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A Different Approach to Investigating Social Inequalities. The Relationship Between Height and Education in Italy

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Essays

A different approach to investigating social inequalities

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1. Introduction

Studies on social mobility in Italy and other countries give education great importance in accounting for social inequalities. Education is therefore often used as a dependent or independent variable to measure the increase or decrease in such inequalities, and it is thus a proxy for social change [Pisati 2002; Blossfeld and Shavit 1993; Blau and Duncan 1967]. In Italy, the role of education in social inequality is much debated. But there is general agreement that educational inequalities have not substantially changed in Italy since the 1950s and 1960s [Pfeffer 2008; Breen et al. 2005]; at most, they have slightly decreased [Triventi 2010]. Indeed, according to the work of Ballarino and colleagues [2009] – which stresses the decrease of educational inequalities in Italy – the greatest decrease took place in the 50-59 cohort in comparison with the previous ones, and then stabilized in the subsequent cohorts. All these studies assume the importance of the effects exerted by education on social positions in terms of income, occupational conditions, access to higher skills, and cultural habits, although their comparability is biased by differences among dis-

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tinct temporal and spatial contexts in terms of educational systems, living costs, and changes in the structure of the labor market [Barone 2009; Pfeffer 2008; Ballarino and Schaade 2006; Breen et al. 2005; Hout et al. 1993; Cobalti 1990].

In this paper we propose an original contribution to the debate on social change in educational inequalities by putting forward a very unusual thesis: that the variability in height among specific groups of individuals is an indicator of non-observable social inequalities. Physical stature, ceteris paribus genetic determinants, is correlated with an individual's socio-economic familial origins and with his/her health status in early years of life [Monden and Smits 2009; Wehkalampi et al. 2008; Blane et al. 1999]. We thus intend to investigate change in social inequalities by analyzing the relation between physical stature and education, using the former as a proxy for a latent independent variable (the embedding disadvantage), and the latter as an observed dependent variable (the associated social outcome).

This approach is innovative in sociological research, for which reason the following two sections justify the analytical choices made and present empirical studies on the determinants of height.

2. Empirical evidence on social and biological determinants of height

Empirical evidence shows an association between individuals' social characteristics and their height. The positive relationship between height and socio-economic background is well known [Batty et al. 2009; Silventoinen 2003; Cavelaars et al. 2000; Floud et al. 1990; Peck and Vagero 1987; Goldstein 1971], and diachronic change in the average height of a population, or of a particular group, has been widely used as a comparative measure with which to evaluate the longitudinal trends of its socio-economic level [Fogel et al. 1982; Costa and Steckel 1997]. Indeed, several studies point out the correlation among occupation, education, early childhood life and the height of individuals, regularly finding evidence of a relationship between lower social position and lower height.

Variance in the height of human beings is due to both biological and social factors. In particular, the genetic code inherited from the parents interacts with the social and environmental conditions in which an individual grows up, thereby also shaping the height phenotype.[1]

With regard to genetics, the important role played by certain sexual chromosome genes is scientifically proven, although it still difficult to establish their ex-

[1] A phenotype is an observable morphological or behavioural trait.

act contribution to an individual's height [Silventoinen et al. 2000a][2]. To date, researchers collaborating with the GIANT consortium have identified 180 genetic traits (loci) which determine 10% of human body height [Allen et al. 2010]. Moreover, there is no doubt that physical stature is a phenotype related to different kinds of genes, whose correlation with height varies according to sex and population group as well [Kimura et al. 2008]. Sammalisto [2008, 9] concludes thus from the results of his study: "even though genetic effects explain a great proportion of height variance, it is likely that there are tens or even hundreds of genes with small individual effects underlying the genetic architecture of height". Therefore, the thesis that most of differences in individuals' height are due to the genetic inheritance, and thus to the parents' DNA, is widely accepted[3]. Likewise, the influence of social characteristics in shaping height is not a controversial matter, since it is widely recognized as well.

Among the most important factors are the mother's living conditions during pregnancy: women living in poor environments give birth to children who, on average, are shorter and thinner [Spencer and Logan 2002]. More specifically, the chances of a child's untimely death are higher if the mother is shorter in comparison with the average female height, and they increase when coupled with conditions of socio-economic disadvantage [Monden and Smits 2009]. A major role is also played by living conditions during childhood and the fundamental stages of a human being's physical development [Wehkalampi et al. 2008][4]. Specifically, low nutritive intake, higher exposure to diseases, and psycho-physical stress interfere with the potential physical development (in height terms) of the human body. Generally speaking, every variable connected to bad health episodes is correlated with a lower height: deprived socio-economic conditions, especially of the parents, can reduce the psycho-physical wellbeing of individuals, thus affecting their height [Gulliford et al. 1991; Ogden et al. 2004; Kuh and Wadsworth 1989].

The best cases for study of the relation between social conditions and height are pairs of monozygotic twins, whose DNA is identical: on keeping the genetic background under control, possible height differences between twins can be traced back to environmental factors[5]. Studies of this kind estimate that about 20% of height

[2] At the moment the GIANT consortium (Genetic Investigation of Anthropometric Traits) is working on the genes responsible for the different anthropometric characteristics:
http://www.broadinstitute.org/collaboration/giant/index.php/GIANT_consortium

[3] At the ecological level, also the genetic differences among distinct populations play an important role: as shown, for instance, by the fact that the average height of people from Northern Europe is greater than that of people from Southern Europe [Cavelaars *et al.* 2000].

[4] Even social mobility due to improvement in the father's social position is presumed to be linked with greater height during early childhood [Lasker and Mascie-Taylor, 1989].

[5] Nevertheless, in this case the individuals share the same living conditions during the mother's

variance is explained by social-environmental variables – especially nutrition and predictable diseases, both of which are strictly correlated with socio-economic conditions [Silventoinen et al. 2003; Sammalisto 2008; Nance et al. 1998][6]. This estimate is based on a series of empirical studies on height determinants. Several Finnish studies, for example, have estimated this correlation at between 10% and 30% in monozygotic twins, although in female pairs it is slightly lower. Silventoinen and colleagues [2000a] calculate the genetic inheritance (h^2)[7] of female twins to be 0.78 compared with the 0.89 of male twins in the 1938-49 age cohort and 0.67 compared with 0.82 in the 1975-79 age cohort. A predictive regression based on social variables has been able to explain, respectively, 18% and 16% of male and female height variance [Silventoinen et al. 1999], while a later study calculates that the genetic inheritance value (h^2) is 0.78 for men and 0.75 for women [Silventoinen et al. 2000b]. Finally, it is estimated that genetic effects contribute, respectively, to 86% and 82% of height variability (in standard deviation values) among men and women [Wehkalampi et al. 2008].

Hence much of literature asserts the importance of both genetic and social factors in accounting for the height differences among individuals of a given population. However, the two determinants have different causal weights according to the context and the period considered. In particular, where living conditions are worse, social characteristics play a greater role: in Western countries the effect of genetic inheritance on young pairs of twins has grown in comparison with the older cohorts at the beginning of the last century. Moreover, research shows that social-environmental conditions are less important in Europe than elsewhere, i.e. Western Asia and India, where the biological impact on height is estimated at 56-58% [Silventoinen et al. 2000c; Singh and Harrison 1997].

However, for the purposes of this study, we must look at these results from a sociological perspective. As a consequence, it seems that genetic factors can display their entire potential influence when socio-economic differences are less pronounced. Differences in height among individuals with similar genetic backgrounds seem smaller when there are fewer social inequalities. A similar point of view has been proposed as regards infant ability in reading [Tucker-Drob et al. 2011; Nielsen 2006;

pregnancy, a variable which is not fully independent from the fetus's neuronal development. However, some studies claim that this influence is not significant [Toga and Thompson 2005].

[6] Kimura and colleagues (2008) report a variability of between 75% and 90%.

[7] (*h2)* is a measure of the extent to which variance in a phenotype derives from differences in genotype, as opposed to environmental differences. It may be defined as the proportion of the variance within like-sexed dizygous twin pairs attributable to genetic factors. A version of the formula is:

$$h^2 = \left(\sigma_D^2 - \sigma_M^2\right) / \sigma_D^2 \text{ ; where } \sigma_D^2 \text{ and } \sigma_M^2$$

are the within-pair variances for dizygous and monozygous twins respectively (Clark 1956).

Turkheimer et al. 2003]. "Genetic influence was higher and environmental influence was lower among children whose parents had a high level of education, compared with children whose parents had a lower level of education." [Friend et al. 2008, 1124]. Also "Genomes may matter much more in some originating environments than others, as reflected in arguments that poor environments thwart the so-called 'genetic potential' of actors and thus attenuate genomic effects much more than richer environments do." [Freese 2008: 12; Freese and Shostak 2009].

Height is just one of the several characteristics of an individual. Knowledge of the extent to which this merely physical feature is affected by social factors can furnish a comparative tool for analysis of the relation between social and biological variables. Indeed, we can expect to find that social variables such as lexical capacity, which are intrinsically cultural, are less affected by biological factors, and that, differently, physical variables such as resistance to particular diseases are less determined by social conditions.[8]

3. Trend of average height in Italy

In order to introduce and contextualize the influence of social conditions on physical stature, we consider the general trend in the average height of Italian army conscripts born between 1901 and 1980 derived from the results of the medical examinations required for entry into military service.[9] The examinations were conducted on males aged between 17 and 19 years.[10]

The trend illustrated in Figure 1 shows a general and marked increase in the average height of the young male population. Also to be noted, however, is that the increase changes across periods. Over the eighty years considered, average stature grew by ten centimeters. Males born in 1901 had an average height of 164.5 cms, while for males born in 1980 [last year available] the average height was 174.6 cms. These trends confirm well-known empirical evidence showing that improved living conditions and greater overall wealth led to an increase in the average height of the European populations during the period considered [A'Hearn 2003; Cavelaars, 2000; Fogel et al. 1982].

[8] There is heated debate in the literature on the relationship among genetic factors, the brain's cognitive ability, and environmental conditions [Toga and Thompson 2005]. In the case of the relationship between height and intelligence there are also hypotheses concerning a common latent genetic factor related to both characteristics (Bielicki and Waliszko 1992), which, however, has not been proved [Silventoinen 2000b].

[9] Data provided by Istat: original sources are Ministry of War, Ministry of Defence, Ministry of the Navy.

[10] For a more exhaustive analysis of these data see Arcaleni 2006 and Corsini 2008.

However, the growth rate varied during the last century. We can easily observe that the increase in height tended to proceed slowly in association with socio-economic periods of crisis concurrently with the two World Wars [Costa and Steckel 1997]. Moreover, the growth rate was higher in the late 1950s and early 1960s in association with the economic boom in Italy.

Figure 2 shows the relation between the smoothed (on three years) annual growth rate of height and the smoothed (on three years) annual growth rate of the "consumer price index for families of manual workers and employees."[11] The figure clearly shows that, for subjects born after every socio-economic crisis (see arrows at the top: 1910s, 1940s), their growth rate tends to stop. In particular, males born during the war years tend to be shorter. In these cases, the rate of increase is negative (see arrows at the bottom). Differently, males born in the 1950s tend to be significantly taller than males born in the previous generation. Interestingly, the data show that severe conditions of deprivation (malnutrition and disease) do not directly influence the height of adult persons, but they have effects on the physical stature of the subsequent generations [Arcaleni 2006; Costa and Steckel 1997].

Summarizing, variations in average height in Italy are closely related to changes in general socio-economic conditions. Over the last century in Italy we observe a general improvement of living conditions and a corresponding general increase in the average height, although the growth rate of height changes during the period considered (in particular during the two World Wars). This empirical finding on the trend in average Italian height is a starting point for an evaluation of the general impact of temporal contexts from a long-range perspective.

However, our research question here concerns social inequalities at individual level: we assume that not all people live in the same socio-economic conditions, and therefore that social characteristics are different among individuals. In fact, we are interested in investigating whether the influence of distal material disadvantages (embedding in lower height) changes with different levels of education. We therefore need data on height and education at individual level considering changes across time.

[11] Data provided by Istat.

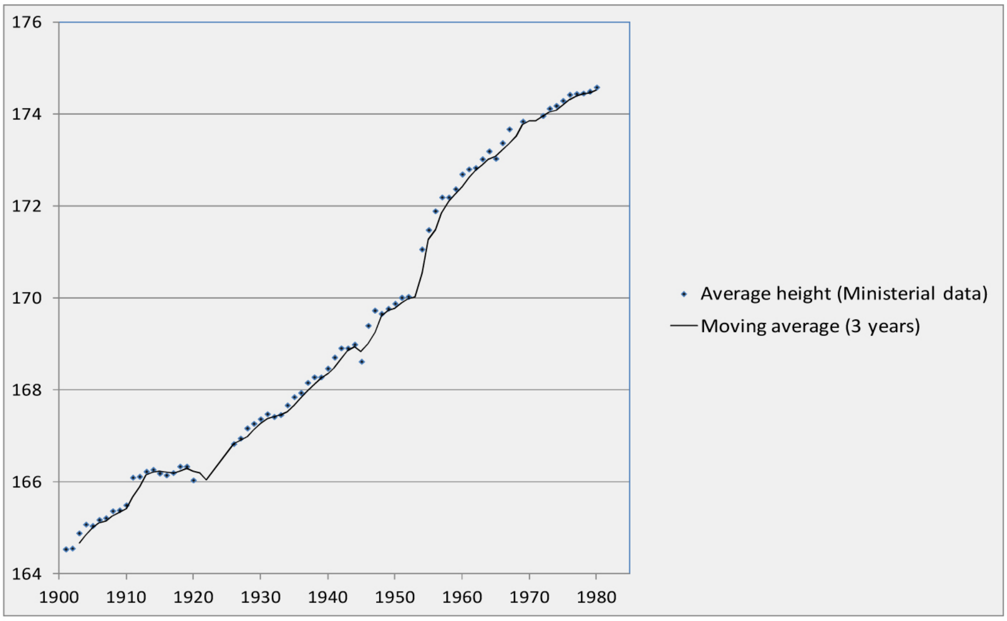

FIG. 1. Trend of the average height in Italy (measures at medical examination for military service). Elaboration on Istat data (source: Ministry of War, Ministry of Defence, Ministry of the Navy).

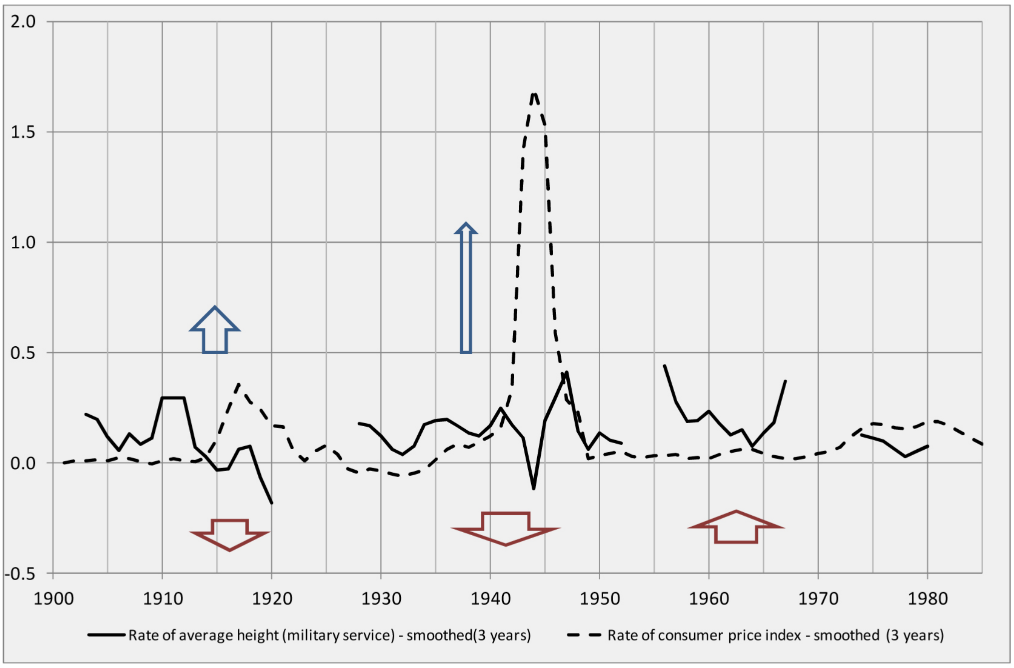

FIG. 2. Trend of the increase rates in average height and in the consumer price index for families of workers and employees (data linearly rescaled). Elaboration on Istat data.

4. Assumptions and hypothesis

In what follows we use the heterogeneity in physical stature as a proxy for the non-observable material disadvantages experienced by individuals in their social origins. Our detailed hypothesis is that, if we find that the association between height and education has been decreasing in time, then socio-economic background today matters relatively less than previously in terms of educational success.

In order to confirm this hypothesis we should bear in mind that phenotypes (one of which is height) are the expressions of the genetic pool, the environmental context, and complex interactions between them [Seabrook and Avison 2010; Plomin et al. 1977]. However, we are not interested here in the biological determinants of a phenotype, nor in the problematic decomposition of its variance among genetic, environmental and interactional effects [see Lucchini et al. 2011; Udry 1995]. To be emphasized is that our approach instead assumes that the genetic pool (and therefore the biological impact on height) cannot change over a few human generations for various reasons: genetic invariance, the Hardy-Weinberg equilibrium,[12] and the absence of dramatic selection processes [Cavalli Sforza 2004; Dawkins 1986; Monod 1970]. Thus, if we find a change across the considered period in the association between height and education (used as a proxy for social outcome), we will consider this change to be due only to variations in social-environmental conditions.[13]

The next section presents the data and methods used. Section 6 will focus on the analyses, describing the correlation between height and education in a diachronic perspective.

5. Data and methods

To investigate the relationship between education and height in Italy we use the random samples of the "Multiscopo-Aspetti della Vita Quotidiana" and "Condizioni di Salute e Ricorso ai Servizi Sanitari" cross-section surveys (ISTAT) gathered in 1994, 1999, from 2001 to 2007 and from 2009 to 2010. These surveys collected a great deal of information, including the socio-demographic conditions, lifestyles and health status of a random sample of Italians (stratified two-stage design with face-to-face interviews).

[12] Genotypic frequencies remain constant from generation to generation in a population unless evolutionary events occur (mutations, selection or genetic drift).

[13] In particular, we can hypothesize that the change is the effect of the diminished importance of social origins for height, or of the increase educational opportunities. However, whatever the underlying process, our concern here is to estimate the change in inequalities.

Families permanently living in Italy are the units of analysis, and the data on height and educational level concern each family member older than seventeen. Information about education and height are self-declared, and this is an unavoidable limitation of the study.[14]

We consider individuals aged between 18 and 64 corresponding to the 1934-1989 cohort.[15] With cross-sectional data, selection effects cannot be evaluated (Willson et al. 2007], although premature mortality in these cohorts may be considered not relevant.[16]

Moreover, we must take into account that most of the youngest respondents may still be studying (mostly at tertiary level). People born in the early 1980s could be in this situation.

Descriptive analysis of the variables of interest shows that the average height for males in the sample is 174.2 cms and for females it is 163 cms (see Table 1). In a diachronic perspective Figure 3 shows the raw average height trend according to the year of birth of individuals. It is a substantially monotonic trend for both genders. However, it should be noted that the increase is stronger in the 1960s for males and less marked in the 1970s according to the ministerial data (see Figure 1 above). On average, men born in the late 1980s are 6.9 centimetres taller (177 cms) than those born in the 1930s (170.1 cms) and women are 3.9 centimetres taller (165.1 cms) than those born in the late 1950s (161.2 cms), while the rate of increase is about 0.14 centimetres per year for men and 0.09 for women.

TAB. 1. *Data on height by gender (individuals born between 1934 and 1992)*

	MALES	FEMALES
N	230605	236771
Mean	174.2	163.0
Standard Deviation	7.133	6.230
Median	175	163
Minimum	150	140
Maximum	200	190

[14] In a Finnish study the correlation between the declared height and the one actually measured is 0.98 for men and 0.96 for women [Silventoinen *et al.* 2003]. Analysis on a Swedish sample by Boström and Diderichsen (1997) reveals that self-declared data slightly underestimate height (and weight) differences among the social classes.

[15] For reasons of sample size, the 1932-1933-1934 and 1989-1990-1991-1992 cohorts have been re-aggregated.

[16] Persons in the worst social positions have poor health and tend to have a life expectancy lower than that of persons in better socio-economic positions.

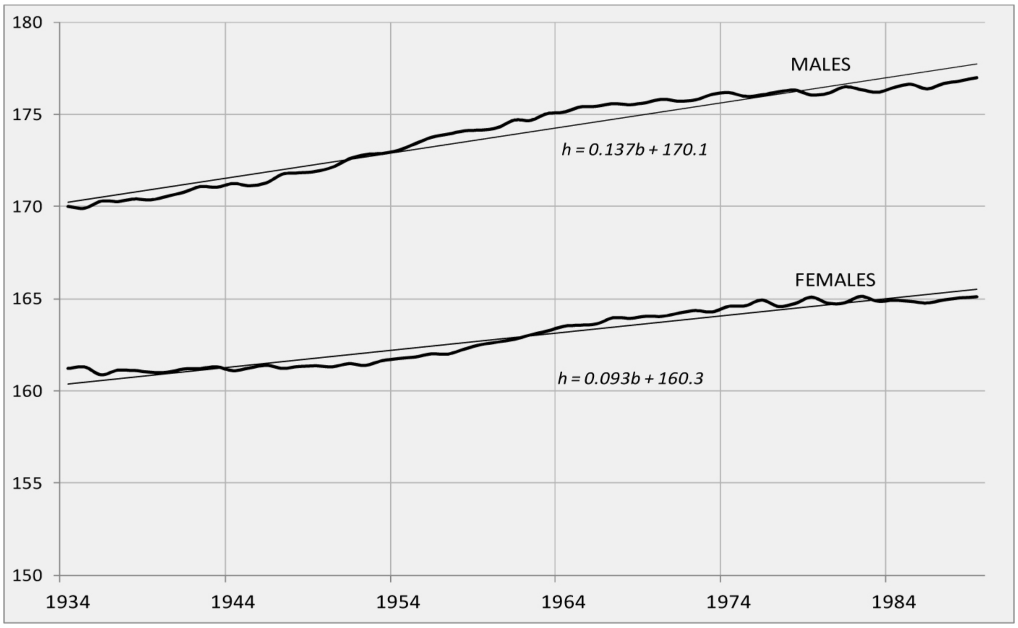

FIG. 3. Trend of the average height values of individuals born between 1934 and 1992 (aged between 18 and 64 at the moment of the interview) and linear regressions. Elaboration on Istat data.

In order to estimate the association between height and education more accurately, one must consider the geographical areas of the interviews. At the ecological level, genetic differences in height among distinct populations may play an important role – as shown, for instance, by the fact that the average height of people from Northern Europe is greater than that of people from Southern Europe [Cavelaars et al., 2000]. As a consequence, when studying the relationship between social characteristics and height, one should consider either the geographic area and the genetic population to which individuals belong. One must therefore take into account the Hardy-Weinberg equilibrium principle,[17] which states that members of a population are genetically homogeneous when they have a high chance of choosing their partner within the population and giving birth to children [Cavalli Sforza 2004: 47].

Moreover, a historical analysis by Arcaleni [2006] has shown the variability in height among Italian areas, although the difference has decreased as the rate of economic development has increased.[18]

[17] See also note 8 above.

[18] However, Arcaleni (2006) suggests that Italian economic disparities among areas may be correlated with variation in height, in addition to possible differences in genetic endowments. In this regard, we also considered models with interaction effects between height and areas, but they were not substantially significant. The only significant coefficient was "North-East*Height", but the value was very low (-0,025; standard error 0.004).

In order to investigate the diachronic perspective of the relationship between height and education in our analysis, we applied hierarchical regression models to estimate the change across time controlling for the years of birth (used as contextual units at the higher level). This technique allowed us to estimate precisely and with parsimony the contextual time effects applying only one model per gender [Snijders and Bosker 1999; Goldstein 1995]. In addition, by using multilevel models, we could control the auto-correlation within familial contexts, given that Italian families are the units of sampling of the ISTAT surveys.

We could thus appropriately measure the variation of the coefficient between height and the years of school attendance, considering all information simultaneously.

In the analysis we recoded the levels of education into years of school attendance as follows[19]:

a) Without title = 0;
b) Primary = 5;
c) Lower secondary = 8;
d) Vocational training/education (2/3 years) = 10;
e) Upper secondary (5 years) = 13;
f) University level = 18.

The models are defined by the following basic equations:

$$E_{ift} \sim N(X\mathrm{B}, \Omega)$$

$$E_{ift} = \beta_{0ift} + \beta_1 X_{1ift} + \sum_{g=2}^{G-1} \beta_g X_{gft_t}$$

$$\beta_{0ift} = \beta_0 + u_{0t} + a_{0f} + e_{0ift}$$

Where: E is the dependent variable, the years of formal education (as a proxy for social outcome); X_{1ift} is the main independent variable, height (as a proxy for inequality background); i represents individuals; f the familial context; and t is the temporal context, the years of birth. Other independent variables X_g regard the G geographical areas. The letters u, a and e denote respectively the residuals at the third, second and first level (where levels t and f are independents). Beta coefficients of the regression are the values that we wanted to estimate[20].

[19] We also tested binomial hierarchical models considering the education level as a dichotomous variable, where: "Upper secondary (5 years) or university level" = 1; "Others levels" = 0. The results of the binomial models were consistent with those of the linear models, also considering the interactions effects.

[20] We used MLWIN software.

6. Analysis of the relation between height and education

At this stage, we tested a hierarchical linear model with individuals at the first level, families and birth years at the upper levels, with the aim of confirming our initial hypothesis about the change in social inequality.

The results of the multilevel models for males and females are reported in Table 3. The intercept represents the variation of the average years of school attendance for all temporal contexts, net of the geographical area. The general average of the coefficients between physical stature and education is 0.098 for males and 0.065 for females. Thus, for every centimeter the model predicts a significant increase in years of education (i.e. for males an average difference of ten centimeters equals approximately one additional year of education).

TAB. 3. *Multilevel linear model for males and females: variation in the years of school attendance (at the moment of interview): esteem of regression coefficients and standard deviations.*

	Males		Females	
Intercept+	-7.135	(0.804)	-0.970	(0.472)
Height in centimetres+	**0.098**	**(0.004)**	**0.065**	**(0.002)**
North West	0.292	(0.029)	0.441	(0.029)
Nord East	0.121	(0.029)	0.295	(0.029)
Centre	0.516	(0.029)	0.652	(0.029)
South	0.333	(0.027)	0.009	(0.027)
Islands		0		0
Random:				
- Variation between individuals	4.80	(0.311)	4.34	(0.286)
- Variation between families	8.69	(0.313)	9.77	(0.288)
- Variation between years of birth+	33.60	(6.771)	9.70	(2.347)
- Covariance between intercept and height+	**-0.156**	**(0.033)**	**-0.032**	**(0.010)**
N		230605		236771
IGLS Deviance =-2Ln(L)		1254694		1298993

Figure 4 shows the results for males. On the left, the trend of the intercept confirms the increase in schooling. On average, it increases until? the cohorts born in the 1970s (recall, however, that those born in the late 1980s could still be tertiary students). On the right of Figure 4, the residuals (random slope variation at the *t*-level) concern the years of school attendance for each centimeter. They are significantly above the average in the 1930s and 1940s, while they are significantly below the average in the late 1960s. Hence Italian males born in the 1950s and

1960s exhibit a substantial decrease in the association between education and physical stature.

The covariance between intercept and height is -0.156 (standard error is 0.033). This means that, over the years, the association between years of education and height tends to decrease.

For females, Figure 5 shows a similar trend in the increase of education levels. More interesting are the residuals at the temporal level. They do not clearly decrease and are less important than those of males. The covariance between intercept and height for females is -0.032 (standard error is 0.010). Only a few cohorts are significantly above the average in the early 1950s and below the average in the 1980s, but the residuals are very low in absolute terms (they are all between -0.02 and 0.02).

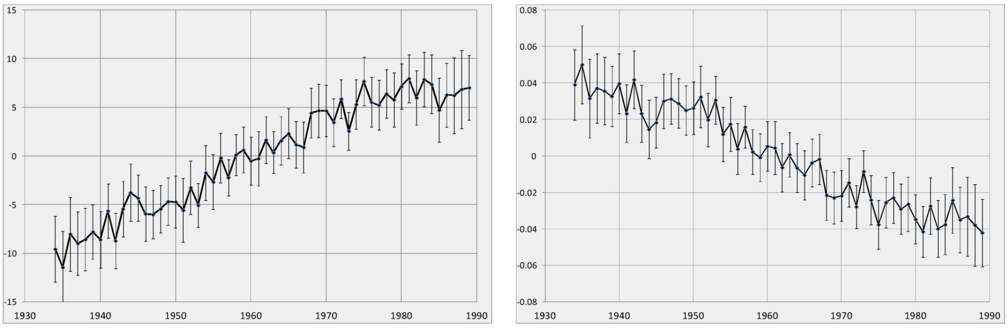

FIG. 4. Multilevel linear model for males: intercept (years of school attendance) by years of birth on the left, and residuals for every centimetre of height on the right (controlled by geographic area. Elaboration on Istat data.

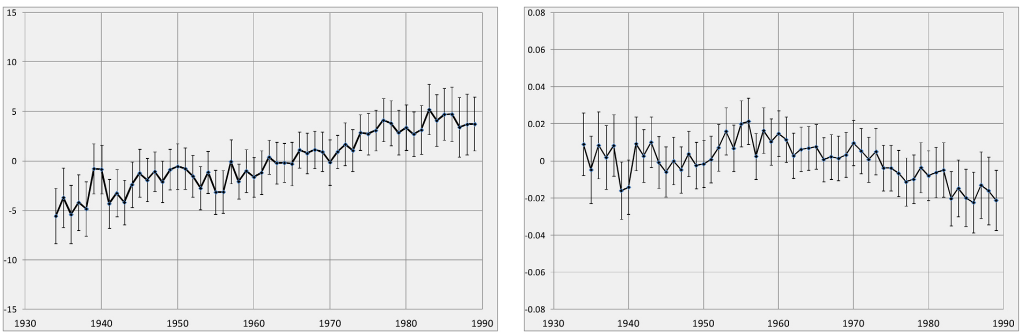

FIG. 5. Multilevel linear model for females: intercept (years of school attendance) by years of birth on the left, and residuals for every centimetre of height on the right (controlled by geographic area). Elaboration on Istat data.

7. Conclusions

This study has treated height and years of school attendance as proxies for, respectively, the distal socioeconomic disadvantages and social outcomes of individuals. In this regard, analysis of their relationship is a different way to estimate the impact of social inequalities.

The goal has been to investigate the relationship between physical stature and social characteristics, using a random sample of Italians as the empirical basis. The data used were taken from the Istat Surveys (from 1994 to 2010) concerning people aged between 18 and 39 years old, born from the 1930s to the 1980s.

The study has some limitations in regard to the data observed: we did not have objective anthropometric measures but self-declarations;[21] we did not have information about the geographical area of birth of the interviewees, we only knew the residential area at the moment of interview. These aspects introduced heterogeneity that was not controllable in our analysis. However our hypothesis concerned comparative analysis across time, so that these limitations became problematic only if we believed that they interacted with the temporal dimension. But there are no reasons to believe that people fallaciously declared their heights differently in the years of the surveys; nor is there any particular reason to believe that migrations have macroscopically changed the genetic characteristics of the Italian population as a whole [Gueresi and Del Panta 2008].[22]

Summing up, differentials in height among homogenous genetic groups of individuals indicate differences on average in their socio-economic origins. Consequently, we suppose that height is associated with educational outcome: the lower the impact of the biological determinants, the greater are the socio-economic disadvantages, thereby preventing the complete expression of an individual's genetic pool [Silventoinen 2003; Lasker and Mascie-Taylor 1989].

The relationship has been investigated from a diachronic perspective, and the data analysis revealed that height has increased on average by 0.14 centimeters per year for males, and by 0.09 centimeters for females, but the relationship between physical height and years of school attendance has remained substantially stable (on

[21] Several international surveys instead register, through experts, a certain number of variables connected to the physical conditions of the interviewees such as height, weight or blood pressure (Kumari *et al.* 2006; Sarti *et al.* 2011).

[22] We have already discussed the possibility of distortion due to migration from south to north (see above footnote 12).

average, one additional centimeter predicts 0.098 additional years of school attendance for males and 0.065 for females).[23]

More in particular, the diachronic analysis revealed that the relationship between height and education exhibits significant variation for males born in the 1950s and 1960s. Instead?, for females the variation is very slight and concentrated in the 1980s.

We cannot directly compare these results with those of other studies on social inequalities in education because the independent variable is different. Nevertheless, there is general agreement that, in Italy, since the 1950s and 1960s, educational inequalities have not substantially changed [Breen et al. 2005; Pfeffer 2008]; at most, they have slightly decreased [Triventi 2010; Barone 2009]. In particular, according to Ballarino and colleagues [2009], who stress the decrease of educational inequalities in Italy, the greatest decrease took place in the 50-59 cohort in comparison with the previous ones, and then stabilized with reference to the subsequent cohorts. This is consistent with our results, which show a slightly larger gradient for Italian males born in the years before the 1950s.

In this study we have applied an unusual method to investigate changes in social inequalities in Italy. Despite its limitations, mainly due to weaknesses in the empirical data, we believe that this study can add a different perspective to the sociological debate.

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[23] The results show that the weight of social variables is less strong for women than men. They are consistent with the so-called "invariance thesis", which states that the impact of social factors is lower for women because they have greater biological resistance to possible environmental pressures [Silventoinen *et al.* 2000a; Bostrom and Diderischen 1997; Stinson 1985]. Nevertheless, some empirical studies do not agree, pointing out the possible distortion of results due to the survey's self-declared data [Kuh *et al.* 1991; Silventoinen *et al.* 2000a].

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A different approach to investigating social inequalities

The relationship between height and education in Italy

Abstract: This study focuses on the longitudinal relationship between height and years of school attendance, considering this association to be a measure of social inequality within the Italian population. In this regard, if we think that social inequalities in education have been progressively decreasing, we should expect this relation to attenuate. To test this hypothesis, we use data gathered from ISTAT "Multiscopo" and "Condizioni di Salute e Ricorso ai Servizi Sanitari" 1994, 1999, 2001-2007 and 2009-2010 surveys (we consider about 460 thousand individuals born from the 1930s to the 1980s). Hierarchical linear regression models applied in the analysis show an important increase in the education levels and the average height of the Italian population, and a slight decrease in the relationship between height and years of school attendance for males born in the 1950s and 1960s but substantial stability in the following years. The decrease is less marked for women. The findings add evidence of a partial attenuation of social inequalities in the post-war period, but their persistence in later years.

Keywords: Height, Physical stature, Social stratification, Social inequalities, Education inequalities

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