Centre d'Estudis Demogràfics

HUMAN CAPITAL AND BIOLOGICAL WELL-BEING: A FIRST EXPLORATION OF INTRAGENERATIONAL AND INTERGENERATIONAL EFFECTS IN 20TH-CENTURY SPAIN

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Resum.- *Capital humà i benestar biològic: una primera exploració dels efectes intrageneracionals i intergeneracionals a Espanya en el segle XX*

Durant les darreres cinc dècades, Espanya ha experimentat una ràpida transició cap a nivells de desenvolupament i benestar més alts. La contribució específica del capital humà a aquest procés i la seva interacció amb el benestar biològic és un aspecte encara poc investigat dins d'aquesta transició. En aquest sentit, desconeixem fins a quin punt el creixement econòmic espanyol hauria repercutit, en termes de salut, si no s'hagués donat, en paral·lel, una millora en els nivells de formació, particularment entre les mares. Es desconeix també el paper específic que ha jugat la formació del capital humà, en la configuració de les diferències de salut entre les regions espanyoles i entre les classes socials.

En aquest treball s'explora, per a Espanya, la relació entre el capital humà i el benestar biològic de la població al llarg del segle XX,. El capital humà es troba a partir del nivell d'instrucció, mentre que pel benestar biològic s'utilitza l'alçada adulta de les generacions. Es plantegen dos nivells d'anàlisi: intrageneracional i intergeneracional, per a les cohorts nascudes entre 1910 i 1976, a partir de microdades de l'Enquesta Nacional de Salut (ENSE; edicions 1987-2006). Es combina l'anàlisi demogràfica amb l'anàlisi de regressió i s'introdueixen diverses variables sociodemogràfiques com a controladors de la relació abans esmentada.

Paraules clau.- Capital humà, benestar biològic, efectes generacionals, Espanya, segle XX.

Resumen.- *Capital humano y bienestar biológico: una primera exploración de los efectos intrageneracionales e intergeneracionales en España en el siglo XX*

Durante las últimas cinco décadas, España ha experimentado una rápida transición hacia altos niveles de desarrollo y bienestar. La contribución específica del capital humano a este proceso así como su interacción con el bienestar biológico, es un aspecto aún poco investigado dentro de esa transición. En este sentido, se desconoce hasta qué punto el crecimiento económico español habría repercutido de igual forma, en términos de salud, sin una mejora en paralelo de los niveles de formación, particularmente entre las madres. Se desconoce también el papel específico de la formación del capital humano, en la configuración de las diferencias de salud entre las regiones españolas y las clases sociales.

En este trabajo se explora la relación entre el capital humano y el bienestar biológico de la población a lo largo del siglo XX en España. El capital humano se deduce del nivel educativo mientras que para el bienestar biológico se utiliza la estatura adulta de las generaciones. Se plantean dos niveles de análisis: intrageneracional e intergeneracional para las cohortes nacidas entre 1910 y 1976 a partir de microdatos de la Encuesta Nacional de Salud (ENSE; ediciones 1987-2006). Se combina el análisis demográfico con el análisis de regresión y se introducen diversas variables sociodemográficas como controladores de la relación mencionada.

Palabras clave.- Capital humano, bienestar biológico, efectos generacionales, España, siglo XX.

Abstract.- *Human capital and biological well-being: a first exploration of intragenerational and intergenerational effects in 20th-century Spain*

During the last five decades, Spain experienced a rapid transition towards high levels of development and well-being standards among Western societies. The specific contribution of human capital to the attainment of high development levels and its interaction with well-being and its biological components remains understudied. It is ignored to what extend economic growth and modernization would have rendered in terms of health without the improvement of educational status, particularly among mothers. It is also unknown to what extent differences in health status among Spanish regions and social classes are due to the human capital factor.

In this paper it is aimed to explore the relationship between human capital formation and the biological wellbeing throughout the 20th century in Spain. The former will be approached by educational levels whereas cohort adult height will serve as a proxy of biological well-being. We will study both intra and intergenerational effects of human capital accumulation on the biological well-being of the Spanish population born between 1910 and 1976. A number of sociodemographic and socioeconomic characteristics will be used as control variables. The bulk of this work is based on microdata from the waves of the Spanish National Health Survey (ENSE) held between 1987 and 2006. Demographic analysis together with regression techniques form the core of the methodology.

Keywords.- Human capital, biological well-being, cohort effects, Spain, 20th Century.

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HUMAN CAPITAL AND BIOLOGICAL WELL-BEING: A FIRST EXPLORATION OF INTRAGENERATIONAL AND INTERGENERATIONAL EFFECTS IN 20TH-CENTURY SPAIN[1] [2]

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1.- Aims and research hypothesis

The implications of the socioeconomic modernization for the rise of living standards experienced by Spain during the second half of the 20th century have been well studied. In turn, the specific contribution of human capital and its interaction with some variables at the macro level remains less studied issues. Actually, it is not straightforward to distinguish the effect of the shifts in key qualitative aspects of human capital (like education and health) from the general process of modernization and economic growth upon the several dimensions of human well-being throughout the 20th century and particularly since the decade of 1950. Alternatively, indirect approaches based on data at the micro level may render some results.

In this paper it is aimed to explore the relationships between human capital formation (approached by educational attainment) and the biological aspects of well-being reflected by a *net nutritional status* indicator like height is (the result of energy intake mainly from food minus the energy expenditure mainly derived from the exposure to illness and the physical effort until the physical growth of individuals ends). The related literature is extensive to this latter respect. In very few words, the height reached by an individual in

[1] Associated research projects funded by the Spanish Ministry of Science and Innovation: "*Implicaciones Sociodemográficas de las condiciones de salud en las edades adultas"* (CS02009-09851) and "*Demographic behaviours and social integration of immigrants and their children in Spain*" (CSO2008-04778/SOCI).

[2] First draft. Authors acknowledge not citing without permission.

adulthood is accepted to mirror the interaction between genetics and the environmental living conditions until the physical growth process ends. Thus, within a genetically uniform population, environment (that may even influence during the prenatal period; Roseboom *et al*, 2006) prevails in determining the adult height and its trends over time and among different birth cohorts. Infancy appears to be the most critical period so that height at early childhood has extensively demonstrated its predictive value on the final height reached in adulthood (Chen and Zhou, 2007).

The relationships between human capital formation and biological well-being will be considered from two different perspectives that are supplementary. On one hand, it is aimed to observe how determining the educational attainment is in explaining the net nutritional status of different Spanish cohort groups (i.e. to what extent education explains the height differentials within different cohorts once other individual sociodemographic characteristics are controlled for). We will refer to this approach as *intragenerational*. On the other hand, it is intended to capture the lagged effect of education on height by establishing an ecological research design that simulates the transfer of human capital formation in favor of descendants (*intergenerational* effects). While the former approach does not imply any *a priori* causation, the latter assumes that the educational attainment of progenitors (particularly of mothers) has a positive effect on their descendants' biological well-being. For these purposes, data on Spanish cohorts born since the beginning of the 20th century and until the 1980 are utilized, thus properly covering the central stage of the health transition process as well as the initial period of socioeconomic modernization that brought Spain into the group of most developed countries.

We hypothesize that intragenerational effects of human capital formation decrease among younger cohorts due to the improvement of nutrition and sanitary conditions and the spread in the access to health services and a broader range of commodities. In other words it is expected educational attainment to have determined more importantly the biological well-being of the Spanish population as we consider older cohorts due to the ties between education and socioeconomic status (the latter mediating the access to basic resources, a healthier environment and an easier escape from hardship). Conversely, educational attainment is expected to be a weaker determinant amongyounger cohorts due, for instance, to the spread of compulsory schooling and the progressive attainment of higher educational levels on the part of an increasing percentage of the population.

2.- Basic synergies between health, human capital and well-being

Human *well-being* encompasses many dimensions of living conditions and lifestyles. Actually it has tended to be identified with the concept of *quality of life* which includes not only objective but also a good number of subjective components. Whatever the meaning, health strongly contributes to activate many of the well-being vectors. Illustratively, the health transition processes (Frenk *et al*, 1991; Caldwell, 1993) are one of the most solid evidence of the improvement in general well-being standards. In addition, health is a qualitative component of human capital so that it can be interpreted as both a means and a final output of human capital at different levels (Ross and Wu, 1995). Conversely, human capital formation empowers people so that key areas of human development such as health are effectively promoted. Well educated people usually self-report good health while poor health levels are likely to constrain the individual's educational attainment.

Regarding only one direction of this association, there exist diverse paths through which education and health education may influence health. The strength of this association depends on both the individual's educational attainment and its relative level with respect to its surrounding social environment. In general, an improved access to health-related information and an improved capacity to manage such information promote preventive health since this favors adequate health related behaviors. Also, a more precise and realistic perception about the health risks associated to behaviors and lifestyles favors a higher degree of self-control, healthier time-use preferences, etc. Furthermore, private and public health care provision, occupational hazards, consumption patterns and income are also dimensions more or less mediated by the educational attainment.

Finally, it is worth noting that these interactions between health and education are often mediated by development levels at a macro level and by socioeconomic status at the micro level.

3.- Health, human capital and cohorts

Health and human capital are submitted to demographic dynamics. As a population projection is based, among others, on the expected reproductive behavior of a given group

of cohorts that works as baseline, the characteristics of human capital at present, including health, result from dynamics or addressed interventions that took place years or decades before. Likewise the more or less promising future of a society in terms of empowerment greatly depends on what is being done today.

The cohort adscription is the *historical DNA* of a person which reports on the general living conditions at a macro level along the life course. For instance, those Spaniards born in 1937 areassociated with a context of war and scarcity during their infancy and adolescence although the situations might have varied depending of diverse sociodemographic factors at the micro level (sex/gender, household socio-economic status, parent's education, etc.) By aggregating those historical DNA's we obtain both the quantitative and qualitative dimensions of the human capital of a society, say, at present.

The formerly described associations between health and education stand not only within a generation but also between generations through lagged effects that remarkably are not unidirectional (descendants with higher education may influence their progenitors health related behaviors in a positive manner). Traditionally, it is the transfer from older to younger generations what have mattered. To this respect, education may have a benefiting effect at the basic levels of health care: hygiene, maternal practices and nutritional habits in the domestic context. Illustratively in developing countries infant mortality levels and mothers' education are inversely correlated so that a final output health indicator is partly determined by one dimension of human capital established one generation earlier. In this and other examples, as the well-beingstandards of a society rise, it is more complex to assess these associations due to both very low levels of infant mortality and the spread of high educational levels among mothers. Consequently, for the most partwe may coincide that both the intensity and velocity of sociodemographic changes may shape the above described associations.

Causation is probably better captured as faster the transition in any field of well-being happens. Accelerated transitions have been and still are typical of developing countries whereas those countries with high well-being standards have usually transitioned more gradually. Health illustrates this. In current developed countries, the bulk of the health transitions occurred between the middle of the 19th century and the first decades of the 20th century. In these cases the study of the relationships between health and human capital are partly an issue of historical demography. Exceptionally, some current affluent societiesreached their high-development statusrelatively late as they performed rapid

socioeconomic and health transitions. In Western Europe, Spain is an example of this whereby the central stage of the health transition process took place during the 20th century. Furthermore, there was wide room for improvement during the second half of that century since the residual adverse effects of the Civil War and the subsequent autarchy period held back the Spanish economy until the end of the 1950's. For instance food security was not fulfilled until the middle of the 1950s. Likewise the access to elementary education was not generalized until the last quarter of the 20th century because the access to education represented an almost unreachable opportunity cost for many families. As a consequence, until the second half of the century, child labor –remained as one of the main cause of truancy and high illiteracy rate. It was not until the economic recovery and after the generalized literacy campaigns of the 1960's that Spain walked towards the total school enrolment of the population between 6 and 12 years of age.

In Spain many people that experienced those changes were still alive at the time that the Spanish health survey system began to develop at the end of the 1980s. This favored that health interview surveys in Spain could provide information on cohorts with very different lifestyles and vital experiences in terms of well-being (from those variably affected by scarcity, poverty and –in some cases- famine to those born in a context of affluence). Moreover and interestingly, older cohorts have witnessed the bulk of this transition and have also benefited from the dramatic improvement of living standards occurred during the second half of the 20th century as reflected by health and education indicators. Given that the health interview surveys do not only collect information on health but also on a variety of sociodemographic variables, they provide the opportunity to study the interaction between health and human capital in a context of transition from scarcity to affluence in a currently high developed society. Two approaches will be developed in this paper: intra-generational and inter-generational.

WITHIN a given group of cohorts (which may not strictly match a 'generation' as defined by cultural or historical facts) the biological well-being may present differences related to educational level once other variables have been controlled for. These differences may also vary in time and across subpopulations but all in all we are analyzing the impact of educational attainment on the biological living standard within a given cohort or group of cohorts. We then define these effects as intra-generational.

BETWEEN successive cohorts or cohort groups lagged effects of human capital on biological well-being may exist as described above for the case of infant mortality. These

effects are associated with reproductive behaviors and thus they cannot be studied by defining arbitrary groups of cohorts or even 'generations' as commonly accepted. In this case, the length of the lag matters and must be established in demographic (i.e. reproductive) terms. For instance, it can be done by regarding a period of about 30 years between the potential progenitors and the potential descendants. In absence of panel data (i.e. a longitudinal follow-up) these transfers have to be simulated through an ecological research design as detailed below. Alternatively, since the household head's educational attainment is sometimes provided, a different approach based on this variable is also presented. The latter requires the previous identification of a potential relationship progenitor-descendant by regarding the age gap between the respondent and the household head.

4.- Data

The bulk of this work is based on the microdata from the adult samples of the Spanish National Health Survey (ENSE; waves 1987-2006). The microdata from these waves were aggregated into one large database (Table 1).

Table 1.- Initial size of the aggregated database

Wave	Frequency	Percentage	Cum.
1987	29.647	23,0%	23,0%
1993	21.061	16,3%	39,3%
1995	6.396	5,0%	44,3%
1997	6.396	5,0%	49,2%
2001	21.067	16,3%	65,5%
2003	21.650	16,8%	82,3%
2006	22.833	17,7%	100,0%
Total	**129.050**	**100%**	

This is a cross-sectional survey (there is no follow-up of individuals) and the sampling methods follow the traditional multi-stage method with proportionality criteria by sex, age and place of residence. Data are representative at a national level through the weight coefficients provided. In this paper, these are used in the descriptive analysis of some variables (i.e. height) but not in the models. All the information is self-reported and collected through *face to face* interviews (to ensure the comparability between surveys and

to homogenize the respondent type in the final unified database, only direct informants have been selected; proxies were used in the surveys of 2003 and 2006 and they have been discarded for the analysis). Also, only Spanish nationals have been selected.

The aggregation of the microdata from the different waves of ENSE allows to obtaining a good representativeness of cohorts born throughout the 20 century. This Also permits to observe the evolution of the key variables of the study for each group of cohorts over time. To this respect, it is important to note that previous studies based on the ENSEhave shown that the mean height of a group of cohorts remains very stable once adulthood is reached. The same may be expected about education for which a threshold of 25 years of age has been established.

Data on educational level, occupation and income were not uniformly coded over the ENSE waves. Thus these variables have had to be re-coded as described next.

Our initial final sample had about 129,000 cases. Of them, a different number of valid cases have been utilized for the different analysis and approaches depending on the variables involved and the model specification (Table 2).

Table 2.- Valid cases by variable[3]

Variable	Valid cases	% valid
Age	101.546	78.7%
Age (household)	90.132	69.8%
Civil Status (household)	90.097	69.8%
Educational attainment	98.808	76.6%
Educational attainment (household)	87.604	67.9%
Habitat	101.535	78.7%
Height	101.546	78.7%
Income	100.823	78.1%
Occupation	87.919	68.1%
Occupation (household)	88.018	68.2%
Occupational status	101.274	78.5%
Occupational status (household)	90.045	69.8%
Sex	101.546	78.7%
Sex (household)	90.170	69.9%

[3] In order to recover some missing values for height and age (i.e. cohort) we run a multiple imputation (three runs) that was later used to summarize the information in a variable that took the mean value of those imputations. The advantage of a multiple imputation is its higher accuracy and that it does not assume any distribution pattern of the missing values but a specific pattern previously done *ad hoc*. In this way, this imputation system fits the level of randomness of the missing values.

Age and sex

The survey asks for the age of the interviewee at its last birthday. Sex is coded as male or female.

Cohort

The birth year is only provided in the last two surveys (2003 and 2006). In the rest of waves (1987-2001) the birth cohort is computed by subtracting the self-reported age to the year of survey. Since most of the surveys were taken either throughout a year or preferably during the central months, it is expected that the computation does not affect the actual cohort adscription distribution. The aggregation of cases in cohort groups also prevents potential biases in this sense (Table 3).

Table 3.- Distribution of cases by age and cohort. Aged 25+

Cohort / Age	**25-34**	**35-44**	**45-54**	**55-64**	**65-74**	**75-84**	**85+**	
Born until 1929				3.161	7.874	8.492	1.894	**21.421**
1930-1939			3.837	6.574	7.818	639		**18.868**
1940-1949		3.371	6.901	7.272	593			**18.137**
1950-1959	3.653	7.604	8.154	656				**20.067**
1960 -	18.689	11.448	775					**30.912**
Total	**22.342**	**22.423**	**19.667**	**17.663**	**16.285**	**9.131**	**1.894**	**109.405**

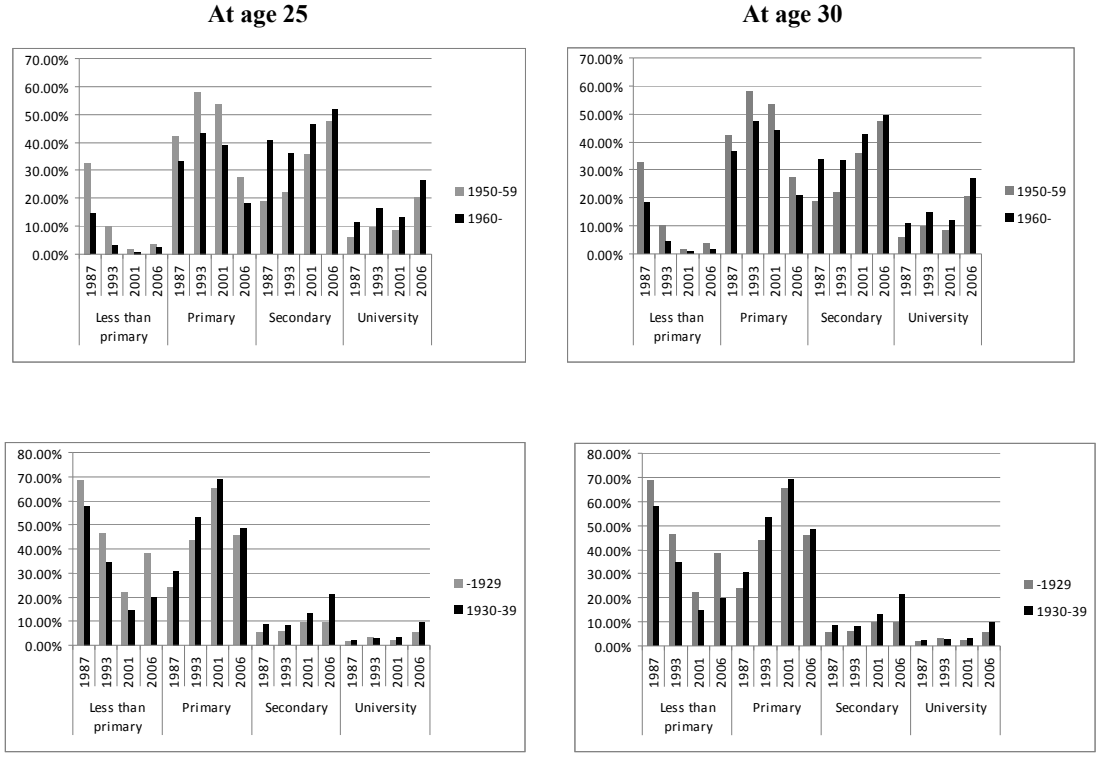
Educational attainment

We have taken into account the educational attainment at 25 years-of-age on the basis that that even among the younger cohorts analysed most of individuals are not expected to have improved substantially their educational level after that age (Group of Figures 1).

Particularly for older cohorts, the selection effect (more life expectancy for those more educated) may shift the distribution of the educational attainment as well as adult schooling which was strongly promoted in Spain during the 1980s and 1990s. Also for younger cohorts a margin of improvement after age 25, though narrow, is observed. However, the large variations observed in the distribution (especially those happened in the

low educational levels) for a given group of cohorts at the four moments displayed in Group of Figures 1 has to do with changes in the wording and the response set of the survey that cannot be fully harmonized as explained next.

Group of Figures 1.- Distribution of the educational attainment by cohort group



The educational level is provided in different ways throughout the waves of the ENSE. The person interviewed was sometimes asked for the years of education and sometimes for the highest degree of education attained. Also the educational degrees are not uniform in the response set due to the changes in the educational system happened during the last five decades in Spain. Consequently, we had to harmonize this variable to finally obtain four categories:

1. *Less than primary*: individuals who did not complete the first degree at school which implies less than six years of schooling. This category includes both literate and illiterate people (it is not possible to distinguish between these two categories in all the waves of the ENSE).

2. *Primary*: individuals who did complete the first degree at school. They are all literate and spent at least six years at school.
3. *Secondary*: individuals who completed a second degree at school (old system), the secondary school (new system) or obtained a professional training degree (new system and equivalent to secondary school in total years of schooling).
4. *University*: individuals who obtained a university degree, PhD, or equivalent in the old system.

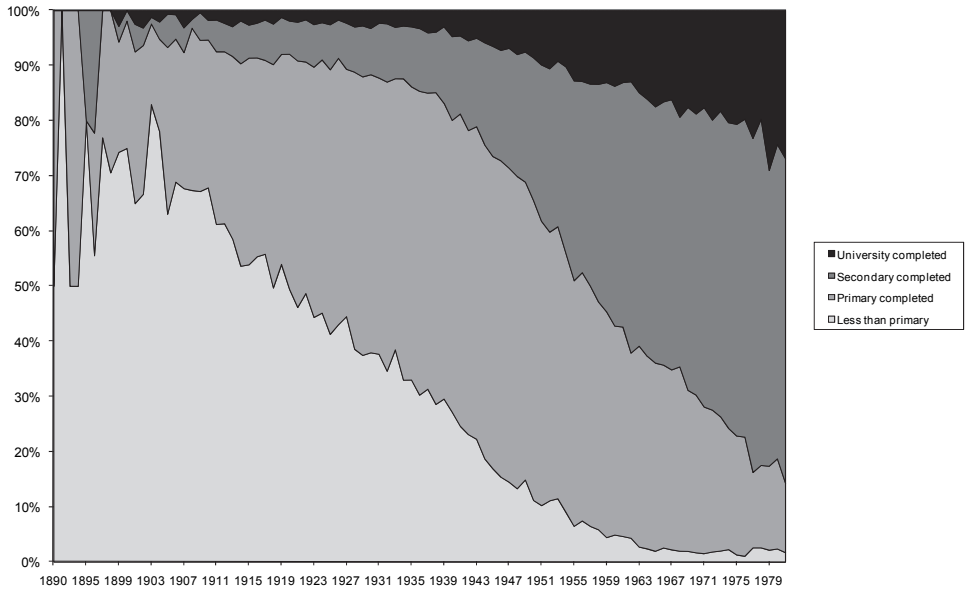
The four moments of observation selected in Figure 1 match the changes in the response set of the survey. For instance, in 1987 and 1993, the response sets were (in ordinal scale):

1987	**1993**
Less than 6 sch-yrs cannot read	No studies
Less than 6 sch-yrs can read	Studies finished at 14-15 years
Primary studies completed or general culture	Studies finished at 16-19 years
Professional Training	Further studies (no university)
Secondary School (elementary)	University
Secondary School (High)	
Intermediate Degree	
University or High Degree	
Others	

From Figure 1 we may also conclude that the decrease in the first level (less than primary) and the almost proportional increase in the second one (primary) between 1987 and 1993 for any cohort group is the result of the change in the wording and codification system. We hypothesize that those literate together with those who attended school (even without finishing the primary degree) rejected to respond 'No studies' in 1993. In our study, this is the only category that can be merged with the two first categories in 1987. In consequence, the lowest level of our re-coded scale may have lost weight in the proportional distribution of the educational attainment within a given group of cohorts. However, the relative differences in the educational attainment of the cohort groups stand in time and its trends by cohort are very coherent as displayed in Figure 2. Finally, education is a variable introduced in the models at the individual level and the response set reflect its differentials

despite the aforementioned changes. For these reasons, all in all, the self-reporting of this variable must be considered solid and adequate for our purposes.

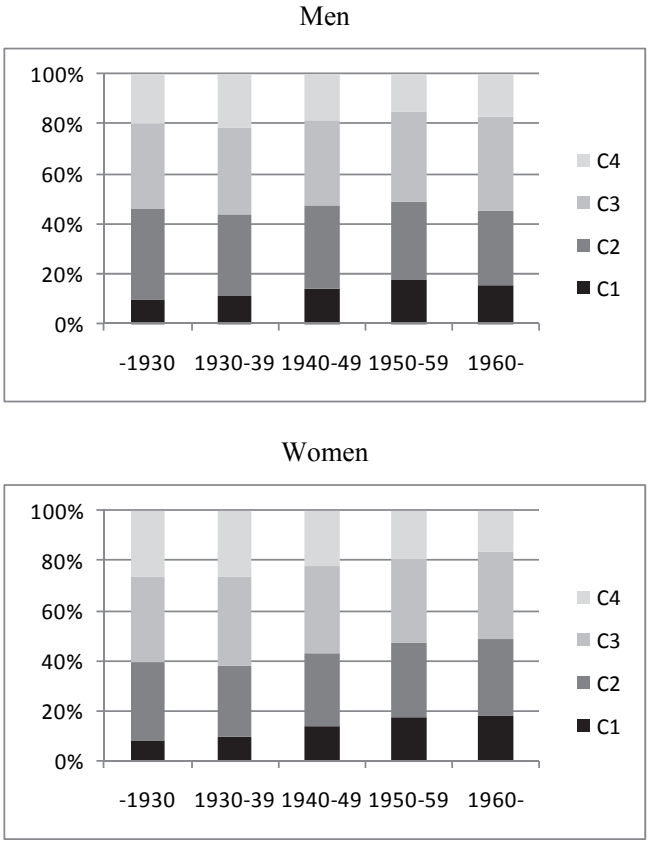
Figure 2.- Educational attainment by cohort



Occupation

The occupation has been harmonized following the simplest codification among the waves of the ENSE. In few words, the last wavesprovide the occupation in a much more detailed way (i.e. through the four-digit codes of the National Classification of Occupations - CNO79 in 2001 and CNO94 in 2003 and 2006- whereas the early waves only include the occupation in broad categories (i.e. skilled workers, non-skilled workers, etc.) Fortunately, the last waves also include a so named CLASS variable that consists on the aggregation of the occupations into seven broad categories that are roughly equivalent to the former response sets. Thus we have been able to harmonize this variable in four categories: CLASS 1 (High positions in public administration, big entrepreneurs and liberal professions); CLASS 2 (Intermediate positions in public administration, small entrepreneurs and white collar workers); CLASS 3 (Skilled workers); CLASS 4 (Unskilled workers).

Figure 3.- Distribution of occupation by sex and cohort group. Age 25+



Income

No data on income is provided in the waves of 1993 and 1995. The household annual income is provided in the rest of waves as a categorical variable defined in intervals. We have opted to merge them into three new categories: *low*, *medium* and *high*. While no deflector has been applied we do take into account the trend followed by prices in Spain between 1987 and 2006. For instance, the lowest interval of a medium income in 1987 was coded as low income in 1993 due to the inflation process experienced during those years. Income *per capita* is computable because the surveys provide the household size but we have opted to regard household income as representative of SES regardless the household size (Tables 4 and 5).

As for the rest of key variables, it can be observed that the missing values are randomly distributed by cohort and sex.

Table 4.- Distribution of household income by cohort group. Age 25+

Cohorts	0	High	Low	Medium	NA	(without details)	Total
-1929	4.858	1.613	7.687	5.583	1.451	229	21.421
1930-1939	3.980	1.231	5.393	6.372	1.773	119	18.868
1940-1949	4.048	1.443	2.926	7.417	2.160	143	18.137
1950-1959	4.453	1.717	1.932	9.398	2.409	158	20.067
1960-	4.888	1.920	3.145	16.425	4.426	108	30.912
Total	22.227	7.924	21.083	45.195	12.219	757	109.405

Table 5.- Distribution of household income by sex. Age 25+

Gender	0	High	Low	Medium	NA	(Without details)	Total
Men	10.623	4.054	8.185	21.113	5.318	533	49.826
Women	11.604	3.870	12.898	24.082	6.901	224	59.579
Total	22.227	7.924	21.083	45.195	12.219	757	109.405

Habitat

The type of habitat (*urban* / *mixed* / *rural*) reports on the place of residence at the time the interview was held. No information on the place of origin is provided in the survey. The categories have been set as follows:

Rural: municipalities with less than 10,000 inhabitants

Mixed: municipalities from 10,000 to 50,000 inhabitants

Urban: municipalities with more than 50,000 inhabitants and capital cities regardless the population size

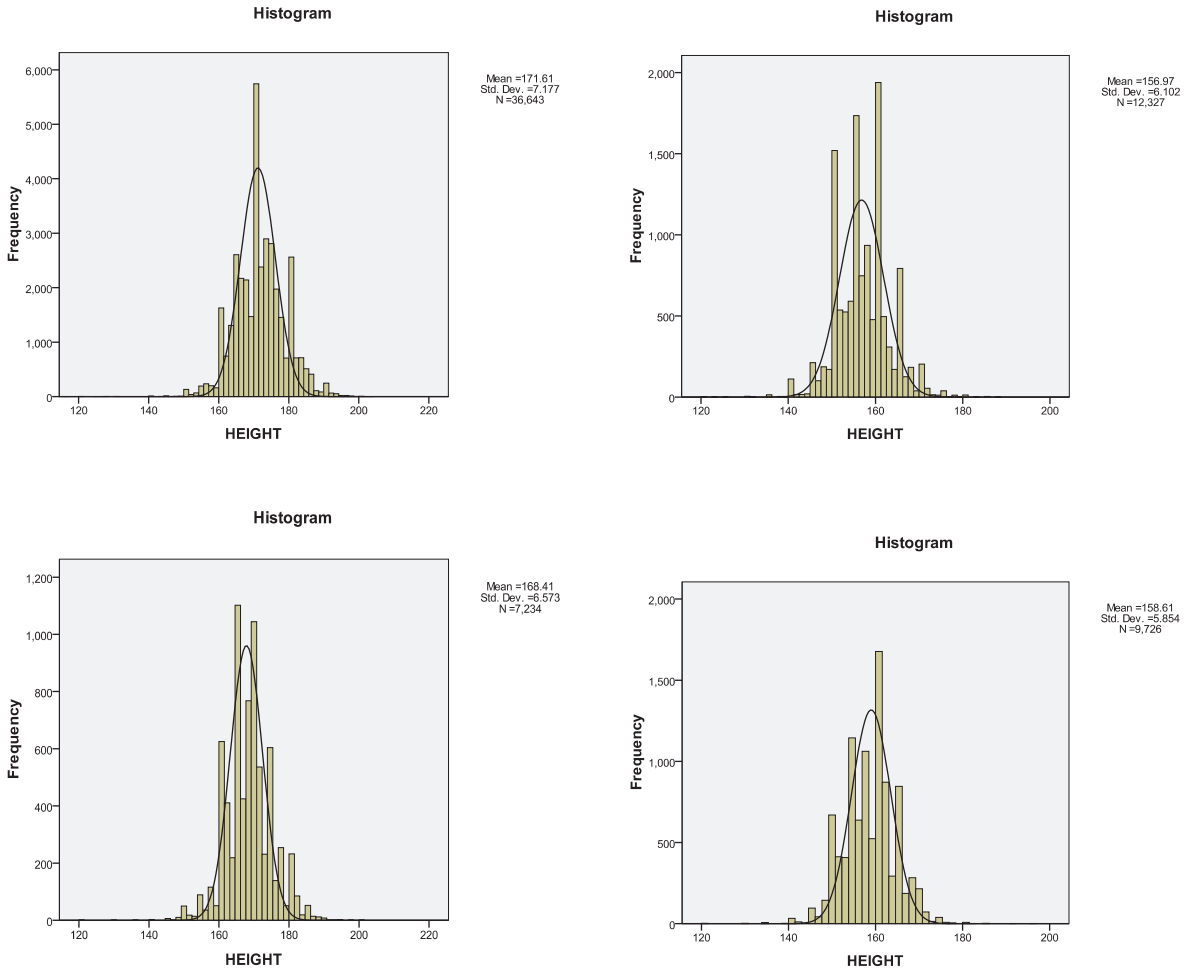
Height

Height is provided in centimetres and the question wording (uniform across surveys) specifies that it must be regarded without shoes ("*¿Cuánto mide, aproximadamente, sin zapatos?*"- *Approximately, what is your height without shoes?*) In previous works the high stability of the mean cohort height among different waves of the ENSEwas assessed (Spijker et al., 2008). This confirms that cohort height remains relatively constant once

adulthood is reached. More importantly, this permits that cohort adult height –used as a final-output indicator of the biological components of well-being- could be disaggregated by other variables.

Additional tests must be carried out to assess the adequacy of self-reported height. The height distribution must have a relatively normal shape and also the standard deviation must keep relatively constant over time and across subpopulations (Group of Figures 4).

Group of figures 4.- Height distribution by cohort group and sex



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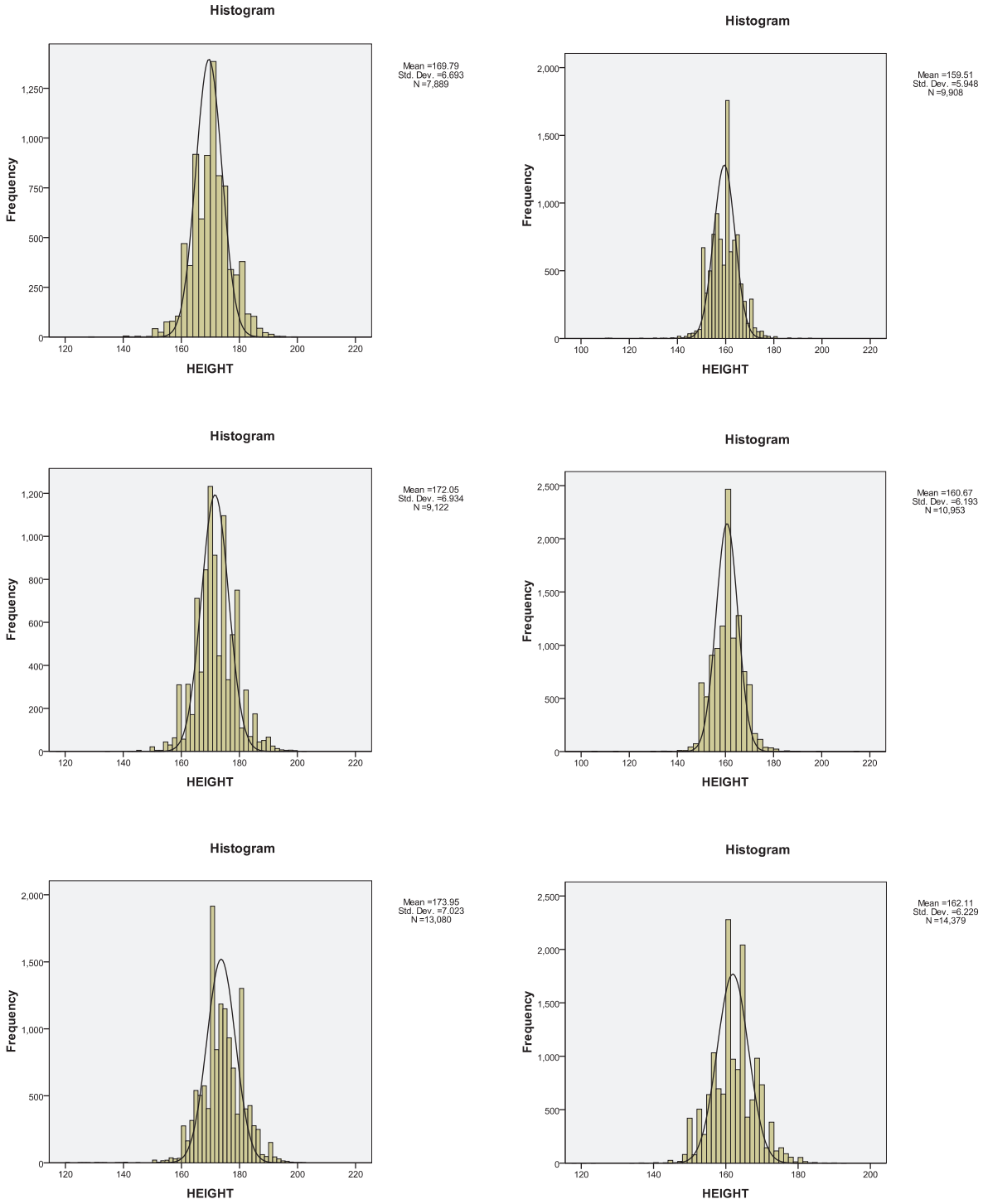


Finally, sex dimorphism remains within the biologically normal margins theorized by Auxology (Bogin, 1998).

5.- Methods

5.1.- Intragenerational effects

We established five cohort groups that roughly fit with historical periods and socioeconomic contexts in Spain during the 20th century. Moreover it is pursued to obtain a good representativeness for all cohort groups as well as to avoid a too biased age distribution in the open groups. These criteria result in the following cohort aggregation (with a succinct description of the historical context):

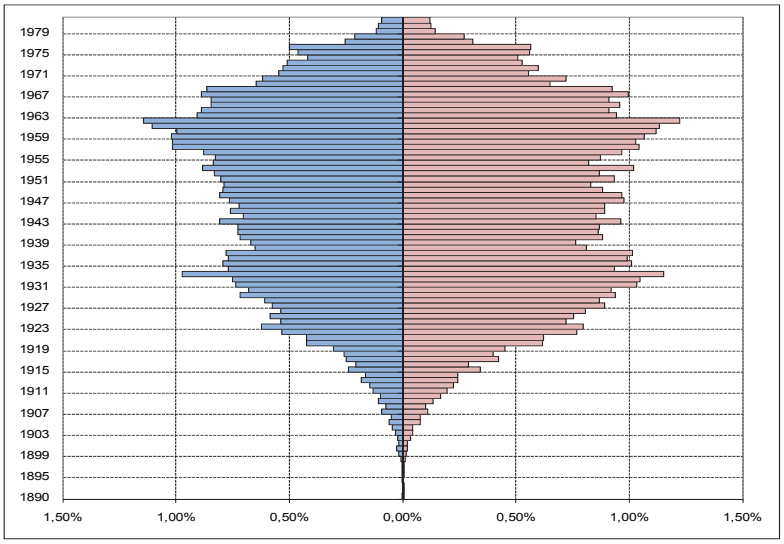
- Cohorts born before 1930 (Economic growth and transformation of productive structures)
- Cohorts born 1930-39 (Second Republic, economic downturn and Civil War period)
- Cohorts born 1940-49 (Post-war decade, economic Autarchy)
- Cohorts born 1950-59 (Economic recovery, attainment of food security, urbanization process)
- Cohorts born after 1959 (Strong economic development, convergence with Western Europe in well-being standards)

Table 6.- Distribution of potential observations by sex and cohort. Aged 25+

Cohort group	N	% Men	% Women	%Total
-1929	21421	8.08	11.50	19.60
1930-39	18868	7.57	9.68	17.25
1940-49	18137	7.53	9.05	16.60
1950-59	20067	8.89	9.45	18.34
1960-	30912	13.48	14.77	28.25

The open groups include cohorts born since 1890 to 1929 and since 1960 to 1981 (Figure 5). The latter was preferred to be more populated instead of being subdivided in two groups (in that case, the last group would have contained about 10,000 cases and would have been noticeably younger). In addition, there is not a large socioeconomic gap between the decades of 1960 and 1970.

Figure 5.- Sample distribution by cohort and sex. Age 25+



5.2.- Intergenerational effects

In order to estimate the effects of development policies and social mobility within generations, we have specified an intergenerational effects model using parental attainment as main proxy. As we have mentioned before, ENSEdoes not provide a longitudinal sample.Two different definitions of a 'generation' were used in our analysis. Even when the magnitude of the effects could differ between models, the aim of these specifications was to show if there is an intergenerational effect between the educational attainment of the *X-1* on the *Xth* generation biological well-being measured by height. Higher parental education is associated with more substantial family investments in children, and these investments have an effect far greater than the societal educational investments made when the child enters school (Ridell, 2006). Children of more educated parents generally perform better in school and in the labor market, and have better health.

First, given that mother's educational attainment effect on height and health has been previously shown (Behrman and Skoufias, 2004) we have included a proxy for the mother's educational attainment. Following Lee and Goldstein (2003), we have assumed a life cycle in which pre-adult lifelasts until age 30, letting reproduction occur at that same age. Then, considering the cohort of birth of the i^{th} individual, we have approximated the mother's characteristics by estimating the attainment of the (*i-30*)'s female cohort. Even

when this is not a precise method, it will let us approximate the effect of a generation over their potential offspring. Also, the social expenditure as percentage of the GDP per year has been used in order to include the effect of social policies over children development.

Generations were defined according to key Spanish economic and political changes following the following distribution:

- Individuals born before 1939, when Franco's government was instituted. Individuals born during this period suffered from malnutrition and the limitations of the autarchic economic system, registering a height decline that in some cases represented 2 cm. (Martínez Carrión, 2005).
- Individuals born between 1940 and 1969, consistent with the decline and subsequent economic growth.
- Individuals born after 1970, when economic development and institutional changes lead the country into the EEC. Favourable economic conditions lead to a rapid recovery of biological well-being displayed by height and other health indicators.

Finally, household's head characteristics were used as a proxy of parental variables. The sample was limited to those households where age difference between the household head and the individual was between 15 and 49 years and heads are at least 25 years old. We have included also non-direct respondents in the sample and we have considered the household's head cohort in order to establish the different generations. Given the cohort distribution of the resulting database, two parental generations were defined as:

- Parents born before 1930
- Parents born in 1930 or later

5.3.- Selection effects

Since the main objective of this work is to capture the net effect of human capital on biological well-being, a number of additional factors, aside of individual sociodemographic characteristics, must be controlled. Mortality is one of them due to its potential selection-related effects on adult cohort height. It is worth noting that mortality plays a double role in terms of selection: the taller are likely to live longer and consequently more likely to be

surveyed at older ages. It means that respondents from older cohorts may own a selective bias with respect to the dependent variable (a review of the related literature in Alter, 2004).

In a similar manner, the percentage of high educated interviewees within the older cohorts is likely to be overrepresented. Although it is not the aim of this paper to cope with these issues specifically, we have tried to partly control for these effects by including a straightforward measure of mortality that summarizes the strength of selection during early life for each individual according to its cohort adscription. We have named this *selection coefficient*. Mortality conditions affect a birth cohort throughout the whole life cycle. However and for parsimony purposes in this work, since a good part of the selection effect occur at early ages, only infant and child mortality have been taken into account to construct this indicator which is given to each individual included in the database. Also, in terms of well-being, infant mortality can be used as a proxy of access to health services not only during pregnancy and birth but during the first years of life. In that sense, it also can be seen as an indicator of development; the analysis of physical stature must account not only for health and nutritional inputs but also for workload and labor organization (Steckel, 1995). The data have been obtained from the Human Mortality Database and this coefficient has been computed as follows.

A male born in 1930 is given a selection coefficient that is the weighted average of male mortality rates between ages 0 and 5 in 1930. By weighting the average it is intended to capture the changes in the epidemiological pattern over time (i.e. the variation in the percentage of infant and child mortality rates). This weighting is made just by previously computing the relation between m0 and m1-4. In this way we are giving a synthetic mortality level to each cohort also distinguishing by sex. Then, the selection coefficient $SC = f(M_{0\,1}, M_4)$ is defined as:

$$X_{it} = \left(\frac{M_0}{{}_1M_4} \over \frac{M_0}{{}_1M_4} + 1 \right)_{it} \quad (1)$$

where:

$$i = \{male, female\}$$
$$t = \{cohort\} = 1908,...,1981$$

Then, the selection coefficient can be defined as:

$$SC_{it} = \left[\frac{M_0 \cdot X + {}_1M_4 \cdot (1 - X)}{2} \right]_{it} \quad (2)$$

where:

$$SC_{it} > 0$$
$$\frac{\partial SC}{\partial {}_1M_4} < 0 \quad (3)$$

Consistent with the *a priori* expected, the selection coefficient reaches its maximum on the cohorts of 1920 for men and 1918 for women, related to Spanish flu pandemic deaths and war deaths among males.

5.4.- Model specification and results

Intra-generational effects

As we have mentioned before, several models were estimated depending on the study of inter-generational or intra-generational effects. Intra-generational effects were estimated considering the sample of 25+ year-old direct respondents following the next model:

$$h_{ij} = h_{0j} + \beta_j X_{ij} + \gamma_j Y_{ij} + \varepsilon_{ij} \quad (4)$$

where:

h_i = height of the i^{th} individual (in centimetres)
X_i = matrix of individual characteristics
Y_i = matrix of familiar/contextual characteristics
i = {1, … , n} individuals
t = {until 1929, … , after 1960} generations

Individual characteristics included educational attainment, the selection coefficient and occupation. All analyses were done for men and women separately. Results can be seen on Tables 7a and 7b.

Table 7a.- Regression coefficients. Adult height regressed on socio-demographic variables. Intra-generational effects among males

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	1.004779	0	0.9480576	0	0.9187699	0	0.8756881	0	0.7880663	0	0.8760258	0	0.8628577	0	0.7448808	0
Secondary completed	2.888679	0	2.843164	0	2.739524	0	2.486241	0	2.293504	0	2.619378	0	2.555346	0	2.233927	0
University completed	3.361255	0	3.307111	0	3.18085	0	2.481689	0	2.290706	0	3.070043	0	2.996411	0	2.2163	0
Selecion Coefficient			-38.15439	0	-38.24642	0			-39.54316	0	-39.04524	0	-39.0917	0	-39.69418	0
Habitat																
Mixed					0.3220708	0.112			0.4662682	0.024			0.3197141	0.119		
Urban					0.3640673	0.035			0.5106824	0.004			0.2557901	0.142		
Income																
Low											-0.6565197	0.001	-0.6271486	0.001	-0.6493572	0.001
Medium											0.1027183	0.594	0.1124948	0.56	0.0865949	0.658
High											0.8651231	0.002	0.876194	0.001	0.9120472	0.001
Occupation																
Class 1							1.068461	0.005	1.068751	0.005					1.006028	0.008
Class 2							0.3764181	0.132	0.5497915	0.028					0.3424	0.177
Class 3							-0.1528064	0.557	-0.1676108	0.521					-0.1909132	0.467
Class 4							-0.5943387	0.028	-0.4957431	0.068					-0.6018195	0.029
Constant	166.2605	0	169.1036	0	168.9171	0	166.363	0	168.9506	0	169.3295	0	169.1606	0	169.5089	0

Generación 1930-39

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	1.012772	0	1.012774	0	0.9932682	0	0.9649039	0	0.9395719	0	0.9466485	0	0.936147	0	0.9072337	0
Secondary completed	3.160302	0	3.160576	0	3.109616	0	2.755831	0	2.677817	0	2.957821	0	2.937134	0	2.593816	0
University completed	4.723894	0	4.725558	0	4.659855	0	4.033237	0	3.935403	0	4.345532	0	4.318418	0	3.703326	0
Selecion Coefficient			-8.264654	0.605	-8.511039	0.595			-5.409657	0.737	-9.922626	0.536	-10.23427	0.524	-7.46555	0.645
Habitat																
Mixed					-0.1825119	0.377			-0.0467431	0.823			-0.2476574	0.233		
Urban					0.1232057	0.471			0.2293558	0.188			0.0190258	0.912		
Income																
Low											-0.7470099	0	-0.7447041	0	-0.6597393	0.002
Medium											0.056562	0.748	0.0514388	0.77	0.1002217	0.576
High											0.807869	0.007	0.7989581	0.007	0.8290946	0.006
Occupation																
Class 1							1.096943	0.001	1.098866	0.001					0.9843776	0.004
Class 2							0.7384057	0.001	0.7553945	0.001					0.6546896	0.004
Class 3							-0.2203963	0.336	-0.228961	0.319					-0.2672117	0.246
Class 4							-0.2543955	0.342	-0.2434674	0.364					-0.3167457	0.244
Constant	167.1919	0	167.726	0	167.7455	0	167.1014	0	167.3837	0	168.0081	0	168.0826	0	167.772	0

Generación 1940-49

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	0.9079762	0	0.8516773	0	0.853517	0	0.7964838	0	0.7377714	0	0.7472102	0	0.751013	0	0.6489285	0.002
Secondary completed	3.000968	0	2.905762	0	2.908709	0	2.658582	0	2.540924	0	2.687875	0	2.698102	0	2.374304	0
University completed	4.405818	0	4.309952	0	4.322196	0	3.765551	0	3.643004	0	3.915866	0	3.939248	0	3.276624	0
Selecion Coefficient			-19.35643	0	-19.32989	0			-19.5148	0	-17.71416	0	-17.66158	0	-17.73099	0
Habitat																
Mixed					0.1307113	0.526			0.2291564	0.271			0.130895	0.528		
Urban					-0.0074868	0.966			0.0553046	0.754			-0.0474472	0.787		
Income																
Low											-1.177744	0	-1.186547	0	-1.094967	0
Medium											-0.125612	0.457	-0.1236974	0.464	-0.123333	0.47
High											0.6519633	0.016	0.6600361	0.015	0.5863315	0.035
Occupation																
Class 1							0.7102262	0.022	0.7671926	0.013					0.8239183	0.008
Class 2							0.5829335	0.013	0.629637	0.007					0.5470746	0.02
Class 3							-0.3978996	0.086	-0.3823577	0.1					-0.3166034	0.175
Class 4							-0.4997677	0.07	-0.4771065	0.083					-0.4277791	0.123
Constant	168.2326	0	169.3435	0	169.3147	0	168.3688	0	169.3939	0	169.5224	0	169.5067	0	169.6083	0

Generación 1950-59

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	0.5663675	0.04	0.4971471	0.071	0.4717768	0.086	0.3819302	0.17	0.2800515	0.313	0.3784818	0.177	0.3596066	0.199	0.1932633	0.495
Secondary completed	2.643798	0	2.467985	0	2.38268	0	2.284604	0	2.008753	0	2.267193	0	2.198517	0	1.911442	0
University completed	4.531901	0	4.369646	0	4.224684	0	3.792931	0	3.467637	0	4.017979	0	3.902405	0	3.303035	0
Selecion Coefficient			-136.5242	0	-136.7176	0			-140.9057	0	-138.0816	0	-138.304	0	-141.889	0
Habitat																
Mixed					0.1542642	0.424			0.0595397	0.76			0.1348789	0.489		
Urban					0.4772963	0.005			0.4227938	0.013			0.4048284	0.017		
Income																
Low											-1.172557	0	-1.152631	0	-1.042188	0
Medium											-0.3473864	0.031	-0.3339705	0.038	-0.3037068	0.062
High											0.5056384	0.045	0.4974623	0.048	0.5404382	0.035
Occupation																
Class 1							0.6491323	0.018	0.6731645	0.014					0.6375013	0.02
Class 2							-0.0079298	0.972	0.0244413	0.912					0.0116109	0.959
Class 3							-0.4112828	0.062	-0.4252727	0.052					-0.3677917	0.096
Class 4							-1.035635	0	-1.049353	0					-1.039106	0
Constant	169.9095	0	174.2779	0	174.0915	0	170.4008	0	174.7655	0	174.7122	0	174.5439	0	175.2689	0

Generación desde 1960

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	-0.2669818	0.443	-0.2690623	0.433	-0.2335903	0.496	-0.2276608	0.521	-0.1447463	0.679	-0.3659233	0.291	-0.3316868	0.338	-0.2573306	0.466
Secondary completed	1.666134	0	1.454651	0	1.439736	0	1.457372	0	1.252328	0	1.263782	0	1.251618	0	1.131064	0.001
University completed	2.923295	0	2.718651	0	2.645081	0	2.284186	0	1.981031	0	2.402481	0	2.337656	0	1.83341	0
Selecion Coefficient			-162.6387	0	-161.0734	0			-167.2427	0	-165.1782	0	-163.5425	0	-169.6579	0
Habitat																
Mixed					0.4644686	0.004			0.4413013	0.008			0.4608088	0.005		
Urban					0.5136856	0.001			0.4875303	0.001			0.490778	0.001		
Income																
Low											-1.211255	0	-1.189517	0	-0.8142143	0.001
Medium											0.0098628	0.942	0.0183482	0.893	0.0179786	0.897
High											0.8986966	0	0.8903639	0	0.8462314	0.001
Occupation																
Class 1							0.8659617	0	0.8840263	0					0.8980558	0
Class 2							0.1558527	0.4	0.3887915	0.035					0.3878087	0.036
Class 3							-0.4494277	0.008	-0.5495098	0.001					-0.4641605	0.006
Class 4							-1.248022	0	-1.177791	0					-1.045984	0
Constant	173.3129	0	176.4815	0	176.0943	0	173.6456	0	176.5066	0	176.7413	0	176.3567	0	176.9797	0

Table 7b.- Regression coefficients. Adult height regressed on socio-demographic variables. Intra-generational effects among females

Generación hasta 1929																
	0.02															
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	0.9829502	0	0.9260837	0	0.8918706	0	0.9378023	0	0.8729649	0	0.8971197	0	0.8748009	0	0.8672398	0
Secondary completed	2.3798	0	2.291514	0	2.18541	0	2.114502	0	1.948165	0	2.066814	0	1.994277	0	1.901008	0
University completed	1.747614	0.002	1.677675	0.003	1.568053	0.006	1.498299	0.018	1.379272	0.032	1.353549	0.017	1.280955	0.025	1.242445	0.048
Selecion Coefficient			-39.57177	0	-39.02809	0			-44.93641		-40.11012	0	-39.70525	0	-45.53312	0
Habitat																
Mixed					0.3976739	0.008			0.503437	0			0.3758208	0.012		
Urban					0.4022554	0.001			0.3557337	0.004			0.3091401	0.014		
Income																
Low											-0.680101	0	-0.6525817	0	-0.7198424	0
Medium											0.6024116	0	0.6131182	0	0.2284874	0.263
High											0.5135639	0.028	0.5371855	0.022	0.215628	0.605
Occupation																
Class 1							1.073013	0.004	1.054598	0.005					1.104426	0.003
Class 2							-0.2449042	0.171	-0.1376911	0.463					-0.1095955	0.572
Class 3							-0.6955169	0	-0.7369166	0					-0.5208917	0.01
Class 4							-0.8353589	0	-0.8206745	0					-0.6668911	0.001
Constant	156.4205	0	158.9809	0	158.7081	0	156.5566	0	159.1685	0	159.1301	0	158.8894	0	159.6194	0
Generación 1930-39																
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	1.083343	0	1.083069	0	1.093165	0	1.067343	0	1.087956	0	1.018644	0	1.033599	0	1.019019	0
Secondary completed	2.285224	0	2.284956	0	2.307501	0	1.974326	0	2.048776	0	2.095743	0	2.141019	0	1.856159	0
University completed	2.219432	0	2.219543	0	2.222894	0	1.564372	0.006	1.616804	0.004	1.8367	0	1.859511	0	1.266285	0.027
Selecion Coefficient			-1.571507	0.916	-1.000529	0.947			-1.306136	0.941	0.082339	0.996	0.6742315	0.964	-1.793576	0.919
Habitat																
Mixed					0.2913976	0.068			0.3111591	0.1			0.264444	0.097		
Urban					0.0247554	0.856			-0.1451608	0.383			-0.0663473	0.627		
Income																
Low											-0.7994345	0	-0.8100876	0	-0.6672603	0
Medium											0.106453	0.468	0.1113896	0.447	-0.1644658	0.407
High											1.065015	0	1.071968	0	1.087235	0.008
Occupation																
Class 1							0.3777905	0.276	0.3714873	0.284					0.4471222	0.212
Class 2							0.1749388	0.37	0.1552946	0.434					0.268743	0.205
Class 3							-0.6946814	0	-0.7179302	0					-0.4759198	0.022
Class 4							-1.161917	0	-1.177955	0					-0.9497734	0
Constant	157.8042	0	157.8897	0	157.7785	0	158.0006	0	158.0608	0	158.0139	0	157.9445	0	158.2571	0
Generación 1940-49																
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	0.5057618	0.001	0.4855495	0.001	0.4920786	0.001	0.6458616	0.001	0.6253167	0.001	0.4828435	0.001	0.492001	0.001	0.5655739	0.003
Secondary completed	1.80648	0	1.773539	0	1.79591	0	1.645122	0	1.624637	0	1.640231	0	1.673227	0	1.459364	0
University completed	2.712837	0	2.673372	0	2.697576	0	2.161361	0	2.132438	0	2.454671	0	2.490837	0	1.91806	0
Selecion Coefficient			-5.856913	0.189	-5.918472	0.185			-8.878944	0.095	-4.398975	0.324	-4.459974	0.317	-6.97588	0.189
Habitat																
Mixed					-0.1550122	0.364			-0.0244289	0.904			-0.1792894	0.294		
Urban					-0.1289258	0.361			-0.1153295	0.495			-0.1819949	0.198		
Income																
Low											-0.5406784	0.003	-0.55471	0.002	-0.6233602	0.005
Medium											0.3410815	0.015	0.3401926	0.016	0.2304121	0.2
High											0.9905978	0	0.9887681	0	0.8013154	0.027
Occupation																
Class 1							0.7657903	0.01	0.7713924	0.01					0.6161197	0.043
Class 2							0.5619238	0.006	0.5448918	0.008					0.5040862	0.02
Class 3							-0.8051355	0	-0.8155746	0					-0.7716431	0
Class 4							-0.9462009	0	-0.9570253	0					-0.9034331	0
Constant	158.7372	0	159.026	0	159.1151	0	158.7188	0	159.2092	0	158.8722	0	158.9909	0	159.1292	0
Generación 1950-59																
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	-0.0407895	0.838	-0.0629026	0.753	-0.0621492	0.756	0.0203122	0.938	-0.0165687	0.949	-0.1644397	0.416	-0.1660889	0.411	-0.1060168	0.685
Secondary completed	1.166301	0	1.095707	0	1.149149	0	1.145139	0	1.087231	0	0.9473222	0	1.001421	0	0.9630331	0
University completed	1.640162	0	1.570713	0	1.66979	0	1.228445	0	1.198215	0	1.340886	0	1.442777	0	1.029803	0.002
Selecion Coefficient			-53.253	0.001	-53.41796	0.001			-65.30536	0	-52.21145	0.001	-52.32602	0.001	-64.65954	0
Habitat																
Mixed					-0.3912081	0.019			-0.0756269	0.69			-0.3640437	0.028		
Urban					-0.5062712	0			-0.2549403	0.126			-0.5208041	0		
Income																
Low											-0.9989623	0	-1.018112	0	-0.9421418	0
Medium											-0.3217839	0.015	-0.3311016	0.012	-0.4751373	0.003
High											0.4457668	0.053	0.4368843	0.058	0.0359451	0.898
Occupation																
Class 1							0.4691511	0.088	0.4475551	0.103					0.5546521	0.049
Class 2							0.6358127	0.002	0.6074687	0.003					0.7750088	0
Class 3							-0.6033434	0.002	-0.6360952	0.001					-0.3848913	0.074
Class 4							-0.9056241	0	-0.937655	0					-0.6822412	0.004
Constant	159.6432	0	161.0408	0	161.3553	0	159.6778	0	161.5454	0	161.3481	0	161.6698	0	161.6168	0
Generación desde 1960																
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Education																
Primary completed	-0.3777406	0.112	-0.3463428	0.143	-0.3374578	0.154	-0.1179453	0.655	-0.032716	0.901	-0.3576156	0.128	-0.350716	0.137	-0.0643355	0.806
Secondary completed	0.8019002	0.001	0.6282931	0.006	0.6224284	0.007	0.8666447	0.001	0.7125829	0.005	0.5750548	0.012	0.5716527	0.012	0.6840566	0.007
University completed	1.998548	0	1.752628	0	1.72888	0	1.726243	0	1.460199	0	1.589915	0	1.574896	0	1.401553	0
Selecion Coefficient			-135.1944	0	-135.8026	0			-145.4214	0	-143.8514	0	-144.1936	0	-149.8467	0
Habitat																
Mixed					-0.0528709	0.704			-0.0008828	0.995			-0.0455378	0.743		
Urban					0.1363013	0.274			0.1944787	0.143			0.0960702	0.441		
Income																
Low											-0.816504	0	-0.8091189	0	-0.4957687	0.018
Medium											-0.2063291	0.074	-0.2006233	0.082	-0.1212224	0.342
High											0.638167	0.004	0.632423	0.005	0.4841494	0.043
Occupation																
Class 1							0.4513164	0.032	0.2649349	0.208					0.2712096	0.207
Class 2							0.3406888	0.056	0.2123621	0.233					0.2267407	0.216
Class 3							-0.4235042	0.011	-0.7395444	0					-0.6816038	0
Class 4							-0.8871428	0	-1.069337	0					-0.9835645	0
Constant	161.5995	0	163.6649	0	163.6272	0	161.646	0	163.9111	0	164.0055	0	163.9755	0	164.1532	0

Inter-generational effects

As we have mentioned before, intergenerational estimations included three different model specifications and definitions in order to estimate the indirect effects between cohorts. Unlike the intra-generational model, inter-generational specifications will be referred to the three historical aggregated generations mentioned above. Results are shown in Tables 8a and 8b.

i) Effect of mother's educational attainment. We have defined the model as:

$$h_i = h_0 + \beta \overline{X}_j + \gamma Y_i + \varepsilon_i \quad (5)$$

where:

h_i = height of the i^{th} individual (in centimeters)

$\overline{X}_j$ = estimated mother's average educational attainment (in years)

Y_i = matrix of individual and contextual characteristics

i = {1, … , n} individuals

t = {until 1939, 1940-1969, after 1970} generations

The distribution of individual and estimated mother's educational attainment as years of education is shown on Figure 6. As we can see, the results of the estimation are consistent with the population's distribution taking into account the cohorts considered.

Figure 6.- Ego's educational attainment (years of education) and mothers' generation educational attainment

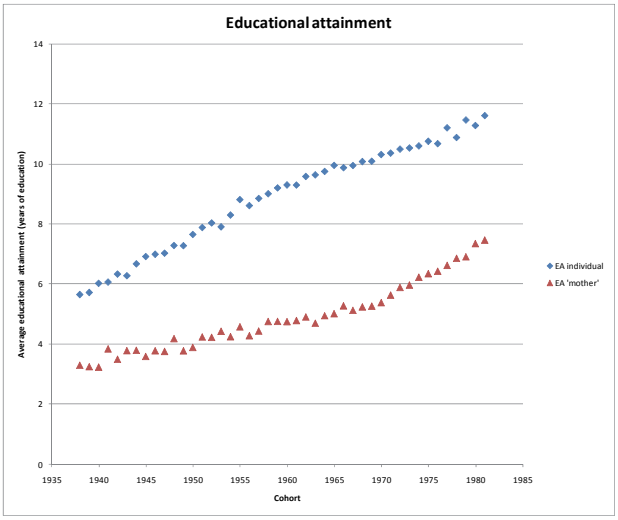


Table 8a.- Intergenerational effect of mother's education on height

Generación de hijos: entre 1940-69										
	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficier	p	Coefficier	p	Coefficier	p	Coefficier	p	Coefficier	p
´Mother's´educational attainment	0.665913	0	1.886444	0	2.426153	0	1.963873	0	1.620046	0
Average social expenditure			0.41403	0					0.216084	0.001
Male					11.3763	0	11.33292	0	11.33547	0
Age							-0.03603	0		
30-39									-0.20586	0.041
40-49									-0.51684	0
50-59									-1.06895	0
60-69									-1.07324	0
Constant	164.5437	0	155.9591	0	149.8409	0	153.4255	0	153.1616	0
Generación de hijos: desde 1970										
	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficier	p	Coefficier	p	Coefficier	p	Coefficier	p	Coefficier	p
´Mother's´educational attainment	0.665913	0	0.764812	0.001	0.761956	0	0.57017	0.001	0.812727	0
Average social expenditure			-0.05415	0.443					-0.08856	0.084
Male					12.67418	0	12.64937	0	12.66097	0
Age							-0.05275	0.055		
30-39									-0.21747	0.2
40-49										
50-59										
60-69										
Constant	164.5437	0	164.5838	0	158.3715	0	161.114	0	159.2271	0

Table 8b.- Intergenerational effects of parental education on height

Padres hasta 1929										
	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficier	p	Coefficier	p	Coefficier	p	Coefficier	p	Coefficier	p
Children's Education (ref. less than primary)										
Primary completed			2.398071	0	2.357508	0	1.222175	0.008	0.372404	0.436
Secondary completed			4.204829	0	4.168326	0	3.328034	0	2.113522	0
University completed			4.2406	0	4.234028	0	2.947728	0	1.724366	0.014
Male							10.60044	0	10.93768	0
Selection coefficient									-72.3821	0
Parent's Education (ref. less than primary)										
Primary completed	0.468024	0.235	-0.42449	0.303	-0.42724	0.3	0.044572	0.892	0.118018	0.731
Secondary completed	2.379337	0	1.018951	0.103	0.959923	0.126	1.771845	0	2.006375	0
University completed	3.807969	0	2.285078	0.011	2.137382	0.018	2.190401	0.001	2.246304	0.001
Family size					0.18339	0.074	0.246916	0.001	0.099114	0.236
Constant	166.7447	0	164.1352	0	163.4036	0	157.982	0	161.2393	0
Padres desde 1930										
	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficier	p	Coefficier	p	Coefficier	p	Coefficier	p	Coefficier	p
Children's Education (ref. less than primary)										
Primary completed			-0.19909	0.71	-0.19471	0.716	0.046996	0.911	0.093343	0.87
Secondary completed			1.016229	0.052	1.028468	0.05	1.51027	0	1.92246	0.001
University completed			1.559421	0.032	1.572395	0.032	1.588878	0.006	1.992407	0.004
Male							10.54368	0	11.71698	0
Selection coefficient									-190.182	0
Parent's Education (ref. less than primary)										
Primary completed	0.468024	0.235	0.144071	0.62	0.144201	0.62	0.257897	0.255	0.16933	0.562
Secondary completed	2.379337	0	1.039124	0.011	1.034917	0.012	1.109077	0.001	1.094594	0.014
University completed	3.807969	0	1.789788	0.009	1.779849	0.009	1.813046	0.001	1.660988	0.014
Family size					0.028688	0.735	0.036694	0.589	0.04686	0.588
Constant	166.7447	0	167.3594	0	167.2094	0	161.136	0	164.0249	0

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