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**Changes in smoking behaviour over family transitions:  
evidence for anticipation and adaptation effects**

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**Abstract:**

**Objectives:** This paper aimed to analyse the temporal relation between family transitions (partnership formation, first childbirth, separation) and changes in smoking initiation and cessation.

**Methods:** We propose a discrete-time logistic model to explore the timing of changes in terms of leads and lags effects up to three years around the event in order to measure both anticipation and adaptation mechanisms. Retrospective biographical data from the *Santé et Itinéraires Professionnels* (SIP) survey conducted in France in 2006 are used.

**Results:** Partnership formation was followed for both genders by a fall in initiation and a contemporaneous rise in cessation. Effects related to first childbirth were strongly patterned by gender, as a protective anticipation effect was found in initiation and cessation for women, while only a contemporaneous rise in cessation was observed for men. Separation was preceded by unhealthy behavioural changes in women, while this effect was contemporaneous for men.

**Conclusion:** Our findings highlight opportunities for more targeted interventions over the life course to reduce smoking, and therefore have relevance for general practitioners and public policy elaboration.

**Key words:** smoking, family life transitions, life cycle, longitudinal analysis, anticipation effects; adaptation effects

## **Introduction**

Over the past decades, the dissemination of information on the harmful effects of tobacco and the implementation of public policies have contributed to a gradual and continuous decrease in smoking prevalence. In fact, this decline in smoking was largely attributed to a decrease in prevalence in the most privileged groups and was more contrasted for women<sup>1-3</sup>. These evolutions have led to a sharp increase in social inequalities in smoking and a convergence of male and female prevalence.

At the present time, differences between men and women remain in the age pattern of smoking for the most recent cohorts: in the most educated group, women more frequently smoke regularly than men before the age of 25, and do so less frequently after this age. These differences can probably be explained by a greater cessation of women at the approach of their first pregnancy, especially among the most educated, and could also reflect the specificities of smoking patterns by gender and social group<sup>4-6</sup>. Exploring the dynamics of changes in smoking behaviors over the life course appears to be a promising line of research to understand the persistence as well as the evolution of smoking disparities over cohorts and over ages.

Smoking during childhood and adolescence has been studied in detail since this period of life is crucial to the understanding of the context of experimentation and transition to daily use of cigarettes. This literature has highlighted the responsiveness of smoking initiation to price and regulation factors as well as family and peer contexts explaining smoking initiation<sup>7-9</sup>. But the period of smoking initiation goes beyond adolescence and corresponds to the period of the transition into adulthood. This period of life is associated with the transitions to adult work and family roles and the related changes in health behaviors<sup>10,11</sup>, which could explain differences in smoking across social groups<sup>12</sup>. To date, the literature on the impact of family life transitions on smoking behaviors is very limited. The present study is therefore an attempt to fill this gap by focusing on the impact of family transitions on smoking behavior, especially in relation to couple formation, first childbirth and separation.

Empirical findings on smoking behaviors and family events are mostly based on contemporaneous correlations in cross-sectional data, with a focus on the effect of family status rather than on family events. A protective effect of being in couple on smoking has been shown with a greater influence of living with a partner for men, whereas women are more affected by separation<sup>13,14</sup> which is consistent with the greater vulnerability of women to stressful events<sup>15</sup>. These effects can also be explained by an influence of partner on smoking, but for that it is necessary to distinguish the effects of matching or bargaining: matching between partners would come from a tendency of individuals to choose a partner sharing the same lifestyles or preferences whereas bargaining refers to a negotiation process between spouses or partners about smoking<sup>16</sup>. Some authors have shown that the correlation of smoking between partners would rather be due to the effects of matching than bargaining<sup>17</sup> but an influence of partner on smoking have also been demonstrated<sup>18</sup>. Concerning the birth of a child, the literature shows few

changes in smoking of men in comparison with women. For women, there would be relatively little long-term effect because of relapse after pregnancy<sup>19-21</sup>. Studies of men's smoking behaviors at the time of the birth of their child are rare and show little changes in smoking behavior or only among the best-educated<sup>22</sup>, with the exception of changes in their habits such as not smoking in the home<sup>23</sup>.

One shortcoming of available studies is that they have considered family transitions as discrete events and only considered the subsequent changes. Viewing family transitions as discrete events per se is questionable, as those transitions are the outcome of a long process and their consequences develop over time. For instance, marital relations start to deteriorate long before the partners break up, and there is often a long time elapsing from the initiation of the project of having a child to the actual birth<sup>14</sup>. Family transitions may therefore lead to changes in behavior occurring before the happening of the event ("anticipation effects"). They may also lead to changes after the transition has taken place, and those may be temporary or permanent ("adaptation effects"). Another aspect which has hardly been addressed is that of the gendered dimension of the long-term processes. In other words, do transitions within the family similarly influence men's and women's health behaviors, and if not, what are the gender-specific patterns?

In this paper, we investigate the question of family life transitions and smoking with a perspective integrating both the time and gender dimensions. We are specifically interested in the roles of partnership, separation or childbirth as transitions triggering changes in terms of smoking uptake or cessation and in the gender-specific dynamics in this respect. Furthermore, we enlarge the observation window by considering both the three-year period preceding the actual transitions and the three-year period following them, in order to visualize the unfolding of the processes, from anticipation of impending changes to adaptation to different family life circumstances, be they positive (partnership consolidation, birth of a child) or negative (partnership breakdown), or both at the same time. To conduct this analysis, we use the Santé et Itinéraires Professionnels (SIP) survey conducted in 2006 in France, which provides both retrospective information on the timing of family life events and age of smoking initiation and eventual cessation.

## **Methods**

### ***Empirical strategy***

The aim of this paper is to estimate the impact of family events on smoking trajectory, and particularly the changes in smoking behavior before (anticipation), during (contemporary) and after (adaptation) the transition to a different family situation.

### ***A general approach***

We favor a discrete time approach with panel econometric strategies to distinguish between individual variations and within individual variations in longitudinal data structure. This strategy is usual in

multilevel analysis and estimates both within and between individual effects by including individual means of time-varying variables, called within-between estimator or Mundlak specification in the econometric literature <sup>24,25</sup>. The formulation allows to test within and between effects in the same model. An alternative approach often used in linear model is to estimate within effects separately using fixed effects model. For the case of a binary outcome variable, such as smoking status, we favor the within-between strategy instead of the conditional logit fixed effects model that would have excluded individuals without longitudinal variation. This approach has the advantage to include ever-smokers and never-smokers in the analysis.

We consider a discrete-time logistic regression of smoking with the following formulation of the latent variable of smoking for the individual  $i$  at age  $t$ :

$$S_{it}^* = \alpha \cdot X_{it} + \beta \cdot E_{it} + \delta \cdot \bar{E}_i + \gamma \cdot Z_i + w_i + e_{it} \quad (Eq. 1)$$

with  $i=1, \dots, N$  and  $t=17, \dots, T$ .

where  $X_{it}$  is a vector of time-varying individual variables,  $E_{it}$  is a vector of time-varying individual family variables (i.e. living with a partner, having a first child, being separated, including leads and lags),  $\bar{E}_i$  is a vector of individual means of the family variables,  $Z_i$  a vector of fixed individual control variables,  $w_i$  an individual specific effect of unobserved variables and  $e_{it}$  an idiosyncratic errors terms.

In this model, the successive observations for a given individual from the retrospective age of 17 to the age at the time of the survey are not independent. Consequently, logistic model was estimated with heteroscedasticity adjustment on individual clusters.

#### *A specific approach to measure leads and lags*

The general approach presented before assumes a contemporary relationship between variables which could be very restrictive. Here, we propose a specific approach to measure leads (anticipation) and lags (adaptation) effects of family transitions on smoking in addition to contemporary effects. This approach estimates effect of life events on smoking behaviors up to three years before and after the event. It has been used in the context of the study of the effect of life events on life satisfaction <sup>26-28</sup>, alcohol consumption <sup>29</sup> and more generally in the context of treatment effect analysis of public policy for example <sup>30</sup>.

We propose to consider a three years window around life events, with dummies of leads effect (3 years before, 2 years before, on year before), the contemporary effect and dummies of lags effect (one year after, two years after, three of more years after) :

$$S_{it}^* = \alpha \cdot X_{it} + \sum_{j=1}^3 \beta_{t-j} \cdot E_{it-j} + \beta_t \cdot E_{it} + \sum_{j=1}^3 \beta_{t+j} \cdot E_{it+j} + \gamma \cdot Z_i + \delta \cdot \bar{E}_i + w_i + e_{it} \quad (Eq. 2)$$

We assume here a reference category for the interpretation of this dynamic, which is “being at least three years before the occurrence of the event” (including never experiencing it).

The effect of the different transitions are estimated jointly in the same model to adjust for successive events. We estimate a model for smoking initiation and another for cessation, separating men and women in each of them.

### ***Data***

This empirical work is based on the data derived from the national representative SIP (Santé et Itinéraire Professionnel) survey, performed by the French Ministries of Labour and Health (DARES and DREES), the French Centre for Employment Studies (CEE) and the French National Institute of Statistics and Economic Studies (INSEE). This survey conducted in France in 2006-2007 is retrospective and jointly accounts for health events and the career paths of individuals. In 2006, households were randomly selected from the 1999 census, which was updated for new housings, and in each household, one individual aged between 20 to 74 years was randomly selected for interview. Finally, 13,648 men and women from the general French population were interviewed at home by a trained interviewer. The participation rate was 76%. The scope of the analysis is restricted to individuals aged between 25 and 74 at the time of the survey, which amounts to 4,989 men and 5,812 women.

The questionnaire made it possible to retrospectively date the age of initiation of daily smoking and the age at the time of smoking cessation (“*Si vous fumez actuellement tous les jours, depuis quel âge?*” / “*Si auparavant vous fumiez tous les jours, de quel âge à quel âge ?*”). Assuming the continuity of smoking from the age the respondent started until the age s/he quit (ex-smokers) or the year of the survey (current smokers), we constructed a smoking binary indicator for every year between the age of 10 and the age at interview, whose value is one if a respondent smoked or zero otherwise.

We use information collected on a biographical grid to construct the family status variables. Partnership episodes are reported and allow to date the age at union and separation periods (“*Avez-vous déjà vécu en couple ? Si oui, situez la ou les périodes*”). The questionnaire defined a partnership episode as a cohabitation period (not necessarily a marriage) during at least one year. Shorter episodes are reported only in the case of the birth of a child. We also used information on the age at first birth (“*Avez-vous eu ou bien adopté des enfants ? Si oui, notez les années de naissance*”).

Adjustment was made for activity status as a time-varying variable in 5 categories: long-term employment (five years or more), short-employment (less than five years, or inactivity and unemployment of less than one year), unemployment (more than one year), inactivity (more than one year) and schooling. The following variables were also adjusted for: social class from last or current (6 categories); number of major life events during childhood (handicap or serious illness, health problems or death of a relative, family conflict or separation, violence, financial difficulties, etc.); educational level; migration status; residence in a rural municipality at the time of the survey; birth cohort, and; log

of cigarette prices of the period (see Table S2 in supplementary materials for descriptive statistics of the variables).

The distributions of age at smoking initiation and cessation and of family events are presented in supplementary materials Table S1 (see Figures S1 and S2 in supplementary materials for graphical representations). This retrospective information is used to construct a person-years database of smoking status, family status and other time-varying or fixed individual variables. Given the age of the first family events, we restricted the person-year database of analysis from 17 years old to 50 years old.

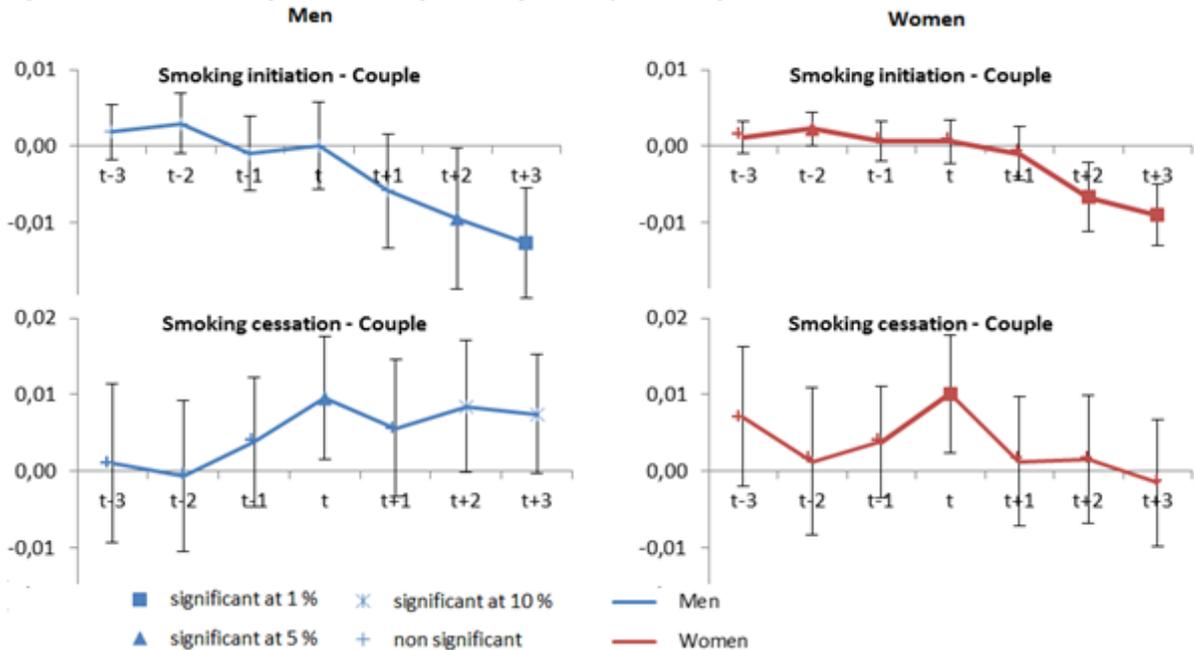
**Results**

*Anticipation and adaptation in smoking behaviors with family transitions*

First, we highlight the impact of family transitions on smoking trajectories of men and women separately (for a complete table of regression results including all covariates, see supplementary materials Table S3-S4). The results originate from different models (smoking initiation and cessation) where the effects of the family events are estimated jointly. This section presents a graphical illustration of the dynamic effect of each family transition on smoking behavior through marginal effects of the timing variables. This dynamic effect has to be interpreted in reference to the baseline level which represents at least three years before the event or never having experienced it.

The graphs in Figure 1 refer to couple formation. Living with a partner has a protective effect on smoking initiation: it delays and decreases smoking initiation after 3 years of cohabitation for men and at least after two years for women (top panel). This protective effect of living in couple occurs as a break in behavior as smoking initiation was significantly higher for women 2 years before this event and as similar but non-significant effects are observed for men.

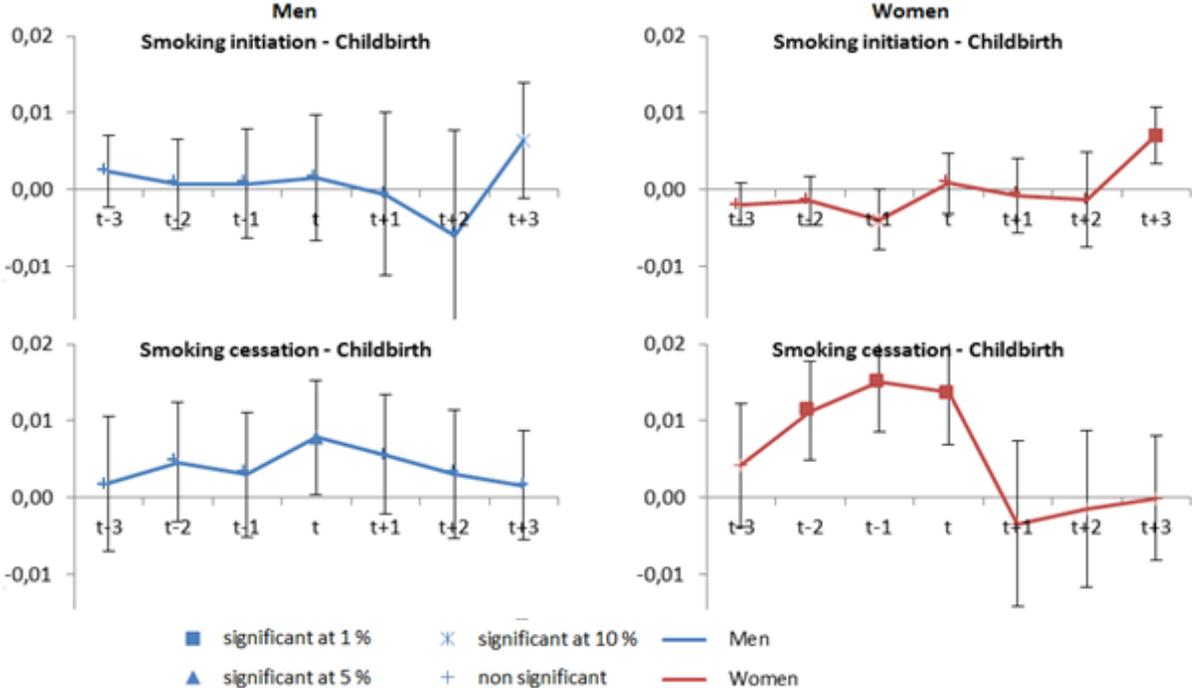
**Figure 1: Leads and lags in smoking – Living in couple (Marginal effects)**



Living with a partner has also an effect on smoking cessation but this effect is mainly a contemporaneous effect which is significant for men and women at the time of the event (bottom panel). This protective effect is consistent with the hypothesis of bargaining effect between partners at the time of couple formation leading to a change in behavior or with the pleasure or ease of being in couple. There is also a long term effect of living with a partner as it increases slightly smoking cessation for men after at least 2 years from this transition (although no such effect is observed in women). Those results confirm the behavioural change following couple formation and the long-term effects of living with a partner, the effects being larger for men than for women.

The graphs in Figure 2 refer to first childbirth. Contrary to couple formation, the birth of a child has a different effect for men and women. Anticipation effects are visible among women two years before childbirth with a rise in smoking cessation up to two years before the birth as well a fall in initiation the year preceding the birth of a child (column 2, top and bottom panel). For men, the birth of a child has only a contemporaneous effect on smoking with a slight increase in smoking cessation at the time of birth (column 1, bottom panel).

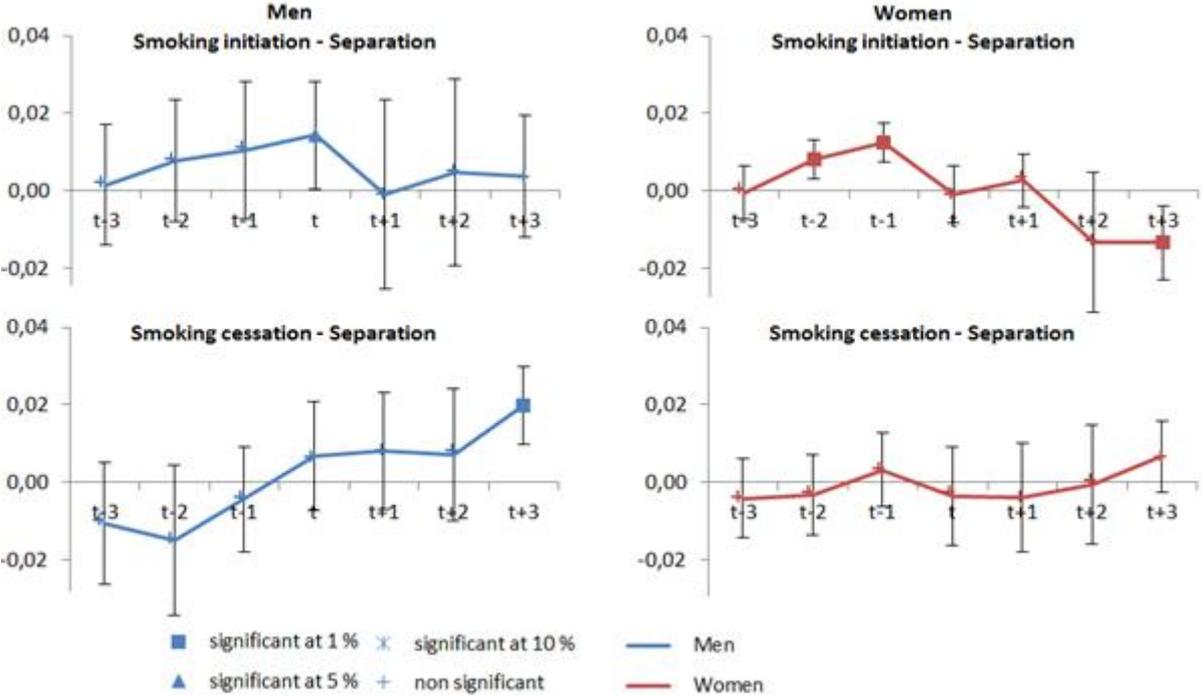
**Figure 2 : Leads and lags in smoking – First childbirth (Marginal effects)**



Further to that, there are adaptation effects related to the birth of a child. We find an increase in smoking initiation at least three years after first childbirth for women and to a lesser extent for men (top panel). This result can be interpreted as a response to the stress and constraints related to the joint exercise of the work and family roles<sup>31</sup>, that would limit the protective effect of childbirth in the long term, especially for women.

The dynamics of separation is also characterized by a contrast between anticipation and adaptation effects and a strong gender pattern (Figure 3). Anticipation effects precede separation for women with an increase in smoking initiation two years and one year before the separation, while the effect is only contemporaneous for men (top panel). Additionally, there is an adaptation effect, with an increase in smoking cessation after three years of separation for men (column 1, bottom panel) and a decrease in smoking initiation after three years of separation for women (column 2, top panel).

**Figure 3 : Leads and lags in smoking – Separation (Marginal effects)**



**Discussion**

We studied the associations between family transitions and tobacco smoking with a method that distinguishes anticipation, contemporaneous and adaptation effects. This takes into account the fact that most of the family transitions are not precisely delimited in time nor defined with a set of criteria: there are continuums in definition and time. As stated by Nystedt (2006) “Most marital life course changes are not instant and totally unexpected since a marriage generally creaks some time before it breaks”. Living in couple or even cohabiting with the partner is the result of a continuous change in life circumstances; even the first childbirth is generally expected and anticipated and it may produce long term behavioural effects, but those might not be permanent. By comparing years before, during and after the family transitions, we shed light on the dynamic of the smoking behaviour associated with major events of the lifecycle.

*Summary of the findings*

Men and women tend to behave in the same way with two exceptions: the first childbirth and the couple formation. The first childbirth accelerates cessation and delays initiation among women, while it only has a positive effect on cessation for men, which is mainly contemporaneous and fades quickly. These results are in line with previous publications regarding anticipation of pregnancy among women and reduced effects in men<sup>5,23</sup>. But this beneficial effect of childbirth may also be temporary for some women who initiate smoking after the birth of their child.

Similarly, living with a partner deters initiation for both genders, while it has a long-term enhancing effect on cessation for men but not for women (for whom only a contemporaneous effect is found). This is in line with the literature that emphasises the fact that marriage is protective against smoking<sup>14,32</sup> and more generally favourable in terms of health behaviours<sup>16</sup> and coherent with findings showing that being married/cohabiting is important for men's cessation success but not for women's. No anticipation effect is clearly visible. Finally a separation is accompanied by an increase in initiation the years before and an increase in cessation some years after. This accords with previous studies concluding that marital disruption is connected to increased smoking risks<sup>14,33</sup>, but we further reveal that the adaptation effects lead in the long term to a return to more balanced behaviours.

### *Limitations*

Our study is based on retrospective data which may lead to some biases and measurement errors. First, differential mortality among smokers could lead to an underestimation of the prevalence of smoking for people older than 70 as suggested by a study testing the validity of retrospective data on smoking<sup>34</sup>. This bias may be limited because only a very small part of our sample is aged more than 70. The use of retrospective data could also entail recall bias and reporting errors. It was demonstrated that these biases were lower for heavy smokers<sup>35</sup> but we cannot address this problem because of lack of information on the number of cigarettes that former smokers were smoking. These biases may vary with level of education and lead to underestimating educational inequalities in smoking in the case of under-reporting by the less educated. The reconstruction of smoking itineraries is also limited by the recall of a single smoking period per individual, not allowing for temporary quitting, which is commoner among the less educated, whose attempts to quit are more numerous and less successful<sup>36,37</sup>. This bias could in fact minimize the short term effect of some family events or transitions as adult ex-smokers are more likely to start smoking again. Nevertheless, the use of retrospective data on smoking avoids attrition and mortality with age which can be encountered with longitudinal studies. Furthermore, the questionnaire was based on an age-event grid, a validated technique of high reliability that allows a homogenous and coherent recall of family and occupational life events<sup>38</sup>. In addition, the advantage of our data is that the unit of time is the year, which is shorter than what is used in the vast majority of longitudinal surveys in which subjects are surveyed every two or five years without any retrospective report of change in

smoking behaviour. This allows a much more detailed analysis, especially the measurement of lags and leads effects.

It is worth noting that we focus on some key family events related to the life cycle, adjusting on the mean time passed in each configuration (couple, first childbirth and separation/single) during the whole life. Couple formation and separation may occur many times during life and it has been shown that multiple broken partnerships reduce the probability of smoking cessation in men <sup>39</sup>, while it is likely that the anticipation or adaptation effect would vary over age and repetition of the same events. And yet, the succession of the events and their timing are likely to moderate the effects on tobacco smoking: for example maternal age is strongly linked to an initiation after birth <sup>40</sup>. Our measure of the average effects of the family events is a strong argument for the robustness of our results.

Contrarily to most papers published on the subject, we did consider cohabitation and living with a partner rather than marital status: this definition is broader and less specific, but maybe more adapted to contemporary life. Nystedt (2006) found that the cohabitation was linked to an increase in smoking compared to marriage, for both genders, which is consistent with a long term protective effect of partnership.

### *Conclusions*

Family life transitions influence health behaviors, leading to permanent or more temporary changes, and those changes are visible well before and sometimes well after the actual shift to a different family configuration. The anticipation effects develop during the long term process leading to those transitions, and the adaptation to this different family setting also necessitates a long period of time. This vision is a better reflection of the unfolding of health behaviour changes during adult life in response to the reconfiguration and instability of close family ties. Our approach shed light on the limitation of the traditional analytic strategy that takes only the contemporary effect of the life events or family status into account and lead to miss the real timing of the changes in smoking behaviour. Attending to the specific vulnerabilities related to partnership disruption and using forthcoming roles and responsibilities as a motivator for positive changes could be an important component of smoking prevention and cessation efforts.

## **Supplementary materials**

### **Tables**

Table S1: Distributions of age at smoking initiation and cessation and at family events

Table S2: Descriptive statistics

Table S3: Discrete-time logistic regression of smoking initiation – Men and Women (Odds-ratio)

Table S4: Discrete-time logistic regression of smoking cessation – Men and Women (Odds-ratio)

### **Figures**

Figure S1: Prevalence of smoking over ages

Figure S2: Distribution of family events over ages

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### **Author Contributions**

Damien Bricard conceived the original idea for the analysis and wrote a first draft of the paper;

Damien Bricard prepared the data and made the statistical analysis with support from Stéphane

Legleye; Myriam Khlat and Stéphane Legleye provided critical feedback and revisions.

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### **Conflict of interest**

The authors declare no conflict of interests.

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