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ABSTRACT

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This paper considers the long-term effects of smoking on disability retirement. Exploiting population-wide registry data from Sweden, we contribute to the literature by accounting for a much broader range of potential confounders. In particular, by the use of sibling and twin fixed effects, we account for all unobserved heterogeneity in childhood environment and family characteristics. Moreover, we are able to control for detailed information on socioeconomic status, marital status and health. We also contribute by comparing effects on different diagnoses for which disability pension was granted, thus shedding some light on the biological mechanisms linking smoking to disability retirement. We demonstrate a strong association between smoking and disability retirement. Among individuals aged 50-64, smokers have a six percentage point higher probability of receiving (full) disability pension. However, while the relationship remains significant when accounting for confounders such as family environment, the size of the effect is much attenuated. Effects are concentrated to mental and musculoskeletal conditions, but effects on neoplasms, nervous system, eye and circulatory diagnoses are also found. The results are largely driven by health problems severe enough to merit hospitalization, and there is no evidence of a role played by financial incentives.

JEL Classification: I12, J26

Keywords: smoking, disability retirement, specific conditions, siblings, twins

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1. INTRODUCTION

Smoking is strongly associated with worse health and labour market outcomes. The effects on morbidity and mortality are particularly well-recognised, and smoking is often referred to as "the leading preventable cause of premature disease and death" in developed countries (e.g. USDHHS 2014). Compared to pure health outcomes, evidence on labour market outcomes, such as the ability to stay in the labour force in old ages, is more sparse. As populations grow older and policy-makers seek to consolidate public finances by making people stay in the labour force longer, a precise understanding of the effects of smoking on work ability becomes crucial. This study contributes to the understanding of this issue by estimating smoking's effects on disability retirement.

The medical literature has in particular provided strong evidence that smoking increases the risk of cancer (Gandini et al. 2008), respiratory diseases (Jayes et al. 2014), and cardiovascular diseases (Mons et al. 2015). Mortality from these conditions is drastically higher among smokers, and active smokers die about 10 years earlier than non-smokers do (Doll et al. 2004; Prabhat, Landsman and Anderson 2013). Effects on diseases such as diabetes (Chielero et al. 2008), various musculoskeletal conditions (Murray 2014) and mental conditions (Johnson et al. 2000; Banham and Gilbody 2010), have been documented as well.

Associations between smoking and income, sick-leaves or disability pension have been estimated by a rather small number of studies. In the U.S., current smokers have been found to earn 1-8 percent less than non-smokers (Leigh and Berger 1989; Levine, Gustafson and Velenchik 1997). In Canada, they earned 8 percent less (Auld 2005) and in the Netherlands 10 percent less (van Ours 2004), although in the latter study this effect was confined to men only. Smokers also have lower life-time income than others (Böckerman, Hyytinen and Kaprio 2015). Finally, they are more likely to be on sick-leave (Lundborg 2007; Skillgate et al 2009) and to receive disability pension (e.g. Eriksen et al. 1998; Husemoen et al. 2004; Haukenes et al 2013; Lalluka et al. 2015).

Because of small data sets and limited availability of control variables, almost all studies on the effects of smoking on disability pension have been unable to distinguish between smoking and confounders such as childhood environment and family background. The failure to account for family background is potentially worrisome, as smoking is related to factors such as the absence of one or two parents during upbringing, parental smoking, and other unobserved factors that are shared between siblings (Isohanni, Moilanen and Rantakallio 1991; Gilman et al. 2008; Baska et al. 2010; Melchior 2010). If factors like these are also related to productivity or to the propensity to work, this will bias the estimated effect of smoking unless sibling or even

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twin comparisons are made. A series of papers based on Finnish twins (Koskenvuo et al. 2011; Ropponen et al. 2013; Korhonen et al. 2015) have considered smoking's effect on disability retirement. However, as the analysis was confined to twins only, sample sizes were rather small and, with the exception of Korhonen et al. (2015), these studies only considered disability retirement due to particular diseases.

In contrast to previous studies on smoking and disability retirement, we are able to exploit a comprehensive population sample. This also allows us to extensively account for confounders. In particular, family background is accounted for by comparing outcomes of siblings but also twins. Whereas the latter has the advantage that we may be able to more fully account for genetic and environmental factors, the former enables us to exploit a much larger and likely more representative sample. Our analysis focuses on siblings and we view the results based on twins more as a sensitivity check.

We exploit information from the Swedish Medical Birth Register, which records smoking habits among all women who have given birth since 1983; these data are then linked to a number of national registers. As an additional contribution, we contrast the effects on disability retirement due to different types of diagnoses. Disability retirement is observed on average two decades after the smoking information is recorded, implying that our focus is on the long-term effects of mid-life smoking.[1]

We find a strong correlation between smoking and disability retirement. However, our results suggest that much of the relationship is due to confounders such as family background. In particular, almost half of the effect disappears when sibling fixed effects are controlled for. Our results can be partly explained by health problems severe enough to merit hospitalization, and there is no evidence that smokers enter disability retirement because of their lower labour incomes.

2. METHODS

2.1 Data

We use the Swedish Interdisciplinary Panel (SIP), administered by the Centre for Economic Demography, Lund University, Sweden. The database is obtained from Statistics Sweden (*Statistiska centralbyrån*) and comprises several national registers covering the entire Swedish

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[1] In contrast to several studies based on survey data, we are unable to account for lifestyle factors such as alcohol consumption and physical exercise. However, previous evidence (Korhonen et al. 2007; Haukenes et al. 2013; Ropponen et al. 2013; Korhonen et al. 2015) suggests that accounting for these variables makes only a small difference.

population. These include the Medical Birth Register, the Tax Register, the Education Register, the Patient Register, and a register with information on disability pension spells from the National Agency for Social Insurance (*Försäkringskassan*). Siblings are identified as having the same biological mother and twins are identified as being siblings with the same month of birth.

Information on smoking status is obtained from the Birth Register. From 1983 and onwards, at her first visit to antenatal care, every pregnant woman was asked whether she smokes at least one cigarette per day.[2] The individual was also asked whether she smoked 10 or more cigarettes per day. Our main analysis employs an indicator for smoker which takes the value of one if the individual smoked at least one cigarette per day during at least one pregnancy; we also create an indicator for heavy smoker, taking the value of one if the individual smoked at least 10 cigarettes per day during at least one pregnancy. Needless to say, some women might temporarily quit smoking when becoming pregnant, and our estimates will capture effects among individuals who are somewhat more dependent or less aware of the consequences of smoking. In addition to smoking, the register contains information on maternal height and weight at the first visit to antenatal care.

We define disability retirement as the uptake of full disability pension during the entire year, and focus on the year 2011 in our analysis. Full disability pension is granted to individuals who are below the age of 65 and who are deemed incapable of ever doing work, due to illness, injury or other disability. There is also information on the diagnosis underlying the disability pension. We create groups of diagnoses based on "chapters" according to the ICD-10 classification, provided by the World Health Organization. 16 groups of diagnoses are available: infectious and parasitic diseases; neoplasms; conditions of blood and blood forming organs; endocrine, nutritional and metabolic diseases; mental and behavioural disorders; diseases of the nervous system; diseases of the eye and adnexa; diseases of the ear and mastoid process, diseases of the circulatory system; diseases of the respiratory system; diseases of the digestive system; diseases of skin and subcutaneous tissue; diseases of the musculoskeletal system and connective tissue; diseases of the genitourinary system; congenital anomalies; and injuries and poisonings. [3]

Our analysis is based on the population of native Swedish women born between 1947 and

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[2] The first visit to antenatal care normally takes place between week 8 and 12 of the pregnancy.

[3] Despite the requirement that the individual must be deemed incapable of ever doing work, disability pensions are sometimes terminated. Moreover, up to year 2008 the eligibility rules were less tight and individuals could receive temporary disability pension. As rules were tightened, there was a relatively large outflow from disability retirement between 2008 and 2010. We focus on the year 2011 because this is the most recent year for which we have data, and because disability retirement in earlier years may not represent chronic disability.

1961 (thus aged 50-64 in 2011), who gave birth to at least one child between the years 1983 and 2011. Excluding those not alive in 2011 (2 percent), those with missing information on smoking at all their pregnancies (3 percent) and those with missing information on education (0.04 percent), our full sample contains 317,277 individuals. Of these individuals, there are 83,295 for which at least one sister is also in the full sample; we refer to these as belonging to the "sibling sample". Moreover, there are 2,312 twins for which their co-twin is also in the full sample; we refer to these as belonging to the "twin sample".

Table I provides means and standard deviations of relevant variables in our three samples. As it turns out, the samples are all quite similar in characteristics. Individuals are on average born in 1956-1957, and smoking is on average observed in 1988. About 28 percent of all individuals are smokers.[4]

< Table I about here >

2.3 Econometric method

Much of our analysis will be using sibling fixed effects, meaning that we compare smoking and disability pension between siblings. In addition, we will compare outcomes of twins, thus further accounting for differences in environments and genetic factors. While the use of twins requires us to use a smaller sample and raises some issues of external validity, it is interesting to see if the results are much different from those obtained when comparing siblings.

For computational tractability and in order to be able to interpret effects in percentage points, we run linear probability models, where the outcome variable is an indicator taking the value of one if the individual obtains full disability pension in 2011 (in most models, due to any condition). The regression equation takes the following form.

$$DP_{ij} = \alpha + \beta Smoker_{ij} + X_{ij}\gamma + f_j + \varepsilon_{ij}$$

Here, i is an index for the individual and j for the mother or the twin pair.[5] X contains one

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[4] Responses to surveys distributed by Statistics Sweden suggest that among the general population of women aged 25-44, smoking prevalence was 34 percent in 1988 (Danielsson, Gillian and Hemström 2009), a number that is somewhat higher than ours is. Midlöv et al. (2014) suggest that 33 percent of individuals in (roughly) our cohorts smoked in 1988/89. Due to quitting, this number had then reduced to 21 percent in 2004/05.

[5] Note that "mother" refers to the mother of the mother observed in the Medical Birth Register, as the person of interest is the woman with smoking records in the birth register. Our analysis uses biological mothers, but replacing them with adoptive mothers or dropping individuals that were adopted makes essentially no difference the the results.

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or several control variables; in our most simple models we use dummies to control for birth year, family size and birth order of the individual, parents' years of education and the number of times the individual has been asked whether she smokes (apart from missing values, this is the number of children of the individual of interest). We then add controls for mother (or twin pair) fixed effects. More extensive models also include fixed effects for the individual's years of attained education, occupation, and marital status. Income and adult health are likely to be endogenous to smoking, but we further run models accounting for these, in order to explore mechanisms. Standard errors are clustered at the family (i.e. mother) level.

3. RESULTS

3.1 OLS on different samples

We begin our analysis by running models without sibling or twin fixed effects. Table II shows the results, where we first run the analysis on the full sample, the sibling sample and the twin sample. We find that siblings and twins are representative in the sense that the associations between smoking and disability pension are similar across the three samples. The estimates based on the full sample and the sibling sample are even identical up to four decimal points, and suggest that smokers face a 5.64 percentage point higher probability of receiving disability pension.

< Table II about here >

We also run these regressions on two subsamples of the siblings and twins samples. In particular, since only families (or twins) where there is a variation in smoking behaviour are going to contribute to the forthcoming fixed effects estimates, it is of interest to separately consider those for which these is a variation in smoking – and those for which there is not. When considering families for which there is no variation, the smoking dummy simply becomes an indicator for coming from a family where every girl ends up smoking, rather than coming from a family where no girl ends up smoking. Indeed, the estimated effect of this indicator may capture many aspects of family quality as well.[6]

Restricting attention to siblings that do not differ in terms of smoking, we find an effect of

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[6] Taking father's years of education as one indicator of family quality, we find that in families where no daughter becomes a smoker, fathers on average have 10.05 years of education, whereas in families where all daughters become smokers, they only have 8.91. In families where we observe a variation in daughters' smoking behaviour, fathers' average years of education is 9.31.

0.0745, almost two percentage points higher than the effect in the overall sample. Considering the complement subsample of siblings differing in smoking, we find an effect that is instead two percentage points (or more than a third) lower than the one in the overall sample, attaining a value of 0.0365. The estimate based on twins not differing in smoking is also higher than the one based on twins differing in smoking, but the difference is less pronounced.

3.2 Main results

We then turn to our main results, using sibling or twin fixed effects. Results are shown in panel A of Table III. We find that adding sibling fixed effects reduces the estimate by almost a half, to 3.33 percentage points (see column A). This estimate, however, is not much lower than the OLS estimate based on siblings with different smoking behaviours, suggesting that in these "intermediate quality families", confounding family characteristics are not very relevant.

< Table III about here >

In Model B, we add controls for educational attainment, occupation, and marital status. This reduces the estimate by another 50 percent, to 0.0171. While this effect is relatively modest, it is still highly significant, and one should note that it is potentially an underestimate of the *net effect* of smoking, since all the added controls may simply be mediators in the relationship between smoking and retirement due to disability.[7]

Models C and D show our fixed effects results based on the twin sample. These results are less precise than the ones obtained using the sibling sample, and they cannot statistically be distinguished. The estimate in Model C (where further controls have not been added) is virtually the same as the one based on OLS, and adding further controls reduces the estimate somewhat.

In panel B, we consider effects in different age spans, by interacting smoking with three different age indicators: 50-54, 55-59 and 60-64. The effect on disability retirement becomes substantially stronger, the higher the age. At age 50-54, a smoking sibling has a 2.21 percentage point higher probability of being on disability pension when not accounting for confounders; the effect increases to 3.85 percentage points at age 55-59 and to 6.58 percentage points at age 60-64. Adding controls makes the effects diminish similarly to before.

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[7] If the result of model D represents the causal effect of smoking, these results suggest that 8 percent of all instances of disability retirement could be eliminated by turning smokers into non-smokers. Furthermore, assuming that the effect extends to all individuals aged 50-64 and assuming that these can produce the average GDP per worker in Sweden, production in Sweden could increase by about 7 billion SEK (1 billion USD) per year by turning smokers into non-smokers.

3.3 Quitting and intensity of smoking

While we are not able to follow individuals' smoking behaviour for a long period of time, we can examine some effects of smoking cessation by considering women who have given birth more than once, and were thus asked about their smoking habits multiple times. We create indicators for "always smokers", taking the value of one if the mother was a smoker at the beginning of all her pregnancies, and for "quitters", taking the value of one if the mother was a smoker up to a given pregnancy and then was a non-smoker at all pregnancies thereafter. Few individuals initiate smoking or switch back and forth between being a smoker and a non-smoker between pregnancies, and we exclude these from the analysis.

In panel A of Table IV, we show results when re-running our main analysis using the two indicators. According to all of our models, the coefficient for quitters is very close to zero and it is statistically insignificant. Women quitting smoking in middle age do not appear to face a higher probability of disability retirement.

< Table IV about here >

In panel B of Table IV, we then examine whether heavy smoking (smoking at least 10 cigarettes per day) has an additional effect. In a sibling fixed effects model with no further controls, the baseline effect of smoking is 2.80 percentage points, and being a heavy smoker adds another 1.43 percentage points. However, when adding further controls, the additional effect of heavy smoking becomes much less pronounced and statistically insignificant.

3.4 Medical reason for retirement

In Table V, we consider disability pension due to different conditions. The analysis thus explores effects health insults that may result from smoking, where severity is measured in terms of the increased probability of work limitation. In order to keep precision high, we here, as well as in the forthcoming sections, focus on siblings only.

< Table V about here >

In models accounting for sibling fixed effects but no further controls, we find that at the 10 percent level of significance, 6 types of conditions are affected by smoking. In line with the observation that smoking reduces life expectancy due to neoplasms and circulatory conditions, we find that smokers are more likely to withdraw from the labour market due to these. However,

the estimated effects are small, in absolute terms. The probability of disability pension due to neoplasms is only elevated by 0.0006 and the probability of disability retirement due to circulatory conditions is only elevated by 0.0021. Interestingly, no effect on respiratory problems is obtained.

Most of the effect on disability retirement is accounted for by mental and musculoskeletal conditions, with coefficients of 0.0150 and 0.0089, respectively. This is not entirely surprising as these are also the two most common types diagnoses for which individuals obtain disability pension. However, the effect on mental diagnoses is proportionally large and corresponds to 45 percent of the overall effect of smoking. Finally, we also obtain effects on disability retirement due to conditions of the nervous system and eye conditions, but these effects are rather small and only significant at the 10 percent level.

As when estimating the overall effect on disability pension, we find that further controlling for socioeconomic and marital status reduces the estimates. Effects on disability retirement due to problems with the nervous system and eyes are now no longer statistically significant at conventional levels. For the other diagnoses that where significant effects were previously found, estimates reduce by about half on average.[8]

3.5 Accounting for health

In this section, we explore the relationship between smoking and two more objective measures of health. The analysis serves two different purposes. First, we wish to determine whether unhealthy individuals select into smoking. If this is the case, our results may be driven by omitted health variables. Second, we are interested in whether our results to some extent can be explained by measures of objective health close to the outcome year. If not, we would worry that results instead reflect some unobserved characteristics of smokers, such as a higher disutility from work.

In the first column of Table VI, we examine whether smoking is related to height, within siblings.[9] Height is a commonly used measure of overall health during childhood (Elo and Preston 1992) and is as such unlikely to be influenced by smoking itself. We find no evidence of a relationship between height and smoking, suggesting that selection into smoking among unhealthy individuals may not be an issue.[10]

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[8] The table also shows sample averages of disability pension due to different conditions, allowing us to calculate relative effects of smoking. By far, the largest relative effects are obtained for circulatory conditions; smoking is found to increase the probability of disability retirement due to circulatory conditions by around 200 percent. The second largest relative effects are obtained for neoplasms (more decimals used for exact calculation).

[9] Height is measured in centimeters and averaged over pregnancies.

[10] Further information in the Birth Register includes the woman's pre-pregnancy weight and her newborn's

We are then interested in health measures that are observed later and that we may think of as mediators of the smoking-disability retirement relationship. We here use inpatient visits between 2001 and 2011. The second column of Table VI shows results from regressions of hospitalization (at least one hospital day between 2001 and 2011) against smoking. We find that smoking has a significant effect on the probability of hospitalization; with an estimate of 0.0309 or 0.0211, depending on whether further controls are added.

Given the significant relationship between smoking and hospitalization, we move on and add controls for hospitalizations to our main models. For completeness, we create controls for hospitalization due to each and every type of health problem (according to the ICD chapters), and we create not only indicators for at least one day, but also for the total number of days and for the total number of days squared. We find that estimates fall by almost 30 percent when adding indicators for at least one hospital day due to various health problems. Further adding linear and quadratic controls for the number of hospital days to due to various diagnoses makes only a small difference. The results suggest that a substantial share of smoking's effect on disability retirement can be explained by health problems severe enough to merit hospitalization, although the majority of the effect is still unexplained.

3.6 Accounting for economic status

Rather than through work disability, the effect of smoking may operate through discrimination or a lower productivity before entering disability retirement. If these factors are at play, working may be less attractive and individuals may try to obtain disability pension by exaggerating health problems.[11] We limit the sample to individuals not on disability pension in 2001, because we want to be able to measure financial variables at a time before individuals entered disability retirement.

In Table VII, we explore the relevance of these hypothesises. In a model without further controls, we find that smokers earn about 8,000 SEK less per year, corresponding to 4 percent

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weight. We find that a smoking mother has significantly lower body mass index (weight divided by height squared) and gives birth to significantly lighter children. The interpretation of these results is complicated, however, as they may reflect both causal effects of smoking and selection into smoking (Chiolero et al. 2008; Fertig 2010). In any case, controlling for these variables in our main regressions makes little difference to our results.

[11] The presence of a minimum and maximum disability pension is one reason why those with lower incomes may be more prone to enter disability retirement. Other potential reasons include emotional costs due to discrimination and a lower motivation for work among less productive individuals.

of an average income. The effect is much lower when controlling for further variables. We also look at spousal income and family net wealth. Partly because of a lower probability of marrying, we find large negative effects of smoking on these variables, also in models with further controls.

< Table VII about here >

Since the relationships between smoking and financial variables turned out significant, we then move on to control for these in our main regressions. Without the financial controls, the effect of smoking on disability retirement is in this sample 0.014 or 0.010, depending on the specification. Adding the controls for financial variables reduces the estimates only slightly, to 0.013 and 0.009, suggesting that financial variables are not important in explaining our overall results.

4. DISCUSSION

Using a population-wide dataset and controlling for a broad range of potential confounders, this study estimated the long-run effects of midlife smoking on disability retirement. While raw correlations suggest smoking to be a major determinant of the uptake of disability pension, our estimates based on sibling comparisons suggest dramatically smaller, yet significant, effects. The differences between OLS results and sibling fixed effects results are largely driven by families where every individual shares the same smoking behaviour., pointing at the importance of unobserved characteristics only in these families.

Effects are concentrated to mental and musculoskeletal problems (the most common causes for disability retirement), but effects on neoplasms and on circulatory conditions are found as well. Our results indicate that the aspects of health that are the most affected by smoking may be quite different when work disability is considered, compared to mortality or other pure health outcomes. A substantial part of our relationships can be explained by health problems severe enough to merit hospitalization, but there is no evidence of any role played by incentives or financial circumstances.

To grasp the benefits from reducing or abolishing smoking, individuals and policy-makers are in need for knowledge about the long-term labour market consequences of smoking. This paper has provided one piece of such evidence – showing that abolishing smoking would likely enable individuals to stay longer in the labour force instead of entering disability retirement.

Disability retirement, however, may only represent "the top of the iceberg" of the disutility from work experienced by individuals in poor health. The benefits to workers from giving up smoking are thus likely to be higher than what is immediately implied by this paper.

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6. Tables

Table I: Descriptive statistics

	Full sample	Sibling sample	Twin sample
Birth year	1956 (4)	1956 (4)	1957 (3)
Average year of childbirth	1988 (4)	1988 (4)	1988 (4)
Aged 50-54	0.5016	0.4934	0.5865
Aged 55-59	0.3498	0.3807	0.3354
Aged 60-64	0.1487	0.1259	0.0770
Primary education	0.1023	0.1071	0.1012
Secondary education	0.4657	0.4582	0.4951
Tertiary education	0.4320	0.4347	0.4035
Father's years of education	9.6017	9.6770	9.5787
	(3.0670)	(3.1817)	(3.1039)
Mother's years of education	9.1328	9.1854	9.2190
	(2.5892)	(2.6585)	(2.5917)
Disability retirement	0.0616	0.0595	0.0528
Disability retirement if smoker	0.1045	0.1029	0.0936
Disability retirement if non-smoker	0.0447	0.0422	0.0381
Disability retirement if aged 50-54	0.0474	0.0477	0.0472
Disability retirement if aged 55-59	0.0642	0.0616	0.0553
Disability retirement if aged 60-64	0.1037	0.0996	0.084
Smoker	0.2826	0.2850	0.2634
Always smoker	0.2285	0.2283	0.2050
Quitter	0.0369	0.0391	0.0407
Heavy smoker	0.1186	0.1196	0.1056
Height	166.55	166.48	165.99
	(5.81)	(5.84)	(5.72)
Hospitalized 2001-2011 (any condition)	0.3137	0.3126	0.2849
Inpatient days 2001-2011 (any condition)	3.97	3.96	4.36
	(22.58)	(21.15)	(27.15)
Average income 1997-2001 (2001 SEK)	188,992	188,871	184,657
	(92,729)	(93,184)	(80,046)
Spousal average income 1997-2001	198,279	195,789	200,162
	(237,199)	(232,479)	(213,877)
Family net wealth 2001 (SEK)	894,024	823,787	833,165
	(1,64E07)	(3,386,389)	(2,542,311)
Individuals	317,277	83,285	2,312

Table II: Disability retirement due to any health problem – OLS on different samples

	Full sample	Sibling sample	Twin sample	Sibling sample, same	Sibling sample, different	Twin sample, same	Twin sample, different
Smoker	0.0564***	0.0564***	0.0503***	0.0745***	0.0365***	0.0542***	0.0485**
	(0.0011)	(0.0022)	(0.0127)	(0.0035)	(0.0031)	(0.0169)	(0.0201)
Individuals	317,277	83,295	2,312	56,617	26,678	1,806	506

Notes: *** indicates significance at the 1 percent level, ** significance at the 5 percent level, and * significance at the 10 percent level. The outcome is an indicator for receiving full disability pension in 2011. Column A shows results for the full sample, column B for the full sibling sample, column C for the sibling sample where siblings are all smokers or non-smokers, column D for the sibling sample where siblings differ in whether they smoke, column E for the full twin sample, column F for the twin sample where twins are both smokers or non-smokers, column G for the twin sample where twins differ in whether they smoke. All regressions control for birth year fixed effects, family size fixed effects, birth order fixed effects, fixed effects for parental years of schooling and fixed effects for the number of times the individual has been asked whether she smokes. Standard errors are clustered at the mother level.

Table III: Disability retirement due to any health problem – sibling or twin fixed effects

	A	B	C	D
A. Overall effect on disability pension in 2011				
Smoker	0.0333***	0.0171***	0.0514***	0.0405**
	(0.0031)	(0.0027)	(0.0197)	(0.0172)
Individuals	83,295	83,295	2,312	2,312
B. Effects of smoking on disability pension in 2011, among different age groups				
Smoker, aged 50-54	0.0221***	0.0096***	0.0171	0.0299
	(0.0039)	(0.0035)	(0.0255)	(0.0228)
Smoker, aged 55-59	0.0385***	0.0200***	0.0880**	0.0453
	(0.0047)	(0.0041)	(0.0344)	(0.0303)
Smoker, aged 60-64	0.0658***	0.0409***	0.1447*	0.0957
	(0.0097)	(0.0084)	(0.0778)	(0.0610)
Individuals	83,295	83,295	2,312	2,312

Notes: *** indicates significance at the 1 percent level, ** significance at the 5 percent level, and * significance at the 10 percent level. The outcome is an indicator for receiving full disability pension in 2011. Models A-B are based on the sibling sample and Models C-D on the twin sample. In Model B and D, we add controls for level of education, type of occupation, and marital status. All regressions control for birth year fixed effects, birth order fixed effects and fixed effects for the number of times the individual has been asked whether she smokes. Standard errors are clustered at the mother or twin pair level.

Table IV: Stopped smoking and heavy smoking – sibling or twin fixed effects

	A	B	C	D
A. Always smokers vs quitters				
Always	0.0379***	0.0247***	0.0824*	0.0844*
	(0.0072)	(0.0066)	(0.0427)	(0.0459)
Quitter	0.0079	0.0015	0.0053	-0.0095
	(0.0074)	(0.0067)	(0.0252)	(0.0289)
Individuals	24,777	24,777	908	908
B. Smokers and heavy smokers				
Smoker	0.0280***	0.0162***	0.0418**	0.0353*
	(0.0035)	(0.0030)	(0.0199)	(0.0180)
Heavy smoker	0.0143***	0.0024	0.0324	0.0181
	(0.0054)	(0.0046)	(0.0367)	(0.0321)
Individuals	83,295	83,295	2,312	2,312

Notes: *** indicates significance at the 1 percent level, ** significance at the 5 percent level, and * significance at the 10 percent level. The outcome is an indicator for receiving full disability pension in 2011. Models A-B are based on the sibling sample and Models C-D on the twin sample. In Model B and D, we add controls for level of education, type of occupation, and marital status. In panel B, the effect for "Heavy smoker" represents the additional effect of smoking 10 or more cigarettes a day, over and above the effect for "Smoker". All regressions control for birth year fixed effects, birth order fixed effects and fixed effects for the number of times the individual has been asked whether she smokes. Standard errors are clustered at the mother or twin pair level.

Table V: Disability retirement due to different diagnoses – sibling fixed effects

	Infections	Neoplasms	Blood	Endo etc	Mental	Nervous syst	Eye	Ear
Smoker, SFE model	0.0001	0.0006**	0.0001	0.0003	0.0150***	0.0014*	0.0003*	0.0000
	(0.0002)	(0.0003)	(0.0001)	(0.0005)	(0.0019)	(0.0007)	(0.0002)	(0.0002)
Smoker, SFE model with further controls	-0.0001	0.0006**	0.0001	0.0002	0.0089***	0.0004	0.0003	-0.0001
	(0.0002)	(0.0003)	(0.0001)	(0.0004)	(0.0018)	(0.0007)	(0.0002)	(0.0002)
Non-smoker mean	0.0002	0.0006	0.0001	0.0007	0.0130	0.0030	0.0002	0.0003

	Circulatory	Respiratory	Digestive	Skin	Musculoskeletal	Urogenital	Congenital	Injury
Smoker, SFE model	0.0021***	0.0000	0.0004	0.0003	0.0089***	0.0000	0.0003	0.0001
	(0.0006)	(0.0004)	(0.0003)	(0.0003)	(0.0020)	(0.0001)	(0.0003)	(0.0008)
Smoker, SFE model with further controls	0.0017***	-0.0001	0.0001	0.0002	0.0039**	-0.0000	0.0003	-0.0009
	(0.0006)	(0.0004)	(0.0003)	(0.0003)	(0.0019)	(0.0001)	(0.0003)	(0.0008)
Non-smoker mean	0.0010	0.0004	0.0005	0.0003	0.0154	0.0002	0.0002	0.0028

Individuals	83,295

Notes: *** indicates significance at the 1 percent level, ** significance at the 5 percent level, and * significance at the 10 percent level. The outcome is an indicator for receiving full disability pension due to a certain type of diagnosis in 2011."SFE" is shorthand for "sibling fixed effects". In models "with further controls", we control for level of education, type of occupation, and marital status. All regressions control for birth year fixed effects, birth order fixed effects and fixed effects for the number of times the individual has been asked whether she smokes. Standard errors are clustered at the mother level.

Table VI: Health status

	Height	Hospitalization	DP	DP	DP	DP
Smoker, SFE model	0.0509	0.0309***	0.0333***	0.0244***	0.0235***	0.0233***
	(0.0586)	(0.0057)	(0.0031)	(0.0030)	(0.0030)	(0.0029)
Smoker, SFE model with further controls	0.0966	0.0211***	0.0171***	0.0122***	0.0116***	0.0116***
	(0.0599)	(0.0057)	(0.0027)	(0.0026)	(0.0026)	(0.0026)
Hospitalization controls:						
Hospitalization				X	X	X
Hospital days					X	X
Hospital days squared						X
Individuals	67,053	83,295	83,295	83,295	83,295	83,295

Notes: *** indicates significance at the 1 percent level, ** significance at the 5 percent level, and * significance at the 10 percent level. The outcome is an indicator for receiving full disability pension in 2011."SFE" is shorthand for "sibling fixed effects". In models "with further controls", we control for level of education, type of occupation, and marital status. All regressions control for birth year fixed effects, birth order fixed effects and fixed effects for the number of times the individual has been asked whether she smokes. Standard errors are clustered at the mother level.

Table VII: Income (1997-2001) and wealth (2001)

	Income	Spousal income	Family wealth	DP	DP	DP
Smoker, SFE model	-7,958*** (1,018)	-46,287*** (2,524)	-229,691*** (41,442)	0.014*** (0.002)	0.013*** (0.002)	0.013*** (0.002)
Smoker, SFE model with further controls	-1,877** (920)	-17,648*** (2,037)	-122,379*** (38,151)	0.010*** (0.002)	0.010*** (0.002)	0.009*** (0.002)
Financial controls: Income					X	X
Spousal income and family wealth						X
Individuals			75,266			

Note: *** indicates significance at the 1 percent level, ** significance at the 5 percent level, and * significance at the 10 percent level. Income is measured as the average real income between 1997 and 2001 (2001 prices in SEK), and wealth is measured in 2001. The outcome is an indicator for receiving full disability pension in 2011. "SFE" is shorthand for "sibling fixed effects". The sample is restricted to individuals not on disability pension between 1997 and 2001. In models "with further controls", we control for level of education, type of occupation, and marital status. All regressions control for birth year fixed effects, birth order fixed effects and fixed effects for the number of times the individual has been asked whether she smokes. Standard errors are clustered at the mother level.