The effect of breastfeeding on passive smoking's issues of smoking mother's infants at 9 months. A cross-sectional study

Yhan Monney (✉ yhan.monney@uvsq.fr)

Universite Versailles Saint-Quentin-en-Yvelines UFR des sciences de la sante Simone Veil

<https://orcid.org/0000-0001-6778-4071>

Amélie Marier

Conseil Départemental des Yvelines

Sandrine Esquerre

Conseil départemental des Yvelines

Pascal Clerc

Universite Versailles Saint-Quentin-en-Yvelines UFR des sciences de la sante Simone Veil

Olivier Saint-Lary

Universite Versailles Saint-Quentin-en-Yvelines UFR des sciences de la sante Simone Veil

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Abstract

Background It has been suggested that the adverse effects of passive smoking on children could be avoided by breastfeeding, especially when they were breastfed longer than 4 months. However, those results have to be more consistent. On the other hand, it has already been shown that tobacco could pass through breast milk with adverse effects on child depending on components. Our aim was to study the link between passive smoking and breastfeeding on health issues of children exposed to passive smoking by their mother during the pregnancy. **Methods** We identified our variables on child's health statements at 8 days and 9 months of life. Each child-smoking mother pair was included in the study. Univariate then multivariate logistic regressions were conducted to estimate first an adjusted odds-ratio of being sick at nine months according to the duration of breastfeeding, and then to estimate another adjusted odds-ratio of being breastfed for longer depending on whether the child was sick before nine months or not. **Results** Univariate analysis have shown a protective effect of a breastfeeding longer than 4 months (OR = 0.44, 95% CI [0.22; 0.90]), which disappeared in multivariate analysis after adjustment (aOR = 0.47, 95% CI [0.22; 1.01]). However, being healthy at nine months increased the probability to be breastfed at least 4 months (aOR = 2.85, 95% CI [1.31; 6.23]). **Conclusion** Breastfeeding's effect seems to be insufficient on passive smoking's adverse effects. Smoking cessation is still a priority when the mother smokes whether she breastfeeds or not.

Background

Smoking during pregnancy, when the mother smokes or is exposed to passive smoking, is considered as the first avoidable cause of many childhood diseases, mainly: prematurity, low birth weight, respiratory tract infections, atopic disorders including asthma and eczema, otitis media, gastro-oesophageal reflux, and metabolic disorders (1). This negative effect can persist during infancy, especially when children are exposed to cigarette smoke at home.

Nicotine disseminates in breast milk reaching concentrations 10-fold higher than those present in the mother's plasma when the mother smokes or is exposed to passive smoking (2). It is quickly metabolised by infant's bowel, accumulated in several tissues, and is suspected to induce apnoea, restlessness, and vomiting (3) in suckling infants. There are few studies based on other toxic components found in tobacco smoke, but it is believed that those components also spread in breast milk with their own adverse effects (4,5).

On the other hand, breast milk is considered as the gold standard of infants' feeding, especially in the first six months of life (6), and is known to protect mothers and children. A large meta-analysis, published in 2016 (7), has shown that breastfeeding could protect against: infant mortality (all causes), diarrhoea, respiratory tract infections and obesity. The effect of breastfeeding on the risk of atopy is still controverted.

Whereas toxic components of tobacco can be found in breast milk, few studies suggest that breastfeeding could protect against passive smoking outcomes on children, especially on respiratory tract infections (8), infantile colic (9,10), and cognitive performances (11). Occurrence risk of passive smoking diseases in childhood became non-significant when infants were breastfed for longer periods of time (4 or 6 months depending on studies).

To our knowledge, similar studies don't exist in France, where breastfeeding initiation and duration are among the lowest in Europe(12,13), and maternal smoking during pregnancy is among the highest, given that 80% of women who stop smoking when pregnant relapse during the first year after delivery (14).

Our objective was to study the relationship between breastfeeding (including its duration) and passive smoking's adverse effects on children of mothers who have smoked during the pregnancy, at 9 months.

Methods

Aim, design and setting of the study

The study was conducted in the aim of exploring the influence of being breastfed on the health's status of smoking mother's children, taking into account that tobacco's components diffuse across breastmilk and the benefits of breastfeeding on children.

Our design consisted in a cross-sectional comparative study between "sick" and "healthy" children exposed to tobacco by their mother during the pregnancy.

With the County Council of our department's agreement, we analysed data from health statements completed during two systematic general practitioner visits (the first visit took place eight days after delivery and the second at nine months).

Study population

A mother was considered to have smoked during the pregnancy if she had smoked at least one cigarette while she was pregnant.

We included all infant/smoking mother's pairs living in Yvelines department (France) from 2009 to 2014 for whom we had data from both health statements. Yvelines department has been chosen for multiple methodological reasons:

- Agreement of County Council of Yvelines department for the access to health assessments of children database.
- Socio-demographic variability.
- Ethnic diversity.

- 8th day assessments of health collecting near 100%.

For twins' pregnancies, we have included an infant/mother's pair for each of the new-borns.

Variables selection and coding

We have selected variables available in the database known to be associated with maternal smoking: "recurrent otitis", "recurrent respiratory tract infections", "other respiratory tract diseases", "gastro-oesophageal reflux", "eczema", and "other dermatologic diseases" (15). Children were considered "sick" if they had at least one of the health issues listed above before 9 months, and "healthy" if not.

Breastfeeding was coded with a binary response variable (yes/no). Breastfeeding duration was coded with a categorical variable separated into 3 categories: "from 1 to 8 weeks", "from 9 to 18 weeks", and "more than 18 weeks".

Confusion variables were chosen when they interfered with passive smoking outcomes in children and/or breastfeeding and its duration, based on literature's evidence (15), that is to say:

- Neonatal comorbidities: "gestational age", "mode of delivery", "birth weight", "intensive cares".
- Socio-demographic characteristics of parents: "mother's age at delivery" (< 37 / > 37 years old), "mother and father's professional status" (at work/at home), "parents' socio-professional categories" (independent manager / executive or intellectual profession / employee or worker).

Statistical analyses

Descriptive statistics of the sample were expressed in proportions for binary response and categorical variables, with a 95% confidence interval. For continuous variables, they were expressed in median and extremes.

We used a logistic model to estimate the probability, for smoking mothers' infants, to present one or more of tobacco's adverse effects before 9 months, depending on breastfeeding and its duration. Confusion variables were kept if they were associated with the "being sick" status at a 20% threshold or if they were already known to be associated with it in literature. The odds ratio was adjusted on our confusion variables, with its confidence interval at 95%, by a multivariate logistic regression. The model adequacy was evaluated with a Hosmer and Lemeshow test.

Because of a possible inversed causality argument, we used a second model, the inversed logistic model, on data from breastfed children, to calculate the probability, for a smoking mother's child, of being breastfed for longer (at least 18 weeks), knowing that he hasn't been sick before 9 months.

Statistical analysis were conducted with the SAS® 9.3 software. Confidence intervals and statistical significance degrees were estimated with an alpha risk at five percent.

Results

Descriptive statistics of the sample

The flow chart of the study is described in *figure 1*.

Out the 5,041 children for whom we had the 8th day assessment of health and whose mother had declared to have smoked during pregnancy, there were 1,765 children (35%) for whom we had the 9th month assessment of health and who were included in the study.

Descriptive statistics of the sample are summarized in *table 1*.

The median breastfeeding duration was 12 weeks. Extremes were going from 1 to 45 weeks. Our 3 groups of breastfed children were homogeneous for the duration of breastfeeding ($p = 0.63$).

In the 7.3% ($n = 122$) sick children, some of them had at least two issues.

The median birth weight was 3.130 kg and extremes were going from 0.790 kg to 4.600 kg.

The median of gestational age was 39 weeks, and extremes were going from 25 to 42 weeks.

The median of mothers' age at the delivery was 30 years old, and the extremes were going from 15 to 45 years old.

First modelling

The first model concerned the probability to be "sick" when being breastfed for longer. The results are summarized in the *table 2*.

Multivariate logistic regression model has read 1491 / 1765 observations (84.5%). Missing values were not significantly linked to our variable of interest ($0.25 < p < 0.99$).

Confusion variables which could be kept ($p < 0.20$) were:

- Mother's age at birth > 37 years old
- Birth weight (continuous)
- Gestational age at birth (continuous)
- Birth by caesarean
- Neonatal reanimation necessity

- Mother's work status (stay at home mother)

We could observe that future "sick" children at nine months were breastfed or bottle-fed at birth without any significant difference ($p = 0.65$). At nine months, being breastfed for at least 18 weeks seemed to be protective in univariate analysis ($p = 0.009$) whereas it wasn't in multivariate analysis ($p = 0.052$).

Neither comorbidities nor having an unemployed mother were associated to the status of "being sick" at nine months.

Second modelling

The second model estimated the probability to be breastfed for longer when being "healthy" before nine months. The results are summarized in the *table 3*.

The inversed logistic model has read 697 observations (86% of the breastfed children).

To be healthy at 9 months wasn't associated with being breastfed at birth: OR = 0.98 (IC95% [0.66; 1.46]).

On the contrary, to be healthy at nine months was strongly and significantly associated with a high probability of being breastfed for longer ($p = 0.009$). The same conclusion was applicable for the mother's social status: to be at home for a smoking mother was significantly associated with a longer duration of breastfeeding ($p = 0.002$).

The other comorbidities were not significantly associated with the duration of breastfeeding in our model.

The Hosmer and Lemeshow test validated the model fit to data ($p = 0.39$). Our statistical power has been evaluated to 99.8%.

Discussion

Main results

We have shown that breastfeeding wasn't significantly associated with a decrease of passive smoking issues at 9 months for children of smoking mothers, when considering an adjustment on neonatal health issues or and socioeconomic status of mothers. On the contrary, in a secondary analysis, healthy children seemed to be breastfed for longer (more than 18 weeks).

Strengths and limits

Our study was the first to explore the effect of breastfeeding on tobacco's adverse effects on children of smoking mothers in France. It has been done on public funding and without conflicts of interest.

8th day assessment of children health is a standardised, reproducible and systematic survey asked to mothers for all the new-borns.

9th month assessments of health collecting was estimated to 42%. This inclusion bias can be explained by the differences between doctors in the involvement in preventive medical care. It can be considered as non-differential.

Our sample size has permitted to reach a statistical power of 99.8%. Our study was robust. Groups for breastfeeding duration were statistically homogeneous in number. Missing values proportion was acceptable. Bias were non differential.

This study contained some methodological limits.

First, neither smoking duration nor smoking cessation were analysed. Smoking behaviour during or after pregnancy could have an effect on breastfeeding's decision or duration. An Italian study on 3669 women, published in 2012, found that smoking mothers who are breastfeeding smoke less than those who don't breastfeed, and that those who have quit smoking during pregnancy relapse more often until 12 months after the delivery when they don't breastfeed (16). Another study, on 6093 Norwegian infants, published in 2015, found that breastfeeding duration was shorter when the mother smoked (17). In this study, the choice was to include all smoking mothers' children without any selection because we didn't want to select only strongly exposed children and make an interpretation bias. We wish to emphasise that there isn't any threshold under which there isn't adverse effects due to tobacco (14).

Second, the data didn't permit to describe the exposure to tobacco by making a difference between being exposed as a foetus to a smoking pregnant mother and as a child to smoking parents (mother and/or father) through the breastmilk and/or through the contaminated air. Our choice was to consider the children to be or have been exposed to tobacco when the mother declared to have smoked at least one time during her pregnancy. This consideration may have diluted a potential effect of breastfeeding on the children with a high or long exposition to tobacco. To our knowledge, these considerations and their impact on the results haven't been yet published in any article. This could be justified by the fact that most of the smoking mothers who succeed to quit smoking during pregnancy have a relapse few days or weeks after the delivery (16).

Third, in our study, we haven't taken account of the type of breastfeeding (exclusive or not). An American study on 393 infants, published in 2014, has shown that in-hospital formula use increases early breastfeeding cessation among first-time mothers intending to exclusively breastfeed (18).

This points should be studied more precisely in further researches.

Finally, our explorations were limited to one geographical department and may not permit to extrapolate to other departments or countries.

Even though tobacco products can diffuse through breast milk, our study showed that breastfed children are not significantly sicker than bottle-fed children. Tobacco isn't a contraindication for breastfeeding, which is confirmed by evidence in medical care (19).

On the contrary, after adjusting on our confusion variables, we have shown that breastfeeding duration (even if higher than 18 weeks) was no longer associated with a healthy status. We don't find any dose-response effect between breastfeeding effect and its duration. No causality argument was found.

Observed difference in univariate analysis could be explained by an inversed causality: healthy children were breastfed for longer.

An American study on 1177 mothers, published in 2013, found that early termination was positively associated with mothers' concerns regarding illness or need to take medicine (20). A Turkish study, published in 2011, have found that babies with regurgitations, intensive crying, colic, or a shorter sleeping time have a lower breastfeeding score (21). An Australian study, published in 2012, on 179 infants, separated in 2 groups (92 term healthy infants and 87 sick/preterm infants), haven't found any link between healthy status and breastfeeding duration, possibly due to lack of statistical power (22).

Perspectives

The better explanation is that children who have adverse effects of passive smoking, like chronic otitis media or chronic lung diseases (bronchiolitis, asthma, etc.), have more feeding difficulties or are admitted in hospital more frequently or for longer (23,24), which doesn't allow to benefit from optimal conditions for the prolongation of breastfeeding. We can also say that, as it is stated in the literature, smoking induces a lower milk production and a poor quality of breast milk (25). These negative feelings of mothers on their capacity to feed their child is recognized to induce an early weaning in breastfeeding (13). These points have to be studied more precisely in further works.

Conclusion

Although breastfeeding is good for child's and mother's health, and it is not contraindicated when the mother smokes, it could be not enough to offset the increased risk of health issues in children. In front of a mother who smokes and breastfeed, it should be careful not to focus her on the duration of breastfeeding (as suggested in the literature) but on the interest of using breastfeeding as a way to quit smoking and to help her in this way. Nowadays, evidence is consistent in the fact that tobacco cessation will improve the child's health and potentially increase the duration of breastfeeding.

Abbreviations

(a)OR: (adjusted) odds-ratio; 95% CI: 95% confidence interval; kg: kilograms; yr.: year

Declarations

Ethics approval and consent to participate

L2132-3 article of the Public Health code in France authorizes that information, being anonymised, appearing on the obligatory health assessments of child, could be treated, in goal of statistical and epidemiological follow of children's health, supervised by a doctor and under the responsibility of his director (CNIL[®] agreement number : 1091359). Taking that in consideration, and because health assessments of child are filled out by the child's referent doctor always during a consultation in current care, the parents' consent to participate is obtained verbally.

Consent for publication

Not applicable

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to the County Council of Yvelines Department which asked the destruction of the data 5 years after they've been collected, but are available from the County Council of Yvelines Department on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Not applicable.

Authors' contribution

YM conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript.

AM collected datas, carried out the initial analyses, and reviewed and revised the manuscript.

SE coordinated and supervised data collection, and critically reviewed the manuscript for important intellectual content.

PC coordinated and supervised the study, and reviewed and revised the manuscript.

OSL critically reviewed the manuscript for important intellectual content.

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Authors' information

None.

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Figures

Figure 1

flow chart of the study

Supplementary Files

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- [Table3MultivariatelogisticregressionSecondmodel.pdf](#)
- [Table2MultivariatelogisticregressionFirstmodel.pdf](#)