

NATIONAL AND DISTRICT LONGITUDINAL GROWTH PROFILES FROM 7 TO 17 YEARS IN PORTUGAL

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Abstract: This work represents a co-ordinated effort lasting 11 years and carried out by a diversified team in 18 towns involving dozens of people. We made these studies always with the same observers, the same measuring instruments and the same young people observed. Our study is based on the measurements (weight and height) taken in 9022 boys and 9135 girls, in a total of 31913 and 33500 observations, respectively. All the young people studied were born in 1964. They were investigated from their age of 7 to 14 which initially allowed us to draw up national and district mixed longitudinal profiles. By a selection of young people observed at least ten times (164 boys and 275 girls), it was possible to obtain national pure longitudinal profile which is also shown in percentiles.

Key-words: Growth standards, Longitudinal growth profiles, School children, Heights and Weights

Introduction

Our growth study was started in 1971 in 18 towns of Portugal (Fig. 1). The number of boys and girls investigated yearly is given in Table 1. The number of observations was diminishing progressively since 1978, because pupils moved from school to school or from school to work.

Table 1. Number of yearly investigated boys and girls

Year of investigation	Boys investigated	Girls
1971	1571	1365
1972	2696	2713
1973	3373	3718
1974	3337	3314
1975	3523	3543
1976	3187	3664
1977	3856	3142
1978	3404	3299
1979	2729	3170
1980	2450	3117
1981	1787	2455
Total	31913	33500

It was 1970/71 when we realized the National Tables of Height and Weight, a controlled cross-sectional growth study carried out in all over the country, including also Tables for Districts.

The basic idea of our work was the complexity of the child (mode of life, with physical, ethical, pedagogical, social, etc. values) which passes through our study. We did not really consider to be important whether he or she was tall or heavy, but to be healthy, and to have an equilibrium as the aim what we have to attain.

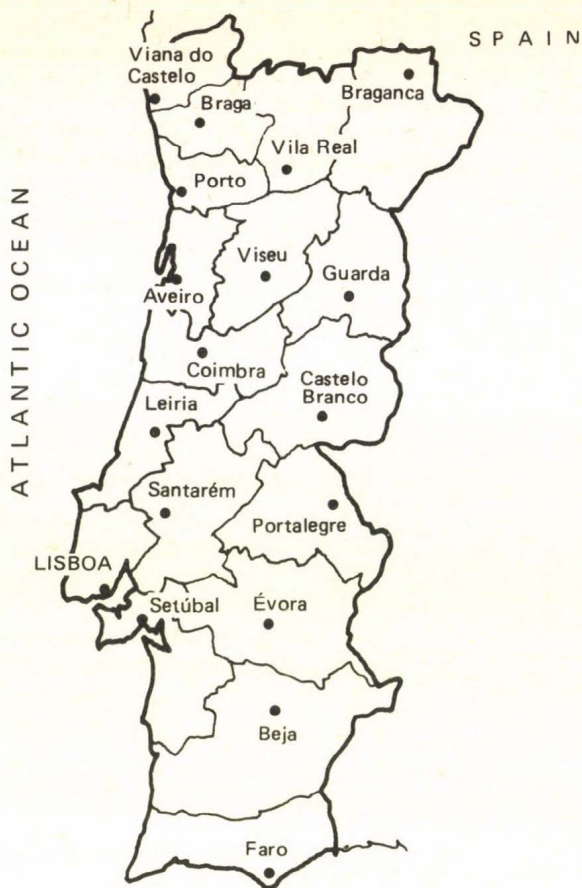


Fig. 1: Map of Portugal with district where the growth study was carried out

Methodology

Our project was accomplished by the School Health Service, with the collaboration of Pedagogical Authorities and Health Authorities. We had (1) in each town a doctor and a health visitor or nurse and in each school a teacher (of physical education); (2) for the country a team, circulating from town to town: two health visitors and a driver. When the country team arrived in the town, the doctor of that town was responsible for the work there.

Centrally, we were outlining sequences, liaisons; coordinating the peripheral and central work; cathering data; obtaining the statistical approach; maintaining the sequential rhythm, that is to say, from town to town, over five weeks, without breaks, the work was going on. Over 11 years the work was always accomplished.

Locally, we were searching young people to be observed (find in the schools the requested boys and girls), all of them were born in 1964; centralising activities, one or two places in each town (or session); adapting transports and liaisons; putting files in order, filling up maps of registration.

The fact of putting the girls and the boys in groups, according to the trimester they were born, gives to the work statistical accuracy. To be acquainted with the environment, as well as with the local possibilities, is also essential. We must underline this idea, all the work was done without prejudicing school life.

The accuracy of the task depends on these purposes. Obviously the pupils were not always the same. But all of them were born in 1964. The percentage was different from town to town. We have only one town where 50% of the pupils were observed 6 times, but in most towns the percentage was about 20%. Therefore we consider our whole sample as a *mixed longitudinal* one. We have, however a lot of young people (164 boys and 275 girls) whom we could investigate at least ten times, over these eleven year period. With them we could obtain the *pure longitudinal* profiles.

The basic conditions described were present in the mind of the observers: Minimal clothes: in boys underpants or shorts or training-suit, in girls panties or training-suit or bathing-suit; time: in the morning after a light breakfast; previous urination; the same period of the year (April–May). We considered the estimated weight of the clothes to be discounted.

Observers were acquainted with the criteria established by the W.H.O. to obtain the accuracy we needed. The previous training was essential. We can have a look of these criteria: barefoot; joined heels; buttocks, shoulders and head contacting with the vertical surface; interior orbital border and the auditive external canal in the same horizontal line; upper surface of the scale touching the crown of the head.

The same automatic balance and the same graduated scale were used which were 50 gramms fractions and measuring every 0.5 cm, respectively.

In this work we have the same observers with the same criteria and same training, the same measuring instruments, balance and scale, the same pupils to be investigated (when possible).

Results

Based on our whole sample (mixed longitudinal) means of height and weight in Portuguese boys and girls are shown in Fig. 2. The curves of boys and girls show the well-known phenomenon: during puberty girls are taller and heavier than their male-counterparts, however, at the age of 17 year („final” production of our study) boys are taller and heavier. We compared these mixed growth profiles to our pure longitudinal profiles as shown in Fig. 3. The differences between means of the whole and selected (i.e. mixed longitudinal and pure longitudinal, resp.) samples can be observed in Table 2.

To study secular trend, we made a comparison between the data of the 1970/71 Portuguese cross-sectional growth study and our present study. The well-known phenomenon of secular trend is observable well. The 17 year-old boys and girls in 1971, i.e. ten years before, had a smaller size than boys and girls at the same age in 1981. The evidence of secular trend is demonstrated by the following differences. Height in boys in 1971 was 168.3 cm, and in 1981 it was 171.1 cm, the difference is +2.8 cm. The same values in girls were 155.6 cm, and 158.5 cm, resp., the difference is +2.9 cm. We can also see an increase of weight which in boys in 1971 was 58.7 kg, in 1981 it was 60.8 kg, the difference is +2.1 kg; in girls 52.1 kg and 52.8 kg, resp., and the difference is +0.7 kg. – We add to these that the adolescent growth spurt comes obviously later, especially in boys. Consequently, in the male, the whole body has a longer period of growth, causing a generally greater size.

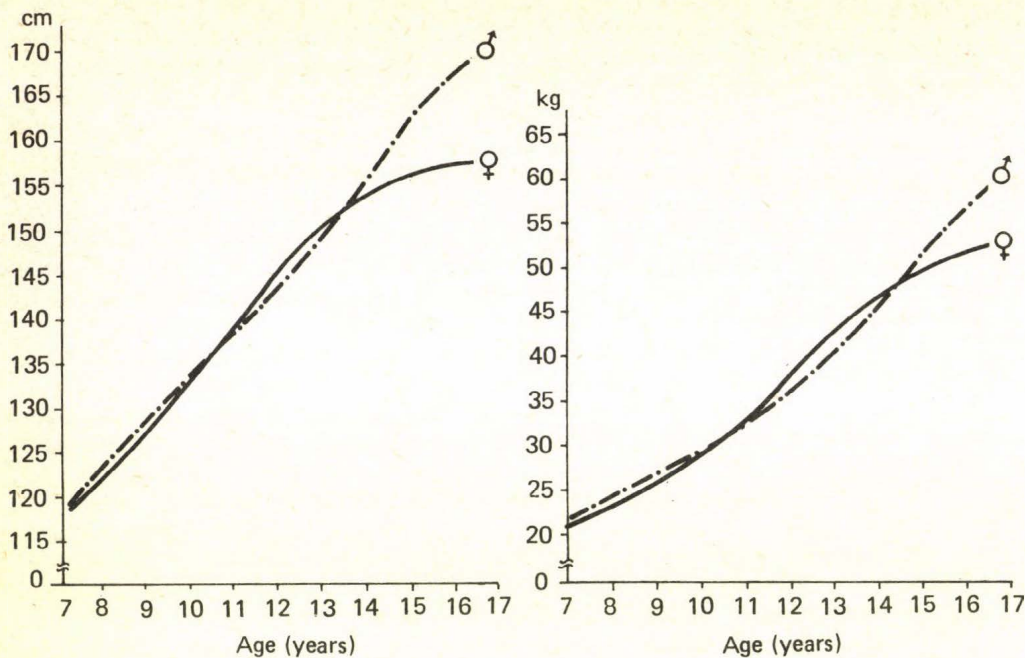
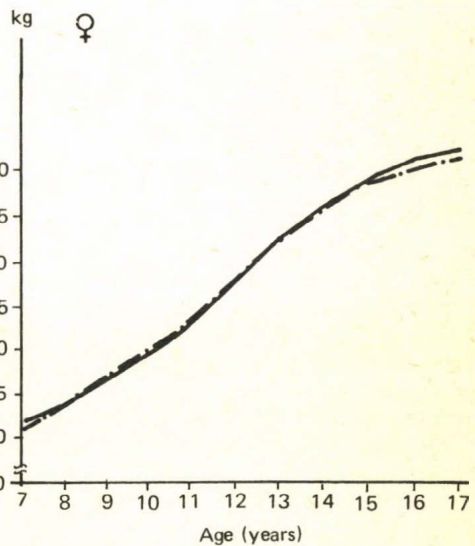
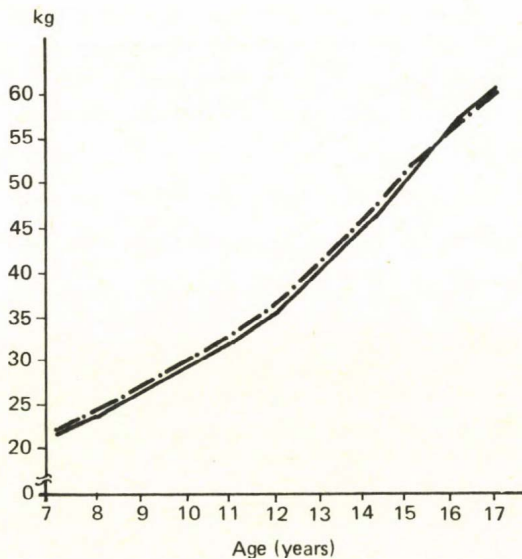
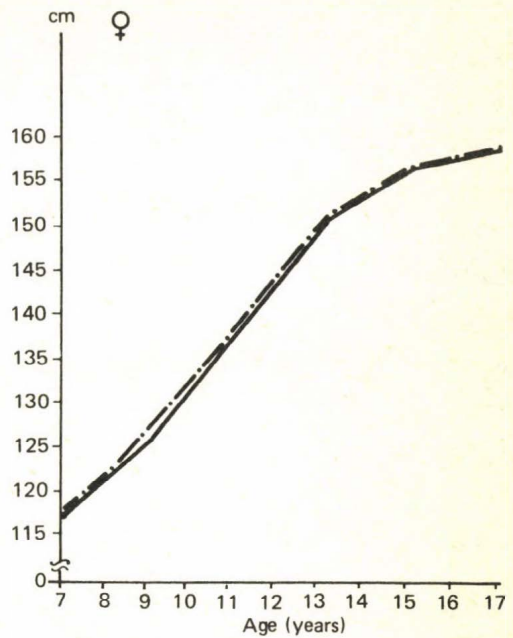
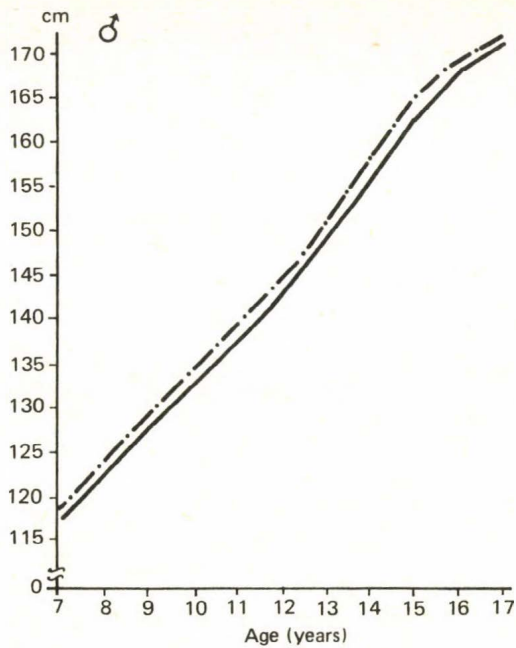


Fig. 2: Growth curves of height and weight in Portuguese boys and girls based on the whole sample (mixed longitudinal)

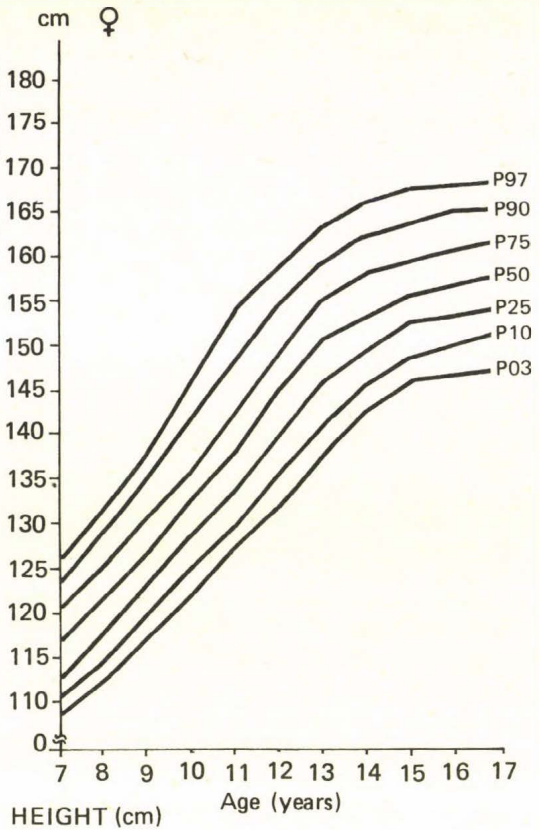
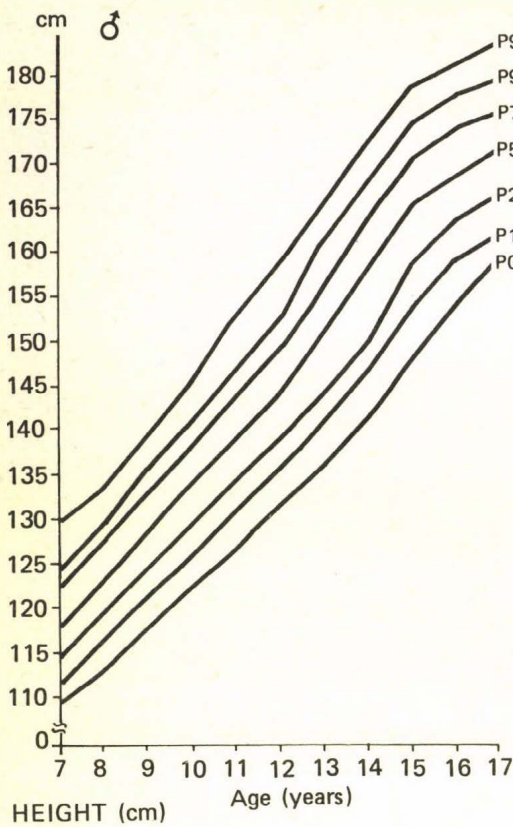
Table 2. Means of height and weight of Portuguese boys and girls, based on the whole sample (mixed longitudinal) and on the selected sample, „pure” longitudinal

Age (years)	Height				Weight			
	Boys		Girls		Boys		Girls	
	Whole sample	Sample „pure”	Whole sample	Sample „pure”	Whole sample	Sample „pure”	Whole sample	Sample „pure”
7	117.7	119.0	117.0	117.3	21.8	22.3	21.6	21.4
8	122.2	123.8	121.8	122.0	23.8	24.3	23.5	23.5
9	127.6	129.3	126.4	127.7	26.5	27.3	26.3	26.6
10	132.7	134.4	132.0	133.2	29.3	30.2	29.4	29.6
11	137.7	139.6	138.2	139.3	32.2	33.1	33.0	33.1
12	142.8	144.7	144.6	145.7	35.6	36.5	37.7	37.9
13	148.9	150.9	150.2	151.2	40.0	41.0	42.7	42.5
14	155.5	157.8	153.9	154.5	45.1	46.3	46.9	46.3
15	162.7	165.0	156.5	156.9	51.0	52.3	49.6	49.0
16	167.9	169.2	157.7	158.0	56.6	56.4	51.7	50.9
17	171.1	171.9	158.5	158.7	60.8	60.2	52.7	51.8



— Whole sample - - - - - Pure longitudinal sample

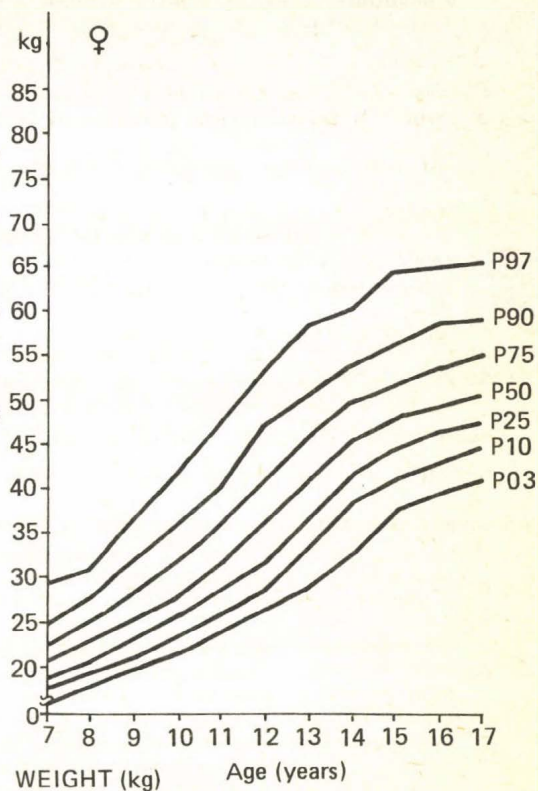
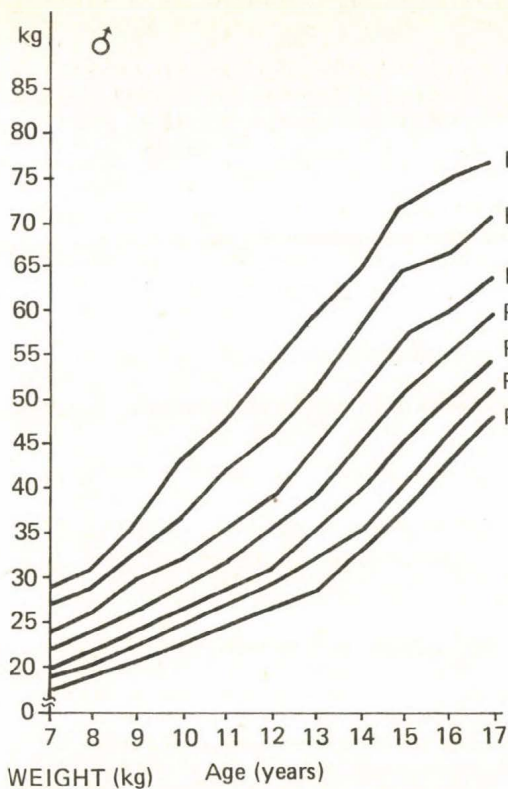
Fig. 3: Height and weight curves of Portuguese boys and girls based on the whole sample (mixed longitudinal) and on the selected sample, a pure longitudinal one



Age	P03	P10	P25	P50	P75	P90	P97
7	110,0	112,0	115,0	118,5	123,0	125,0	130,5
8	113,5	117,0	120,0	123,5	128,0	130,0	134,0
9	118,5	122,0	125,0	129,5	133,5	136,5	140,0
10	123,0	126,5	130,0	134,5	138,5	141,5	146,0
11	127,0	131,5	135,0	139,5	144,0	147,5	153,5
12	132,5	136,0	139,5	144,5	149,5	153,0	159,5
13	136,5	141,5	144,5	151,0	156,5	161,8	166,0
14	142,0	147,0	150,5	158,5	164,5	169,0	173,0
15	149,0	154,5	159,0	166,0	171,0	175,0	179,0
16	155,0	160,0	163,8	169,0	174,5	178,0	181,5
17	160,0	162,5	167,0	172,0	176,0	180,0	184,0

Age	P03	P10	P25	P50	P75	P90	P97
7	109,0	111,0	113,0	117,2	121,0	124,0	126,5
8	113,0	115,0	118,0	122,0	125,5	129,5	132,5
9	118,0	120,5	123,5	127,0	131,5	135,5	139,0
10	122,5	125,5	129,0	133,0	136,5	142,5	146,0
11	128,0	130,0	134,0	138,5	143,5	149,0	155,0
12	132,5	136,5	140,5	145,8	150,0	155,5	159,5
13	138,5	142,0	146,8	151,2	156,0	160,0	164,0
14	143,5	146,5	150,5	154,0	159,0	163,0	167,0
15	146,5	149,5	153,5	156,5	160,5	164,5	168,5
16	147,5	151,0	154,0	157,5	161,5	166,0	169,0
17	148,0	152,0	155,0	158,5	162,5	166,0	169,0

Fig. 4: Percentiles of height in Portuguese boys and girls



Age	P03	P10	P25	P50	P75	P90	P97
7	17,600	18,900	19,850	22,000	24,125	27,150	28,950
8	18,800	20,300	21,750	24,025	26,400	29,075	31,200
9	20,600	22,450	24,350	26,300	30,000	33,200	36,350
10	22,500	24,750	26,875	29,325	32,225	36,900	43,850
11	24,500	27,250	29,075	31,950	35,950	42,125	48,000
12	26,650	29,450	31,800	35,625	39,175	46,100	54,050
13	28,700	32,575	35,575	39,125	44,750	51,675	60,000
14	33,350	35,450	40,150	45,350	50,800	58,400	64,850
15	37,700	40,500	46,700	51,325	57,775	65,000	71,950
16	43,600	46,600	51,025	55,600	60,650	66,850	75,500
17	48,550	51,400	54,600	59,800	64,300	70,900	77,000

Age	P03	P10	P25	P50	P75	P90	P97
7	16,300	17,850	19,050	21,000	22,800	25,050	29,900
8	18,050	19,500	20,850	23,000	25,300	28,100	31,425
9	20,050	21,450	23,350	25,650	28,700	32,500	37,100
10	21,700	23,750	25,900	28,350	32,200	36,400	42,100
11	24,150	26,250	28,700	32,000	36,300	40,500	48,250
12	26,700	29,350	32,450	36,700	41,525	47,400	54,450
13	29,450	33,800	37,050	41,550	46,350	51,000	58,650
14	33,250	38,600	41,950	45,800	50,050	54,200	60,900
15	37,900	41,700	45,050	48,400	52,000	56,950	65,000
16	40,100	43,600	47,050	50,000	54,200	58,800	65,400
17	41,300	45,100	48,000	51,100	55,300	59,300	65,800

Fig. 5: Percentiles of weight in Portuguese boys and girls

We wanted to see *differences in school boys and girls of the various districts* of our country. Analysing the regression lines we can see the districts (Fig. 1) where the best correlations were obtained: Lisboa, Santarem and other low regions, with mild climate, as Porto, Aveiro, Braga, Coimbra, Leiria, contrasting with the poverty of the interior regions, as Guarda, Castelo Branco, followed by Vila Real, Bragança, Portalegre, that we have mentioned as having the worst indicators of development (mountainous regions, cold climate, monotonous nourishment, etc.) This is an evidence we have known for a long time. Problems to be discussed, to be resolved in each region.

As it was mentioned above, we have done a *pure longitudinal profile*, collecting boys and girls, who were observed, at least, ten times over the work.

These numbers are without statistical value for the regions. We think to be important, however, to use the national values (as „median”) in the whole country, and to give them in percentiles in growth curves to our colleagues (endocrinologists, adolescentologists, pediatricians, school doctors).

We have seen how similar are the mixed and the pure longitudinal profiles. Now, we can see that the values of the median and of the mean do not differ statistically.

In case of height the median is greater by 0.1 cm than mean in boys, but it is smaller by 0.2 cm than mean in girls. In case of weight median is smaller than mean in both sexes, in boys by 0.4 kg and in girls by 0.7 kg, resp. In Table 3 we summarized the data of height and weight in 17 year-old boys and girls, the means of the whole (mixed longitudinal) sample, the selected i.e. pure longitudinal sample and the median i.e. 50th percentile value of the last one.

The numerical values and the graphs we have obtained are the „end products” of our national pure longitudinal growth study (Figures 4 and 5).

As conclusions:

This work makes worthy of importance of the team and its continuity over the years. It underlines the value of the collaboration between pedagogical and health authorities.

It allowed the knowledge of Portuguese longitudinal profile of growth (7 to 17 years), national and districtal, the pure longitudinal profile and, considering the skewed distribution of weights, the use of the median as the central value. It confirms, with accuracy, what we know about growth and development of boys and girls and the secular trends towards a greater adult size.

It constitutes an element for study of growth to scientists working on the fields of Endocrinology, Pediatrics, Social Adolescentology, etc.

Table 3. Means and medians (50th percent values) of height and weight in 17-year-old Portuguese boys and girls

Mean/Median	Boys		Girls	
	Height	Weight	Height	Weight
Whole sample mean (mixed longitudinal)	171.1	60.7	158.5	52.7
Selected sample mean (pure longitudinal)	171.9	60.2	158.7	51.8
50th percentile	172.0	59.8	158.5	51.1

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