Effect of stressful life events on changes in smoking among the French: longitudinal findings from GAZEL

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Background: Changes in life events may play a contributing role in changes in smoking behaviors. The objective was to examine the impact of stressful life events (SLEs) on smoking among French adults. **Methods:** We examined smoking prevalence in 20 625 employees of the French GAZEL cohort for up to 5 years before and after a SLE during three time periods (years –1 vs. –5; years +1 vs. –1; years +5 vs. +1). Repeated measures analysis of time series data indexed to events were used, employing generalized estimating equations. **Results:** For women, comparing 1 year after vs. 1 year before SLEs, decreased odds of smoking were found for employment promotion (OR: 0.80; 95% CI=0.67–0.95), marriage (OR: 0.57; 95% CI=0.48–0.68) and divorce (OR: 0.78; 95% CI=0.68–0.90). Comparing 5 years after to 1 year after SLEs, women had decreased odds of smoking for important purchase (OR: 0.87; 95% CI=0.79–0.96), children leaving home (OR: 0.83; 95% CI=0.74–0.93), retirement (OR: 0.73; 95% CI=0.64–0.83) and death of loved one (OR: 0.86; 95% CI=0.79–0.93). For men, decreased odds of smoking were observed in all three time periods for all SLEs except when comparing 1 year before to 5 years before marriage (OR: 1.66; 95% CI=1.09–2.52) and divorce (OR: 1.49; 95% CI=1.25–1.77). **Conclusion:** Time surrounding SLEs during which individuals are susceptible to changing smoking behaviors may be an important consideration.

Introduction

Major life changes requiring substantial adjustments can have implications for health and health behaviors.^{1,2} Referred to as stressful life events (SLEs), these changes can comprise undesirable events (e.g. widowhood), desirable events (e.g. employment promotion) or mixed ones that consist of both desirable and undesirable characteristics (e.g. children leaving home). SLEs may play a causative role in health outcomes³ through lifestyle risk factors.^{4,5} Smoking—one of the biggest contributors to morbidity and premature mortality^{6–8}—is one such risk factor that may be used as a coping mechanism for dealing with stress associated with life events.^{5,9–11} Some evidence also suggests that SLEs may be associated with both unhealthy and healthy changes in smoking behavior, depending on the nature of the life event.¹² A growing number of studies have explored the relationship between different SLEs and smoking^{5,10,12–16}; however, gaps remain due to methodological approaches used in many of these studies, thereby limiting our understanding of the relationship between these factors.

A number of said studies have used a cross-sectional study design⁵; restricted their analysis to short follow-ups^{12,17}; or focused on younger cohorts.¹⁸ Observing such relationships over time is vital as it offers broader insight into both short- and long-term behavior effects of SLEs; this is particularly relevant for an aging population given that individuals accumulate more SLEs as they get older (e.g. divorce and retirement). Research has also suggested that certain SLEs may influence health-related outcomes prior to the event

occurring due to anticipatory effects; likewise, research has intimated that select SLEs may influence health-related outcomes after the event due to lingering effects.¹⁹ Further, fewer studies have accounted for gender-specific differences in the SLE-smoking relationship¹²; it is unclear whether women may respond differently.²⁰

France is a unique country to study smoking trajectories and their relationship with SLEs. Compared with the USA, the French have one of the world's longest life expectancies while also having one of the highest smoking rates among industrialized nations.²¹ According to France's 2010 Health Barometer, 27.9% of women and 35.6% of men between the ages of 15 and 85 years smoke.²² Though rates drop after 30 years of age, notable ones remain for middle-aged and older adults, especially under 65 years (45–54 years—women: 29.3%, men: 32.8%; 55–64 years—women: 15.5%, men: 20.6%).²² What's more, while men's smoking levels have decreased in recent years, women's have increased.²²

The goal of this investigation was to examine the impact of SLEs representing two major life domains (i.e. interpersonal and financial) on smoking prevalence among middle-aged and older French women and men, using a longitudinal cohort design with annual self-reported measures of smoking from 5 years before to 5 years after each SLE. For each of the three time periods observed (years –1 vs. –5; years +1 vs. –1; years +5 vs. +1), for both women and men, we hypothesized that desirable events would result in decreased odds of smoking while undesirable ones would result in

increased odds. We further hypothesized that mixed events could result in either increased or decreased odds in smoking.

Methods

Study population

This study used data from GAZEL—a cohort consisting of 20 625 French national gas and electricity company employees. The GAZEL cohort has been described in vast detail in earlier studies.^{23,24} Briefly, the GAZEL cohort of 20 625 participants included 15 010 men (73%), aged 35–50 years at baseline in 1989. Besides collecting data from administrative sources of the company, participants are asked to complete annual self-administered surveys, covering a number of areas, including socio-demographics, health behaviors, life changes and occupational characteristics. The initial participation rate was 44.8%. Of the 20 625 participants at inception in 1989, 17 907 (4895 women and 13 012 men) were still participating in the cohort as of 31 December 2013. Almost 10% have died (2 028 deaths: 328 women or 5.8% of the initial women's population, and 1700 men or 11.3% of the initial men's population). Further, 555 (2.6%) either never answered the annual questionnaire after 1989 or formally decided to stop their participation and are considered to be dropouts; 135 (0.6%) were lost to follow-up. The study protocol, including a written consent of the cohort participants, was approved by the French authority for data confidentiality (Commission Nationale Informatique et Liberté # 105 728) and by the Ethics Evaluation Committee of INSERM (IRB0000388, FWA00005831).

Measures

Stressful life events

Informed by the Holmes and Rahe list of SLEs that impact health, we investigated important changes in interpersonal and financial domains; interpersonal: i) marriage, ii) children leaving home, iii) divorce, iv) widowhood and v) death of loved one; financial: vi) employment promotion, vii) important purchase and viii) retirement.²⁵ We defined life events as the first instance after 1989 that an individual experienced a given event in the past 12 months (yes/no). We selected the initial occurrence of a SLE given that the first occurrence has been found to be more impactful compared with subsequent ones due to the 'sensitization' hypothesis.²⁶

Smoking

We used smoking prevalence as our outcome variable. This was defined as those who were current smokers vs. non-smokers. In annual surveys, smoking status (yes/no) was determined by one question gauging whether participants were current smokers (at least one daily cigarette), non-smokers or former smokers.

Covariates

All covariates were captured via participants' self-administered surveys. The following variables were adjusted for in the models based on *a priori* knowledge of their potential for confounding the association between SLEs and smoking: age (35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65+), self-perceived health status (excellent, good, fair, poor) and education (< high school, high school, > high school) and employment grade (manual worker/clerk, administrative associate/technician, manager) at baseline.

Statistical analyses

The aim of this study was to characterize smoking prevalence before, during, and after an SLE. Because women and men generally have distinct smoking practices and may respond dissimilarly to SLEs,^{12,20}

all analyses were stratified by gender. We used a single group pre-post study design with repeated measures analysis of time series data indexed to SLEs. Prevalence of smoking over time was estimated using generalized estimating equations to account for the within-subject correlation, with a logit-link, binomial distribution in STATA vs. 11.2.²⁷ An independent working correlation was used to account for time-varying covariates.

Across all models, analyses used up to 11 years of data (from 1989 to 2010) for each participant who experienced a given event ($N=20\,625$). We included individuals who provided data on smoking for the year of the SLE and for at least 2 years before and after each event ($N=18\,523$). Though participants could experience several events between and within categories, for the purpose of this study, we only focused on the first instance an event was experienced, given that initial occurrences are typically the most impressionable.²⁶ For each of the eight SLEs, we restricted the analysis to subjects who experienced the specific SLE, leading to different sample size denominators (ranging from $n=574$ for marriage for women to $n=13\,570$ for retirement for men).

We first tested for differences in odds of smoking in three separate time periods (before, during and after each SLE), adjusting for socio-demographics. We report relative odds of smoking: odds for smoking (smoking/not smoking) during one time point relative to the odds of smoking (smoking/not smoking) during another time point. To test for smoking before an SLE, we tested for a difference in the odds of smoking 1 year pre-event compared with 5 years pre-event (years -1 vs. -5). To test for smoking during the time of the SLE, we tested for a difference in the odds of smoking 1 year post-event compared with 1 year pre-event (years $+1$ vs. -1). To test for smoking after the SLE, we tested for a difference in the odds of smoking 5 years post-event compared with 1 year post-event (years $+5$ vs. $+1$). We then produced graphs of covariate-adjusted trajectories to show trends in smoking prevalence over time for each SLE, separately for women and men.

Results

The socio-demographic profile of participants in our study ($N=18\,523$; results not shown) was as follows: roughly 73% of participants identified as male. The overall mean age was approximately 58 years at baseline (women tended to be younger), with 10% below 50 years of age. Forty-two percent had at least a high school education. The vast majority reported being in good or excellent health and nearly 60% held an administrative associate/technician position at baseline.

Tables 1 and 2 show odds ratio (OR) of smoking in three different time periods (years -1 vs. -5 ; $+1$ vs. -1 ; $+5$ vs. $+1$) for each SLE and for women and men, separately. By and large, we observed decreased odds of smoking, especially in the 1 year period surrounding the life events and in the years after life events.

Interpersonal events

In comparing the odds of smoking 1 year before the event compared with 5 years before the event, significant decreased odds of smoking were reported for children leaving home (women: OR = 0.73, 95% confidence interval (CI) = 0.66–0.80; men: OR = 0.65, 95% CI = 0.62–0.69), widowhood (women only: OR = 0.76, 95% CI = 0.59–0.98) and death of loved one (women: OR = 0.80, 95% CI = 0.72–0.89; men: OR = 0.74, 95% CI = 0.71–0.78). Among men, we observed 66% increased odds of smoking for marriage (95% CI = 1.09–2.52) and 49% increased odds of smoking for divorce (95% CI = 1.25–1.77). For the 1 year after the time of the event vs. the year before, we observed decreased odds of smoking for marriage (women: OR = 0.57, 95% CI = 0.48–0.68; men: OR = 0.44, 95% CI = 0.38–0.51), divorce (women: OR = 0.78, 95% CI = 0.68–0.90; men: OR = 0.63, 95% CI = 0.57–0.69), widowhood (men only: OR = 0.74, 95% CI = 0.65–0.85) and death of loved one (both sexes displayed 13% decrease in the odds of smoking). In the

Table 1 Smoking ORs for women during three time periods relative to SLE^a

		Year -1 vs. -5		Year +1 vs. -1		Year +5 vs. +1	
	<i>n</i>	OR	95% CI	OR	95% CI	OR	95% CI
Interpersonal events							
Marriage	574	0.85	0.50 – 1.43	0.57 ^b	0.48 – 0.68	0.9	0.72 – 1.12
Divorce	980	1.01	0.76 – 1.33	0.78	0.68 – 0.90	0.9	0.77 – 1.06
Children leaving home	2411	0.73	0.66 – 0.80	1.06	0.98 – 1.16	0.83	0.74 – 0.93
Widowhood	586	0.76	0.59 – 0.98	0.85	0.70 – 1.02	0.9	0.71 – 1.13
Death of loved one	4136	0.8	0.72 – 0.89	0.87	0.81 – 0.94	0.86	0.79 – 0.93
Financial events							
Employment promotion	810	0.74	0.58 – 0.95	0.8	0.67 – 0.95	1.02	0.86 – 1.21
Important purchase	3230	0.74	0.66 – 0.82	0.93	0.86 – 1.01	0.87	0.79 – 0.96
Retirement	4017	0.89	0.81 – 0.98	0.87	0.79 – 0.95	0.73	0.64 – 0.83

Year 0 is the year of the experienced life event.

a: Adjusted for age, self-rated health, and education and employment grade at time of event.

b: The odds of smoking for a woman is 0.57 times or (43%) lower 1 year after getting married compared with 1 year before getting married.

Table 2 Smoking ORs for men during three time periods relative to SLE^a

		Year −1 vs. −5		Year +1 vs. −1		Year +5 vs. +1	
	<i>n</i>	OR	95% CI	OR	95% CI	OR	95% CI
Interpersonal events							
Marriage	732	1.66 ^b	1.09 – 2.52	0.44	0.38 – 0.51	0.78	0.65 – 0.92
Divorce	1830	1.49	1.25 – 1.77	0.63	0.57 – 0.69	0.79	0.71 – 0.88
Children leaving home	6444	0.65	0.62 – 0.69	0.96	0.91 – 1.01	0.73	0.68 – 0.78
Widowhood	1123	0.93	0.79 – 1.09	0.74	0.65 – 0.85	0.81	0.67 – 0.98
Death of loved one	11 444	0.74	0.71 – 0.78	0.87	0.84 – 0.91	0.78	0.74 – 0.82
Financial events							
Employment promotion	1490	0.78	0.65 – 0.94	0.79	0.71 – 0.88	0.83	0.79 – 0.93
Important purchase	10 001	0.75	0.71 – 0.79	0.91	0.87 – 0.94	0.76	0.72 – 0.80
Retirement	13 570	0.81	0.77 – 0.84	0.84	0.81 – 0.88	0.72	0.69 – 0.76

Year 0 is the year of the experienced life event.

a: Adjusted for age, self-rated health, and education and employment grade at time of event.

b: The odds of smoking for a man are 1.66 times or (66%) higher 1 year before getting married compared with 5 years before getting married.

years subsequent to the event (i.e. comparing 5 years after vs. 1 year after), for women, significant decreased odds of smoking were reported after children leaving home (OR=0.83, 95% CI=0.74–0.93) and death of loved one (OR=0.86, 95% CI=0.79–0.93) and across all interpersonal events for men.

Financial events

In the years before the event (years -1 vs. -5), significant decreased odds of smoking were reported for employment promotion (women: OR=0.74, 95% CI=0.58–0.95; men: OR=0.78, 95% CI=0.65–0.94), important purchase (women: OR=0.74, 95% CI=0.66–0.82; men: OR=0.75, 95% CI=0.71–0.79) and retirement (women: OR=0.89, 95% CI=0.81–0.98; men: OR=0.81, 95% CI=0.77–0.84). For the 1 year around the time of the event, we observed significant decreased relative odds of smoking in the 1 year after vs. the year before for employment promotion (OR=0.80 for both women and men), important purchase (men only: OR=0.91, 95% CI=0.87–0.94) and retirement (women: OR=0.87, 95% CI=0.79–0.95; men: OR=0.84, 95% CI=0.81–0.88). In comparing the odds of smoking 5 years after the event compared with 1 year after, significant decreased odds of smoking were reported after important purchase (OR=0.87, 95% CI=0.79–0.96), and retirement (OR=0.73, 95% CI=0.64–0.83) for women, and across all financial events for men.

To provide additional perspective to the results in tables 1 and 2, we produced graphs (figure 1) showing trends of smoking rates over

time relative to each experienced SLE, adjusted for covariates, for women and men, separately. For both genders, most prominent changes were peaks in the percentage of smokers prior to marriage and divorce, with trends staying relatively stable and/or slightly declining over time, especially in the years after an experienced event.

Discussion

Summary of findings

The goal of this study was to explore the influence of several important interpersonal and financial SLEs on smoking prevalence across time, among a large sample of aging French adults, paying particular attention to years before, during and after each life event. Overall, our findings suggest a healthy influence of SLEs on smoking behavior, with decreased odds of use typically observed across time, for both women and men. More specifically, women reported significantly reduced odds of smoking more frequently in the before time period (comparing years -1 vs. -5). Men reported significantly reduced odds of smoking more frequently in the after time period (comparing year +5 vs. +1), although significant relationships were noted for nearly all SLEs in the three time periods. Trajectories revealed a spike in the percentage of smokers prior to marriage and divorce; still, overall, percentages remained steady and comparable to pre-event levels or declined slightly over time.

Figure 1 Percentage of smokers relative to SLE, separately for women and men

Explanation of findings

With some exceptions, our results suggest that SLEs—be they desirable, undesirable or mixed—could serve as a protective factor against increased odds of smoking for both women and men. These findings appear counterintuitive, especially in light of evidence that smoking may be used as a coping mechanism to deal with stress.

Interpersonal events

Evidence has revealed that interpersonal loss—such as widowhood and experiencing the death of a loved one—can motivate healthy behavior change, particularly when the behavior is widely known to increase mortality.¹²

Studies have also found that through characteristics of ties and support, social relationships can both negatively¹⁶ and positively^{28,29} influence smoking. Marital status or a change in status can play a big role in smoking behavior in several ways. For one, partner smoking status has been found to impact an individual's smoking behavior^{16,30}. Second, increased stress brought on by potential marital strife or, contrarily, reduced stress experienced through marital resolution can also influence smoking practices³¹; these relationships may also be cyclical.

Another social relationship (one's children) may also impact smoking use. In France, adolescents and young adults aged 15–25 years represent the leading consumers of tobacco, with nearly 21% and 27% of 15- to 19-year-old young women and men, respectively, smoking and almost 39% and 43% of 20- to 25-year-old women and men, respectively, smoking. Thus, young smokers leaving home may have a healthy impact on their parents' smoking habits. That said, youth who move away from home are themselves more likely to smoke compared with their peers still living at home.²²

Financial events

Financial-related SLEs may also have healthy effects on smoking behavior. We found that higher employment grade (i.e. by way of a promotion) is linked to less smoking, which is in line with

research showing that workers who are more formally educated and/or reach white-collar rather than blue-collar positions report decreased odds of smoking. Likewise, evidence also supports our finding of decreased smoking for retirement.³² One explanation posited is reduced finances brought on by a non-working status. Over the last two decades, the cost of a pack of cigarettes in France has risen from roughly 1.98 euros to 6.10 euros, on average, and up to 7 euros/pack, with other forms of tobacco costing even more.³³ In the same way, making an important purchase, which by definition would equate to fewer funds, might also follow a similar pattern.

Limitations and strengths

Several limitations must be noted when interpreting these findings. SLEs examined reflected those experienced in the prior 12 months; thus, reporting bias is a possibility, although given the magnitudes of changes observed, we contend that this most likely does not pose issue. Further, some evidence has suggested that undesirable or negative SLEs may be more likely to be recollected compared with desirable or positive ones^{4,34} leading to recall bias. Smoking is a behavior generally initiated at earlier ages³⁵ than of those in the GAZEL cohort. What's more, smokers typically suffer from premature mortality⁶ thereby contributing to decreased prevalence of smoking over time. Hence, age and time are important factors when considering the relationships examined in this study. That said, the prevalence of middle-aged and older French smokers in the general population is still noteworthy and our analyses did adjust for age.²² The study sample consisted of only 27% women, which could have had a negative impact on power among the female strata. This could explain why we did not identify the same frequency of significant findings for women compared with men even though the direction and magnitude of the ORs were very similar between the sexes. We also controlled for socioeconomic factors (e.g. education) that may not change over time and thus may not serve as true confounders due to the within-subject design where we are using the time periods as the 'exposure'

condition. Though we adjusted for self-rated health, it is possible that there could be a causal pathway that connects SLEs, smoking and self-rated health. Future studies should focus on uncovering those potential causal pathways. Finally, findings may not be generalizable to non-French or other like populations who have distinct norms and attitudes toward smoking and smoking bans, as well as different smoking policies.

We also offer several study strengths. We examined a number of SLEs that are universally experienced, while also adding to current evidence by assessing how individual SLEs influence smoking, separately for women and men. We also studied smoking trajectories within a sizeable and constant population over many years—an essential approach given the continued impact of smoking on morbidity and mortality, which is especially salient for an aging population.

Conclusion

The success of tobacco control efforts depends on recognizing the fundamental causes that change smoking behavior. Examining determinants across the life course that may render individuals more or less vulnerable to smoking is an important avenue of research to aid in these efforts. Additional investigation into the influence (and directionally of said influence) that SLEs may have on smoking is needed to better understand some of the underlying mechanisms involved in these relationships over time.

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Conflicts of interest: None declared.

Key points

- Stressful life events may have implications for smoking behavior.
- Less is known about the impact of desirable, undesirable and mixed SLEs on smoking prevalence among women and men, over time.
- SLEs may have a healthy impact on smoking prevalence.

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