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JEL Classification: I12, J13, N33

Keywords: Passive Smoking, Stature, Nineteenth Century Italy, Infant Development

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Effects of Passive Smoking on Prenatal and Infant Development: Lessons from the Past*

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1 Introduction

Ireland banned indoor smoking in public spaces in 2004. This was at least partly due to the wide scientific consensus, despite the occasional dissenting voice (Enstrom et al., 2003), on the strength of the negative externality constituted by passive smoking (see USEPA, 1993; IARC, 2004; USDoH, 2006, or for recent reviews, Flouris et al. 2009; Banderali et al. 2015). Many countries, no doubt in consequence of its somewhat unexpected public popularity (Koh et al., 2007), have followed Ireland's lead and enacted legislation to reduce exposure to other people's smoking (WHO, 2007).

Our paper contributes to the literature on the effect of passive smoking. Specifically, we add to the specialised area of research on the consequence of exposure of yet-to-be-born and very young children on their height as adult. The typical approach of the studies of the effect of passive smoking on children[1] is to analyse individuals explicitly recruited for the study, which therefore tend to limit the samples size and the time span between exposure and effects. One of the earliest studies is Goldstein (1971). The smoking habit of pregnant women is recorded and their children measured at age seven. Goldstein finds an effect of about one centimetre for smoking ten or more cigarettes per day whilst pregnant, controlling for a host of other potential factors. Many subsequent studies (an earlier meta-analysis is Meredith, 1975) confirm this effect. Among more recent studies in Goldstein's footsteps are Berkey et al. (1984), Little et al. (1994), and Koshy et al. (2010).

In this paper, we use instead aggregate geographical data, from two separate historical longitudinal datasets for Italy, with annual data from 1875 to 1910. These allow us to link the height of 20-year old men to their likely past exposure to smoke. The use of aggregate data is fairly common for the study of the effect

[1] An extensive review is Charlton's (1994), its conclusions generally confirmed by the many subsequent studies, such as Aycicek et al. (2005) and Seyedzadeh et al. (2012).

of tax or other policy variables on smoking (Baltagi and Levin, 1986; Peterson et al., 1992; Stehr, 2005) though rarer for the analysis of the effect of smoking (but see Lightwood and Glantz (2016) and the literature cited there for recent examples). An aspect of our approach, novel to the best of our knowledge, is to use data which refers to a period, the second half of the 19th century Italy, when the adverse effects of smoking, let alone passive smoking, were unknown, and when, moreover, tobacco consumption increased with income. Both these features of our data help reduce the impact of two potentially confounding factors which nowadays may make it difficult to disentangle the direct effects of passive smoking from those of other unobservable behaviours which may also harm a foetus or an infant. Firstly, today's children growing up in family environments where adults exhibit disregard for their health by exposing them to passive smoking are more likely also to be suffering from other manifestations of the adults' negligence, such as inadequate medical care, deficient or unhealthy nutrition, insufficient exercise, and so on. Secondly, smoking is today an inferior good (Chaloupka and Warner, 2000; Franks et al., 2007; Gospodinov and Irvine, 2009). Thus, today's lower income parents smoke more on average than their better off peers, and because of their lower income, may also be less able to provide an adequate growing environment for their children.[2] These two confounding factors were unlikely to be relevant in 19th century Italy. Moreover, given that smoking among women was very unusual or even outlawed,[3] for cultural, rather than health reasons, we can attribute any effect we find to passive smoking, rather than absorption of harmful substances through the placenta or during breast feeding.

In detail, we link the annual consumption of dozens of tobacco products in

[2] Further complexity may be added by non-linearities, whereby tobacco appears to be a normal good for low income households (Kenkel et al., 2014).

[3] See, for example, Elliot (2001), or Brandt (2007, p 69ff): the "Torches of Freedom" Easter Sunday Parade which established smoking in public as an emblem of the emancipation of women happened only in 1929 (Amos and Haglund, 2000).

each of the 69 Italian provinces to the average height of 20-year old Italian males recorded at their conscription medical visit, also at the province level. Controlling for changes in income, literacy, child mortality, and infrastructure, we find that changes in the incidence of smoking in a province predict changes in the future average height of Italian conscripts. Using well established linear econometric models for longitudinal data, we estimate that a 10% reduction in the quantity of smoking tobacco consumed in a province translates into a cohort approximately 1.2mm taller twenty years later. This is a non-negligible effect, and it is robust to different specifications.

Consumption of snuff, tobacco powder, which is consumed without smoke (Rogoziński, 1990), did not on the other hand affect height. This difference in the effects for different modes of consuming tobacco is in line with what we know today about the mechanism by which tobacco is harmful to long term human development. Snuff (like chewing tobacco) does not affect people other than the consumers, except during pregnancy and lactation (Napierala et al., 2016). Thus, since tobacco consumption at the time was almost exclusively a man's habit (Elliot, 2001), the presence of tobacco in the maternal bloodstream or milk would be very rare indeed and undetectable in aggregate provincial data.

We also find that potential exposure to passive smoking at age four does not affect subsequent adult height. This is in line with the cited medical evidence, which identifies other negative health effects, but concludes that passive smoking at this age does not cause stunting. Thus our estimation of the effect of exposure to passive smoking at age four should be seen as a placebo. The paper ends with some robustness tests.

The paper is organised as follows. Section 2 presents the data and the simple econometric specification, with the results in Section 3, and a brief concluding section follows.

2 Data and econometric specification

The paper is built around the idea that passive smoking directly harm normal body development in young children: if more babies in a sufficiently large population are exposed to more passive smoking, they will be, on average, shorter when they are adult. Height as young adults has a long standing pedigree of being used as a proxy for physical development from conception onwards: the remarkable drop in the average recorded height of French conscripts is recognised as one of the effects of the climatic change in the middle of the seventeenth century (Parker, 2013). Komlos (1994), Komlos (2007), Peracchi and Arcaleni (2011), and Hatton et al. (2016) among others, use height as a measure of the adverse long-term effects of disease and economic conditions in various European times and countries. We can formalise this by positing that a adult's height is determined by exposure to passive smoking during their development. Formally, if $H_{i,t}$ is the height individual i born in period t will reach as a twenty year old, that is in year $t+20$, then

$$H_{i,t} = \beta \mathbf{S}_{i,t} + \gamma \mathbf{X}_{i,t} + \varepsilon_{i,t}. \tag{1}$$

In (1), $\mathbf{S}_{i,t}$ is a vector of the relevant measures of tobacco consumption by those in regular contact with individual i at date t, $\mathbf{X}_{i,t}$ are other time-varying environmental factors potentially affecting adult height, and $\varepsilon_{i,t}$ is an idiosyncratic error, which includes any relevant fixed effects.

We are able to draw from from several dataset, which, despite the underdeveloped conditions of the Kingdom of Italy in the second half of the 19th century, are remarkably rich in detail. We do not have individual level data, and so the dependent variable in (1), $H_{i,t}$, is the average height, measured in year $t+20$, of the conscripts born in year t in each of the 69 administrative units, called provinces and indexed by i, Italy was divided in at the time.[4] This is based on the data organised by A'Hearn, Peracchi and Vecchi (2009), which in turn they obtain from military archival data collected at the medical examination for conscription. The data is an average of all of the conscripts, even if they did not meet the minimum height required for military service (Arcaleni, 2012, p 1). We direct the reader to A'Hearn et al. (2009) for a detailed discussion of some of the data problems they identify and their careful solutions. Absenteeism due to desertion[5] was relatively rare after the first half of the 1870s and internal migration was limited and very close to the municipalities of birth.[6] External emigration was instead an important phenomenon in the period we consider,[7] and it accounted for most of the discrepancies between the conscription roll and those examined. Its effect on height is in general ambiguous as "emigrants can be selected either positively or negatively".[8]

We proxy exposure to passive smoking during pregnancy and infancy in province i in year t with the per capita quantity of smoking tobacco sold in the province. This is collected in a dataset described in detail in Ciccarelli and De Fraja (2014). It reports the quantities sold of each individual tobacco product on sale in each province in Italy in each year, for around 40 years. Figure 1 illustrates the per capita consumption of the two product types, measured in kg, with the provincial differences highlighted in the coloured band which includes the middle half in

[4]Caserta and Naples are together in the original data on conscript height, and so we aggregate the rest of the data of the two provinces, into a single unit of observations.

[5]The Ministry of war records that 3.5% of those summoned did not report for the military visit in 1875, 3.3% ten years later, but increasing to 6.1 in 1895, and 8.6 in 1905, presumably in consequence of the increase in emigration (Vercelli, 2019).

[6]Less than 10% of citizens of all ages were living in a commune different from that of birth, given the likely pattern of local migration, it seems natural that children were probably underrepresented in those moving far (Golini, 1976).

[7]"An estimated 14 million left Italy between 1871 and 1914" (Hatton and Williamson, 1998, p 95). To put things in perspective, the Italian population in 1913 was around 35 million.

[8]As explained by A'Hearn et al. (2009, p 6). The limited evidence (Danubio et al., 2005) while suggesting positive selection, which would reduce the average height of the conscripts, relies on a small sample and lacks geographic details. Spitzer and Zimran (2018) note the uneven distribution across regions and social classes of those landing in the US, but also point out that those liable to military service could not legally emigrate. In addition, we include province fixed effects and a year trend, which should account for systematic difference in space and in time.

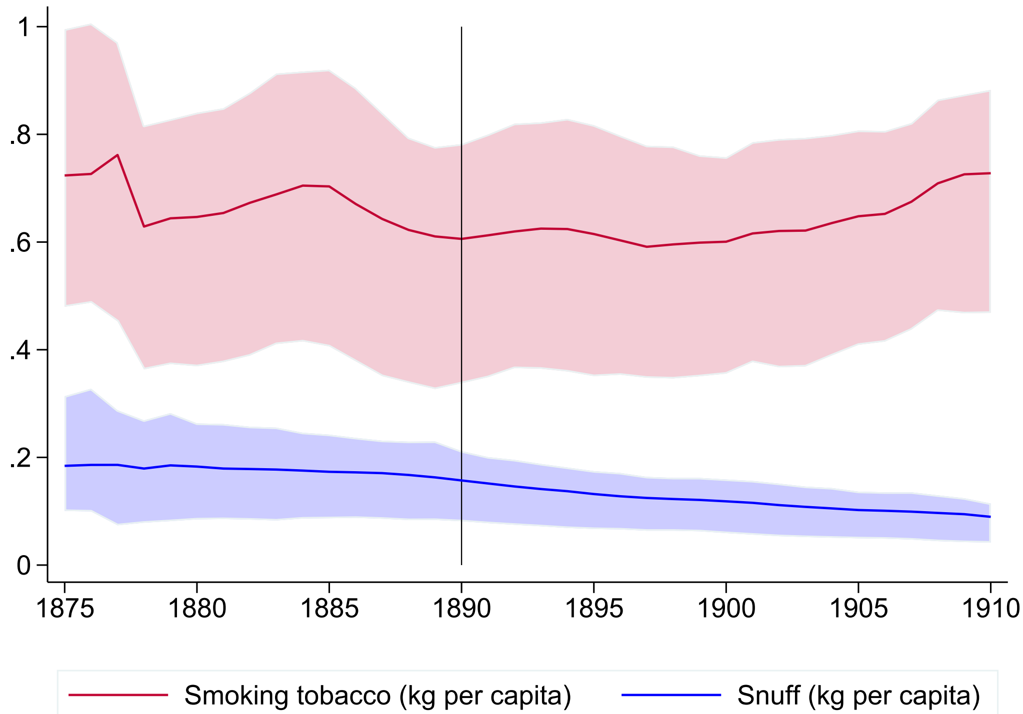
the rank of the provinces, namely from the 25th to the 75th percentile, evidencing considerable national variation. Following that paper, we group all products into two categories, which we include separately in the regression: cigars, cigarettes,[9] and loose leaf or fine-cut tobacco, for rolling or use in pipes, denoted by $C_{i,t}$, and snuff, powder which is sniffed and not burnt, denoted by $F_{i,t}$. Formally, the vector $\mathbf{S}_{i,t}$ in (1) is given by $\mathbf{S}_{i,t} = (C_{i,t}, F_{i,t})$. We include the two types of products as separate regressors, because, in view of their respective modes of consumption, they are likely to differ in the extent the harmful components of the tobacco consumed by the primary user affect those around them. Spending time in a smoky environment harms physical development, whereas snuff can harm a person other than the primary user only through placental exchange and lactation. Given that the few women which used snuff were well past the child bearing age (Elliot, 2001), we expect the coefficient for $C_{i,t}$ and $F_{i,t}$ to differ, only the former indicating a significant effect. This is indeed what we find.

Though constrained by the data availability, the vector of time-province specific controls, $\mathbf{X}_{i,t}$, does contain several of the variables the literature has identified as affecting child development. In detail, we include education, today an important determinant of smoking (Walque, 2007; Farrell and Fuchs, 1982) and health outcomes (Lindeboom et al., 2009). We proxy education with the percentage of the population who are literate, $\ell_{i,t}$, recorded in the census years, 1871, 1881, 1901, and 1911 (there was no population census in 1891), interpolating it for the non-census years.[10] Figure 3(e) highlight the very high education inequality across the country, also confirmed by (A'Hearn et al., 2011) analysis of primary and secondary enrolment rates at the regional level.

[9] Cigarettes sales increased sharply in the period we consider, mainly due to the greater availability which followed the purchase of Bonsack machines (Hannah, 2006, pp. 64–67), by the Italian manufacturers, at the expense of cigars sales.

[10] Alternative measures, such as the literacy rate for the population over a certain age, or of one sex only, are all highly correlated with our measure.

Figure 1:
Tobacco consumption in Italy



Note: The graph illustrates the per capita consumption of smoking tobacco and snuff in Italy from 1875 to 1910. Both are measured in kg per year. The coloured bands include the 25th and 75th centile of the province distribution of the year. Source Ciccarelli and De Fraja (2014).

Average real per capita income, $Y_{i,t}$, is a proxy for the province average socio-economic conditions, which in general affects child development. It is in turn proxied by certain categories of taxation, which, as argued in Ciccarelli and De Fraja (2014) and Brunetti et al. (2011), are very pro-cyclical, and, in addition, correlate strongly with independent measures of *regional* income in the period (Brunetti et al., 2011). As with literacy, there is considerable income inequality across the country (see Figure 3(e)). Note, however, that at 0.37, the correlation between income and literacy is lower than perhaps one might expect. We also include data on the extent of the railway infrastructure,[11] $R_{i,t}$, following the literature which

[11]Obtained from (Ciccarelli and Groote, 2017); see `bit.do/italianrailways` which provides a

uses it to measure changes in the level of economic development.[12]

Pozzi (2000) reports detailed data on natality and child mortality by province and by year in the second half of the 19th century Italy. If changes in mortality due to exogenous factors such as the weather are not random, then one may consider that the children more likely to die as those who are weakest and therefore less likely to develop fully. In other words, an unexpectedly high level of child mortality in one year would, by preventing children destined to remain short from being measured at age 20, *increase* the average height. This positive selection effect may be counterweighted by a negative scarring effect, whereby unobserved factors, such as an especially severe winter, which cause both child mortality and stunting, would produce spurious positive correlation between mortality and adult height (Bozzoli et al., 2009, p. 4).[13] While theoretically ambiguous, the effects of child mortality on average height are potentially important, given the very high mortality rate in European countries in the 19th century, illustrated, in the case of Italy, in Figure 3(d), and its notable reduction through the period we consider. To reduce the influence of the indirect effects of this factor on the interpretation of our results, we include the post natal mortality rate, $m_{i,t}$, measured by the proportion of children born who die within one year of birth in our main regression.[14]

Finally, we attempt to control for the parents' height, by including in the regression the average height of the individuals who were 20 years before their military

historical geodatabase of the Italian railway network for the years 1839-1913.

[12]See Groote et al. (2009) for a historical example and Jedwab and Moradi (2016) for a recent one in developing countries.

[13]Hatton (2011) examine historical town-level panel data on the heights of school children, and find no evidence for the selection effect, but some support for the scarring effect. Overall average height increased in England and Wales by about half a centimetre per decade in the first half of the twentieth century (p. 951).

[14] This variable can be split in its two components of those dying in the first month and those who die after the first month, but before their first birthday. Replacing our measure with these variables, separately or in conjunction, does not alter the results, and neither does considering the mortality of boys only. We have also run the regressions with infant mortality in year $t+1$, to account for the possibility that a child death is due to event during the the first year of life, but happens a few months later. The results change at most marginally.

examination. While the age at marriage of men was around 27 (Livi Bacci, 1977, Table 2.22, p 100), and thus fathers had a considerably higher average age, as only a minority of the conscripts were first born, increasing the gap too much reduces the number of available observations. We take 20 as a compromise between not including parental age and including a realistic proxy for it.

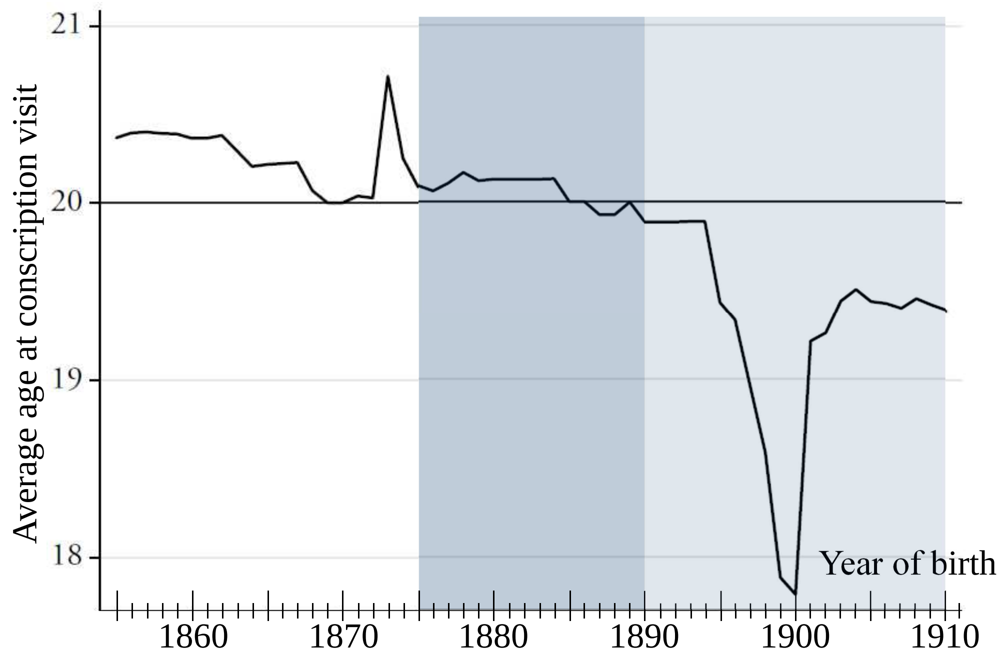
To sum up, we estimate the following, using standard panel data analysis:

$$\begin{aligned} H_{i,t} =& \beta_C C_{i,t} + \beta_F F_{i,t} + \beta_\ell \ell_{i,t} + \beta_Y Y_{i,t} + \beta_R R_{i,t} + \beta_m m_{i,t} \\ &+ \beta_H H_{i,t-20} + \alpha_i + \tau_t + \varepsilon_{i,t} \qquad t = 1, \ldots, T, \quad i = 1, \ldots, 68 \end{aligned} \tag{2}$$

In (2) $H_{i,t}$ is the average height at age 20 of individuals born in year t in province i. Boys around that age are still growing, which might affect the accuracy of the measurement of their adult height. Figure 2 reports the average age when the conscripts born in a given year where measured. It highlights in dark grey the subset of the period that we consider in our main regression, namely the conscripts born from 1875 to 1890; the lighter shade of grey are the years that we can include in our sample when we omit child mortality as an explanatory variable. As the figure indicates, these conscripts were measured when they were very close to 20 years of age. At any rate, A'Hearn et al. (2009) adjust carefully the figures, to calculate the theoretical height conscripts would have at age 20, to ensure comparability across years,[15] of those born in each of the calendar years considered, irrespective of the time when they were measured. $C_{i,t}$ and $F_{i,t}$ are the log of the per capita consumption of tobacco in province i in year t. The controls $\ell_{i,t}$, $Y_{i,t}$, $R_{i,t}$, $m_{i,t}$ measure the literacy rate, the log of (the proxy for) per capita income, the rail network, and

[15] This adjustment is necessary as teenage men are still growing so a lower height recorded for, say, the 1900 cohort would be rightly attributed to the fact that when those born in 1900 were measured they were more that two years younger that those born in 1880. They were of course conscripted at such a young age because of the dire need to replete the army in the final months of the first world war. We have not found any plausible explanation for the 1873 spike, which is anyway outside our period of interest.

Figure 2:
Average conscript age. 1855-1911



Note: National average age of the conscripts at the military visit. The darker grey area includes the years included in the main regression the light area the one in column (4) in Table 3. Source: A'Hearn et al. (2009).

the one-year mortality rate, all in province i in year t. The variable $H_{i,t-20}$ proxies the height of the conscripts' fathers. The province fixed effects, α_i account for time invariant factors, from genetic make-up to different geographical weather patterns, affecting provinces differently: these vary considerably across the national territory as shown in Figure 3(c). The variables τ_t, a time trend or year fixed effects, account for changes in smoking habits and other countrywide factors affecting children's development over time.

Our analysis is constrained by the availability of data. Data on the conscripts height is available for those born from 1855 to 1910; data on the sales of tobacco products is instead available for all provinces from 1871 to 1910 (from 1877 for the seven Sicilian provinces), and data on mortality from 1872 to 1890. To include data on parental height and on child mortality we therefore need to restrict our data to the those born between 1875 and 1890 inclusive, although we drop this variable in the robustness regression we report in the last column of Table 3.[16]

A child born on 1st January 1880 would be exposed while in uterus to tobacco smoked in her province in the year 1879. Children born later in the year would be exposed to a combination of the tobacco smoked in the later months on 1879 and in the month of 1880 before her birthday. And all children born from October would be exposed exclusively to tobacco smoked in 1880. If births, survivals, and exposure to passive smoking were all uniform throughout the year, the weights of years -21 and -20 would be approximately $\frac{1}{3}$ and $\frac{2}{3}$. But survival was certainly affected by the month of birth, as was the pattern of exposure to passive smoking, likely to more intense in the winter months, when more time is spent indoors, by active and passive smokers alike. In addition, it is not necessarily the case that the potential harm of passive exposure to tobacco products be constant throughout the pregnancy. For all these reasons, it seems difficult and arbitrary to construct a realistic weighted average of the amount of tobacco smoked in years $t-1$ and t of those born in year t, and we simply take the amount of tobacco smoked in year t as the exposure to passive smoking during pregnancy.

Table 1 reports summary statistics for the variables included in the regressions, and Figure 3 illustrates differences across the country. It reports provincial values, averaged over the period of, clockwise from top left, cigar and cigarette smoking, consumption of snuff, average male height at age 20, income, literacy, and infant mortality.

3 Empirical results

Table 2 reports the main results from the estimation of (1) in the time period 1875-1890. In the first column, we include only the variables measuring tobacco

[16] We also note that the Sicilian provinces only entered in the smoking data in 1877, thus the panel is unbalanced prior to that year.

Table 1:
Summary Statistics.

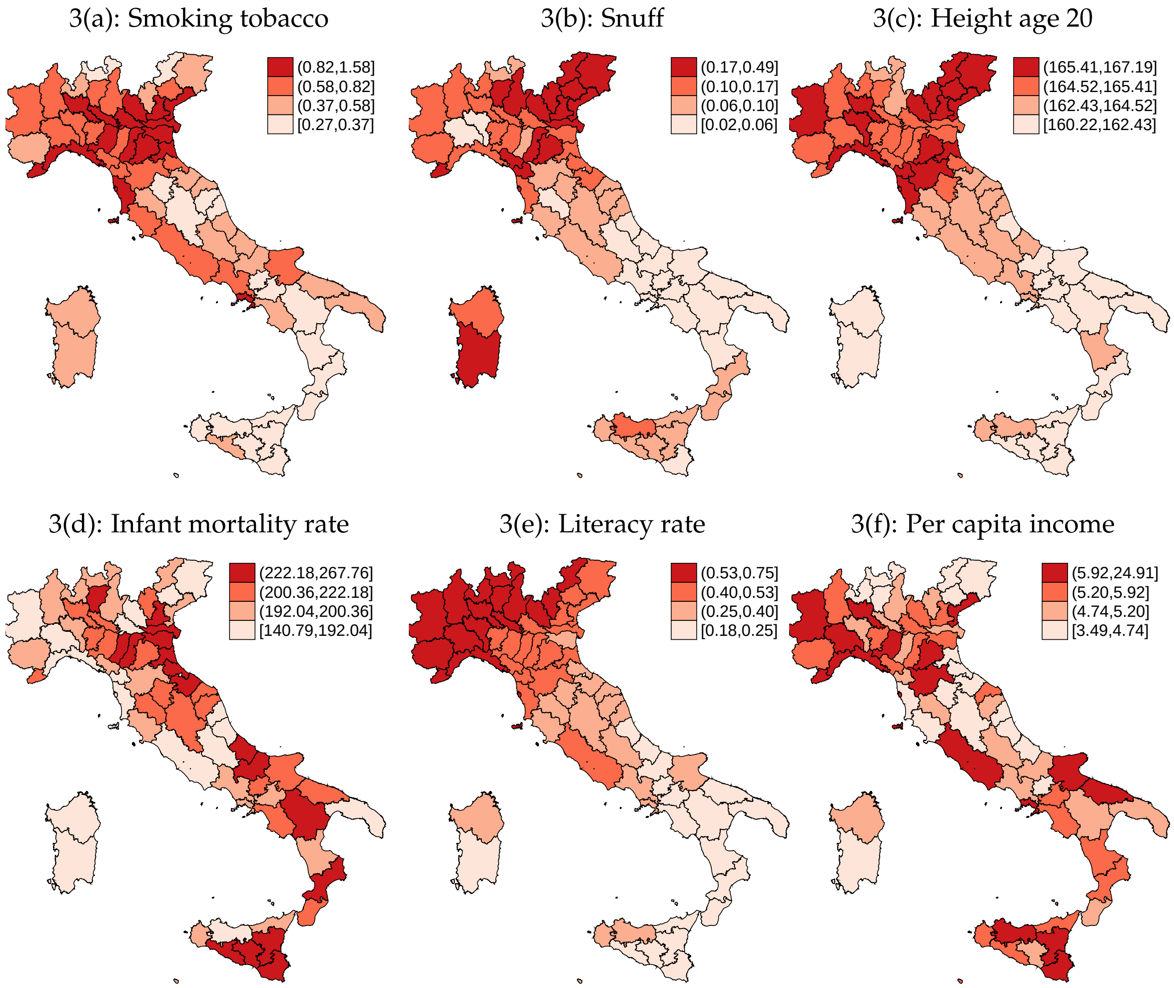
	1875-1890				1875-1910			
	Mean	St. Dev	Min	Max	Mean	St. Dev	Min	Max
Smoking tobacco	0.66	0.33	0.20	1.90	0.64	0.31	0.20	1.90
Snuff	0.20	0.15	0.03	0.74	0.16	0.13	0.01	0.74
Average height	163.48	1.86	158.87	170.61	163.96	2.00	158.87	170.61
Child mortality	202.25	30.84	119.52	325.30				
Per capita income	5.04	3.16	1.82	33.74	5.83	3.46	1.82	33.74
Literacy rate	0.32	0.15	0.10	0.70	0.38	0.17	0.10	0.82
Railway network	145.70	100.80	0.00	526.37	192.14	133.35	0.00	782.49
Observations	1074				2434			

Notes: The period covered by the data is 1875-1910, except for child mortality, which ends in 1890. Smoking tobacco and snuff are the per capita annual consumption, in kg. Average height is the theoretical height at age 20, computed by A'Hearn et al. (2009); child mortality is the percentage of live born children who died before the age of one, reported by Pozzi (2000). The literacy rate is obtained by interpolation from census data, and the railway network is the end of the year total endowment of railway lines in the province, in km obtained from Ciccarelli and Groote (2017).

consumption of smoking tobacco and of snuff, both in kg per capita, with a time trend and province fixed effect. The sign for the consumption of tobacco is negative and statistically significantly different from zero for smoking tobacco, and not statistically significantly different from zero for snuff. Model (M2) in the second column confirms these coefficients when "biology" variables are added, with the plausible result that taller fathers beget taller children, and the suggestion in the negative sign of adverse factors in the year of birth affecting both the likelihood of a child dying and his future physical development. When we further add, in the third column, socio-economic variables such as the province's average income literacy rate, and railway infrastructure, these are not significant, withe the exception of the last, and the coefficients for the smoking variables, do not change qualitatively. The estimates from this last regression imply that a 10% change in per-capita consumption of smoking tobacco (cigars and cut-tobacco) is associated with a reduction in future heights of about 1.2 millimeters.

The last two columns of the table consider a different time frame for the effects

Figure 3:
Provincial disparities 1875-1890



Note: Choropleth maps of the main variables included in the regressions. The maps report provincial averages of the variables evaluated over the period 1875-1890. Sources: Tobacco, literacy, and income from Ciccarelli and De Fraja (2014), heights from A'Hearn et al. (2009), child mortality from Pozzi (2000).

of smoking to influence a child's development. In model (M4), the fourth column, the RHS variables are those in year we consider that the effects of passive smoking and the other socio-demographic influences to which a child is subject exert their influence whilst the child is in his first year of age, again with the same aggregation assumption we posited for the main regression. This is considered (Banderali et al., 2015; Little et al., 1994; Aycicek et al., 2005) still an age when passive smoking can affect adult height: indeed, the results of this estimation confirms this to be the case. Formally, we estimate the following model:

$$\begin{aligned} H_{i,t} =& \beta_C C_{i,t+1} + \beta_F F_{i,t+1} + \beta_\ell \ell_{i,t+1} + \beta_Y Y_{i,t+1} + \beta_R R_{i,t+1} + \beta_m m_{i,t} \\ &+ \beta_H H_{i,t-20} + \alpha_i + \tau_t + \varepsilon_{i,t} \qquad t = 1, \ldots, T, \quad i = 1, \ldots, 68 \end{aligned} \tag{3}$$

In the last column of the main table, we run the same regression as in the previous column, but taking the values of the socio-demographic variables at $t + 4$ instead of $t + 1$. This gives the interpretation of the coefficients as the effect on adult height of passive smoking and of the other covariate on four year old boys. There are many ways in which children's health can be affected by passive smoking (Charlton, 1994), but we have not found evidence that height is affected beyond a certain age. Thus we would expect no effect on height, with this regression seen as a placebo, and indeed we find none.

Having established the negative effect of passive smoking around the time of a child's birth, we can delve deeper into the analysis by investigating if the effect differ across the height distribution. The vertical axis in Figure 4 measures the coefficient of the consumption of smoking tobacco, β_C in (2), when the dependent variable is the i-th percentile of the height distribution, calculated from the mean and standard deviation as reported by A'Hearn et al. (2009). The picture suggests that taller individuals are affected more in absolute value. We report the full results of two of these regressions the third and the first quartile in the first two columns of Table 3.

The rest of the regression results in Table 3 report the output of some robustness tests: column (M3) replaces the heights with its natural logarithm. Results are similar both in sign and in order of magnitude, once elasticities are converted into centimetres. The same is true when we replace all variables with their three-year moving average, as we do in column (M4). This suggest that the results are not driven

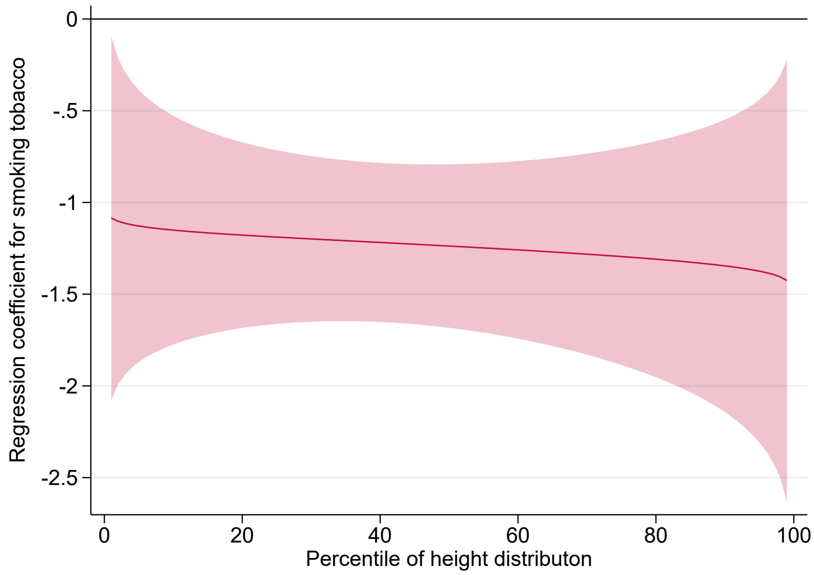
Table 2:
Height and consumption of tobacco: main regression results.

	(M1) f. effects only	(M2) health contr.	(M3) main regr.	(M4) effect on infants	(M5) effect on 4yrs olds
Smoking tobacco	-0.992***	-1.022***	-1.237***	-1.008***	0.0916
	(0.219)	(0.221)	(0.222)	(0.275)	(0.263)
Snuff	-0.362	-0.393	-0.439	-0.274	-0.288
	(0.246)	(0.237)	(0.266)	(0.317)	(0.296)
Father's height		0.0924*	0.104*	0.0864	0.0801
		(0.0439)	(0.0440)	(0.0442)	(0.0511)
Child mortality		-0.0176**	-0.0166**	-0.0164**	-0.0135*
		(0.00525)	(0.00528)	(0.00538)	(0.00589)
Per capita income			0.132	-0.240	-0.348*
			(0.177)	(0.194)	(0.149)
Literacy rate			4.724	3.323	0.572
			(3.600)	(3.821)	(3.959)
Railways endowment			0.124	0.0384	0.00607
			(0.0623)	(0.105)	(0.122)
Observations	1074	1074	1074	1074	1074

Notes: All regressions include the constant term and provincial fixed effects. Robust standard errors in parenthesis. *,**,*** denote significance at the 10, 5, and 1 percent level. The dependent variable is the height at age 20 of the Italian conscripts born in the years 1875-1890 in the 68 Italian provinces. The panel is unbalanced as the Sicilian provinces are included from 1877. Smoking tobacco and snuff are the quantities of the two products sold in each province in each year; father's height is the average height of conscripts 20 years before; child mortality is the number of children who die within twelve months per one thousand births; literacy rates the fraction of the province population who was reported as not illiterate in the census, and railways endowment the extension, in km, of the province railway infrastructure. All regressions include time trend and province fixed effects M4: as M3, with all independent variables one year ahead. M5: as M3, with all independent variables four years ahead.

by spikes in odd years or by the potentially arbitrary long-term time structure that we have posited. In the remaining three columns of the table, we change the structure of the time and province fixed effects. In detail, in model (M5), we replace the time trend with year fixed effects: as can be seen, there are limited changes in the

Figure 4:
Effect of passive smoking across the distribution



Note: The graph illustrates the coefficient and the confidence intervals for smoking tobacco obtained from estimating (2) with each percentile of the height distribution instead of the average as dependent variable.

coefficients. In the next column, model (M6), we calculate spatial HAC errors following Conley (1999). This is to account for the potential spatial spillover, whereby unobserved factors affecting one province may be more likely to affect more neighbouring provinces that provinces at the other end of the country. Finally, in the last column, we extend the period to all the years for which we have data, namely up to 1910. This comes at the sacrifice of the inclusion of child mortality as an explanatory variable, as the data is not available beyond 1890, but again confirms the result in the considerably longer dataset.

4 Conclusion

This simple paper exploits a number of rich historical datasets collecting Italian provincial data from 1855 to 1910. We linked these datasets to determine the effect of being exposed to passive passive smoking during one's mother's pregnancy and

Table 3:
Height and consumption of tobacco: additional regression results.

	(M1) 75-th perc.	(M2) 25-th perc.	(M3) log height	(M4) 3 year aver.	(M5) time f. effects	(M6) HAC errors	(M7) long sample
Smoking tobacco	-1.295***	-1.179***	-0.008***	-1.410***	-1.404***	-1.404***	-1.076***
	(0.337)	(0.275)	(0.001)	(0.283)	(0.347)	(0.234)	(0.295)
Snuff	-0.547	-0.332	-0.003	-0.339	-0.340	-0.340	0.127
	(0.344)	(0.285)	(0.002)	(0.253)	(0.279)	(0.199)	(0.182)
Father's height	0.132**	0.076	0.105**	0.200***	0.135***	0.135***	0.016
	(0.052)	(0.059)	(0.043)	(0.056)	(0.046)	(0.044)	(0.006)
Child mortality	-0.018**	-0.015**	-0.000***	-0.004	-0.015**	-0.015**	
	(0.008)	(0.006)	(0.000)	(0.005)	(0.007)	(0.008)	
Per capita income	0.321	-0.057	0.001	0.0950	0.219	0.219	0.121
	(0.243)	(0.178)	(0.001)	(0.230)	(0.231)	(0.150)	(0.215)
Literacy rate	3.883	5.565	0.0287	5.408	5.971	5.971**	5.478***
	(4.435)	(4.063)	(0.022)	(3.477)	(3.656)	(2.460)	(1.277)
Railways endowment	0.052	0.195**	0.001*	0.100	0.119*	0.119 ***	0.102
	(0.065)	(0.092)	(0.000)	(0.075)	(0.063)	(0.044)	(0.078)
Observations	1,074	1,074	1,074	1,081	1,074	1,074	2,434

Notes: Data and explanatory variables as in Table 2. The dependent variable is the height at 75th and 25th percentile of the distribution in M1 and M2, respectively; the logarithm of the average height in M3; the three year moving average of each variable in M4. M5, M6 and M7 replace the time trend with time fixed effects. In M6, results are based on spatial HAC errors for OLS regression. In M7 the sample is extended to 1875-1910.

one's first year of life on one's height as adult. We detect a non-negligible effect, even though, of course, the aggregate provincial data does not permit to distinguish among individuals subject to different levels of exposure to second-hand smoking. A 50% increase in the consumption of smoking tobacco in a province would cause the average height of the boys born in that province of over 6mm. The coefficients in the regression indicate that the model is well specified. In addition we modified our main regression in several ways, and conclude that the result is robust, and does not depend on the details of the regression.

While the harmful effects of passive smoking are well known in the general public, our work confirms that it was the case when they were not, and thus excludes correlation with other variables, from disregard for the health of children and socio-economic conditions which may bias recent and contemporary studies.

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