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Physical and mental health changes in the five years before and five years after childbirth: A population-based panel study in first-time mothers and fathers from Germany

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Eva Asselmann, Susan Garthus-Niegel, Susanne Knappe, Julia Martini

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Physical and mental health changes in the five years before and five years after childbirth: a population-based panel study in first-time mothers and fathers from Germany^a

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Abstract

Background: The transition to parenthood is characterized by far-reaching changes in life. However, little prospective-longitudinal evidence from general population samples exists on changes of general physical and mental health in the years around the birth of a child among mothers and fathers. **Methods:** Using data from the German Socio-Economic Panel Study (SOEP), this study examined continuous and discontinuous short- and long-term changes of general physical and mental health from five years before until five years after the birth of the first child in women ($N = 1,912$) and men ($N = 1,742$). Whether a child was born was assessed annually throughout the study. Physical and mental health was assessed biannually from 2002 to 2018 with the SF-12v2. **Results:** Multilevel analyses revealed that women experienced a considerable decrease of physical health during pregnancy, which remitted after delivery. On average, women's mental health increased in the last year before and first year after delivery. These mental health improvements were stronger in older vs. younger mothers and remained largely stable in the years after childbirth. In contrast, little evidence for changes of general physical or mental health in (expectant) fathers was found. **Limitations:** Physical and mental health was assessed with a short questionnaire only (SF-12v2). **Conclusions:** On average, women's mental health tends to improve before and after the birth of the first child. Men seem to be much less affected by the birth of a child than many previous studies suggest.

Keywords: Pregnancy; parenthood; well-being; psychopathology; prospective-longitudinal

Highlights

- We studied health changes in the years before and after becoming a mother or father.
- Women's physical health was much worse during (but not after) pregnancy.
- Women's mental health improved during pregnancy and especially after childbirth.
- These improvements remained largely stable in the following years.
- In contrast, men's health changed little around the birth of their first child.

Introduction

The transition to parenthood relates to significant changes in life. Women experience far-reaching (psycho-)physiological alterations during pregnancy and after delivery, and both women and men need to prepare for and adjust to their new family situation and parental role before and after the birth of a child (Asselmann & Specht, 2021; Doss & Rhoades, 2017). Being a parent often means joy and fulfillment but also more stress (e.g., less independency, a lack of sleep, and spare time) (Asselmann et al., 2020b; Baldwin et al., 2018; Richter et al., 2019) as well as changes in the partnership (Asselmann, Wittchen, Petzoldt, et al., 2016; van Scheppingen et al., 2018), sexuality (Asselmann, Hoyer, et al., 2016), and social network (Asselmann, Wittchen, Erler, et al., 2016). These changes may last for several years and impact parents' physical and mental health.

Various previous studies have focused on peripartum changes of physical and mental health problems (Asselmann et al., 2020a; Asselmann et al., 2020b; Baron et al., 2017). However, these previous studies were often based on clinical or high-risk samples and focused on women but not men, the time frame of pregnancy or the early postpartum period, as well as specific somatic or psychological symptoms (e.g., depression and anxiety). In contrast, we know surprisingly little about nuanced short- and long-term changes of general physical and mental health from several years before until several years after childbirth in both women and men from the general population. Research on this issue is particularly important because changes of general physical and mental health related to the birth of a child might not only alter the risk of specific health conditions (e.g., affective disorders) in new parents. They also impact the development of their offspring and, for example, contribute to the familial transmission of mental disorders (Grote et al., 2010; Schetter & Tanner, 2012; Stein et al., 2014). Large samples need to be prospectively followed up over long periods of time to obtain enough parents-to-be

(who will have children in the future) and thus be able to analyze changes of general health from several years prior to pregnancy onwards.

Studying health trajectories in the years before and after childbirth requires taking continuous and discontinuous short- and long-term changes into account (Asselmann et al., 2020a; Asselmann et al., 2020b; Asselmann & Specht, 2021). The last year before and first year after childbirth might be characterized by particularly pronounced changes in parental health – due to the pregnancy, delivery, and potential breastfeeding in women and the immediate psychosocial adaptation to the new family situation in both women and men. However, some of these changes might already set in much earlier – when future parents plan to have a family and adjust their mindset and lifestyle accordingly. Moreover, the life of parents typically continues to differ for several years (i.e., beyond the first year postpartum) and at the same time changes as children grow up. Thus, also long-term differences as well as gradual changes in the years before and after childbirth, respectively, need to be considered.

The role of gender

In women, the last year before and first year after childbirth are characterized by far-reaching bodily changes due to the pregnancy, delivery, and (potential) breastfeeding. Especially at the end of pregnancy and shortly after delivery, these changes might lead to restrictions in everyday life (e.g., climbing several flights of stairs or lifting heavy objects might be difficult). Furthermore, being pregnant relates to an increased risk of medical complications (e.g., hypertension/ preeclampsia, gestational diabetes, or birth injuries), which in turn have been linked to physical health problems later in life (e.g., cardiovascular disease or diabetes) (Eades et al., 2017; Li et al., 2020; Wu et al., 2017). Taken together, this line of research suggests that women might experience lower levels of physical health in the last year

before and first year after childbirth (vs. before). These impairments might remit partly but not fully in the following years.

Moreover, the peripartum period is considered a high-risk period for mental health problems in women (Howard & Khalifeh, 2020; Martini, Knappe, et al., 2016), including depressive disorders (Woody et al., 2017), anxiety disorders (Dennis et al., 2017; Martini et al., 2015; Viswasam et al., 2019), pregnancy- and child-related fears (Martini, Asselmann, et al., 2016), panic attacks (Martini et al., 2020), obsessive-compulsive symptoms (Brok et al., 2017), or (birth-related) posttraumatic stress (Ayers et al., 2016; Storksen et al., 2012; Yildiz et al., 2017). However, at the same time, several studies found that depressive and anxiety symptoms in women – on average – remained stable or even decreased during pregnancy and/or after delivery (Asselmann et al., 2020a; Asselmann et al., 2020b; Figueiredo & Conde, 2011; Grant et al., 2008; Heron et al., 2004; Leach et al., 2014; Moss et al., 2009; Schubert et al., 2017; Skouteris et al., 2009). Similarly, population-based panel studies revealed that cognitive (Krämer & Rodgers, 2020; Myrskylä & Margolis, 2014) and affective (Anusic et al., 2014; Luhmann et al., 2012) well-being – on average – improved temporarily around the birth of a child. Based on these findings, one could speculate whether women experience higher levels of mental health in the last year before and first year after childbirth.

In men, the peripartum period has also been associated with pronounced psychological problems, including partnership problems (Knappe et al., 2021), sleep problems (Richter et al., 2019), stress (Baldwin et al., 2018), fatigue (Wynter et al., 2020), depression (Cameron et al., 2016; Garfield et al., 2014; Garthus-Niegel et al., 2020; Rao et al., 2020), anxiety (Leiferman et al., 2021), and post-traumatic stress symptoms after the birth (Kress et al., 2021; Schobinger et al., 2020). For example, one study in young fathers found that depressive symptoms decreased slightly during pregnancy but increased substantially during the first five years after childbirth (Garfield et al., 2014). Nonetheless, the majority of research focused on mothers but

not fathers, and prospective-longitudinal evidence on health changes in men before and after childbirth mostly stems from clinical samples. Moreover, participating fathers in previous studies were often recruited indirectly via participating mothers. This sampling strategy might double selection effects, lead to an overrepresentation of particularly engaged fathers, and limit the generalizability of previous findings to the general population.

The role of age

Furthermore, changes of general physical and mental health in the years before and after childbirth might vary by age. Younger women tend to be at lower risk for medical complications during pregnancy and delivery (Lean et al., 2017), and younger individuals tend to be more energetic and flexible (Asselmann & Specht, 2021). Thus, it is plausible to assume that younger parents have fewer difficulties in adjusting to the new family situation and associated strains (e.g., a lack of sleep or work-family conflicts) (Yang et al., 2020), which might lead to fewer physical and mental health problems in the surrounding years.

On the other hand, older individuals tend to be more mature, experienced, and settled in life (Asselmann & Specht, 2021). They might be “readier” for a child, more often plan the pregnancy intentionally, prepare for the birth more thoroughly, and experience a steeper increase of subjective meaning and fulfillment after becoming a parent (Myrskylä et al., 2017). Moreover, older age at childbirth has been linked to a range of sociodemographic advantages, including higher education, occupational status, income, and financial security (Myrskylä et al., 2017; Sobotka & Beaujouan, 2018). These advantages may allow for greater flexibility, higher support, and better health-/ childcare, which can lower stress and ease the life of a family. In line with these assumptions, previous research found that older (vs. younger) parents experienced a stronger increase in cognitive well-being around childbirth (Myrskylä &

Margolis, 2014). Therefore, it is also plausible to assume that older parents experience more favorable health changes before and after the birth of a child than younger parents.

Aims

Using data from the German Socio-Economic Panel Study (SOEP), this study examined continuous and discontinuous short- and long-term changes of general physical and mental health from five years before until five years after the birth of the first child. In first-time mothers and fathers, we investigated health differences in the last year before childbirth vs. all other years (pre-year effects), in the first year postpartum vs. all other years (post-year effects), and more than one year postpartum vs. all previous years (post-post-year effects). In addition, we examined gradual long-term changes of general physical and mental health in the five years before (gradual pre-birth effects) and five years after (gradual post-birth effects) childbirth. Finally, we tested whether these effects vary by parental age at childbirth.

Aspects of general physical and mental health considered herein include functioning and limitations in everyday life due to physical and/ or mental health problems, pain, vitality, and the subjectively perceived overall quality of physical and mental health.

Materials and methods

Study sample

We used data from the German Socio-Economic Panel Study (SOEP), a nationally representative panel study based on private households from Germany with multistage probability sampling that started in 1984 (Goebel et al., 2019; Kroh et al., 2018). The data are collected yearly and mostly stem from face-to-face interviews with the adult members of the target households. The initial SOEP sample has been replenished regularly with new participants to counteract attrition and to increase the sample size. Here, data from 2002 (the first year in which physical and mental health was assessed) to 2019 (the most recent wave so far) are considered.

Detailed information on the SOEP, including the sample structure, subsamples, and panel attrition, has been previously presented (Goebel et al., 2019; Kroh et al., 2018) and is provided at <https://paneldata.org/soep-core>. The procedures and measures of the SOEP are described at <https://data.soep.de/soep-core>. Previous SOEP publications can be found at https://www.diw.de/sixcms/detail.php?id=diw_02.c.298578.en. The data are available from the DIW Berlin after signing a contract on data distribution (https://www.diw.de/en/diw_02.c.222829.en/access.html). Because this study only involved secondary analyses of anonymized SOEP data provided by the DIW Berlin, ethical approval was not required.

Assessment of childbirth

Participants who entered the panel were initially asked how many children they have and when these children were born. Each year, participants were additionally asked whether and when a child was born in the current or previous year. We merged these data to obtain lifetime information on whether participants had children and when their first child was born

(in years and months, see below). Participants who already had children when they entered the study or experienced the birth of their first child prior to 2002 were excluded.

Assessment of physical and mental health

From 2002 to 2018, information on physical and mental health was assessed biannually with the SOEP version (Andersen et al., 2007) of the SF-12v2 (Ware et al., 2002), a 12-item short version of the SF-36v2 (Ware et al., 2001). The SF-12v2 measures four domains of physical health that can be combined to a Physical Component Summary Scale (PCS) and four domains of mental health that can be combined to a Mental Component Summary Scale (MCS) (Andersen et al., 2007). The physical health domains include Physical Functioning (physical health problems limiting everyday activities such as climbing several flights of stairs or lifting something heavily, reverse coded), Role Physical (achieved less or limited at work/ in everyday activities due to physical health problems, reverse coded), Bodily Pain (suffered from severe physical pain, reverse coded), and General Health (perceiving one's current health status as good). The mental health domains include Social Functioning (contacts with friends, acquaintances, or relatives limited due to physical or mental health problems, reverse coded), Role Emotional (achieved less or limited at work/ in everyday activities due to mental health or emotional problems, reverse coded), Vitality (feeling full of energy), and Mental Health (feeling calmer, more balanced, less down, and less gloomy).

The SF-12v2 is a well-established instrument for the assessment of general physical and mental health in larger socioeconomic and psychological surveys. Its reliability, validity, and cross-cultural comparability have been shown to be satisfactory (Salyers et al., 2000; Tibubos & Kröger, 2020). The SOEP version is not identical but very similar to the original SF-12v2. More detailed information on nuanced differences has been presented elsewhere (Andersen et al., 2007).

Statistical analysis

The analyses were performed with Stata 15 (StataCorp, 2017). Only SOEP participants were considered who (a) provided information on their physical and mental health at least twice between 2002 and 2018 and (b) experienced the birth of their first child between 2002 and 2019 ($N = 3,654$). In these participants, we coded the time point of the birth relative to the time point of the respective health assessment (in years and months). Based on these data, we applied multilevel analyses with measurement occasions (Level 1) nested within persons (Level 2) to model changes of general physical and mental health from five years before until five years after the birth of the first child. We built separate models for physical and mental health in women and men and modeled the effects as fixed effects. The alpha level was set at .05. Specifically, we regressed the standardized physical or mental health score on five event-related predictors to examine pre-year, post-year, post-post-year, gradual pre-birth, and gradual post-birth effects. Each model was adjusted for potential time-dependent confounders, including linear age (to account for continuous age effects), quadratic age (to account for discontinuous age effects), and testing effects (to account for potential biases due to repeated health assessments over time). Table S1 of the SI Appendix shows how each predictor was defined and coded. Table S2 indicates the number of observations per cell and event-related predictor in women and men, respectively.

To test whether health changes before and after childbirth varied by parental age, we repeated the analyses and included an interaction term between age (dimensional score) and the respective event-related predictor. When the interaction was statistically significant, it was decomposed. That is, the respective model was built separately in younger (< 25 years at childbirth), middle-aged (≥ 25 and ≤ 35 years at childbirth), and older (> 35 years at childbirth) parents to assess the direction of interaction.

Results

Sample characteristics

The total sample ($N = 3,654$) included 1,912 (52.33 %) women and 1,742 (47.67 %) men. On average, women were aged $M = 30.00$ years ($SD = 5.66$ years, range: 17 – 49 years) across all waves and aged $M = 29.32$ years ($SD = 5.26$ years, range: 16 – 47 years) when their first child was born. Men were aged $M = 33.03$ years ($SD = 6.71$ years, range: 17 – 89 years) across all waves and aged $M = 32.36$ years ($SD = 6.35$ years, range: 16 – 86 years) when their first child was born.

Across all waves, the means for physical health in the current sample were 54.25 ($SD = 7.40$) in women and 54.88 ($SD = 7.02$) in men (on a scale with $M = 50$ and $SD = 10$ in the total SOEP sample; Andersen et al., 2007). The means for mental health were 48.95 ($SD = 9.59$) in women and 50.99 ($SD = 8.88$) in men. The correlation of physical and mental health was $r = -.07$ in women and $r = -0.11$ in men.

Further information on general physical and mental health of the SOEP sample has been published by Andersen and colleagues (2007). More detailed information on sociodemographic characteristics of the SOEP sample has been published by Goebel and colleagues (2019) as well as Kroh and colleagues (2018), which can be found at <https://paneldata.org/soep-core>.

Health changes before and after childbirth in women

Physical health

Changes of general physical and mental health before and after becoming a mother are shown in Table 1 and Figure 1a and 1b. In the last year before childbirth (i.e., mostly during pregnancy), women's physical health was much lower compared to all other years (pre-year effect: $b = -0.36$). Partially, this decline already started in the previous years (gradual pre-birth

effect: $b = -0.04$ per year). No significant post-year, post-post-year, and gradual post-birth effects on physical health were found. That is, women's physical health remitted to baseline levels after delivery (Figure 1), but there were no additional changes of physical health in the first year or more than one year postpartum.

Supplemental analyses revealed that the effects on physical health were mainly driven by changes of the subscales Physical Functioning and Role-Physical (Table S3). That is, women reported considerably higher limitations in activities of daily living due to physical health constraints in the last year before childbirth (i.e., mostly during pregnancy) vs. all other years.

Mental health

Women's mental health levels were higher in the last year before childbirth (pre-year effect: $b = 0.21$) and first year postpartum (post-year effect: $b = 0.23$). These mental health benefits largely remained in the following years (post-post-year effect: $b = 0.17$) but attenuated slightly over time (gradual post-birth effect: -0.03 per year).

As shown in Table S4, the effects on mental health were mainly driven by changes of general mental health, social functioning, and emotional functioning. On average, women felt less down and gloomy but calmer and more balanced in the last year before childbirth (i.e., mostly during pregnancy) and first year postpartum. These improvements largely remained but diminished slightly in the following years. In the first year postpartum, women also experienced fewer limitations in daily living due to mental health or emotional problems. Again, these benefits remained in large parts but attenuated slightly in the following years.

The role of age

Moreover, changes of mental health in the last year before childbirth and first year postpartum varied by maternal age (age x pre-year effect: $b = 0.17$, 95% CI: 0.03; 0.30, $p = .014$; age x post-year effect: $b = 0.16$, 95% CI: 0.04; 0.28, $p = .012$). Decomposing these interactions revealed that not in younger but only in middle-aged and older mothers, mental health was higher in the last year before childbirth (middle-aged mothers: $b = 0.26$, 95% CI: 0.13; 0.38, $p < .001$; older mothers: $b = 0.41$, 95% CI: 0.12; 0.70, $p = .005$) and first year postpartum (middle-aged mothers: $b = 0.18$, 95% CI: 0.05; 0.31, $p = .008$; older mothers: $b = 0.69$, 95% CI: 0.39; 0.99, $p < .001$). Changes of physical health before and after childbirth did not vary by maternal age.

Health changes before and after childbirth in men

In men, there were no significant changes of physical and mental health in the years before and after the birth of the first child (Table 1 and Figure 1c and 1d). The only exception was that physical health decreased slightly in the five years after becoming a father (gradual post-birth effect: $b = -0.03$ per year). As shown in Table S3, this was due to an increase of bodily pain after the first child was born. However, these effects were small. Investigating the role of paternal age revealed that health changes before and after childbirth did not vary by paternal age.

Discussion

Using data from a large and nationally representative panel study from Germany, this study investigated changes of general physical and mental health up to five years before and five years after the birth of the first child in both women and men. Our main findings are discussed below.

Health changes before and after childbirth in women

In women, levels of physical functioning were considerably lower in (but not after) the last year before childbirth, which is plausible due to the pregnancy. These impairments remitted after delivery, and there was little evidence for additional postpartum changes of general physical health, except that levels of perceived general health decreased slightly over time. After childbirth, women often experience increased stress in everyday life (e.g., due to a lack of sleep or work-family conflicts) (Asselmann et al., 2020b; Richter et al., 2019; Schaber et al., 2020), which might explain these results.

On average, women' mental health was better in the last year before childbirth (i.e., mostly during pregnancy) and first year postpartum. Because the peripartum period has been linked to an increased risk of mental disorders in women (e.g., depression and anxiety) (Dennis et al., 2017; Martini et al., 2015; Viswasam et al., 2019; Woody et al., 2017), these results might be surprising at first sight. However, consistent with our findings, also other research found that psychopathological symptoms – on average – remained unchanged or decreased during pregnancy and/ or after delivery (Asselmann et al., 2020a; Asselmann et al., 2020b; Figueiredo & Conde, 2011; Grant et al., 2008; Heron et al., 2004; Leach et al., 2014; Moss et al., 2009; Schubert et al., 2017; Skouteris et al., 2009). Our findings considerably add to this previous evidence, as we could show that these mental health benefits were relatively stable in the long run and attenuated only slightly in the following years.

The role of age

In terms of age, we found that the increase of mental health levels in the last year before childbirth and first year postpartum was stronger in older vs. younger women. These findings are consistent with previous evidence that cognitive well-being around childbirth increased more in older vs. younger women (Myrskylä & Margolis, 2014). On average, older women might be more settled and “ready” for a child and have larger socioeconomic resources that can ease the transition to motherhood (Myrskylä et al., 2017).

In contrast, changes of general physical health around the birth of the first child did not vary by maternal age. In this regard, one could speculate whether older women tend to compensate age-related disadvantages by more favorable health behaviors (e.g., more frequent health check-ups, a healthier diet, and less smoking) (Myrskylä et al., 2017), which could explain these results.

Health changes before and after childbirth in men

In men, there was little evidence for changes of general physical or mental health in the years around the birth of the first child. The only exception was that physical pain increased slightly in the five years after childbirth. That is, the transition to parenthood seemed to have fewer effects on men vs. women, which could be explained by biological differences and gender-specific role expectations (Valiquette-Tessier et al., 2019). Although men are increasingly involved in childcare nowadays, they might still contribute less (on average) and also experience no (direct) changes due to the pregnancy, delivery, and (potential) breastfeeding (Del Boca et al., 2020; Valiquette-Tessier et al., 2019).

Nonetheless, our findings contradict previous evidence for prevalent health problems in (expectant) fathers (Cameron et al., 2016; Garfield et al., 2014; Garthus-Niegel et al., 2020; Leiferman et al., 2021; Rao et al., 2020; Schobinger et al., 2020; Thiel et al., 2020; Wynter et

al., 2020). In many cases, previous studies specifically focused on peripartum health, and (expectant) fathers were recruited indirectly through their pregnant partners. Such approaches might lead to an overrepresentation of fathers who strongly identify with their parental role and care much about health. In contrast, our data come from a nationally representative household panel study with a broader focus on socio-economic research. Thus, the group of male participants might have been more heterogeneous, including fathers who are differently interested in family issues and health. Taken together, these methodological differences could explain why our study – in contrast to previous research – found little evidence for changes of general physical or mental health before and after becoming a father.

Strengths and limitations

We used data from a large and nationally representative household panel study from Germany. Whether a child was born was assessed yearly, and information on physical and mental health was assessed every two years since 2002. The comprehensive data allowed us modeling nuanced changes of general physical and mental health up to five years before and five years after the birth of the first child in both women and men over and above potential time-dependent confounders (i.e., age and testing effects).

However, a few limitations need to be mentioned: First, health was assessed with the SOEP version of the SF-12v2 (Andersen et al., 2007), a short scale that considers core domains of physical and mental health such as functioning and limitations in everyday life due to physical and/ or mental health problems, pain, vitality, and subjectively perceived levels of health. The SF-12v2 is widely used in socio-economic and psychological research, and its psychometric properties have been shown to be satisfactory (Salyers et al., 2000; Tibubos & Kröger, 2020). The SF-12v2 is very comprehensive. However, due to its broadness, it does not focus on detailed aspects of specific somatic and psychological symptoms. It should thus be

kept in mind that specific symptom changes (e.g., in anxiety, depression, or psychosomatic complaints) might deviate from each other and from general health trajectories. Moreover, subjectively perceived levels of health might differ from objective health indicators. Thus, additional research on similarities and differences between changes of different health measures around the transition to parenthood would be useful. Such research could also focus on clinical features (e.g., symptom severity and comorbidity) and their role for specific symptom changes before and after becoming a parent. Second, potentially important moderators (e.g., a previous history of mental disorders, medical complications during pregnancy or delivery, or identification with the parental role) were not assessed and thus could not be examined herein. Third, our findings might not be generalizable to other regions outside Germany.

Conclusions

Our findings based on the general population from Germany suggest that women experience considerable physical limitations during pregnancy that bounce back after delivery. On average, their mental health improves during pregnancy and after delivery, and these mental health benefits remain largely stable in the following years. In contrast, men experience few changes of general physical or mental health before and after becoming a father and seem to be much less affected by this experience than many previous studies suggest. Future studies may investigate under which circumstances (expectant) fathers experience health changes in the years before and after the birth of the first child (moderators) and which mechanisms can explain these results (mediators). Moreover, future studies may zoom into symptom changes with respect to specific somatic diseases and mental disorders during this critical period, including the role of specific clinical features such as severity and comorbidity.

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Conflicts of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Contributors

All authors were responsible for the conceptualization of the current study. Eva Asselmann conducted the analyses and wrote the manuscript draft. Susanne Knappe, Susan Garthus-Niegel, and Julia Martini provided critical revision and contributed to the interpretation of the findings.

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Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Because this study only involved secondary analyses of anonymized SOEP data provided by the DIW Berlin, ethical approval was not required.

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All authors had complete freedom to direct the analysis and its reporting without influence from any sponsors. There was no editorial direction or censorship from any sponsors.

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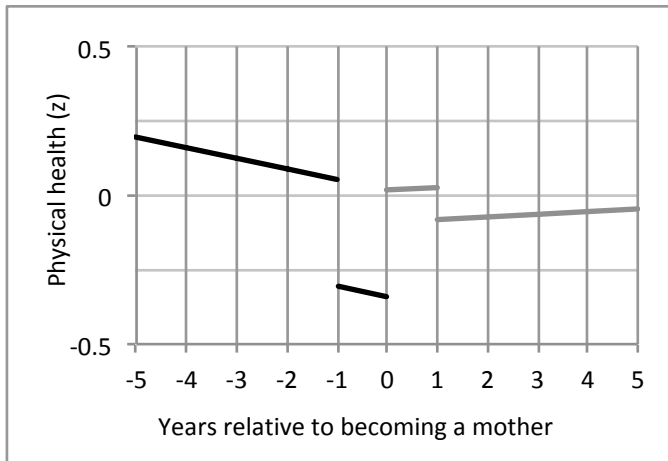
Table 1

Changes of physical and mental health from five years before until five years after the birth of the first child in women (N = 1,912) and men (N = 1,742)

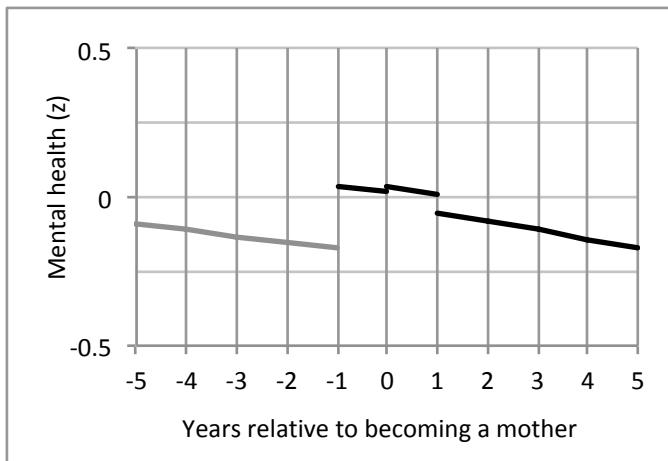
Coefficient	Physical health (SF-12v2 PCS)							
	Women			Men				
	b	95% CI	p	b	95% CI	p		
Pre-year	-0.36	-0.47 -0.25	<.001	-0.01	-0.12	0.09	.779	
Post-year	0.00	-0.11	0.12	.993	0.01	-0.10	0.12	.863
Post-post-year	-0.11	-0.25	0.03	.114	-0.02	-0.15	0.11	.806
Gradual pre-birth (5 years)	-0.04	-0.07 0.00	.046	-0.01	-0.05	0.02	.389	
Gradual post-birth (5 years)	0.01	-0.02	0.04	.559	-0.03	-0.06 0.00	.039	
Coefficient	Mental health (SF-12v2 MCS)							
	Women			Men				
	b	95% CI	p	b	95% CI	p		
Pre-year	0.21	0.11 0.32	<.001	0.04	-0.06	0.14	.462	
Post-year	0.23	0.12 0.35	<.001	0.07	-0.04	0.18	.212	
Post-post-year	0.17	0.04 0.31	.013	-0.01	-0.14	0.13	.929	
Gradual pre-birth (5 years)	-0.02	-0.05	0.02	.340	-0.01	-0.05	0.02	.391
Gradual post-birth (5 years)	-0.03	-0.06 0.00	.033	0.00	-0.03	0.03	.791	

Notes. Multilevel analyses, adjusted for linear age, quadratic age, and testing effects. b = coefficient from multilevel analyses; CI = confidence interval; p = p-value.

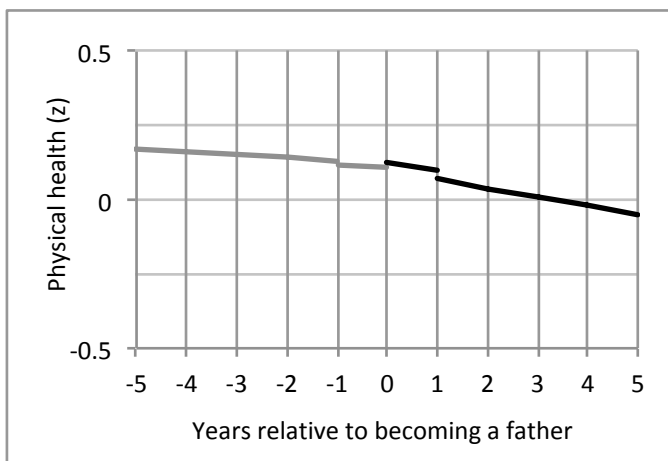
(a)



(b)



(c)



(d)

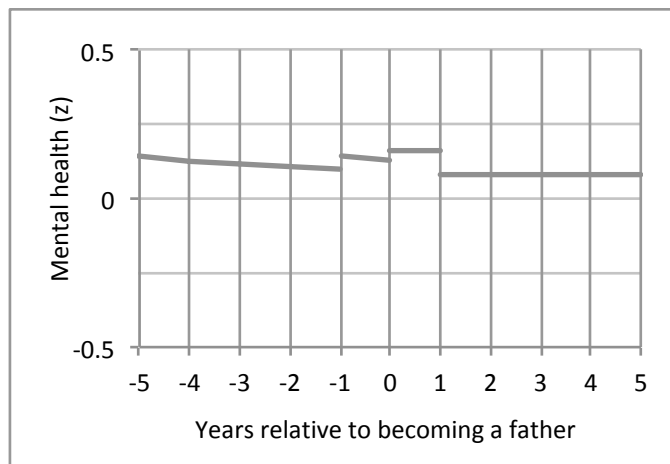


Figure 1: Changes of physical and mental health from five years before until five years after the birth of the first child in women (N = 1,912) and men (N = 1,742)

Note. The first line indicates health changes more than one year before childbirth. It is based on the intercept plus the gradual pre-birth effect multiplied by the time (in years) until delivery. The second line indicates health changes in the last year before childbirth. It is based on the intercept plus the pre-year effect plus the gradual pre-birth effect multiplied by the time (in years) until delivery. The third line indicates health changes in the first year postpartum. It is based on the intercept plus the post-year effect plus the gradual post-birth effect multiplied by the time (in years) since delivery. The fourth line indicates health changes more than one year postpartum. It is based on the intercept plus the post-post-year effect plus the gradual post-birth effect multiplied by the time (in years) since delivery. A black line indicates that any of the effects during the respective time frame (first line: gradual pre-birth effect; second line: pre-year effect and/ or gradual pre-birth effect; third line: post-year effect and/ or gradual post-birth effect; fourth line: post-post-year effect and/ or gradual post-birth effect) was statistically significant ($p < .05$).

Table S1

Description and coding of the predictors

Event-related predictors		
Pre-year (Level 1)	<ul style="list-style-type: none"> Short-term health differences in the last year before childbirth vs. all other years 	<ul style="list-style-type: none"> Coded with 1 for health assessments in the last year before childbirth Coded with 0 for all other health assessments
Post-year (Level 1)	<ul style="list-style-type: none"> Short-term health differences in the first year after childbirth vs. all other years 	<ul style="list-style-type: none"> Coded with 1 for health assessments in the first year after childbirth Coded with 0 for all other health assessments
Post-post-year (Level 1)	<ul style="list-style-type: none"> Long-term health differences more than one year after childbirth vs. all previous years 	<ul style="list-style-type: none"> Coded with 1 for health assessments more than one year after childbirth Coded with 0 for all other health assessments
Gradual pre-birth (5 years) (Level 1)	<ul style="list-style-type: none"> Gradual health changes in the five years before childbirth 	<ul style="list-style-type: none"> Coded with the time span (in monthly increments; from -5 to 0) between the respective health and the date of birth in the five years before childbirth Coded with 0 for all other health assessments
Gradual post-birth (5 years) (Level 1)	<ul style="list-style-type: none"> Gradual health changes in the five years after childbirth 	<ul style="list-style-type: none"> Coded with the time span (in monthly increments; from 0 to 5) between the respective health assessment and the date of birth in the five years after childbirth Coded with 0 for all other health assessments
Control variables		
Linear age (Level 1)	<ul style="list-style-type: none"> Linear age effects 	<ul style="list-style-type: none"> Age in years (divided by 10) Grand-mean centered in the total sample
Quadratic age (Level 1)	<ul style="list-style-type: none"> Quadratic age effects 	<ul style="list-style-type: none"> Squared term of the linear age variable
Testing (Level 1)	<ul style="list-style-type: none"> Effects due to repeated health assessments 	<ul style="list-style-type: none"> Coded with the number of previous health assessments (i.e., with 0 for the first, 1 for the second, and 2 for the third health assessment, etc.) Grand-mean centered in the total sample

Note: The linear age variable was divided by 10 to ensure that the linear and quadratic age effects would not become too small to be displayed rounded to two decimal places. The age and testing variable were centered in the total sample (including women and men) to allow for comparisons

between women and men. We do not report standardized beta-coefficients because our models include dummy and timing variables that cannot be interpreted in a standardized metric.

Table S2

Number of observations per cell and predictor in women (N = 1,912) and men (N = 1,742)

	Women	Men
Number of observations	6,268	5,616
Pre-year		
0	5,493	4,895
1	775	721
Post-year		
0	5,468	4,866
1	800	750
Post-post-year		
0	3,519	3,180
1	2,749	2,436
Gradual pre-birth (5 years)		
0	3,600	3,233
< 0 & \geq -1	782	727
< -1 & \geq -2	611	546
< -2 & \geq -3	545	478
< -3 & \geq -4	387	335
< -4 & \geq -5	343	297
Gradual post-birth (5 years)		
0	2,719	2,430
> 0 & \leq 1	800	750
> 1 & \leq 2	813	734
> 2 & \leq 3	730	646
> 3 & \leq 4	649	573
> 4 & \leq 5	557	483

Table S3

Changes of individual sub-scores of physical health from five years before until five years after the birth of the first child in women (N = 1,912) and men (N = 1,742)

Physical Functioning (everyday activities limited due to physical health problems, e.g., climbing several flights of stairs or lifting something heavily, reverse coded)								
Coefficient	Women			Men			p	
	b	95% CI	p	b	95% CI	p		
Pre-year	-0.51	-0.62	-0.40	<.001	-0.01	-0.11	0.09	.854
Post-year	0.01	-0.10	0.13	.815	0.00	-0.10	0.11	.959
Post-post-year	-0.06	-0.20	0.08	.385	0.03	-0.09	0.16	.583
Gradual pre-birth (5 years)	-0.05	-0.09	-0.02	.004	-0.02	-0.05	0.01	.202
Gradual post-birth (5 years)	0.00	-0.03	0.03	.947	-0.03	-0.05	0.00	.057
Role Physical (achieved less or limited at work or in everyday activities due to physical health problems, reverse coded)								
Coefficient	Women			Men			p	
	b	95% CI	p	b	95% CI	p		
Pre-year	-0.34	-0.45	-0.22	<.001	0.07	-0.04	0.17	.206
Post-year	0.03	-0.09	0.16	.589	0.07	-0.04	0.19	.189
Post-post-year	-0.09	-0.24	0.05	.221	-0.02	-0.15	0.12	.800
Gradual pre-birth (5 years)	-0.03	-0.07	0.00	.082	-0.02	-0.05	0.01	.226
Gradual post-birth (5 years)	0.02	-0.02	0.05	.318	-0.01	-0.04	0.02	.478
Bodily Pain (suffered from severe physical pain, reverse coded)								
Coefficient	Women			Men			p	
	b	95% CI	p	b	95% CI	p		
Pre-year	-0.05	-0.16	0.05	.329	-0.05	-0.15	0.06	.389
Post-year	0.11	-0.01	0.22	.073	0.01	-0.11	0.12	.912
Post-post-year	0.05	-0.08	0.19	.440	-0.03	-0.16	0.11	.719
Gradual pre-birth (5 years)	-0.03	-0.06	0.00	.089	-0.01	-0.05	0.02	.525
Gradual post-birth (5 years)	-0.01	-0.04	0.02	.539	-0.04	-0.07	-0.01	.018
General Health (perceiving one's current health status as good)								
Coefficient	Women			Men			p	
	b	95% CI	p	b	95% CI	p		
Pre-year	0.09	-0.02	0.20	.103	0.02	-0.08	0.13	.663
Post-year	0.17	0.05	0.28	.004	0.06	-0.05	0.16	.312
Post-post-year	0.02	-0.12	0.15	.791	-0.02	-0.15	0.11	.784
Gradual pre-birth (5 years)	-0.01	-0.04	0.03	.713	-0.01	-0.05	0.02	.407
Gradual post-birth (5 years)	-0.04	-0.07	0.00	.023	-0.01	-0.04	0.02	.426

Notes. Multilevel analyses, adjusted for linear age, quadratic age, and testing effects. b = coefficient from multilevel analyses; CI = confidence interval; p = p-value.

Table S4

Changes of individual sub-scores of mental health from five years before until five years after the birth of the first child in women (N = 1,912) and men (N = 1,742)

Social Functioning (contacts with friends, acquaintances, or relatives limited due to physical or mental health problems, reverse coded)								
Coefficient	Women			Men				
	b	95% CI	p	b	95% CI	p		
Pre-year	0.07	-0.04	0.19	.214	0.04	-0.07	0.15	.444
Post-year	0.21	0.09	0.33	.001	0.07	-0.05	0.18	.258
Post-post-year	0.11	-0.04	0.25	.154	0.07	-0.07	0.20	.350
Gradual pre-birth (5 years)	-0.03	-0.06	0.01	.170	-0.02	-0.05	0.02	.365
Gradual post-birth (5 years)	-0.01	-0.04	0.02	.607	-0.02	-0.05	0.01	.208
Role Emotional (achieved less or limited at work or in everyday activities due to mental health or emotional problems, reverse coded)								
Coefficient	Women			Men				
	b	95% CI	p	b	95% CI	p		
Pre-year	0.07	-0.04	0.19	.207	0.03	-0.07	0.14	.538
Post-year	0.16	0.04	0.28	.009	0.09	-0.02	0.20	.107
Post-post-year	0.20	0.05	0.34	.008	0.07	-0.06	0.20	.316
Gradual pre-birth (5 years)	-0.04	-0.07	0.00	.053	-0.02	-0.05	0.01	.266
Gradual post-birth (5 years)	-0.04	-0.07	0.00	.031	-0.02	-0.05	0.01	.170
Vitality (feeling full of energy)								
Coefficient	Women			Men				
	b	95% CI	p	b	95% CI	p		
Pre-year	0.02	-0.09	0.13	.746	-0.05	-0.16	0.06	.399
Post-year	0.04	-0.08	0.15	.527	-0.06	-0.17	0.06	.344
Post-post-year	-0.05	-0.19	0.08	.441	-0.18	-0.32	-0.04	.012
Gradual pre-birth (5 years)	-0.02	-0.06	0.01	.230	0.00	-0.03	0.04	.969
Gradual post-birth (5 years)	0.02	-0.02	0.05	.320	0.03	-0.01	0.06	.106
Mental Health (feeling calmer, more balanced, less down, and less gloomy)								
Coefficient	Women			Men				
	b	95% CI	p	b	95% CI	p		
Pre-year	0.16	0.06	0.27	.002	0.05	-0.05	0.16	.335
Post-year	0.26	0.15	0.37	<.001	0.08	-0.03	0.19	.170
Post-post-year	0.16	0.03	0.29	.014	0.00	-0.14	0.14	.992
Gradual pre-birth (5 years)	-0.01	-0.04	0.03	.750	-0.02	-0.05	0.02	.270
Gradual post-birth (5 years)	-0.05	-0.08	-0.02	.001	0.00	-0.03	0.03	.827

Notes. Multilevel analyses, adjusted for linear age, quadratic age, and testing effects. b = coefficient from multilevel analyses; CI = confidence interval; p = p-value.