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Demographic Transitions and Lifestyle Factors: Quantifying the Burden of Smoking-Attributable Diseases on Germany's Healthcare System

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Abstract

This study focuses on the long-term effects of the Baby Boomers' (born between 1960 and 1979) historical smoking prevalence in Germany. It emphasizes the linkage to an anticipated increase in smoking-attributable diseases and corresponding healthcare costs by 2035. Our analysis leverages data from the German Federal Statistical Office, the Mikrozensus, and the Federal Health Report, along with treatment costs, to document the persistently high smoking rates among this cohort. In addition, it also projects the ensuing economic burden on healthcare from conditions such as COPD and lung cancer. Highlighting the necessity for targeted public health interventions aimed at smoking cessation and lifestyle modifications, this study draws on UK strategies, including support for quitting. We suggest Germany could adopt similar measures to address these challenges effectively. These insights aim to guide policymakers in developing targeted interventions to reduce the future healthcare burden. We estimate smoking attributable healthcare costs to rise by 56% until 2035 totaling €193 billion over the period. Although our projections are conservative compared to other literature, incorporating data from Effertz (2019) suggests that annual costs could skyrocket to as much as €46 billion. Adequate strategies could reduce these costs.

Key words: Smoking-Attributable diseases; Demographic transitions; Life style factors; Public health

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1. Introduction

Germany is facing massive social and economic challenges, with problems such as a shortage of skilled workers, the inability to finance social systems such as pension and healthcare systems and high national debt (Grimm et al. (2023), Deutsche Bundesbank (2024)). In addition to many other factors, the ageing population is one of the main factors (Grimm et al. (2023), Pimpertz (2023)). This refers to the fact that the proportion of 65+ year old, which equals retirement age in Germany, has increased from 15% in 1991 to 22% in 2022. This trend is being driven by the lower birth rates of younger cohorts (Pötzsch (2016)). The cohorts of the 1960s and 1970s, also known as baby boomers and currently the largest in Germany, will retire in the next few years. As a result, they will no longer be available to the labor market, will no longer pay into social insurance schemes such as pension and health insurance and at the same time will receive high social insurance payments. This development means that an ever-smaller number of people will have to bear the increasing costs of the older, larger population. In 1962 there were six contributors per recipient of old-age pensions. By 2021, this ratio had decreased to 2.1 contributors per recipient (Demografie-portal 2024). This trend of less people having to bear the burden of an ageing population is expected to continue. This is especially alarming as younger generations are already burdened by inflation, falling purchasing power, high real estate prices and high national debt.

On the other side, the German healthcare system is widely regarded as one of the most comprehensive and efficient in the world, providing universal coverage to its citizens. The system is primarily funded through a social insurance model, with both employers and employees contributing to statutory health insurance funds. This allows for broad access to a wide range of medical services, including outpatient care, hospitalization, rehabilitation, and prescription drugs. However, Germany's healthcare expenditures are projected to increase significantly, driven by factors such as demographic change, medical progress, and rising incomes (Zeddies 2023, Breyer 2013, Adam 2007). This growth raises concerns about the long-term sustainability of the system, with potential implications for the funding and provision of healthcare (Hans 2007). The need for increased social security contributions, tax subsidies, and private health spending is likely to become more pronounced as a result.

While the relationship between population aging and healthcare costs is well-established, the role of preventable risk factors, such as smoking, has received less attention in the literature on

the German healthcare system. As the Baby Boomer generation, characterized by high rates of unhealthy behaviors, reaches advanced age, understanding the impact of their lifestyle choices on future healthcare demands and expenditures is of critical importance. Addressing this research gap could provide valuable insights to policymakers as they work to ensure the long-term viability of Germany's renowned healthcare system.

Hence, the healthcare system, particularly, is facing distinctive and unparalleled obstacles, which, if not adequately addressed by policymakers, could lead to significant uncertainty and strain on the German economy and the younger generation. This is particularly of concern as the baby boomers reaching an age at which consumption-induced diseases are beginning to erupt. Excessive consumption is particularly evident in the fact that almost 70% of male baby boomer and 50% (BPB 2022) of female baby boomer are overweight, more than 8% (Eurostat 2024) drink alcohol every day and the smoking prevalence of around 24% (GBE 2023) in this age group is the highest of all age groups in Germany and was even higher in the past.

More precisely, this study aims to quantify the consequences of unhealthy consumption and the burden on the healthcare system by estimating the future healthcare costs of baby boomers due to excessive tobacco consumption. We specifically focused on the direct healthcare expenses associated with smoking, as these costs are estimated to be twice as high as those related to alcohol consumption (Effertz, 2020), thus positioning smoking as the larger threat in terms of healthcare expenditure. Other risk factors such as alcohol consumption and obesity merit further investigation and analysis in subsequent studies.

To do this, we use population attributable fractions (PAF) to determine the cases of disease attributable to smoking and estimate these for the next 10 years using a panel regression per birth cohort based on smoking history. Annual health expenditure by disease per patient from Germany are utilized to allow estimations of treating smoking related diseases.

This study shows that, despite declining prevalence, the burden on the healthcare system attributable to smoking is not expected to decrease and smoking is still one of the greatest threats to society. Both from a health and a cost perspective. The findings of this study underscore, therefore, the urgent need for Germany to rethink its approach to tobacco control and address the impending healthcare crisis driven by the aging Baby Boomer generation's smoking habits. The projections of escalating smoking-related healthcare costs, with the Baby Boomer cohort accounting for over 50% of the future burden, call for targeted and comprehensive policy interventions.

The paper is structured as follows. Sections 2 and 3 provide an overview of the related literature and the German context, respectively. Section 4 outlines the data and methods utilized in the study, while Section 5 presents the key findings. Section 6 offers concluding remarks, summarizing the main results, and discussing the limitations and policy implications of the study.

2. Related literature

The rising healthcare costs, particularly considering an aging population, present a complex challenge that has gained significant academic interest worldwide. According to the 2019 report by the Bertelsmann Stiftung, Germany's healthcare expenditures are projected to increase cumulatively by 87% by 2040, indicating the need for a significant increase in health insurance contributions to ensure the sustainability of the healthcare system. However, the relationship between an aging population and healthcare costs is complex. According to Stahmeyer et al. (2018), 17.3% of the cost increase from 1992 to 2015 could be directly attributed to demographic changes. Other factors, such as inflation increasing treatment costs, and the introduction of more expensive medical interventions, also play a role. However, Stahmeyer et al. (2018) did not consider the impact of lifestyle choices, such as the use of damaging products, on healthcare spending trends.

This perspective is reinforced by the work of Brockmann et al. (2005). This paper predicts that while healthcare spending will increase with the aging of the baby boomer cohort, an exponential increase is unlikely to happen because medical advances will improve efficiency and reduce per capita costs. Given what the experience of the last 20 years has shown, the conclusions of Brockmann et al. were, possibly, too rosy. International research supports the theory that an aging population drives healthcare expenditures. Wu et al. (2023) do so for China, while Braendle et al. (2017) do the same for Switzerland. Also, the OECD emphasizes the role of demographics and highlights the disproportionately high costs associated with end-of-life care in its 2017 model for estimating healthcare expenditures.

The literature consistently indicates that an aging population places significant pressure on healthcare expenditures. However, these studies primarily focus on demographic changes and do not consider the impacts of preventable diseases caused by unhealthy lifestyles. Therefore, it is crucial to conduct further examination of risky consumption and its differences between generations to understand the potential increase in healthcare expenditures resulting from such consumption patterns, combined with the effects of an aging population.

As such, examining smoking prevalence across different cohorts provides further important insights into the existing challenges for public health. Holford et al. (2014) found significant differences in smoking habits between age groups in the United States. Fernandez et al. (2002) documented increased smoking rates for the Baby Boomer generation in Spain. Early studies in Germany by Brenner (1993) and Rohrmann et al. (2003) emphasize the importance of looking at lifestyle choices in the context of different generations. Still, these analyses are outdated. Brenner (1993), for instance, refers to the baby boomer generation as young people. Today, this generation is between 45 and 64 years old, which suggests reexamining their smoking behavior and the implications from a long-term perspective.

The literature on the costs of smoking in Germany consistently demonstrates that smoking imposes a substantial economic burden on the healthcare system, amounting to billions of Euros annually. Studies by Effertz (2016) estimated annual costs at 79 billion Euros and Ruff et al. (2008) identifying direct healthcare costs at 17 billion Euros. Sonntag et al. (2017) project lifetime excess costs for smokers at 42 billion Euros, highlighting the potential savings of at least 2 billion Euros through comprehensive tobacco control policies.

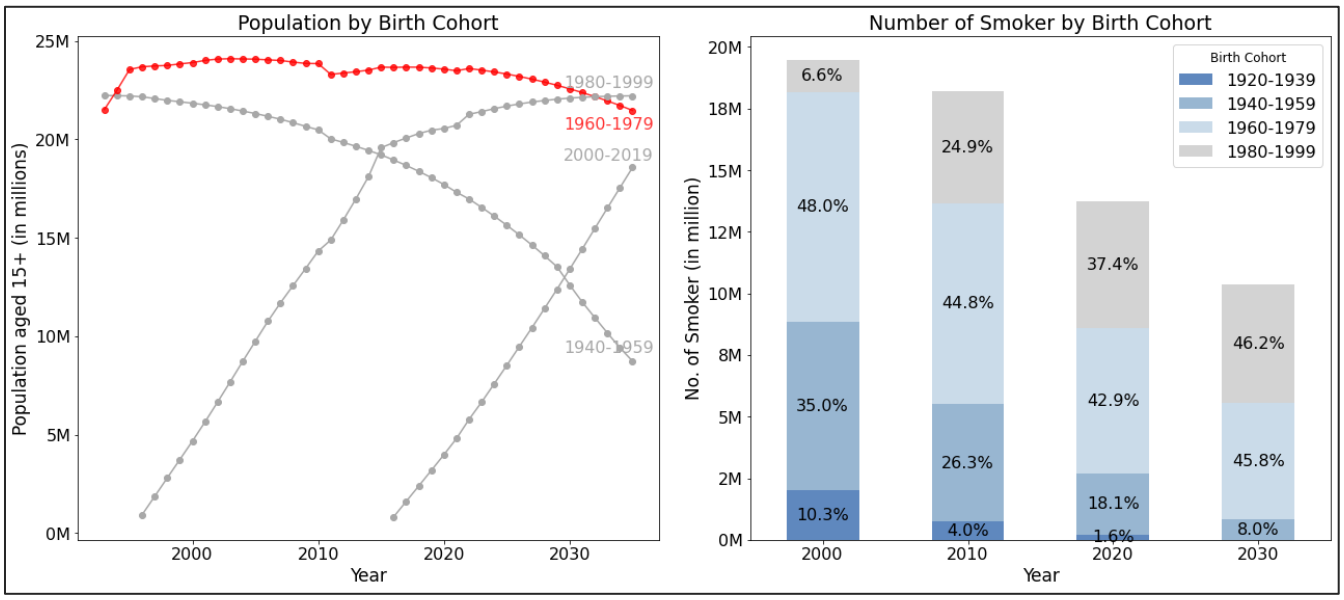
In summary, addressing the challenges in healthcare and public health requires a comprehensive approach. It is important to consider factors such as risky consumption, which has not yet been examined in connection with an aging population. This has led to a significant research gap in the specific examination of the financial and health impacts that arise from the combination of an aging population with high smoking rates, particularly the Baby Boomer generation. Although smoking and its associated costs are well documented, there is a lack of in-depth analysis regarding the upcoming challenges resulting from the aging of this specific smoking population segment. Addressing this gap is crucial for developing effective strategies and interventions to curb healthcare costs and improve public health, especially in the face of an increasingly aging population.

3. Demographics and risky consumption

Our analysis zeroes in on the Baby Boomer generation, born between 1960 and 1979, as they are by far the largest demographic group impacting future healthcare expenditures due to their historically high smoking rates. As this group, defined by the German Federal Statistical Office as having the highest birth rates from 1956 to 1969, moves into the age bracket of 55 to 74

years, the resultant increase[1] in smoking-attributable diseases is anticipated to significantly elevate healthcare costs. This trend is reinforced by the cohort's persistent smoking behavior, representing 45% of all smokers between 2000 and 2020, with only a marginal expected decrease by 2030 (see Figure 1).

Figure 1: Population size and number of smokers by birth cohort



Source: own calculation based on Destatis (2024a) and GBE (2023)

The enduring high prevalence of smoking among Baby Boomers, coupled with age-related illnesses, necessitates a strategic approach to healthcare planning. This includes targeted interventions and policies to mitigate the effects of such lifestyle choices, alongside preparing for the broader health needs of an aging population. Our projections, leveraging mortality and migration trends from the German Federal Statistical Office, address the intricate link between demographic shifts, lifestyle behaviors, and healthcare demands.

4. Data and methods

Our study integrates data from the German Federal Statistical Office, the Mikrozensus, and the Federal Health Report. It focuses on demographic trends, smoking prevalence, and disease incidences like ischemic heart disease, COPD, stroke, and lung cancer. We assess the economic

[1] Stahmeyer et al. (2018) found that 17.3% of the increase in healthcare expenditure between 2004 and 2015 in Germany can be explained by the ageing of the population

impact of smoking on healthcare through treatment costs of these diseases calculated as the total costs by disease divided by the number of treated patients per disease in 2020. We use public data on number of disease cases and hospital expenditure (statement of costs of the hospitals) from the German Federal Statistical Office. We utilize the Producer Price Index (PPI) for its adeptness at tracking changes in healthcare services and product pricing. The PPI's reflection of economic dynamics, including inflation, production costs, and service pricing, renders it suitable for approximating future healthcare treatment costs based on historical and current price trends.

4.1 Forecast smoking-related diseases cases

This study aims to provide an outlook on the development of smoking-attributable healthcare costs per birth cohort in Germany up to 2035. The key determinants of the evolution of smoking-related healthcare costs are the smoking history per birth cohort and the associated disease cases for non-communicable diseases (NCDs) induced by smoking. The diseases caused by smoking that we consider in this study are: Cerebrovascular diseases, Ischaemic heart diseases, Malignant neoplasm of bronchia and lung, Chronic obstructive pulmonary disease, Malignant neoplasms of lip, oral cavity and pharynx, Malignant neoplasm of oesophagus, Malignant neoplasm of stomach, Malignant neoplasm of pancreas, Malignant neoplasm of corpus uteri (Endometrium), Malignant neoplasm of kidney, except renal pelvis, Diabetes mellitus, Malignant neoplasm of bladder, Malignant neoplasm of liver and intrahepatic bile ducts, Malignant neoplasm of cervix uteri (Scarborough et al. 2014) (see **Error! Reference source not found.**).

Table 1: Treatment costs (euros) per disease in 2020

Disease	ICD-10 Code	Costs
Cerebrovascular diseases	I60-I69	41,971 €
Ischaemic heart diseases	120-125	14,087 €
Malignant neoplasm of bronchia and lung	C34	27,082 €
Chronic obstructive pulmonary disease	J40-J44	33,920 €
Malignant neoplasms of lip, oral cavity and pharynx	C00-C14	19,009 €
Malignant neoplasm of oesophagus	C15	21,377 €
Malignant neoplasm of stomach	C16	19,350 €
Malignant neoplasm of pancreas	C25	21,379 €
Malignant neoplasm of corpus uteri (Endometrium)	C54	23,994 €
Malignant neoplasm of kidney, except renal pelvis	C64	17,180 €
Diabetes mellitus	E11; E14	44,154 €
Malignant neoplasm of bladder	C67	11,909 €
Malignant neoplasm of liver and intrahepatic bile ducts	C22	21,377 €

Malignant neoplasm of cervix uteri	C53	18,145 €

Source: own calculation based on Destatis (2024c) and Destatis (2024d)[2]

As a first step, we approximate the smoking history per cohort through smoking prevalence, due to the lack of microdata for a sufficient time series. For each birth year, we calculate how many cumulative smoker-years an average person has. This calculation is based on the annual data on smoking prevalence by age group and is weighted by population size. An initiation age of 16 years is assumed.

The cumulative smoking years adjusted by the number of smokers within a demographic cohort is represented as:

$$\text{Cumulative years of smoking}_{(i,j)} = \sum_{k=1}^{n} \left(\frac{\text{age}_k - 16 \times \text{n\_smoker}_k}{\text{pop}_k} \right)$$

where:

- (i) represents a unique birth year,
- (j) represents a unique sex within the birth year cohort,
- (n) is the total number of cohorts ((i, j)),
- (age_k) is the age of the (k^{th}) cohort,
- (n_smoker_k) is the number of smokers for the (k^{th}) cohort,
- (pop_k) is the population size for the (k^{th}) cohort.

This formula aggregates the adjusted smoking years across all demographic cohorts to provide a cumulative measure of smoking exposure, enabling more accurate assessments of its impact on health and economic outcomes.

As a second step, the smoking-attributable disease cases are determined by taking into account the annual data on smoking prevalence by age group and the number of disease cases from the Federal Statistical Office, along with literature-based relative risks[3] per disease, age group, and gender of smokers. The gender- and cohort-specific PAF for each smoking-attributable disease is calculated using the following formula:

[2] Calculated as total cost per disease in 2020 divided by the number of patients per disease in 2020.
[3] Thun et al (2000), Gandini et al. (2008), Willi et al. (2007), Lee et al. (2009), Zhou et al. (2008).

$$\mathrm{PAF}_{ij} = \frac{\mathrm{SP}*(\mathrm{RR}_{ij}-1)}{1+\mathrm{SP}*(\mathrm{RR}_{ij}-1)},$$

where (SP) denotes smoking prevalence, (RR) relative risk, (i) represents the NCD and (j) reflects age and gender cohorts.

Finally, and using a panel regression with fixed effects, we estimate the number of smoking-attributable disease cases per birth cohort. Our dependent variable is the sum of the smoking-attributable disease cases estimated in step 2. Our independent variable is the approximated smoking history (estimated in step 1), an interaction term from smoking prevalence, age, and population using data from 2000-2023.

$$\text{Smoking attr. disease cases per } 100{,}000 = \beta_1 \text{Cumulative years of smoking} + \varepsilon$$

The constant is removed from the regression as there are no smoking-attributable disease cases without smokers. A robustness check is performed using a panel regression with random effects. The estimated regression is applied to future smoking histories, which are based on the population forecast of the Federal Statistical Office and the trend calculation of smoking prevalence per birth cohort.

4.2 Project smoking-related health costs

In order to estimate the health care costs caused by smoking, the estimated smoking-related disease cases are further enriched by including the average treatment costs per smoker (see **Error! Reference source not found.**). The treatment costs per disease are calculated as the total costs of treatment by disease divided by the number of treated patients per disease in 2020 and have been adjusted up to 2035 using the compound annual growth rate of the Producer Price Index (PPI). This adjustment allows for the calculation of future healthcare costs associated with smoking, taking into account not only the expected increase in disease incidence but also the inflationary trends in healthcare services and treatments.

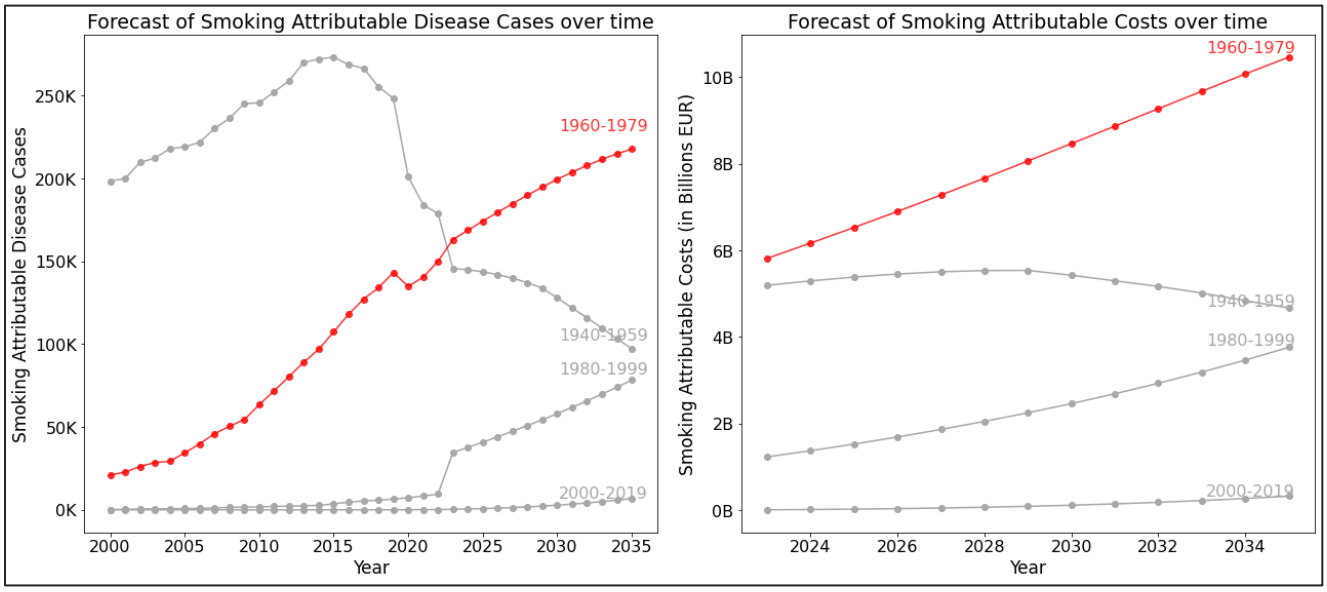
5. Results

Using Panel OLS regression with 1,196 observations across 63 entities over 23 years, the study analyzed the impact of cumulative smoking years on the rate of smoking-related diseases per

100,000 individuals (see Appendix). The findings indicate a significant positive correlation, with a coefficient of 2.68 for cumulative smoking years, suggesting that longer smoking duration is linked to higher disease incidence, supported by a highly significant p-value (<0.0001). The model explains 36.98% of the variance within entities (within R-squared), demonstrating robustness with between and overall R-squared values of 66.11% and 63.77%, respectively. The model's validity is further confirmed by an F-statistic of 664.19 and a significant F-test for poolability (51.44), both with p-values < 0.0001, highlighting the importance of entity-specific effects and the appropriateness of the fixed-effects model.

The projection of smoking-related healthcare costs in Germany indicates an increase from €13 billion in 2024 to €19 billion by 2035, totaling €193 billion over the period. This escalating financial burden underscores the urgent need for effective smoking cessation and prevention strategies. The baby boomer generation, born between 1960 and 1979, is a focal point, with 51% of future costs attributed to their smoking habits. As shown in Figure 2 this group is expected to experience a 29% increase in smoking-related disease incidences, reaching over 192,000 cases by 2035, highlighting the critical need for targeted public health initiatives.

Figure 2: Smoking attributable disease cases and costs over time by birth cohort



Source: own calculation based on Destatis (2024a, b, c, d) and GBE (2023)

6. Conclusion and Policy implications

This study set out to quantify the long-term impact of the Baby Boomer generation's smoking habits on Germany's healthcare system. By integrating data from the German Federal Statistical Office, Mikrozensus, and Federal Health Report, the analysis tracked demographic trends, smoking prevalence, and the incidence of smoking-related diseases such as COPD, lung cancer, and cardiovascular conditions.

Using a panel regression approach, we estimated the number of smoking-attributable disease cases per birth cohort, with the cumulative smoking years adjusted for the size and smoking behavior of each demographic group. The findings indicate a significant positive correlation between longer smoking duration and higher disease incidence, underscoring the substantial burden that the Baby Boomer generation's persistently high smoking rates will have on the healthcare system.

The projections paint a concerning picture, forecasting a rise in smoking-related healthcare costs from €13 billion in 2024 to €19 billion by 2035, totaling €193 billion over the period. Notably, the Baby Boomer cohort, born between 1960 and 1979, is expected to account for 51% of these future costs and experience a 29% increase in smoking-attributable disease incidences by 2035. These stark results highlight the critical need for Germany to implement targeted public health interventions to address the impending healthcare crisis driven by the aging of this high-risk population segment.

However, projecting treatment costs in healthcare is inherently complex, encompassing a wide array of factors beyond the scope of this study. This complexity includes evolving medical technologies, changes in healthcare delivery methods, and fluctuations in disease incidence and prevalence across the population. Given these intricacies, accurately forecasting any form of treatment costs extends beyond our study's objectives. Instead, we utilize the Producer Price Index (PPI) as a proxy to forecast these costs. While the PPI offers a generalized reflection of economic trends affecting healthcare prices, it carries limitations in this context. Specifically, the PPI may not precisely account for the unique cost trajectories of individual treatments, particularly as innovative therapies emerge or as treatment protocols evolve.

Due to the lack of detailed individual smoking data, our analysis utilizes an alternative approach, aggregating smoking history by age and gender cohorts. This method aims to identify trends in smoking-attributable disease incidences, using annual smoking prevalence data segmented by age and gender, to inform predictions.

Our methodology, therefore, balances data limitations and forecasting practicalities, leveraging age and gender-specific smoking prevalence to project disease trajectories. This approach highlights the need for more detailed data collection and analytical methods to improve predictive accuracy. Enhanced longitudinal studies on smoking habits could offer deeper insights into the relationship between smoking behaviors and health outcomes. For example, we cannot include other aspects of smoking such as the type or severeness of smoking which likely play a role for the disease risk, or linked health behavior trajectories such as alcohol consumption or physical activity, which may moderate the implications of cumulative smoking years. The omission of increased disease risk in former smokers, due to data constraints, means our estimates should be seen as conservative.

Compared to other results from the literature (e.g., Effertz 2019), our figures are at the lower end of the estimates distribution. For example, Effertz (2019) estimates the annual costs for the healthcare system at 30 billion euro and a further 67 billion euro for productivity losses for companies and employees. Effertz utilizes non-public data from the statutory health insurance system which allows to control for smoking-related co-morbidities. If we were to use this figure and simultaneously consider our projected increase of smoking-attributable healthcare costs in the next few years, the financial burden would skyrocket to 46 billion euros per year in 2035.

Germany's tobacco control is considered one of the weakest of all 37 European countries (Graen et al. 2021), with few regulations on advertising bans and strong regulations on potentially less harmful smoke-free alternatives. Smoking remains one of the biggest health threats in Germany and there is no sign of this trend being reversed. It is necessary to rethink Germany's tobacco regulations.

Looking at other countries can bring valuable insights. Some countries have made interesting policy decisions, and they should be taken into consideration given the results achieved. Sweden, for example, has effectively reduced its smoking rate by promoting smoke-free alternatives like snus, complementing traditional tobacco control measures with a less damaging product. The UK has implemented for years the "Swap-to-Stop" initiative, encouraging smokers to switch to less harmful alternatives like e-cigarettes, heat-not-burn devices, and snuff. The results have been positive, although authorities should continue to monitor the uptake of e-cigarettes among the youth (DHSC and O'Brien 2023). Certainly, the UK demonstrates a potential strategy for reducing health risks and economic burdens on healthcare systems. The UK has also moved forward, proposing the ban on cigarette sales to those born after January 1, 2009. At the time of writing, the proposal's credibility is still up in

the air, and several aspects of it make a demographer think that there are far more efficient interventions (specifically, on the part of the population that is actually attracted by cigarettes), it is still interesting to observe the UK path in privileging alternatives. Alongside these efforts, France and the UK have adopted plain packaging laws since 2017, mandating cigarettes be sold in uniform packages with health warnings, which has been shown to encourage smokers to quit.

These strategies illustrate a range of efforts to combat tobacco use, each contributing to the broader goal of reducing smoking prevalence and its associated health risks.

Overall, our results suggest that the older groups of society are the main drivers of the avoidable financial burden of smoking. Starting from this observation of reality, the German tobacco regulation should pay special attention to this target group. The objective of policymaking should be to obtain the best results possible with the lowest cost for society. In this sense, targeting the part of the population using the harmful product seems the logical thing to do. Studies such as the one by Mons et al. (2015) suggest that the health risks associated with long-term smoking can also be significantly reduced for people over 60, indicating a strategic opportunity for policy interventions to reduce the economic impact of the boomer generation's smoking habits. However, smoking cessation efforts in older populations face factual challenges, showing lower success rates among those aged 60 and over. An initiative similar to the UK's 'Swap-to-Stop', targeting the boomer generation, could be a useful tool to circumvent the issues presented by the very low cessation efforts in older generations. The German Federal Institute for Risk Assessment (BfR) highlights the potentially less harmful properties of "heat-not-burn" products or e-cigarettes (2021). Given the BfR research and its credibility, it seems that these products could be a valuable tool to reduce the German burden of smoking and that the UK path could be a promising one if implemented in Germany.

Germany must take urgent action. The cost of smoking will continue to rise, inexorably, over the next few years. As studies show, we are still in time to act. Data in hand, other countries such as Sweden and the UK seem to have approached this issue more efficiently than others. A mix of measures tailored to Germany and its aging population could be an effective approach to flattening the costs of the healthcare system.

While the costs presented in this study might seem large, they are still moderate when compared to the existing literature. When combining our estimates with those of Effertz (2019) costs might reach up to 46 billion euros per year in 2035. This sum could also be used to eliminate the investment backlog of more than 45 billion euros in German schools and thus invest in the

future of Germany instead of sinking into the healthcare system (KFW 2022). This is, simply put, unsustainable for the already-battered German budget.

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Appendix

Table A.1: Panel OLS entity-fixed and random effects results

Panel OLS Entity Fixed Effects			
Dep. Variable:	Smoking attributable cases per 100k	R-squared:	0.3698
Estimator:	Panel OLS	R-squared (Between):	0.6611
No. Observations:	1,196	R-squared (Within):	0.3698
Cov. Estimator:	Unadjusted	R-squared (Overall):	0.6377
Entities:	63	Log-likelihood:	-7943.0
Avg Obs:	18.984	F-statistic:	664.19
Min Obs:	1.000	P-value:	0.0000
Max Obs:	23.000	Distribution:	F(1,1132)
Time periods:	23		
Avg Obs:	52.000	F-statistic (robust):	664.19
Min Obs:	41.000	P-value:	0.0000
Max Obs:	63.000	Distribution:	F(1,1132)

Parameter Estimates				
	Parameter	**P-value**	**Lower CI**	**Lower CI**
um_smoking_yrs_n	2.6838***	0.0000	2.4794	2.8881

F-test for Poolability: 51.439
P-value: 0.0000
Distribution: F(66,113)

Random Effects Estimation Summary			
Dep. Variable:	Smoking attributable cases per 100k	R-squared:	0.4362
Estimator:	Random Effects	R-squared (Between):	0.7141
No. Observations:	1,196	R-squared (Within):	0.3634
Cov. Estimator:	Unadjusted	R-squared (Overall):	0.6860
Entities:	63	Log-likelihood:	-8015.6
Avg Obs:	18.984	F-statistic:	924.48
Min Obs:	1.000	P-value:	0.0000
Max Obs:	23.000	Distribution:	F(1,1195)
Time periods:	23		
Avg Obs:	52.000	F-statistic (robust):	924.48
Min Obs:	41.000	P-value:	0.0000
Max Obs:	63.000	Distribution:	F(1,1195)

Parameter Estimates				
	Parameter	**P-value**	**Lower CI**	**Lower CI**
um_smoking_yrs_n	3.0375 ***	0.0000	2.8415	3.2335

F-test for Poolability: 51.439
P-value: 0.0000
Distribution: F(66,1132)

Table A.2: Projection of attributable healthcare costs for smoking

Year	Smoking attributable healthcare costs
2023	€ 12.3 bn
2024	€ 12.9 bn
2025	€ 13.5 bn
2026	€ 14.1 bn
2027	€ 14.7 bn
2028	€ 15.3 bn
2029	€ 15.9 bn
2030	€ 16.5 bn
2031	€ 17.0 bn
2032	€ 17.6 bn
2033	€ 18.1 bn
2034	€ 18.7 bn
2035	€ 19.2 bn