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Working Paper Series

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ECINEQ 2024 671

ECINEQ 2024 671
2024 July
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Abstract

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Keyword: Adult health, Health inequality, Inequality of opportunity, Spain

JEL Cassification: D6, I14, I18, I30

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DAVID PÉREZ-MESA AND ÁNGEL S. MARRERO

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- We would like to thank an anonymous referee, Gustavo A. Marrero, Pedro Salas-Rojo, Sandy Tubeuf, Sara Darias-Curvo, Juan Gabriel Rodríguez and Raquel Sebastián for their valuable comments and suggestions. The authors acknowledge financial support from the Ministerio de Ciencia e Innovación of Spain through the projects PID2019-107161GB-C33 and PID2022-137352NB-C44. Pérez-Mesa also thanks the financial support from the Gobierno de Canarias through its FPI program (TESIS2019010156 grant), co-funded by the European Social Fund. All views and any remaining errors or omissions are our sole responsibility.

1. INTRODUCTION

In recent years, we have witnessed a growing theoretical and empirical literature on inequality of opportunity across different fields of economic research, including income, health and education.[1] It has been motivated by its normative relevance since this literature builds upon a fundamental distinction between unfair and fair sources of inequality (Roemer, 1998; Fleurbaey and Schokkaert, 2011). According to this framework, an individual's outcome depends on variables beyond and within his/her control, denoted as circumstances and efforts, respectively. Thus, total inequality can be seen as a combination of inequality caused by different circumstances that are considered unfair, referred to as inequality of opportunity, and inequality caused by factors more related to the willingness to exert effort, which is considered fair as it belongs to the sphere of individual responsibility.[2] Moreover, empirical evidence shows that inequality of opportunity negatively affects economic growth and could end up discouraging subsequent development (World Bank, 2006; Marrero and Rodríguez, 2013, 2023). Therefore, the analysis of the inequality of opportunity is relevant not only from a social justice and equity perspective, but also from an efficiency point of view.

Particularly, an expanding body of literature has addressed the measurement of inequality of opportunity in health (Fleurbaey and Schokkaert, 2009; Rosa Dias, 2009; Trannoy et al., 2010; Jusot et al., 2013; García-Gómez et al., 2015; Davillas and Jones, 2020). This literature has mainly focused its analysis on adult populations in developed European countries, either individually or for a sample of countries. Only few of these studies have analysed inequality of opportunity in health in Spain (Jusot et al., 2010; Tubeuf and Jusot, 2011; Bricard et al., 2013; Kim, 2016; Pasqualini et al., 2017; Pinilla et al., 2017; Bigorne et al., 2021), all of them using data from multiple waves of the Survey of Health, Ageing and Retirement in Europe (SHARE), with the exception of Pinilla et al. (2017), who use the Spanish Survey of Household Finances (EFF).

The studies using SHARE employ multiple waves to extract different circumstances and current characteristics of the respondents, but they cover only a segment of the Spanish adult population,

[1] See Ramos and Van de Gaer (2016), Jusot and Tubeuf (2019), and Asadullah et al. (2021) for a review of the literature on inequality of opportunity in income, health and education, respectively.

[2] This distinction between different types of inequality is reasonable when dealing with adult population, but the literature of inequality of opportunity has also focused on the analysis of the child population. In the latter, all inequality must be considered inequality of opportunity since all factors related to children are beyond their control (Roemer and Trannoy, 2016; Hufe et al., 2017; Pérez-Mesa et al., 2022). Thus, the literature on inequality of opportunity is closely related to the literature on early-life factors and their long-term impact on future outcomes (Case and Paxson, 2010; Currie, 2011; Almond et al., 2018).

given that it is a longitudinal database representative of the European population aged 50 and above. Meanwhile, Pinilla et al. (2017) pooled data from four waves of the EFF, which covers the entire adult population in Spain, although they limited their analysis to the reference person in the household (aged 28-85 years) and his/her partner, and they only use one variable relating to the social background of these individuals during their childhood.

These studies use self-assessed health (SAH) as the dependent variable, while the most commonly used circumstances are parental occupation, the number of books at home as a proxy for parental education, parental longevity and parental health-related behaviors, such as smoking and drinking. In addition, effort is generally captured by the individual's education and occupation, and lifestyles by alcohol consumption, smoking, obesity and exercise status. Finally, they included the age and sex of the respondents as demographic variables.

The main goal of this paper is to estimate inequality of opportunity in health for the Spanish adult population, disentangling the contribution of unfair (circumstances) and fair (efforts and lifestyles) components in explaining health inequality. To this end, we use a survey module conducted by the Centro de Investigaciones Sociológicas (CIS) in 2017, focusing on a representative sample of the Spanish adult population. Methodologically, we follow the two-stage estimation strategy proposed by Trannoy et al. (2010). Firstly, we estimate "relative" efforts/lifestyles, which entails assessing individual efforts and lifestyles that are isolated from circumstances, thus exclusively attributed to personal responsibility (Jusot et al., 2013). Secondly, we conduct a regression analysis connecting adult health with circumstances and relative efforts/lifestyles, while controlling for demographic variables. Additionally, we employ the Shapley decomposition method to calculate the contribution of each variable group in explaining health inequality.

The contribution of this study rests on two main aspects. First, to the best of our knowledge, it is the first paper that examines health inequality using the CIS database. Second, we analyse a sample of the Spanish population aged 25 years and older and consider a larger set of circumstances, efforts and lifestyles compared to the aforementioned studies. Specifically, we consider parental education, parental socioeconomic status (SES), region of birth, place of residence, birth order and sex as circumstances. In terms of efforts and lifestyles, we consider education, employment status, smoking, exercise, and vegetable consumption. Additionally, compared to studies using SHARE data, we source

all variables from the same wave, thereby mitigating the potential for temporal inconsistencies and response bias.

As a parallel objective of this study, our approach also allow us to analyse the transmission channels through which individual circumstances may influence health. These channels encompass factors that, to some extent, fall under individual responsibility, yet contribute to the influence of unequal opportunities on individual health. Specifically, we focus on the educational attainment of the individual, a significant channel discussed in the literature (Rosa Dias, 2009; Trannoy et al., 2010; Tubeuf et al., 2012). We examine whether the circumstances exert a direct effect on health, or whether their effect can be channeled through the individual's education.

In terms of circumstances, we find that father's education and SES, birth order, sex and age significantly affect adult health, whereas in terms of efforts and lifestyles, employment status, exercise and vegetable consumption are the significant factors. Moreover, the set of circumstances and individual age each contribute to explaining around 43% of health inequality, while the fairness component (efforts and lifestyles) only contributes 14%. Additionally, we show that the health status of the individuals is significantly influenced by their education, which also mitigates the effect on health of some circumstances, such as birth order and sex, but also acts as a channel for the effect of circumstances, such as the place of residence and the educational and socioeconomic level of the mother.

The rest of the paper is structured as follows. Section 2 describes the database and the key variables used. Section 3 presents the methodology and decomposition approach. Section 4 shows the main results. Finally, Section 5 presents the discussion.

2. DATA

We gather information from the module 'Social Inequality and Social Mobility´ (CIS 3178), based on Marrero et al. (2017) and conducted by the CIS during 2017. This database, which comprises a sample of 2482 individuals, is representative of the Spanish adult population aged 18 years and older. The questionnaire provides information on four types of variables: respondent demographics, including sex and age; individual's outcomes, such as health status, educational attainment, employment status and income; a set of individual circumstances measured by the family background; and the individual's efforts and lifestyles, such as smoking or exercise.

Table 1. Descriptive statistics

	N	%		N	%
DEPENDENT VARIABLE			**Place of residence**		
Self-assessed health			Rural	763	41.95
Very good	366	20.12	Urban	1056	58.05
Good	866	47.61	*Total*	1819	100
Fair	460	25.29	**Region of birth***		
Bad	121	6.65	Spain	1625	89.33
Very bad	6	0.33	Abroad	194	10.67
Total	1819	100	*Total*	1819	100
CIRCUMSTANCES			**DEMOGRAPHICS**		
Father's education			**Age**		
No education	660	36.28	25-30	184	10.12
Primary	658	36.17	31-50	773	42.5
Secondary	336	18.47	51-70	620	34.08
Higher	165	9.07	More than 70	242	13.3
Total	1819	100	*Total*	1819	100
Mother's education			**EFFORTS AND LIFESTYLES**		
No education	690	37.93	**Education**		
Primary	755	41.51	No education	157	8.63
Secondary	252	13.85	Primary	535	29.41
Higher	122	6.71	Secondary	692	38.04
Total	1819	100	Higher	435	23.91
Father's SES			*Total*	1819	100
Unemployed/inactive	39	2.14	**Employment status**		
Lower class	141	7.75	Non-employed	919	50.52
Middle class	1448	79.6	Employed	900	49.48
Upper class	191	10.5	*Total*	1819	100
Total	1819	100	**Smoking**		
Mother's SES			Smoker	510	28.04
Unemployed/inactive	1206	66.3	Non-smoker	1309	71.96
Lower class	134	7.37	*Total*	1819	100
Middle class	386	21.22	**Physical activity**		
Upper class	93	5.11	Once/less than once per week	969	53.27
Total	1819	100	Daily/several times per week	850	46.73
Birth order			*Total*	1819	100
First	665	36.56	**Vegetables consumption**		
Second and third	819	45.02	Once/less than once per week	172	9.46
Fourth or more	335	18.42	Daily/several times per week	1647	90.54
Total	1819	100	*Total*	1819	100
Sex					
Male	900	49.48			
Female	919	50.52			
Total	1819	100			

Note: Constructed by the authors using data from CIS (2017).
* Details of the regions of Spain are not shown for space limitations.

From the full sample of 2482 individuals, following the literature on inequality of opportunity (Ferreira and Gignoux, 2011; Carrieri et al., 2020), we restrict our sample to the adult population aged 25 years and older to avoid potential life-cycle bias[3] and maximize the sample size, obtaining a subsample of 2273 individuals. From this subsample, we remove those individuals with at least one missing value on

[3] This age restriction allows us to focus on individuals who have completed their educational qualifications and with a higher proportion of employed persons, as we include the individual's education and employment status as effort variables in our analysis.

any of the variables used in our models.[4] By performing this procedure, we obtain our final sample of 1819 individuals.[5] Table 1 presents the descriptive statistics of the main variables used.

2.1. Health

The variable of interest is health in adulthood as measured by self-assessed health (SAH). Despite its subjectivity and other problems reported in the literature (Bago d'Uva et al., 2008; Black et al., 2017; Davillas et al., 2023), SAH is one of the most common measures of health collected in surveys and it is widely used in health economics (Van Doorslaer et al., 2000; Contoyannis and Jones, 2004; Currie et al., 2015). It has been validated as a good predictor of future mortality, health care utilization and a relatively reliable indicator of health at the individual level (Idler and Benyamini, 1997; DeSalvo et al., 2005; Doiron et al., 2015).

In the CIS questionnaire, individuals were asked: "In general, would you say that your current health is... very good, good, fair, poor or very poor?" Based on this question, we have considered health as a binary variable grouping very good and good health against fair, poor and very poor health.[6] In our database, more than 60% of the individuals reported good or very good health (see Table 1), which is consistent with other studies in the related literature (Trannoy et al., 2010; Jusot et al., 2013; Pinilla et al., 2017).

2.2. Circumstances

Eight circumstances are considered: father's and mother's education, father's and mother's socioeconomic status (SES), birth order, sex, type of place of residence and region of birth. Parental education is measured as the highest education level attained by the father/mother when the individual was 16 years old, categorised into no education, primary education, secondary education and higher

[4] From the subsample of individuals older than 25 years (2273 observations), we remove 454 individuals because of missing values, i.e., 20% of the sample. Conducting a simple exploratory analysis on the randomness of these missing values, it is observed that individuals omitting responses to certain questions, such as those relating to parental education and SES, tend to report poorer health and education. These patterns, together with the fact that we do not have the complete set of determinants of health inequality, may underestimate health gaps within our sample, thus our estimates should be considered as a lower bound of the explained inequality. Addressing these missing values (see for example Brunori, Salas-Rojo and Verme., 2022, and the literature referenced therein), although desirable, exceeds the scope of this paper.

[5] It is worth noting that we have only one individual per household, therefore there is not a potential correlation within family units.

[6] We categorise our dependent variable in this way because we want to compare those individuals who are at least in good health with the others, as usual in the literature (see for example Tubeuf et al., 2012; Jusot et al., 2013, among others), and to avoid a highly unbalanced distribution of the observations across categories. However, an alternative categorisation of our health variable, such as grouping very poor and poor against the other categories (results available upon request), generates different results in terms of health inequality, as expected given the existing evidence in the literature (Wagstaff and Van Doorslaer, 1994; Van Doorslaer et al., 1997; Ziebarth, 2010).

education. Less than 10% of fathers/mothers have achieved higher education, although fathers have attained higher levels of secondary and tertiary education than mothers.

Regarding parental SES, we follow Cabrera et al. (2021) to group the parents of the individuals into three social classes (lower, middle and upper class), taking into account the ten large occupational groups of the ISCO-08 classification.[7] In addition, since the above classification only covers employed individuals, we also include a category for unemployed/inactive parents. As shown in Table 1, while almost all fathers were employed, 66% of the mothers were unemployed/inactive (mostly inactive); moreover, 80% of the fathers and 21% of the mothers worked in occupations belonging to the middle social class, respectively.

Birth order is divided into the following categories: first, second and third, and fourth or more. Approximately 37% and 45% of the individuals are the first-born and second/third at birth, respectively. Following Davillas and Jones (2020), Balasooriya et al. (2021) and Brunori et al. (2022), among others, we also include sex as a circumstance, although we are aware that other authors argue against this consideration and classify it as a demographic variable (Trannoy et al., 2010; Jusot et al., 2013; Deutsch et al., 2018).[8] As illustrated in Table 1, each sex corresponds to half of the sample.

The type of place of residence and the region of birth during the adolescence are introduced to control for regional differences within Spain. The type of place of residence is classified into rural and urban, while the region of birth includes the 17 Autonomous Communities of Spain, a joint category for Ceuta and Melilla and another for abroad. 42% and 58% of respondents lived in a rural and urban location, respectively, while about 89% were born in Spain.

2.3. Efforts and lifestyles

Five individual effort and lifestyle variables are included. Efforts are measured by the highest level of education of the individual, classified in the same groups as parental education (no education, primary, secondary and higher education), and by his/her employment status, divided into employed and unemployed/inactive (similar to Brunori et al., 2022). In comparison with their parents, descendants

[7] Lower class is composed by the group 9 in the ISCO-08 classification, middle class by 3 to 8 groups, and upper class comprises groups 1 and 2. Regarding individuals in the armed forces, given their small number, the observations are assigned to a specific class according to the studies they indicate and their membership (officers or troops).

[8] See García-Gómez et al. (2015) for a discussion on the treatment of age and sex from a normative perspective and its implications for estimating inequality of opportunity.

have higher levels of education, with 24% of them having tertiary education, 38% secondary education and only 9% with no education. In addition, half of the sample is employed.

Lifestyle variables refer to the health-related behaviors of the respondents with respect to smoking, physical activity and vegetable consumption.[9] While smoking classifies individuals as currently smokers or non-smokers, the other two variables refer to how often individuals are physically active and consume vegetables, grouping the responses into daily/several times per week and once/less than once per week. The majority of the sample reported a healthy lifestyle regarding smoking (almost 72% of the respondents do not smoke) and vegetable consumption (91% eat vegetables daily/several times per week), although less than half of the individuals are physically active.

Finally, we consider the age of the individual as a demographic variable, which we divide into four groups of age: under 30 years (25-30 years), 31-50 years, 51-70 years and over 70 years. The average age of the sample is 51 years, with a minimum and maximum age of 25 and 93 years, respectively.

3. METHODOLOGY

3.1. Measuring inequality of opportunity in health

Let us assume that the health status H_i of the individual i is a function of a vector of circumstances C_{ki}, a vector of effort and lifestyles variables E_{ki}, a demographic variable D_i given by the individual's age and a residual term u_i:

$$H_i = \alpha + \sum_{k=1}^{K} \beta_k C_{ki} + \sum_{k=1}^{K} \omega_k E_{ki} + \gamma D_i + \mathrm{u}_i \qquad (1)$$

Circumstances are variables beyond the individual's control, while efforts are characteristics that belong to the sphere of his/her responsibility. However, efforts can also be affected by individual circumstances (Ferreira and Gignoux, 2011; Jusot et al., 2013; Roemer and Trannoy, 2016). Thus, the impact of circumstances on health occurs both through a direct effect on individual health, and an indirect effect through the influence of circumstances on the individual's efforts and lifestyles.

[9] Since the database provides a rich number of lifestyles related to the frequency of consumption of particular foods, we considered grouping them into a single variable using the principal components approach (PCA) (Filmer and Pritchett, 2001; Kolenikov and Angeles, 2009). However, given that the first principal component (and even the sum of the three significant components) explained only a small part of the aggregate variability of these habits, we decided to include only vegetable consumption based on its more widespread use in the literature (Rosa Dias, 2009; Carrieri and Jones, 2018; Brunori et al., 2022).

In order to neutralize the impact of circumstances on effort and lifestyles, we adopt the two-stage procedure proposed by Trannoy et al. (2010) and proceed as follows. First, we regress each effort and lifestyle in a separate equation against the vector of circumstances, controlling for demographics (models (2a) to (2e)). For each of these auxiliary regressions, we compute the relative residuals (i.e., purged from circumstances) and introduce them into the subsequent equations describing individual effort.[10] Finally, we regress individual health in adulthood against the vector of circumstances, the estimated relative residuals of the effort equations and demographics (model (2f)). The models are written as follows:

$$Education_i = \alpha^a + \sum_{k=1}^{K} \beta_k^a C_{ki} + \gamma^a D_i + \mathrm{u}_i^a \,, \tag{2a}$$

$$Employment_i = \alpha^b + \sum_{k=1}^{K} \beta_k^b C_{ki} + \gamma^b D_i + \omega_1^b \hat{u}_i^a + \mathrm{u}_i^b \,, \tag{2b}$$

$$Smoking_i = \alpha^c + \sum_{k=1}^{K} \beta_k^c C_{ki} + \gamma^c D_i + \omega_1^c \hat{u}_i^a + \omega_2^c \hat{u}_i^b + \mathrm{u}_i^c \,, \tag{2c}$$

$$Physical\ act_i = \alpha^d + \sum_{k=1}^{K} \beta_k^d C_{ki} + \gamma^d D_i + \omega_1^d \hat{u}_i^a + \omega_2^d \hat{u}_i^b + \omega_3^d \hat{u}_i^c + \mathrm{u}_i^d \,, \tag{2d}$$

$$Vegetables_i = \alpha^e + \sum_{k=1}^{K} \beta_k^e C_{ki} + \gamma^e D_i + \omega_1^e \hat{u}_i^a + \omega_2^e \hat{u}_i^b + \omega_3^e \hat{u}_i^c + \omega_4^e \hat{u}_i^d + \mathrm{u}_i^e \,, \tag{2e}$$

$$Health_i = \alpha^f + \sum_{k=1}^{K} \beta_k^f C_{ki} + \gamma^f D_i + \omega_1^f \hat{u}_i^a + \omega_2^f \hat{u}_i^b + \omega_3^f \hat{u}_i^c + \omega_4^f \hat{u}_i^d + \omega_5^f \hat{u}_i^e + \mathrm{u}_i^f \,. \tag{2f}$$

Models (2a)-(2f) are modelled using binary logit models, where the dependent variables take value 1 if the individual reports having higher education, being employed, non-smoking, exercising daily/several times per week, eating vegetables, and having good or very good health (and take value 0 otherwise), respectively. In the model (2f), the coefficients associated with the circumstances represent their overall effects (i.e., the sum of their direct and indirect effects) on health, and the estimated relative residuals reflect individual effort, unobserved circumstances and other random factors, since they are orthogonal to the circumstances.[11]

Additionally, as a parallel exercise, we analyse the mediating role of education in the relationship between circumstances and health. For this purpose, we first regress only the circumstances on adult health while controlling for the respondent's age (model (2g)). Subsequently, we introduce the individual's education level, denoted as $Educ_i$, into model (2h). This approach allows us to assess

[10] As in Trannoy et al. (2010), these residuals are computed as generalized residuals (Gourieroux et al., 1987).

[11] Since the set of circumstances considered in our regressions are beyond the individual's control, they are considered exogenous. Thus, we do not concern here with endogeneity issues but focus on the correlation between health status and circumstances, which cannot be interpreted as causality.

whether the influence of circumstances on health comes from their direct effect or from an indirect effect mediated through the individual's education level.

$$Health_i = \alpha^g + \sum_{k=1}^{K} \beta_k^g C_{ki} + \gamma^g D_i + u_i^g \ , \quad (2g)$$

$$Health_i = \alpha^h + \sum_{k=1}^{K} \beta_k^h C_{ki} + \gamma^h D_i + \delta^h Educ_i + u_i^h \ , \quad (2h)$$

Furthermore, if the individual's education level is significant in model (2h), we could also assess whether the circumstances are directly or indirectly (through education) affecting health by comparing their significance in models (2a) and (2h), as well as other studies that use this strategy (Fajardo-González, 2016; Deutsch et al., 2018, among others). Thus, if a circumstance's estimated coefficient is only statistically significant in the auxiliary regression (model (2a)), this indicates that its effect on health is indirect. Conversely, if the estimated coefficient is only statistically significant in model (2h), it suggests that its effect on health is direct. Additionally, if a circumstance's estimated coefficient is significant in both models, this implies that the circumstance affects health through both direct and indirect pathways.

3.2. Decomposition of health inequality

We use the Shapley decomposition to estimate the contribution of each factor in explaining health inequality (Sastre and Trannoy, 2002; Chantreuil and Trannoy, 2013; Shorrocks, 2013). Taking into account all possible combinations of circumstances, efforts and lifestyles, and demographics, this approach derives the partial contribution of each factor (or group of factors) to the generation of health inequality. For each explanatory variable, it calculates all marginal effects on inequality when all other factors are sequentially removed, and the contribution of each variable is the average of these marginal effects. The estimated contributions can therefore be interpreted as the expected marginal impact of each factor on health inequality.

More specifically, we apply the Shapley decomposition to the pseudo-R^2 estimated from the health logit regression (model (2f)), which measures the explained variance of the health status (Israeli, 2007; Tubeuf et al., 2012; Deutsch et al., 2018). This method has the advantage that it produces an exact additive decomposition of the explained inequality into its factors, treating all of them symmetrically.

4. RESULTS

This section presents the results of our empirical analysis. First, we show the results of the two-step procedure proposed by Trannoy et al. (2010) and examine the determinants of individual health status. Then, we analyse the role of education as a channel of transmission of health inequality. Finally, we present the Shapley decomposition and compare the contributions of circumstances, efforts and lifestyles, and demographics to the pseudo-R^2 of the health logit regression.

4.1. Regression results

Table 2 shows the estimation results of models (2a)-(2h), which are interpreted in terms of odds ratios. In general, they have the expected sign, and the most relevant and significant results are discussed below.

Looking at the second column of Table 2 (model (2a)), the probability of having tertiary education increases significantly with parental education (with a higher odds ratio for mother's education), and if the father's SES is high. It is also higher for younger cohorts and those who lived in an urban locality. However, this likelihood decreases with birth order and with a lower mother's SES. The latter result may derive from the fact that a working mother has less time to devote to her child than an unemployed or housewife, which could have an impact on the child's education.

Model (2b) shows that the probability of being employed is lower among women and, as expected, much higher for those under 50 compared to individuals over 70 years old. It is higher and significant for individuals born in the more developed regions of Spain (Catalonia, Madrid and the Basque Country) (see Table A1 in Appendix A for birth region estimates), with an educated father or a middle-class mother. Moreover, the effort exerted to obtain a higher education also increases the likelihood of being employed.

Regarding model (2c), we observe that having a middle-class mother and having lived in an urban environment increases the probability of smoking. Being a woman and efforts for higher education reduce the probability of being smoker, although it increases for younger individuals. Moreover, with respect to the reference category, born in some regions of Spain also affects the probability of smoking, but parental education has no impact on it.

Looking at the fifth column (model (2d)), we find that the likelihood of doing regular physical activity is higher for individuals with an educated father, a mother with a high SES and those who lived in an urban area. Women are less likely to exercise daily, although surprisingly age does not affect it significantly. Besides, the relative residuals from the education and smoking regressions have a significant and positive impact on the probability of doing regular physical activity.

Table 2. Estimation results of the logit models

Model	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)	(2g)	(2h)
Dependent variable	Education	Employ. sta.	Smoking	Physical act.	Veget. con.	Health	Health	Health
CIRCUMSTANCES								
Father's education (Reference category: No education)								
Primary	1.550**	1.438**	1.301	1.310*	1.153	1.656***	1.634***	1.545***
	(0.316)	(0.249)	(0.230)	(0.198)	(0.321)	(0.268)	(0.262)	(0.250)
Secondary	2.015***	1.960***	1.179	1.389*	0.753	1.374	1.353	1.231
	(0.465)	(0.412)	(0.244)	(0.262)	(0.248)	(0.273)	(0.268)	(0.249)
Higher	4.918***	1.615	1.159	1.492	0.684	2.861***	2.761***	2.514***
	(1.513)	(0.495)	(0.357)	(0.425)	(0.303)	(0.927)	(0.869)	(0.802)
Mother's education (Reference category: No education)								
Primary	1.711***	1.141	0.785	0.796	1.212	1.165	1.166	1.120
	(0.327)	(0.189)	(0.135)	(0.117)	(0.325)	(0.182)	(0.180)	(0.174)
Secondary	2.560***	1.113	0.744	0.803	1.575	0.836	0.853	0.810
	(0.613)	(0.258)	(0.168)	(0.167)	(0.597)	(0.185)	(0.190)	(0.180)
Higher	5.907***	1.124	0.954	0.721	0.943	1.014	1.051	0.976
	(2.086)	(0.413)	(0.341)	(0.235)	(0.493)	(0.376)	(0.374)	(0.353)
Father's SES (Reference category: Unemployed/inactive)								
Lower	1.418	1.184	1.306	0.821	2.223	1.728	1.709	1.822
	(0.780)	(0.551)	(0.588)	(0.313)	(1.308)	(0.697)	(0.694)	(0.735)
Middle	1.452	1.363	0.863	0.843	2.031	1.843*	1.813*	1.859*
	(0.705)	(0.559)	(0.332)	(0.287)	(0.994)	(0.656)	(0.652)	(0.661)
Upper	2.473*	1.605	0.636	1.210	1.825	1.812	1.802	1.758
	(1.305)	(0.737)	(0.281)	(0.475)	(1.019)	(0.748)	(0.752)	(0.727)
Mother's SES (Reference category: Unemployed/inactive)								
Lower	0.415***	1.118	1.257	1.028	0.657	0.754	0.763	0.776
	(0.134)	(0.248)	(0.286)	(0.199)	(0.191)	(0.168)	(0.168)	(0.173)
Middle	1.059	1.307*	0.744**	1.094	1.274	0.802	0.811	0.815
	(0.159)	(0.193)	(0.103)	(0.141)	(0.280)	(0.116)	(0.115)	(0.116)
Upper	0.611	0.785	1.040	1.903**	2.357	0.912	0.914	0.931
	(0.221)	(0.263)	(0.342)	(0.574)	(1.230)	(0.313)	(0.309)	(0.317)
Birth order (Reference category: First)								
Second and third	0.768*	1.067	0.835	1.017	1.120	1.018	1.024	1.038
	(0.104)	(0.133)	(0.103)	(0.112)	(0.204)	(0.127)	(0.126)	(0.128)
Fourth or more	0.549***	0.954	0.867	1.092	1.498	0.715**	0.727**	0.760*
	(0.113)	(0.161)	(0.146)	(0.159)	(0.393)	(0.112)	(0.112)	(0.119)
Sex (Reference category: Man)								
Woman	1.000	0.490***	1.432***	0.766***	2.106***	0.739***	0.745***	0.757**
	(0.126)	(0.0557)	(0.158)	(0.0747)	(0.366)	(0.0808)	(0.0808)	(0.0825)
Type of place of residence (Reference category: Rural)								
Urban	1.587***	0.963	0.772**	1.290**	0.988	1.022	1.022	0.993
	(0.224)	(0.118)	(0.0944)	(0.137)	(0.179)	(0.121)	(0.120)	(0.117)
Region of birth (Reference category: Abroad)*								

Note: Constructed by the authors using data from CIS (2017).
Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.
* Region of birth coefficients are not included because of space limitations (see Table A1 in Appendix A for complete estimation results).

Table 2. Estimation results of the logit models (continued)

Model	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)	(2g)	(2h)
Dependent variable	Education	Employ. sta.	Smoking	Physical act.	Veget. con.	Health	Health	Health
DEMOGRAPHICS								
Age (Reference category: More than 70)								
25-30	1.816**	154.6***	0.198***	0.937	0.292***	9.682***	9.051***	7.860***
	(0.551)	(113.6)	(0.0576)	(0.207)	(0.120)	(2.736)	(2.516)	(2.236)
31-50	1.796**	290.6***	0.216***	0.906	0.452**	4.289***	4.127***	3.680***
	(0.450)	(209.2)	(0.0532)	(0.147)	(0.153)	(0.753)	(0.717)	(0.663)
51-70	1.363	71.05***	0.327***	1.213	0.634	2.080***	2.051***	1.894***
	(0.344)	(51.12)	(0.0803)	(0.190)	(0.209)	(0.336)	(0.330)	(0.313)
EFFORTS-LIFESTYLES (relative residuals)								
Education		1.647***	2.033***	2.226***	2.647***	1.149		
		(0.241)	(0.312)	(0.291)	(0.654)	(0.172)		
Employment status			1.037	0.961	0.827	1.712***		
			(0.133)	(0.112)	(0.164)	(0.219)		
Smoking				1.533***	1.726***	1.223		
				(0.177)	(0.308)	(0.156)		
Physical activity					2.115***	1.537***		
					(0.378)	(0.176)		
Vegetables consumption						1.396*		
						(0.266)		
EDUCATION (Reference category: No education)								
Primary								1.261
								(0.245)
Secondary								1.582**
								(0.337)
Higher								1.701**
								(0.402)
Pseudo R^2	0.192	0.252	0.077	0.048	0.089	0.116	0.099	0.101
N	1819	1819	1819	1819	1819	1819	1819	1819

Note: Constructed by the authors using data from CIS (2017).
Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

In relation to model (2e), parental background does not affect the likelihood of eating vegetables regularly. This likelihood is higher for women and if the individual has positive lifestyle habits, such as having higher education, non-smoking and doing regular physical activity. In addition, the younger the individual, the lower the probability of eating vegetables, and being born in some regions also has a significant influence on this habit.

Looking at the health regression model (2f), the reported odds ratios show the overall impact of circumstances and efforts on health status in adulthood. The probability of having a good or very good SAH increases as the father's level of education and socioeconomic status increases, decreases significantly with age and is higher for men than for women. Mother's background does not directly influence health in adulthood, as well as the region of birth and place of residence during the adolescence. Furthermore, while being the fourth or more at birth negatively affects the likelihood of having good health, the residuals of employment status, physical activity and vegetable consumption are positively and significantly associated with good health.

In general, the results of model (2f) are consistent with the evidence of the literature on the determinants of health and health inequality. Indeed, parental education and socioeconomic status

significantly affects individual health in Spain, in line with the well-known relationship between family background and health (Case et al., 2005; Marmot, 2005; Almond et al., 2018). It has also been found in the literature that the likelihood of reporting good health decreases with age and among women (Jusot et al., 2013; Li Donni et al., 2014; Pinilla et al., 2017), as well as the (negative) relationship between birth order and later health in adulthood (Hatton and Martin, 2010; Black et al., 2016). Lastly, the non-significance effect of the country of birth and place of residence is in line with the mixed evidence in this regard (Lazar, 2013; Li Donni et al., 2014; Fajardo-Gonzalez, 2016), while the positive impact on adult health of the relative residuals of employment, physical activity and vegetable consumption has been found in the literature of inequality of opportunity (Tubeuf et al., 2012; Bricard et al., 2013; Deutsch et al., 2018).

In addition to the previous analysis, we also assess the mediating role of education in the relationship between circumstances and health by examining the estimates of models (2g) and (2h). Once the education of the individual is introduced into the model (2h), we can see that it has a significant impact on individual's health: having secondary and tertiary education are significant at 5%, meaning that the probability of having better health increases with the education of the individual. Regarding the circumstances, in general, both models (2g) and (2h) are very similar in terms of magnitude and significance of the coefficients (and coincide with those of model (2f)). However, birth order and sex reduce their significance and the odd-ratios of the age decrease considerably, which would indicate that education moderates the effects of these explanatory variables on health.

Furthermore, since education has a significant impact on health, we can also compare models (2a) and (2h) to analyse whether circumstances have a direct effect on health or an indirect one through their influence on education. When making this comparison, we observe that mother's education, mother's SES, and the type of place of residence are significant in model (2a) but not significant in model (2h), indicating that these circumstances have an indirect effect on health. All other circumstances (except the region of birth) are significant in both models, suggesting that they affect health both directly and indirectly through their impact on education.

In summary, our results indicate that the circumstances can affect individual's health in adulthood both through a direct impact and indirectly through their effect on effort-related variables. Moreover, the findings suggest that education has a direct influence on health and also acts as a mediator in the relationship between circumstances and health, thereby mitigating the impact of certain explanatory

variables on health status. These results are in line with those shown in the literature (Rosa Dias, 2009; Trannoy et al., 2010).

4.2. The Shapley decomposition

To estimate the contribution of circumstances, efforts and lifestyles, and demographics in explaining health inequality, we apply the Shapley decomposition to the pseudo-R^2 estimated from the health logit regression. Table 3 presents the contributions of each group of factors and each variable. Both circumstances and demographics explain a significant proportion of the pseudo R^2, around 43%, respectively, while the effort exerted by the individual accounts for only 14%.

Looking at the explanatory variables individually, age explains the largest proportion of the pseudo R^2 of the health logit regression (44%), followed by father's education (15%) and mother's education (10%), the latter two being the most important circumstances. Also noteworthy is the contribution of the region of birth and birth order (almost 5% and 4%, respectively), and that sex does not seem to be relevant in explaining health inequality. The efforts/lifestyles with the greatest and most significant impact are employment status and physical activity.

Comparing with the literature on inequality of opportunity that uses SAH as health outcome, and considering the differences between studies (survey sources, target samples and explanatory variables used), the relative contributions of the circumstances, efforts and demographics are similar to those presented by Jusot et al. (2013) for France. Moreover, circumstances play an important role in the explained health inequality as in Trannoy et al. (2010), and the proportion explained by circumstances (42%) is considerably higher than the one estimated by Tubeuf et al. (2012) for United Kingdom (19%), Deutsch et al. (2018) for Luxembourg (27%) and Bigorne et al. (2021) for a sample of European countries (36%). In these latter studies, the effort represents twice the effort reported in Table 3, although our magnitude of demographics is in line with Deutsch et al. (2018).

In summary, our decomposition demonstrates the great relevance of unfair factors (circumstances) and age in the generation of adult health inequality in Spain, in contrast to the minimal effect of fair

factors (efforts and lifestyles). However, it is also necessary to consider the role of age since it explains half of the estimated health inequality.[12]

Table 3. Contribution of circumstances, efforts and lifestyles, and demographic variables to health inequality: Shapley decomposition

	Shapley value (a)	Contribution to the pseudo R^2 (%) (c)
CIRCUMSTANCES	0.0491	42.49%
Father's education	0.0173	14.95%
Mother's education	0.0114	9.88%
Father's SES	0.0033	2.82%
Mother's SES	0.0019	1.64%
Birth order	0.0048	4.12%
Sex	0.0037	3.19%
Place of residence	0.001	0.85%
Region of birth	0.0058	5.04%
DEMOGRAPHICS	0.0508	43.95%
Age	0.0508	43.95%
EFFORTS AND LIFESTYLES (relative residuals)	0.0156	13.55%
Education	0.0004	0.36%
Employment status	0.0071	6.14%
Smoking	0.001	0.84%
Physical activity	0.0059	5.08%
Vegetables consumption	0.0013	1.13%
Pseudo R^2	**0.1155 (b)**	**100%**

Note: Constructed by the authors using data from CIS (2017). The contribution of each explanatory variable is obtained dividing the Shapley value by the pseudo R^2: (c)=(a)/(b)*100

5. DISCUSSION

In this paper, we have analysed the contribution of circumstances, efforts and lifestyles, and demographics in explaining health inequality among adults in Spain. In general, our results are consistent with the evidence found in the literature on the determinants of health inequality and inequality of opportunity. Parental education and socioeconomic status have a positive and significant association with individual health, while the likelihood of reporting good health decreases with age, birth order and among women. In addition, the efforts and lifestyle choices made by individuals to be employed, exercise and eat healthy are positively and significantly linked to health outcomes. Furthermore, we have shown that circumstances can affect health directly but also indirectly through their effect on effort variables, highlighting in this case the mediating role of the individual's education. Finally, we also find that unfair components (circumstances) and age of individuals account for a significant proportion of the health inequality explained by our model. Among the circumstances,

[12] García-Gómez et al. (2015) emphasize that demographics (in general, sex, but also age) and lifestyle differences are co-determined and influenced by social and behavioral factors, and are not only linked to biological factors; therefore, they should be explicitly considered in any analysis of inequality of opportunity. Moreover, some authors argue that, while it is rational to focus on avoidable differences for policy analysis, "unfair" does not necessarily coincide with "avoidable" (see Fleurbaey and Schokkaert (2009) for a detailed discussion).

parental education is the most important factor, followed by the region of birth and birth order. In contrast, fair components such as efforts and lifestyles have a modest contribution.

Our study has the advantage of the large number of relevant circumstances and effort variables considered simultaneously, which have been collected from the same survey. However, it also has some limitations. First, our measure of adult health is based on a subjective indicator of health status, and this variable may suffer from reporting bias. Second, the results are generated with a sample of living individuals, thus excluding deceased individuals would narrow the health gaps among the respondents and exert downward pressure on the true effect of circumstances on health. Third, since this database does not contain all relevant variables that explain individual health status, the specification of our empirical model could suffer from potential unobserved circumstances and effort variables. Finally, we cannot perform longitudinal analyses given the characteristics of the database.

Potential lines of research include dealing with missing values in order to perform the analysis with the full sample of individuals while reducing the potential biases that this could generate. In addition, it would also be appropriate to analyse whether our results differ by sex or for different age cohorts, as well as to test the robustness of the results to other measures of health, such as height or body mass index.

Overall, our results indicate that the effort and lifestyle of individuals to achieve good health is not enough to offset the influence of the unfair circumstances. Therefore, improving circumstances and early-life factors, or reducing their impact on health through the implementation of compensatory policies, is necessary for reducing health inequality and equalize opportunities for progress in later life. In this context, the evidence shown in this study identifies the education of individuals as a key factor to explain health and health disparities. This outcome highlights the importance of equalizing educational opportunities as a means to reduce health inequality, and also underscores the potential for coordinated policies between the education and healthcare sectors. However, given that our results are descriptive and based on regression analyses, they should not be interpreted as policy recommendations but as potential lines of future exploration.

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APPENDIX A. ESTIMATION RESULTS

Table A1. Complete estimation results of the logit models

Model	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)	(2g)	(2h)
Dependent variable	Education	Employment status	Smoking	Physical Activity	Vegetables consump.	Health	Health	Health
CIRCUMSTANCES								
Father's education (Reference category: No education)								
Primary	1.550**	1.438**	1.301	1.310*	1.153	1.656***	1.634***	1.545***
	(0.316)	(0.249)	(0.230)	(0.198)	(0.321)	(0.268)	(0.262)	(0.250)
Secondary	2.015***	1.960***	1.179	1.389*	0.753	1.374	1.353	1.231
	(0.465)	(0.412)	(0.244)	(0.262)	(0.248)	(0.273)	(0.268)	(0.249)
Higher	4.918***	1.615	1.159	1.492	0.684	2.861***	2.761***	2.514***
	(1.513)	(0.495)	(0.357)	(0.425)	(0.303)	(0.927)	(0.869)	(0.802)
Mother's education (Reference category: No education)								
Primary	1.711***	1.141	0.785	0.796	1.212	1.165	1.166	1.120
	(0.327)	(0.189)	(0.135)	(0.117)	(0.325)	(0.182)	(0.180)	(0.174)
Secondary	2.560***	1.113	0.744	0.803	1.575	0.836	0.853	0.810
	(0.613)	(0.258)	(0.168)	(0.167)	(0.597)	(0.185)	(0.190)	(0.180)
Higher	5.907***	1.124	0.954	0.721	0.943	1.014	1.051	0.976
	(2.086)	(0.413)	(0.341)	(0.235)	(0.493)	(0.376)	(0.374)	(0.353)
Father's SES (Reference category: Unemployed/inactive)								
Lower	1.418	1.184	1.306	0.821	2.223	1.728	1.709	1.822
	(0.780)	(0.551)	(0.588)	(0.313)	(1.308)	(0.697)	(0.694)	(0.735)
Middle	1.452	1.363	0.863	0.843	2.031	1.843*	1.813*	1.859*
	(0.705)	(0.559)	(0.332)	(0.287)	(0.994)	(0.656)	(0.652)	(0.661)
Upper	2.473*	1.605	0.636	1.210	1.825	1.812	1.802	1.758
	(1.305)	(0.737)	(0.281)	(0.475)	(1.019)	(0.748)	(0.752)	(0.727)
Mother's SES (Reference category: Unemployed/inactive)								
Lower	0.415***	1.118	1.257	1.028	0.657	0.754	0.763	0.776
	(0.134)	(0.248)	(0.286)	(0.199)	(0.191)	(0.168)	(0.168)	(0.173)
Middle	1.059	1.307*	0.744**	1.094	1.274	0.802	0.811	0.815
	(0.159)	(0.193)	(0.103)	(0.141)	(0.280)	(0.116)	(0.115)	(0.116)
Upper	0.611	0.785	1.040	1.903**	2.357	0.912	0.914	0.931
	(0.221)	(0.263)	(0.342)	(0.574)	(1.230)	(0.313)	(0.309)	(0.317)
Birth order (Reference category: First)								
Second and third	0.768*	1.067	0.835	1.017	1.120	1.018	1.024	1.038
	(0.104)	(0.133)	(0.103)	(0.112)	(0.204)	(0.127)	(0.126)	(0.128)
Fourth or more	0.549***	0.954	0.867	1.092	1.498	0.715**	0.727**	0.760*
	(0.113)	(0.161)	(0.146)	(0.159)	(0.393)	(0.112)	(0.112)	(0.119)
Sex (Reference category: Man)								
Woman	1.000	0.490***	1.432***	0.766***	2.106***	0.739***	0.745***	0.757**
	(0.126)	(0.0557)	(0.158)	(0.0747)	(0.366)	(0.0808)	(0.0808)	(0.0825)
Type of place of residence (Reference category: Rural)								
Urban	1.587***	0.963	0.772**	1.290**	0.988	1.022	1.022	0.993
	(0.224)	(0.118)	(0.0944)	(0.137)	(0.179)	(0.121)	(0.120)	(0.117)

Note: Constructed by the authors using data from CIS (2017).
Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table A1. Complete estimation results of the logit models (continued)

Model	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)	(2g)	(2h)
Dependent variable	Education	Employment status	Smoking	Physical Activity	Vegetables consump.	Health	Health	Health
Region of birth (Reference category: Abroad)								
Andalucía	1.049	0.982	0.420***	1.041	0.543	0.999	0.984	1.017
	(0.259)	(0.212)	(0.0956)	(0.206)	(0.208)	(0.219)	(0.214)	(0.222)
Asturias	0.778	0.872	0.834	1.024	0.333**	1.196	1.140	1.165
	(0.307)	(0.293)	(0.354)	(0.359)	(0.180)	(0.451)	(0.424)	(0.426)
Baleares	0.834	1.978	0.379**	0.877	0.541	0.965	0.949	0.945
	(0.436)	(1.009)	(0.155)	(0.342)	(0.354)	(0.404)	(0.412)	(0.403)
Canarias	0.571	0.994	0.365***	0.781	0.830	0.614	0.616	0.649
	(0.259)	(0.339)	(0.122)	(0.243)	(0.514)	(0.215)	(0.214)	(0.228)
Cantabria	1.154	1.091	0.269***	2.017*	0.267**	0.581	0.594	0.585
	(0.573)	(0.576)	(0.108)	(0.786)	(0.162)	(0.252)	(0.265)	(0.258)
Castilla y León	1.619	1.264	0.574**	1.174	0.486	1.415	1.397	1.413
	(0.500)	(0.342)	(0.162)	(0.279)	(0.218)	(0.368)	(0.363)	(0.368)
Castilla-La Mancha	0.749	1.051	0.678	1.179	0.421*	0.809	0.809	0.855
	(0.271)	(0.318)	(0.222)	(0.319)	(0.200)	(0.251)	(0.244)	(0.261)
Cataluña	1.039	2.080***	0.412***	0.797	0.570	1.132	1.113	1.114
	(0.268)	(0.517)	(0.0997)	(0.170)	(0.238)	(0.281)	(0.273)	(0.273)
Valencia	1.337	0.996	0.383***	0.982	0.544	0.996	0.980	0.996
	(0.383)	(0.250)	(0.101)	(0.222)	(0.236)	(0.262)	(0.252)	(0.256)
Extremadura	0.899	0.952	0.418**	1.042	0.334**	1.279	1.249	1.343
	(0.432)	(0.340)	(0.151)	(0.324)	(0.168)	(0.453)	(0.439)	(0.482)
Galicia	1.041	1.346	0.638	1.673**	0.406**	0.921	0.916	0.926
	(0.342)	(0.379)	(0.194)	(0.426)	(0.183)	(0.256)	(0.252)	(0.256)
Madrid	1.505	1.604*	0.498***	1.655**	0.714	0.960	0.958	0.959
	(0.385)	(0.412)	(0.128)	(0.377)	(0.306)	(0.242)	(0.243)	(0.243)
Murcia	1.013	1.065	0.452**	0.920	0.682	0.848	0.834	0.869
	(0.419)	(0.390)	(0.160)	(0.302)	(0.428)	(0.296)	(0.284)	(0.297)
País Vasco	1.538	2.486***	0.599	1.155	0.461	1.219	1.216	1.185
	(0.487)	(0.809)	(0.196)	(0.327)	(0.227)	(0.409)	(0.405)	(0.393)
Ceuta and Melilla	0.654	2.247	2.427	1.496	0.260	0.779	0.758	0.733
	(0.579)	(1.573)	(2.482)	(0.921)	(0.253)	(0.513)	(0.520)	(0.504)
DEMOGRAPHICS								
Age (Reference category: More than 70)								
25-30	1.816**	154.6***	0.198***	0.937	0.292***	9.682***	9.051***	7.860***
	(0.551)	(113.6)	(0.0576)	(0.207)	(0.120)	(2.736)	(2.516)	(2.236)
31-50	1.796**	290.6***	0.216***	0.906	0.452**	4.289***	4.127***	3.680***
	(0.450)	(209.2)	(0.0532)	(0.147)	(0.153)	(0.753)	(0.717)	(0.663)
51-70	1.363	71.05***	0.327***	1.213	0.634	2.080***	2.051***	1.894***
	(0.344)	(51.12)	(0.0803)	(0.190)	(0.209)	(0.336)	(0.330)	(0.313)
EFFORTS-LIFESTYLES (relative residuals)								
Education		1.647***	2.033***	2.226***	2.647***	1.149		
		(0.241)	(0.312)	(0.291)	(0.654)	(0.172)		
Employment status			1.037	0.961	0.827	1.712***		
			(0.133)	(0.112)	(0.164)	(0.219)		
Smoking				1.533***	1.726***	1.223		
				(0.177)	(0.308)	(0.156)		
Physical activity					2.115***	1.537***		
					(0.378)	(0.176)		
Vegetables consumption						1.396*		
						(0.266)		
EDUCATION (Reference category: No education)								
Primary								1.261
								(0.245)
Secondary								1.582**
								(0.337)
Higher								1.701**
								(0.402)
Pseudo R^2	0.192	0.252	0.077	0.048	0.089	0.116	0.099	0.101
N	1819	1819	1819	1819	1819	1819	1819	1819

Note: Constructed by the authors using data from CIS (2017).
Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.