The health benefits of education: Evidence from higher education expansion

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Outline of the presentation

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- Identification
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- Main results
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- Evidence from Compulsory Schooling Laws
- Concluding remarks

Motivation

- Widespread evidence of important economic returns to education
- Evidence on the health returns from education is more mixed
- In particular, most evidence come from instrumental variables (IVs) estimates leveraging compulsory schooling laws (CSL) reforms
- However, effects might be non-linear, i.e. differ at different levels of education
- In this paper, we mainly focus on increases in education leveraged by expansion of higher education (HE) supply, i.e. changes in accessibility to HE across birth cohorts

Conceptual framework - I

The conceptual framework is provided by the well established literature on the *demand for health* Grossman (1972, 2006). In particular:

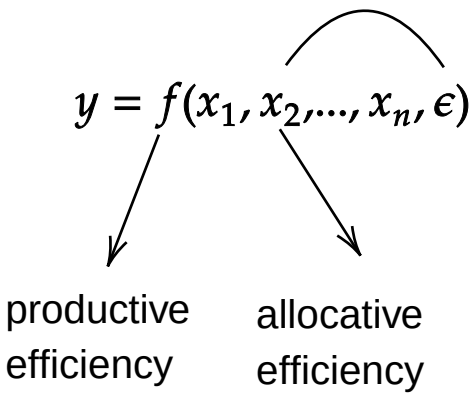
- Education could change the productivity of health inputs in the health production function (*productive efficiency hypothesis*)
- Education could change the inputs in the health production function (*allocative efficiency hypothesis*), i.e. higher demand for 'healthy' behaviors

Yet, there are reasons to think that health outcomes and inputs are endogenous with respect to education (i.e. there are unobservables correlated with the two variables),

- an obvious candidate is the individual intertemporal discount rate. Higher discounting $\longrightarrow$ lower investment in both education and health ('third variable hypothesis', Fuchs (1982), Farrell and Fuchs (1982))

Conceptual framework - II

Grossman health investment model



y : health outcome

$f(.)$: health production function

$x_1, x_2, \ldots, x_n$: health inputs (e.g. behavior)

ϵ : unobserved factors (e.g. discount rate)

Past literature - I

There is a vast amount of literature investigating the effects of education on health, although it has mainly focused on quasi-experiments affecting the left tail of educational attainment (i.e. CSL). Results are mixed. A sample of studies' main findings:

- Kemptner et al. (2011) use CSL for Western Germany and find that education positively affects health, but little evidence that it does affect *health-related behaviors* (such as smoking). Clark and Royer (2013) using a FRDD, and a very strong identification strategy, do not find effect neither on health nor on behaviors;

Past literature - II

- As for BMI and obesity there is some evidence that both are negatively affected by education, and that the effect is larger for women Grabner (2009); Kemptner et al. (2011); Brunello et al. (2013);
- Single studies sometimes find results on given health behaviors or outcomes. E.g., Park and Kang (2008): high school education is associated with a higher probability of exercise and health checkups; Atella and Kopinska (2014): in contrast to Clark and Royer (2013)find significant effects on BMI, dietary habits and physical activity; Using biomarkers: Powdthavee (2010) found a negative effect on hypertension, while Jürges et al. (2013) found no evidence of a protective effect of education on two biomarkers for inflammatory processes.
- Recently Janke et al. (2020), exploit two education reforms in UK (CLS and tertiary) and found no evidence of education on chronic conditions, except diabetes.

Our main contribution to the extant literature

- We report some new evidence on the health returns to education leveraging variation due to HE supply expansion, while most literature is based on CSL
- We compare health returns estimated using CSL and HE expansion in the Italian context, providing evidence of **non-linear returns**

Feature of our study:

- Due to data availability (related to data protection issues), we mainly focus on health-related behaviors rather than on health outcomes

Data

We use two main sources of data:

- Several waves of ISTAT annual survey *Aspects of everyday life* (AVQ, 'Aspetti della vita quotidiana'), covering the period 2001-2013 and 2015-2016 (2014 is missing since the survey was interrupted)
- A database with the geographical evolution of Italian Higher Education supply expansion since Italy's unification collected by Cottini, Ghinetti and Moriconi (see Cottini et al., 2019).

Variables definition/Outcomes

Variable	Description	Definition
Healthy habits		
physact	Physical activity	Performs physical activity at least 1-2 times a week
fruveg	Fruit and vegetables	Eats fruit and vegetables at least once a day
fruveg_5pcs	Fruit and vegetables (5)	Eats at least 5 pieces of fruit or vegetables per day
fruveg_pcs	Fruit and vegetables (pieces)	N. of pieces of fruit and vegetables consumed per day
veg_pcs	Vegetables (pieces)	N. of pieces of vegetables consumed per day
fruit_pcs	Fruit (pieces)	N. of pieces of fruit consumed per day
1.5lt_water	Water	Drinks at least 1.5 lt of water per day
breakfast	Breakfast	Eats something for breakfast
nojunk	No junk food	Eats less than once a week or never eat sweets and salty snacks
fizzy_drinks	No gas beverages	Consumes less than 1-2 glasses of gas beverages (excluding water) per day
Weight		
obese	Obese	Indicator for BMI ≥ 30
bmi	Body Mass Index (BMI)	BMI (= weight in Kg / height^2 in cm)
Alcohol		
alcohol	Alcoholic beverages	Does not drink more than one glass of wine / beer per day
alc_glasses	Glasses of alcoholic drinks	Glasses of alcoholic beverages consumed daily
alc_lt	Milliliters of alcoholic drinks	Ml. of alcoholic beverages consumed daily
no_spirits	No superalcoholic beverages	Never consumes super-alcoholic beverages
Smoking		
ever_smoke	Ever smoked	Ever smoked
curr_smoke	Current smokers	Currently smokes
smoke_nsig	No. of cigarettes	Average daily consumption of cigarettes
Instruments		
Location nearest HE (at least 1 Facoltà: (Extensive margin)		
Same municipality	Same municipality	Nearest Facoltà is in the Municipality of residence
Neighbouring municipalities	Neighbouring municipalities	Nearest Facoltà is in neighbouring Municipalities of that of residence
Same province	Same province	Nearest Facoltà is in the Province of residence
Neighbouring provinces	Neighbouring provinces	Nearest Facoltà is in neighbouring Provinces of that of residence
Same region	Same region	Nearest Facoltà is in the Region of residence
Neighbouring regions	Neighbouring regions	Nearest Facoltà is in one neighbouring Region of that of residence or even further

Descriptive statistics

Table: Descriptive statistics

Variables	**Mean**	**Std.Dev**
Demographics		
Age	51.367	16.023
Female	0.518	0.5
Years of education	9.907	4.350
Tertiary education	0.103	0.304
Healthy habits		
Physical Activity	0.427	0.495
Fruit and vegetables	0.372	0.483
Fruit and vegetables(5)	0.049	0.215
Fruit and vegetables (pieces)	2.311	1.432
Vegetables (pieces)	1.105	0.72
Fruit (pieces)	1.475	0.888
Water	0.512	0.5
Breakfast	0.701	0.458
No junk food	0.851	0.57
No gas beverages	0.889	0.314
Weight		
Obesity	0.104	0.306
Body Mass Index (BMI)	25.119	3.84
Alcohol		
Light Alcohol consumption	0.681	0.466
Number units of alcohol a day	0.695	1.512
Ml of alcohol a day	101.888	232.741
Never consumes superalcohol	0.8	0.4
Smoking		
Ever smoked	0.485	0.5
Current smokers	0.233	0.423
No. of cigarettes	3.077	6.863

Identification (IVs) — First stage

We use an instrumental variables (IVs) strategy, by exploiting presumably exogenous variation in college proximity across birth cohorts.

- Our first stage is

$$e_{ipt} = \alpha_0 + \sum_{i}^{ik} \alpha_{1k} Z_{ik} + \alpha_2 X_{it} + D_{pt} + u_{ipt} \tag{1}$$

  where e_{ipt} are individual years of education; Z_{ik} are dummies for college availability at age 19 (built on current municipality of residence) for: a) municipality of residence; b) neighbouring municipalities; c) same province but not b); d) neighbouring province; e) same region but not d); f) neighbouring region. X_{it} individual controls; D_{pt} year $\times$ province fixed effects

- Controlling for D_{pt} we only exploit within-province variation in college proximity across birth cohorts in each survey wave
- The validity of our identification strategy hinges on the assumption that Z_{ik} are exogenous, i.e. uncorrelated with individual i health or health-behaviors, or factors affecting it.
- Measurement issues: we do not have information on municipality of birth or at age 19 (weak instrument?).

Identification (IVs) — Second stage

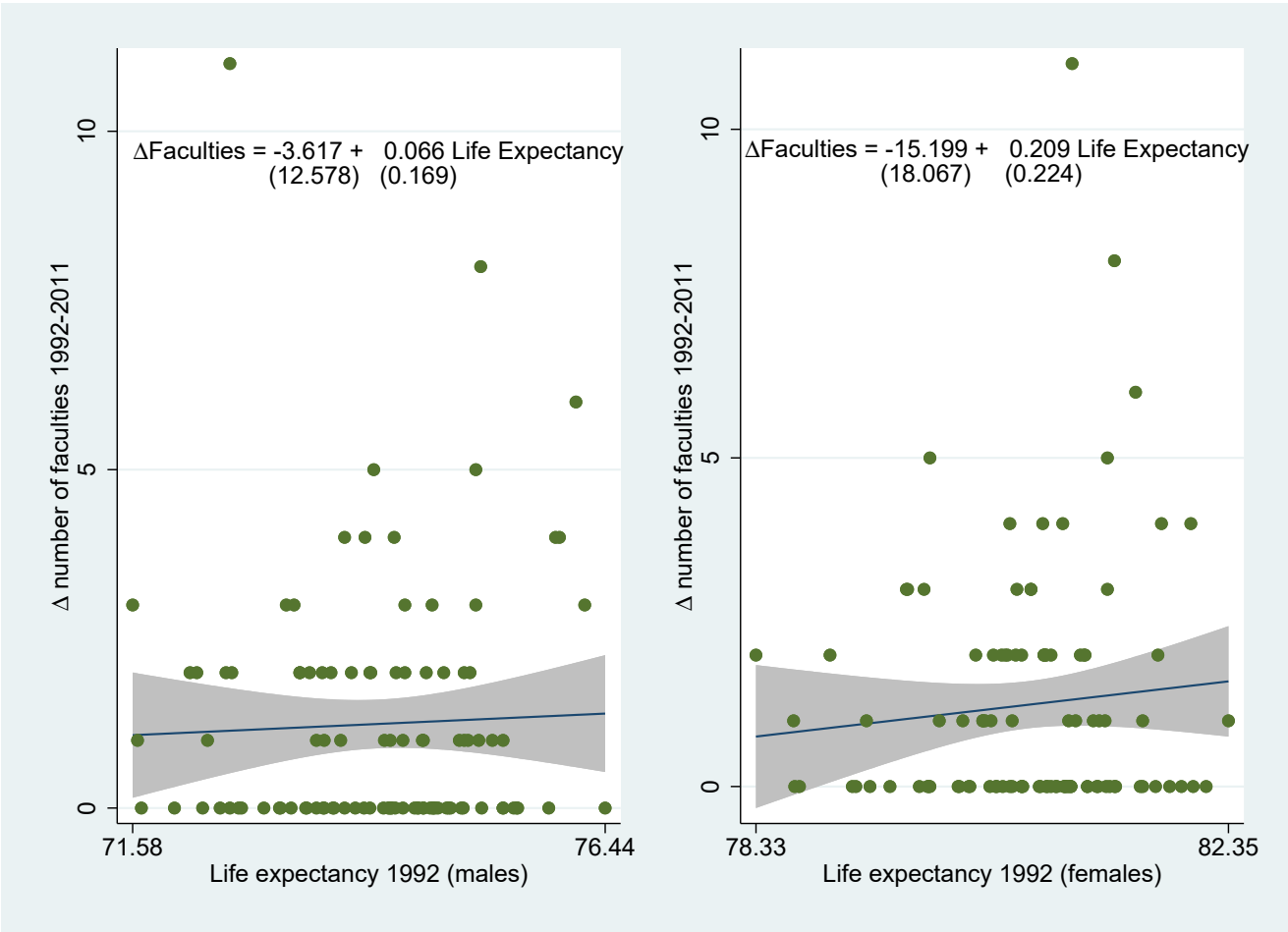
- Our second stage is

$$y_{ipt} = \beta_0 + \beta_1 e_{it} + \beta_2 X_{it} + D_{pt} + \epsilon_{ipt} \tag{2}$$

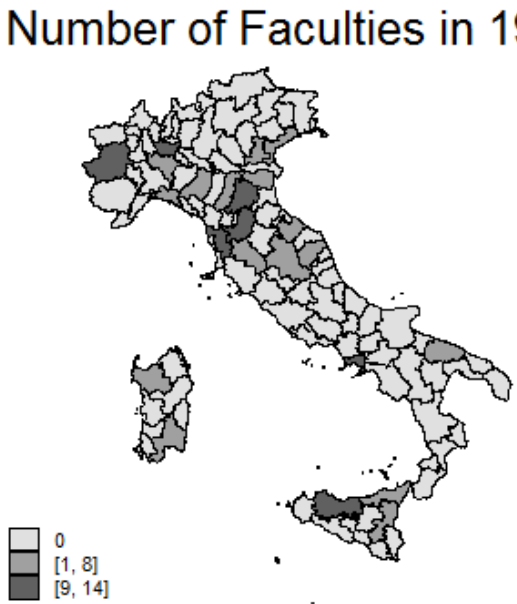
- y_{ipt} are health related outcomes and behaviors
- independent variables as in the first stage.

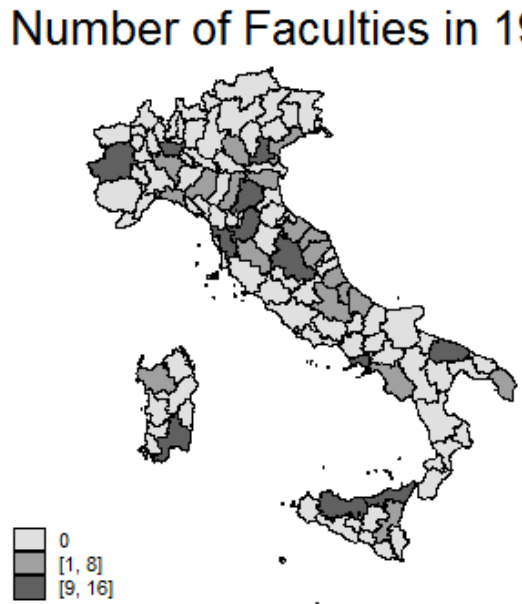
Evidence on HE expansion and instrument 'validity'

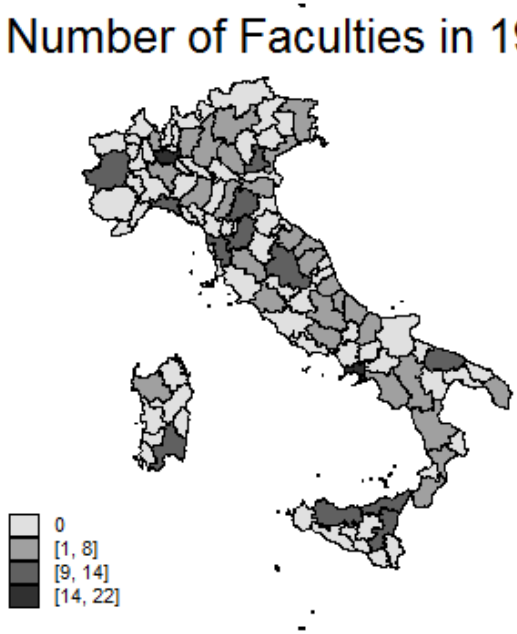
- Demand for education and health can be positively correlated, HE supply may increase more where individuals are healthier. There is no much old data to test this.

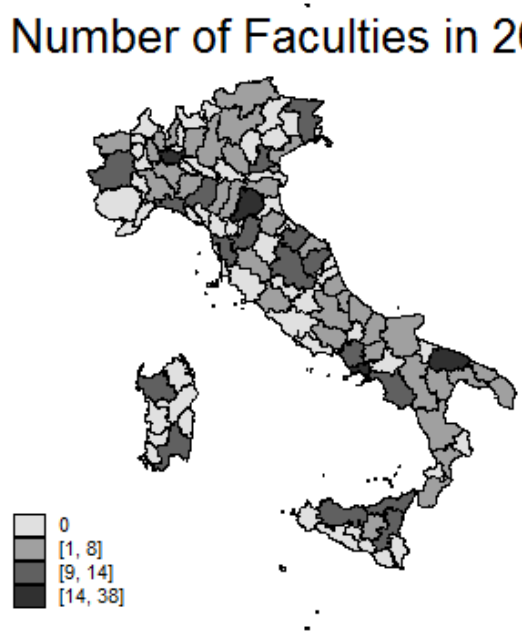


HE supply (by province, i.e. NUTS-3) over time - I









HE supply (by province, i.e. NUTS-3) over time - II

Table: Descriptives of Instruments

Variables	Full sample	By year of HE choice (at 19 yrs)			
		1935-1954	1955-1969	1970-1990	1990-2010
Location of the nearest 'Facoltà':					
Same municipality	0.218	0.209	0.214	0.214	0.231
Neighbouring municipalities	0.114	0.073	0.094	0.112	0.154
Same province	0.295	0.196	0.238	0.316	0.360
Neighbouring provinces	0.333	0.399	0.387	0.333	0.253
Same region	0.026	0.063	0.036	0.025	0.003
Neighbouring regions	0.014	0.06	0.03	0.00	0.00
Number of 'Facoltà' in the nearest location:					
Same municipality	2.549	2.002	2.094	2.428	3.398
Neighbouring municipalities	1.068	0.61	0.810	1.053	1.535
Same province	2.421	1.499	1.72	2.455	3.42
Neighbouring provinces	5.048	4.868	4.785	5.221	5.183
Same region	0.406	0.830	0.536	0.449	0.028
Neighbouring regions	0.37	1.418	0.886	0.00	0.00
N. observations	535,120	66,970	127,488	214,747	125,195

First stage (instrument relevance)

Table: First stage

	All		Male		Female	
	Coef	s.e.	Coef	s.e.	Coef	s.e.
Instrument: Location nearest Facoltà						
Years of education:						
Neighb.municipality	-1.284***	(0.154)	-1.300***	(0.17)	-1.282**	(0.144)
Same province	-1.603***	(0.164)	-1.643***	(0.176)	-1.574***	(0.153)
Neighb. province	-1.495***	(0.154)	-1.544***	(0.168)	-1.471***	(0.146)
Same region	-1.302***	(0.216)	-1.472***	(0.246)	-1.157***	(0.233)
Neighb. region	-1.941	(0.297)	-1.999	(0.308)	-1.910	(0.302)
N. observations	553,213		225,308		277,904	
College:						
Neighb.municipality	-0.115***	(0.008)	-0.122***	(0.011)	-0.111***	(0.008)
Same province	-0.131***	(0.010)	-0.134***	(0.012)	-0.130***	(0.009)
Neighb. province	-0.108***	(0.008)	-0.107***	(0.011)	-0.112***	(0.009)
Same region	-0.088***	(0.027)	-0.081***	(0.032)	-0.094***	(0.026)
Neighb. region	-0.093***	(0.019)	-0.084***	(0.019)	-0.106***	(0.024)
N. observations	203,460		99,500		103,960	
Instrument: CSL						
Years of compulsory schooling:						
	0.156***	(0.037)				
N.observations	195,290					

OLS and IV (based on college proximity): years of education

Table: Baseline estimates (yrs of education)

	OLS		IV						
					Diagnostics				
Outcome	Coef	s.e.	Coef	s.e.	Wald 1st stage	pvalue	Hansen J-stat	pvalue	N
physact	0.023***	(0.00)	0.030***	(0.01)	21.180	0.000	3.288	0.511	533,213
fruveg	0.003***	(0.00)	0.014**	(0.01)	21.144	0.000	3.752	0.441	526,881
fruveg_5pcs	0.002***	(0,00)	0.008**	(0.00)	20.925	0.000	6.007	0.198	449,614
fruvegs_pcs	0.032***	(0,00)	0.074***	(0.02)	20.925	0.000	4.892	0.298	449,614
veg_pcs	0.011***	(0.00)	0.014	(0.01)	21.394	0.000	3.690	0.449	402,853
fruit_pcs	0.016***	(0.00)	0.060***	(0.02)	21.394	0.000	3.433	0.488	402,853
water_lt	-0.002***	(0.00)	-0.012	(0.01)	19.122	0.000	11.033	0.026	315,099
breakfast	0.011***	(0.00)	0.013***	(0.00)	21.137	0.000	5.215	0.266	527,284
alcohol	-0.002***	(0.00)	-0.003	(0.00)	21.758	0.000	5.109	0.276	526,844
alc_glasses	-0.015***	(0.09)	-0.012	(0.01)	21.214	0.000	4.108	0.391	449,611
alc_ml	-2.66***	(0.25)	-1.053	(1.70)	20.214	0.000	4.556	0.336	449,611
no_spirits	-0.006***	(0.00)	-0.022***	(0.00)	21.173	0.000	3.725	0.444	520,897
fizzy_drinks	0.004***	(0.00)	0.008***	(0.00)	21.515	0.000	4.615	0.329	515,033
obese	-0.007***	(0.00)	-0.014***	(0.00)	21.160	0.000	3.933	0.415	535,120
bmi	-0.139***	(0.00)	-0.297***	(0.00)	21.714	0.000	5.246	0.263	535,120
eversmoke	-0.001	(0.02)	0.008*	(0.00)	21.531	0.000	4.451	0.348	526,117
currentsmoke	-0.006***	(0.00)	0.008***	(0.00)	21.751	0.000	7.242	0.123	526,117
smoke_nsig	-0.137***	(0.01)	0.214	(0.16)	21.862	0.000	0.816	0.966	522,755
nojunk	0.003***	(0.00)	0.009**	(0.00)	20.049	0.000	6.148	0.188	446,673

Note: All regressions control for age, age squared, gender and province by year fixed effects. Standard errors clustered by province are reported in parentheses.Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Robustness check: college education vs. upper secondary schooling

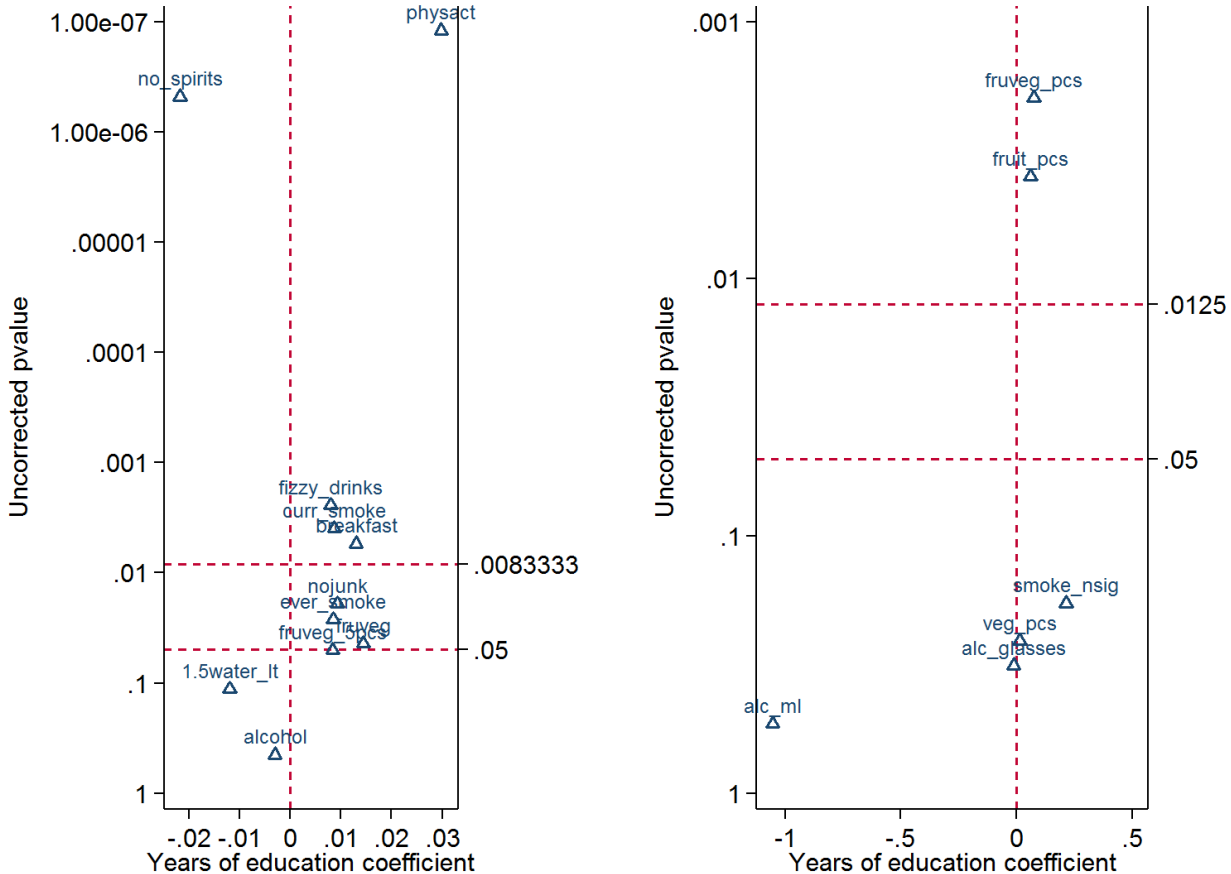
Table: College vs. upper secondary education

	OLS		IV						
					Diagnostics				
Outcome	Coef	s.e.	Coef	s.e.	Wald 1st stage	pvalue	Hansen J-stat	pvalue	N
physact	0.086***	(0.00)	0.276***	(0.06)	54.525	0.001	3.513	0.476	203,460
fruveg	0.024***	(0.00)	0.229***	(0.07)	54.932	0.001	2.375	0.667	201,001
fruveg_5pcs	0.011***	(0.00)	0.008	(0.05)	63.243	0.001	4.689	0.321	175,580
fruvegs_pcs	0.150***	(0.01)	0.951***	(0.31)	63.243	0.001	4.422	0.352	175,580
veg_pcs	0.053***	(0.00)	0.245**	(0.12)	57.674	0.001	2.717	0.606	156,490
fruit_pcs	0.071***	(0.01)	0.613**	(0.25)	57.674	0.001	3.246	0.518	156,490
1.5water_lt	-0.011**	(0.00)	0.003	(0.07)	50.400	0.002	3.831	0.429	118,675
breakfast	0.048***	(0.00)	0.122	(0.08)	54.865	0.001	4.916	0.296	201,075
alcohol	-0.013***	(0.00)	-0.106**	(0.05)	55.297	0.001	4.804	0.308	201,034
alc_glasses	-0.041***	(0.01)	0.138	(0.16)	63.187	0.000	5.703	0.222	175,627
alc_ml	-6.632***	(1.38)	29.535	(22.79)	63.187	0.000	6.084	0.193	175,627
no_spirits	-0.029***	(0.00)	-0.236***	(0.04)	55.233	0.001	4.271	0.371	199,200
fizzy_drinks	0.025***	(0.00)	0.069*	(0.04)	54.805	0.001	2.177	0.703	196,959
obese	-0.022***	(0.00)	-0.119***	(0.03)	56.766	0.001	3.488	0.486	204,184
bmi	-0.592***	(0.02)	-3.009***	(0.52)	56.766	0.001	5.458	0.243	204,184
eversmoke	-0.065***	(0.00)	0.009	(0.06)	54.662	0.001	6.401	0.171	200,694
currentsmoke	-0.050***	(0.00)	0.107***	(0.03)	54.662	0.001	1.625	0.804	200,694
smoke_nsig	-0.888***	(0.05)	1.814***	(0.50)	53.567	0.001	0.982	0.913	198,819
nojunk	0.035***	(0.00)	0.100*	(0.05)	63.449	0.001	3.950	0.413	174,732

Note: All regressions control for age, age squared, gender and province by year fixed effects. Standard errors clustered by province are reported in parentheses.Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Multiple testing (IV estimates on years of education)

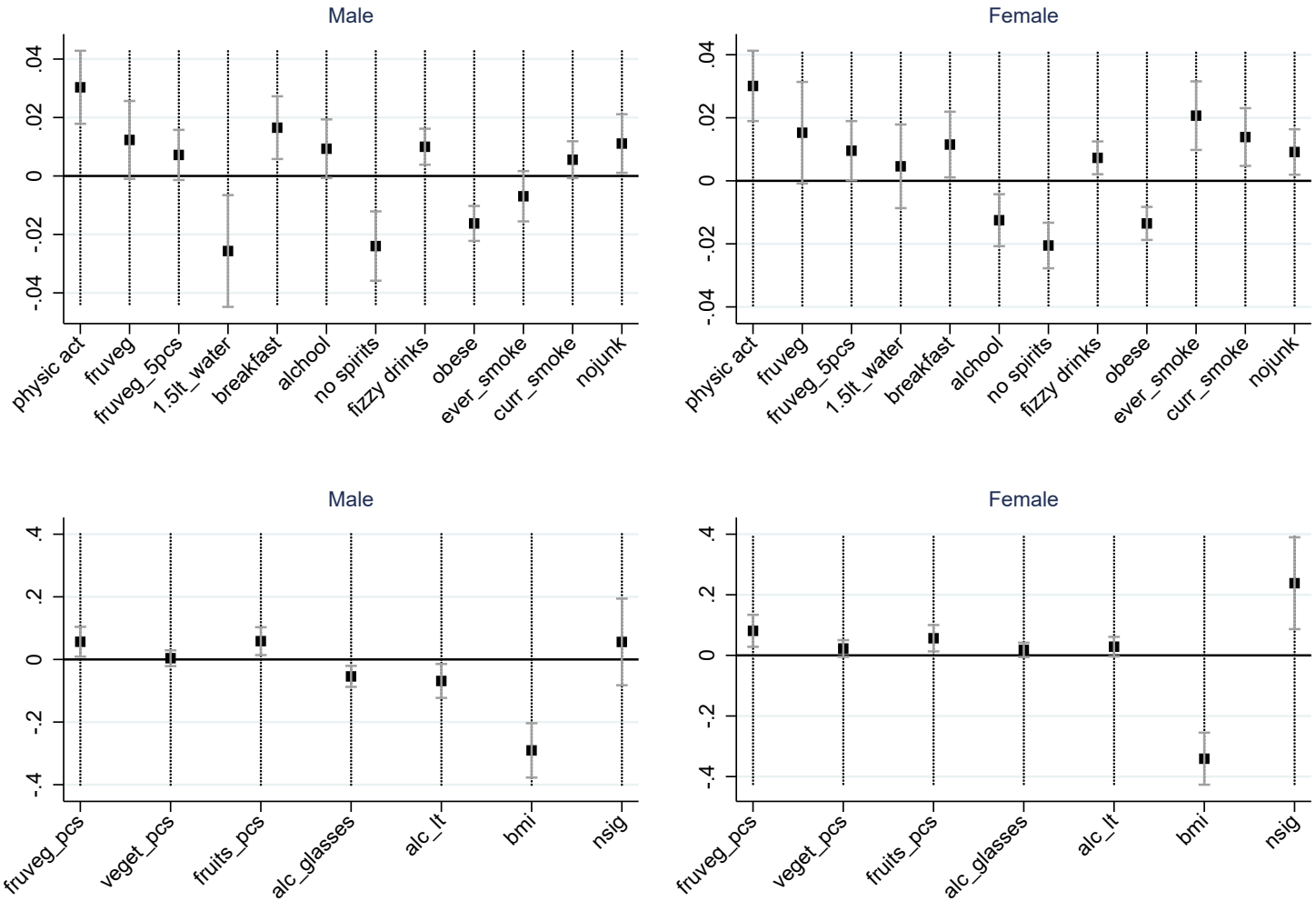
Figure: Corrected $p-$values for multiple testing



Note: Carried out with `multproc` stata command following Holm (1979). Step-down: *pcor* is set to the minimum c_i, such that $Q_i > c_i$, if such a c_i exists, and to the maximum critical $p-$value c_m otherwise.
$c_i = p_{unc}/(m - i + 1)$.

Gender differences

Figure: IV estimates by gender: years of education



Note: All regressions control for age, age squared, gender and province by year fixed effects. Standard errors clustered by province are reported in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Evidence from Compulsory Schooling Laws (CSL)

- Are **health returns from education linear**? If it is the case, using IV strategies that bite at different points in the years of education's distribution, we should obtain similar results (LATE interpretation).
- We focus on a reform that increased compulsory schooling from age 11 to age 14, starting to be effective since October 1963 ('riforma della scuola media', Law n. 1859, 31st December 1962) and that affected individuals born in 1949 or later. This reform has been used in Brunello et al. (2013) and Atella and Kopinska (2014), among others.
- We use an IV approach, in which cohorts born before 1949, in 1949, 1950 and 1951 or later are attributed 5, 6, 7, 9 years of compulsory schooling, respectively (similarly to Brunello et al., 2013).
- However, in RDD style, we also include a polynomial in birth cohort to control for secular changes in health and education (we do not use a FRDD since some cohorts are partially treated).

IV estimates with CSL

- Our first stage is

$$e_{ipct} = \alpha_0 + \alpha_1 C_{ic} + \alpha_2 X_{it} + D_p + D_t + f(c_i) + u_{ipct} \tag{3}$$

  where c is birth cohort subscript, C_{ci} years of compulsory schooling of individual i or birth cohort c (depending on CSL), $f(c_i)$ is a polynomial in birth cohort (see Brunello et al., 2013)

- Our second stage is

$$y_{ipt} = \beta_0 + \beta_1 e_{ipct} + \beta_2 X_{it} + D_p + D_t + f(c_i) + \epsilon_{ipt} \tag{4}$$

- we use a bandwidth of 10 years around the first affected cohort, considering only individuals born between 1940 e 1960

OLS and IV (CSL): years of education

Table: CSL estimates (yrs of education)

	OLS		IV				
					Diagnostics		
Outcome	Coef	s.e.	Coef	s.e.	Wald 1st stage	pvalue	N
physact	0.021***	(0.00)	0.018	(0.02)	10.08	0.007	195,290
fruveg	0.002***	(0.00)	0.01	(0.02)	9.98	0.007	193,174
fruveg_5pcs	0.003***	(0,00)	0.001	(0.01)	12.33	0.003	163,258
fruvegs_pcs	0.032***	(0,00)	0.047	(0.05)	12.33	0.003	163,258
veg_pcs	0.010***	(0.00)	-0.043**	(0.02)	15.17	0.003	150,216
fruit_pcs	0.018***	(0.00)	0.001	(0.03)	15.17	0.003	150,216
1.5water_lt	-0.003***	(0.00)	0.003	(0.02)	14.55	0.003	115,954
breakfast	0.010***	(0.00)	0.006	(0.01)	10.58	0.007	193,338
alcohol	0.000	(0.00)	0.001	(0.01)	10.27	0.007	193,064
alc_glasses	-0.014***	(0.00)	0.04	(0.04)	12.87	0.003	163,175
alc_ml	-2.215***	(0.27)	7.143	(6.64)	12.87	0.003	163,175
no_spirits	-0.006***	(0.00)	0.017	(0.01)	9.72	0.007	190,564
fizzy_drinks	0.002***	(0.00)	0.013**	(0.01)	9.53	0.006	187,539
obese	-0.008***	(0.00)	0.018	(0.02)	10	0.007	195,924
bmi	-0.131***	(0.00)	0.299	(0.2)	10	0.007	195,924
eversmoke	0.006***	(0.00)	0.029	(0.02)	9.84	0.007	192,883
currentsmoke	0.000	(0.00)	0.007	(0.02)	9.84	0.007	192,883
smoke_nsig	-0.061***	(0.02)	0.308	(0.27)	10.11	0.006	191,250
nojunk	0.001***	(0.00)	0.014	(0.01)	11.57	0.003	161,945

Note: All regressions control for age, age squared, gender and province fixed effects, and a linear polynomial in year of birth. Standard errors clustered by year of birth are reported in parentheses.
Significance levels: $*$: 10% $**$: 5% $***$: 1%.

OLS and IV (college proximity): years of education, restricted 1940-1960 sample

Table: College proximity estimates (yrs of education), 1940-60 cohorts

	OLS		IV						
					Diagnostics				
Outcome	Coef	s.e.	Coef	s.e.	Wald 1st stage	pvalue	Hansen J-stat	pvalue	N
physact	0.021***	(0.00)	0.025***	(0.01)	19.419	0.001	4.607	0.330	195,290
fruveg	0.002***	(0.00)	0.006	(0.01)	19.002	0.001	8.372	0.079	193,174
fruveg_5pcs	0.003***	(0.00)	0.006	(0.00)	20.127	0.001	6.707	0.152	163,258
fruvegs_pcs	0.032***	(0.00)	0.039**	(0.02)	20.127	0.001	3.319	0.506	163,258
veg_pcs	0.009***	(0.00)	0.005	(0.01)	24.314	0.001	5.222	0.265	150,174
fruit_pcs	0.017***	(0.00)	0.040**	(0.02)	24.314	0.001	4.384	0.357	150,174
1.5water_lt	-0.003***	(0.00)	-0.014**	(0.01)	20.098	0.000	2.219	0.696	115,954
breakfast	0.010***	(0.00)	0.013***	(0.00)	19.237	0.001	4.219	0.368	193,338
alcohol	-0.001***	(0.00)	-0.001	(0.00)	19.121	0.001	10.513	0.033	193,064
alc_glasses	-0.014***	(0.09)	-0.010	(0.00)	20.542	0.001	5.063	0.281	163,175
alc_ml	-2.150***	(0.30)	0.264	(1.89)	20.542	0.001	3.263	0.515	163,175
no_spirits	-0.006***	(0.00)	-0.020***	(0.00)	18.973	0.001	5.704	0.222	190,564
fizzy_drinks	0.003***	(0.00)	0.005**	(0.00)	19.477	0.001	5.029	0.284	187,539
obese	-0.008***	(0.00)	-0.016***	(0.00)	19.385	0.001	7.917	0.095	195,924
bmi	-0.131***	(0.00)	-0.287***	(0.00)	19.385	0.001	7.352	0.118	195,924
eversmoke	-0.006***	(0.02)	0.018***	(0.00)	19.118	0.001	6.404	0.171	192,883
currentsmoke	-0.001	(0.00)	0.017***	(0.00)	19.118	0.001	1.489	0.829	192,833
smoke_nsig	-0.061***	(0.01)	0.273***	(0.00)	18.982	0.001	0.836	0.934	191,250
nojunk	0.001***	(0.00)	0.004	(0.00)	20.130	0.001	1.919	0.751	161,945

Note: All regressions control for age, age squared, gender and province by year fixed effects. Standard errors clustered by province are reported in parentheses.Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Concluding remarks

- Leveraging presumably exogenous variation in years of schooling generated by college proximity (upper tail of years of education distribution) we find evidence of:
  - positive effects on healthy eating and physical activity
  - negative effects on BMI and obesity
  - *positive* effect on drinking super-alcoholic beverages
  - *positive* effects on smoking (incidence and intensity)
- By contrast, leveraging compulsory schooling reforms we do not find any strong evidence of education affecting health-related behaviors and outcomes
- Overall, our study provides evidence of potential **non-linear effects of education on health behaviors**, which are stronger for college than for low levels of education

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