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Unraveling Gender Disparities in Health: A Comparative Perspective

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The text of chapter 2 of this dissertation, in full, is a reprint of the material as it appears in "Gender, Tobacco Control Policies, and Persistent Smoking Among Older Adults: A Longitudinal Analysis of 11 European Countries" in the August 2022 edition of *Nicotine and Tobacco Research*. The co-authors Chioun Lee and Soojin Park listed in that publication directed and supervised the research that forms the basis for Chapter 2 of this dissertation. I am grateful to Jizzo R. Bosdriesz for providing data on TCS and to Dana A. Glei and Matthew C. Mahutga for their suggestions on early versions of methodological approaches in this manuscript. This work was supported by grants from the National Institute on Aging of the US National Institutes of Health [grant number R00AG052458].

The text of chapter 3 of this dissertation, in full, is a reprint of the material as it appears in "Social Participation and Persistent Smoking Among Older Chinese with Smoking-related Morbidity" in the May 2023 edition of *The Journals of Gerontology: Series B*. The co-authors Soojin Park and Chioun Lee listed in that publication directed and supervised the research that forms the basis for Chapter 3 of this dissertation.

ABSTRACT OF THE DISSERTATION

Unraveling Gender Disparities in Health: A Comparative Perspective

by

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Since the 1980s, research on gender disparities in health has grown significantly (Read & Gorman, 2010). Recent studies call for moving beyond individual-level factors and exploring the broader influence of macro-level structural differences. Adopting a comparative perspective, this dissertation investigates the sociocultural contexts of gender disparities in two health outcomes: persistent smoking and depression. It consists of three empirical chapters that shed light on these issues.

Chapter 2 explores gender disparities in persistent smoking among older Europeans. It reveals that older European women are more likely to be persistent smokers than men. The chapter also highlights the gendered effects of social determinants of health, with a stronger inverse association between education and persistent smoking among women. Additionally, it uncovers how seemingly gender-neutral tobacco control policies have differential effects on persistent smoking based on gender and socioeconomic status.

Chapter 3 extends the investigation to China, examining how sociocultural factors shape persistent smoking among older Chinese adults. In contrast to Europe, Chinese older

women exhibit a slightly lower prevalence of persistent smoking than men, possibly due to the gendered norms of smoking in China. Moreover, the results show that overall social participation is associated with increased risks of persistent smoking in China, which differs from patterns observed in Europe. Additionally, the association between social participation and smoking differs across different forms of activity. This chapter highlights that social gradients of health can be context-specific.

Chapter 4 combines a life course perspective with an institutional approach to understand the gender gap in depression. The findings demonstrate that women are more vulnerable to low childhood socioeconomic status. Importantly, this gendered vulnerability varies across gender regimes. That is, the gender gap is more pronounced in gender regimes characterized by higher levels of gender inequality (traditional and contradictory regimes), while it is absent in regimes with greater gender equality (dual-earner and market-oriented regimes).

Overall, this dissertation contributes to the understanding of gender disparities in health by considering sociocultural contexts and macro-level factors. It emphasizes the importance of these contextual factors in shaping health and highlights the variations in gender disparities across different regions and institutional contexts.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1 : Introduction

Since the early to mid-1980s, researchers have increasingly focused on investigating gender disparities in health (Read & Gorman, 2010). By now, abundant evidence has been accumulated to show the presence of gender differences in health. Although a consistent and evident pattern emerges regarding the gender difference in mortality, with women generally outliving men in developed countries, gender disparities in morbidity are more complex than those observed for mortality (Read & Gorman, 2010). On one hand, men are more susceptible to life-threatening conditions and engage in behaviors that are detrimental to their health, such as smoking. On the other hand, women are more prone to chronic conditions and mental health issues like depression (Read & Gorman, 2010; Piccinelli & Wilkinson, 2000).

Several explanations have been proposed to elucidate the gender disparities in health, including biological, psychological, and behavioral characteristics and conditions that differentiate the experiences of men and women (Read & Gorman, 2010). While biological differences account for some of the gender disparities, they fail to account for the variations observed over time and among different subgroups. Therefore, sociological studies have delved into investigating the social factors that shape behaviors, social roles, and available resources for both genders. This research often revolves around identifying individual-level factors that contribute to differential health outcomes for men and women, such as the gender gap in socioeconomic status and other "fundamental causes" of health inequality (Link & Phelan, 1995; Phelan et al., 2004).

While individual-level research has significantly contributed to understanding gender disparities in health, recent scholarship has called for a shift from individual-level analysis towards contextualizing gender disparities in health research (Borrell et al., 2014; Homan, 2019; Lynch, 2023; Read & Gorman, 2010). Instead of being solely an attribute of individuals, gender is a multilevel social system of difference and inequality (Homan, 2019). Recognizing that individuals are embedded within broader social, cultural, and political contexts that shape their health status (Dodoo & Frost, 2008), this line of research focuses on macrosocial determinants of health to illustrate how structural and institutional factors contribute to gender disparities in health (Borrell et al., 2014; Homan, 2019). For example, Bird and Rieker (2008) introduced the "constrained choices" multi-level framework to explain gender differences in health, which highlights that personal health decisions and outcomes of individuals are influenced and shaped by broader contexts and various social policies. By examining these larger structural factors, researchers aim to provide a more comprehensive understanding of the complex interplay between gender, structures, institutions, and health outcomes.

Inspired by the structural and institutional approach to gender disparities in health, this dissertation seeks to contextualize the gender difference in health by examining various sociocultural contexts of gender and health. Adopting a comparative perspective, this study aims to identify macro-level factors that contribute to gender disparities in health.

Specifically, the focus is on two distinct health outcomes: persistent smoking and depression. Persistent smoking is defined as the continuation of smoking despite having

smoking-attributable chronic diseases (Gao et al., 2022). While extensive research has documented a significant gender gap in smoking, with men being more likely to be current smokers compared to women (Waldron, 1991) and a gender difference in cessation of smoking, with women smokers less likely to quit smoking than men smokers (Smith et al., 2016), few studies explore the gender disparity in persistent smoking. This is concerning given that persistent smoking is a particularly harmful behavior associated with increased risks of morbidity and mortality (Stanton et al., 2016). Conversely, in the case of depression, the gender gap presents an opposite pattern. Consistent findings indicate that women are more likely to experience depression compared to men (Piccinelli & Wilkinson, 2000). By investigating the gender disparities in persistent smoking and depression, both of which exhibit distinct gender gaps, this dissertation attempts to understand the unique challenges and health implications faced by both men and women.

Chapter 2 investigates the associations between gender, education, tobacco control policies, and persistent smoking among older Europeans. Utilizing the theoretical framework of multilevel social determinants of health, this chapter explores individual-level factors and their interactions associated with persistent smoking. Drawing upon the resource substitution theory (Ross & Mirowsky, 2010), it argues the association between education and persistent smoking is stronger among women due to their marginalized social status and fewer available resources to employ for health compared to men. Furthermore, this chapter examines the institutional contexts that contribute to gender disparities in persistent smoking by highlighting the differential impact of tobacco control

policies on persistent smoking based on gender. While current studies on gender disparities in health often highlight the significance of broader gender systems, this chapter presents a different perspective by revealing that seemingly unrelated institutions and policies can still have a gendered impact, contributing to differential health outcomes between genders. It challenges the assumption that gender disparities in health are solely influenced by direct gender-related institutions, providing a broader understanding of the complex interplay between gender, institutions, and health outcomes.

In Chapter 3, the investigation of the gender difference in persistent smoking extends to China, a unique sociocultural context with a gendered pattern of smoking. This chapter focuses on how structural, institutional, and sociocultural factors, such as high exposure to smoking environments among men, easy access to cigarettes, insufficient knowledge of the health risks of smoking, insufficient guidelines for smoking cessation treatment from health providers, and gender norms of smoking, shape older Chinese men and women's behavior of persistent smoking. Moreover, the chapter underscores the importance of considering contexts, as the relationship between individual-level traits (social participation) and persistent smoking exhibits a distinct pattern in China compared to other developed countries like Europe and the United States, suggesting that individual-level determinants of health may vary across different sociocultural contexts. By examining the unique sociocultural context of China, the chapter contributes to a more comprehensive understanding of the complexities of gender differences in persistent smoking and emphasizes the significance of contextual factors in shaping health behaviors.

In Chapter 4, the focus shifts to the gender gap in depression. Taking a life course perspective (Elder et al., 2003; Kuh et al., 2003), this chapter traces the gender difference in depression back to childhood and investigates whether women have a greater vulnerability to adverse childhood socioeconomic status than men, contributing to the gender gap in depression during later life stages. Moreover, this chapter added to recent research that integrates the life course framework with an *institutional approach* to health by bringing a gender perspective (e.g., Anderson et al., 2023). It examines how broader structural inequalities that characterize gender systems, exemplified by various forms of gender regimes, may ameliorate or exacerbate the gender gap in vulnerability to adverse childhood socioeconomic status. By highlighting the importance of considering the differential vulnerability of childhood circumstances by gender, this chapter sheds light on how the gender difference in the long-term effects of adverse childhood socioeconomic status varies across contexts and is conditioned by macro-level gender institutions. These institutions shape the distribution of life-course opportunities and resources along gender lines, ultimately contributing to gender disparities in depression.

Overall, this dissertation contributes to the existing literature on gender disparities in health by contextualizing the association between gender and health. It elucidates the gendered impacts of seemingly non-gender-related policies, underscores the contextual differences in individual-level determinants of health, and uncovers the role of macro-level gender institutions in contributing to the gender difference in the long arm of childhood on health. By uncovering the contextual factors that contribute to gender disparities in persistent smoking and depression, this research aims to inform targeted

interventions and strategies at a more systematic level to address the specific health needs of both men and women.

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Chapter 2 : Gender, Tobacco control policies, and persistent smoking among older adults: A longitudinal analysis of 11 European countries

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Abstract

Introduction Little is known about sociodemographic and macro-level predictors of persistent smoking when one has developed a health condition that is likely caused by smoking. We investigate the impact of gender, education, and tobacco control policies (TCPs) on persistent smoking among older Europeans.

Methods Respondents (aged 50 +) with a smoking history and at least one smoking-related health condition were pooled from the Survey of Health, Aging and Retirement in Europe (SHARE) and the English Longitudinal Study of Ageing (ELSA) from four waves from 2004 to 2013. We fitted gender-specific logistic regression models with two-way fixed effects (country and year) and tested interaction terms between gender, education, and TCPs.

Results Although women are less likely to smoke than men, they were more likely to smoke persistently. The effects of education and general TCPs on persistent smoking were significant for women only. Compared to women with low levels of education, those with moderate education (odds ratio [OR] = .63; .49–.82) and high education (OR=.57; .34–.98) are less likely to be persistent smokers. TCPs are associated with a

reduced risk of women's persistent smoking (OR = .70, .51–.95) and the association is stronger for those having less education.

Conclusions Older women, particularly those with low levels of education, are vulnerable to persistent smoking. TCPs might be effective in reducing persistent smoking for older women, with greater effects for less-educated women. Future studies are needed to understand mechanisms that explain gender differences in responsiveness to TCPs.

Implications

Persistent smoking is a particularly harmful smoking behavior as it is associated with greater risks of comorbidity and mortality. By employing the framework of the multilevel social determinants of health, this study examined the behavior of persistent smoking among older adults in European countries. Women, especially women with low levels of education are vulnerable to persistent smoking. Moreover, tobacco control policies, in general, are significantly related to a reduction in persistent smoking among older women only and the negative association is stronger for those having less education, indicating gender and socioeconomic differences in responsiveness to tobacco control policies.

Keywords: Persistent smoking, Older adults, Gender, Education, Tobacco control policies

Introduction

Despite decades of progress in curbing tobacco use, smoking causes more than eight million deaths per year worldwide (World Health Organization, 2017). The causal association between smoking and several health conditions (e.g., coronary heart disease [CHD], lung cancer) has been well established (U.S. Department of Health and Human Services, 2014). Quitting smoking reduces the risk of developing cardiovascular disease, stroke, and cancer (U.S. Department of Health and Human Services, 2020), yet a substantial proportion of individuals, for example 21% of CHD patients, continue to smoke despite having developed smoking-related conditions (referred to as persistent smoking) (Lee et al., 2020). Persistent smoking is associated with expedited disease progression, worsening outcomes, increased complication rates, and reduced treatment compliance; those who smoke persistently, therefore, are likely to have a greater risk of comorbidity and mortality (Siddiqi et al., 2013). Given the high prevalence and lethality of persistent smoking, more work is needed to facilitate smoking cession interventions among people who persistently smoke. Yet, we have little knowledge about the social determinants that are associated with the risk of persistent smoking.

Previous studies suggest that gender is associated with various characteristics of smoking. For example, compared to men, women are less likely to smoke, but among people who currently smoke, men are more likely to quit smoking (Smith et al., 2016; World Health Organization, 2010). Few studies, thus far, have investigated gender differences in persistent smoking, and previous findings are mixed. Some studies demonstrate that, after being diagnosed with health conditions, the continuation and

relapse of smoking are more common among women than men (Lee et al., 2020), some find a null effect of gender (Rahman et al., 2016), and others report the opposite effect (Fu et al., 2017). In addition to gender, education is a well-known predictor of smoking initiation, cessation, and relapse (Hiscock et al., 2012). Further, prior studies have shown that low levels of education are associated with elevated risk of persistent smoking (Lee et al., 2020). When confronted with emerging health conditions, those with higher levels of education are more likely than their less-educated counterparts to make and adhere to health behavior changes, such as smoking cessation and physical activity participation, perhaps because they are better able to adapt to new health information (Margolis, 2013).

How gender plays a role in the association between education and persistent smoking is an open question. Resource substitution theory suggests that education has a greater influence on health for marginalized groups (e.g., women) than for more advantaged social groups (e.g., men) as the former may have fewer alternative resources to rely on (Ross & Mirowsky, 2010). Further, women, particularly highly educated women, are more likely to participate in health preventive behaviors, such as annual routine physical exams, screenings, and seeking out health information (Deeks et al., 2009; Ek, 2015). Therefore, we expect a stronger inverse association between education and persistent smoking among women than men. Thus far, only one study that we are aware of has found a significant gender difference in the association between education and smoking cessation after a hypertension diagnosis, with a larger effect for women than men (Hernandez et al., 2018). However, this study was conducted in the U.S. context and whether this finding is robust in other cultural and societal settings is unknown.

Few studies have examined how macro-level social context may influence persistent smoking. Constrained choice theorists argue that individuals' decisions and priorities concerning health are influenced by social context (Bird & Rieker, 2008). In the case of smoking, previous studies have suggested an important impact of tobacco control policies (TCPs) on smoking, such as cessation, intensity, and prevalence (Bosdriesz et al., 2016; Serrano-Alarcón et al., 2019). To our knowledge, only one study has found that smoking restriction policies in public places increase the likelihood of quitting among patients who smoke (Fu et al., 2017), yet whether this finding from rural western China is transferable to other societies is questionable. Moreover, focusing on smoke-free policies in public spaces may overlook other TCPs, such as price policies and advertisement regulations, as TCPs contain multi-dimensional policy efforts. Following prior work demonstrating the heterogeneous effects of TCPs across socioeconomic groups (Bosdriesz et al., 2016; Serrano-Alarcón et al., 2019), we investigate whether TCPs contribute to a narrowing or widening of socioeconomic inequalities in persistent smoking.

Given that the development of chronic illnesses is common in midlife through old age, smoking cessation at older ages, particularly those with chronic diseases, can bring significant gains in life expectancy and quality of life(Serrano-Alarcón et al., 2019), for example, a 36% risk reduction in mortality in patients with established CHD (Critchley & Capewell, 2000). Using older adults in Europe where various TCPs have been introduced in recent decades, this study has four aims: testing for (1) gender differences in the risk of persistent smoking among older adults, (2) whether education has an impact on persistent

smoking and whether the effect varies across gender, (3) whether TCPs are inversely associated with persistent smoking, and (4) the extent to which the association between TCPs and persistent smoking varies by education and gender.

Data and Methods

Data

We pooled data from two harmonized longitudinal studies on aging: the Survey of Health, Ageing and Retirement in Europe (SHARE), and the English Longitudinal Study of Ageing (ELSA). 20 The two surveys provide cross-national comparisons in Europe. In each survey, nationally representative samples of households with individuals aged 50 and over were drawn and information was collected from all age-eligible residents from the household and their spouses regardless of age. Detailed descriptions of SHARE and ELSA can be found elsewhere (Börsch-Supan et al., 2013; Steptoe et al., 2013).

Since not all waves include questionnaires related to smoking, we selected the survey waves that contain information on smoking. For SHARE, we used waves 1 (2004–05), 2 (2006–07), 4 (2010–11), and 5 (2012–13) for the 10 countries which participated in all four waves: Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Spain, Sweden, and Switzerland. For ELSA, corresponding waves were included, which were waves 2 (2004–05), 3 (2006–07), 5 (2010–11), and 6 (2012–13). We included respondents aged 50 years and older who participated in the baseline wave (2004–05) plus at least one other wave to obtain a longitudinal sample while preserving the most sample size. The pooled sample included 25,845 respondents and 84,266 observations. 3.7 % of respondents had missing values for at least one of the variables of

interest due to item-specific non-response or missingness in survey weight (N=961, N of observations [Nobs.] =3,220). After we restricted our sample to those with a smoking history and at least one of various smoking-related health conditions over at least two observational periods, 0.5 % of data was missing. We conducted complete data analysis since with less than 1 % of the missing rate the bias due to listwise deletion is minimal (Scheffer, 2002). After listwise deletion, we had 24,716 observations for 8,231 respondents in our final longitudinal sample. For detailed information, see Figure 1 and analytic strategy below and Table S1 in supplementary materials.

[Figure 1 about here]

Measures

Dependent variable

To identify individuals who smoke persistently, we followed the logic developed by previous studies (Edwards et al., 2007; C. Lee et al., 2020). We used the three-stage process depicted in Figure 1. First, we obtained smoking status through a question asking whether the respondent had ever smoked cigarettes. We restricted our sample to those with a smoking history (Stage 1 of Figure 1). Next, among individuals who self-reported as people who ever smoked, we identified those who had ever been diagnosed by doctors with at least one of the following conditions which may be exacerbated by smoking: high blood pressure, diabetes, cancer, lung disease, heart problems, or stroke (Stage 2). Last, we identified people who smoke persistently as respondents who had a smoking history and smoking-related health conditions but indicated that they were currently smoking (Stage 3).

Explanatory variables

Education is commonly used as a measurement of socioeconomic status. Given the differences in education systems across countries, we used a harmonized categorical variable derived from the International Standard Classification of Education (ISCED)-97 codes to standardize the educational level across countries by categorizing into three groups: *low* (less than upper secondary education), *moderate* (upper secondary education or vocational training), and *high* (tertiary education). **TCPs.** TCPs were measured by the tobacco control scale (TCS)(Bosdriesz et al., 2016; Serrano-Alarcón et al., 2019). The TCS is an indicator that quantifies country-level TCPs across six domains: price of tobacco, smoke-free policies, budget for information campaigns, bans on tobacco advertising, health warning labels, and cessation support. It ranges from 0 to 100, with higher scores indicating a higher degree of tobacco control. The scale was developed by Joossens and Raw in 2005 (Joossens & Raw, 2006). To ensure that the scores are comparable across years, we used the recalibrated scores calculated by Bosdriesz and colleagues (Bosdriesz et al., 2016; Serrano-Alarcón et al., 2019). The TCS contains policies that had already been established at the beginning of each year (Serrano-Alarcón et al., 2019). To establish a temporal order between TCPs and smoking status in each country, the TCS scores prior to the survey period were assigned by country to all respondents from that country. The TCS scores for 2004, 2006, 2010, and 2012 were assigned to survey respondents in waves 2004–05, 2006–07, 2010–11, and 2012–13, respectively. To examine the effect of different TCPs, we divided the TCS into three dimensions following previous studies: pricing policies, smoke-free policies, and other

TCPs (Serrano-Alarcón et al., 2019). The other policies include information campaigns, bans on advertisement, health warning labels, and cessation support to people who smoke.

Covariates

Consistent with previous research (C. Lee et al., 2020), we controlled for respondent's **marital status** (1 = partnered, married, or cohabitating; 0 = separated, divorced, widowed, or never married), **age** as a continuous variable, and **gender** for gender-stratified models.

Statistical analysis

For descriptive analysis, we calculated age-adjusted prevalence of persistent smoking per country by gender, to investigate the gender difference in persistent smoking (Aim 1). Next, to examine the association between the change in the TCS and the change in the prevalence of persistent smoking, we calculated Pearson's correlation coefficients and created a scatterplot. For the multivariate analysis, we conducted weighted logistic regression analysis with two-way fixed-effects (Wooldridge, 2010). In our dataset, each individual is nested within countries and individuals are repeatedly measured across different years. Multilevel models are commonly used for such data. However, this method was inappropriate for our analysis as the small cases at the country level could lead to downwardly biased standard errors for country-level predictors and cross-level interactions (Bryan & Jenkins, 2016). To obviate these methodological concerns, we used two-way fixed effects estimators, which control for time-invariant unobserved country characteristics (e.g., culture) and country-invariant unobserved wave effects (e.g.,

economic recession) (Wooldridge, 2010). We computed standard errors by clustering at both the individual and the country level to account for repeatedly measured individuals across different waves and within-country correlation of individuals (Cameron & Miller, 2015; Serrano-Alarcón et al., 2019).

The weighted logistic regression analysis with fixed effects was conducted in a stepwise approach. In Model 1, we regressed persistent smoking on education, controlling for country- and wave-fixed effects and other covariates (Aim 2). In Model 2, the TCS was added to analyze the association between TCPs and persistent smoking (Aim 3). In Model 3, in order to determine whether the association of TCPs with persistent smoking varies by education, we included a cross-level interaction between the TCS and education (Aim 4). All country-level predictors were standardized to have a mean of 0 and a standard deviation (SD) of 1 for ease of interpretation. The analysis was stratified by gender, and gender differences were tested by pooling data from both genders and testing gender interaction terms. All analyses were carried out using Stata version 16.0. Recently, some scholars have argued that the interpretation of the two-way fixed-effect coefficients is unclear (Kropko & Kubinec, 2020). Despite the argument, we decided to use the estimator since it is essential to account for country-fixed and time-fixed omitted variables in our analysis. For robustness check, we conducted country fixed-effect only models and found that the TCPs were marginally significant for women ($p < 0.1$). But other results remained essentially the same (see Table S2 in supplementary materials).

Attrition in longitudinal surveys can occur as a result of death, relocation, or non-response. Our findings will be biased if there are systemic differences between respondents who participated in the baseline wave only and those who followed up in at least one of the other waves. To adjust for potential attrition bias, we calculated inverse probability weights (IPW) (Serrano-Alarcón et al., 2019). First, we calculated the probability of responding in 2+ waves (baseline wave + at least one of the other three waves) based on the following covariates: age, gender, education, smoking status, TCS at the year 2004, self-reported health status, number of physical limitations and chronic conditions. Next, IPWs were gained by the inverse of the predicted probability of responding in 2+ waves. Last, these weights were multiplied by the cross-sectional weights from the 2004–05 wave. The cross-sectional weights are designed to recover the countries' population aged 50 years old or older at the baseline wave. The inverse probability longitudinal weights were applied to all descriptive and multivariate analyses.

Results

Table 1 shows the characteristics of our longitudinal sample and the age-adjusted prevalence of persistent smoking among men and women per country. On average, the rate of current smoking was higher for men than women, whereas the opposite pattern was found for persistent smoking (Prevalence of persistent smoking by each chronic condition, see Table S5). After controlling for all covariates, we found that women are more likely than men to engage in persistent smoking ($p < 0.001$, not shown in Table). Next, we examined the variation of the prevalence of persistent smoking and the variation of the TCS scores (Table S3) and observed a negative association between the change in

persistent smoking prevalence and the change in TCS (the Pearson's correlation = -0.47, see Figure S1).

[Table 1 about here]

Table 2 displays the results from two-way fixed effects logistic regression models to investigate the association between education, TCPs, and persistent smoking for men and women, after controlling for other covariates. In Model 1, we observed that education was inversely associated with the risk of persistent smoking only for women. For men, we found no significant effect of education. Specifically, the odds for women with moderate and high education engaging in persistent smoking were 37.0% (OR = 0.63, CI = 0.49–0.82) and 43.0% (OR = 0.57, CI = 0.34–0.98) lower than those with low levels of education. The results are illustrated in Figure S2 and the interaction between gender and education in the pooled sample was statistically significant ($p < 0.01$, see Model 1 in Table S4).

[Table 2 about here]

Model 2 shows that the association between the TCS and persistent smoking (after controlling for education) was not statistically significant for men but was significant for women (OR = 0.70, CI = 0.51–0.95). For women, after accounting for TCPs, education remained a significant predictor of persistent smoking. Model 3 displays the results of the cross-level interaction between the TCS and education. The interaction term was statistically significant for women. The negative association between the TCS and persistent smoking was weaker for women with moderate (OR = 1.22, CI =0.98–1.52, $p = 0.068$) and high education (OR = 1.60, CI = 1.18–2.17), compared to those with

low education, although this is only statistically significant for women with low education ($p < 0.01$) (see Figure S3). We tested the three-way interaction terms between education, gender, and the TCS, but the interactions were not significant (see Model 2 in Table S4).

Last, we examined the effects of different types of policies and whether these effects are heterogeneous according to individuals' education level and gender. The results are presented in Table 3. In Model 1, we tested the association between different types of TCPs and persistent smoking. In Model 2 to Model 4, we tested for interactions between education and each of the three policies (price policies, smoke-free policies, and other policies), respectively, while controlling for the other types of policies. For men, the effect of price policies was negative overall but varied by education. Controlling for smoke-free and other policies, an increase in price policies was significantly associated with a reduced probability of persistent smoking (Model 1a, OR = 0.82, CI = 0.75–0.89). Moreover, the association between the price policies and persistent smoking was stronger (i.e., less effect of the policies on smoking cessation) for men with high education (Model 2a OR = 1.29, CI =1.03–1.61), compared to those with low education. No significant difference was found between those with moderate education and high education.

For women, similar to men, an increase in price policies was significantly associated with a lower overall probability of persistent smoking (Model 1b, OR = 0.73, CI = 0.62–0.85). Smoke-free policies and other policies were negatively associated with the risk of persistent smoking and significant at the 90% confidence level. Besides, the significant interaction effect between other policies and education indicates that other

policies were associated with greater reduction of persistent smoking among women with low education, compared to women with moderate (Model 4b, OR = 1.34, CI = 1.14–1.58) and high education (Model 4b, OR = 1.80, CI = 1.25–2.60).

[Table 3 about here]

Discussion

Using a longitudinal sample of older Europeans (aged 50+) with a history of smoking and smoking-related health conditions from 11 countries, we investigated social determinants of persistent smoking. At the individual level, we replicated a finding in the existing literature of a gender difference in persistent smoking among older adults(Lee et al., 2020), and expanded its generalizability by employing a longitudinal sample from 11 European countries. We found that compared to older men, older women are at higher risk of persistent smoking. This gender difference in persistent smoking may be due to gender differences in smoking cessation (Smith et al., 2016). Psycho-pharmacological and social/environment contextual factors may play an important role in gender differences in smoking cessation (Smith et al., 2016). Such factors may include hormone variation (Weinberger et al., 2015), smoking cessation medication use (Smith et al., 2015), nicotine dependence (Smith et al., 2014), and gender pay gaps which constrain women's access to adequate healthcare (Redmond & McGuinness, 2019). Given that the risk of dying from many smoking-related diseases, such as lung cancer and cardiovascular disease, is greater for women than men even when exposed to the same level of tobacco exposure (Huxley & Woodward, 2011; Kiyohara & Ohno, 2010), women may encounter more problems from persistent smoking than men.

Our study also extends previous studies on education and smoking by investigating the association between education and a particularly harmful smoking behavior, i.e., persistent smoking. We found a gendered effect of education on persistent smoking. For women, consistent with previous studies on education and smoking, education was inversely associated with the probability of persistent smoking. Highly educated adults might be less likely to engage in persistent smoking as they have more economic and social-psychological resources to facilitate cessation (Phelan et al., 2010), better knowledge of the hazards of smoking (Montez & Zajacova, 2013), and more effective resources when attempting to quit (Reid et al., 2010). Further, previous research has shown that after health shocks such as receiving a disease diagnosis, highly educated individuals are generally more likely to change their health behaviors than those with less education (Hernandez et al., 2018). Our finding for women is consistent with these studies since those with lower levels of education were less likely to quit smoking, even when diagnosed with a smoking-related health condition. However, in elderly men, we did not observe such a clear pattern between education and smoking cessation, a finding that, while perplexing, is consistent with prior work using SHARE data (Trias-Llimós et al., 2017).

Consistent with resource substitution theory that sheds light on the role of education on health for marginalized groups (Ross & Mirowsky, 2010), our study showed that the association between education and smoking is stronger for women than men. These results may offer one explanation for the finding that there is a greater positive impact of education on health for women compared to men (Ross et al., 2012; Uccheddu

et al., 2019). Moreover, our results reveal that less-educated women are at a greater risk of persistent smoking, possibly because they have less knowledge and resources available to them to modify their smoking behaviors. Smoking may be an important coping mechanism for socioeconomically disadvantaged women. Qualitative research has shown that despite knowing the health risks of smoking, socioeconomically disadvantaged women view smoking as a way to relieve stress, socialize with others, and an affordable recreational activity (Stewart et al., 2011).

At the macro level, we found that the effects of TCPs were heterogeneous. For men, TCPs, in general, were not associated with persistent smoking, but for women, an inverse association was observed. Additional analysis disaggregating the TCPs into different types of policies showed a gendered responsiveness to various TCPs. Studies on the gendered responsiveness of TCPs are relatively rare and the results have been mixed, with some indicating that responsiveness to price policies is gendered and some indicating a null impact of gender (Borren & Sutton, 1992; Chaloupka, 1992; Farrelly et al., 2001). Our study contributes to this line of discussion by showing that gender, acting alone, influences the responsiveness to TCPs. Although price policies are effective means of preventing older men and women from engaging in persistent smoking, older men are not responsive to smoke-free and other policies. Smoke-free and other policies might matter more for older women if older women who engage in persistent smoking are more sensitive to smoking-related stigma promoted by TCPs than their male counterparts (Evans-Polce et al., 2015), they may be more likely to quit smoking (Helweg-Larsen et

al., 2020). Future studies are needed to understand the mechanisms of the gender difference in responsiveness to TCPs.

Consistent with previous studies (Serrano-Alarcón et al., 2019), we observed an equalizing effect of TCPs for persistent smoking. For men, consistent with previous studies (Kalousova et al., 2020), we observed a greater negative association between price policies and persistent smoking among men with low levels of education. For women, TCPs, in general, are more effective for those with low levels of education. The effect was driven by other policies, including information campaigns, bans on advertisement, health warning labels, and cessation support. There might be several reasons for this. First, as other TCPs spread more knowledge of the hazards of smoking, women with low education may obtain more knowledge of why they should quit smoking than highly educated women (who might be fully aware of the harms of smoking). Further, more cessation support services and interventions may be especially important for women with low levels of education, as they have limited access to services or resources for quitting smoking (Greaves & Hemsing, 2009; Stewart et al., 2010). For price policies and smoke-free policies, although the direction of coefficients indicates that these policies have greater effects for women with low levels of education, the interactions did not reach statistical significance, possibly due to insufficient sample size.

Limitations

There are several limitations to our study. First, one should be cautious about making causal statements regarding the relationships between TCPs and persistent smoking. There is a possibility that the implementation of TCPs may be driven by

national societal attitudes towards smoking (Serrano-Alarcón et al., 2019). To reduce the possibility of such reverse causality, we used the policy scores before the current smoking status was observed to establish a temporal order between the implementation of policies and persistent smoking. Further, we controlled for all unobserved time-invariant country differences and country-invariant year differences by including country- and year-fixed effects through a longitudinal design. However, we could not rule out the possibility that there still remains confounding that may vary across countries and years.

Second, the limited number of observations at the country level may undermine the robustness of findings at the country level. We addressed the small sample size at the country level by pooling data across different waves, yet we cannot generalize our findings to other European countries or other contexts since countries in our sample were not randomly selected from all European countries. Future studies should replicate our analysis in other aging societies such as the U.S. and other developed countries to investigate whether TCPs reduce the risk of persistent smoking among older adults.

Third, there might be large heterogeneity among those who ever smoked with at least one smoking-related chronic condition. In particular, among those who smoked formerly, the duration of smoking before having chronic conditions might vary (e.g., one year vs. 25 years). Timing of disease development might potentially affect an individual's decision to resume or continue smoking in later life. Due to no information on the timing of disease development, our analysis does not take such heterogeneity into account.

Policy implications

Our results show that TCPs in general have the potential to reduce the risk of persistent smoking among women but not men. Decomposing policies further shows a gendered responsiveness to different types of policies. While price policies are significantly associated with lower risks of persistent smoking among both genders, smoke-free and other policies seem to be effective only among women. Further, the stronger association between price policies and persistent smoking among less-educated men, and the greater association between overall TCPs and persistent smoking among less-educated women suggest that tobacco control policies may also contribute to decreasing the adverse effect of social inequality on population health. The design of TCPs should take into account gender and socioeconomic differences, as responsiveness to particular TCPs may differ across sociodemographic groups.

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Tables and Figures

Table 2.1 Characteristics of the study population and prevalence of persistent smoking in the sample

			Age-adjusted Current smoking (%)		Age-adjusted persistent smoking prevalence (%)		Women (%)	Age		Education (%)		
	N	$N_{obs.}$	Men	Women	Men	Women		mean	SD	Low	Moderate	High
Austria	235	659	18.4	15.0	31.5	46.7	37.0	67.4	0.4	29.5	45.5	25.0
Belgium	895	2,660	19.5	11.2	24.3	35.4	32.3	68.5	0.2	49.7	27.5	22.8
Denmark	502	1,498	27.4	24.2	36.0	37.6	48.7	68.7	0.3	27.5	46.0	26.6
France	537	1,586	17.4	10.1	22.8	36.6	28.3	68.4	0.3	43.6	31.7	24.7
Germany	468	1,292	19.8	14.2	28.1	38.3	39.4	66.6	0.3	12.0	58.2	29.8
Italy	546	1,678	21.9	13.3	30.9	42.7	30.8	68.3	0.3	71.1	23.0	6.0
Netherlands	697	2,045	22.9	19.4	26.7	36.1	42.9	67.9	0.2	56.7	25.3	18.1
Spain	417	1,222	21.9	7.4	26.5	43.0	14.6	69.0	0.3	80.6	9.1	10.3
Sweden	738	2,069	11.9	17.7	17.0	31.1	45.0	68.6	0.2	54.3	27.3	18.3
Switzerland	182	543	23.7	18.0	39.6	41.3	40.9	68.8	0.4	50.0	41.1	8.5
UK	3,014	9,464	13.6	13.7	18.2	22.4	45.6	70.9	0.1	48.8	40.3	10.9
Total	8,231	24,716	20.2	12.7	27.5	38.9	32.3	68.0	0.1	48.8	32.8	18.4

NOTES: Statistics except for current smoking are based on respondents who were aged 50 years and older, with a smoking history and at least one of the following smoking-related health conditions. All the descriptive statistics were calculated using inverse probability longitudinal weights. The age-adjusted current smoking is from respondents who were aged 50 years and older.

Table 2.2 Estimates (Odds Ratio, 95% CI) for two-way fixed effects models predicting persistent smoking for men and women

Persistent Smoking	Men ($N_{obs.}$ = 14,705)			Women ($N_{obs.}$= 10,011)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Low education (ref.)	--	--	--	--	--	--
Moderate education	1.12	1.12	1.03	0.63***	0.63***	0.69*
	(0.77 - 1.62)	(0.77 - 1.62)	(0.75 - 1.40)	(0.49 - 0.82)	(0.49 - 0.82)	(0.49 - 0.97)
High education	0.94	0.94	1.09	0.57*	0.57*	0.73#
	(0.77 - 1.14)	(0.77 - 1.14)	(0.88 - 1.34)	(0.34 - 0.98)	(0.33 - 0.98)	(0.50 - 1.06)
TCS		0.93	0.93		0.70*	0.62**
		(0.74 - 1.16)	(0.73 - 1.19)		(0.51 - 0.95)	(0.45 - 0.86)
TCS × moderate education			0.88			1.22#
			(0.58 - 1.35)			(0.98 - 1.52)
TCS × high education			1.23			1.60**
			(0.95 - 1.61)			(1.18 - 2.17)
Age	0.94***	0.94***	0.94***	0.95***	0.95***	0.95***
	(0.93 - 0.96)	(0.93 - 0.96)	(0.93 - 0.96)	(0.94 - 0.96)	(0.94 - 0.96)	(0.94 - 0.96)
Partnered	0.59**	0.59**	0.58**	0.58***	0.58***	0.58***
	(0.42 - 0.83)	(0.42 - 0.83)	(0.41 - 0.83)	(0.49 - 0.68)	(0.49 - 0.68)	(0.49 - 0.68)

NOTES: *** p<0.001, ** p<0.01, * p<0.05, # p<0.1 (two-tailed tests).

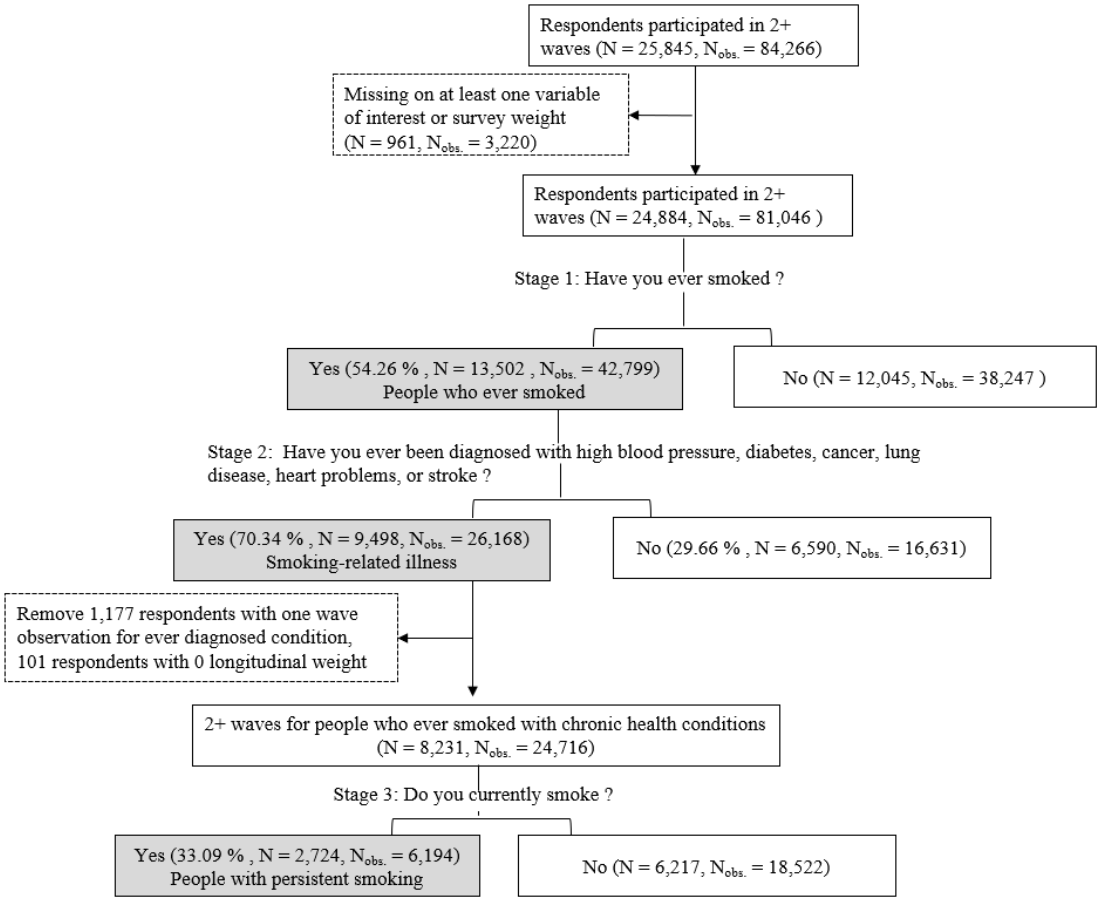
Table 2.3 Estimates (Odds Ratio, 95% CI) for two-way fixed effects models predicting persistent smoking with types of TCPs

Persistent Smoking	Men ($N_{obs.}$ = 14,705)				Women ($N_{obs.}$ = 10,011)			
	Model 1a	Model 2a	Model 3a	Model 4a	Model 1b	Model 2b	Model 3b	Model 4b
Low educ (ref.)	--	--	--	--	--	--	--	--
Moderate educ	1.12	1.11	1.11	0.74	0.63***	0.65*	0.63**	0.77#
	(0.77 - 1.63)	(0.73 - 1.69)	(0.76 - 1.61)	(0.50 - 1.09)	(0.49 - 0.82)	(0.46 - 0.93)	(0.47 - 0.84)	(0.57 - 1.05)
High educ	0.94	1.02	0.95	0.96	0.57*	0.63#	0.58*	0.88
	(0.77 - 1.15)	(0.93 - 1.13)	(0.76 - 1.19)	(0.70 - 1.32)	(0.33 - 0.98)	(0.39 - 1.00)	(0.37 - 0.90)	(0.49 - 1.58)
TCS price	0.82***	0.82***	0.85**	0.77***	0.73***	0.70***	0.76***	0.74***
	(0.75 - 0.89)	(0.74 - 0.91)	(0.76 - 0.94)	(0.66 - 0.89)	(0.62 - 0.85)	(0.61 - 0.80)	(0.67 - 0.87)	(0.64 - 0.85)
TCS smoke free	0.91	0.91	0.89*	0.88	0.86#	0.86#	0.82#	0.87
	(0.79 - 1.04)	(0.78 - 1.05)	(0.81 - 0.98)	(0.74 - 1.06)	(0.73 - 1.02)	(0.73 - 1.02)	(0.66 - 1.01)	(0.74 - 1.03)
TCS other	1.12	1.13	1.11	1.40	0.83#	0.83#	0.84	0.69*
	(0.93 - 1.35)	(0.93 - 1.36)	(0.91 - 1.36)	(0.93 - 2.10)	(0.68 - 1.03)	(0.67 - 1.03)	(0.67 - 1.04)	(0.52 - 0.92)
Age	0.94***	0.94***	0.94***	0.94***	0.95***	0.95***	0.95***	0.95***
	(0.93 - 0.96)	(0.93 - 0.96)	(0.93 - 0.96)	(0.93 - 0.96)	(0.94 - 0.96)	(0.94 - 0.96)	(0.94 - 0.96)	(0.94 - 0.96)

Partnered	0.59** (0.42 – 0.83)	0.59** (0.42 - 0.83)	0.59** (0.42 - 0.83)	0.58** (0.41 - 0.82)	0.58*** (0.49 - 0.68)	0.58*** (0.49 - 0.67)	0.58*** (0.49 - 0.68)	0.58*** (0.49 - 0.68)
TCS price × moderate educ		0.95 (0.68 - 1.32)				1.09 (0.78 - 1.52)		
TCS price × high educ		1.29* (1.03 - 1.61)				1.44 (0.93 - 2.23)		
TCS smoke free × moderate educ			1.03 (0.77 - 1.37)				1.09 (0.91 - 1.29)	
TCS smoke free × high educ			1.14 (0.96 - 1.35)				1.22 (0.83 - 1.79)	
TCS other × moderate educ				0.53* (0.29 - 0.98)				1.34*** (1.14 - 1.58)
TCS other × high educ				0.84 (0.54 - 1.30)				1.80** (1.25 - 2.60)

NOTES: *** p<0.001, ** p<0.01, * p<0.05, # p<0.1 (two-tailed tests). Education is denoted as educ.

Figure 2.1 Sequential process to identify persistent smoking.



Supplementary materials

sTable 2.1 Countries, waves, and number of observations in the sample

Country			Survey period			
	N	$N_{obs.}$	2004–05	2006–07	2010–11	2012–13
Austria	235	659	176	195	147	141
Belgium	895	2,660	693	766	624	577
Denmark	502	1,498	372	409	369	348
France	537	1,586	423	425	394	344
Germany	468	1,292	361	384	309	238
Italy	546	1,678	402	454	416	406
Netherlands	697	2,045	531	549	500	465
Spain	417	1,222	304	317	306	295
Sweden	738	2,069	570	591	462	446
Switzerland	182	543	129	153	137	124
UK	3,014	9,464	2,504	2,552	2,328	2,080
Total	8,231	24,716	6,465	6,795	5,992	5,464

NOTES: In total, 24,716 observations from respondents who were aged 50 years and older, with a smoking history and at least one of the smoking-related health conditions.

sTable 2.2 Sensitivity analysis of Table 2: estimates (Odds Ratio, 95% CI) for only country-fixed effects models predicting persistent smoking for men and women

Persistent Smoking	Men ($N_{obs.}$ = 14,705)			Women ($N_{obs.}$ = 10,011)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Education						
Low education (ref.)	--	--	--	--	--	--
Moderate education	1.110 (0.763 - 1.616)	1.118 (0.771 - 1.622)	1.025 (0.749 - 1.403)	0.628*** (0.488 - 0.809)	0.634*** (0.493 - 0.815)	0.695* (0.499 - 0.967)
High education	0.930 (0.762 - 1.134)	0.935 (0.765 - 1.142)	1.085 (0.879 - 1.340)	0.567* (0.331 - 0.971)	0.574* (0.337 - 0.978)	0.735 (0.506 - 1.068)
TCS		0.920 (0.810 - 1.045)	0.922 (0.719 - 1.182)		0.865# (0.742 - 1.009)	0.752*** (0.643 - 0.880)
TCS × moderate education			0.882 (0.595 - 1.307)			1.235# (0.999 - 1.529)
TCS × high education			1.234# (0.985 - 1.547)			1.621** (1.195 - 2.199)
Age	0.941*** (0.930 - 0.953)	0.942*** (0.930 - 0.955)	0.942*** (0.930 - 0.955)	0.948*** (0.939 - 0.957)	0.950*** (0.943 - 0.957)	0.949*** (0.942 - 0.956)
Partnered	0.589** (0.416 - 0.832)	0.589** (0.417 - 0.832)	0.585** (0.411 - 0.831)	0.576*** (0.489 - 0.677)	0.580*** (0.496 - 0.679)	0.578*** (0.492 - 0.678)

NOTES: *** p<0.001, ** p<0.01, * p<0.05, # p<0.1 (two-tailed tests).

sTable 2.3 Prevalence of persistent smoking of the longitudinal sample per country and wave, and TCS change.

	Prevalence of Persistent smoking (%)					TCS change[c]	
	Wave 2004–05	Wave 2006–07	Wave 2010–11	Wave 2012–13	Absolute change[b]	Absolute	%
Austria	36.3 (29.3 ,43.9)	37.7 (30.9 ,45.0)	42.4 (34.5 ,50.9)	31.5 (24.1 ,40.0)	- 4.8	17	68
Belgium	29.7 (26.2 ,33.5)	28.4 (25.1 ,31.9)	28.5 (25.0 ,32.3)	24.7 (21.2 ,28.6)	-5	16	35
Denmark	44.6 (39.5 ,49.7)	38.4 (33.7 ,43.3)	33.6 (28.9 ,38.7)	29.7 (25.0 ,34.8)	-14.9	20	49
France	30.3 (26.0, 35.1)	27.8 (23.6 ,32.5)	25.9 (21.7 ,30.6)	22.2 (18.1 ,27.0)	-8.1	12	22
Germany	34.9 (29.6 ,40.6)	32.6 (27.6 ,38.0)	31.0 (25.6 ,36.9)	28.8 (23.0 ,35.4)	-6.1	18	64
Italy	40.2 (34.7 ,46.0)	36.7 (31.7 ,42.0)	35.3 (30.2 ,40.8)	25.5 (20.9 ,30.7)	-14.7	21	50
Netherlands	34.3 (30.1 ,38.9)	33.9 (29.6 ,38.4)	29.2 (24.9 ,33.8)	24.9 (20.7 ,29.7)	-9.4	9	19
Spain	38.9 (32.8 ,45.3)	30.8 (25.2 ,37.0)	25.2 (19.9 ,31.3)	21.4 (16.4 ,27.5)	-17.5	33	100
Sweden	26.3 (22.5 ,30.4)	21.5 (18.1 ,25.3)	24.3 (20.3 ,28.8)	21.4 (17.5 ,25.9)	-4.9	15	29
Switzerland	41.6 (33.1 ,50.5)	38.4 (30.8 ,46.6)	44.9 (36.6 ,53.5)	36.2 (27.9 ,45.4)	-5.4	25	81
UK	23.8 (22.1 ,25.6)	21.1 (19.5 ,22.9)	18.5 (16.9 ,20.2)	16.0 (14.4 ,17.8)	-7.8	26	41
Average[a]	35.6	32.4	30.5	25.3	-10.3	19	46

NOTES: Prevalence of persistent smoking was calculated using the weighted longitudinal sample. [a]Unweighted average of countries' prevalence. [b]Absolute change = wave 2012–13 prevalence – wave 2004–05 prevalence. [c]TCS change = TCS in 2012 – TCS in 2004

sTable 2.4 Estimates (Odd Ratio, 95% CI) of two-way fixed-effects logistic models predicting persistent smoking

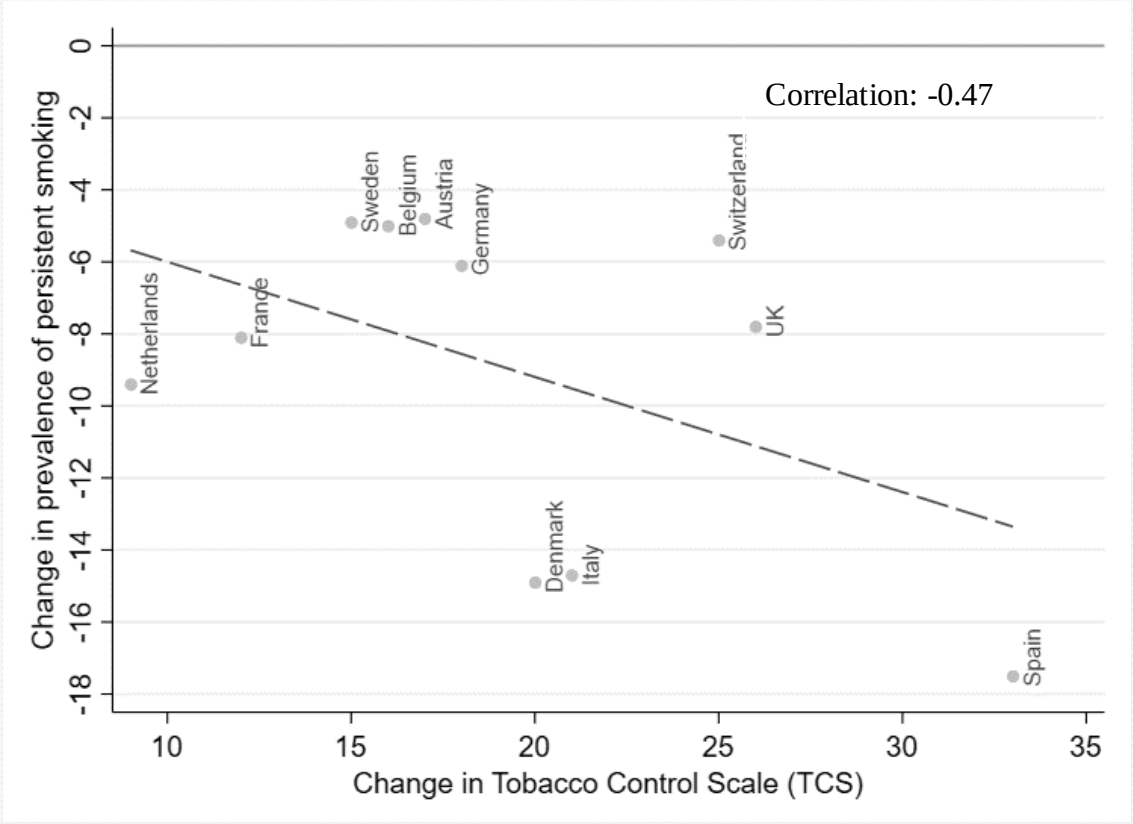
Persistent smoking	Model 1	Model 2
Education		
Low education (ref.)	--	--
Moderate education	1.126	1.030
	(0.819 - 1.548)	(0.764 - 1.389)
High education	0.928	1.072
	(0.730 - 1.179)	(0.884 - 1.300)
Women	2.013***	1.884***
	(1.599 - 2.536)	(1.660 - 2.137)
Women × moderate education	0.563**	0.672
	(0.366 - 0.867)	(0.390 - 1.157)
Women × high education	0.636**	0.713**
	(0.463 - 0.875)	(0.573 - 0.887)
TCS		0.863
		(0.695 - 1.072)
TCS × moderate education		0.892
		(0.624 - 1.276)
TCS × high education		1.242#
		(0.991 - 1.556)
TCS × women		0.859
		(0.615 - 1.199)
TCS × moderate education × women		1.355
		(0.798 - 2.300)
TCS × high education × women		1.313
		(0.849 - 2.031)
Age	0.945***	0.945***
	(0.938 - 0.953)	(0.937 - 0.953)
Partnered	0.578***	0.575***
	(0.454 - 0.736)	(0.450 - 0.735)

NOTES: ***p<0.001, ** p<0.01, * p<0.05 (two-tailed tests). Variables reported in the same column are included in the same regression. All models include country-fixed effects and year-fixed effects.

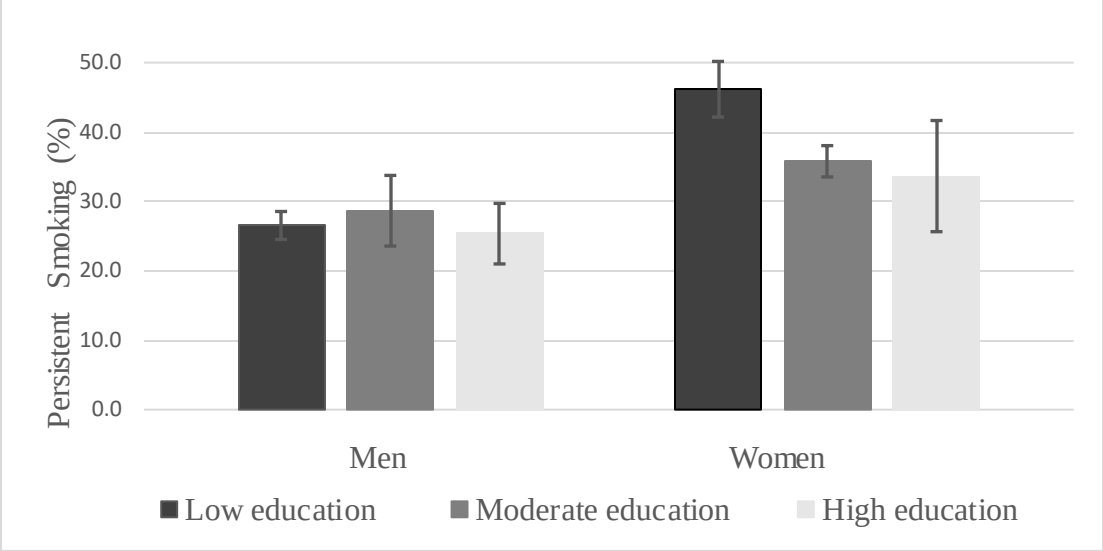
sTable 2.5 Prevalence of Persistent Smoking by Chronic Condition and Gender

	Men (%)	Women (%)
High blood pressure	25.19	37.62
Diabetes	26.68	37.82
Cancer	19.04	35.29
Lung disease	28.93	47.85
Heart problems	23.30	31.14
Stroke	23.45	32.32
1+ conditions	26.99	40.13
Multimorbidity (2+ conditions)	23.06	34.52

sFigure 2.1 Change in the prevalence of persistent smoking (wave 2012–13 – wave 2004–05) versus change in the Tobacco Control Scale (2012–2004)

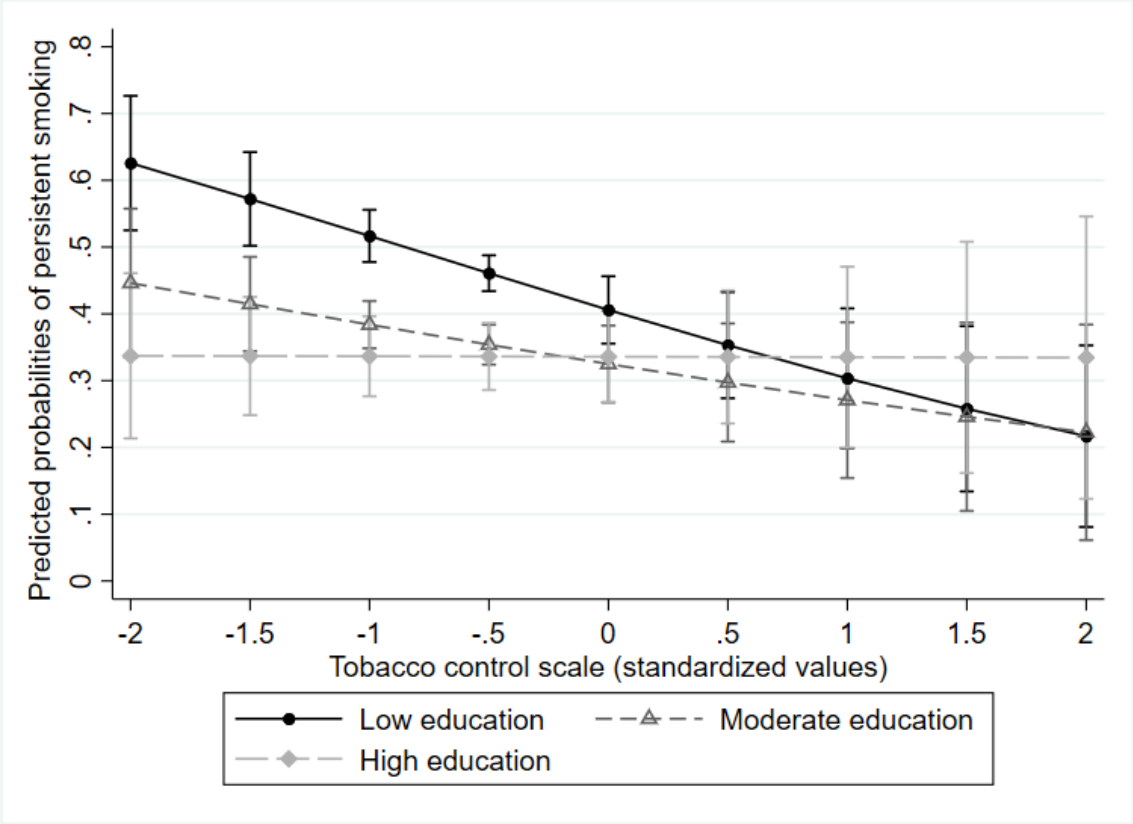


sFigure 2.2 Prevalence of persistent smoking by gender and education



NOTES: Adjusted for age, marital status, country-, and year-fixed effects. Based on Model 1 of Table 2.

sFigure 2.3 Effects of Tobacco Control Scales (TCS) on probability of persistent smoking by educational level for women



NOTES: Adjusted for age, marital status, the TCS, the interactions between education and the TCS, country-, and year-fixed effects. Based on Model 3 of Table 2.

Chapter 3 : Social Participation and Persistent Smoking Among Older Chinese with Smoking-related Morbidity

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Abstract

Objectives: Chronic diseases are common in midlife and old age and smoking can pose more health and longevity challenges for older people with chronic illnesses. In China where smoking is highly prevalent, older adults are likely to continue smoking even after developing severe chronic diseases. We examined the national prevalence of persistent smoking among older adults. We also investigated the sociodemographic characteristics of persistent smoking among ever-smokers with chronic diseases and its association with social participation (of various types).

Methods: We used data from a nationally representative sample of older adults aged 45–80 in the China Health and Retirement Longitudinal Study (CHARLS, 2011–2018). Multinomial logistic and multilevel logistic models were fitted.

Results: The national prevalence of persistent smoking was around 24% of older men and 3% of older women. Among those with a history of smoking and chronic illness, younger, non-married/partnered, non-retired, or less educated individuals are more likely to continue smoking. Social participation is significantly associated with persistent smoking among those with chronic diseases, but the association differs across different

forms of activities. While the most popular but sedentary activities in China (playing Mahjong, chess, or cards) are associated with an elevated risk of persistent smoking, physical social activities (community-organized dancing, fitness, and qigong) are associated with a reduced risk of persistent smoking.

Discussion: Given the enormous burden of persistent smoking on individuals and society, public smoking cessation inventions should address sociocultural factors of persistent smoking and target older adults who participate in specific social activities.

Keywords: Chronic Disease, Gender, Smoking, Social Interaction

Introduction

The numerous health hazards of smoking are well known (Patel et al., 2009), but a substantial proportion of individuals continues to smoke despite having smoking-attributable chronic diseases (Gao et al., 2022). Such individuals, referred to as persistent smokers, are at greater risk of comorbidities and premature death because smoking can accelerate disease progression, worsen treatment efficacy, and lead to higher complication rates (Stanton et al., 2016). Persistent smoking is particularly harmful to middle- and old-aged adults who are already at increased risk of smoking-related diseases, such as cardiovascular disease, chronic respiratory disease, and cancer (Doolan & Froelicher, 2008; Prasad et al., 2012; Shen et al., 2013). Yet, even among older adults with chronic disease, smoking cessation can contribute to improving life expectancy and quality of life (Gellert et al., 2012). Therefore, facilitating smoking cessation among older adults with smoking-related conditions should be a high priority for public health interventions. A growing body of literature has investigated persistent smoking among older adults in the U.S. and Europe (Gao et al., 2022; Lee et al., 2020). It has not been adequately explored in China, the world's largest producer and consumer of tobacco, which has a unique sociocultural context of smoking behaviors (Li et al., 2011). Our study aims to fill this research gap by investigating persistent smoking among middle- and old-aged Chinese adults and its sociocultural determinants.

High Smoking Prevalence and Large Smoking-Related Disease Burden in China

Since 2010, the Chinese government has put a growing emphasis on tobacco control as a public health policy. Despite some progress in the reduction of overall smoking, the

smoking prevalence in China remains high (28.69% in 2018 based on Zhang et al., 2022). China also has been encountering an enormous smoking-related chronic disease burden. Despite representing 18.5% of the global population, China accounts for nearly one-third of the annual global deaths caused by smoking (2.2 million out of 7.1 million) and secondhand smoke (0.4 million out of 1.2 million) in 2017 (Fong et al., 2021). The dire situation is compounded by the low quitting rate (4.4% per year) and high relapsing rate (13.3%) among smokers aged 45+ years old (Qiu et al., 2020).

A limited number of studies have investigated persistent smoking in China, and the findings consistently show a high prevalence of continued smoking among patients with chronic disease (Fu et al., 2017; Li et al., 2021; Liu et al., 2020). That is, the development of chronic diseases only has small effects on smoking cessation. For example, among male current smokers aged 50+, being diagnosed with myocardial infarction, diabetes, stroke, or hypertension increases the likelihood of quitting by less than 10 percentage points (Hu et al., 2021). Prior work, however, is based on clinical settings with patients who have a certain chronic disease and/or are limited to those living in narrow geographical areas. We have little knowledge of the overall prevalence of persistent smoking among older adults in China.

Structural and Institutional Factors, Social Norms, and Gendered Patterns of Smoking in China

Several structural and institutional factors have shaped the initiation and persistence of smoking among adults in China. Policy interventions designed to discourage smoking have been implemented since 2005, yet the government's tobacco control policies are

weak and not strongly enforced. At the national level, there is no smoking ban in public places (Yang et al., 2015). Cigarettes are highly affordable, with the cheapest cigarette only costing 0.40 USD per pack in 2015 (Nargis et al., 2019). And there is an insufficient provision of smoking cessation services. For example, the cost of smoking cessation treatments such as nicotine replacement therapy is not covered by the national medical insurance systems (Yang et al., 2015). The delivery of smoking cessation advice from doctors to patients is not common (Abdullah et al., 2013). Further, anti-smoking media campaigns are unspecific and presented in unattractive forms, resulting in low public awareness of the health risks of smoking (Sun et al., 2022).

The slow progress of tobacco control policies in China is largely due to political alliances between the tobacco industry and the government. As an indispensable part of the national economy, the state-owned tobacco industry is an important state asset and a major contributor to government tax revenue, employment, foreign exchange, and economic stability (Barnett et al., 2021). Thus, interference from the national tobacco industry may have dulled the implementation of anti-smoking policies in China (Barnett et al., 2021). In addition, foreign tobacco companies contribute to the high smoking prevalence by actively expanding their market share in China (Chu et al., 2011).

Last, smoking has been a deeply ingrained social activity in China, especially among adult men (Chuang & Chuang, 2008). Smoking with others is seen as a way of fostering and reinforcing social relationships (Saw et al., 2017). For most Chinese, cigarettes are indispensable for almost all social events such as weddings, funerals, and official activities (Yang et al., 2015). Specifically, cigarette gifts are often exchanged as a

social currency to gain more social capital and social benefits (Yang et al., 2022). Despite the tobacco control efforts made by the Chinese government, anti-smoking messages have not been effective among many older men; for example, lower awareness about smoking-related hazards in chronic diseases, such as stroke and heart attack (Zhang et al., 2019). Many older men may find the social benefits of smoking outweigh the health hazards (Hu et al., 2013; Zhang et al., 2019).

On the contrary, smoking among women is not socially acceptable. Notably, the prevalence of male smokers in China far surpasses that of female smokers, with 53.12% of men smoking, compared with 3.02% of women in 2018 (Zhang et al., 2022). For women, especially those in the older generation, smoking is associated with poor morals and is culturally unattractive (Hermalin & Lowry, 2012). For example, women who smoke are regarded as superficial, sexually immoral, hedonistic, and irresponsible wives and mothers (Hermalin & Lowry, 2012). A strong normative prohibition against women's smoking had taken hold in China by the late 1930s and thus holds for currently middle-aged and older Chinese adults (Hermalin & Lowry, 2012). In short, the gendered social norms of smoking in China situate men to smoke but frame it as deviant and highly stigmatized for women.

In sum, these structural and institutional factors—high exposure to smoking environments among men, easy access to cigarettes, low awareness of the health risks of smoking, and insufficient guidelines for smoking cessation treatment from health providers, all fostered by close ties between tobacco companies and the government—

may make it difficult for older adults in China to quit smoking, even those with smoking-related chronic diseases.

Social Determinants of Persistent Smoking in China

Although nicotine addiction explains why some individuals with adverse health conditions persist in smoking (Gao et al., 2022), research based on European countries and the United States highlights the importance of social factors. Yet, the social determinants of persistent smoking are not well understood in China. For example, these studies found that women and those with low socioeconomic status (SES) are more likely to be persistent smokers (Gao et al., 2022; Lee et al., 2020). Yet, SES and gender may operate differently in China, where smoking prevalence is extremely low among women, in part because of the strong stigma attached to women's smoking (Ma et al., 2013). Moreover, prior studies found inconsistent associations between smoking and various domains of SES (Wang et al., 2018). Although more educated individuals are less likely to smoke, income has a small or even insignificant association with the smoking patterns of Chinese adults (Wang et al., 2018). Further, smoking and chronic diseases disproportionally affect older adults living in rural China (Lee et al., 2019; Wang et al., 2015). Thus, research is needed on the rural-urban disparity in persistent smoking in China.

Social Participation and Persistent Smoking in China

As a process of socialization, social participation plays a role in harmonizing individuals' attitudes and behaviors with those of their socio-cultural milieu (Singh-Manoux & Marmot, 2005). In a collectivistic context like China where smoking is predominant,

social participation may increase the risks of persistent smoking, particularly among men, which is consistent with theories of the dark side of social capital, defined as the resources gained through social connections (Villalonga-Olives & Kawachi, 2017). Specifically, social participation, via social influence and social comparison, enables the collective to maintain the dominant social norms of smoking, which can increase social pressure to smoke for enhanced sociability. For example, greater levels of social participation have been associated with increased activities of offering and receiving gift cigarettes (Wu et al., 2022). Therefore, social participation may facilitate the exchange of misconceptions about smoking and its health-damaging impact.

In addition, social participation can increase individuals' exposure to smoking through behavior contagion, resulting in a greater risk of persistent smoking. Indeed, although social participation was found to be protective against current smoking in the United States and the United Kingdom (Giordano & Lindström, 2011; Lindström et al., 2003), the opposite pattern was observed in China (Luo et al., 2020). Further, different types of social activities may be related to persistent smoking differently. For example, sedentary social activities, such as playing Mahjong, often go hand in hand with smoking, especially among men. Consequently, playing Mahjong may impede smoking cessation and trigger relapse by exposing individuals to a smoking environment (Xie et al., 2020). In contrast, group activities related to physically more intensive exercise (e.g., participating in sports or leisure groups) are considered a viable approach to facilitating smoking cessation (Wen et al., 2021). Given the different nature of various social

activities (physical vs. sedentary), we further examine whether different types of social activities matter more or less in terms of persistent smoking.

Aims of the Present Study

To summarize, chronic illnesses are commonly developed in midlife and old age; thus, continuing to smoke can pose more health and longevity challenges for older people, particularly those with chronic illnesses. In China, older adults are exposed to unique sociocultural situations in terms of persistent smoking. Using a nationally representative dataset of middle-aged and older Chinese, our study is among the first to (a) investigate the national prevalence of persistent smoking among older adults, (b) identify the risk groups of individuals who smoke persistently even after developing chronic disease(s) in terms of their sociodemographic characteristics (gender, SES, and urban vs rural residence), and (c) investigate the extent to which social participation (of various types) is associated with elevated risks of persistent smoking among ever-smokers with chronic diseases.

Data and Methods

Data and Sample

Data come from the China Health and Retirement Study (CHARLS)—a longitudinal survey in China conducted with a nationally representative sample of individuals aged 45 and older as well as their spouses regardless of age (Phillips et al., 2021). Our study uses four waves of CHARLS (2011, 2013, 2015, and 2018) including both longitudinal and refresher samples (Zhao et al., 2020). We included refresher samples to maximize sample size and alleviate possible attrition bias and lack of representativeness of the population

(Deng et al., 2013). In total, 25,586 respondents were surveyed between 2011 and 2018. Given our study's focus on persistent smoking from midlife to old age, we restricted our sample to respondents aged 45 to 80 (N = 24,163, *N of observations [*$N_{obs.}$*]* = 71,374). Our main analysis (excepted Figures 1 and 2) is based on 6,767 respondents ($N_{obs.}$ = 15,421) who have a smoking history and at least one of various smoking-related health conditions. For detailed information including missing data, see the following analytic strategy and Supplementary Appendix 1 and Supplementary Figure 1.

Measures

Following the logic employed by previous studies (Gao et al., 2022; Lee et al., 2020), we identified individuals with persistent smoking based on the three-stage process illustrated in Supplementary Figure 1. First, we restricted our sample to respondents with a smoking history. Second, among ever smokers, we identified those who had ever been diagnosed by a doctor with at least one of the following chronic diseases that can be exacerbated by smoking: high blood pressure, diabetes, cancer (except minor skin cancers), chronic lung diseases, heart problems, stroke, or asthma. Last, respondents smoking persistently were defined as those who ever smoked and had at least one smoking-related health condition but reported that they were currently smoking.

In CHARLS, participants were asked to report whether they had participated in the following social activities in *the past month*: (a) interacting with friends; (b) playing Mahjong/chess/card games or attending a community club; (c) going to community-organized dancing, fitness, qigong, and so on; (d) participating in a community-related organization; (e) providing non-compensated help to families, friends or neighbors who

do not live with the respondent; (f) conducting volunteer or charity work. The responses to the previous questions were binary, with 1 indicating that the respondents engaged in a specific kind of social activity and 0 indicating no engagement. We also created a variable to measure overall social participation in the past month (1 = 1+ social activities, 0 = no participation).

Socioeconomic and demographic factors may affect persistent smoking and also confound the association between social participation and persistent smoking. Thus, we included two measures of SES. Financial status was measured by household expenditure per capita. This measure captures economic position better than household income in developing countries (Lei et al., 2014). We multiplied the original variable of each wave by the 2018 consumer price index to adjust for inflation and then applied the log transformation due to its skewed distribution (Lei et al., 2014). Education was measured as the highest level of education the respondent has attained, categorized into 1 = less than lower secondary education, 2 = upper secondary and vocational training, and 3 = tertiary education.

Consistent with previous studies (Lee et al., 2020), we controlled for: age (centered at age 45); gender (1 = women ; 0 = men); marital status, dichotomized as partnered, married, or cohabitating (= 1) versus non-partnered (separated, divorced, widowed, or never married = 0); retirement status (1 = retired ; 0 = engaging in agricultural work, non-agricultural employed work, non-agricultural self-employed work, non-agricultural unpaid family business work, unemployed, or never worked) and rural versus urban residence (1 = urban residence and 0 = rural residence). We also controlled

for wave (2011, 2013, 2015, or 2018) to account for period effects and the possibility that different periods of data collection might influence the results.

Statistical Method

To examine the national prevalence of persistent smoking among older adults aged 45–80 in China, we utilized the full sample (respondents aged 45–80) and employed multinomial logit models to calculate the age- and gender-adjusted national prevalence of persistent smoking as well as four other smoking statuses: (a) former smokers with at least one smoking-related chronic disease, (b) former smokers without such conditions, (c) current smokers with such conditions (i.e., persistent smoking), (d) current smokers without such conditions, and (e) individuals with no smoking history (nonsmokers), among older adults by waves, using each wave's cross-sectional data. The national prevalence of persistent smoking can help us understand how pervasive this particularly harmful smoking behavior is among older Chinese at the national level.

After describing the national prevalence of the five groups, we analyzed persistent smoking among the sub-sample of ever-smokers with 1+ chronic diseases, to identify risk groups within this population and facilitate smoking cessation. Descriptive analysis was conducted separately by gender across four waves. Using multilevel logistic regression models with the longitudinal data from all available waves, we then estimated the subject-specific associations between social determinants, social participation, and persistent smoking among ever-smokers with chronic diseases. Specifically, we used the variables of social participation and persistent smoking measured from the same waves. The temporal order between the two measures of social participation and persistent

smoking can be established in some cases because participants were asked to report their social participation in the past month and their smoking status at the time of the survey interview. However, in many cases, a temporal order cannot be established because most current smokers would have been in that category a month before, just as most individuals who participated in Mahjong within the past month (which could have been as recently as yesterday) would be considered current social participators. To address the possibility of reverse causality, we conducted a sensitivity analysis using one-wave-lagged social participation variables and the current wave of persistent smoking. Please refer to the sensitivity analysis in the Result section for more details. A random intercept was included to adjust for the correlations of repeated measurements within respondents. We addressed item-level missing data using the multiple imputation techniques based on 20 imputed data sets. All models except descriptive statistics were estimated for each imputed data set, and we combined the 20 sets of estimates using Rubin's Rules (Rubin, 1976; for details, see Supplementary Appendix 1).

In our analysis of persistent smoking among ever-smokers with chronic diseases, we examined the role of a number of sociodemographic factors. Given the large gender difference in smoking in China, we first investigated differences in the probability of persistent smoking by gender at different ages. We estimated the association using the gender-pooled sample, controlling for gender, and then performed gender-separate analyses. As the sample size for women (i.e., female ever-smokers with chronic diseases, 3% or less) is too small to provide sufficient statistical power, subsequent analyses focused on men only. Last, to investigate the association between social participation and

persistent smoking, we added any social participation and six different social activities. All analyses were performed using STATA and multilevel logistic regression was conducted using melogit (Liu, 2015). To facilitate interpretation, the logit coefficients were exponentiated to odds ratios (ORs). In supplementary Table 3, we present predicted group-specific prevalence rates of persistent smoking for categorical predictors in the models of Tables 1 and 2.

Results

Figure 1 presents the age- and gender-adjusted national prevalence of five groups with various smoking and chronic disease statuses across waves among older adults aged 45–80. Although the national prevalence of current smoking without chronic conditions shows a declining trend from 2011 to 2018, that of persistent smoking ("current smokers with chronic diseases") has increased during the period (e.g., from 11.75% in 2011 to 14.40% in 2018). This is because the number of older Chinese adults with at least one chronic disease has increased over time. A further calculation of age-adjusted prevalence by gender revealed a large gender difference in the national prevalence of persistent smoking, with an average of 23.72% of men and 3% of women during 2011–2018 smoking persistently (Figure 2).

[Figure 1 about here]

[Figure 2 about here]

To identify the risk group of persistent smokers among ever-smokers with chronic diseases, we then focused on respondents with a smoking history and 1+ smoking-related health conditions. Supplementary Table 2 presents the summary statistics of our sample

separately by gender and wave. The prevalence of persistent smoking was exceptionally high, around 70% in wave 1 and over 55% in waves 2–4. Among the four social activities, interacting with friends and playing Mahjong, chess, or card games were among the most popular social activities.

Figure 3 displays the predicted age pattern of persistent smoking among ever-smokers with chronic diseases. At age 45, the prevalence was remarkably high (around 75%). Although it decreased with age, the prevalence remained high, with over 30% of ever-smokers with chronic diseases persistently smoking at age 80. Although men had a higher probability than women across the age span, the difference was not statistically significant ($p = 0.346$). On average, the age-adjusted probability of persistent smoking was 62.09% for men and 60.83% for women (not shown in Figure 3).

[Figure 3 about here]

Table 1 presents the associations between sociodemographic characteristics and persistent smoking among ever-smokers with chronic diseases. Panel A investigated the associations with both genders combined and Panel B limited the sample to men only. Findings show mixed results in terms of the associations between SES indicators and persistent smoking. Although education remained a significant indicator, household consumption was not significantly associated with persistent smoking. Specifically, compared with individuals with low education, those with medium (OR = 0.489, confidence interval [CI] = 0.336 – 0.713 in Panel A) and high education (OR = 0.436, CI = 0.192 – 0.989 in Panel A) are less likely to persistently smoke. For men, only the difference between medium and low education was significant (OR = 0.512, CI = 0.349 –

0.752 in Panel B). The nonsignificant difference between high and low education is possibly due to the small sample size for the high education group in our sample. Older age ($p < .001$), having a partner ($p < .001$), and being retired from paid work ($p < .001$) were all significantly associated with a lower risk of persistent smoking. Gender and urban residence, however, were not significantly associated with the outcome.

[Table 1 about here]

Table 2 displays the subject-specific associations between any (1+) social participation(s), diverse types of social participation, and persistent smoking among ever-smokers with chronic diseases. We observed a significant positive association between any (1+) social participation and the outcome. For the different types of social activities, playing Mahjong, chess, or card games was positively associated with persistent smoking ($p < .01$). Meanwhile, those who participated in community-organized dancing, fitness, qigong, and so on had a significantly lower risk of persistent smoking than those who did not ($p < .05$). The other types of social activities were not statistically significant.

[Table 2 about here]

Sensitivity Analysis

We conducted two additional analyses to check the robustness of our findings. First, we conducted sensitivity analyses where we used one-wave-lagged social participation variables (measured at wave *t*-1) as the predictor and the current wave of persistent smoking (measured at wave *t*) as the outcome. Although the statistical significance decreased, we found that the results of these analyses were in line with our original findings (for details, see Supplementary Table 4).

Furthermore, we conducted a sensitivity analysis to check whether the severity of chronic disease matters in terms of the likelihood of persistent smoking among ever-smokers with chronic diseases. For this analysis, we only included severe conditions (cancer, lung disease, heart disease, and stroke) to define persistent smoking among ever-smokers with chronic diseases. The overall results were substantially similar, except that the associations between community-organized exercises and persistent smoking became marginally significant (see Supplementary Table 5 for full results). Overall, we found that even among older adults with more severe chronic diseases, those who participate in sedentary social activities (i.e., Mahjong) are likely to continue smoking.

Discussion

Our findings reveal a relatively high national prevalence of persistent smoking among older Chinese from 2011 to 2018 (around 11% – 14%) compared with that of 11 European countries (around 9.4% in 2011 and 2013; for details, see Supplementary Appendix 2 and Gao et al., 2022). Further, the estimated prevalence of persistent smoking among ever-smokers with chronic diseases was high across the life course−62.09% for men and 60.83% for women, which was much higher than that in 11 European countries−27.5% for men and 38.9% for women (Gao et al., 2022). Several institutional and structural factors, including ineffective tobacco control policies, active smoking promotion by the tobacco industry, and traditional norms of smoking, have been driving such a higher prevalence. Thus, older Chinese (particularly men) remain at high risk of persistent smoking despite having chronic diseases.

As for SES, the inverse association between education and persistent smoking among ever-smokers with chronic diseases is in line with the health benefits of education on continuing smoking in developed countries (Gao et al., 2022; Lee et al., 2020). Yet, we did not observe a significant association between household financial status and persistent smoking, which is consistent with the finding of little or no influence of income on smoking behaviors in China (Wang et al., 2018). Smoking cessation owing to budget concerns might be minimal in China due to the high affordability of cigarettes (e.g., the cheapest brands cost only $0.40 per pack in 2015) and rising incomes (Nargis et al., 2019). Our results suggest that education might be more critical than material resources in shaping persistent smoking, as individuals with higher education are more aware of the health hazards of smoking.

For sociodemographic characteristics, women show a slightly lower prevalence of persistent smoking than men. Although not statistically different, the observed pattern contrasts with findings from the United States and Europe, where women are more likely than men to be persistent smokers (Gao et al., 2022; Lee et al., 2020). Our finding suggests that among ever-smokers with chronic diseases in China, women are about as likely to be persistent smokers as their male counterparts. In terms of the rural/urban gap, there is no significant difference in persistent smoking. Although this finding is perplexing given the well-documented rural/urban disparity in current smoking in China, it is consistent with a prior study that reported no such disparity in smoking cessation behaviors (i.e., former smoking status and smoking cessation duration) (Lee et al., 2019). In accordance with the literature on the positive aspects of marriage/cohabitation on

smoking behaviors (Cho et al., 2008), we found that the risk of persistent smoking is low for older adults who live with a spouse/partner. Last, being retired is a protective factor against persistent smoking. Retirement may offer an opportunity for older adults to remove themselves from work-related social smoking, thus facilitating smoking cessation.

Drawing upon literature on social norms and behaviors in collective societies, we investigated the role of social participation in persistent smoking in China. Our finding expands prior work by indicating that different types of social participation have different associations with a harmful form of smoking, that is, smoking despite having chronic diseases. On the one hand, although prior studies have found that playing Mahjong benefits mental and cognitive health (Wang et al., 2019; Zhou et al., 2020), our study highlights the downside of such social activities for ever-smokers with chronic diseases. On the other hand, our study confirmed the benefits of physical activities in promoting smoking cessation, even among those with chronic diseases (Wen et al., 2021).

The present study has several limitations. First, as an observational study, our results do not imply causal associations between social participation and persistent smoking. Although the results from the sensitivity analysis (i.e., one-wave lagged models) are consistent with our finding, we cannot rule out reverse causality. This is because previous smoking habits (measured at *t*-1) may affect social participation (measured at *t*). Therefore, future studies could use a method that is more robust to reverse causality issues. Second, the probability of persistent smoking among ever-smokers with chronic diseases may vary by the duration of smoking and the timing of

disease development. Yet, we were not able to take into account potential heterogeneity among those who had a smoking history and 1+ smoking-related conditions due to a lack of data. The smoking duration among ever-smokers before developing chronic diseases and the timing of disease development may affect individuals' smoking-related decisions. We also could not investigate the social determinants of persistent smoking among women due to the small sample size. Because smoking is stigmatized among women, social participation may discourage them from persistent smoking. To understand potential gender differences in the social determinants of persistent smoking in China, future studies should focus on women. Last, due to data limitations, our analysis only controls for period effects (i.e., changes in smoking trends across waves and having a refresher in later waves). Given that younger generations in China have benefited from expanding education and other social policies related to smoking, future studies may consider exploring potential cohort differences in persistent smoking.

Despite the earlier limitations, our study is among the first to focus on persistent smoking, a particularly harmful behavior, in China. Chronic disease diagnosis can be a potential teachable moment for health behavior changes; however, the vast majority of individuals diagnosed with a new chronic disease did not adopt healthier behaviors (Newsom et al., 2012). Consistent with this finding, we found that a substantial portion of older adults in China, especially older men, continued to smoke despite having a smoking-related disease. To reduce persistent smoking, public health interventions should be tailored toward risk groups with certain demographic characteristics to meet their specific needs and address the unique challenges they face in quitting. Further, more

smoking cessation services, including nicotine replacement therapy and behavioral support such as individual or group counseling, are needed to facilitate quitting and to prevent relapse. Persistent smokers may also benefit from public health campaigns and education to increase their awareness of the risks associated with smoking. Last, to develop more effective smoking cessation interventions, further research is needed to better understand the structural and institutional factors of persistent smoking.

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Tables and Figures

Table 3.1 Multilevel Model Results (Odds Ratio, 95% CI) for Sociodemographic Characteristics and Persistent Smoking among Ever-smokers with Chronic Diseases

Persistent smoking	**Panel A** Gender-Combined	**Panel B** Men-only
Fixed effects		
Education (ref.: Low education)		
Medium education	0.489***	0.512***
	[0.336,0.713]	[0.349,0.752]
High education	0.436*	0.484
	[0.192,0.989]	[0.215,1.091]
Household consumption	0.915	0.916
	[0.820,1.022]	[0.815,1.028]
Age	0.882***	0.884***
	[0.865,0.899]	[0.867,0.902]
Urban residence	0.952	0.902
	[0.732,1.238]	[0.686,1.186]
Partnered	0.465***	0.409***
	[0.327,0.661]	[0.275,0.609]
Retired	0.401***	0.374***
	[0.323,0.497]	[0.297,0.471]
Women	0.725	
	[0.493,1.066]	
Wave (Ref.: 2011)		
2013	0.514***	0.527***
	[0.381,0.694]	[0.385,0.722]
2015	0.327***	0.331***
	[0.261,0.411]	[0.260,0.421]
2018	0.347***	0.343***
	[0.271,0.444]	[0.265,0.445]
Random effects		
Var (random intercept)	24.63***	23.13***
	[19.23,30.03]	[18.03,28.22]
Respondents	6,767	5,973
Observations	15,421	13,562

Notes: The coefficients for fixed effects are Odds Ratios. 95% confidence intervals in brackets.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Var = Variance.

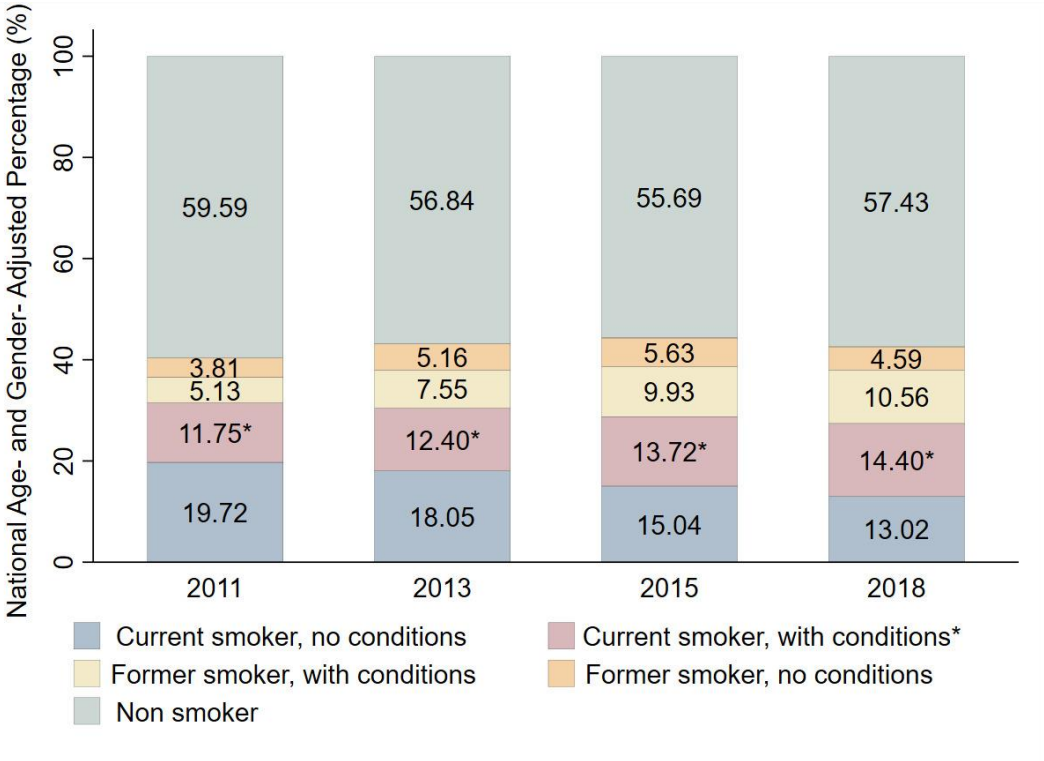
Table 3.2 Multilevel Model Results (Odds Ratio, 95% CI) for Social Participation and Persistent Smoking among Ever-smokers with Chronic Diseases

	Model 1		**Model 2**	
Persistent smoking	(A) Gender-Combined	(B) Men-only	(A) Gender-Combined	(B) Men-only
Fixed effects				
Any (1+) social participation	1.225*	1.217*		
	[1.022,1.468]	[1.005,1.474]		
Interact with Friends			1.117	1.152
			[0.917,1.361]	[0.933,1.422]
Play Mahjong, chess, cards			1.475**	1.400**
			[1.163,1.872]	[1.090,1.798]
Community-organized dancing, fitness, qigong			0.675*	0.670*
			[0.472,0.964]	[0.451,0.994]
Community-related organizations			1.170	1.254
			[0.675,2.029]	[0.700,2.248]
Help people for free			1.016	1.021
			[0.789,1.309]	[0.784,1.329]
Volunteer or charity work			1.294	1.172
			[0.625,2.679]	[0.553,2.484]
Education (ref.: Low education)				
Medium education	0.480***	0.502***	0.480***	0.501***
	[0.329,0.699]	[0.342,0.737]	[0.329,0.700]	[0.341,0.736]
High education	0.420*	0.466	0.438*	0.484
	[0.185,0.952]	[0.207,1.053]	[0.194,0.989]	[0.215,1.091]
Household consumption	0.911	0.911	0.910	0.909
	[0.816,1.018]	[0.811,1.024]	[0.815,1.016]	[0.809,1.022]
Age	0.883***	0.885***	0.884***	0.886***
	[0.866,0.900]	[0.868,0.903]	[0.867,0.901]	[0.869,0.904]
Urban residence	0.940	0.891	0.946	0.901
	[0.723,1.223]	[0.677,1.173]	[0.726,1.234]	[0.683,1.188]
Partnered	0.468***	0.411***	0.467***	0.411***
	[0.329,0.666]	[0.277,0.612]	[0.329,0.663]	[0.277,0.611]

Retired	0.401***	0.374***	0.402***	0.375***
	[0.323,0.498]	[0.297,0.471]	[0.324,0.499]	[0.297,0.473]
Women	0.718		0.745	
	[0.488,1.056]		[0.506,1.097]	
Wave (ref.: 2011)				
2013	0.505***	0.518***	0.501***	0.514***
	[0.376,0.680]	[0.380,0.707]	[0.371,0.676]	[0.375,0.704]
2015	0.325***	0.329***	0.320***	0.323***
	[0.260,0.407]	[0.259,0.418]	[0.254,0.402]	[0.253,0.412]
2018	0.349***	0.345***	0.343***	0.339***
	[0.272,0.447]	[0.266,0.448]	[0.267,0.441]	[0.259,0.442]
Random effects				
Var (random intercept)	24.60***	23.15***	24.34***	22.98***
	[19.22,29.97]	[18.05,28.24]	[19.07,29.61]	[17.96,28.00]
Respondents	6,767	5,973	6,767	5,973
Observations	15,421	13,562	15,421	13,562

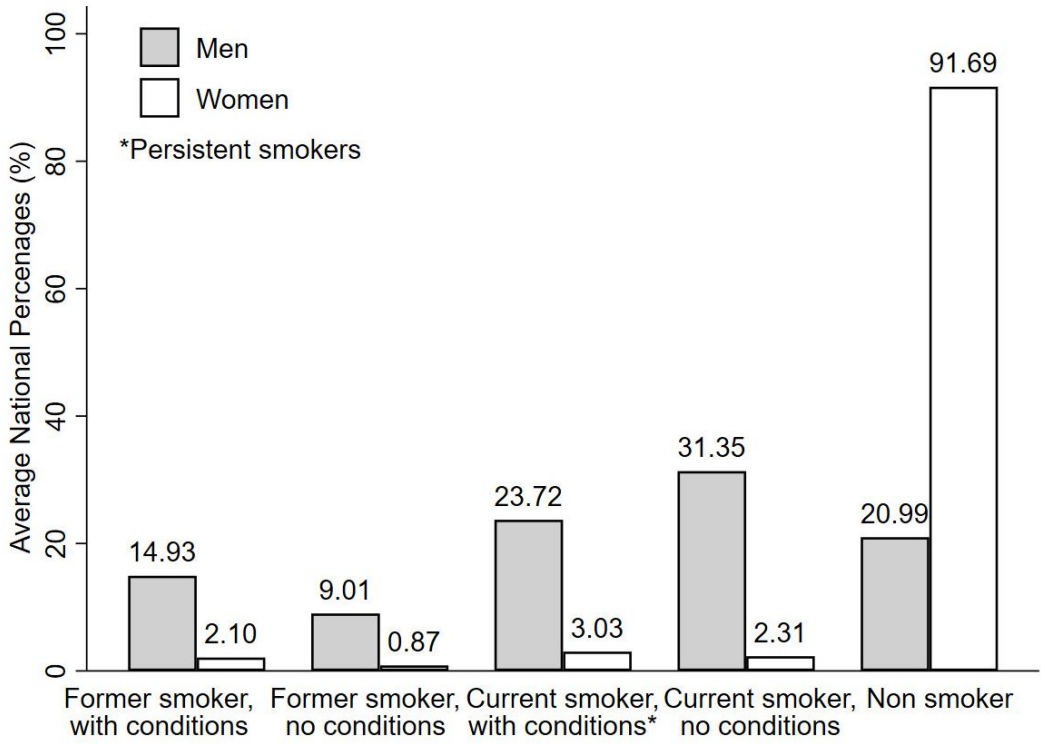
Notes: The coefficients for fixed effects are Odds Ratios. 95% confidence intervals in brackets. Model 1 investigated the association between any social participation and persistent smoking. Model 2 investigated the association between different types of social participation and persistent smoking. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Var = Variance.

Figure 3.1 Age- and Gender-Adjusted National Prevalence of Smoking and Chronic Disease Groups, 2011–2018



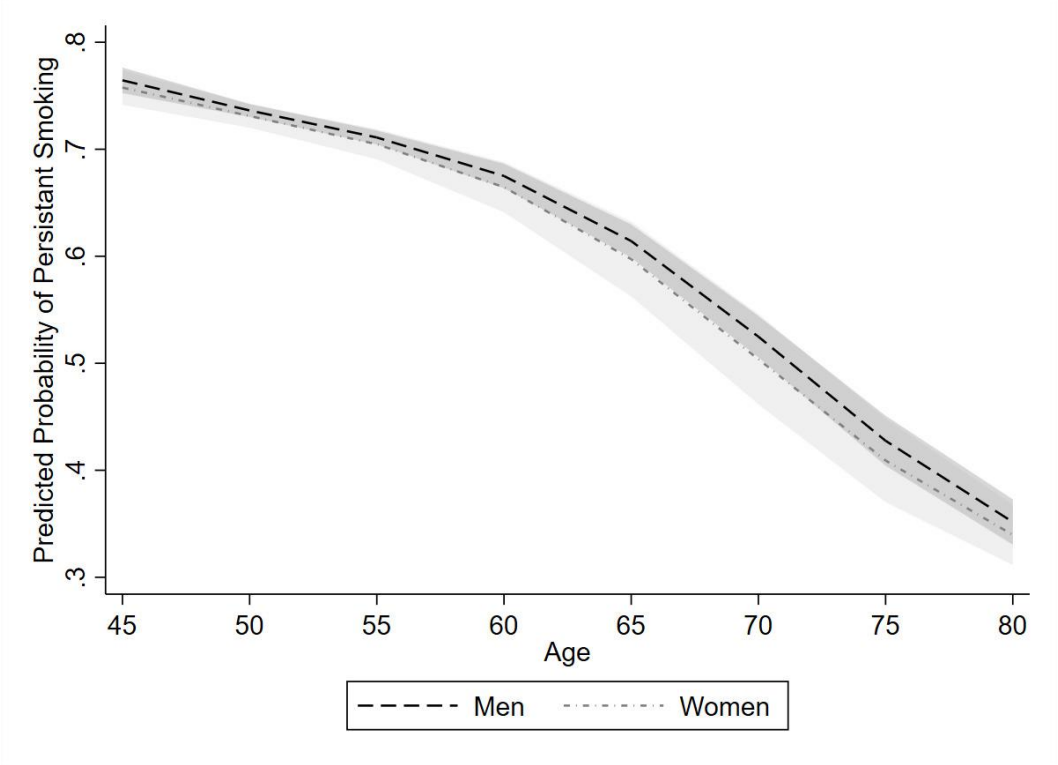
Notes: * current smoker with conditions refers to persistent smoking. The percentages were calculated by multinomial logit models adjusting for age and gender by waves. The sample size includes 16,461 respondents for 2011, 17,384 for 2013, 18,995 for 2015 and 18,534 for 2018.

Figure 3.2 National Prevalence of Smoking and Chronic Disease Groups Among Older Adults by Gender (2011–2018, Combined and Averaged)



Notes: * current smoker with conditions refers to persistent smoking. The average percentages were calculated by multinomial logit models adjusting for age, gender, and wave. N=71,374 includes any respondents aged 45–80 who participated in the China Health and Retirement Study (CHARLS) between 2011 and 2018.

Figure 3.3 Predicted Age-Probability of Persistent Smoking by Gender among Older Adults with a History of Smoking and Chronic Diseases



Supplementary Materials

eAppendix 1. Item-level Missing Data and Imputation Procedure

Item-level missing data (percentages of missing data) on the variables of interest existed across the four waves—such as ever smoked (0.4% ~ 0.8%), current smoking (0.4% ~ 19.8%), and specific health conditions (0.1% ~ 20.0%), which are key variables needed to identify persistent smoking for individuals, social participation (0.4% ~ 9.6%) and household consumption (16.6% ~ 34.5.8%). The missing percentages of other variables in the analysis are all smaller than 2.9%. The relatively large missing values of current smoking and ever-diagnosed health conditions are due to survey errors. More specifically, for current smoking, most missing data came from wave 2 where many respondents who previously reported they smoked were not re-asked if they still smoke currently. For ever-diagnosed conditions, most missing data came from wave 3 when there was an error in the Life History Survey code for "ever had" responses. Thus, most missing values of health conditions were due to refreshers added in Wave 3. We further calculated the percentage of respondents missing data on any current smoking or specific health conditions by wave, as they are the key variables used to construct the measure of persistent smoking (0.4% ~ 26.1%). Table 1 shows the highest missing prevalence (26.1%) by sociodemographic characteristics and social activities. The p-values are from chi-square tests for categorical variables and t-tests for continuous variables.

We imputed the missing data based on information on smoking status (ever smoking and current smoking), individual items of smoking-related chronic disease (high blood pressure, diabetes, cancer [except minor skin cancers], chronic lung disease, heart problems, stroke, or asthma) and all the remaining analysis variables as well as respondents' mobility, cognition, depression scores, household income and wealth as auxiliary variables which were correlated with missing variables and provided additional information to conduct multiple imputation (Zhang & Lu, 2021).

Citation:

Zhang, J., & Lu, N. (2021). The association between childhood conditions and heart disease among middle-aged and older population in China: a life course perspective. *BMC geriatrics*, 21(1), 1-10.

sTable 3.1 Prevalence of Missing Data by Sociodemographic Characteristics and Social Participation

Variables		Missing percentage	*p*-value
Gender	Men	42.51%	$p < 0.001$
	Women	11.17%	
Education	Low	25.20%	$p < 0.001$
	Medium	30.36%	
	High	30.77%	
Urban Residence	No	25.93%	$p = 0.437$
	Yes	26.44%	
Partnered	No	23.89%	$p < 0.01$
	Yes	26.45%	
Retired	No	25.92%	
	Yes	21.36%	
1+ social activities	No	25.04%	$p = 0.717$
	Yes	25.28%	
Interacted with friends	No	26.43%	
	Yes	23.30%	$p < 0.01$
Play Mahjong, chess, cards	No	23.57%	$p < 0.001$
	Yes	30.96%	
Community-organized dancing, fitness, qigong	No	25.62%	
	Yes	20.73%	$p < 0.001$
Community organizations	No	25.16%	$p = 0.867$
	Yes	25.54%	
Help people for free	No	25.52%	$p < 0.01$
	Yes	22.99%	
Volunteer or charity work	No	25.10%	$p = 0.062$
	Yes	30.85%	
Household consumption		/	$p = 0.1933$
Age		/	$p < 0.001$

eAppendix 2. National Prevalence of Persistent Smoking in Europe

The adjusted percentages for European countries were gained through the authors' own calculation based on a sample of adults aged 50 through 80 years old in 11 European countries from the Survey of Health, Ageing and Retirement in Europe (SHARE) and the English Longitudinal Study of Ageing (ELSA). We merged data from the 2011 and 2013 waves of the SHARE and the ELSA, then limited respondents to those aged 50 and 80 years old. Last, We calculated the age- and gender-adjusted national prevalence of persistent smoking as well as four other smoking statuses: 1) former smokers with at least 1 smoking-related chronic disease, 2) former smokers without such conditions, 3) current smokers with such conditions (i.e., persistent smoking), 4) current smokers without such conditions, and 5) individuals with no smoking history (Nonsmokers), using multinomial logit models controlling for age and gender, separately for wave 2011 and 2013. The adjusted national prevalence of persistent smoking was 9.43% in 2011 and 9.45% in 2013.

sTable 3.2 Descriptive Statistics of the Study Sample, by Wave and Gender

	Wave 1 (2011)		wave 2 (2013)		wave 3 (2015)		wave 4 (2018)	
	Men (N = 2440)	Women (N = 345)	Men (N = 3048)	Women (N = 442)	Men (N = 2554)	Women (N = 372)	Men (N = 1958)	Women (N = 272)
Persistent smoking	1692 (69.3%)	243 (70.4%)	1906 (62.5%)	269 (60.9%)	1485 (58.1%)	214 (57.5%)	1101 (56.2%)	163 (59.9%)
At least 1 social activity	1230 (50.4%)	178 (51.6%)	1787 (58.6%)	265 (60.0%)	1355 (53.1%)	203 (54.6%)	893 (45.6%)	140 (51.5%)
Interacted with friends	807 (33.1%)	133 (38.6%)	1168 (38.3%)	200 (45.2%)	857 (33.6%)	129 (34.7%)	589 (30.1%)	96 (35.3%)
Play Mahjong, chess, cards	611 (25.0%)	63 (18.3%)	890 (29.2%)	104 (23.5%)	667 (26.1%)	83 (22.3%)	390 (19.9%)	50 (18.4%)
Community-organized dancing, fitness, qigong	174 (7.1%)	24 (7.0%)	242 (7.9%)	39 (8.8%)	148 (5.8%)	34 (9.1%)	63 (3.2%)	28 (10.3%)
Community organizations	33 (1.4%)	3 (0.9%)	84 (2.8%)	10 (2.3%)	87 (3.4%)	7 (1.9%)	48 (2.5%)	8 (2.9%)
Help people for free	187 (7.7%)	22 (6.4%)	437 (14.3%)	45 (10.2%)	415 (16.2%)	41 (11.0%)	266 (13.6%)	29 (10.7%)
Volunteer or charity work	24 (1.0%)	0 (0.0%)	53 (1.7%)	4 (0.9%)	61 (2.4%)	7 (1.9%)	34 (1.7%)	2 (0.7%)
Low Education	2078 (85.2%)	336 (97.4%)	2543 (83.4%)	426 (96.4%)	2150 (84.2%)	364 (97.8%)	1639 (83.7%)	265 (97.4%)
Medium Education	290 (11.9%)	8 (2.3%)	418 (13.7%)	14 (3.2%)	345 (13.5%)	7 (1.9%)	284 (14.5%)	7 (2.6%)
High Education	72 (3.0%)	1 (0.3%)	87 (2.9%)	2 (0.5%)	59 (2.3%)	1 (0.3%)	35 (1.8%)	0 (0.0%)
Household consumption	13.39 (0.90)	13.34 (0.88)	13.74 (0.89)	13.65 (0.91)	13.88 (0.91)	13.79 (0.99)	14.17 (0.94)	14.08 (0.88)
Age (range 45-80)	60.94 (8.73)	63.20 (9.23)	61.53 (8.79)	63.46 (9.12)	63.09 (8.34)	65.03 (8.58)	65.04 (7.67)	66.72 (7.75)
Urban residence	1005 (41.2%)	147 (42.6%)	1295 (42.5%)	196 (44.3%)	999 (39.1%)	150 (40.3%)	768 (39.2%)	105 (38.6%)
Partnered	2197 (90.0%)	247 (71.6%)	2755 (90.4%)	326 (73.8%)	2290 (89.7%)	268 (72.0%)	2757 (90.6%)	326 (77.3%)
Retired	879 (36.0%)	206 (59.7%)	1070 (35.1%)	248 (56.1%)	965 (37.8%)	208 (55.9%)	1745 (89.1%)	196 (72.1%)

Notes: The current study includes 15,421 observations from 6,767 respondents who have a smoking history and at least one of the various smoking-related health conditions. For discrete binary variables, we reported N (percentage of yes). For continuous variables (household consumption per capita, age), we reported mean (standard deviation).

sTable 3.3 Predicted Group-Specific Prevalence (Probability) of Persistent Smoking among Ever-smokers with Chronic Diseases Based on Model Estimates in Table 3.1 and 3.2

Group-specific prevalence of Persistent smoking	Table 1		Table 2 Model 1		Table 2 Model 2	
	Panel A	**Panel B**	**Panel A**	**Panel B**	**Panel A**	**Panel B**
	Gender-Combined	Men-only	Gender-Combined	Men-only	Gender-Combined	Men-only
Low education	.631	.634	.631	.634	.631	.634
Medium education	.578	.584	.577	.583	.576	.582
High education	.569	.580	.566	.577	.569	.580
Urban residence	.622	.622	.621	.622	.621	.622
Rural Residence	.625	.629	.626	.630	.625	.629
Partnered	.617	.620	.617	.620	.616	.619
Non-partnered	.668	.679	.667	.679	.667	.679
Retired	.584	.581	.584	.581	.652	.581
Non-retired	.653	.656	.653	.656	.583	.656
Women	.604		.603		.605	
Men	.627		.627		.626	
2011	.677	.680	.677	.680	.678	.681
2013	.635	.639	.634	.638	.634	.638
2015	.602	.605	.602	.605	.601	.604
2018	.607	.608	.607	.608	.606	.608
Any (1+) social participation			.631	.633		

No social participation	.616	.619		
Interact with Friends			.629	.633
No			.621	.623
Play Mahjong, chess, cards			.644	.644
No			.617	.620
Community-organized dancing, fitness, qigong			.625	.598
No			.596	.628
Community-related organizations			.634	.641
No			.623	.626
Help people for free			.624	.627
No			.623	.626
Volunteer or charity work			.641	.637
No			.623	.626

Notes: Predicted group-specific prevalence rates of persistent smoking among ever-smokers with chronic diseases based on model estimates are presented. Table 1 investigated the association between sociodemographic characteristics and persistent smoking. Table 2 Model 1 investigated the association between any social participation and persistent smoking. Table 2 Model 2 investigated the association between different types of social participation and persistent smoking. Both models controlled for education, household consumption, age, urban residence, partnership, retirement status, gender, and wave.

sTable 3.4 Multilevel Model Results (Odds Ratio, 95% CI) for One-Wave-Lagged Social Participation and Persistent Smoking among Ever-smokers with Chronic Diseases

Persistent smoking	**Panel A** Gender-Combined	**Panel B** Men-only
Fixed effects		
Model 1		
Lagged Any (1+) social participation	1.260^{+}	1.153
	[0.996,1.594]	[0.878,1.514]
Model 2		
Lagged Interact with Friends	1.166	1.116
	[0.903,1.506]	[0.822,1.514]
Lagged Play Mahjong, chess, cards	1.566*	1.434^{+}
	[1.108,2.213]	[0.970,2.121]
Lagged Community-organized dancing, fitness, qigong	0.734	0.825
	[0.449,1.198]	[0.451,1.507]
Lagged Community-related organizations	0.987	0.782
	[0.442,2.207]	[0.304,2.012]
Lagged Help people for free	1.094	1.064
	[0.784,1.525]	[0.737,1.536]
Lagged Volunteer or charity work	0.499	0.542
	[0.168,1.483]	[0.158,1.861]
Respondents	5,673	6,968
Observations	10,884	9,530

Notes: The coefficients for fixed effects are Odds Ratios. 95% confidence intervals in brackets. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Model 1 investigated the association between one-wave-lagged any social participation and persistent smoking. Model 2 investigated the association between one-wave-lagged different types of social participation and persistent smoking. Both models controlled for education, household consumption, age, urban residence, partnership, retirement status, gender, and wave. While the results of these analyses are consistent with the original findings (in Table 3.2) , the statistical significance was reduced. There might be several reasons why we observed the reduced significance in the sensitivity analyses. To use the lagged independent variable, we limited our sample to respondents with 2+ wave observations and lost around 30% of observations (15,421 to 10,884 for gender-combined models, and 13,562 to 9,530 for men-only models). More importantly, the true causal effect of social participation on persistent smoking can be reduced or even biased if the impact of social participation (playing Mahjong) on smoking behavior is contemporaneous or occurs over a shorter lagged period than two years (a period gap between waves) in China.

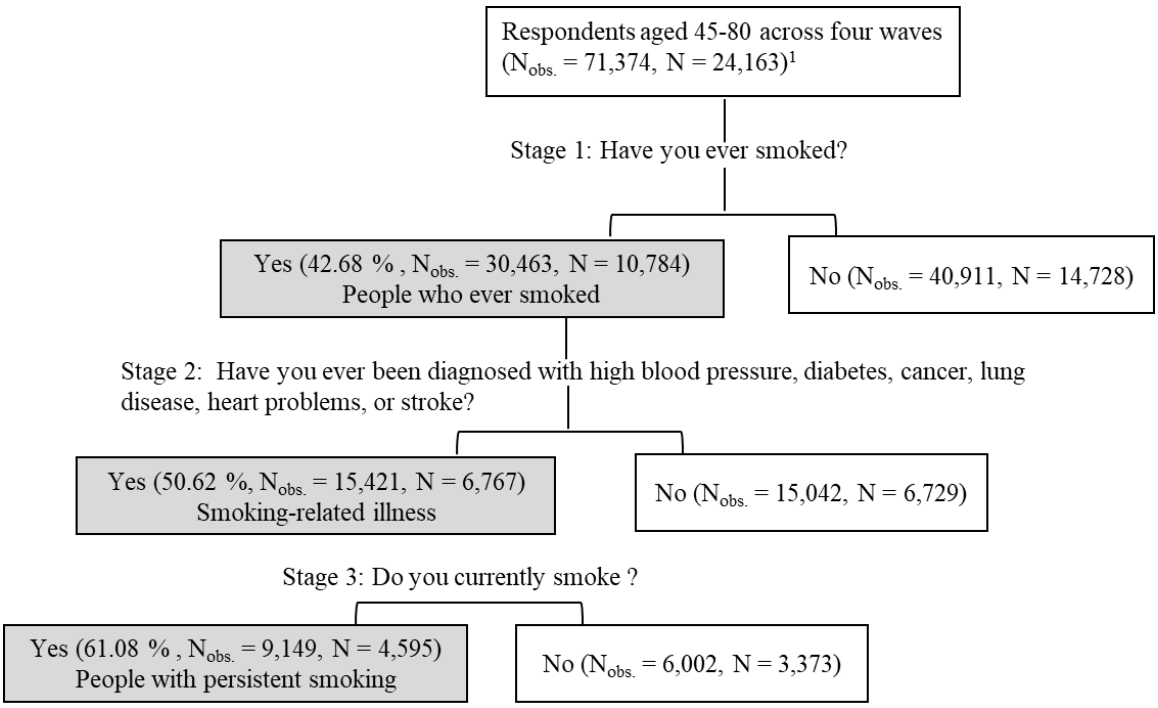
sTable 3.5 Multilevel Model Results (Odds Ratio, 95% CI) for Social Participation and Persistent Smoking among Older Ever-smokers with Chronic Diseases, Excluding Minor Chronic Diseases

Persistent smoking	Model 1		Model 2	
	(A) Gender-Combined	(B) Men-only	(A) Gender-Combined	(B) Men-only
Fixed effects				
Any (1+) social participation	1.304*	1.289*		
	[1.033,1.646]	[1.003,1.655]		
Interact with Friends			1.164	1.185
			[0.904,1.499]	[0.902,1.559]
Play Mahjong, chess, cards			1.641**	1.571**
			[1.213,2.219]	[1.140,2.165]
Community-organized dancing, fitness, qigong			0.622	0.602
			[0.386,1.003]	[0.353,1.026]
Community-related organizations			1.058	1.145
			[0.511,2.191]	[0.541,2.423]
Help people for free			1.099	1.100
			[0.771,1.567]	[0.767,1.578]
Volunteer or charity work			1.170	1.188
			[0.462,2.964]	[0.443,3.187]
Education (Ref.: Low education)				
Medium education	0.405***	0.429**	0.409***	0.431**
	[0.244,0.674]	[0.256,0.719]	[0.247,0.679]	[0.257,0.721]
High education	0.357	0.398	0.387	0.427
	[0.114,1.122]	[0.129,1.225]	[0.123,1.213]	[0.138,1.318]
Household consumption	0.876	0.880	0.874	0.877
	[0.756,1.015]	[0.753,1.029]	[0.755,1.012]	[0.751,1.025]
Age	0.864***	0.870***	0.866***	0.872***
	[0.840,0.888]	[0.847,0.895]	[0.843,0.890]	[0.849,0.896]

Urban residence	1.008	0.968	1.016	0.980
	[0.726,1.399]	[0.685,1.368]	[0.730,1.415]	[0.691,1.388]
Partnered	0.465***	0.441***	0.465***	0.442***
	[0.306,0.706]	[0.273,0.711]	[0.306,0.706]	[0.274,0.713]
Retired	0.387***	0.363***	0.389***	0.366***
	[0.296,0.506]	[0.271,0.486]	[0.298,0.508]	[0.273,0.489]
Women	0.834		0.873	
	[0.538,1.292]		[0.563,1.356]	
Wave (Ref.: 2011)				
2013	0.506**	0.496**	0.499**	0.491**
	[0.335,0.765]	[0.319,0.774]	[0.329,0.758]	[0.314,0.768]
2015	0.434***	0.409***	0.422***	0.396***
	[0.326,0.580]	[0.302,0.555]	[0.314,0.567]	[0.290,0.542]
2018	0.457***	0.417***	0.445***	0.404***
	[0.329,0.636]	[0.296,0.589]	[0.318,0.623]	[0.284,0.575]
Random effects				
Var (random intercept)	24.76***	21.75***	24.45***	21.57***
	[18.10,31.42]	[16.06,27.43]	[17.98,30.92]	[15.99,27.16]
Respondents	4,395	3,799	4,395	3,799
Observations	9,240	7,936	9,240	7,936

Notes: The coefficients for fixed effects are Odds Ratios. 95% confidence intervals in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Model 1 investigated the association between any social participation and persistent smoking. Model 2 investigated the association between different types of social participation and persistent smoking. The major chronic diseases included here are cancer, lung disease, heart disease, and stroke.

sFigure 3.1. Three-Stage Process to Identify Persistent Smoking among Ever-smokers with Chronic Diseases



Notes: [1]The total number of observations and respondents slightly varies across imputations due to small differences in imputed values of smoking and illness status. Specifically, sample sizes for those who had a smoking history (ever-smoked) and at least one smoking-related chronic diseases vary between 15,306 and 15,421. The figure was generated based on one imputed dataset with the sample size 15,421.

Chapter 4 : The Long Arm of Childhood on Depression: Does it Vary by Gender and Gender Regimes?

Abstract

Utilizing cross-sectional data from the European Social Survey, I ask if low childhood socioeconomic status (SES) is more strongly associated with depression in adulthood for women than men, and if macro-level gender inequalities can account for any observed gender gaps. Mounting evidence suggests that low childhood SES is associated with a higher risk of depression in adulthood. However, scant research has examined the role of gender differences or macro-level institutions in ameliorating or exacerbating any observed gender gaps. Macro-level gender inequalities expressed through gender regimes represent an understudied yet crucial contextual factor that may contribute to differential vulnerability to adverse childhood conditions based on gender. The findings show that among those with low childhood SES, women are more vulnerable than men to higher rates of depression. However, this gendered vulnerability is not uniformly observed across Europe. Instead, the gender gap in depression is more pronounced in gender regimes characterized by higher gender inequality (traditional and contradictory regimes) and is absent in regimes characterized by greater gender equality (dual-earner and market-oriented regimes). These findings shed light on the complex interplay between childhood SES, gender, and institutional contexts in shaping mental health outcomes.

Keywords: Childhood Socioeconomic Status, Gender, Gender Regimes, Depression

Introduction

Extensive research has focused on the gender gap in depression, revealing that women are approximately twice as likely as men to experience depression over their lifetime (Kuehner, 2017; Piccinelli & Wilkinson, 2000; Van de Velde et al., 2010). This gap can be attributed to several factors, including gender differences in biological and psychological susceptibility to stress, as well as gender inequalities in social contexts and determinants of health, such as economic position and access to resources (Kuehner, 2017; Platt et al., 2016). Moreover, cross-country studies indicate that the gender gap in depression varies across different countries, suggesting that contextual gender inequalities play a role in mental health disparities (Van de Velde et al., 2013). However, most studies have focused on current social contexts (e.g., Van de Velde et al., 2013) and individual social status. The potential influence of early-life factors on these gender disparities in depression has not been adequately studied.

Childhood socioeconomic status (SES) significantly influences adult health outcomes, as highlighted by the life course theoretical approach (Ferraro & Shippee, 2009). Research has increasingly demonstrated that disadvantaged childhood circumstances, including low childhood SES, elevate the risk of depression in later life (Bøe et al., 2017; Santini et al., 2021). Moreover, scholars have examined how the association between childhood SES and adult health vary by individual characteristics such as gender, integrating the life course perspective with the intersectionality theories (López & Gadsden, 2016 ; Collins, 2015) to understand gender disparities in depression. Due to systemic power imbalances and gender inequalities, women from disadvantaged

family backgrounds may have fewer resources and opportunities to mitigate the adverse effects of economic adversities throughout their life course (Homan, 2019; Ridgeway & Correll, 2004). Therefore, women from low SES backgrounds may have a higher likelihood of experiencing depression in later life than men with identical childhood SES, suggesting that childhood socioeconomic status (SES) can serve as a starting point for gender disparities in depression during later stages of life.

Prior studies have suggested the effect of low childhood SES on various health outcomes varies by gender (e.g., Angelini et al., 2019; Lee & Park, 2020; Morrissey & Kinderman, 2020; Wolfova et al., 2021). However, these studies often focus exclusively on specific countries, neglecting the contextual variations. Recognizing that individuals' life course experiences are shaped differently by distinct social and economic contexts, recent research has begun exploring the institutional factors that can mitigate the impact of early childhood disadvantages (e.g., Andersson et al., 2023; Widding-Havneraas & Pedersen, 2020). Building upon this body of literature, I adopt a gender perspective to examine the contextual variations in the association between childhood SES and later depression. Given that macro-level gender inequalities have been found to contribute to the gender gap in depression (Van de Velde et al., 2010; Van de Velde et al., 2013; Homan, 2019), I investigate whether country-level gender inequality, expressed through different gender regimes, can moderate the relationship between childhood SES and depression.

Utilizing data from the European Social Survey, which includes multiple countries and represents individuals aged 25 years or older, this research aims to

investigate two main questions: (1) whether the association between childhood SES and depression is stronger for women compared to men, and (2) whether the association varies across different gender regimes. The results show that women are more vulnerable than men to the negative effects of low childhood SES on depression. Moreover, the extent of this gendered vulnerability varies depending on the gender regimes. I conclude by discussing the significance of macro-level gender inequalities as institutional factors that can either exacerbate or buffer the gendered vulnerability to adverse childhood experiences throughout the life course.

Theories and Hypotheses

Childhood SES and Adult Health: Exploring Differential Vulnerabilities by Gender

The life course perspective on health posits that an individual's early life experience, such as low childhood socioeconomic conditions serve as precursors to their adult health outcomes (Elder et al., 2003; Ferraro & Shippee, 2009). To elucidate the association between childhood SES and later-life health, four major conceptual mechanisms have been proposed (Kuh et al., 2003; Morrissey & Kinderman, 2020; Pudrovska & Anikputa, 2014). First, the critical period model suggests that exposures to adversities during periods of rapid growth and development have enduring and potentially irreversible effects on later health through biological imprinting mechanisms. Second, the accumulation of risks model highlights the contribution of low SES across the entire life course, rather than at specific stages, to poor health outcomes. Third, the life course pathway model emphasizes the interconnected pathways linking early-life deleterious exposures to health outcomes in later life, as well as the ripple effects of the early-life

environment. Here, initial disadvantages lead to "chains-of-risks" in subsequent life course trajectories (Ben-Shlomo & Kuh, 2002). Last, the social mobility model suggests that the burden of low SES in early life may be alleviated or even reversed through upward social mobility. Extensive research has shown that multiple mechanisms operate together to link childhood SES to various adult health outcomes, including the risk of depression (Bøe et al., 2017; Morrissey & Kinderman, 2020; Santini et al., 2021; Schaan, 2014).

Research has also drawn attention to potential gender differences in the association between childhood SES and adult health outcomes. Intersectionality theories propose that gender, as another axis of inequality, interacts with SES to shape an individual's health conditions (López & Gadsden, 2016; Collins, 2015). Each of the aforementioned mechanisms may operate differently for men and women. First, men and women may exhibit distinct biological vulnerabilities to certain diseases, leading them to respond differently to adverse childhood exposures (e.g., Lee et al., 2018). Moreover, due to women's marginalized social status, adverse childhood SES may disproportionately increase health risks for women compared to men through compromised life-course processes (Lee & Ryff, 2019; Lee & Park, 2020). For example, women from disadvantaged families tend to accumulate fewer human, social, and health resources than similarly situated men (Hamil-Luker & O'Rand, 2007). They also face fewer opportunities for upward mobility, particularly if they are overweight or obese (Heraclides & Brunner, 2010). Consequently, throughout the life course, women from disadvantaged families are more likely to encounter social and economic constraints and

experience adversities, while at the same time having fewer economic and psychological recourses to cope with those challenges (Lee, Ryff, et al., 2018).

A growing body of literature indicates that women are more adversely affected by childhood socioeconomic adversity in terms of various health outcomes, including cardiovascular diseases, obesity, cognitive function and decline, functional limitations, chronic diseases, and mortality (Etherington et al., 2016; Hamil-luker & O'Rand, 2007; Landös et al., 2019; Pudrovska et al., 2014; Pudrovska & Anikputa, 2014; Walsemann et al., 2016; Wolfova et al., 2021). However, studies examining the gender difference in the association between low childhood SES and later-life depression have produced inconsistent conclusions. While some studies suggest a greater association between childhood socioeconomic status (SES) and depression among men compared to women (Morrissey & Kinderman, 2020; Verropoulou et al., 2021), others conclude the opposite (Angelini et al., 2019; Csajbók et al., 2021), suggesting a need of further empirical investigation. Thus, following this stream of research, I first hypothesized that:

H1: (*Differential vulnerability*) The association between childhood SES and adult depression is stronger for women than men.

Contextual Difference: Gender Regimes and Gendered Vulnerability to Childhood SES

Existing studies examining the long arm of childhood SES on health have predominantly relied on data from a single country or treated countries as control variables in cross-sectional designs (Angelini et al., 2019; Gilman et al., 2002). These approaches do not take account the broader social and economic contexts that shaped the individual-level

processes of cumulative advantage and disadvantage (Crystal, 2020; McEwen & McEwen, 2017).

Recent studies have shown cross-national differences in exposure to adverse childhood experiences and the strength of the association between childhood SES and adult health (Haas & Oi, 2018; Hughes et al., 2017). To understand the cross-national differences in the association between childhood SES and later adult health outcomes, these studies have integrated a life course framework with an institutional approach to health to identify institutional factors that may ameliorate or exacerbate the effects of childhood disadvantage (Andersson et al., 2023). Welfare regimes, for example, are a well-established macro-determinant of health (Bambra, 2011; Beckfield & Bambra, 2016; Beckfield et al., 2015). Increasing evidence has shown that welfare regimes may mitigate childhood economic disparities across various indicators of health, such as self-reported health (Widding-Havneraas & Pedersen, 2020; Sieber et al., 2020), cancer (Widding-Havneraas & Pedersen, 2020), frailty (Van Der Linden et al., 2020), and depression (Verropoulou & Serafeinidou, 2019; Verropoulou et al., 2021).

Welfare regime studies suggest the importance of macro institutions in moderating the impact of childhood adversities, yet existing research lacks a gender perspective. As criticized by scholars from the gendered welfare state field, welfare states are not gender-neutral institutions, but rather reflect and reinforce gender inequalities (Orloff, 1993; Sainsbury, 1999). Compared to men, women may disproportionately rely on public welfare services throughout the life course (Bolzendahl & Brooks, 2007). Thus, while welfare programs reduce childhood economic disparities and thereby reduce health

disparities in adulthood, these impacts may differ by gender. Indeed, one study suggests that welfare states can shape gender gaps in the association between childhood SES and depression and its underlying mediating mechanism among older European adults (50+) (Csajbók et al., 2021). Yet, this study was limited to older European adults (50+) and whether the findings can apply to younger adults is unknown. Further, a statistical test is needed to formally establish the contextual difference in the gendered vulnerability of childhood SES.

More importantly, the welfare regime may not be a suitable indicator for examining the gender differences in the association between childhood socioeconomic status (SES) and depression, as it primarily emphasizes class rather than gender inequalities (Orloff, 1993; Sainsbury, 1999). In response to the gender-blindness of welfare regime typologies, scholars have proposed and developed a gender-regime model that aims to capture the impact of state interventions on men's and women's paid and unpaid work (Korpi, 2000, 2010; Korpi et al., 2013; Lewis, 1992). These gender regimes provide a proxy measure of the configuration of gender equality policies by considering the characteristics of family policies that influence the division of paid and unpaid labor between genders (Korpi, 2000; Palència et al., 2017). Different gender regime typologies reflect varying degrees of gender inequality at the macro level.

Five main types of regimes have been proposed (Ferrarini & Sjoberg, 2010; Korpi et al., 2013; Palència et al., 2017; Palència et al., 2014). The first is the dual-earner regime, where women and men's equal share in both paid and unpaid work is supported by transferring the unpaid caring responsibilities from the family to the public sector. The

second is the traditional-central regime, where the traditional men as breadwinners and women as caregivers' division of labor was encouraged through high support for all families. The third is the traditional-southern regime, characterized by a strong familialism with a strong reliance on women's unpaid labor and a lack of public support for families. The fourth is the market-oriented regime, where the market is the principal institution distributing resources to individuals and families and there is a lack of strong public support for either the dual-earner models or traditional models. The last is the contradictory regime, where women's participation in paid work and the traditional division of household labor are supported simultaneously. It consists of post-socialist countries where their family policies have changed after the transition.

Empirically, extensive research has demonstrated the critical role of macro-level gender inequalities in shaping the gender gap in health (Homan, 2019; Lee et al., 2021; O'Neil et al., 2020; Van de Velde et al., 2010; Van de Velde et al., 2013). Overall, studies have consistently found that in countries and gender regimes that prioritize gender equality, there are smaller gender gaps in health or exhibit smaller gender gaps in health or social determinants of health (e.g., Bracke et al., 2020; Palencia et al., 2016). For instance, gender inequalities in self-reported health were more pronounced in regimes with less emphasis on gender equality, such as traditional-southern European countries, which were partially explained by gender inequalities in individual social determinants of health (Palencia et al., 2016).

Based on the aforementioned findings, I expect that the gender regimes might shape the gender difference in the association between childhood SES and later

depression. There are several reasons to expect a larger gender gap in the vulnerability to low childhood SES in gender regimes with less gender equality. First, compared to boys from poor families, girls growing up from poor families might be more exposed or vulnerable to other adversities encountered in the critical period, especially when they are marginalized in society. For example, living in families with low SES is associated with an elevated risk of childhood abuse, which has more detrimental health consequences for women and is more frequent in less gender egalitarian countries (Lee & Ryff, 2019; LeSuer, 2022).

Second, in societies with greater gender inequalities, women from disadvantaged family backgrounds face additional challenges in accessing resources and opportunities compared to men throughout the life course. For example, family policies oriented to the traditional division of labor and traditional gender norms may confine women to caregiving and domestic responsibilities and deprive them of educational and employment opportunities. Consequently, women, especially those with low SES, may face compounded disadvantages in terms of lack of access to agency and resources, leading to poorer health outcomes in adulthood (Korpi et al., 2013). Further, women from less advantaged families might be less likely than similarly situated men to achieve upward social mobility due to systematic gender discrimination such as occupational segregation (Bukodi & Paskov, 2020). Thus, in societies with limited gender equality, women who come from low SES backgrounds may face significant challenges in breaking free from poverty and remaining in a low SES position throughout the entire life course, which contributes to an increased vulnerability to depression.

In this study, gender regimes are utilized as a means to approximate the country-level gender inequality experienced by individuals throughout their life course. While several country-level measures of gender equality, such as the Gender Empowerment Measure, have been developed, they are not applicable to this study as they are only available for the period after the 2000s and do not cover the early life circumstances of the respondents. The gender regimes, on the other hand, encompass both gender and class inequality, making them particularly relevant for examining the intersectional effect of gender and socioeconomic status on adult health (Korpis, 2000). Moreover, instead of focusing on single policies or institutions, the gender regime approach captures the synergistic impact of policies and institutional choices in various domains, which jointly shape individuals' opportunities and constraints at critical life-course stages (Crystal, 2020).

In summary, in regimes characterized by greater gender equality, girls growing up in disadvantaged families may have similar opportunities, resources, and constraints throughout their life course as boys, whereas in regimes that perpetuate gender inequality, women growing up with low SES may experience a "double disadvantage" compared to their male counterparts. The second hypothesis is:

H2: (*Gender regime moderation*) The gender difference in the association between childhood SES and later-life depression is smaller in regimes with greater gender equality.

Data and Methods

Data and Sample

To investigate the associations between childhood SES and adult depression across different gender regimes, I utilized data from the 2014 European Social Survey (ESS), which contains rich information on various childhood circumstances, social determinants of health, and health indicators. The ESS is a nationally representative survey conducted across Europe. Using random probability sampling, participants from the resident national population aged 15 years or older living in private households were drawn and data were collected in face-to-face interviews with standardized questionnaires. Respondents under the age of 25 were excluded because they might not have finished their education at the time of the survey (Andersson & Vaughan 2017; Bøe et al., 2017). After excluding Israel, for which the gender regime typology is not available, and Hungary, in which parental education was not collected, the sample consisted of N = 31,804 respondents across 19 countries. The amount of missing data on relevant variables in the sample was low (ranging from 0.1% to 1.2%). As a result, complete data analysis was used, as the potential bias due to listwise deletion is minimal when missing data is small (Scheffer, 2002). Thus, the final sample analyzed in this study includes 30,725 respondents from 19 countries: Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Ireland, Lithuania, the Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom.

Measures

Dependent Variable

The dependent variable in this study is depression. Depressive symptoms were measured using the eight-item version of the Center for Epidemiological Studies Depression Scale (CES-D scale) (Radloff, 1977). Respondents were asked to indicate how often they experienced various symptoms of depression during the past week. The items included: (1) feeling depressed, (2) feeling that everything they did was an effort, (3) having restless sleep, (4) feeling happy (reverse-coded), (5) feeling lonely, (6) enjoying life (reverse-coded), (7) feeling sad, and (8) feeling unable to get going. Response categories ranged from "none or almost none of the time" (1) to "all or almost all the time" (4). A depressive symptom score was computed by averaging the responses across all items for respondents with at least six non-missing items (Bøe et al., 2017) (alpha =.83). Previous studies have demonstrated the metric equivalence of the CES-D eight-item version across age, gender, and European countries (Missinne et al., 2014; Van de Velde et al., 2010).

Independent Variables

Childhood socioeconomic status (SES)

In line with previous studies (Andersson et al., 2023), a composite measure of *childhood SES* was created based on parental education, parental occupation at age 14, and self-reported childhood financial strain. Specifically, parental education was measured as the highest level of education attained by either parent, which was based on the International Standard Classification of Education, ranging from less than lower secondary education (1) to lower secondary education (2), lower tier upper secondary education (3), upper

secondary education (4), advanced vocational education (5), lower tertiary education (6), and higher tertiary education (7). Parental occupation was measured as the highest occupational class across both parents when the respondent was age 14. It included five ranks: professional or technical (5); administrative, clerical, or sales occupations (4); service occupations (3); skilled or semiskilled worker (2); and farmer worker (1), with 5 corresponding to the highest rank and 1 indicating the lowest rank. The childhood financial strain was measured based on respondents' answers to how often their family experienced severe financial difficulties while they were growing up (reverse-coded; 1 = always and 5 = never).

Childhood SES was computed by first normalizing the three variables on a 0 to 1 scale, and averaging over the three normalized variables, given at least one valid response (Andersson et al., 2023; Ferraro et al., 2016). The scale ranges from 0 to 1, with a higher score indicating a higher childhood SES. The composite measure of childhood SES captures three distinct socioeconomic indicators and thus provides more complete information on childhood socioeconomic status (Suglia et al., 2022).

Gender

Gender was measured as the biological sex of the respondents, using a binary indicator where 1 indicated women and 0 indicated men.

Gender Regime

Countries were classified into five gender regimes based on the extent of their family policies supporting women in paid and unpaid work, following the classification by Palència, Malmusi, and colleagues (2014). This classification expanded Korpi's typology

to include southern and eastern European countries (Ferrarini & Sjobery, 2010; Korpi et al., 2013). The five gender regimes and the corresponding countries are as follows: (1) Dual-earner regime: Denmark, Finland, Norway, and Sweden; (2) Traditional-central regime: Austria, Belgium, Germany, France, and the Netherlands; (3) Traditional-southern regime: Spain and Portugal; (4) Market-oriented regime: Switzerland, the United Kingdom, and Ireland; (5) Contradictory regime: the Czech Republic, Estonia, Lithuania, Poland, and Slovenia.

Covariates

Adulthood socioeconomic status

Adulthood SES is created using a similar procedure to that of the childhood SES measure. It was characterized as the average of the sum of adult education, occupation, and indicators of adulthood financial status, which were normalized before averaging (Andersson et al., 2023). Education was measured as the highest level of education attained, categorized according to the International Standard Classification of Education. It ranged from less than lower secondary education (1) to higher tertiary education (7). Occupation was measured by the respondent's occupations based on the International Standard Classification of Occupations (ISCO-88). Following previous studies (Andersson et al., 2023), the original scores were converted to broader decile ranks ranging from armed forces occupations (1) to managers (10), in parallel to the parental occupational measure. Last, adult financial strain was measured as the household income decile derived from family total net income from all sources. The scale ranges from 0 to 1, with a higher score indicating a higher adulthood SES.

Childhood control variables

Household conflict during childhood was measured based on respondents' indications of how often there was serious conflict between the people living in their household while they were growing up. The original response was reverse coded (1 = never, 2 = hardly ever, 3 = sometimes, 4 = often, 5 = always) and normalized to a range of 0 to 1 (inclusive), so that a higher score indicates a higher frequency of household conflicts.

Parental absence during childhood was measured based on respondents' answers to the question "When you were 14, did your father (mother) work as an employee, was he (she) self-employed, or was he (she) not working then?". Respondents indicated if either parent was "dead or absent" as a response.

Demographic control variables

Age was measured as years from the birth date and top-coded at 95 (99.97 percentile). Squared age was also included to account for the non-linear association between age and depression (Van de Velde et al., 2010). *Marital status* was dichotomized as being in a partnership or not (1 = legally married, in a legally registered civil union; 0 = legally separated, legally divorced/civil union dissolved, widowed/civil partner died, never married, or in a legal civil union). *Immigrant status* was determined by whether respondents reported being born in the survey country. *Residential population density* was measured in terms of respondents' living area, classified into urban (big cities or the suburbs or outskirts of a big city), rural (country villages or a farm or home in the countryside), and town or small cities (reference category).

Country-level control variables

I included lagged country-level covariates that might account for country differences in depression from multilevel ESS data and OECD data. The *Country's gross domestic product (GDP) per capita* in 2013 was measured in US dollars at current prices. *Public social spending as a percentage of GDP* in 2013 is included as an estimate of overall welfare state generosity (Andersson et al., 2023; OECD, 2023; Widding-Havneraas & Pedersen, 2020). Last, I include OECD data on *public health spending (%GDP)* in 2013 which has been shown as an important macro determinant of population health (Andersson et al., 2023; OECD, 2023; Widding-Havneraas & Pedersen, 2020).

Statistical Method

First, summary statistics were computed by gender and gender regime. Statistical significance was determined using t-tests for continuous variables and chi-square tests for categorical variables.

Second, to examine the association between childhood SES, gender, gender regime, and depression, multilevel linear regression models were estimated. This approach accounted for the nested structure of individuals within countries, and the dependent variable, depression, was measured on a continuous scale. Previous research indicates that a random slope term on individual-level variables involved in a cross-level interaction should be included when fitting multilevel models with cross-level interactions (Heisig & Schaeffer, 2019). Thus, I included a random intercept and two random slopes for childhood SES and gender to address within-country correlations and capture between-country variation in childhood SES, gender, and depression. The

standard errors were clustered at the country level. In accordance with the guidelines provided by the European Social Survey (ESS, 2020), survey weights (anweight) were applied to all statistical analyses, including descriptive and regression analyses. These weights adjusted for the probability of nonresponse within and across countries.

Models were fitted in a stepwise approach. To test whether the association between childhood SES and adult depression differs by gender (hypothesis 2), a two-way interaction between childhood SES and gender was included. Model 1 estimated unadjusted associations. Model 2 added childhood covariates (household conflicts, parental absence) and non-adulthood demographics (age, age squared, immigrant status) to see whether the two-way interaction results changed. Model 3 added individual-level adulthood covariates (adult SES, marital status, and residential population density) to investigate whether adulthood characteristics mediate the association between childhood SES, gender, and depression. Last, Model 4 further included all country-level covariates and displayed the results in the full model. Predicted scores of depression and confidence intervals were generated for low, medium, and high childhood SES (i.e., at one standard deviation below the mean, the mean, and one standard deviation above the mean), separately by gender, based on Model 4.

To investigate whether the gender gap in the association between childhood SES and depression differs by gender regime, a three-way statistical interaction between childhood SES, gender, and gender regime was included. Models were fitted in a similar procedure as two-way interaction models, where Model 1 examined the crude association and Model 4 included a full set of covariates. I used the dual-earner regime as the

reference category and then assessed the differences among other gender regimes by changing the reference category. Average marginal effects [AMEs] of childhood SES by gender were computed separately for each gender regime based on Model 4 (Long & Freese, 2014).

Results

Table 1 presents the summary statistics by gender across different regimes. Across all five regimes, women have a higher score of depression than men ($p < 0.001$). The gender gap in depression is largest among the traditional-southern regime and smallest in the market-oriented regime. The level of depression is highest for both men and women in the traditional-southern regime while it is lowest in the dual-earner regime.

[Table 1 about here]

There is a mixed pattern regarding gender differences in childhood SES, and exposure to childhood adverse experiences. For childhood SES, women have a slightly lower childhood SES than men in the traditional-central ($p < 0.05$) and the contradictory regime ($p < 0.001$). No significant gender difference regarding childhood SES was observed in other regimes. In contrast, women are more likely to be exposed to household conflicts while growing up compared to men in all regimes except the traditional-southern regime ($p < 0.05$). No gender difference in parental absence during childhood was found.

For adulthood characteristics, women have a lower adult SES than men in the traditional-central ($p < 0.001$), traditional-southern ($p < 0.001$), and market-oriented regime ($p < 0.05$). Women are older and less likely to be in partnerships than men in the

traditional-central ($p < 0.001$), traditional-southern ($p < 0.05$), and contradictory regimes ($p < 0.001$). No significant gender differences were detected for other covariates.

[Table 2 about here]

Table 2 shows the results of the multilevel regression models on the gender differences in the associations between childhood SES and depression. In the unadjusted analysis (Model 1), the two-way interaction between childhood SES and gender is statistically significant (b = - 0.15, 95% confidence interval [CI] = - 0.24 to - 0.06), suggesting that the association between childhood SES and gender is stronger for women than men. Results from the AMEs analysis show that while one unit increase in childhood SES is associated with a 0.26 score decrease in depression for men (CI = -0.31 to -0.2), it is associated with a 0.41 score decrease for women (CI = -0.51 to -0.31). Model 2 adds other childhood covariates, and individual-level demographics (age, age squared, immigrant status). The two-way interaction remains significant (b = 0.14, $p < 0.001$), and the coefficients of childhood SES become smaller for both genders (for men, b = -.16, $p < 0.001$; for women, b = -0.30, $p < 0.001$). Additionally, exposure to household conflicts while growing up is associated with a higher level of depression (b = 0.34, CI = 0.30 to 0.37). while there is no significant association between parental absence and depression (p =0.931). Model 3 further adds adulthood covariates (adulthood SES, marital status, and residential population density). The two-way interaction remains significant (b = -0.13, CI = -0.19 to -0.07). A higher adult SES is associated with a lower level of depression (b = -0.35, CI = -0.39 to -0.31). After adjusting for adulthood indicators, the association between childhood SES and depression becomes non-

significant for men (p =0.156), while remains significant, albeit with a smaller magnitude for women (b = -0.16, CI = -0.22 to -0.10), suggesting that adulthood circumstances partially mediate the relationship between childhood SES and depression. Last, after further adjusting for country-level covariates, the results from the fully adjusted model (Model 4) show a similar pattern.

[Figure 1 about here]

Figure 1 shows the gender gap in the predicted depression scores for low, medium, and high childhood SES (i.e., at one standard deviation below the mean, at the mean, and at one standard deviation above the mean), generated based on Model 4. This figure shows that the slope of childhood SES is steeper for women than for their male counterparts. Moreover, the gender gap in depression is larger for individuals with a lower childhood SES. Overall, the results provide evidence that a lower childhood SES is more adversely associated with higher depression in women than men.

[Table 3 about here]

Table 3 presents the results of the multilevel regression models on the three-way interaction between childhood SES, gender, and gender regime. The unadjusted model (Model 1) shows that the gendered vulnerabilities in depression to childhood socioeconomic strains vary by gender regimes (see three-way interaction: gender regime*women*childhood SES in Table 3). After adjusting childhood covariates and some individual demographic indicators, the pattern remains similar, except that the gender difference in the slope of childhood SES on depression loses significance in the dual-earner regime (Model 2). Compared to the dual-earner regime, the gender gap in the

association between childhood SES and depression is significantly larger for the traditional-central (b = - 0.12, CI = - 0.19 to - 0.06) and contradictory regime (b = - 0.27, CI = - 0.34 to – 0.21), and marginally significantly larger for the traditional-southern regime (b = -0.2, $p = 0.052$). In contrast, the gender gap is smaller in the market-oriented regime than in the dual-earner regime (b = 0.07, CI = 0.02 to 0.11). Interestingly, in the market-oriented regime, there is a reverse gender pattern where the association between childhood SES and depression is significantly stronger for men than women ($p < 0.001$). After further adjusting the adulthood indicators (Model 3) and country-level covariates (Model 4), the difference between the market-oriented regime and the dual-earner regime is no longer significant.

[Figure 2 about here]

Figure 2 shows the AMEs of childhood SES on depression by gender and gender regime. As shown in the figure, there is a heterogenous gender difference in the AMEs of childhood SES on depression, by gender regime. Specifically, the gender gap in vulnerability to low childhood SES is most pronounced in the contradictory regime, where women are more than twice as likely as men to experience depression because of low childhood SES (b = - 0.16 for men, $p < 0.001$; b = -0.45 for women, $p < 0.001$; gender difference = -0.29, $p < 0.001$). The magnitude of the gender gap is also large in traditional-southern (b = -0.05 for men, $p < 0.05$; b = -0.27 for women, $p < 0.01$; gender difference = -0.23, $p < 0.05$) and traditional-central (b = -0.002 for men, $p = 0.93$; b = - 0.13 for women, $p < 0.001$; gender difference = -0.13, $p < 0.001$). In contrast, the gender gap in the AMEs of childhood SES on depression is not significant in the dual-earner

regime (p = 0.63) and very minimal in the market-oriented regime (b = - 0.007 for men, p = 0.76; b = -0.024 for women, p = 0.15; gender difference = -0.03, $p < 0.001$). All pairwise differences between the regimes are significant at least at the conventional level ($\alpha = 0.05$), except for the pairs traditional-central versus traditional-southern, dual-earner versus market-oriented, and contradictory versus traditional-southern. In summary, women's mental health suffers more from exposure to low childhood SES than their men counterparts in traditional (both central and southern countries) and contradictory regimes but not in dual-earner or market-oriented regimes.

To quantify how much variance in the gender gap in the marginal effects of childhood SES on depression is explained by gender regimes, I conducted an additional analysis. First, all the fixed effects in model 4 of Table 2 were included, with a two-way interaction between gender and childhood SES as the random coefficients. Next, the fixed effects were further augmented by incorporating a three-way interaction between gender, childhood SES, and gender regimes. The variance of the random coefficient of the two-way interaction reduced from 0.0015 to nearly 0, indicating that gender regimes play a substantial role in accounting for the gender differences in the relationship between childhood SES and depression.

Sensitivity Analysis

To check the robustness of the findings, I performed four sensitivity analyses. First, I included the macro-gender inequality measured as the gender inequality index (GII) in 2013 in the final model, because previous research found that macro-gender inequality matters for depression (Bracke et al., 2020). The GII is not a significant predictor of

depression in the model and the results are substantially similar. Second, although multilevel models are a common modeling approach for nested data, the model estimates may be biased due to the relatively small number of countries in the dataset (Bryan & Jenkins, 2016). Thus, I employed alternative modeling strategies. I conducted pooled ordinary least squares regression with standard errors clustered at the country level, which is a reasonable approach for comparative analysis with a limited number of countries (Andersson et al., 2023; Bryan & Jenkins, 2016). The results are substantially similar.

Next, I performed analyses by disaggregating SES facets in the prediction of depression. For parental education, substantively comparable results were found as those of the composite SES index. For parental occupation, similar findings existed except that the difference between the dual-earner regime and the traditional-central regime lost significance. For self-rated financial strain, only the difference between the dual-earner and the contradictory regime was statistically significant. These results suggest that the findings of the composite childhood SES were driven by more objective indicators of childhood SES than a more subjective evaluation of childhood SES. Prior research evaluating retrospective measures of childhood SES has found that parental education performs nearly as well as prospective measures of childhood SES (Brady et al., 2022). Thus, this sensitivity analysis provides some evidence that the results are less prone to recall bias in the retrospective measure of childhood SES.

Last, to alleviate the concern that the results are driven by individual countries instead of gender regimes, I employed the bootstrap procedure to estimate the models,

which entails drawing repeated observations from the dataset and then making inferences based on resampled data. Unfortunately, the bootstrap procedure in STATA does not allow for applying the survey weights to multilevel models, so I estimate the unweighted models. The results are substantively similar except that the difference between the contradictory regime and the dual-earner regime became marginally significant (p = 0.066). In summary, the sensitivity analyses show that the results are robust to additional covariates, alternative modeling strategies, the measurement of childhood SES, and the configuration of countries.

Discussion

More than two decades of research has consistently documented the long-term influence of childhood SES on adult health (Ferraro et al., 2016). Within this broad theme, two streams of research have emerged. One focuses on the differential vulnerability to adverse childhood SES by individual demographics such as gender (Morton & Ferraro, 2020; Lee et al., 2018). The other stream draws attention to the macro-level policies and institutional contexts of the long arm of childhood adversities, showing that the associations between childhood SES and adult health vary across institutions and countries (Andersson et al., 2023; Widding-Havneraas & Pedersen, 2020). However, little research has considered the intersection of both streams. That is, it is unknown whether the gender differences in the association between childhood socioeconomic circumstances and adult health outcomes vary across different contexts (excluding Verropoulou et al., 2021). Building on the two streams of research, this study investigated the differential vulnerability to childhood socioeconomic conditions by

gender, utilizing a representative cross-national European dataset that covers adults of all age spans (age 25+). More importantly, this study examined whether the gender difference varies by gender regime.

First, I observed evidence of gendered vulnerability to childhood SES, with the association between childhood socioeconomic status and adult depression being stronger for women compared to their male counterparts. This finding is consistent with previous research based on data from older Europeans (aged 50+) (Angelini et al., 2019; Csajbók et al., 2021). Additionally, while adulthood SES indicators fully mediate the association between childhood SES and adult depression for men, childhood SES remains a significant predictor for women even after adjusting for adulthood indicators. These findings suggest that among those with low childhood SES, women are more likely than me to face challenges throughout the life course even after taking into account adult SES. Recent studies emphasize the need to apply an intersectionality lens to research on health inequality and consider multiple systems of oppression (Collins, 1991; Harari & Lee, 2021). By combining the life course and intersectionality frameworks, this study demonstrates how later life mental health is shaped by the interaction of gender and childhood SES, which have been identified as the most relevant socio-demographic and economic factors of depression (Bøe et al., 2017; Piccinelli & Wilkinson, 2000).

Second, prior studies have proposed several explanations that may account for women's higher likelihood of encountering depression due to low childhood SES. These explanations include women's greater biological vulnerability to adversities, their higher likelihood of encountering life adversities, and their fewer psychological resources to

cope with adverse experiences (Csajbók et al., 2021; Lee et al., 2019). However, existing research has largely neglected the role of macro-level institutional contexts in exacerbating or alleviating the gender gap in the association between childhood SES and adult depression.

Recent studies integrating life course and multilevel frameworks have emphasized that macro-level institutions such as the healthcare system and the welfare state can buffer early disadvantages (Andersson et al., 2023; Widding-Havneraas & Pedersen, 2020; Sieber et al., 2020). This study extends this line of research by adopting a unique gender lens and demonstrating that macro-level gender regimes can shape gendered life course opportunities. The findings of this study demonstrate that gender vulnerability to childhood SES is not uniformly present across European countries but varies across different gender regimes. The gender gap in depression attributed to low childhood SES is pronounced in contradictory and traditional regimes (both southern and traditional), but it is not observed in the dual-earner regime and is minimal in the market-oriented regime. Overall, the results indicate that countries with more gender equity tend to exhibit more positive outcomes in terms of the gender difference in depression related to low childhood SES.

The moderating effects of macro-level gender regimes are substantively important. In market-oriented and dual-earner regimes, the gender gap in the association between childhood SES and adulthood depression is minimal or non-significant, but this gap is large and statistically significant in the traditional and contradictory regimes. Thus, egalitarian gender regimes likely increase the probability that women and men have

similar life course opportunities and resources that they can employ for their health. However, in regimes that prioritize women's caregiver role over their employment (e.g., traditional central and southern regimes) or heavily rely on women in the family (e.g., the contradictory regime), women with low childhood SES may lack power, status, and financial resources that could be gained from the labor market. They may also face the double burden of paid work and unpaid caregiving responsibilities (Palència et al., 2017; Palència et al., 2014). As highlighted in the gendered welfare state literature, women may disproportionately rely on public welfare services throughout their lives (Bolzendahl & Brooks, 2007). Therefore, the lack of sufficient public support may increase the risk of depression to a greater extent for women with early disadvantages compared to men facing similar adverse conditions due to compromised life course processes. By emphasizing the role of gender institutions, this study moves beyond attributing mental health outcomes solely to individual factors and underscores the long-term impact of institutions and policies on mental health.

This study has some limitations. First, the gender regime approach, while informative, may overlook within-regime heterogeneity and changes over time. It may also hinder our ability to identify specific country-level characteristics that are relevant to gendered vulnerabilities to childhood adversities (Palència et al., 2017). Ideally, data on country-level gender inequality during respondents' childhood should be utilized. However, existing gender inequality indexes often have limitations in terms of their temporal and geographical coverage. Therefore, future research could explore better

measures of macro-level gender inequalities and identify more specific gender-relevant institutions and policies.

Second, although the temporal order of childhood SES and adult health can be conceptually established, the presented results only show associations and do not imply any causal inferences. Longitudinal data would be necessary to establish the time order of the variables more effectively. For example, gender regimes or country-level gender inequalities collected from the respondents' childhood are better ways to establish the sequence order of variables. Additionally, childhood indicators are measured retrospectively, which introduces the possibility of recall bias. To mitigate this bias, a multidimensional measure of childhood SES was employed, with parental education shown to have a similar performance to prospective measures (Brady et al., 2022).

Lastly, this study did not investigate the specific mechanisms through which gender regimes moderate the gender differences in the association between childhood SES and adult depression. It is possible that in more egalitarian gender regimes, women have similar levels of intergenerational mobility as men and similar resources to cope with early life adversities. Further research is needed to uncover these mechanisms.

In conclusion, by integrating theoretical insights from the life-course theories, the intersectionality theories, and the multilevel framework, this study contributes to the existing literature by illustrating the complex interplay between childhood SES, gender, and macro-level gender regimes in shaping long-term mental health outcomes. The findings emphasize the need for targeted interventions and policies to address women's greater vulnerability to childhood adversities. Furthermore, the study highlights the

importance of policies aimed at reducing gender inequalities at the systemic and institutional levels to reduce the differential vulnerabilities by gender.

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Tables and Figures

Table 4.1 Summary Statistics by Gender and Gender Regimes

	Dual Earner (N=5855)		Traditional Central (N=9076)		Traditional Southern (N=2799)		Market Oriented (N=5379)		Contradictory (N=7616)	
	Men (N=2928)	Women (N=2927)	Men (N=4393)	Women (N=4683)	Men (N=1360)	Women (N=1439)	Men (N=2486)	Women (N=2893)	Men (N=3188)	Women (N=4428)
Individual-level variables										
Depression score (1-4)	1.51 (0.41)	1.60 (0.47)	1.58 (0.43)	1.73 (0.50)	1.66 (0.50)	1.88 (0.61)	1.59 (0.46)	1.66 (0.51)	1.62 (0.53)	1.80 (0.62)
Childhood social and economic indicators										
Childhood socioeconomic status (0-1)	0.53 (0.25)	0.51 (0.25)	0.50 (0.23)	0.49 (0.23)	0.41 (0.23)	0.40 (0.23)	0.50 (0.25)	0.50 (0.25)	0.42 (0.23)	0.40 (0.22)
Household conflict growing up (0-1)	0.29 (0.24)	0.34 (0.27)	0.31 (0.26)	0.34 (0.28)	0.16 (0.22)	0.17 (0.24)	0.28 (0.27)	0.29 (0.28)	0.27 (0.24)	0.28 (0.25)
Absent parent growing up	5.20%	7.30%	8.90%	9.70%	7.00%	6.30%	7.50%	9.40%	10.50%	10.10%
Adult socioeconomic status (0-1)	0.56 (0.23)	0.57 (0.24)	0.54 (0.24)	0.50 (0.24)	0.47 (0.27)	0.43 (0.28)	0.54 (0.26)	0.52 (0.25)	0.50 (0.24)	0.50 (0.25)
Age	52.55 (16.15)	53.36 (17.05)	52.05 (15.78)	53.30 (16.53)	50.77 (15.91)	52.70 (17.01)	51.05 (16.31)	51.27 (16.36)	49.57 (15.43)	51.63 (16.18)
Immigrants	10.10%	10.70%	12.40%	13.00%	8.40%	8.70%	18.10%	17.30%	2.00%	2.30%
Partnered	55.00%	51.80%	64.70%	61.40%	62.70%	57.10%	60.40%	59.30%	68.40%	63.40%
Residential population density: urban	35.90%	37.10%	31.30%	30.30%	26.40%	26.00%	32.20%	28.30%	25.60%	23.30%
Residential population density: rural	33.10%	31.80%	38.30%	35.70%	41.30%	43.70%	27.20%	31.70%	41.10%	42.30%
Country-level variables										
GDP per capita /1000	66.55 (18.57)	65.88 (18.17)	45.83 (2.85)	45.76 (2.86)	28.21 (2.70)	28.13 (2.78)	47.52 (12.98)	47.52 (12.98)	15.22 (2.88)	15.23 (2.86)
Total social spending (% of GDP)	25.96 (3.34)	26.08 (3.33)	26.95 (4.12)	27.06 (4.12)	17.07 (3.42)	17.17 (3.51)	21.49 (2.03)	21.49 (2.03)	20.74 (1.81)	20.69 (1.86)
Health expenditures (% of GDP)	9.34 (0.65)	9.36 (0.65)	11.04 (0.33)	11.05 (0.33)	6.50 (1.19)	6.54 (1.22)	9.93 (0.21)	9.93 (0.21)	6.85 (1.01)	6.85 (0.99)

Notes: Mean or percentage reported in the table. Standard errors in the parentheses.

Table 4.2 Multilevel Models for Gendered Vulnerabilities of Childhood Socioeconomic Status and Adult Depression

	Model 1	**Model 2**	**Model 3**	**Model 4**
Fixed effects				
Childhood SES	-0.26***	-0.16***	-0.03	-0.03
	[-0.31, -0.20]	[-0.21, -0.11]	[-0.07,0.01]	[-0.07,0.02]
Women	0.20***	0.18***	0.17***	0.17***
	[0.14,0.26]	[0.13,0.24]	[0.13,0.22]	[0.13,0.22]
Childhood SES*women	-0.15***	-0.14***	-0.13***	-0.13***
	[-0.24, -0.06]	[-0.22, -0.06]	[-0.19, -0.07]	[-0.19, -0.08]
Household conflict growing up		0.34***	0.33***	0.33***
		[0.30,0.37]	[0.29,0.37]	[0.29,0.37]
Absent parent growing up		0.003	-0.01	-0.01
		[-0.06,0.06]	[-0.06,0.04]	[-0.06,0.04]
Adult SES			-0.35***	-0.35***
			[-0.39, -0.31]	[-0.39, -0.31]
Random effects				
Logged SD (childhood SES)	-2.27***	-2.31***	-2.40***	-2.27***
	[-2.89, -1.66]	[-2.91, -1.70]	[-3.01, -1.79]	[-2.90, -1.65]
Logged SD (women)	-3.15***	-3.09***	-3.13***	-3.18***
	[-3.53, -2.77]	[-3.48, -2.70]	[-3.50, -2.77]	[-3.60, -2.75]
Logged SD (random intercept)	-2.13***	-2.10***	-2.17***	-3.36***
	[-2.49, -1.77]	[-2.42, -1.77]	[-2.48, -1.85]	[-3.88, -2.85]

Notes: N = 30,725 from 19 countries. Weighted unstandardized coefficients and confidence intervals (in the squared brackets) are presented. Model 1 is unadjusted. Model 2 adjusts for individual-level demographics (age, age squared, immigrant status). Model 3 further adjusts for individual-level marital status and residential population density. Model 4 adjusts for all individual level variables and country level variables (gendered regimes, social spending, health spending, and GDP per capita in 2013).

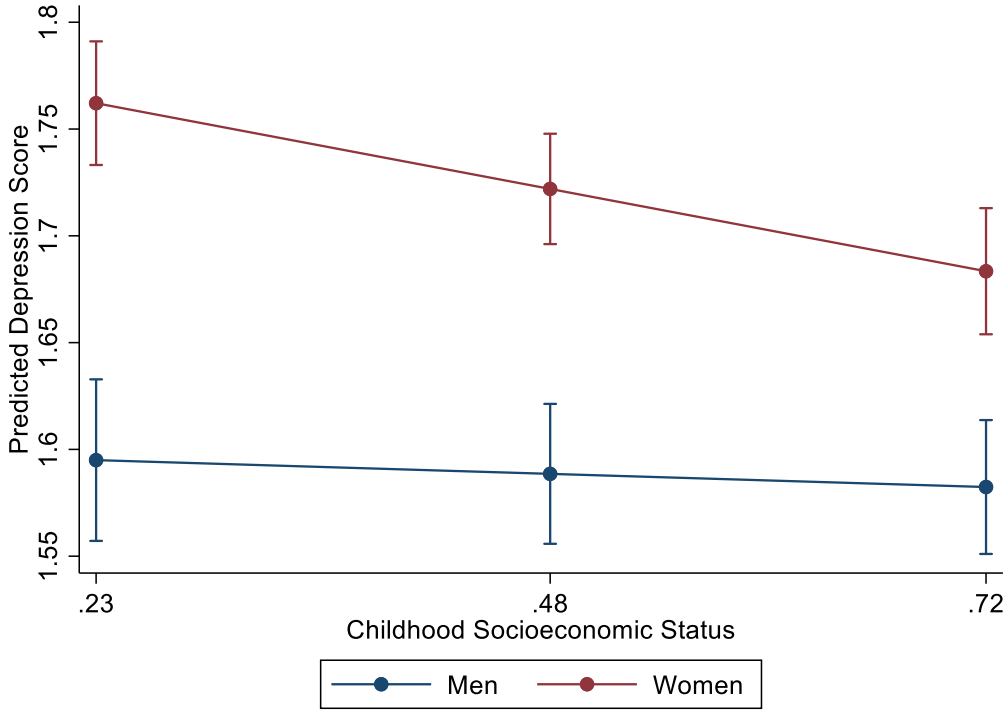
Table 4.3 Multilevel Models for Interactions of Gendered Regimes, Gender, Childhood Socioeconomic Status and Adult Depression

	Model 1	**Model 2**	**Model 3**	**Model 4**
Fixed effects				
Childhood SES	-0.10***	-0.02	0.07*	0.07*
	[-0.16, -0.05]	[-0.09,0.06]	[0.00,0.14]	[0.01,0.14]
Women	0.11***	0.09***	0.08***	0.08***
	[0.07,0.16]	[0.04,0.13]	[0.03,0.12]	[0.03,0.12]
Childhood SES*women	-0.05*	-0.04	-0.01	-0.01
	[-0.10, -0.01]	[-0.08,0.00]	[-0.04,0.03]	[-0.04,0.03]
Gender regime (Ref: Dual Earner)				
Traditional Central	0.10***	0.09***	0.09***	0.07*
	[0.06,0.13]	[0.05,0.14]	[0.05,0.12]	[0.00,0.14]
Traditional Southern	0.24***	0.29***	0.26***	0.17***
	[0.19,0.30]	[0.26,0.33]	[0.23,0.29]	[0.07,0.28]
Market Oriented	0.11**	0.11***	0.07**	0.06
	[0.04,0.18]	[0.05,0.17]	[0.03,0.11]	[-0.04,0.16]
Contradictory	0.31***	0.31***	0.29***	0.20**
	[0.21,0.41]	[0.22,0.40]	[0.21,0.37]	[0.08,0.32]
Gender regime*childhood SES				
Traditional Central *childhood SES	-0.11**	-0.10**	-0.07**	-0.07**
	[-0.17, -0.04]	[-0.16, -0.04]	[-0.12, -0.02]	[-0.12, -0.03]
Traditional Southern*childhood SES	-0.17***	-0.18***	-0.12***	-0.12***
	[-0.23, -0.11]	[-0.25, -0.11]	[-0.17, -0.07]	[-0.17, -0.07]
Market Oriented*childhood SES	-0.18***	-0.17***	-0.06*	-0.07*
	[-0.24, -0.12]	[-0.23, -0.11]	[-0.12, -0.01]	[-0.12, -0.01]
Contradictory*childhood SES	-0.31***	-0.29***	-0.23***	-0.23***
	[-0.39, -0.22]	[-0.37, -0.20]	[-0.32, -0.15]	[-0.32, -0.15]

Gender regime*women				
Traditional Central *women	0.12***	0.13***	0.11***	0.11***
	[0.07,0.17]	[0.08,0.18]	[0.06,0.16]	[0.06,0.16]
Traditional Southern*women	0.20***	0.22***	0.21***	0.21***
	[0.10,0.30]	[0.11,0.32]	[0.11,0.31]	[0.11,0.31]
Market Oriented*women	-0.05*	-0.03	0.005	0.005
	[-0.10, -0.01]	[-0.08,0.02]	[-0.04,0.05]	[-0.04,0.05]
Contradictory*women	0.18***	0.19***	0.19***	0.19***
	[0.12,0.24]	[0.13,0.25]	[0.13,0.25]	[0.13,0.25]
Gender regime*women*childhood SES				
Traditional Central *women*childhood SES	-0.12***	-0.12***	-0.12***	-0.12***
	[-0.19, -0.05]	[-0.19, -0.06]	[-0.16, -0.07]	[-0.16, -0.07]
Traditional Southern*women*childhood SES	-0.19	-0.2	-0.22*	-0.22*
	[-0.39,0.00]	[-0.40,0.00]	[-0.40, -0.03]	[-0.40, -0.03]
Market Oriented*women*childhood SES	0.08***	0.07**	-0.02	-0.02
	[0.03,0.13]	[0.02,0.11]	[-0.06,0.02]	[-0.06,0.02]
Contradictory*women*childhood SES	-0.28***	-0.27***	-0.28***	-0.28***
	[-0.35, -0.21]	[-0.34, -0.21]	[-0.35, -0.22]	[-0.35, -0.22]
Random effects				
Logged SD (childhood SES)	-15.54	-14.31	-15.17	-11.92
	[-15.54, -15.54]	[-131.91,103.29]	[-15.17, -15.17]	[-11.92, -11.92]
Logged SD (women)	-17.72	-13.12	-18.79	-17.69
	[-17.72, -17.72]	[-134.40,108.16]	[-18.79, -18.79]	[-17.69, -17.69]
Logged SD (random intercept)	-2.69	-2.78***	-2.85	-2.90
	[-2.69, -2.69]	[-3.16, -2.40]	[-2.85, -2.85]	[-2.90, -2.90]

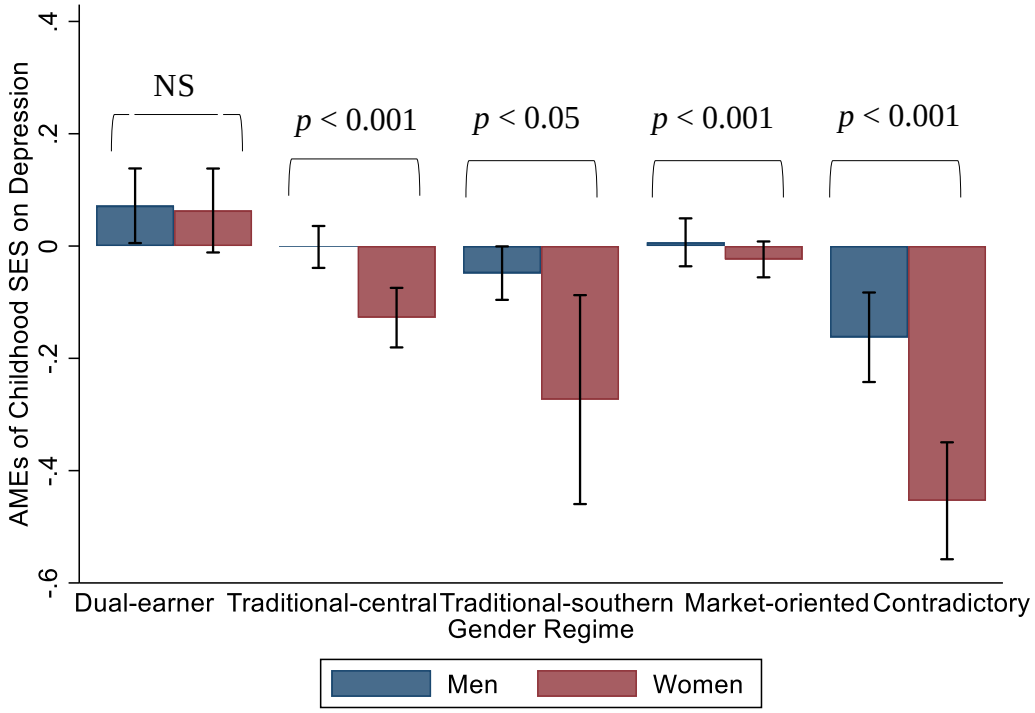
Notes: N = 30,725 from 19 countries. Weighted unstandardized coefficients and confidence intervals (in the squared brackets) are presented. Model 1 is unadjusted. Model 2 adjusts for individual-level demographics (age, age squared, immigrant status). Model 3 further adjusts for individual-level marital status and residential population density. Model 4 adjusts for all individual level variables and country level variables (social spending, health spending, and GDP per capita in 2013).

Figure 4.1 Predicted Adult Depression by Childhood SES and Gender Childhood SES and Adult Depression, by Gender



Notes: This figure was generated based on Model 4 from Table 2. The capped spikes indicate 95% confidence intervals.

Figure 4.2 The Gender Gap in the Average Marginal Effects (AME) of Childhood SES on Adult Depression, by Gender Regimes.



Notes: This figure was generated based on Model 4 from Table 3. The capped spikes indicate 95% confidence intervals. The texts above the brackets indicate the statistical significance of the gender difference. NS= not significant.

Chapter 5 : Conclusion

In contrast to a person's biological sex, gender is socially constructed and refers to the culturally defined roles, responsibilities, attributes, and entitlements associated with being a woman or man, as well as the power dynamics between women and men within a specific social context (Hart et al., 2019; Heise et al., 2019). Recent research has introduced the concept of "contextualizing" gender disparities in health to gain a deeper understanding. This approach moves beyond the predominant focus on individual-level variations in biological, behavioral, and social factors. Instead, it involves expanding the analysis to examine the broader impact of structural differences at the macro level (Homan, 2019; Lee et al., 2021; Read & Gorman, 2010). Drawing from this body of literature, this dissertation aims to contextualize gender and health by adopting a comparative perspective.

How does context matter in the study of gender disparities in health? First, the extent and/or direction of gender disparities in health vary by context. In the first two empirical chapters, I examined the gender difference in a novel health behavior known as persistent smoking, which refers to the continuation of smoking despite having developed smoking-related chronic conditions. The gender gap in persistent smoking and whether it differs across different contexts remain unknown. To address this gap, I conducted an investigation using data from European countries and China to explore gender differences in persistent smoking within both contexts. The findings revealed intriguing patterns. First, the gender disparity in persistent smoking was not uniform across all European countries, with variations observed in the magnitude of the gender difference. Second,

there were contrasting patterns regarding the gender difference in persistent smoking between Europe and China. Among older European adults, women were found to have a higher likelihood of engaging in persistent smoking compared to men. In contrast, among Chinese adults, women exhibited a slightly lower prevalence of persistent smoking than men. Although this difference was not statistically significant, it contrasted with the patterns observed in Europe and the United States, possibly due to the unique sociocultural context of smoking in China. Therefore, the results indicate cross-national variations in gender gaps regarding persistent smoking.

Second, apart from contextual differences in the gender gap in health, these chapters also emphasize the variability of social determinants of health based on gender and context. Chapter Two highlights that the associations between social determinants and health vary by gender. At the individual level, education has a gendered impact on persistent smoking. Consistent with recourse substitution theory, which elucidates the role of education in health for marginalized groups, it is shown that the association between education and persistent smoking is stronger for women than men. At the macro-level, this chapter demonstrates the gendered impact of tobacco control policies on persistent smoking. While these policies, in general, were not associated with persistent smoking among men, women exhibited an inverse association. This gendered responsiveness to tobacco control policies underscores the importance of not only examining directly gender-related institutions but also unraveling the potential gendered impact of seemingly gender-neutral policies and institutions. Chapter Three shows the contextual variation in the social determinants of health. While overall social

participation is associated with less smoking in Europe, it is associated with higher risks of smoking and persistent smoking in China. Given that smoking is prevalent, particularly among men in China, the increased risks of persistent smoking linked to social participation highlight the negative aspects of social capital. These findings collectively shed light on how social gradients of health may vary based on gender and context.

Third, the gendered effects of social determinants of health can also vary by context. In response to the research call for investigating contextual effects in a longitudinal framework to understand how health unfolds across the life course (Read & Gorman, 2010), the third empirical chapter examines gender disparities in depression by integrating an institutional approach with a life-course perspective on health. The findings reveal that women exhibit greater vulnerability to childhood SES in relation to higher rates of depression compared to men. Moreover, this gendered vulnerability is not consistently observed across Europe. Instead, the gender gap is more prominent in gender regimes characterized by higher levels of gender inequality (traditional and contradictory regimes), while it is absent in regimes characterized by greater gender equality (dual-earner and market-oriented regimes). This chapter aligns with the research on structural sexism (Homan, 2019) and demonstrates that inequality in gender systems varies across social contexts. Moreover, gender inequalities in institutional power structures contribute to and perpetuate gendered differences in susceptibility to childhood adverse experiences and mental health disparities throughout the life course. Overall, this chapter underscores the contextual variation in the gendered effects of social determinants of health.

In summary, this dissertation highlights the significance of contextualizing gender disparities in health and identifying macro-level institutions that may contribute to these differences. There are several avenues for future research in this area.

First, recent studies have emphasized the need for improved measures of gender in research on gender and health (Hart et al., 2019). While this dissertation employed the binary categorization of sex to measure gender, it is important to recognize that sex and gender are not synonymous. Furthermore, the measurement of gender should extend beyond a simple binary classification of masculine and feminine. Empirical research has already begun utilizing more comprehensive measures of gender, such as self-perceived femininity and masculinity, to clearly distinguish between gender and sex (Hart et al., 2019). As these improved measures become more prevalent in social surveys, future studies can leverage this data to elucidate the relationships between gender and health.

Second, future research in gender disparities in health can incorporate the lens of intersectionality theory (López & Gadsden, 2016; Collins, 2015) to examine how gender interacts with other dimensions of inequality such as ethnicity, race, sexuality, and immigrant status to shape health disparities. Since systems of oppression such as racism, sexism, and classism are interlocking, mutually constituted, and reinforcing (Collins 2000), employing the intersectional approach allows for a more comprehensive understanding of the complex and interconnected nature of inequality and its impact on health. By examining the joint and potentially synergistic effects of multiple dimensions of inequality, future research can shed light on the unique experiences and health challenges faced by individuals at the intersections of various marginalized identities,

paving the way for more targeted interventions and policies to address health disparities. Moreover, it is important to examine intersectionality at a more systematic level beyond the individual level (Gkiouleka et al., 2018; Homan et al., 2021). For example, the structural intersectionality approach emphasizes the structural aspects of intersectional discrimination and "the consequences of multiple systems of oppression, involving systematic subordination and exclusion of marginalized groups with respect to resources, opportunities, and freedoms in major social institutions" (Homan et al., 2021, p. 354).

Third, while macro-level gender-related policies and institutions are key factors that may contribute to gender disparities in health, the findings from the first chapter indicate that seemingly gender-neutral policies (e.g., tobacco control policies) can have gendered impacts. Hence, future research can adopt a gender perspective to examine whether there are differential responses to policies and institutions based on gender.

Last, both gender and the social determinants of gender and health are dynamic rather than static. Contextualizing gender and health involve not only the cross-sectional dimension but also the temporal dimension. Cohort studies can be employed to investigate how changes in social contexts over time that different cohorts experience shape gender disparities in health over time.

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