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The effect of having children on parental mental health in the United Kingdom

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ABSTRACT

This Bachelor thesis investigates the effect of having children on parental mental health in the United Kingdom. It thereby investigates how differences in gender influence this effect and whether there exists any heterogeneity in the effect of having children on parental mental health by socioeconomic status. This study uses British panel data from Understanding Society, the UK Household Longitudinal Study, from 2009 to 2019. This study contributes to the existing literature by using an event study to investigate the effect of having children on parental mental health. Therefore, it measures a more causal effect, whereas almost all previous work is correlational. Furthermore, the area studied of the existing literature is extended by performing models that investigate the effect of having a child on parental mental health for parents who belong to different socioeconomic status groups. The methodological approach of this study consists of event study models with individual fixed effects, which allows us to provide a graphical representation of the anticipation effects and the dynamic treatment effects of having children on parental mental health. The first set of results shows that there seems to be a decrease in mental health for both men and women in the years after having the first child compared to the year in which the parent or the parent's partner was pregnant. Similarly, a decline in mental health is observable for mothers in the years following when having a second child. For men, however, this is not observable when having a second child. Furthermore, the results show that there seem to be no differential patterns for the effect of having a first child on parental mental health by socioeconomic status groups

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CHAPTER 1 Introduction

The birth of a child is a life-changing event that impacts life in many areas. A study by Rhoades, Stanley, and Markman (2009), investigated the effect that the birth of a child has on relationship functioning. Their study shows that the birth of a child causes a sudden deterioration in observed and self-reported relationship functioning. This deterioration tended to persist, at least for the remaining years of the study. The birth of a child also affects a variety of other areas, for example, the mental health of parents. Many studies investigate the influence of parental mental health on their children. However, an area that has not been studied that much is the effect of having children on parental health. The literature that does exist about the relationship between parenthood and mental health often yields contradictory results.

Helbig et al. (2006) used cross-sectional data from the German Health Survey to investigate the association between parenthood and mental health. In their research, parenthood was positively associated with mental health, particularly for men. They found, among other things, lower rates of depressive disorders and substance use disorders. Leach et al. (2016) used Australian longitudinal data to investigate the association between fatherhood and mental health. In this Australian study, no negative mental effects were found for becoming a father either. The results even showed a small improvement in mental health after an individual became a father. Another study by Mckenzie and Carter (2012) used three waves of longitudinal data in New Zeeland to investigate the association between parenthood and mental health. This study distinguished between having a first and a subsequent child and found that receiving a first child was positively associated with parental mental health. Furthermore, parents experienced less psychological distress in the years after they had their first child. Mckenzie and Carter also investigated the effect of having a subsequent child and reported that these parents experience an even lower level of psychological distress.

However, some other papers find decreases in parental mental health after the arrival of a new child. The results of a study that uses cross-sectional data in the United States show that becoming a father is associated with significantly increased feelings of depression (Knoester & Eggebeen, 2006). Another research in the United States that focused on young motherhood found that teen mothers were more likely to be associated with depressive symptoms in the subsequent years compared to women who became a mother at a later age or did not become a mother at all. (Falci, Mortimer & Noel, 2010). Yet another study that focuses on fathers in Australia also found an increase in mental health problems for fathers after the birth of a child. This study found that fathers who just had a child significantly more experienced mental health problems compared to male adults of their age who didn't have a child (Giallo et al., 2012). A more recent study by Rupanner, Perales and Baxter (2018) also used Australian data to investigate the association between parenthood and mental

health. They used 16 years of panel data, and they also distinguished the effect of having a first and a second child on parental mental health. Their main results concerning parental mental health are that the mental health of mothers improves after a first child, while the mental health of fathers decreases after the birth of a second child.

This research investigates whether having children improves or decreases parental mental health in the United Kingdom. Therefore, the research question is as follows:

"What is the effect of having children on parental mental health in the United Kingdom?"

This study builds on the existing literature by investigating the effect of having children on parental mental health. This research contributes to the existing literature by using a new sample, namely the Understanding Society data, a household panel study in the United Kingdom. However, the main contribution of this research is that this study uses an event study to investigate the effect of having children on parental mental health and therefore measures a more causal effect, whereas almost all previous work is correlational. Most of the existing literature about the effect of having children on parental mental health compares individuals who got a child with individuals who did not become a parent. The main limitation of this approach is that the results of these studies cannot be causally interpreted. These studies essentially perform a with-and-without regression that tries to account for observable differences between the treatment and control groups. However, it is almost impossible to control for all relevant variables, as there will be unobserved differences between the different groups in general. Therefore, these studies do not estimate a causal relationship but rather a correlation (Khandker, Koolwal & Samad, 2009).

This study is thus one of the first studies that aim to estimate the causal effect of having children on mental health. In the existing literature, some studies also aimed to estimate the causal effect of having children on a different outcome (e.g., the labour market). For example, the study of Kleven, Landais & Søgaard (2019) used an event study model to estimate the effect of having children on the earnings of women relative to men in the Danish labour market. The event study approach that this study used, relies on a different source of variation than most of the existing studies that estimate the effect of having children on parental mental health use. The Danish study only includes individuals that all had a first childbirth between 1985 and 2003. Therefore, it exploits individual-level variation in the timing of first births. This approach estimates a causal relationship, if individuals who experience it are similar and if the timing is random. The results of the study show that women experience a wage drop of 20 per cent in the long run as a consequence of having children. Another recent Danish study from the same authors, Kleven, Landais & Søgaard (2020), also used event study models to estimate

the effect of having children on labour market outcomes of men and women. This study used a similar event study approach to investigate whether parents of biological children experience a larger effect of having children on labour market outcomes than parents of adopted children. The results of the study show that the effect of having children on labour market outcomes of women relative to men are in the long run similarly for biological and adoptive families.

This study uses a similar event study approach with which it aims to estimate the causal effect of having children on parental mental health. This study uses ten waves of a British household sample in which every individual who did not become a parent in these years is removed. Therefore, the variation this study uses to identify the treatment effect is an individual-level variation, similar to the source of variation of the studies of Kleven, Landais & Søgaard. This study will thus exploit differences in the timing of birth among a sample of individuals that all gave birth at different times. Therefore, the model only assumes that the timing of birth is random. The methodological approach of this study will be discussed in more detail in the methodology section.

A major limitation of cross-sectional data, which is also widely used in the existing literature, is that it is hard to account for confounding factors that are correlated with becoming a parent and mental health. For example, it is likely that individuals with higher incomes have more money available, which may help to prevent mental health problems. Furthermore, as the study of Kleven, Landais & Søgaard (2019) showed that women's earnings dropped by around 20 percent as a consequence of having children, it is likely that income is correlated both with becoming a parent and mental health. Therefore, it is important to control for confounding socioeconomic factors, such as employment status and income, when assessing the effect of having children on parental mental health. This study will use longitudinal data, which makes it easier to control for these confounding socioeconomic factors. The variables that will be controlled for will be discussed in section 2.4 Control variables.

The hypotheses in this study will also be based on the results of recent studies that investigated the effect of having children on parental mental health with longitudinal data because this study also uses longitudinal data. Therefore, the methodological approaches of the studies of Mckenzie and Carter (2012) and Rupanner et al. (2018) will be discussed in more detail. Both studies used an individual fixed effects model that used within-individual variation to identify the treatment effects. Therefore, the variation these studies used is similar to the variation this study will use, however, an assumption of individual fixed effects is that the within-individual variation should be random, while with an event study model, only the timing of the treatment should be random, as all individuals in the sample eventually get treated (Khandker, Koolwal & Samad, 2009). The studies of both Mckenzie and Carter and Rupanner et al. controlled for time-varying confounding variables with

which they tried to ensure that the within-individual variation is random. However, if there are time-varying omitted variables, this invalidates the most important assumption of individual fixed effects.

Furthermore, the studies of Mckenzie and Carter and Rupanner et al. both investigated the effect of having a first and a subsequent child on parental mental health separately. Both studies suggest that the first child improves paternal mental health. And the study of Mckenzie and Carter also reported a beneficial impact on mental health for a subsequent child. In contrast, the study of Rupanner et al. shows that paternal health decreases after a second child. This research investigates whether these contradictory results also occur in the United Kingdom. As this research uses a different methodological approach and a different sample, and the existing literature is divided about the sign of the effect, the hypotheses in this research will be tested two-sided, as this is the more conservative approach. Furthermore, this research will also estimate the effect of having a first and a subsequent child on parental mental health separately and for men and women separately, which brings us to the following hypotheses:

Having a first child has an effect on parental mental health (H1).
Having a second child has an effect on parental mental health (H2).
The effect of having children on parental mental health differs between men and women (H3)

Besides investigating the effect of having children on parental mental health by using an event study model, which allows this study to estimate more causal effects, whereas most of the existing literature estimated correlations, this study also contributes to the existing literature by extending the area studied. This study addresses the effect of having children on the mental health of parents who belong to different socioeconomic status groups. This study thereby investigates whether there exists any heterogeneity in the effect of having children on parental mental health by socioeconomic status. This research thereby focuses on one subgroup of the socioeconomic status, namely income. Parents who report having relatively high household incomes in the year they or their partners get pregnant are compared to parents who report having relatively low household incomes. Within the sample, parents with the lowest half of household income are assigned to the low-income group and parents with the highest half of household income are assigned to the high-income group.

Apart from the scientific relevance of this research, it is also likely that the results of this research contribute to society. First of all, it is relevant for people to know what the mental health consequences might be when they have a child. In addition to the fact that it is relevant for people to know this, it is also possible that if this research shows, for example, that having a child has negative consequences on parental mental health, that parents can adjust and prepare for this, which may

reduce this negative effect. It may be that parents will think more carefully when they have a child, and more often only have a child when they are ready. Furthermore, this study is also societally relevant because mental health problems are a social problem and are common today. The results of this research could contribute to the knowledge of the possible effects of having a child on parental mental health. Based on this knowledge, policymakers could adjust their policies because policymakers also benefit if mental health remains as good as possible. If this study were to show that there are negative effects of having a child on mental health, policymakers could consider how to reduce these effects with their policies. They could, for example, look at where the mental health problems come from and think of policies (e.g., better maternity leave conditions) that deal with these problems.

CHAPTER 2 Data

2.1 Data collection

This study uses annual panel data from Understanding Society, the UK Household Longitudinal Study, from 2009 to 2019. This is a longitudinal survey that started in 2009 with members of approximately 40,000 households in the United Kingdom. Every person in every household is visited each year to collect information about the person's health, work, education, income, family and social life status. The data of the Understanding Society panel dataset is collected through face-to-face interviews and self-completed questionnaires. For this study, the available data of 10 different waves were merged to create a panel dataset, which runs from 2009 to 2019. The waves consist of overlapping years; therefore, the dataset consists of 10 waves and 11 years. The dataset initially contained 444,148 person-year observations (203,378 for men, 240,770 for women) of 87,033 individuals (41,232 men, 45,801 women). Subsequently, the dataset needed to be modified to retain only the relevant observations.

First, anyone who already got a child before 2009 was removed because this study is examining, among other things, the effect of having a first child on parental mental health. Removing these observations results in 206,433 person-year observations (100,341 for men, 106,092 for women) from 43,319 individuals (21,766 men, 21,463 women). In addition, all parents who did not have a child between 2009 and 2019 were removed, which causes 175,811 person-year observations to be removed. Moreover, an additional amount of 443 person-year observations was removed because parents who had twins or triplets will also be removed, as this will have a very different impact on their lives than having only one child at a time because if having one child has a certain positive or negative effect on parental mental health, two children at the same time may amplify this effect. Furthermore, only observations of respondents within main childbearing ages (20 to 50 years) will be included, as from the already discussed research of Falci, Mortimer & Noel (2010), it becomes clear that teen mothers were more likely to be associated with depressive symptoms after having a child than later mothers. Similarly, parents who have a child only after the age of 50 are likely to be very different from parents who have a child between the age of 20 and 50. Therefore, any individual who has a child before the age of 20 or after the age of 50 is removed, which causes 4,106 person-year observations to be removed. Finally, individuals with missing observations on the outcome variable mental health were dropped. This caused another 8,241 person-year observations to be removed, which causes an unbalanced panel dataset to remain with 17,847 person-year observations (7,588 for men and 10,259 for women) from 2,399 individuals (1,031 men and 1,368 women).

There are many ways to deal with the missing observations. However, this study considered two common techniques, namely listwise deletion and imputing missing data. Listwise deletion is a

technique where individuals with missing observations are deleted, and imputing missing data is a technique where missing data is replaced with substituted values (Young & Johnson, 2015). In this study, both techniques were used for different variables. For the outcome variable mental health, listwise deletion was chosen because, in this study, an event study model will be used that uses within-individual variation over time. As imputing missing data replaces missing data with substituted values, it is likely that this could distort the individual trend and could create a bias (Young & Johnson, 2015). Furthermore, missing observations were only removed for the outcome variable mental health; as for the control variables, missing data was imputed (which will be discussed in more detail in section 2.4 Control variables). This leaves many observations left to apply the event study model.

2.2 Dependent variable: Mental health

The outcome variable of interest is mental health. To measure mental health the Understanding Society data has two possible measures, namely the SF-12 and GHQ. The SF-12 is a shorter version of the SF-36, which was also used in previous longitudinal studies (Mckenzie and Carter, 2012 and Rupanner et al., 2018). Jenkinson et al. (1997) investigated whether the shorter SF-12 could replicate the results of the SF-36. Their study results suggest that the shorter SF-12 is also a suitable measure in longitudinal studies. They also investigated the Mental Component Summary (MCS-12) scale of the SF-12, which will be used in this study. They showed that the MCS-12 scale was as precise as the more elaborate SF-36 scale. Gill, Butterworth, Rodgers and Mackinnon (2007) compared the GHQ and the SF-12 measures of mental health. Their results indicate that the MCS-12 scale of the SF-12 is an excellent instrument to detect mental disorders. They concluded that the MCS-12 scale was better able to detect mental health problems than the GHQ scale.

Therefore, the MCS-12 scale of the SF-12 will be used in this study. This mental health index is constructed out of responses to all the 12 questions of the SF-12 survey. These responses were converted into a single mental functioning score, with a continuous scale and a range of 0 (low functioning) to 100 (high functioning). Next, the mental health score was standardized because this makes it easier to interpret the coefficients. Coefficients of a standardized variable will be interpreted as standard deviation changes, rather than unit changes. Standardizing the mental health score was done by first subtracting the average mental health value from the initial value for each case, which results in a mean of zero. Subsequently, the resulting difference between the initial score and the mean was divided by the standard deviation, which results in a standard deviation of one. The resulting standardized mental health score is increasing in good mental health. In the analysis, the standardized mental health score will be used.

2.3 Independent variable: Parenthood

The parenthood variable consists of several variables that contain information about parents who got children. First, a dummy variable was created that indicated if an individual had ever had children before 2009. As already explained in the data collection part, these individuals were removed. Next, a dummy parenthood variable was created that indicates the year in which an individual got a child. For men and women, this variable was constructed from different variables. For women, the outcome of pregnancy was used to obtain the variable. Women who had one child at a time via caesarean or normal delivery were added to this variable. Women with twins and triplets were also discovered via the pregnancy outcome, and these were then removed from the dataset, as already explained in the data collection part. For men, a variable was used that indicated how many new children a man had since the previous wave. This variable was already available in the dataset. If this variable was equal to one, this means that the individual became the father of one child. In this case, this individual was added to the parenthood variable. If this variable was equal to two or three, this means a father had a twin or a triplet. Therefore, these individuals were again removed from the dataset.

Since this study will also examine the difference between first and second children, the parenthood variable was further processed. Dummy variables were created indicating the year in which individuals had a first, second, third or fourth child (The maximum number of children is four in the dataset). There are 2,399 first births, 935 second births, 83 third births and only 3 fourth births. Because of the low amount of third and fourth births, this study only focused on first and second births. Finally, for the first and the second birth, timing variables were created that indicated 0 in the year the parent or the partner of the parent was pregnant, and for the years before and after the pregnancy, the timing variable equals the number of years relative to t=0. Thus, for this sample, for the first child, the value of the timing variable varies between t=-8 and t=9 and for the second child, it varies between t=-8 and t=8. With, for example, t=-1 denoting one year before the parent or the partner of the parent was pregnant and t=1 denoting the first year the parent has the child.

2.4 Control variables

This study used control variables to control for time-varying effects that may confound the relationship between parenthood and mental health. As already discussed in the introduction, individuals with higher incomes likely have more money available that may help to prevent mental health problems. Therefore, it is important to control for these socioeconomic factors. For this study, observed time-varying variables that are potentially confounding were added in all models. This includes the following factors: first of all, the net household income of an individual was included. Furthermore, the highest educational qualification (Higher degree, A level, GCSE, other qualification

and no qualification) was included. Subsequently, the employment status of an individual (employed, unemployed, long term sick or disabled and other employment status) was included, where the other employment status consists of individuals who indicated job statuses as doing something else, being a full-time student or being retired. There were only 2 person-year observations that indicated being retired, which also makes sense since this sample only includes individuals who had a child between the age of 20 and 50. Moreover, the marital status of an individual (living with a partner/married, single or divorced/separated/widowed) and the presence of long-term health diseases (yes/no) were included. Finally, the age and age squared of an individual were added in all models. The squared term of age was added to the model to allow the effect of age to be non-linear. All these variables could influence the mental health of an individual and could also influence the likelihood that an individual has a child and therefore, these variables are potentially confounding and were thus included as control variables. Some of these control variables are more time-varying than others. For example, the highest educational qualification will not vary much for people between the age of 20 and 50. However, since the highest educational qualification may change for some people and thus may be time-varying, this variable is still included.

There were a few missing observations among the control variables. Namely, there were 47 person-year missing observations for education, 21 missing observations for marital status, 7 missing observations for long-term health diseases, and 2 missing observations for employment status. As already mentioned, the missing data for the control variables were imputed. This is mainly because deleting individuals who only miss one or a few observations for the control variables is not ideal because this leads to reduced sample size and thus less statistical power, and, in addition, bias could occur if the missing data is not missing at random (Young & Johnson, 2015). Imputation of the missing values was done by replacing the missing value of an individual with a value one year earlier or later. This method was chosen because for many of the control variables, it seems plausible that the year in which an individual misses a value for one of the control variables, that this actual value is equal or about the same as this individual's value for one of the control variables a year earlier or later. This is especially the case with the control variables that have missing values. Marital status, employment status, education and the presence of long-term health diseases are all variables that could vary over time, but that on average do not vary much over time. Therefore, for the missing values for the control variables in this study, the assumption is made that the missing values of these control variables are equal to the value one year earlier or later. For statistical reasons (reduced statistical power with listwise deletion), it seems to be the best choice to make this assumption.

2.5 Descriptive statistics

After imputing some of the missing observations of the control variables, the dataset remains at the initial 17,847 person-year observations (7,588 for men and 10,259 for women) from 2,399 individuals (1,031 men and 1,368 women). Descriptive statistics for all the variables that will be used in this study are presented in Table 1. Separate descriptive statistics for men and women are presented in Table A1 and Table A2 in the Appendix.

Table 1. *Descriptive statistics on model variables*

Variable	Mean	Standard Deviation	Min	Max	N
Standardized Mental Health	0	1	-5.114	2.445	17,847
Age	32.643	5.720	20	50	17,847
Net monthly household income	3568.843	2576.989	-792.11	170180	17,847
Highest educational qualification					
Degree	0.578	0.494	0	1	17,847
A level	0.235	0.424	0	1	17,847
GCSE	0.147	0.354	0	1	17,847
Other qualification	0.026	0.160	0	1	17,847
No qualification	0.013	0.114	0	1	17,847
Marital status					
Partnered / Married	0.866	0.341	0	1	17,847
Single	0.115	0.319	0	1	17,847
Widowed, Divorced, Separated	0.019	0.137	0	1	17,847
Employment status					
Employed	0.871	0.335	0	1	17,847
Unemployed	0.104	0.305	0	1	17,847
Long term sick / Disabled	0.007	0.081	0	1	17,847
Other job status	0.018	0.081	0	1	17,847

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 17,847 observations (7,588 for men and 10,259 for women) from 2,399 individuals (1,031 men and 1,368 women). All variables in the table are time-varying. Missing observations for the outcome variable (mental health) were removed. Missing observations for the control variables were imputed by replacing the missing value of an individual with a value one year earlier or later.

CHAPTER 3 Methodology

This paper aims to answer the research question, as stated in the introduction, by testing the following set of hypotheses:

Having a first child has an effect on parental mental health (H1).
Having a second child has an effect on parental mental health (H2).
The effect of having children on parental mental health differs between men and women (H3)

Furthermore, this study investigates whether there exists any heterogeneity in the effect of having children on parental mental health by socioeconomic status. Similar studies in the past that also examined the effect of having children on parental mental health with panel data often used an individual fixed effects regression (Mckenzie & Carter, 2012 and Rupanner et al., 2018). The main advantage of an individual fixed effects regression is that it uses within-individual variation. This causes all time-invariant variables to be captured when taking within individual differences over time. Therefore, it is not possible to control for time-invariant control variables and only needs to control for time-varying control variables (Khandker, Koolwal & Samad, 2009).

In this study, some components of the individual fixed effects model are combined with an event study model. The event study model this study uses, also uses panel data. The main advantage of the event study model this study uses is that it more closely estimates a causal effect compared to models that just compare individuals who had children to those who did not. Another big advantage of an event study model is that it allows for anticipation before the treatment and dynamic treatment effects after the treatment (Khandker, Koolwal & Samad, 2009). Most of the existing literature used individual fixed effects when investigating the effect of having children on parental mental health. However, it would be interesting also to investigate whether there exists anticipation before the actual treatment takes place and if there exist dynamic treatment effects afterwards. In the case of parents receiving a child, it seems likely that at least some parents planned this event carefully, which makes anticipation effects likely. It is also plausible that the treatment effects after the child is born are dynamic. Therefore, in this study, it is expected that an event study will more closely estimate a causal analysis compared to a model that solely uses individual fixed effects. The model that this study uses is also preferred over ordinary OLS models, which are also used by some of the existing literature. This is mainly because the event study model does not compare those with to those without children and is, therefore, more likely to estimate a causal effect. Another advantage of the event study models that compare those with to those without children is that by taking the within-individual differences over time, events study models control for subjective outcome variables. The outcome variable in this

study is subjective because it is constructed from individuals' responses to several questions. It is therefore likely that unobserved differences between study participants influence this measure. Comparing individuals who had children with individuals who did not have children could therefore be biased. Therefore, this model is preferred over models that compare persons who have received treatment with persons who have not received treatment.

As already explained in the data section, the dataset is modified in such a way that there exist only parents in the dataset who received a child sometime between 2009-2019. Therefore, the model this study uses does not have a control group, but it uses individuals that experienced the same event but at a different point in time as a control. Therefore, this model only assumes that the timing of the treatment is random, instead of the treatment itself in the case of an individual fixed effects model. To avoid the possibility that timing would still have an impact, the model will also control for year fixed effects.

For the three different hypotheses and to test whether the patterns of the effect of having a child on parental mental health differ for high and low income, an event study model will be performed, which will also control for individual fixed effects. This event study model will also be run separately for men and women to measure a potential difference between the two (H3). The regression for the first set of hypotheses will have the following form:

$$\Upsilon_{it} = \beta_0 + \sum_{j=-8}^{9} \lambda_j \mathbb{I}[t - t_0 = j] + \gamma_t + \delta_t Z_{it} + \alpha_i + \varepsilon_{it}$$

Where Υ_{it} is the dependent variable which denotes the standardized mental health score and subscript i denotes for which individual and subscript t denotes the year relative to t=0, which is the year the individual or the partner of the individual got pregnant, where t lies between -8 and 9. β_0 denotes the constant term. The term $\sum_{j=-8}^{9} \lambda_j \mathbb{I}[t - t_0 = j]$ denotes the timing part, with j ≠ 0, because j=0 denotes the year in which the individual or the partner got pregnant and is used as the reference category. The timing part will capture the anticipation before the treatment and the dynamic treatment effects afterwards relative to the year in which the individual or the partner got pregnant. $\mathbb{I}$ is an indicator function, where t_0 is the year in which an individual or the partner of the individual got pregnant. The term γ_t denotes the year fixed effects. The term $\delta_t Z_{it}$ is a vector of the control variables, where δ_t stands for the coefficient and Z_{it} stands for all the observed time-varying confounding variables, which are included. The term α_i denotes the individual fixed effects and ε_{it} stands for the error term.

For H1, the regression will be performed with a timing term that considers the timing of the first baby. For H2, the regression will be performed with a timing term that considers the timing of the second baby of an individual. These timing variables were described in section 2.3 (Independent

variable: Parenthood). When considering the event study model for H2, which considers the effect of having a second child on parental mental health, the sample is restricted to included only individuals who had a second child. With this event study model, there is a possibility that the time between the first and second child could affect the mental health of parents. However, this birth spacing effect will drop out in the model of this study because the age difference between two siblings is time-invariant and will thus drop out because of the fixed effects. Therefore, there is no need to control for the timing of the second child. As already explained, to test H3, the regressions will also be run separately for men and women. The outcome of this model will be presented in several graphs, which will graphically show the potential anticipation and dynamic effects. All different regressions will also be separately run with and without the observed control variables to investigate how the model reacts to the addition of the control variables. The variables that will be controlled for are discussed in section 2.4 (Control variables). Both models, however, will control for age and its square, as age is exogenous in this study. The other variables are not completely exogenous, and therefore these separate regressions will be performed for all different hypotheses. The expectation, however, is that the addition of control variables will not change the coefficients much, since this study is only exploiting differences in the timing of birth among a sample of individuals that all gave birth at different times. The addition of these control variables should therefore not influence the estimates very much, as the timing variables and the control variables will be highly correlated because individuals in this sample will most likely be very similar for observed control variables in the years around the birth of a child.

To test whether the patterns of the effect of having a child on parental mental health differ for relatively good and poor socioeconomic status groups, similar regressions will be performed separately for men and women. To test the effect of having children on parental mental health for parents with a relatively poor or good socioeconomic status, a similar regression as with the three different hypotheses will be used. However, the regression will only be performed conditional on parents who belong to a certain group. The socioeconomic status of parents will be measured through a variable that was available in the dataset, household income. The year in which an individual or the partner got pregnant will be used to determine if an individual belongs to the relatively good or poor socioeconomic status group. Therefore, the observations in this year will be used to assign parents who belong to the lowest half of household income to the low-income group and parents who belong to the highest half of household income to the high-income group. Some parents are not observed in the year they or their partners get pregnant. This causes a few observations to drop out in the analysis for the second part. However, there are still enough observations left to do the analysis, and this approach is preferred over taking the year parents got their first child as the measure year (one year

later). The year parents got their first child as the measure year is likely to create a bias in the estimates, as it is likely that the birth of a child could influence the household income.

The investigation of whether there exists any heterogeneity in the effect of having children on parental mental health by socioeconomic status only considers the effect of having a first child in the analysis because this sample is large enough to do the analysis. The group of parents in the sample who also got a second child is too small to divide into two (for the different socioeconomic status groups) and is therefore not included separately in the analysis. The two groups are also not merged because having a first child is different from having a second child, and this will make it hard to interpret the estimates. The outcome for this analysis will also be presented in several graphs. In addition, all regressions for this analysis will be separately run for men and women and with and without observed control variables to investigate how the model reacts to the addition of the control variables.

CHAPTER 4 Results

In the results section, the results of analyzing the three different hypotheses and whether the patterns of the effect of having a child on parental mental health differ for relatively good and poor socioeconomic status groups are shown.

4.1 Effect of having a first child on parental mental health

This section provides the results of analyzing the effect of having a first child on parental mental health (H1) and how these results differ between men and women (H3).

4.1.1 Effect of having a first child on parental mental health for men and women combined

First, event study models with individual fixed effects were performed to examine the effect of having a first child on parental mental health for both men and women. These regressions were performed separately with and without the control variables, as discussed in the methodology section. The results of these regressions are graphically presented in Figure 1.

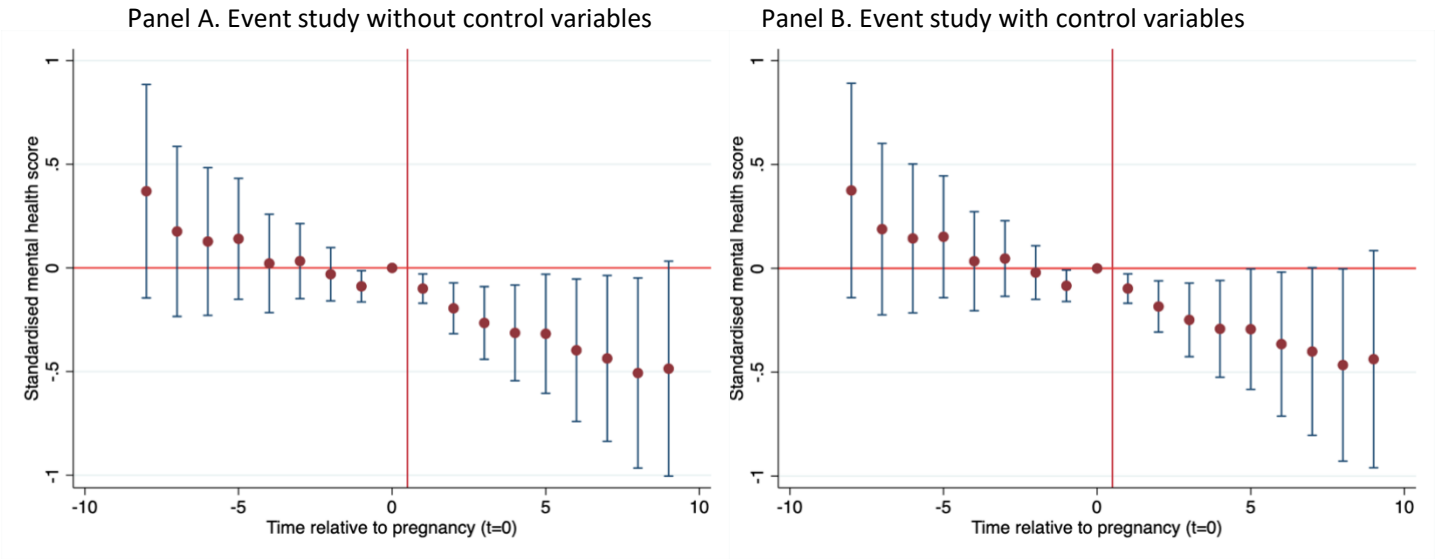


Figure 1. *Impact of having a first child on parental mental health*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 17,847 observations (7,588 for men and 10,259 for women) from 2,399 individuals (1,031 men and 1,368 women). This figure shows the effect of having a first child on the standardized mental health score for parents (both men and women). Panel A shows the graphical outcome of the event study model without control variables (only controlling for age and its square), and Panel B shows the outcome with control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled). Both Panels control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

Figure 1 shows the effect of having a first child on parental mental health, where Panel A is the event study model controlling only for age and its square and Panel B is an event study model with all control variables. The fact that the patterns and coefficients of Panel A and Panel B are very similar suggests that the addition of control variables has very little effect. This result is consistent with the expectation discussed in the methodology section. This model is exploiting differences in the timing of birth among a sample of individuals that all gave birth. Therefore, individuals in this sample are very similar on observed control variables. Therefore, in spirit with the work of Altonji et al. (2005), it could be assumed that the potential addition of unobserved variables would also not change the treatment effect because Altonji et al. suggest that the way the treatment effect reacts to the addition of observed control variables will most likely be the same for the potential addition of unobserved control variables. Thus, the fact that this also seems to be the case here, makes it more plausible that the treatment effect shown in the graphical representation is the actual treatment effect.

H1 stated that having a first child would improve parental mental health. To test this hypothesis, Figure 1 Panel B and Table B1 in Appendix B will be considered. Table B1 is the table that belongs to the graphical representation of the event study in Panel B. From the graphical representation of Panel B, it becomes clear that in the years after a parent has got his/her first child (i.e., from t=1), parents have lower mental health. For almost all years following the pregnancy (t=0), the 95 per cent confidence interval lies below the standardized mental health score of 0. This means that for all those years, it can be stated with 95 per cent certainty that the actual coefficient lies within this interval and therefore below the standardized mental health score of 0. In addition, the graphical representation shows that the standardized mental health score continues to decrease slightly as the years increase. From this, one can conclude that the mental health of parents who have a child in the first years after having a child on average continues to decline a little further. However, the graphical representation also shows that the confidence intervals become larger and larger as you move further away from t=0 (i.e., the confidence intervals of t=-8 and t=9 are very large). This is because there are fewer and fewer observations available for those years. Therefore, the confidence intervals of years further away from t=0 (i.e., t=8 and t=9) overlap with the confidence intervals of the years closer to t=0 (i.e., t=1 and t=2) and one thus cannot conclude with certainty that the standardized mental health scores slightly decrease as the years increase.

From Table B1, it also becomes clear that parents report having lower mental health in the years after they had received their first child. For example, for t=1, which denotes the first year the parent got his/her first child, parents report a significantly 0.097 lower standardized mental health score as compared to the reference category t=0. This means that the mental health is 0.097 standard deviations lower in the first year a parent has a child compared to the year the parent or the partner of the parent was pregnant. Furthermore, all coefficients until t=8 are significant at the per cent level, except t=7. This is also visible in the graphical analysis in Figure 1, Panel B. All 95 per cent confidence intervals of the coefficients until t=8, except t=7, lie below the standardized mental health score line of 0. From both Panel B and Table B1, it can thus be concluded that parents report a significantly lower mental health after receiving a first child. Therefore, the null hypothesis of H1, which stated that having a first child would have no effect on parental mental health, is rejected.

Apart from the dynamic treatment effects on parental mental health, after a parent receives his/her first child, there also seems to be anticipation effects visible from the graphical analysis in Panel B of Figure 1 in the years before a or the partner of the parent was pregnant. First of all, there appears to be a downward trend in mental health in the years before the pregnancy of the first child. Therefore, it seems that the mental health of parents seems to decline over time more generally. However, there are large confidence intervals, and therefore this cannot be claimed with certainty.

Moreover, this declining trend in parental mental health could also simply be the result of anticipation effects in the years before birth and dynamic treatment effects in the years after birth. One noteworthy anticipation effect that becomes clear from the graphical analysis that is significant is the coefficient one year before pregnancy. The mental health one year before pregnancy is significantly lower than the year the pregnancy actually takes place. The significance of the coefficient is visible in the graphical analysis, as the confidence interval lies below the standardized mental health score line of 0, and in addition, the significance is also reported in Table B1. The corresponding coefficient is -0.084, which means that the mental health is 0,084 standard deviations lower in the year before a parent or the partner got pregnant compared to the year the parent or the partner of the parent was pregnant. The graphical representation of Figure 1 allows us to interpret the coefficient at t=-1 as the significant negative anticipation effect of a possible birth one year before the parent or the partner of the parent becomes pregnant. At the same time, however, the coefficient at t=0 could also be interpreted as the positive anticipation effect in the year of pregnancy, anticipating the birth because the graphical representation shows that the pregnancy leads to a significant increase in t=0, compared to t=-1, after which it drops again (the dynamic treatment effects). Since parents at t=-1 do not yet know that they or their partners will be pregnant in the following year, while at t=0 they do, it seems more likely that the anticipation of the actual birth causes the observed pattern in the year the parents or their partners are pregnant (at t=0).

4.1.2 Effect of having a first child separately on maternal and paternal mental health

To test hypothesis H3, which stated that the patterns for H2 and H3 differ between men and women, in this section, the event study regressions for H1 were also separately run for men and women. These regressions were again also separately run with and without the control variables to investigate how the model reacts to the addition of the control variables. The results of these regressions are graphically presented in Figure 2, and as there, the same as with Figure 1, are no major differences for men and women in the models with and without control variables, the figures without control variables are reported in Figure B1 in Appendix B, and only the figures with control variables are reported in the text (Figure 2). The coefficients with significance levels of the figures with control variables are reported in Table B2 in Appendix B.

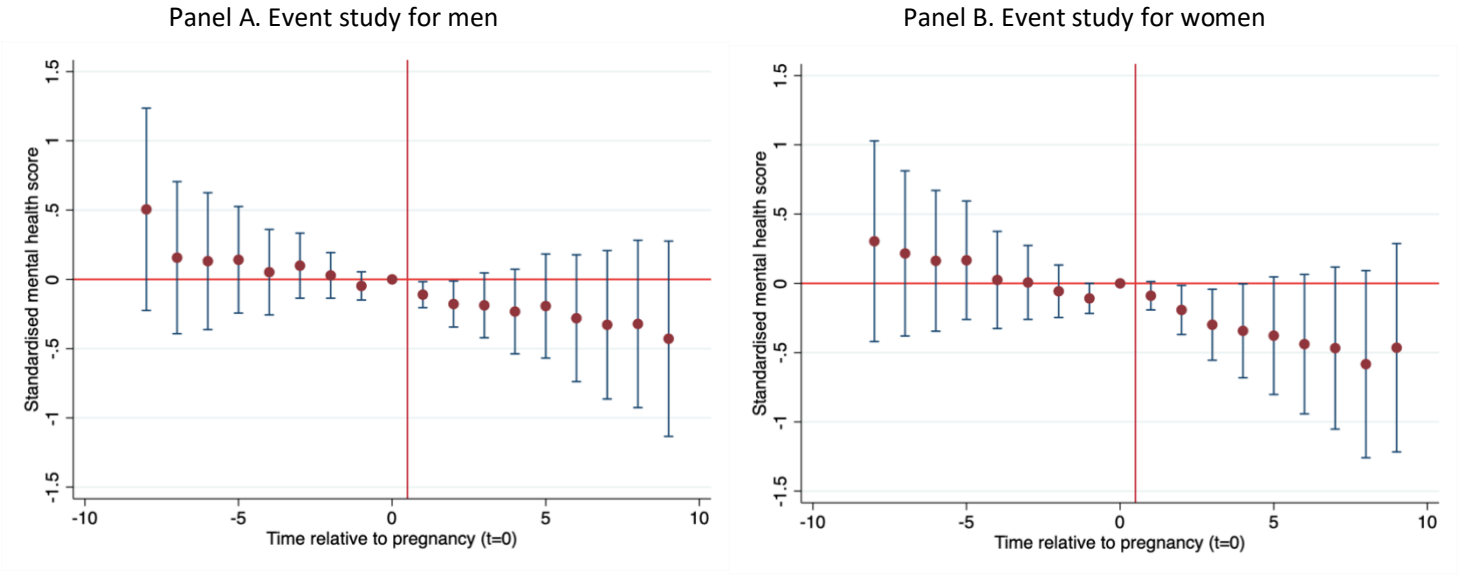


Figure 2. *Impact of having a first child on parental mental health separately for men and women*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 7,588 observations for men from 1,031 individuals and 10,259 observations for women from 1,368 individuals. This figure shows the effect of having a first child on the standardized mental health score for parents (separately for men and women). Panel A is the graphical outcome for the event study model for men, and Panel B is the graphical outcome for women. Both Panel A and Panel B show the graphical outcome of the event study model with control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled) and Panel A and Panel B also control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

From the graphical representation of Figure 2, it becomes clear that at least in the first years after a parent has got his/her first child (i.e., from t=1), both men and women report having lower mental health. However, from Panel A, which considers the outcome of the event study model for men, it becomes clear that only for t=1 and t=2 the mental health for men is significantly lower than for t=0, while from Panel B, which considers the outcome of the event study model for women, it becomes clear that for t=1 until t=4 the mental health for women is significantly lower than for t=0. This means that for women, the reported mental health is significantly lower for the first four years after their first child was born, compared to their mental health in the year that they were pregnant, while for men, the reported mental health for only the first two years after their first child was born is significantly lower, compared to their mental health in the year that their partner was pregnant. Furthermore, the coefficients for women seem to be lower in the graphical representation

compared to men (Also visible in Table B2). However, the confidence intervals of men and women overlap much, and therefore, it cannot be stated with confidence that the effect is stronger for women.

The anticipation effects in the years before a parent receives his/her first child for men and women seem to be similar. For both men and women, there appears to be a downward trend in mental health in the prior years before the pregnancy of the first child. However, there are large confidence intervals, and therefore this cannot be claimed with certainty, except for women in the year before they are pregnant (t=-1). For women in the year before they are pregnant, there seems to be a significant anticipation effect of a possible birth on mental health one year before the mother becomes pregnant. The corresponding standardized mental health coefficient is -0.109 (See Table B2), which means that the mental health is 0.109 standard deviations lower for mothers in the year before they are pregnant compared to the year they are pregnant. However, the observed pattern for women is similar to the observed pattern in Figure 1 (for men and women combined). Therefore, the anticipation effect for women is probably caused by the positive anticipation effect in the year of pregnancy, anticipating the birth. For men, the same pattern is visible because their coefficient is also negative. However, for men, the coefficient is not significant.

Thus, the results suggest that the effect of having a first child on parental mental health does not differ between men and women because the observed patterns of both men and women are similar. Therefore, the null hypothesis of H3 with respect to H1, which stated that the effect of having a first child on parental mental health does not differ between men and women, is not rejected. Both men and women seem to have similar anticipation effects before receiving a child and similar dynamic treatment effects after receiving a child.

4.2 Effect of having a second child on parental mental health

This section provides the results of analyzing the effect of having a second child on parental mental health (H2) and how these results differ between men and women (H3).

4.2.1 Effect of having a second child on parental mental health for men and women combined

To investigate the effect of having a second child on parental mental health for both men and women, similar event study regressions, as with H1, were performed. These regressions were again separately performed separately with and without the control variables to investigate how the model reacts to the addition of the control variables. The results of the regression with control variables are graphically presented in Figure 3, and the figure without control variables can be found in Figure B2 in Appendix B. The coefficients with significance levels from Figure 3 are reported in Table B3 in Appendix B.

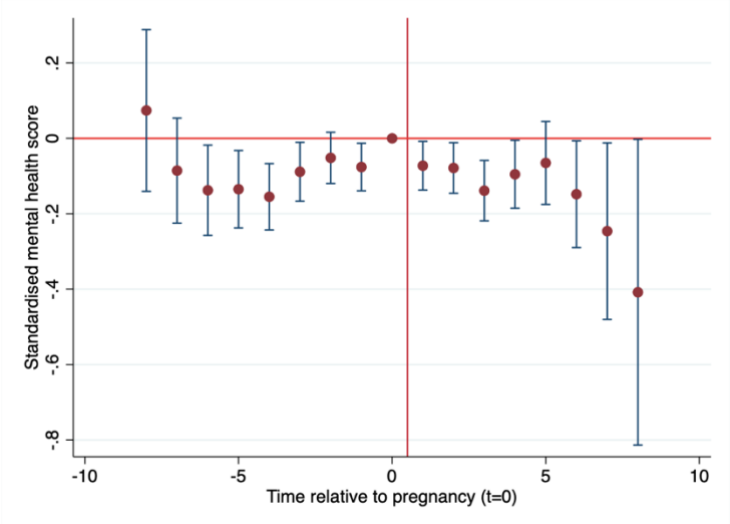


Figure 3. *Impact of having a second child on parental mental health*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 7,932 observations (3,307 for men and 4,625 for women) from 935 individuals (390 men and 545 women). This figure shows the effect of having a second child on the standardized mental health score for parents (both men and women). The graphical outcome of the event study model controls for control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled), year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

From the graphical representation of Figure 3, it becomes clear that at least the first four years after a parent has got his/her second child (i.e., from t=1), parents report to have a lower mental health, compared to the mental health of parents in the year that they or their partners were pregnant.

When looking at the years before the year of pregnancy (t=0), the anticipation effects, it is observable that mental health is also significantly lower in these years compared to the year of pregnancy. However, it is important to note here that the effect that is probably primarily being measured here is the mental health consequences of having the first child for parents. It is therefore difficult to say whether the anticipation effects of the years before the parents or the partners of the parents become pregnant (i.e., before t=0) are anticipation effects for the pregnancy of a second child, or whether it is still related to the pregnancy of the first child. However, what is also observable in the graphical representation of Figure 3, is that in the year the parents or the partners of the parents are pregnant (t=0), there seems to be a positive anticipation effect, anticipating the birth. Therefore, in

the graphical representation of Figure 3, there seems to be a similar anticipation effect in the year of pregnancy as was also observed in the graphical representation of Figure 1.

Two other points to consider are, first of all, the fact that there are fewer observations in this case. For the first years before and after the pregnancy of the second child, are the most observations and the smallest confidence intervals, but for longer-term effects of a second pregnancy on mental health, there are very few observations, making the confidence intervals very large (see t=7 and t=8). In addition, the sample for measuring the effects of a second child on mental health in this study is fairly specific, as only people who had a first and a second child in the period 2009-2019 are included in the sample. Parents who have a longer time between a first and second child will not be in this sample. By themselves, these two points do not take anything away from the graphical representation of Figure 3, but it is important to take them into account when drawing conclusions.

Hypothesis 2 stated that having a second child has an effect on parental mental health. Taking the previously discussed points and the graphical representation of Figure 3 into consideration, it can be concluded that the null hypothesis of H2 is rejected. As already mentioned, the pattern of anticipation effects associated with having a second child cannot be stated with certainty. But the dynamic treatment effects of having a second child on the mental health of parents after pregnancy are observable. Mental health in the first few years after having the second child returns to the level it was at after having the first child. Even for the observations for which there are few observations in this sample (see t=7 and t=8), the coefficients are significant despite the large confidence intervals (also see Table B3). This suggests that there are longer-term effects on the parental mental health of having a second child. However, it is important to note that this could also partly be the effect of having the first child. In conclusion, it can be assumed that having a second child lowers the mental health of parents, at least compared to the mental health that they had in the year that they or their partner were pregnant.

4.2.2 Effect of having a second child separately on maternal and paternal mental health

To test hypothesis H3, which stated that the patterns for H2 and H3 differ between men and women, in this section, the event study regressions for H2 were also separately run for men and women. The results of these regressions are graphically presented in Figure 4, and the figures without control variables can be found in Figure B3 in Appendix B. The coefficients with significance levels of the figures with control variables are reported in Table B4 in Appendix B.

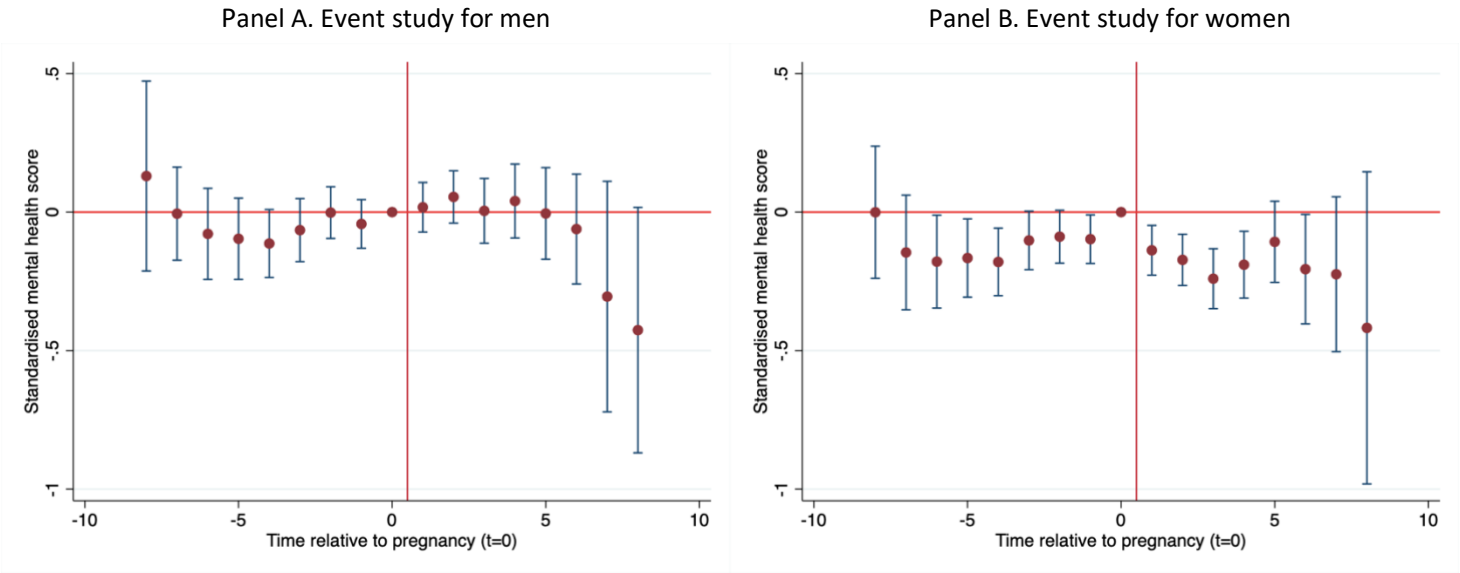


Figure 4. *Impact of having a second child on parental mental health separately for men and women*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 3,307 observations for men from 390 individuals and 4,625 observations for women from 545 individuals. This figure shows the effect of having a second child on the standardized mental health score for parents (separately for men and women). Panel A is the graphical outcome for the event study model for men, and Panel B is the graphical outcome for women. Both Panel A and Panel B show the graphical outcome of the event study model with control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled) and Panel A and Panel B also control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

Figure 4 shows the graphical representation of the event study model that measures the effect of having a second child on paternal mental health (Panel A) and maternal mental health (Panel B). From the graphical representation of Figure 4, it becomes immediately clear that the effect of having a second child on mental health for men and women differs. From Panel A of Figure 4, one can observe that the anticipation effects and the dynamic treatment effects of having a second child on paternal mental health are insignificant, while from Panel B is observable that there does exist significant anticipation effects and dynamic treatment effects for maternal mental health. Therefore, it can be concluded that for paternal mental health, there exist no significant treatment effects for having a second child on mental health, and hence, the null hypothesis of H2 cannot be rejected for men. For women, however, the graphical representation of the effect of having a second child on mental health is similar to the representation in Figure 3. Therefore, the same conclusion as with general parental mental health holds for maternal mental health, and the null hypothesis of H2 is rejected for women.

From Panel A and Panel B of Figure 4, it also appears that the conclusion drawn on Figure 3, that parental mental health (for both mothers and fathers) declines after the birth of the second child, is primarily because mothers' mental health declines after the birth of the second child. As previously described when discussing the results of Figure 3, the fact that the birth of the first child could influence at least partly the dynamic treatment effects of mothers and fathers also holds in this case. And also, the previously discussed points of low observations and specific samples apply again for these models.

Thus, the results suggest that the observed patterns of having a second child on parental mental health differ for men and women. Therefore, the null hypothesis of H3 with respect to H2, which stated that the effect of having a second child on parental mental health does not differ between men and women, is rejected. Furthermore, the null hypothesis of H2 is not rejected for men, as the graphical representation in Panel A of Figure 4 even shows some slightly positive coefficients in the first years the second child is born. However, these coefficients are insignificant, and for the longer-term effects of having a second child on paternal mental health (t=6 until t=8), the coefficients become negative (but still insignificant). And finally, for maternal mental health, it can be assumed that having a second child lowers the mental health of mothers, at least compared to the mental health that they had in the year that they were pregnant, and therefore, the null hypothesis of H2 is rejected for women.

4.3 The effect of having children on the mental health of parents who belong to different socioeconomic status groups.

This section will analyze the results of the event study models that estimate the effect of having children on the mental health of parents who belong to different socioeconomic status groups. This section thereby investigates whether there exists any heterogeneity in the effect of having children on parental mental health by socioeconomic status. Furthermore, this section also examines how these effects differ for men and women. As described in the methodology section, the socioeconomic status of parents was measured through a variable that was available in the dataset, household income.

4.3.1 The effect of having a first child on parental mental health for relatively high-income and relatively low-income parents

To investigate the effect of having children on parental mental health for parents who belong to relatively poor and relatively good socioeconomic status groups, similar event study regressions as with H1 up to H3 were performed. These regressions were again separately performed separately with

and without the control variables. The results of the regressions with control variables are graphically presented in Figure 5, and the figures without control variables can be found in Figure B4 in Appendix B. The coefficients with significance levels of the figures with control variables are reported in Table B5 in Appendix B.

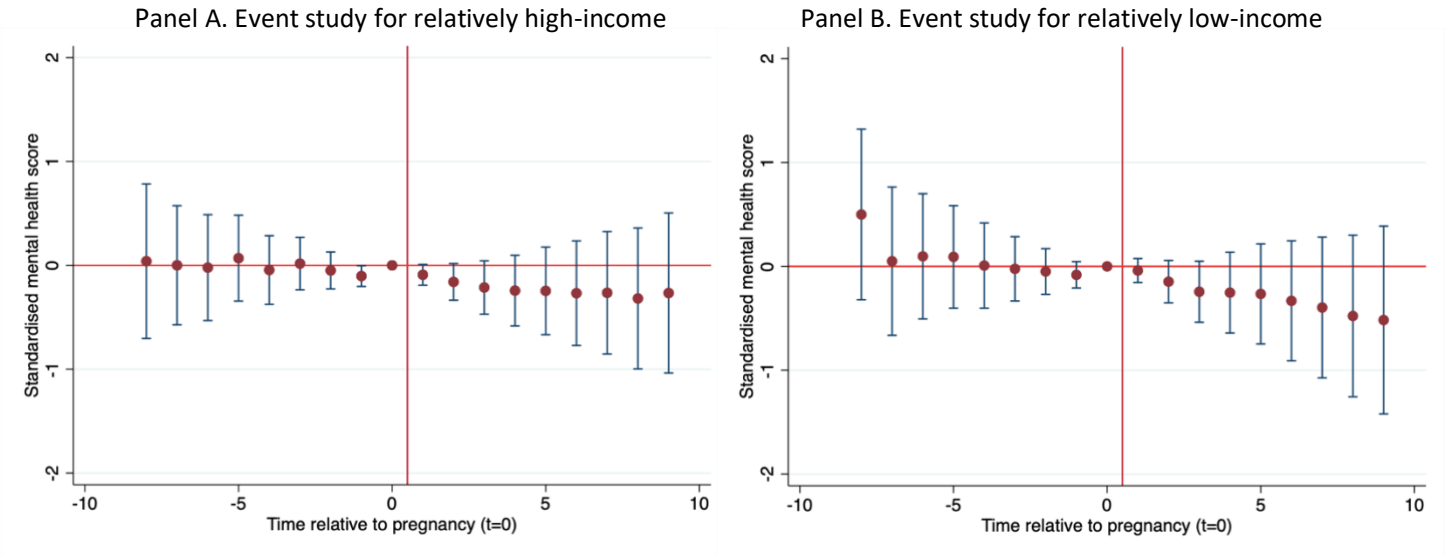


Figure 5. *Impact of having children on parental mental health conditional on their income*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample for Panel A: 7,203 observations (3,158 for men and 4,045 for women) from 910 individuals (393 men and 517 women). Sample for Panel B: 7,042 observations (4,050 for women and 2,992 for men) from 912 individuals (398 men and 514 women). This figure shows the effect of having a first child on the standardized mental health score for parents who belong to the relatively high-income group (Panel A) and parents who belong to the relatively low-income group (Panel B). Both Panel A and Panel B show the graphical outcome of the event study model with control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled) and Panel A and Panel B also control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

Figure 4 shows the graphical representation of the event study model that measures the effect of having a first child on parental mental health for parents who belong to a relatively high-income group (Panel A) and parents who belong to a relatively low-income group (Panel B). First of all, the two different models don't seem to be very different from each other, and they seem to follow the same pattern. The coefficients that denote the year before a parent or the parent's partner is pregnant (t=-1) are negative for both models, which was also observed in Figure 1 (about the impact of having a first child on parental mental health), although the coefficient is significant only for the parents who belong to the relatively high-income group. The corresponding coefficient is -0.051 (See Table B5),

which means that the mental health is 0.051 standard deviations lower for parents who belong to the high-income group one year before a parent or the partner of the parent got pregnant compared to the year the parent or the partner was pregnant. Thus, from the graphical representation of Figure 5, Panel A, there again seems to be a positive anticipation effect, anticipating the birth that in the year the parents or the partners of the parents are pregnant (t=0).

The pattern of Panel A and Panel B after the first child is born is also similar to the pattern observed in Figure 1. For both groups, there seems to be a similar negative effect of having a first child on mental health. However, the coefficients of both Panel A and Panel B are not significant. A reason that the coefficients are not significant is that the sample is divided into two different income groups. In addition, as already discussed in the methodology section, parents were classified in the two different income groups in the year before the parent or the parent's partner is pregnant, which caused some observations to be lost because some parents did not have an observation in this year. Partly because of this, 95 per cent confidence intervals are slightly larger, which in turn contributes to more results not being significant.

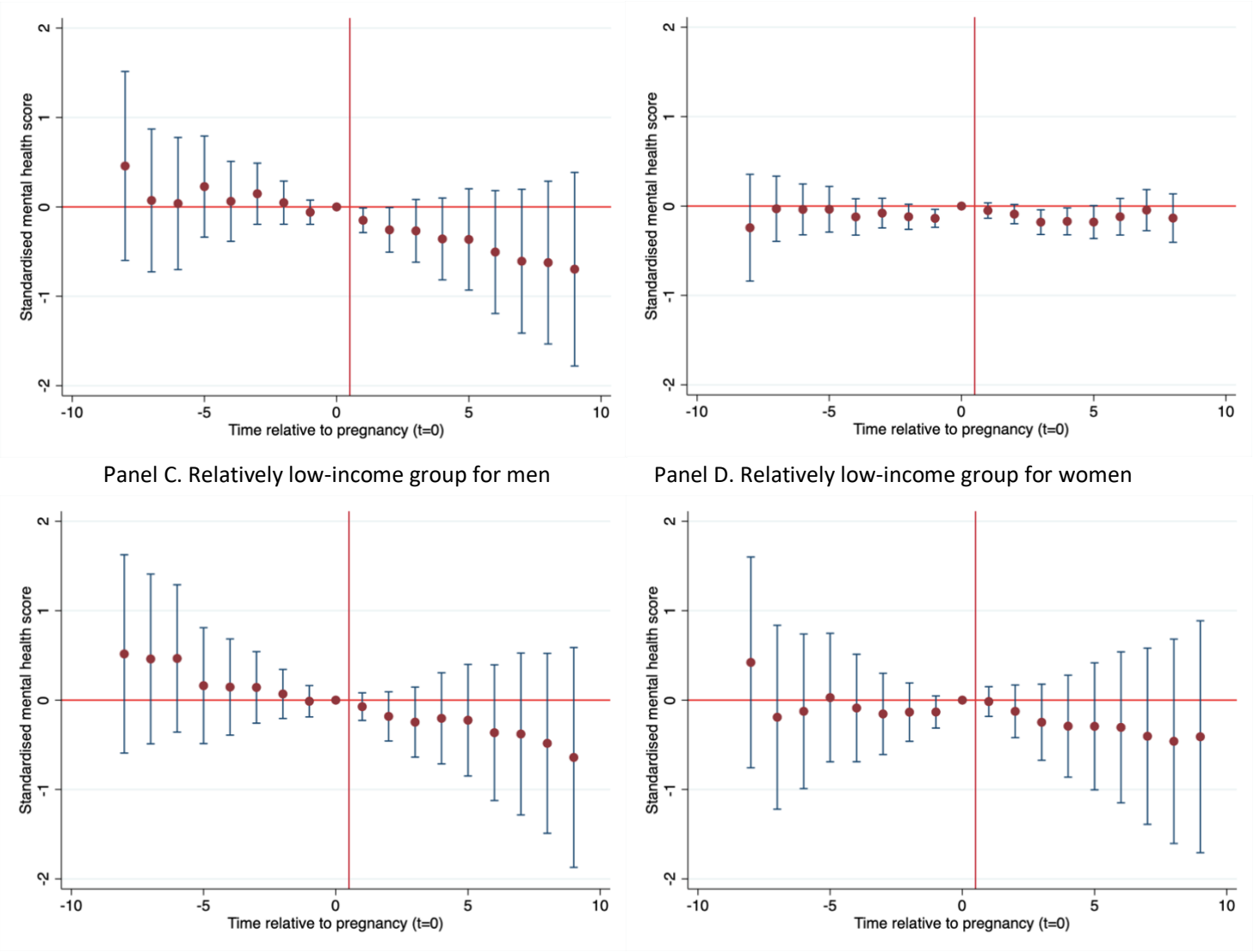
Because the high-income and low-income groups are composed of the sample used for Figure 1, and the pattern of all three groups is the same, it thus seems that the fact that most of the coefficients in Figure 5 are not significant is mainly due to the smaller sample size. Therefore, the results suggest that there does not seem to be heterogeneity in the effect of having children on parental mental health by socioeconomic status for fathers and mothers combined. The next section examines whether there is a difference observable when fathers and mothers are modelled separately.

4.3.2 The effect of having a first child separately on paternal and maternal mental health for relatively high-income and relatively low-income parents

To investigate whether there exists any heterogeneity in the effect of having children on parental mental health by socioeconomic status when fathers and mothers are modelled separately, the event study regressions were also separately run for men and women. The results of these regressions are graphically presented in Figure 6, and the figures without control variables can be found in Figure B5 in Appendix B. The coefficients with significance levels of the figures with control variables are reported in Table B6 in Appendix B.

Panel A. Relatively high-income group for men

Panel B. Relatively high-income group for women



Panel C. Relatively low-income group for men

Panel D. Relatively low-income group for women

Figure 6. *Impact of having children on paternal and maternal mental health conditional on their income*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample for Panel A: 3,158 observations (men) from 393 individuals. Sample for Panel B: 4,045 observations (women) from 517 individuals. Sample for Panel C: 2,992 observations (men) from 398 individuals. Sample for Panel D: 4,050 observations (women) from 514 individuals. This figure shows the effect of having a first child on the standardized mental health score for parents who belong to the relatively high-income group (Panel A and B) and parents who belong to the relatively low-income group (Panel C and D), separately for men and women. All panels show the graphical outcome of the event study model with control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled), and all panels also control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

Figure 5 shows the graphical representation of the event study model that measures the effect of having a first child on parental mental health for parents who belong to a relatively high-income group (Panel A and B) and parents who belong to a relatively low-income group (Panel C and D) separately for men and women. This model was performed to investigate whether the effect of having children on parental mental health for parents with different socioeconomic statuses would differ for fathers and mothers.

First of all, it is noticeable that there are only a few significant coefficients in Panel A and Panel B and that there are no significant coefficients in the other panels. The reason that this occurs is mainly the sample size, as also discussed in the previous section. However, these samples were divided even further because the sample was first divided into a high-income and low-income group and then further divided for men and women. This decreases the sample size even more, which makes the confidence intervals even larger, and many coefficients are therefore not significant.

While looking at the fathers and mothers who belong to the low-income group (Panel C and D), it is observable that the patterns of the graphical representations of the effect of having a first child on paternal and maternal mental health seem to be similar. Especially the pattern after the first child is born (i.e., from t=1) is similar, as, for both fathers and mothers, there seems to be a downward trend of a similar size. For the anticipation effects, it seems that mothers report to have a slightly lower mental health than fathers in the years before their pregnancy. However, for both fathers and mothers, all the coefficients are insignificant (See Table B6), which is probably due to the smaller sample size, as discussed. This makes it more difficult to be certain that the downward trend is due to the arrival of the child and not based on chance, and similarly, one cannot be sure that the anticipation effects are different. Thus, for the difference between men and women in the low-income group, the graphical representation gives no reason to assume that it is very different between fathers and mothers for this group.

While looking at the fathers and mothers who belong to the high-income group (Panel A and B), it is observable that the patterns of the graphical representations of the effect of having a first child on paternal and maternal mental health are not very similar. First of all, the observation t=9 for the relatively high-income group for mothers (Panel B) was omitted because of collinearity. Furthermore, the confidence intervals of the relatively high-income mothers are much smaller than the confidence intervals of the relatively high-income fathers (Panel A). This suggests that high-income women react very similar to the birth of a first child, which results in similar trends and little variation and, thus, a smaller confidence interval. The narrower confidence intervals contribute to the fact that there are some significant coefficients in the relatively high-income mothers group. However, also for the relatively high-income fathers group, there are significant some coefficients (See Table B6). For the

relatively high-income fathers, the coefficients at t=1 and t=2 are significant and respectively -0.150 and -0.257. This means that the mental health is 0.150 standard deviations lower in the first year and 0.257 standard deviations lower in the second year after a father received a child, compared to the year the partner of the father was pregnant. For the relatively high-income mothers, only the coefficients at t=-1, t=3, and t=4 are significant, which are respectively -0.138, -0.180 and -0.172. Even though different coefficients are significant for high-income fathers and mothers and that the effect of having a first child seems to be stronger for fathers, particularly because of the large confidence intervals of the high-income fathers, it cannot be concluded with certainty that there is a difference between the two groups. This is because the confidence intervals of the high-income fathers for almost all possible values of t (except for t=-8) overlap the confidence intervals of the high-income mothers. Therefore, the results suggest that for the relatively high-income group, there are no significant differences for high-income fathers and mothers in the effect of having a first child on their reported mental health.

Finally, it is also interesting to investigate whether there are differences between the high-income group (Panel A and B) and the low-income group (Panel C and D). One can observe that only for the high-income group there are some significant coefficients. However, as already discussed, the main cause of the insignificant coefficients is probably the relatively small sample sizes for the four different groups. Furthermore, it can be observed that the patterns of the graphical representations of all four groups are similar. The coefficients after childbirth (i.e., from t=1) are negative for all groups. Moreover, due to the large 95 per cent confidence intervals of Panel A, C, and D, no differences can be determined with certainty. Therefore, also for the relatively high-income group and the relatively low-income group, the results suggest that there are no significant differences in the effect of having a first child on their reported mental health. Thus, the conclusion, in general, is that the results suggest for the effect of having children for parents who belong to relatively good and relatively poor socioeconomic status groups, there exist no significant differences in effects between men and women.

CHAPTER 5 Conclusion

In this study, 10 years of British panel data was used to investigate the effect of having children on parental mental health in the United Kingdom. It thereby also investigated how differences in gender influenced this effect and whether there existed any heterogeneity in the effect of having children on parental mental health by socioeconomic status. As discussed in the introduction, investigating this effect using an event study model contributes to the existing literature because almost all previous work is correlational, and an event study model measures a more causal effect. Furthermore, this effect has not been investigated in the United Kingdom yet. Moreover, this study also extended the area studied of the existing literature by performing models that investigated the effect of having a child on parental mental health for parents who belong to different socioeconomic statuses. The methodological approach of this study consisted of event study models with individual fixed effects, which allowed us to provide a graphical representation of the anticipation effects and the dynamic treatment effects of having children on parental mental health.

The first hypothesis (H1) stated that having a first child has an effect on parental mental health. As seen in sections 4.1.1 and 4.1.2 the null hypothesis of H1 is rejected for parental mental health (men and women together) and also for paternal and maternal mental health separately. For both men and women, there appears to be a downward trend in mental health in the prior years before the pregnancy of the first child. However, only for women in the year before they are pregnant, there is a significant anticipation effect of having a child on mental health. As already discussed, the observed pattern is probably caused by the positive anticipation effect in the year of pregnancy, anticipating the birth. This suggests that in the year of pregnancy, there seems to be an increase in mental health, anticipating the birth, after which it dropped again in the years following. Both men and women also report a significant decrease in mental health after receiving a child. However, the observed effect of having a child on maternal mental health tends to be stronger and more significant than the observed effect of having a child on paternal mental health (Figure 2). These results are inconsistent with previous research based on different longitudinal samples (Mckenzie & Carter, 2012 and Rupanner et al., 2018). Because Mckenzie and Carter and Rupanner et al. both found that having a first child was positively associated with parental mental. A possible reason for the inconsistency of the findings of this study with similar studies in the past is the fact that the methodological approach is different in these studies, as they used an individual fixed effects model. Studies with a different methodological approach also estimate something different. Furthermore, the studies of Mckenzie and Carter and Rupanner et al. were conducted in respectively New Zeeland and Australia. It could be that parents in these countries and in the United Kingdom react differently to having a first child. This could have different reasons; for example, the policies regarding maternity leave conditions in these

countries could differ, causing parents in the country with the relatively worse conditions to experience more stress and time pressure, which in turn has negative effects on mental health.

The second hypothesis (H2) stated that having a second child has an effect on parental mental health. The null hypothesis of H2 is rejected for parental mental health for men and women together (Section 4.2.1) and also for women separately (Section 4.2.2). However, for men separately, there existed no significant negative treatment effects for having a second child on mental health, and hence, the null hypothesis of H2 was not rejected for men (Section 4.2.2). The graphical representation in Figure 4 showed that fathers reported in the first years after some slightly positive standardized mental health coefficients, which means that there exists no significant negative treatment effect for having a second child on paternal mental health. For mothers, the graphical representation of Figure 4 was similar to the graphical representation of Figure 3, which considered the effect of having a second child on parental mental health for both men and women. Therefore, the same conclusion as with Figure 3 holds for mothers, namely that having a second child lowers the mental health of mothers, at least compared to the mental health that they had in the year that they were pregnant. These results also have inconsistencies with previous research based on longitudinal samples. Rupanner et al. (2018) found in their research that the mental health of fathers decreased after the birth of a second child, while this study found no significant decrease, but even a small (insignificant) increase in mental health after having a second child for fathers. Mckeinzie and Carter (2012) found that a first child increased the mental health of parents and that a second child increased the mental health even further. The results regarding the effect of having a second child are inconsistent for mothers in this study and for fathers, this cannot be stated with certainty because the treatment effects were insignificant. However, the observed pattern in the study of Mckenzie and Carter is inconsistent with both fathers and mothers in this study. Possible reasons that these inconsistencies occur are, for example, the different methodological approaches and that the different studies were conducted in different countries, as already discussed.

This study also investigated whether there existed any heterogeneity in the effect of having children on parental mental health by socioeconomic status. There seem to be no significant differences for the effect of having a first child on parental mental health for parents (both men and women) who belong to the relatively high-income and low-income group (Section 4.3.1). For both groups, there is a similar insignificant negative pattern observable in Figure 5. Also, when fathers and mothers are modelled separately, no differences could be observed with certainty (Section 4.3.2). Therefore, one can conclude that it seems that the patterns of the effect of having a first child on parental mental health for both men and women do not differ for relatively good and relatively poor socioeconomic status groups. These findings cannot be related to previous literature because this

particular aspect of the effect of having children on parental mental health has not been studied yet. The fact that it seems that there are no differential patterns for the effect of having a first child on parental mental health by socioeconomic status groups, is a meaningful contribution to the existing literature, as it is relevant for people of different socioeconomic statuses to know if they would react differently to having children. Furthermore, for policymakers, it is also relevant to know that parents of different socioeconomic statuses seem to have a similar effect of having children on parental mental health.

To answer the research question, which stated: *"What is the effect of having children on parental mental health in the United Kingdom?"* the results of this study will be used. First, the results of the first hypothesis (H1) suggest that for both men and women, when they have a first child, there is a decrease in mental health in the years after having the first child compared to the year in which the parent or the parent's partner was pregnant. Similarly, when having a second child (H2), a decline in mental health is observable for mothers in the years following. For men, however, this is not observable when having a second child. Furthermore, the results of this study suggest that there seem to be no differential patterns for the effect of having a first child on parental mental health by socioeconomic status groups. Therefore, the general answer to the research question is that having a first child decreases mental health for fathers and mothers, and having a second child also decreases mental health for mothers, while this is not observable for fathers.

The results of this study also contributed to the knowledge of the effect of having a child on parental mental health in the United Kingdom. As this effect has not been investigated in the United Kingdom yet, the results of this study are of particular interest to society and policymakers in the United Kingdom. Possible implications for the results of this study have already partly been discussed in the introduction. For society, it is relevant to know what the mental health consequences might be if you would have a child. The results of this study show that having children in most cases decreases parental mental health in the United Kingdom. It could be that when parents know that having a child reduces parental mental health on average, they better prepare for this, which may reduce this effect. It may, for example, be that parents who know the results of this study will think more carefully when they have a child and more often only have a child when they are ready. Possible implications for policymakers in the United Kingdom are that policymakers consider how to reduce these negative effects on the parental mental health of having children. Future research could investigate which factors play an important role in the occurrence of these mental health problems and think of possible policies that deal with these problems. For example, it could be that parents experience much more stress when having a child and that better maternity leave conditions could prevent this. However, future research should investigate whether this is the case.

Despite the contributions of this research, this study also has limitations that create possible avenues for future research. First, something that has already been discussed in the results section is the small sample size with some of the regressions. For example, when investigating the effect of having children for relatively high-income and low-income parents, separately for men and women, the initial sample size is twice divided into two. Therefore, the sample size became smaller and the confidence intervals larger, which in turn contributes to more results not being significant. Thus, for future research, it is recommended to use a sample that is large enough that these kinds of problems are not encountered.

Second, the sample of this study consisted of 10 years of panel data. This made it possible to investigate relatively short-term anticipation and treatment effects of having children on mental health, but relatively long-term effects could not be investigated with this sample. Furthermore, for longer-term effects that are measurable in this sample, there are relatively low observations. Therefore, it is recommended for future research to use a sample that consists of more years of panel data, as it would be very interesting to investigate the longer-term effects of having children on parental mental health.

Third, the parenthood variable in this study was not measured very accurately. As described in section 2.3 about the parenthood variable, for women, the outcome of pregnancy was used to obtain the variable, and for men, a variable was used that indicated how many new children a man had since the previous wave. Therefore, for both men and women, it was assumed that this was the first year they had the child and the year before they or their partner was pregnant from the child. However, the parenthood variable would have been more accurately measured if, for example, the dataset contained a variable in which the month was given a parent had a child, or even better, the exact day.

Fourth, as already discussed in the results section (Sections 4.2.1 and 4.2.2), how the anticipation and treatment effects exactly are when having a second child cannot be stated with certainty. This is because all parents in this sample who had received a second child were also observed when they had received their first child. As already discussed, this makes the sample more selected, as only people who had a first and a second child in the period 2009-2019 are included in the sample. Furthermore, this makes the graphical representation for the second child less accurate. The first child will especially influence the coefficients for the anticipation effects because these years contain the negative treatment effects of receiving a first child. However, also for the dynamic treatment effects after receiving a second child, this effect could partly be the effect of the first child. Therefore, for future research, it would be interesting to investigate how much effect having the first child still has on mental health after the second child is already born (e.g., by decomposition analysis).

Fifth, the methodological approach of this study did not take advantage of the fact that the sample of this study, from the Understanding Society, was composed at the household level. The event study models of this study used within-individual variation to identify the treatment effects and did thus not consider that some individuals in this sample belonged to the same household. Therefore, it could be that this study left some potentially confounding factors at the household level uncontrolled. However, because this study controlled for individual fixed effects, the time-invariant factors that belong to the household level are being controlled for.

Finally, the generalisability of this study is limited by parents in the United Kingdom. As discussed earlier, this study used 10 years of British panel data of the Understanding Society, which included all four countries in the United Kingdom. As parents in the United Kingdom will be different from parents in other countries and as there will be other factors that affect parents in the United Kingdom and other countries differently, for example, different policies regarding maternity leave conditions, the external validity of the results of this study is limited. As already discussed, the findings in this study are inconsistent with previous research based on longitudinal samples that were conducted in New Zeeland and Australia (Mckenzie & Carter, 2012 and Rupanner et al., 2018). However, the three different studies also used three different methodological approaches and therefore estimated a different effect. Especially this study differed from the studies of Mckinzie and Carter and Rupanner et al., as this study used an event study model and their studies used individual fixed effects models. The event study model allows us to provide a graphical representation of the anticipation effects and the dynamic treatment effects. Furthermore, with this model, this study aimed to estimate a more causal effect. In order to determine whether estimating a causal effect has been succeeded, it is necessary to check whether the most important assumption of an event study model is fulfilled.

As already discussed, the key assumption of an event study model is that the timing of the treatment should be random, as all individuals in the sample eventually get treated. To determine whether this assumption is met, it is necessary to determine whether there were any factors at the time of the sample that might have interfered with it. A potential factor that might have interfered with this key assumption is the Great Recession of 2008, since the sample of this study is from 2009 to 2019. The study of Boyce, Delaney and Wood (2018) investigated how subjective well-being in the United Kingdom changed in the years following the Great Recession. Their key results suggest that although there were only small changes in well-being observable at the national level, there were large changes in well-being observable among small sub-groups in the population. For example, individuals that lost their job reported a relatively large drop in subjective well-being. Although the specific effect of the Great Recession in 2008 on the likelihood of certain sub-groups (e.g., individuals

who lost their jobs) having children has not been studied, it is likely to assume that the Great Recession, through the well-being of individuals in the United Kingdom, or through other channels has influenced the likelihood of some parents having children. Therefore, there may be a differential selection intro pregnancy related to the Great Recession. This would mean that the sample of this study is less representative for the whole population in the United Kingdom, as certain sub-groups will be under-represented and certain sub-groups over-represented.

To conclude, the expectation is that the Great Recession will have had some impact on the generalisability of the results. Through which channels the Great Recession will have had this impact cannot be determined with certainty because this has not been investigated yet. It would be very interesting if future research would investigate what the effect of having children on parental mental health is using an event study model. It would thereby be interesting if future research would investigate this effect in the United Kingdom to investigate whether the potential selection intro pregnancy related to the Great Recession had a great impact on the results of this study. Furthermore, it would also be interesting if future research would focus on other European countries, also to investigate the generalisability of the results of this study and because this effect has not been studied much yet in Europe.

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Appendix A – Additional data

Table A1. *Descriptive statistics on model variables for men*

Variable	Mean	Standard Deviation	Min	Max	N
Standardized Mental Health	0.120	0.943	-4.742	2.353	7,588
Age	33.545	5.829	20	50	7,588
Net monthly household income	3648.046	2379.325	-792.11	58716.67	7,588
Highest educational qualification					
Degree	0.531	0.499	0	1	7,588
A level	0.262	0.430	0	1	7,588
GCSE	0.166	0.372	0	1	7,588
Other qualification	0.032	0.176	0	1	7,588
No qualification	0.009	0.095	0	1	7,588
Marital status					
Partnered / Married	0.891	0.312	0	1	7,588
Single	0.095	0.293	0	1	7,588
Widowed, Divorced, Separated	0.014	0.118	0	1	7,588
Employment status					
Employed	0.943	0.231	0	1	7,588
Unemployed	0.038	0.191	0	1	7,588
Long term sick / Disabled	0.005	0.068	0	1	7,588
Other job status	0.014	0.119	0	1	7,588

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 7,588 observations for men from 1,031 individuals. All variables in the table are time-varying. Missing observations for the outcome variable (mental health) were removed. Missing observations for the control variables were imputed by replacing the missing value of an individual with a value one year earlier or later.

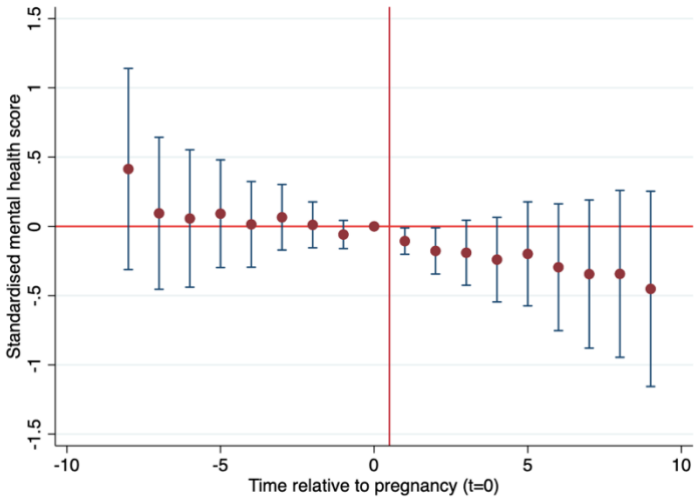
Table A2. *Descriptive statistics on model variables for women*

Variable	Mean	Standard Deviation	Min	Max	N
Standardized Mental Health	-0.089	1.031	-5.114	2.445	10,259
Age	31.975	5.544	20	50	10,259
Net monthly household income	3510.261	2712.57	0	170180	10,259
Highest educational qualification					
Degree	0.613	0.487	0	1	10,259
A level	0.215	0.411	0	1	10,259
GCSE	0.133	0.340	0	1	10,259
Other qualification	0.022	0.147	0	1	10,259
No qualification	0.016	0.127	0	1	10,259
Marital status					10,259
Partnered / Married	0.847	0.360	0	1	10,259
Single	0.130	0.337	0	1	10,259
Widowed, Divorced, Separated	0.023	0.150	0	1	10,259
Employment status					
Employed	0.812	0.386	0	1	10,259
Unemployed	0.152	0.359	0	1	10,259
Long term sick / Disabled	0.008	0.090	0	1	10,259
Other job status	0.021	0.145	0	1	10,259

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 10,259 observations for women from 1,368 individuals. All variables in the table are time-varying. Missing observations for the outcome variable (mental health) were removed. Missing observations for the control variables were imputed by replacing the missing value of an individual with a value one year earlier or later.

Appendix B – Additional results

Panel A. Event study without control variables (men)



Panel B. Event study without control variables (women)

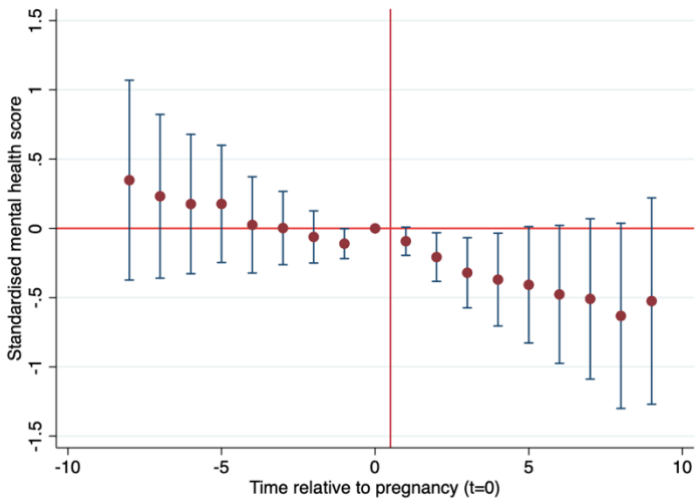


Figure B1. *Impact of having a first child on parental mental health separately for men and women*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 7,588 observations for men from 1,031 individuals and 10,259 observations for women from 1,368 individuals. This figure shows the effect of having a first child on the standardized mental health score for parents (separately for men and women). Panel A is the graphical outcome for the event study model for men and Panel B is the graphical outcome for women. Both Panel A and Panel B show the graphical outcome of the event study model without control variables (only controlling for age and its square). and Panel A and Panel B also control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

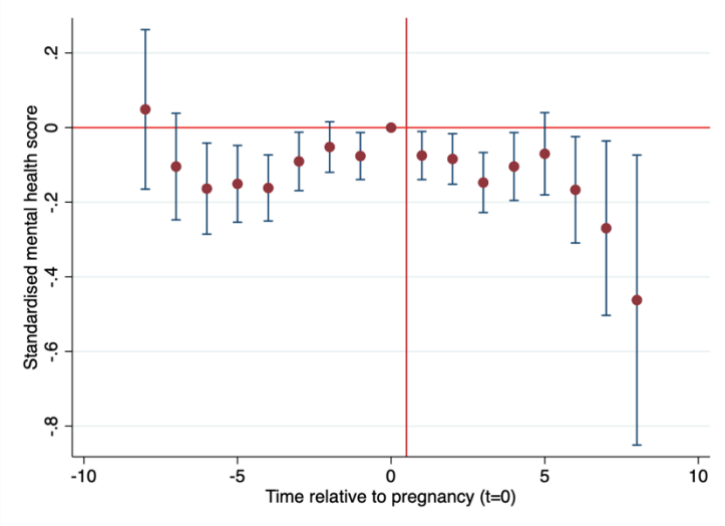
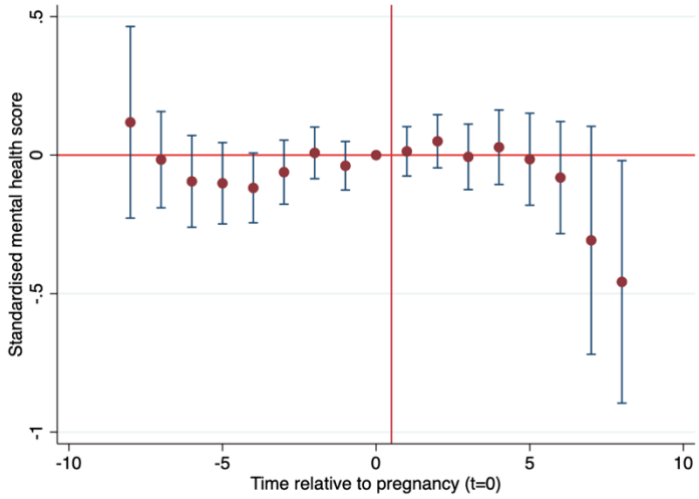


Figure B2. *Impact of having a second child on parental mental health without control variables*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 7,932 observations (3,307 for men and 4,625 for women) from 935 individuals (390 men and 545 women). This figure shows the effect of having a second child on the standardized mental health score for parents (both men and women). The graphical outcome of the event study model only controls for the control variables age and age squared, year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

Panel A. Event study without control variables (men)



Panel B. Event study without control variables (women)

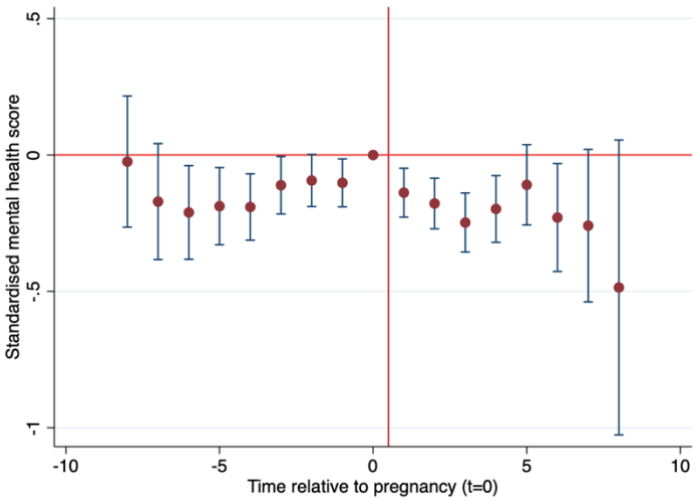
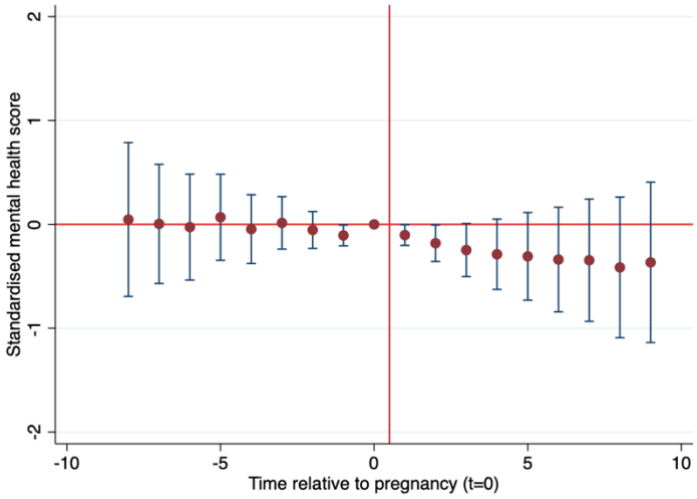


Figure B3. *Impact of having a second child on parental mental health separately for men and women*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 3,307 observations for men from 390 individuals and 4,625 observations for women from 545 individuals. This figure shows the effect of having a second child on the standardized mental health score for parents (separately for men and women). Panel A is the graphical outcome for the event study model for men and Panel B is the graphical outcome for women. Both Panel A and Panel B show the graphical outcome of the event study model without control variables (only controlling for age and its square). and Panel A and Panel B also control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

Panel A. High-income without control variables



Panel B. Low-income without control variables

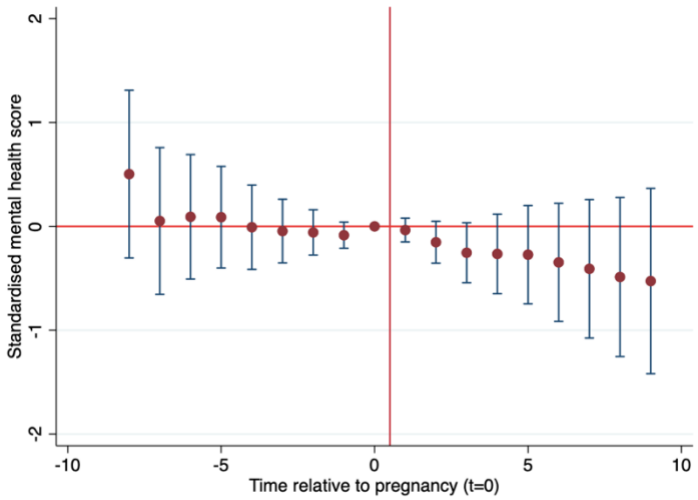
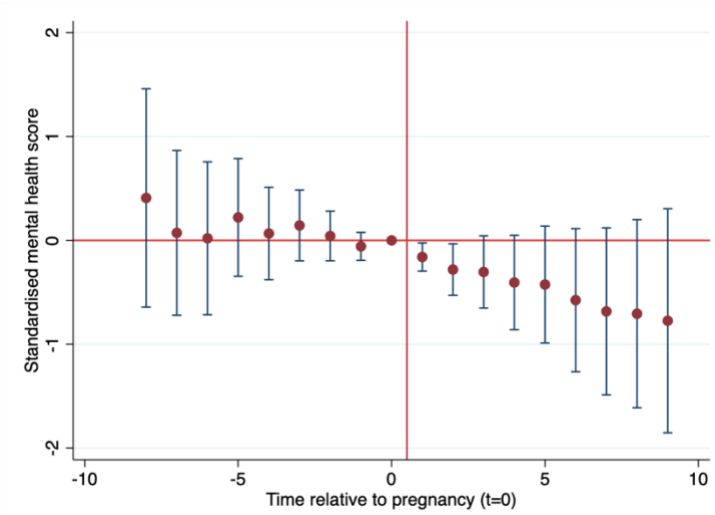


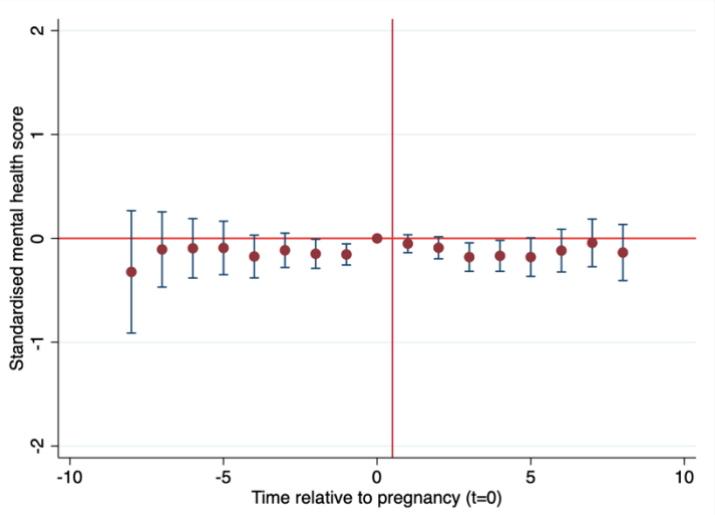
Figure B4. *Impact of having children on parental mental health conditional on their income without control variables*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample for Panel A: 7,203 observations (3,158 for men and 4,045 for women) from 910 individuals (393 men and 517 women). Sample for Panel B: 7,042 observations (4,050 for women and 2,992 for men) from 912 individuals (398 men and 514 women). This figure shows the effect of having a first child on the standardized mental health score for parents who belong to the relatively high-income group (Panel A) and parents who belong to the relatively low-income group (Panel B). Both Panel A and Panel B show the graphical outcome of the event study model without control variables (only controlling for age and its square). and Panel A and Panel B also control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent intervals. The confidence intervals are based on clustered standard errors at the individual level.

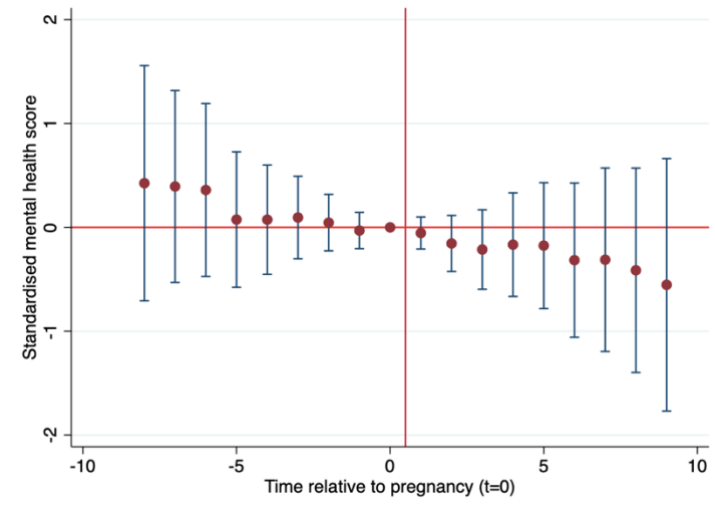
Panel A. Relatively high-income group for men



Panel B. Relatively high-income group for women



Panel C. Relatively low-income group for men



Panel D. Relatively low-income group for women

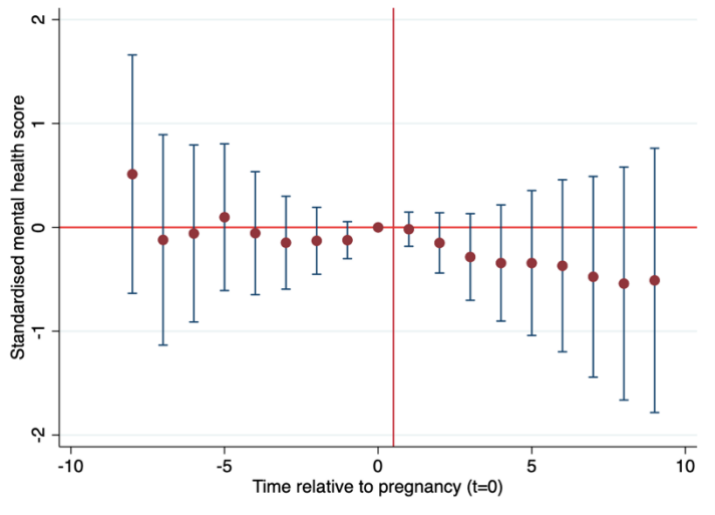


Figure B5. *Impact of having children on paternal and maternal mental health conditional on their income without control variables*

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample for Panel A: 3,158 observations (men) from 393 individuals. Sample for Panel B: 4,045 observations (women) from 517 individuals. Sample for Panel C: 2,992 observations (men) from 398 individuals. Sample for Panel D: 4,050 observations (women) from 514 individuals. This figure shows the effect of having a first child on the standardized mental health score for parents who belong to the relatively high-income group (Panel A and B) and parents who belong to the relatively low-income group (Panel C and D), separately for men and women. All panels show the graphical outcome of the event study model without control variables (only controlling for age and its square), and all panels also control for year fixed effects and individual fixed effects. The horizontal axis shows the time relative to pregnancy, where t=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The vertical red line at t=0.5 denotes when a parent approximately got his/her first child. The vertical axis shows the standardized mental health score. The red points denote the estimated standardized mental health scores, and the blue intervals show the 95 per cent confidence intervals. The confidence intervals are based on clustered standard errors at the individual level.

Table B1. *Effect of having a first child on parental mental health for men and women combined*

Time relative to pregnancy (t=0)	Standardized mental health score
-8	0.375
	(0.263)
-7	0.189
	(0.210)
-6	0.144
	(0.183)
-5	0.152
	(0.149)
-4	0.034
	(0.122)
-3	0.047
	(0.093)
-2	-0.020
	(0.066)
-1	-0.084**
	(0.039)
1	-0.097***
	(0.036)
2	-0.184***
	(0.063)
3	-0.248***
	(0.090)
4	-0.291**
	(0.119)
5	-0.293**
	(0.148)
6	-0.365**
	(0.177)
7	-0.400*
	(0.206)
8	-0.465**
	(0.236)
9	-0.437
	(0.266)

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 17,847 observations (7,588 for men and 10,259 for women) from 2,399 individuals (1,031 men and 1,368 women). This table shows the effect of having a first child on the standardized mental health score for parents (both men and women). T=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The event study model controls for year fixed effects, individual fixed effects, and control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled). Standard errors are clustered at the individual level and reported between brackets. Significance levels: *p<0.1, **p<0.05, ***p<0.01.

Table B2. *Effect of having a first child separately on maternal and paternal mental health*

Time relative to pregnancy (t=0)	Standardized mental health score for men	Standardized mental health score for women
-8	0.505	0.304
	(0.372)	(0.369)
-7	0.156	0.216
	(0.280)	(0.304)
-6	0.131	0.163
	(0.252)	(0.259)
-5	0.141	0.167
	(0.196)	(0.218)
-4	0.052	0.025
	(0.157)	(0.179)
-3	0.099	0.007
	(0.120)	(0.136)
-2	0.029	-0.057
	(0.084)	(0.097)
-1	-0.047	-0.109*
	(0.052)	(0.055)
1	-0.110**	-0.089*
	(0.047)	(0.052)
2	-0.178**	-0.192**
	(0.085)	(0.090)
3	-0.187	-0.297**
	(0.120)	(0.131)
4	-0.232	-0.343**
	(0.156)	(0.173)
5	-0.193	-0.378*
	(0.192)	(0.217)
6	-0.281	-0.439*
	(0.233)	(0.257)
7	-0.328	-0.467
	(0.273)	(0.298)
8	-0.322	-0.583*
	(0.308)	(0.344)
9	-0.423	-0.465
	(0.359)	(0.384)

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 7,588 observations for men from 1,031 individuals and 10,259 observations for women from 1,368 individuals. This table shows the effect of having a first child on the standardized mental health score for parents (separately for men and women). T=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The event study models control for year fixed effects, individual fixed effects, and control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled). Standard errors are clustered at the individual level and reported between brackets. Significance levels: *p<0.1, **p<0.05, ***p<0.01.

Table B3. *Effect of having a second child on parental mental health for men and women combined*

Time relative to pregnancy (t=0)	Standardized Mental Health Score
-8	0.074
	(0.109)
-7	-0.086
	(0.071)
-6	-0.138**
	(0.061)
-5	-0.135**
	(0.052)
-4	-0.155***
	(0.045)
-3	-0.089**
	(0.040)
-2	-0.052
	(0.035)
-1	-0.076**
	(0.032)
1	-0.073**
	(0.033)
2	-0.079**
	(0.034)
3	-0.139***
	(0.041)
4	-0.095**
	(0.046)
5	-0.065
	(0.056)
6	-0.148**
	(0.072)
7	-0.246**
	(0.119)
8	-0.408**
	(0.207)

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019 Sample: 7,932 observations (3,307 for men and 4,625 for women) from 935 individuals (390 men and 545 women). This table shows the effect of having a second child on the standardized mental health score for parents (both men and women). T=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The event study model controls for year fixed effects, individual fixed effects, and control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled). Standard errors are clustered at the individual level and reported between brackets. Significance levels: *p<0.1, **p<0.05, ***p<0.01.

Table B4. *Effect of having a second child separately on maternal and paternal mental health*

Time relative to pregnancy (t=0)	Standardized mental health score for men	Standardized mental health score for women
-8	0.130	-0.000
	(0.175)	(0.122)
-7	-0.006	-0.146
	(0.086)	(0.105)
-6	-0.079	-0.179**
	(0.084)	(0.086)
-5	-0.096	-0.166**
	(0.075)	(0.072)
-4	-0.113*	-0.180***
	(0.062)	(0.062)
-3	-0.065	-0.102*
	(0.058)	(0.054)
-2	-0.002	-0.089*
	(0.048)	(0.049)
-1	-0.043	-0.098**
	(0.045)	(0.045)
1	0.017	-0.138***
	(0.046)	(0.046)
2	0.055	-0.172***
	(0.048)	(0.047)
3	0.005	-0.240***
	(0.060)	(0.055)
4	0.040	-0.190***
	(0.068)	(0.061)
5	-0.005	-0.107
	(0.084)	(0.075)
6	-0.061	-0.206**
	(0.101)	(0.101)
7	-0.305	-0.224
	(0.212)	(0.142)
8	-0.426*	-0.418
	(0.226)	(0.287)

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample: 3,307 observations for men from 390 individuals and 4,625 observations for women from 545 individuals. This table shows the effect of having a second child on the standardized mental health score for parents (separately for men and women). T=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The event study models control for year fixed effects, individual fixed effects, and control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled). Standard errors are clustered at the individual level and reported between brackets. Significance levels: *p<0.1, **p<0.05, ***p<0.01.

Table B5. *Effect of having a first child on parental mental health conditional on their income*

Time relative to pregnancy (t=0)	Standardized mental health score for high-income	Standardized mental health score for low-income
-8	0.040	0.500
	(0.379)	(0.418)
-7	0.001	0.050
	(0.292)	(0.364)
-6	-0.069	0.097
	(0.260)	(0.307)
-5	0.069	0.091
	(0.211)	(0.251)
-4	-0.045	0.008
	(0.168)	(0.209)
-3	0.017	-0.024
	(0.129)	(0.158)
-2	-0.049	-0.050
	(0.091)	(0.112)
-1	-0.103**	-0.082
	(0.051)	(0.065)
1	-0.091*	-0.040
	(0.051)	(0.059)
2	-0.159*	-0.147
	(0.090)	(0.104)
3	-0.213	-0.244
	(0.131)	(0.150)
4	-0.243	-0.253
	(0.173)	(0.198)
5	-0.246	-0.265
	(0.215)	(0.245)
6	-0.268	-0.332
	(0.256)	(0.294)
7	-0.264	-0.396
	(0.300)	(0.345)
8	-0.318	-0.478
	(0.346)	(0.396)
9	-0.266	-0.512
	(0.393)	(0.461)

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample for relatively high-income: 7,203 observations (3,158 for men and 4,045 for women) from 910 individuals (393 men and 517 women). Sample for relatively low-income: 7,042 observations (4,050 for women and 2,992 for men) from 912 individuals (398 men and 514 women). This table shows the effect of having a first child on the standardized mental health score for parents who belong to the relatively high-income group and parents who belong to the relatively low-income group (for men and women together). T=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The event study models control for year fixed effects, individual fixed effects, and control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled). Standard errors are clustered at the individual level and reported between brackets. Significance levels: *p<0.1, **p<0.05, ***p<0.01.

Table B6. *Effect of having a first child on paternal and maternal mental health conditional on their income*

Time relative to pregnancy (t=0)	Standardized mental health score for high-income men	Standardized mental health score for high-income women	Standardized mental health score for low-income men	Standardized mental health score for low-income women
-8	0.130	-0.242	0.516	0.422
	(0.175)	(0.304)	(0.564)	(0.600)
-7	0.072	-0.030	0.460	-0.192
	(0.406)	(0.145)	(0.483)	(0.524)
-6	0.038	-0.038	0.466	-0.125
	(0.376)	(0.145)	(0.420)	(0.440)
-5	0.227	-0.036	0.162	0.028
	(0.287)	(0.130)	(0.330)	(0.366)
-4	0.062	-0.122	0.146	-0.088
	(0.228)	(0.103)	(0.274)	(0.306)
-3	0.147	-0.079	0.142	-0.155
	(0.174)	(0.085)	(0.203)	(0.231)
-2	0.047	-0.120*	0.069	-0.134
	(0.123)	(0.071)	(0.140)	(0.166)
-1	-0.059	-0.138***	-0.013	-0.133
	(0.069)	(0.051)	(0.089)	(0.092)
1	-0.150**	-0.090	-0.073	-0.016
	(0.070)	(0.055)	(0.079)	(0.085)
2	-0.257**	-0.090	-0.182	-0.125
	(0.127)	(0.055)	(0.140)	(0.150)
3	-0.269	-0.180**	-0.246	-0.248
	(0.178)	(0.070)	(0.199)	(0.217)
4	-0.358	-0.172**	-0.204	-0.292
	(0.233)	(0.077)	(0.259)	(0.290)
5	-0.364	-0.179*	-0.225	-0.293
	(0.288)	(0.094)	(0.317)	(0.361)
6	-0.505	-0.120	-0.364	-0.305
	(0.350)	(0.104)	(0.386)	(0.430)
7	-0.608	-0.045	-0.379	-0.404
	(0.409)	(0.117)	(0.461)	(0.501)
8	-0.623	-0.134	-0.483	-0.461
	(0.463)	(0.138)	(0.512)	(0.582)
9	-0.697		-0.641	-0.410
	(0.551)		(0.625)	(0.660)

Notes: Understanding Society, UK Household Longitudinal Study data, 2009-2019. Sample for high-income men: 3,158 observations from 393 individuals. Sample for high-income women: 4,045 observations from 517 individuals. Sample for low-income men: 2,992 observations from 398 individuals. Sample for low-income women: 4,050 observations from 514 individuals. This table shows the effect of having a first child on the standardized mental health score for parents who belong to the relatively high-income group and parents who belong to the relatively low-income group (separately for men and women). T=0 denotes the year in which the individual or the partner got pregnant, and t=0 is used as the reference category. The event study models control for year fixed effects, individual fixed effects, and control variables (age, age squared, marital status, education, household income and long-term health diseases/disabled). Standard errors are clustered at the individual level and reported between brackets. Significance levels: *p<0.1, **p<0.05, ***p<0.01.