adiposity limit to between moderate and high. Similar to young boys, girls have shown decreased relative fatness; however, girls start to increase in relative fatness again during adolescence, unlike boys, who increase in muscle mass (28). One of the causes of increased fat tissue in adolescents may be sex hormones, which contribute to an accumulation of a higher percentage of dermal fat; therefore, adolescents are more prone to obesity during this period (28). However, a normal level of adipose tissue can be differentiated from that contributing to chronic diseases. Chile has reported some causes of obesity, such as the excessive consumption of hypercaloric food (29), differences in socioeconomic status (14), and/or decreased physical activity (1,30). This profile of high relative adiposity increases the likelihood that this population suffers from chronic non-transmissible and cardiovascular diseases extending into adulthood (31).

The limitations of this study include the selection of data published in 1996 for comparison with our results in the discussion section. The small sample sizes of 6-, 14-, and 15-year-old males and 6-, 10-, 11-, and 14-year-old females compared with the present study make it difficult to generalize trends in somatotype components. Future studies should explore the Chilean somatotype trends in youth. Nevertheless, in most ages, it was possible to show a displacement of the endomorphic components for both sexes, particularly females. Another limitation of the previous study was that their participants were sampled from one region of Chile, and therefore might not represent other localities. However, the region of Valparaíso is the third most populated, and the sample only represents schoolchildren.

In summary, this study reflects an important sexual dimorphism in which the mesomorphic component associated with musculature decreased and the endomorphic component increased in Chilean schoolchildren, particularly in female adolescents. In addition, this study shows a displacement of the higher endomorphic components in schoolchildren compared with studies from three decades ago.

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