

Infant regulation during the pandemic: Associations with maternal response to the COVID-19 pandemic, well-being, and socio-emotional investment

Tilman Reinelt  | Debora Suppiger  | Clarissa Frey |
Rebecca Oertel | Giancarlo Natalucci 

Department of Neonatology, Family Larsson-Rosenquist Foundation Center for Neurodevelopment, Growth, and Nutrition of the Newborn, University Hospital Zurich, University of Zurich, Zurich, Switzerland

Correspondence

Tilman Reinelt, Department of Neonatology, Family Larsson-Rosenquist Foundation Center for Neurodevelopment, Growth, and Nutrition of the Newborn, University Hospital Zurich, University of Zurich, Frauenklinikstrasse 10, 8091 Zurich, Switzerland.
Email: tilman.reinelt@uzh.ch

Abstract

In the transition to parenthood, the COVID-19 pandemic poses an additional strain on parental well-being. Confirmed infections or having to quarantine, as well as public health measures negatively affect parents and infants. Contrary to previous studies mainly focusing on the well-being of school-aged children and their parents during lockdown periods, the present study investigated how mothers of infants respond to the COVID-19 pandemic and whether this is related to maternal well-being, maternal socio-emotional investment, and infant regulation. Between April and June 2021, 206 mothers of infants ($M_{\text{age}} = 7.14$ months, $SD_{\text{age}} = 3.75$ months) reported on COVID-19 infections, their response to the COVID-19 pandemic, their well-being, socio-emotional investment, and their infant's regulation. Exploratory factor analyses yielded five dimensions of maternal response to the COVID-19 pandemic: social distancing, worrying about the child, birth anxiety, distancing from the child, and information on COVID-19-related parenting behavior and support. These dimensions were related to mother-reported infant regulatory problems. Path analyses revealed paths via reduced maternal well-being and maternal socio-emotional investment. Maternal perceptions of

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial License](https://creativecommons.org/licenses/by-nc/4.0/), which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2022 The Authors. *Infancy* published by Wiley Periodicals LLC on behalf of International Congress of Infant Studies.

infant regulatory problems are related to how the mothers respond to the COVID-19 pandemic. Better information about COVID-19-related parenting behavior and support might buffer against these effects.

The COVID-19 pandemic poses challenges for parents and children. Such pandemic-related stress might be especially challenging for parents during the transition to parenthood as parents already need to adjust to new roles (Epifanio et al., 2015; Lévesque et al., 2020). Several studies investigated effects of the COVID-19 pandemic on the well-being and parenting behavior of parents of pre-school and school-aged children. But only little is known about how the COVID-19 pandemic affects parental well-being, parental investment, and subsequently infant development (e.g., infant regulatory behavior). In particular, it is unknown which parental responses to the COVID-19 pandemic (e.g., reducing social contacts, wearing masks, worrying about the infant's health) are related to infant regulation. The present study, therefore, investigates parental responses to the COVID-19 pandemic and their associations with infant regulatory behavior.

1 | PUBLIC HEALTH MEASURES TO STOP THE SPREADING OF THE VIRUS

On March 11th, 2020, the World Health Organization declared the COVID-19 pandemic (WHO, 2020). Subsequently, countries all over the world adopted several public health measures to stop the spreading of the virus, reduce the number of cases and keep their population healthy. While countries differed with regard to what and when measures were implemented, most measures included compulsory mask-wearing, sanitization, the reduction of social contacts, mandatory working from home, and at some point the shutdown of several industries (e.g., restaurants, non-essential businesses, and facilities), kindergartens, and schools (Koh, 2020; Nussbaumer-Streit et al., 2020). During the last two years, the adopted public health measures changed in response to the severity of the COVID-19 pandemic: If the number of cases decreased, measures were relaxed. However, if the number of cases increased, measures were intensified. For instance, among the countries in the world with the highest number of COVID-19 cases per-capita, and in the wake of other neighboring European states, Switzerland experienced the first drastic national 'shutdown' measures from March 16th to April 26th, 2020. Subsequently, the intensity of the preventive measures to fight the propagation of COVID-19 was adapted to the severity of the infection rate. In June 2020, the extraordinary situation was revoked allowing again gatherings of up to 1000 people. Measures were intensified in winter 2020 by restricting gatherings to a maximum of 15 people and closing discos and bars to lift these measures again in spring 2021 while providing free COVID-19 tests (Bundesamt für Gesundheit (BAG), 2022). For an overview of the adopted public health measures in relation to the number of COVID-19 cases in Switzerland see Figure 1.

2 | PARENTAL WELL-BEING AND PARENTING DURING THE PANDEMIC

Worries about getting infected or having an infected child, as well as increased demands in balancing work and family life due to the implemented public health measures (e.g., working from home),

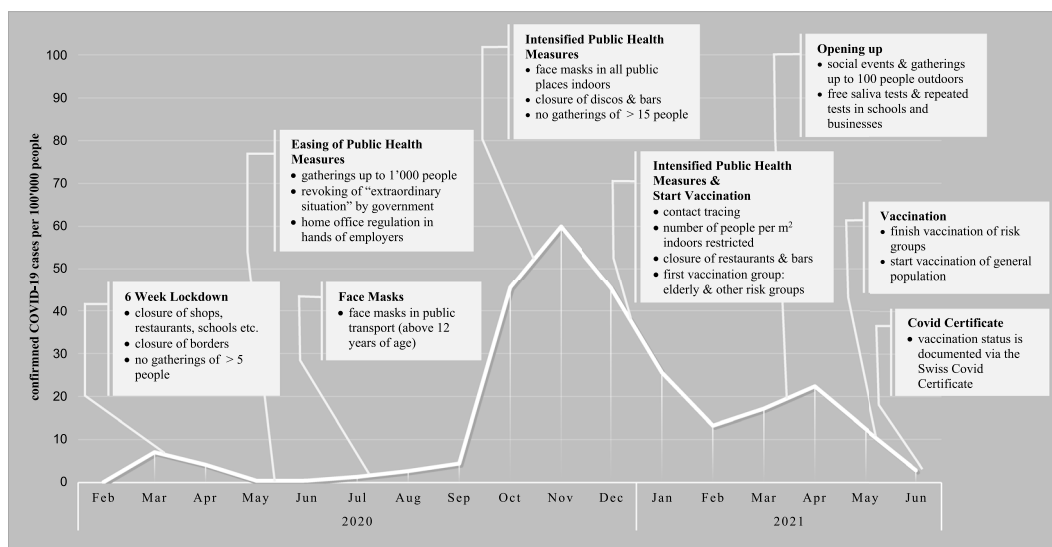


FIGURE 1 COVID-19 incidences and implemented public health measures in Switzerland over time. *Note:* Data and measures derived from Bundesamt für Gesundheit (BAG)

are associated with increased stress levels in parents (Huebener et al., 2021; Spinelli et al., 2020). In particular, during pregnancy or after giving birth in the transition to parenthood, these pandemic-related stressors pose additional burdens to an already stressful period. Parents need to adjust to their caregiving role, develop new routines, and adapt their lifestyle to their child's needs (Epifanio et al., 2015; Lévesque et al., 2020). This adaptation already starts during pregnancy. During this vulnerable period, higher stress levels, however, increase the likelihood to suffer from psychological disorders such as maternal anxiety, and prenatal or postnatal depression (Davis & Narayan, 2020).

During the COVID-19 pandemic, the level of maternal internalizing symptoms, such as symptoms of depression and anxiety, increased worldwide both prenatally and postpartum (Davenport et al., 2020; Fallon et al., 2021; Fan et al., 2022; Liu et al., 2021; Matsushima & Horiguchi, 2020; Spinola et al., 2020). Analyses of parental responses to the pandemic—how parents think, feel, or behave in response to the COVID-19 virus and the implemented public health measures—identified that COVID-19-related health concerns regarding both the mother and the infant, worries that the partner might not be able to attend the delivery, and concerns about having access to professional care and support (e.g., by midwives or in hospitals), were associated with higher symptom levels in mothers (Lebel et al., 2020; Liu et al., 2021; Wyszynski et al., 2021). In contrast, pregnant and new mothers, who reported greater knowledge about preventing a COVID-19 infection, displayed lower levels of depressive symptoms (Fan et al., 2022).

Increased levels of parental psychopathology are a risk factor for early child development. Maternal symptoms of depression and anxiety are among the strongest predictors of child regulatory problems and externalizing symptoms (Reinelt et al., 2019; Ölmestig et al., 2021). In addition, higher parental stress levels can affect child development via parental investment and parenting behavior (Bradley et al., 1997; Nepl et al., 2016). Parental investment refers to parents investing resources in their child (e.g., time or money) or being socio-emotionally invested (e.g., not wanting to be separated from the child) (Bradley et al., 1997; Longo et al., 2017). Higher levels of parenting stress, parental dysphoria, and parental depression negatively affect parental investment and parenting behavior both in mothers and fathers (Bradley et al., 1997; Cummings et al., 2005; Nepl et al., 2016). This

association can already be observed in the first year after the child is born. A meta-analysis revealed that higher levels of maternal depressive symptoms are related to less maternal sensitivity (Bernard et al., 2018). Higher amounts of invested resources (e.g., shared activities and cognitive stimulation) have been related to better child cognitive development, whereas higher amounts of parental socio-emotional investment have been related to fewer socio-emotional problems in childhood and adolescence (Gershoff et al., 2007; Longo et al., 2017).

According to the Family Stress Model (Masarik & Conger, 2017), external stressors like the COVID-19 pandemic lead to social disruption and hardship. This is theorized to result in parental stress, reduce parental well-being, and in turn, is assumed to impair parental investment and parenting behavior. This disruption in parenting behavior further affects child adjustment. The Family Stress Model served as the theoretical bases for several studies investigating the impact of the COVID-19 pandemic on family functioning and child development (e.g., Oppermann et al., 2021; Singletary et al., 2022; Wade et al., 2021). In this context, a recent reformulation of the model (Prime et al., 2020) states an additional bi-directional relationship between reduced parental well-being and child adjustment problems.

Evidence for the Family Stress Model in the context of the COVID-19 pandemic comes from Germany indicating that higher parental stress levels during the first lockdown in 2020 were related to diminished parental investment in terms of shared activities with the child in families of children up to the age of six years (Oppermann et al., 2021). Like-wise, data from Singapore suggested that parents who felt more impacted by the COVID-19 pandemic during the lockdown used more harsh parenting strategies toward their children younger than 12 years of age (Chung et al., 2020). An increase in harsh parenting behavior as compared to pre-pandemic levels has also been observed during the lockdown in the Netherlands (Sari et al., 2022). In the US, higher parental stress levels during the COVID-19 pandemic were associated with both harsh parenting, but also lax parenting, and neglect (Connell & Strambler, 2021; Fosco et al., 2022). Higher levels of harsh and lax parenting in turn were related to increased internalizing and externalizing symptoms in preschool children (Fosco et al., 2022). Like-wise, during the 2020 lockdown in Italy, higher parental stress levels and reduced parental investment were associated with increased externalizing symptoms in children older than three years of age (Giannotti et al., 2021).

In summary, during the COVID-19 pandemic higher levels of parental stress and psychological symptoms have been observed both prenatally and postnatally in young parents. These increased stress levels and psychopathology could be related to COVID-19-related health, worries that the partner might not be able to attend the delivery, or concerns about the level of professional care. Following the Family Stress Model (Masarik & Conger, 2017), these increased stress levels might impact parental investment. However, little is known about which parental responses to the pandemic (e.g., wearing masks, reducing social contacts) are particularly related to parental investment.

3 | EARLY CHILD DEVELOPMENT DURING THE PANDEMIC

The Family Stress Model postulates that parental stress impairs parental investment and parenting behavior and thus leads to problems in child development. So far, effects of the COVID-19 pandemic on mental health and development of children have mainly been studied in school-aged or preschool-aged children (Fosco et al., 2022; Giannotti et al., 2021; Lips, 2021; Ravens-Sieberer et al., 2021). Both self-report and parental report indicated reduced well-being in children and adolescents as well as increased rates of internalizing and externalizing symptoms as compared to before the COVID-19 pandemic (Feinberg et al., 2022; Marques de Miranda et al., 2020; Ravens-Sieberer et al., 2021).

In contrast, less is known about the well-being and development of infants and toddlers during the COVID-19 pandemic. Infants might be even more vulnerable to parental stress and resulting parenting behavior as they depend heavily on their caregivers. Less sensitive parenting can result in infant regulatory problems such as increased crying, feeding problems, or sleeping problems (Samdan et al., 2020). Stressed parents tend to be less able to timely and adequately respond to their infants' needs (Feldman et al., 2004). Correspondingly, the precautionary measures implemented during the COVID-19 pandemic reduced the availability of professional support or family support which might buffer against parental stress or depressive symptoms (Samdan et al., 2022). Indeed, according to representative German data from the first lockdown in 2020, especially parents of younger toddlers indicated dissatisfaction with the availability of professional childcare as childcare providers often had to close their facilities. With toddlers and younger children needing lots of attention due to their lack of independence, this increased the load on the parents (Andresen et al., 2020).

While effects of the COVID-19 pandemic on early child developmental outcomes have rarely been investigated, qualitative results from Switzerland indicate that early child sleep problems might arise due to families failing to implement new family routines in response to the lockdown (Lannen et al., 2021). These results are in line with results from Italy demonstrating that higher perceived maternal COVID-19-related stress levels during pregnancy predicted more severe infant regulatory problems at three months. Furthermore, this effect was related to increased postnatal maternal anxiety, parenting stress, and reduced mother-infant bonding (Provenzi et al., 2021). Finally, moving beyond early child regulation, data from the US suggests that verbal, motor, and cognitive development might be impaired in infants born during the COVID-19 pandemic as compared to infants from pre-pandemic years (Deoni et al., 2021).

In summary, only a few studies investigated effects of the COVID-19 pandemic on early child development. However, initial results suggest an increase in regulatory problems. Reported associations with increased maternal stress during pregnancy and postnatal maternal anxiety levels, as well as reduced mother-infant bonding and missing family routines are in line with the Family Stress Model (Masarik & Conger, 2017).

4 | RESEARCH AIMS

However, there are several questions regarding the COVID-19 pandemic and early child development that remain unanswered. First, few studies investigated associations with early child regulation and development in the first year of life, leaving the magnitude of the impact of the COVID-19 pandemic on infants unclear. Second, so far, most data on parental stress have been collected during lockdowns. However, a lockdown might constitute extraordinary circumstances. In many countries, a lockdown was restricted to the beginning of the pandemic in Spring 2020. Thus, it is unclear, whether results from lockdown data apply to later phases of the pandemic. Third, many studies did not operationalize how parents respond to the pandemic: For instance, do parents wear a mask when in contact with their children, are they worried that the infant might get sick, or are they seeing other families with children? Instead, studies often assessed parental stress or well-being as indicators for COVID-19 pandemic-related effects on the family. However, this leaves out what families actually do in response to the pandemic and what specifically affects child outcomes. Furthermore, most studies so far investigated the early phases of the pandemic. At that point, many families neither experienced a confirmed COVID-19 infection nor had to quarantine due to a suspected infection (e.g., because of being in contact with another person who tested positive for COVID-19 or because of symptoms without a test result yet). However, stress is likely higher in the presence of a confirmed or suspected

COVID-19 infection and parenting behavior in response to the pandemic-related restrictions might change accordingly.

The present study, therefore, investigates the following research questions in a sample of families with children born after the onset of the COVID-19 pandemic experiencing no lockdown at the time of data collection.

- (1) How do parents of infants respond to the pandemic? Are there differences between parents who experienced an infection or had to quarantine compared to parents who did not experience an infection and did not have to quarantine?
- (2) Is there an association between parental response to the pandemic and infant regulatory problems?

Specifically, it was hypothesized that

- (1a) Parents respond more strongly to the pandemic if they have experienced a COVID-19 infection or had to quarantine.
- (2a) Infants of mothers, who respond more strongly to the COVID-19 pandemic, show more regulatory problems.
- (2b) Infants show more regulatory problems if their mothers have experienced a COVID-19 infection or had to quarantine.
- (2c) The association between parental response to the pandemic and infant regulatory problems can be explained by reduced parental well-being and parental socio-emotional investment.
- (2d) The association between parental experience of a (suspected) COVID-19 infection and infant regulatory problems can be explained by reduced parental well-being and parental socio-emotional investment.

5 | METHODS

5.1 | Participants

This study was part of a larger pilot study on early child nutrition, child development, and parenting behavior, taking place between April and June 2021. Several items on parental response to the COVID-19 pandemic were created and added to the study. The study was conducted according to guidelines laid down in the Declaration of Helsinki, with digital consent obtained from a parent or guardian for each child before any assessment or data collection. All procedures and materials were reviewed by the Ethical Committee of the Canton Zurich attesting no ethical concerns according to Swiss law.

German-speaking parents of children up to 2;6 years were eligible for the study. However, for the purpose of the current study, only parents with children born after the declaration of the pandemic on March 11th, 2020, who also reported on their child's regulatory problems, were considered. As an incentive, participants took part in a lottery. Among all participants, 10 vouchers worth CHF 50 each were raffled. A total of $N = 214$ parents (8 fathers) of 214 children fulfilled these inclusion criteria. Fathers were excluded from the sample because the number of fathers was small and fathers tend to respond differently to the COVID-19 pandemic than mothers (e.g., with less COVID-19-related health anxieties, but more parenting stress than mothers) (Ben-Yaakov & Taubman - Ben-Ari, 2021; Taubman - Ben-Ari et al., 2021). Approximately half of the children were female ($n = 105$; 51%) and the average age was $M_{\text{age}} = 7.14$ months ($SD_{\text{age}} = 3.75$ months). Except for 10 families, all participants

resided in Switzerland. The socio-economic status of the mothers was rather high as indicated by 76.2% of the mothers having a university degree and also the household net income on average was larger than the average household net income of families in Switzerland with children (approximately 8300 CHF if the oldest child is younger than four years) (Bundesamt für Statistik, 2021). See Table 1 for a detailed sample description.

TABLE 1 Sample characteristics

	<i>M</i>	<i>SD</i>
Child age (months)	7.14	3.75
	Range: 0–13	
Gestational age at birth (weeks)	38.8	1.6
	Range: 25–43	
Parental age (years) ^a	34.48	4.44
	Range: 22–49	
	<i>n</i>	%
Child gender		
Male	101	49.0
Female	105	51.0
Parity		
Primipara	103	50.0
Multipara	101	49.0
Education level		
< Tertiary	49	23.8
≥ Tertiary	157	76.2
Partner		
Yes	201	97.6
No	5	2.4
Monthly household income after taxes in CHF ^b		
Preferred Not to answer	20	9.7
	<i>n</i>	%
<3'300	7	3.4
3'300–4'300	1	0.5
4'300–5'300	11	5.3
5'300–6'400	9	4.4
6'400–7'500	15	7.3
7'500–8'700	19	9.2
8'700–10'100	27	13.1
10'100–12'000	25	12.1
12'000–15'300	37	18.0
≥ 15'300	35	17.0

(Continues)

TABLE 1 (Continued)

	<i>n</i>	%
Occupation		
full-Time job ^c	27	13.1
part-Time job (min. 5 h/week)	87	42.2
unemployed	23	11.2
maternal Leave	57	27.7
other	12	5.8
Country of residence		
Switzerland	196	95.1
Other	10	4.9
Migration background ^d		
yes	93	45.1
no	113	54.9

^a26 parents reported implausible age values (e.g., age = 0 years or 130 years);

^bIncome was assessed based on the categories of the European Social Survey; currencies other than CHF were transformed to the equivalent CHF categories;

^cat least 90% of the regular working time (e.g., 37.8 h/week in Switzerland);

^dA person was considered as having a migration background if the person was born outside the country of residence.

5.2 | Procedure

Participants were mainly recruited by contacting women who gave birth in a large hospital in Zurich, Switzerland. In addition, advertisements were placed on social media. Advertisements included a study description and a link to an online study. Participants were informed, that the study aimed at both understanding the impact of the COVID-19 pandemic on early child development and testing questionnaires for a larger longitudinal study on early nutrition, parenting, and child development. The study constituted of two parts: The first part was a baseline questionnaire on maternal response to the COVID-19 pandemic, parental socio-emotional investment, early child regulation, and nutrition. The questionnaire lasted approximately 50 min. The following second part consisted of a 10-day evening diary of 5–10 min each day. The current study only relied on data from the baseline questionnaire.

5.3 | Measures

Parental Response to the COVID-19 pandemic. To assess how parents responded to the COVID-19 pandemic a set of 44 items was created. The set was reviewed by three external psychological researchers to ensure that parental responses to the COVID-19 pandemic were covered adequately. Two of these researchers gave birth during the pandemic themselves, while all three of them parented children under the age of two. In the introduction, it was emphasized that the items relate to parents responding to the pandemic (“People and families, in particular families with young children, cope differently

with the pandemic”) or experiencing public health measures (“The measures to stop the COVID-19 pandemic can limit the possibilities to interact with other mothers to take part in support programs. How do you experience the situation?”). Items were answered on a Likert scale from 1 (“does not apply at all”) to 5 (“fully applies”). A factor analysis yielded a 5-factor solution. Factors were labeled as (1) social distancing (6 items; $\alpha = 0.80$, e.g., “My baby and I meet other families with children.”), (2) worrying about child (3 items; $\alpha = 0.93$, e.g., “I am worried about my child’s health”), (3) birth anxiety (8 items; $\alpha = 0.76$, e.g., “I was worried my partner could miss the birth due to COVID-19 controls.”), (4) COVID-19 information (6 items; $\alpha = 0.76$, e.g., “I was well informed about the current status of breastfeeding in the case of COVID-19 infection.”), and (5) distancing from the child (4 items; $\alpha = 0.62$, e.g., “I have not held and cuddled my child as often as I would have wanted.”). Subsequently, mean scores were calculated for each factor. Higher values indicate that mothers practiced more social distancing, worried more about their infant’s health, were more anxious about giving birth, were better informed on parenting, and distanced themselves more from their infant, respectively. All items and details on the factor analysis are displayed in Supplement S1.

In addition, parents stated whether they or any member of their household, family, or friends ever had to quarantine due to a confirmed or suspected COVID-19 infection. In case of a confirmed or suspected infection in the household, parents reported how they handled this situation in an additional set of items (not used for the current analyses).

Infant regulatory problems. Infant regulatory problems were assessed by the Questionnaire for Crying, Sleeping, and Feeding (Groß et al., 2013). Parents reported on a 4-point Likert scale how often they perceived their infant showing certain regulatory problems or how much they are bothered by their child’s behavior. The total scale consists of 49 items ($\alpha = 0.87$ in the present study), which comprise subscales on crying, whining, and sleeping (24 items; $\alpha = 0.87$; e.g., “an infant crying for more than 30 min from waking up to noon p.m.”), feeding (13 items; $\alpha = 0.66$, e.g., “infant has chewing, sucking, or swallowing problems”), and co-regulation (12 items; $\alpha = 0.80$; e.g., “carrying the child around for soothing”). Higher values indicate more perceived regulatory problems. The validity of the questionnaire has been demonstrated by medium-sized correlations with parental diaries on their infants’ sleeping, crying, and feeding behavior. The questionnaire also distinguishes infants with a regulatory disorder from healthy infants (Groß et al., 2013).

Parental socio-emotional investment. Parental socio-emotional investment was assessed by three subscales of the Parental Investment in Child Scale (Bradley et al., 1997). The scales were translated into German. Two independent researchers checked the translations. In the case of disagreement, translations were discussed by three people until a consensus was reached. Items were answered on a 6-point scale ranging from 1 (“never”) to 6 (“always”). Higher values of the subscale *Delight* (6 items; $\alpha = 0.64$, e.g., “Holding and cuddling my child is more fun than most other things I do”) are indicative of parents who take greater pleasure from interacting with their child or thinking about their child. Higher values of the subscale *Knowledge/Sensitivity* (5 items; $\alpha = 0.70$, e.g., “Babies have to learn they can’t be picked up every time they cry”) reflect parents who are less concerned about their infant’s needs. Finally, higher values of the subscale *Separation Anxiety* (5 items; $\alpha = 0.79$, e.g., “I worry when someone else cares for my child”) refer to parental worrying when a child is alone or cared for by other people. Construct validity has been reported by meaningful correlations with various dimensions of the HOME questionnaire (Caldwell & Bradley, 1984), other measures of separation anxiety, and parental stress.

Maternal well-being. Maternal well-being was assessed by self-report. The WHO-5 well-being index (WHO, 1998) consists of five items asking about their health in the last 2 weeks and are

answered on a 6-point Likert scale (range: 0–5; $\alpha = 0.87$; e.g., “Over the past 2 weeks, I have felt calm and relaxed”). Higher values indicate better well-being. Values below 13 are indicative of clinical depression (Topp et al., 2015).

5.4 | Data analysis

An exploratory factor analysis (EFA) was performed to identify latent factors that describe relevant themes on how mothers of infants respond to the COVID-19 pandemic. Subsequently, patterns of missing data were analyzed. Missing data concerning maternal response to the COVID-19 pandemic, infant regulation, maternal socio-emotional investment, and maternal well-being occurred in less than 0.01% of the data with no item containing more than 1.0% of missing data. In addition, Little’s MCAR test was not significant, $\chi^2(628) = 616.97$, $p = 0.616$, suggesting data being observed at random. One participant only answered 8 of 49 questions on the SFS questionnaire and thus, was excluded from all analyses involving infant regulation. Regarding all other missing data, item-level missing values were estimated by the Expectation Maximization (EM) algorithm (Dempster et al., 1977).

Associations of how mothers responded to the COVID-19 pandemic and mother-reported infant regulatory problems were analyzed with Pearson correlations. *t*-tests were performed to test for differences in infants of parents with an experienced or suspected COVID-19 infection and parents without reporting a (suspected) COVID-19 infection. As, we did not expect a high prevalence of (suspected) COVID-19 infections, statistical power to detect differences between groups is limited. In addition, frequentist *t*-tests cannot quantify support for the null hypothesis. However, when considering the tenability of public health measures to contain the COVID-19 pandemic, it is important to know whether or not experiencing (suspected) COVID-19 infections is related to parental well-being or infant development. Therefore, Bayesian *t*-tests were calculated in JASP, version 0.16.2 (JASP Team, 2021). Bayesian *t*-tests can quantify both the support for the null hypothesis and the alternative hypotheses given the data (Wagenmakers et al., 2018). A Bayes factor (BF) of $BF_{10} > 3$ indicates substantial evidence for the alternative hypothesis, while a $BF_{10} < 0.33$ indicates substantial evidence for the null hypothesis (Wetzels & Wagenmakers, 2012). Analyses of Bayesian *t*-tests assumed a Cauchy prior distribution with $r = 1/\sqrt{2}$. To test for the robustness of results (Duncan et al., 2014), analyses were repeated comparing only parents with a postpartum (suspected) COVID-19 infection to parents without a (suspected) infection postpartum. Suspected infections were defined as a situation where a person had to quarantine, for instance, because of contact with a person who tested positively for COVID-19 or having symptoms but without a test result yet (e.g., due to the lack of tests available) (Cohen et al., 2020).

Finally, a manifest path analysis was carried out in JASP (JASP Team, 2021). The path model follows the Family Stress Model (Masarik & Conger, 2017) and thus consists of three sets of regression models. In the first regression, maternal well-being was regressed on maternal responses to the COVID-19 pandemic. In the second set of regression analyses, parental socio-emotional investment was regressed on maternal responses to the COVID-19 pandemic and maternal well-being. In the final regression, infant regulatory problems were regressed on maternal responses to the COVID-19 pandemic, maternal well-being, and parental socio-emotional investment. The path analysis fits the three regressions models simultaneously. It thereby includes covariances between the dimensions of maternal response to the COVID-19 pandemic as well as covariances between the maternal socio-emotional investment subscales. To check whether the results of the path analysis are robust (see Duncan et al., 2014), analyses were repeated controlling for demographic characteristics (infant age,

infant sex, infant's gestational age at birth, parental age, educational background, occupation status, migration background, and whether the infant was the only child in the household).

6 | RESULTS

6.1 | COVID-19 infections and maternal response to the COVID-19 pandemic

A total of 56 mothers (27.2%) reported the experience or suspicion (i.e., needed to quarantine because of contact with an infected person or displaying symptoms without a test result yet) of a COVID-19 infection: 19 (9.2%) during pregnancy and 44 (21.4%) after giving birth. Five mothers reported a (suspected) infection both before and after the infant's birth. In contrast, only four infants (1.9%) suffered from a COVID-19 infection, while additional 17 (8.3%) infants were suspected cases. In total, 132 (64%) of the mothers witnessed at least one confirmed case of a COVID-19 infection in their family or friends. For an overview of parental exposure to COVID-19 infections see Table 2.

To investigate how mothers respond to the COVID-19 pandemic an EFA was performed. Details on the EFA are presented in Supplement S1. Eventually, five factors could be extracted. *Social distancing* (e.g., "Friends visit us", reverse coded) characterizes mothers who reduce social contacts. They meet up less with their friends, family members, or other families with children. They refrain from public transport and in general, tend to prevent other people from getting close to their infant. *Worrying about the child* (e.g., "I am worried about my baby due to COVID-19") describes parents worrying that their infant might be getting sick, while *Birth anxiety* (e.g., "I was afraid of giving birth in a hospital") refers to parents worrying about the level of care in the hospital or that their partner could not attend the delivery due to COVID-19 protocols in hospitals. They might have thought about delivering on an outpatient basis and in extreme cases would have liked to get pregnant at a later time-point. *COVID-19 information* (e.g., "I was well informed about the current status of breastfeeding in the case of COVID-19 infection.") describes how well parents feel informed about parenting issues

TABLE 2 Exposure to COVID-19 infections: Number of cases (percentages in parentheses)

	Confirmed COVID-19 infection			Suspected COVID-19 infection			No (suspected) COVID-19 infection
	During pregnancy	After giving birth	Total	During pregnancy	After giving birth	Total	
Participant (mother)	5 (2.4)	11 (5.3)	16 (7.8)	14 (6.8)	31 (15.0)	40 (19.4)	150 (72.8)
Partner	4 (1.9)	7 (3.4)	11 (5.3)	14 (6.8)	35 (17.0)	43 (20.9)	152 (73.8)
Infant	-	4 (1.9)	4 (1.9)	-	17 (8.3)	17 (8.3)	185 (89.8)
Infant's siblings	1 (0.5)	5 (2.4)	6 (2.9)	12 (5.8)	12 (5.8)	20 (9.7)	180 (87.4)
Other household members	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.5)	1 (0.5)	4 (1.9)	172 (83.5)
Other family members	32 (15.5)	44 (21.4)	67 (30.6)	15 (7.3)	29 (14.1)	39 (18.9)	108 (52.4)
Friends	71 (34.5)	85 (41.3)	110 (53.4)	20 (9.7)	34 (16.5)	47 (22.8)	61 (29.6)

Note: $N = 206$. Totals can be higher than the sum of (suspected) infections during pregnancy and after giving birth as some mothers were infected or suspected an infection in both periods.

that theoretically could be affected by the virus (e.g., breastfeeding). As information on giving birth and early child care is often received from care professionals, higher values also indicate parents who could take part in parent-child courses or pregnancy courses. Finally, *Distancing from the child* (e.g., “I have not held and cuddled my child as often as I would have wanted.”) refers to a rather rare behavior, where parents have less body contact with their infants than they wish. Table 3 contains descriptive statistics for the five factors.

6.2 | Differences in responding to the COVID-19 pandemic by infection status

There were no significant differences in responding to the COVID-19 pandemic between mothers who experienced a (suspected) COVID-19 infection and those who reported no (suspected) infection themselves. However, compared to mothers without a (suspected) COVID-19 infection, mothers with a (suspected) COVID-19 infection reported reduced well-being (see Table 3). However, maternal well-being was still in the normal range, although a total of 29 mothers (14.1%) scored below the clinical cut-off of 13 suggesting clinically relevant depressive symptoms. No differences between

TABLE 3 Mothers experiencing an own (suspected) COVID-19 infection versus mothers without experience of an own (suspected) COVID-19 infection

	Total sample (<i>n</i> = 206)		Confirmed/suspected COVID-19 infection (<i>n</i> = 56)		No (suspected) COVID-19 infection (<i>n</i> = 150)		Test statistics
	M	SD	M	SD	M	SD	
COVID-19 social distancing	2.53	0.89	2.41	0.89	2.57	0.89	$t(204) = -1.61, p = 0.247, d = 0.18; BF_{10} = 0.32$
COVID-19 worrying about child	2.97	1.17	3.03	1.22	2.95	1.15	$t(204) = 0.45, p = 0.651, d = 0.07; BF_{10} = 0.19$
COVID-19 birth anxiety	2.52	0.82	2.62	0.90	2.48	0.79	$t(204) = 1.11, p = 0.268, d = 0.17; BF_{10} = 0.30$
COVID-19 information	2.62	0.82	2.51	0.77	2.67	0.83	$t(204) = -1.25, p = 0.213, d = 0.20; BF_{10} = 0.35$
COVID-19 distancing from child	1.23	0.45	1.19	0.39	1.26	0.48	$t(204) = -0.95, p = 0.343, d = 0.16; BF_{10} = 0.26$
Maternal well-being	18.78	5.23	16.66	5.17	19.57	5.05	$t(204) = -3.65, p < 0.001, d = 0.57; BF_{10} = 71.35$
PI delight	4.43	0.68	4.46	0.71	4.43	0.67	$t(204) = 0.34, p = 0.738, d = 0.05; BF_{10} = 0.18$
PI knowledge/sensitivity	2.94	0.81	2.86	0.85	2.97	0.80	$t(204) = -0.86, p = 0.393, d = 0.13; BF_{10} = 0.24$
PI separation anxiety	3.09	1.09	3.20	1.10	3.06	1.09	$t(204) = 0.82, p = 0.412, d = 0.13; BF_{10} = 0.23$
Infant regulatory problems	1.84	0.32	1.86	0.39	1.83	0.29	$t(203)^a = 0.56, p = 0.575, d = 0.09; BF_{10} = 0.20$

Abbreviation: PI, parental investment.

^a*n* = 149 in group no (suspected) COVID-19 infection.

the mothers with and without a (suspected) COVID-19 infection were observed for any dimension of maternal socio-emotional investment.

The results were confirmed by the Bayesian analyses. Whereas the Bayes Factor for maternal well-being indicated strong evidence for reduced well-being in mothers who experienced a (suspected) COVID-19 infection, all other Bayes Factors except for COVID-19 information ($BF = 0.35$) were smaller than one-third. Thus, Bayesian evidence pointed to no differences between the two groups regarding responses to the COVID-19 pandemic and maternal socio-emotional investment. Results were robust if instead of a maternal (suspected) COVID-19 infection anytime only maternal (suspected) COVID-19 infections postpartum were considered.

6.3 | Responding to the COVID-19 pandemic: Maternal well-being, maternal socio-emotional investment, and infant regulation

Correlational analyses (Table 4) revealed that how mothers responded to the COVID-19 pandemic was related to how they perceived their infant's regulatory problems, their maternal socio-emotional investment, and their general well-being. According to their mothers, infants showed more regulatory problems if mothers more strongly reduced their social contacts, worried more about their infant's health, were more anxious about giving birth during the COVID-19 pandemic, or distanced themselves more from their infant. In contrast, better information about giving birth or parenting during the pandemic was related to fewer parent-reported regulatory problems in the infant. Associations between maternal response to the COVID-19 pandemic and maternal socio-emotional investment revealed higher levels of separation anxiety in mothers who reduced social contacts more, worried more about their infant's health, or were more anxious about giving birth during the COVID-19 pandemic. Mothers, who distanced themselves more from their infants were less sensitive to their infant's needs (parental socio-emotional investment: knowledge/sensitivity). Higher scores on the delight dimension were related to increased worries about the infant's health, and better information and support regarding infant care. Finally, all response to COVID-19 pandemic dimensions were associated with reduced well-being except for *COVID-19 information* which might buffer against detrimental health effects.

Reduced maternal well-being was related to increased separation anxiety and more mother-reported infant regulatory problems. Of the three dimensions of parental socio-emotional investment, separation anxiety and delight were positively correlated and both dimensions were associated with increased mother-reported infant regulatory problems.

6.4 | Path analysis based on the Family Stress Model

The path analysis explained 30% of the variance in infant regulatory problems, 13.4% of the variance in maternal well-being, and 8%–13% of the variances in the dimensions of parental socio-emotional investment. The path model is depicted in Figure 2. It includes only significant paths to foster readability. For an overview of all pathway coefficients see Supplement S2. Higher levels of maternal well-being were related to less birth anxiety and better information concerning COVID-19 parenting and enhanced care. With regard to maternal socio-emotional investment, higher levels in delight were related to higher levels both in worries about the infant's health and in better information concerning COVID-19 parenting and care. Higher levels of the investment dimension knowledge/sensitivity were related to less social distancing and more distancing from the infant. Separation anxiety was related to more worrying about the infant's health and reduced maternal well-being. Finally, higher

TABLE 4 Correlations between study variables

	1	2	3	4	5	6	7	8	9	10
1 COVID-19 social distancing	1.00***	0.45***	0.29***	-0.14***	0.21***	-0.14***	0.10***	-0.12***	0.21***	0.15***
2 COVID-19 worrying about child	1.00***	1.00***	.35***	-0.17***	0.27***	-0.19***	0.21***	0.06***	0.30***	0.25***
3 COVID-19 birth anxiety				-0.25***	0.18***	-0.28***	0.10***	-0.07***	0.21***	0.34***
4 COVID-19 information				1.00***	0.06***	0.27***	0.15***	>0.01***	-0.02***	-0.14***
5 COVID-19 distancing from child					1.00***	0.02***	0.02***	0.19***	0.14***	0.18***
6 Parental well-being						1.00***	-0.01***	0.08***	-0.19***	-0.42***
7 PI delight							1.00***	0.02***	0.31***	0.17***
8 PI knowledge/sensitivity								1.00***	0.08***	-0.14***
9 PI separation anxiety									1.00***	0.33***
10 infant regulatory problems										1.00***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

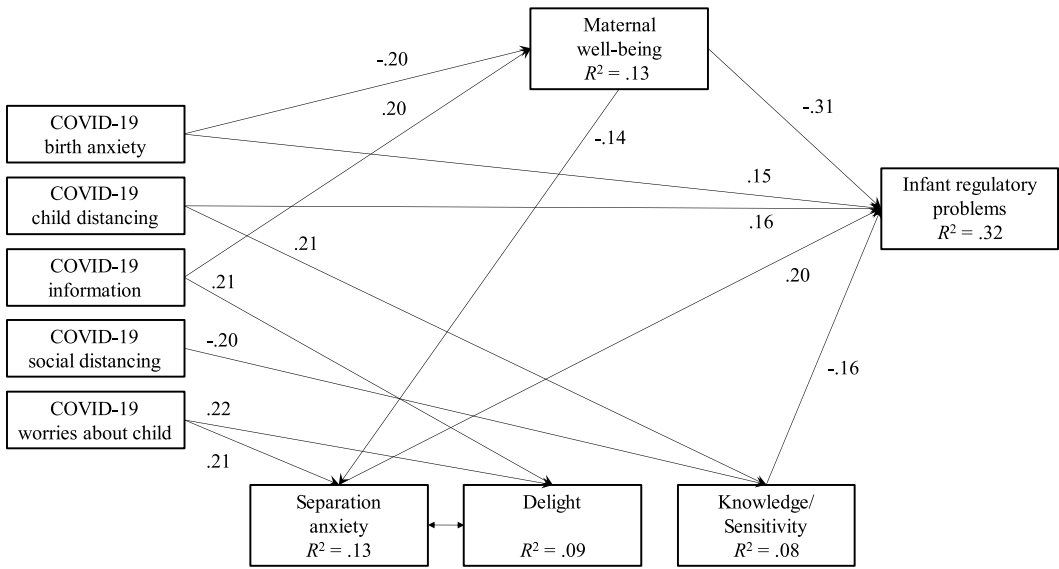


FIGURE 2 Path model: Associations between maternal response to the pandemic, maternal well-being, maternal socio-emotional investment, and infant regulation. *Note.* Only significant paths are shown. All coefficients are standardized.

levels of perceived infant regulatory problems were related to more birth anxiety, more distancing from the infant, reduced maternal well-being, higher levels of separation anxiety, and lower levels of knowledge/sensitivity.

A sensitivity analysis controlling for infant age, infant sex, gestational age at birth, maternal age, maternal education, occupation status, migration background, and the presence of other children in the household confirmed the pattern of results (see Supplement S3 for details on the analysis). Only the paths from COVID-19 social distancing to knowledge/sensitivity and from worrying about the infant’s health to separation anxiety were no longer significant. Instead, a pathway from distancing from the child to delight emerged indicating higher levels of distancing from the child being related to lower levels of delight. In addition, higher levels of delight were related to higher levels of infant regulatory problems. None of the control variables were associated with infant regulation. Maternal well-being was higher if the newborn infant was a single child. Furthermore, mothers with a higher educational background reported less separation anxiety, less delight, and lower levels of knowledge/sensitivity. In contrast, higher levels of knowledge/sensitivity were associated with a migration background, whereas mothers who worked full-time or part-time reported less separation anxiety.

6.5 | Path analysis: Indirect pathways

Further examination of indirect pathways from maternal responses to the COVID-19 pandemic to perceived infant regulatory problems yielded the following indirect pathways: Increased levels of COVID-19 birth anxiety were related to higher perceived levels of infant regulatory problems via reduced maternal well-being, $\beta = 0.06$, $z = 2.42$, $p = 0.016$. In contrast, better information about COVID-19 parenting and care was related to better maternal well-being and in turn to lower perceived levels of infant regulatory problems, $\beta = -0.06$, $z = -2.51$, $p = 0.012$. An additional indirect pathway to perceived infant regulatory problems was observed for higher levels of COVID-19 worries about

the infant's health via increased separation anxiety, $\beta = 0.04$, $z = 2.08$, $p = 0.038$. A further pathway to lower levels of perceived infant regulatory problems included mothers who distanced themselves more from their infant but were less concerned about their infant's needs (higher values in knowledge/sensitivity), $\beta = -0.03$, $z = -1.97$, $p = 0.049$. However, these latter two indirect pathways could not be replicated after repeating the analysis with demographic control variables (see Supplement S3).

7 | DISCUSSION

This study is the first to investigate how mothers of infants in the first year of life respond to the COVID-19 pandemic and how this relates to infant regulation. Results suggest that suffering from a (suspected) COVID-19 infection and maladaptive maternal response to the COVID-19 pandemic are related to reduced maternal well-being, but only maternal response to the pandemic further relates to mother-reported infant regulatory problems. This association is partly explained by reduced maternal well-being and maternal socio-emotional investment.

This study differs from other studies as a new questionnaire was created to capture parents' thoughts, feelings, and behavior in response to the COVID-19 pandemic. Other scales often explicitly asked people to indicate changes in their lives since the start of the COVID-19 pandemic or assessed general stressors related to the pandemic (e.g., working from home, loss of job, exposure to the virus) (Brown et al., 2020; Grasso et al., 2021). This questionnaire, however, is similar to the recent labor and delivery supplement and the infant supplement of the Epidemic-Pandemic Impacts Inventory (EPII-LD; EPII-I; Briggs-Gowan, Carter et al., 2020; Briggs-Gowan, Muzik et al., 2020). The questionnaire in this study directly asks for parents' pandemic-related thoughts, feelings, and behavior (e.g., wearing masks, meeting with other families, using public transport, not cuddling with the infant). In addition, there is a focus on specific pandemic-related thoughts, feelings, and behavior of (expectant) mothers during pregnancy and postpartum (e.g., being afraid of partners missing the birth due to COVID-19 protocols, being able to attend services for pregnant women).

In contrast to most previous studies on well-being and child development during the COVID-19 pandemic, the present study focused on infant development, maternal well-being, and maternal socio-emotional investment in mothers who gave birth during the COVID-19 pandemic. Furthermore, data were not collected during a national lockdown in the spring of 2020, and thus offers insight into associations of maternal response to the COVID-19 pandemic, maternal well-being, maternal socio-emotional investment, and infant regulation at a later phase of the pandemic.

7.1 | Infection status and responding to the pandemic

Having experienced a COVID-19 infection or having to quarantine was associated with reduced maternal well-being. Contrary to studies mostly conducted during the first lockdown in the spring of 2020, the rate of mothers with clinically relevant depressive symptoms (14.1%) was comparable to the normal range of clinical depression in the postpartum period (Gavin et al., 2005)—and thus, much lower than the rates (36%–44%) reported from other countries during the lockdown (Davenport et al., 2020; Fallon et al., 2021; Liu et al., 2021; Spinola et al., 2020). Thus, lockdowns might have been extreme situations in the extraordinary time during the COVID-19 pandemic.

Surprisingly, having experienced a confirmed or suspected COVID-19 infection was unrelated to response to the COVID-19 pandemic, infant regulatory problems, and maternal socio-emotional investment. One possible explanation might be that most parents as young adults have a rather mild

disease progression, often displaying only light or no symptoms at all (Levin et al., 2020). Thus, parents often might not change their behavior much toward their children. This interpretation was confirmed by taking a closer look at what mothers reported to have done during quarantine. Most mothers did not reduce body contact or wear a mask when interacting with their infants. However, we observed single cases where mothers reported not being in contact with their infants until they had been free of COVID-19 symptoms. Like-wise, there might be differences between mothers who suffered from a COVID-19 infection and mothers, who only had to quarantine but did not test positive for the virus. We decided to combine these groups, as we expected quarantine to drive differences in maternal response to the COVID-19 pandemic. In addition, during the beginning of the COVID-19 pandemic, the display of symptoms was treated as a diagnosis due to the lack of testing capacities (see Suthar et al., 2022). However, quarantining without displaying symptoms might have different effects on maternal response to the pandemic than quarantining with symptoms or a confirmed diagnosis. Unfortunately, this study did not contain enough power to differentiate between these groups. Larger samples are needed, including severe cases, to further investigate the effect of maternal infections or quarantine on maternal response to the COVID-19 pandemic.

7.2 | Maternal response to the pandemic

The exploratory factor analysis revealed five dimensions on which mothers responded to the pandemic: social distancing, worrying about the child, birth anxiety, distancing from the child, and information on the COVID-19 pandemic. These dimensions correspond to results from other studies. For instance, worries that the partner might miss the delivery have been common during the beginning of the pandemic in spring 2020 (Schaal et al., 2021; Wyszynski et al., 2021). Such worries have been related to increased levels of maternal birth anxiety (Schaal et al., 2021), and were directly related to different policies hospitals implemented whilst adapting to the COVID-19 pandemic (Davis-Floyd et al., 2020). Like-wise, worries about family members not being able to visit (social distancing) or family members getting sick, and adverse long-lasting effects of the COVID-19 pandemic on child development (worrying about the child) have been voiced (Ben-Yaakov & Taubman - Ben-Ari, 2021; Lebel et al., 2020; Schaal et al., 2021; Wyszynski et al., 2021). Information regarding caring for a newborn in the presence of a COVID-19 infection (e.g., breastfeeding) and limited access to professional support reflect difficulties in receiving care during the COVID-19 pandemic. This is in line with reports of Canadian mothers during April 2020. Many of them had problems reaching the desired amount of prenatal care as appointments often were canceled (Lebel et al., 2020). Lack of prenatal and postnatal care (e.g., birth preparation courses) might particularly affect mothers with low levels of maternal self-efficacy as attending these services strengthens mothers' beliefs in their parenting abilities. Potential risk groups include first-time mothers and mothers from a higher socioeconomic status as they are more likely to use these services and more often question their parenting abilities (Samdan et al., 2022). However, the present study lacked the statistical power to investigate such interaction effects. Finally, we could not find any other sources describing maternal distancing from the infant. However, it could reflect parental worries to infect the infant, which has been mentioned in other studies (Schaal et al., 2021).

7.3 | Maternal response to the pandemic and infant regulation

All dimensions of maternal response to the COVID-19 pandemic were correlated with infant regulatory problems. However, when the dimensions were simultaneously analyzed in a path analysis, only

COVID-19 birth anxiety and COVID-19 distancing from the child directly predicted an increase in infant regulatory problems. In addition, robust indirect pathways were observed from COVID-19 birth anxiety and COVID-19 information to maternal well-being and in turn to infant regulation. Increased levels of birth anxiety were associated with reduced maternal well-being and higher levels of infant regulatory problems, whereas mothers who felt better informed about parenting and care during the pandemic expressed better well-being and perceived their infants as less problematic.

The associations of both birth anxiety and distancing from a child with infant regulatory problems could reflect difficulties in mother-infant bonding. Birth anxiety has been shown to reduce mother-fetus bonding during pregnancy (Göbel et al., 2018) and reduced bonding has recently been reported in German mothers who were pregnant in spring 2020 as compared to mothers who were pregnant before the beginning of the pandemic (Schaal et al., 2021). Distancing from the infant, although only rarely been shown, might constitute an even more severe case of impaired parent-infant bonding. Parental touch has been shown to have an important soothing function in co-regulating an infant's negative affect (Carozza & Leong, 2021; Feldman et al., 2010). If a child is not cuddled it becomes harder to be soothed when stressed and might cry more frequently or for longer durations. Touch also buffers against the aversive effects of separation (Morrison, 2016).

The indirect pathway from COVID-19 information and care on better perceived infant regulation via higher levels of maternal well-being likely reflects a buffering effect of social support. Especially when infants display regulatory problems or are hard to soothe, support from family and friends, but also professional support (e.g., from midwives) can increase parents' efficacy in dealing with their infants' behavior (Mercer & Walker, 2006). In addition, social support has consistently been shown to reduce parental stress and depressive symptoms (Glazier et al., 2004). Consequently, feeling better informed about COVID-19 in relation to pregnancy and parenting, and having the opportunity to take part in pregnancy courses or contact midwives was related to better maternal well-being. In addition, such social support might increase a mother's locus of control (Shieh et al., 2010), which has been shown to buffer against COVID-19 pandemic-related stress (Fan et al., 2022; Krampe et al., 2021).

The observed paths follow the revised Family Stress Model (Prime et al., 2020), which proposes both direct relations of COVID-19-related social disruption with child regulatory problems and indirect relations via reduced maternal well-being. Also according to the model, reduced maternal well-being showed the strongest relations with perceived infant regulatory problems. These results fit well with the general notion that maternal stress and internalizing symptoms are predictive of infant regulatory problems (e.g., excessive crying) and early child externalizing behavior (Ölmestig et al., 2021; Petzoldt, 2018; Reinelt et al., 2019). Interestingly, there was no evidence for indirect pathways from maternal response to the pandemic to maternal socio-emotional investment via reduced maternal well-being. Like-wise, there was no evidence for indirect pathways from reduced maternal well-being to infant regulatory problems via maternal socio-emotional investment. These results contradict the Family Stress Model and are in disagreement with results showing that parental stress is negatively related to parental investment during the lockdown in Germany in spring 2020 (Oppermann et al., 2021). While this disagreement could be related to data collection during a lockdown versus one year into the COVID-19 pandemic, it could also point to different associations with COVID-19-related stress and different forms of parental investment. Oppermann and colleagues focused on the time parents spend with their children, whereas this study focused on socio-emotional investment. Yet, at least some pandemic-related stressors (e.g., working from home) might rather impact invested time or resources than a mother's socio-emotional investment.

Finally, despite the associations of maternal response to the COVID-19 pandemic with infant regulatory problems, it is less clear whether these problems are clinically relevant. Due to a lack of normative data and the absence of pre-pandemic data, the present Swiss sample can only be compared

to clinical and non-clinical samples from a previous German study (Groß et al., 2013). When developing the measure Groß and colleagues tested both non-clinical, healthy infants and infants with a diagnosed regulation disorder. The current Swiss sample differed from both groups as mothers perceived more infant regulatory problems than the German non-clinical sample, but on average fewer regulatory problems than infants diagnosed with a regulation disorder.

8 | LIMITATIONS AND IMPLICATIONS

8.1 | Path model and causality

The present study followed the Family Stress Model (Masarik & Conger, 2017). Thus, in principle, it was assumed that maternal responses to the pandemic negatively affect maternal well-being, which impacts maternal socio-emotional investment, and in turn, results in perceived infant regulatory problems. However, the cross-sectional nature of the study does not allow causal inferences. Indeed, the reformulation of the Family Stress Model in the context of the COVID-19 pandemic (Prime et al., 2020) assumes a bi-directional association between maternal well-being and infant regulatory problems. In addition, although the majority of studies assume that parenting behavior affects infant regulation, there is also evidence for an infant's regulatory problems to influence parenting behavior (see Samdan et al., 2020 for a review). In addition, effects of the COVID-19 pandemic on maternal well-being, maternal socio-emotional investment, and infant regulation likely vary with available resources or in the presence of other risk factors. For instance, negative effects of the COVID-19 pandemic on child development could be stronger for preterm infants or infants with special needs (Mete Yesil et al., 2022; Shuffrey et al., 2021). Like-wise, infants with more regulatory problems pose more challenges to maternal care and, thus, might contribute to increased maternal stress levels. Thereby, the COVID-19 pandemic might amplify already existing parenting difficulties, whereas the availability of social support might buffer against these effects.

Longitudinal studies are needed to further clarify the causal relation of response to the COVID-19 pandemic, parental health, parental involvement, and infant regulation. Such longitudinal studies could also identify which pandemic-related stressors have the strongest impact, whether infant regulatory problems are clinically relevant, whether stressors and thus maternal response to the pandemic change over time, and which infants are particularly at risk. Identifying risk groups and other moderator variables could also help to increase effect sizes as in the present study effect sizes for maternal well-being and parental socio-emotional investment were rather small.

8.2 | Sample composition and generalizability

In addition to its limitations regarding causality, the results of the present study are restricted to mothers from a high-SES background residing in Switzerland. A higher SES usually is associated with better maternal health postpartum (Goyal et al., 2010) and also might protect against COVID-19-related stress (Huebener et al., 2021; Spinelli et al., 2021). In addition, infants from low-SES families, in general, have worse regulatory skills already in the first year of life (Jansen et al., 2009). Thus, although there are likely differences in maternal response to the COVID-19 pandemic, the association between reduced maternal well-being and infant regulatory problems might be pronounced in the whole population.

The low number of fathers participating in the present study made it impossible to analyze differences between mothers and fathers in their response to the pandemic, and its relations to parental well-being, parental socio-emotional investment, and infant regulatory problems. Few studies investigated associations between paternal parenting behavior and infant regulation in the first 2 years of life (Samdan et al., 2020). However, following the “father vulnerability hypothesis” and the “differential reactivity hypothesis” (Cummings et al., 2004), fathers might be more affected by family stress than mothers and infants might be more affected by anger and hostility expressed by their fathers than by their mothers. Indeed, fathers of 7-12-month-old infants reported higher parenting stress levels than mothers during the COVID-19 pandemic in Israel (Ben-Yaakov & Taubman - Ben-Ari, 2021). In addition, fathers seem to show less COVID-19-related anxiety than mothers (Ben-Yaakov & Taubman - Ben-Ari, 2021). Thus, the response to the COVID-19 pandemic likely differs between mothers and fathers. However, regarding the association between reduced parental well-being and increased infant regulatory problems, even stronger associations could be assumed for fathers than for mothers.

Finally, the course of the COVID-19 pandemic and the implemented public health measures differed between countries. Switzerland had higher infection rates than other Western European countries, whilst applying less strict measures to contain the pandemic. Thus, maternal responses to the COVID-19 pandemic might differ between countries. To compare the effects of the pandemic on infant regulation between countries and reduce the typical bias toward research on people from predominantly Western, high-SES countries, multi-center studies are needed (Frank et al., 2017).

8.3 | Measures

This study only relied on maternal self-reported questionnaire data. Although measures, therefore are confounded by the reporting source (i.e., the mother), associations between parental socio-emotional investment or parental behavior with infant regulation usually show weaker associations when infant regulation is assessed by questionnaire (maternal report) as compared to structured or semi-structured assessments (e.g., during mother-child interactions) (Samdan et al., 2020). As reliabilities for the parental investment scales also were rather low, this could explain the small associations between parental investment and infant regulatory problems.

Like-wise, COVID-19 infection status was assessed by maternal report instead of objective diagnosis. Also, the present study did not consider the duration mothers spent in quarantine, symptom severity, or symptoms of long-COVID. Symptom severity and duration of quarantine likely might affect parenting behavior and infant regulation. Future studies should address these limitations.

9 | CONCLUSION

The present study demonstrated that increased infant regulatory problems are related to how mothers respond to the COVID-19 pandemic. Reduced maternal well-being and separation anxiety were related to higher levels of infant regulatory problems. In particular, being anxious about giving birth during the pandemic was related to reduced maternal well-being and in turn to increased infant regulatory problems. In contrast, better information about COVID-19 concerning parenting, as well as the availability of professional support can buffer against these effects.

ACKNOWLEDGMENT

We are grateful for the support of the Family Larsson-Rosenquist Foundation. The authors declare no conflicts of interest with regard to the funding source for this study.

ORCID

Tilman Reinelt  <https://orcid.org/0000-0003-0951-5927>

Debora Suppiger  <https://orcid.org/0000-0003-2330-7649>

Giancarlo Natalucci  <https://orcid.org/0000-0003-0225-2431>

REFERENCES

- Andresen, S., Lips, A., Möller, R., Rusack, T., Schröer, W., Thomas, S., & Wilmes, J. (2020). Kinder, Eltern und ihre Erfahrungen während der Corona-Pandemie: Erste Ergebnisse der bundesweiten Studie KiCo [Children, parents, and their experiences during the Corona pandemic: First results from the nationwide study KiCo]. https://www.forum-transfer.de/fileadmin/uploads/Bibliothek/Wichtiges_Wissen_für_alle/KiCo_FamilienCorona.pdf
- Ben-Yaakov, O., & Taubman - Ben-Ari, O. (2021). COVID-19-related anxieties and parenting stress among first-time mothers and fathers in their first year of parenthood. *Psychology and Health*, 1–15. Advance online publication. <https://doi.org/10.1080/08870446.2021.1942875>
- Bernard, K., Nissim, G., Vaccaro, S., Harris, J. L., & Lindhiem, O. (2018). Association between maternal depression and maternal sensitivity from birth to 12 months: A meta-analysis. *Attachment & Human Development*, 20(6), 578–599. <https://doi.org/10.1080/14616734.2018.1430839>
- Bradley, R. H., Whiteside-Mansell, L., Brisby, J. A., & Caldwell, B. M. (1997). Parents' Socioemotional investment in children. *Journal of Marriage and Family*, 59(1), 77. <https://doi.org/10.2307/353663>
- Briggs-Gowan, M. J., Carter, A. S., Gray, S. O., Drury, S., Moyer, C., Chavez, A., Ford, J., & Grasso, D. J. (2020). *The Epidemic – Pandemic Impacts Inventory Postnatal – Infancy Supplement (EPII-I)*. University of Connecticut School of Medicine.
- Briggs-Gowan, M. J., Muzik, M., Drury, S. S., Gaston-Hawkins, L., Moyer, C., Gleason, M. M., Johnson, A., Carter, A. S., Ford, J. D., & Grasso, D. J. (2020). *The Epidemic – Pandemic Impacts Inventory Labor and Delivery Supplement (EPII-LD)*. University of Connecticut School of Medicine.
- Brown, S. M., Doom, J. R., Lechuga-Peña, S., Watamura, S. E., & Koppels, T. (2020). Stress and parenting during the global COVID-19 pandemic. *Child Abuse & Neglect*, 110, 104699. <https://doi.org/10.1016/j.chiabu.2020.104699>
- Bundesamt für Gesundheit (BAG) (2022). Coronavirus: Massnahmen und Verordnungen. [Coronavirus: Measures and ordinances]. <https://www.bag.admin.ch/bag/de/home/krankheiten/ausbrueche%2Ddepidemien%2Dpandemien/aktuelle%2Dausbrueche%2Ddepidemien/novel%2Dcov/massnahmen%2Ddes%2Dbundes.html%231570431754>
- Bundesamt für Statistik. (2021). Haushaltseinkommen und -ausgaben von Paaren mit Kindern nach Altersklasse des ältesten Kindes. [Household income and household expenditure for couples with children by age of the oldest child]. FSO: je-d-20.02.01.00.41
- Caldwell, B. M., & Bradley, R. H. (1984). *Home observation for measurement of the environment*. University of Arkansas at Little Rock.
- Carozza, S., & Leong, V. (2021). The role of affectionate caregiver touch in early neurodevelopment and parent-infant interactional synchrony. *Frontiers in Neuroscience*, 14, 613378. <https://doi.org/10.3389/fnins.2020.613378>
- Chung, G., Lanier, P., & Wong, P. Y. J. (2020). Mediating effects of parental stress on harsh parenting and parent-child relationship during Coronavirus (COVID-19) pandemic in Singapore. *Journal of Family Violence*. Advance online publication. <https://doi.org/10.1007/s10896-020-00200-1>
- Cohen, P. A., Hall, L. E., John, J. N., & Rapoport, A. B. (2020). The early natural history of SARS-CoV-2 infection: Clinical observations from an urban, ambulatory COVID-19 clinic. *Mayo Clinic Proceedings*, 95(6), 1124–1126. <https://doi.org/10.1016/j.mayocp.2020.04.010>
- Connell, C. M., & Strambler, M. J. (2021). Experiences with COVID-19 stressors and parents' use of neglectful, harsh, and positive parenting practices in the Northeastern United States. *Child Maltreatment*, 26(3), 255–266. <https://doi.org/10.1177/10775595211006465>

- Cummings, E. M., Goeke-Morey, M. C., Raymond, J., & Lamb, M. E. (2004). Fathers in family context: Effects of marital quality and marital conflict. In M. E. Lamb (Ed.), *The role of the father in child development* (4th ed., pp. 196–221). Wiley.
- Cummings, E. M., Keller, P. S., & Davies, P. T. (2005). Towards a family process model of maternal and paternal depressive symptoms: Exploring multiple relations with child and family functioning. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *46*(5), 479–489. <https://doi.org/10.1111/j.1469-7610.2004.00368.x>
- Davenport, M. H., Meyer, S., Meah, V. L., Strynadka, M. C., & Khurana, R. (2020). Moms are not ok: COVID-19 and maternal mental health. *Frontiers in Global Women's Health*, *1*, 1. <https://doi.org/10.3389/fgwh.2020.00001>
- Davis, E. P., & Narayan, A. J. (2020). Pregnancy as a period of risk, adaptation, and resilience for mothers and infants. *Development and Psychopathology*, *32*(5), 1625–1639. <https://doi.org/10.1017/S0954579420001121>
- Davis-Floyd, R., Gutschow, K., & Schwartz, D. A. (2020). Pregnancy, birth and the COVID-19 pandemic in the United States. *Medical Anthropology: Cross Cultural Studies in Health and Illness*, *39*(5), 413–427. <https://doi.org/10.1080/01459740.2020.1761804>
- Dempster, A. P., Laird, N. M., & Rubin, D. B. (1977). Maximum likelihood from incomplete data via the EM algorithm. *Journal of the Royal Statistical Society: Series B*, *39*(1), 1–38. <https://doi.org/10.1111/j.2517-6161.1977.tb01600.x>
- Deoni, S. C., Beauchemin, J., Volpe, A., & Dâ Sa, V., & RESONANCE Consortium. (2021). Impact of the COVID-19 pandemic on early child cognitive development: Initial findings in a longitudinal observational study of child health. *medRxiv : The Preprint Server for Health Sciences*. <https://doi.org/10.1101/2021.08.10.21261846>
- Duncan, G. J., Engel, M., Claessens, A., & Dowsett, C. J. (2014). Replication and robustness in developmental research. *Developmental Psychology*, *50*(11), 2417–2425. <https://doi.org/10.1037/a0037996>
- Epifanio, M. S., Genna, V., De Luca, C., Roccella, M., & La Grutta, S. (2015). Paternal and maternal transition to parenthood: The risk of postpartum depression and parenting stress. *Pediatric Reports*, *7*(2), 38–44. <https://doi.org/10.4081/pr.2015.5872>
- Fallon, V., Davies, S. M., Silverio, S. A., Jackson, L., De Pascalis, L., & Harrold, J. A. (2021). Psychosocial experiences of postnatal women during the COVID-19 pandemic. A UK-wide study of prevalence rates and risk factors for clinically relevant depression and anxiety. *Journal of Psychiatric Research*, *136*, 157–166. <https://doi.org/10.1016/j.jpsychires.2021.01.048>
- Fan, H. S. L., Choi, E. P. H., Ko, R. W. T., Kwok, J. Y. Y., Wong, J. Y. H., Fong, D. Y. T., Shek, N. W. M., Ngan, H. Y. S., Li, J., Huang, Y., Ouyang, Y., & Lok, K. Y. W. (2022). COVID-19 related fear and depression of pregnant women and new mothers. *Public Health Nursing*, *39*(3), 562–571. <https://doi.org/10.1111/phn.13035>
- Feinberg, M. E., Mogle, A. J., Lee, J. K., Tornello, S. L., Hostetler, M. L., Cifelli, J. A., Bai, S., & Hotez, E. (2022). Impact of the COVID-19 pandemic on parent, child, and family functioning. *Family Process*, *61*(1), 362–375. <https://doi.org/10.1111/famp.12649>
- Feldman, R., Eidelman, A. I., & Rotenberg, N. (2004). Parenting stress, infant emotion regulation, maternal sensitivity, and the cognitive development of triplets: A model for parent and child influences in a unique ecology. *Child Development*, *75*(6), 1774–1791. <https://doi.org/10.1111/j.1467-8624.2004.00816.x>
- Feldman, R., Singer, M., & Zagoory, O. (2010). Touch attenuates infants' physiological reactivity to stress. *Developmental Science*, *13*(2), 271–278. <https://doi.org/10.1111/j.1467-7687.2009.00890.x>
- Fosco, G. M., Sloan, C. J., Fang, S., & Feinberg, M. E. (2022). Family vulnerability and disruption during the COVID-19 pandemic: Prospective pathways to child maladjustment. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *63*(1), 47–57. <https://doi.org/10.1111/jcpp.13458>
- Frank, M. C., Bergelson, E., Bergmann, C., Cristia, A., Floccia, C., Gervain, J., Hamlin, J. K., Hannon, E. E., Kline, M., Levelt, C., Lew-Williams, C., Nazzi, T., Panneton, R., Rabagliati, H., Soderstrom, M., Sullivan, J., Waxman, S., & Yurovsky, D. (2017). A collaborative approach to infant research: Promoting reproducibility, best practices, and theory-building. *Infancy*, *22*(4), 421–435. <https://doi.org/10.1111/inf.12182>
- Gavin, N. I., Gaynes, B. N., Lohr, K. N., Meltzer-Brody, S., Gartlehner, G., & Swinson, T. (2005). Perinatal depression: A systematic review of prevalence and incidence. *Obstetrics & Gynecology*, *106*(5), 1071–1083. <https://doi.org/10.1097/01.AOG.0000183597.31630.db>
- Gershoff, E. T., Aber, J. L., Raver, C. C., & Lennon, M. C. (2007). Income is not enough: Incorporating material hardship into models of income associations with parenting and child development. *Child Development*, *78*(1), 70–95. <https://doi.org/10.1111/j.1467-8624.2007.00986.x>

- Giannotti, M., Mazzoni, N., Bentenuto, A., Venuti, P., & Falco, S. (2021). Family adjustment to COVID-19 lockdown in Italy: Parental stress, coparenting, and child externalizing behavior. *Family Process, 61*(2), 745–763. Advance online publication. <https://doi.org/10.1111/famp.12686>
- Glazier, R. H., Elgar, F. J., Goel, V., & Holzapfel, S. (2004). Stress, social support, and emotional distress in a community sample of pregnant women. *Journal of Psychosomatic Obstetrics and Gynecology, 25*(3–4), 247–255. <https://doi.org/10.1080/01674820400024406>
- Göbel, A., Stuhmann, L. Y., Harder, S., Schulte-Markwort, M., & Mudra, S. (2018) (July). The association between maternal-fetal bonding and prenatal anxiety: An explanatory analysis and systematic review. *Journal of Affective Disorders, 239*(July), 313–327. <https://doi.org/10.1016/j.jad.2018.07.024>
- Goyal, D., Gay, C., & Lee, K. A. (2010). How much does low socioeconomic status increase the risk of prenatal and postpartum depressive symptoms in first-time mothers? *Women's Health Issues, 20*(2), 96–104. <https://doi.org/10.1016/j.whi.2009.11.003>
- Grasso, D. J., Briggs-Gowan, M. J., Carter, A. S., Goldstein, B. L., & Ford, J. D. (2021). Profiling COVID-related experiences in the United States with the epidemic-pandemic impacts inventory: Linkages to psychosocial functioning. *Brain and Behavior, 11*(8), 1–16. <https://doi.org/10.1002/brb3.2197>
- Groß, S., Reck, C., Tiel-Bonney, C., & Cierpka, M. (2013). Empirical basis of the questionnaire for crying, feeding and sleeping. *Praxis der Kinderpsychologie und Kinderpsychiatrie, 62*(5), 327–347. <https://doi.org/10.13109/prkk.2013.62.5.327>
- Huebener, M., Waights, S., Spiess, C. K., Siegel, N. A., & Wagner, G. G. (2021). Parental well-being in times of Covid-19 in Germany. *Review of Economics of the Household, 19*(1), 91–122. <https://doi.org/10.1007/s11150-020-09529-4>
- Jansen, P. W., Raat, H., Mackenbach, J. P., Jaddoe, V. W. V., Hofman, A., Verhulst, F. C., & Tiemeier, H. (2009). Socioeconomic inequalities in infant temperament: The Generation R Study. *Social Psychiatry and Psychiatric Epidemiology, 44*(2), 87–95. <https://doi.org/10.1007/s00127-008-0416-z>
- JASP Team. (2021). JASP (Version 0.16). Computer Software.
- Koh, D. (2020). COVID-19 lockdowns throughout the world. *Occupational Medicine, 70*(5), 322. <https://doi.org/10.1093/occmed/kqaa073>
- Krampe, H., Danbolt, L. J., Haver, A., Stålsett, G., & Schnell, T. (2021). Locus of control moderates the association of COVID-19 stress and general mental distress: Results of a Norwegian and a German-speaking cross-sectional survey. *BMC Psychiatry, 21*(1), 1–13. <https://doi.org/10.1186/s12888-021-03418-5>
- Lannen, P., Duss, I., Bombach, C., Graf, N., & Simoni, H. (2021). Kleinkinder und ihre Familien zu Zeiten der COVID-19 Pandemie in der Schweiz [Young children and their families during the COVID-19 pandemic in Switzerland]. *Frühförderung Interdisziplinär, 40*(3), 119–133. <https://doi.org/10.2378/fi2021.art12d>
- Lebel, C., MacKinnon, A., Bagshawe, M., Tomfohr-Madsen, L., & Giesbrecht, G. (2020). Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic. *Journal of Affective Disorders, 277*, 5–13. <https://doi.org/10.1016/j.jad.2020.07.126>
- Lévesque, S., Bisson, V., Charton, L., & Fernet, M. (2020). Parenting and relational well-being during the transition to parenthood: Challenges for first-time parents. *Journal of Child and Family Studies, 29*(7), 1938–1956. <https://doi.org/10.1007/s10826-020-01727-z>
- Levin, A. T., Hanage, W. P., Owusu-Boaitey, N., Cochran, K. B., Walsh, S. P., & Meyerowitz-Katz, G. (2020). Assessing the age specificity of infection fatality rates for COVID-19: Systematic review, meta-analysis, and public policy implications. *European Journal of Epidemiology, 35*(12), 1123–1138. <https://doi.org/10.1007/s10654-020-00698-1>
- Lips, A. (2021). The situation of young people at home during COVID-19 pandemic. *Childhood Vulnerability Journal, 3*(1–3), 61–78. <https://doi.org/10.1007/s41255-021-00014-3>
- Liu, C. H., Erdei, C., & Mittal, L. (2021). Risk factors for depression, anxiety, and PTSD symptoms in perinatal women during the COVID-19 Pandemic. *Psychiatry Research, 295*(3), 139–148. <https://doi.org/10.1016/j.psychres.2020.113552>
- Longo, F., Lombardi, C. M. P., & Dearing, E. (2017). Family investments in low-income children's achievement and socioemotional functioning. *Developmental Psychology, 53*(12), 2273–2289. <https://doi.org/10.1037/dev0000366>
- Marques de Miranda, D., da Silva Athanasio, B., Sena Oliveira, A. C., & Simoes-e-Silva, A. C. (2020). How is COVID-19 pandemic impacting mental health of children and adolescents? *International Journal of Disaster Risk Reduction, 51*(January), 101845. <https://doi.org/10.1016/j.ijdr.2020.101845>
- Masarik, A. S., & Conger, R. D. (2017). Stress and child development: A review of the family stress model. *Current Opinion in Psychology, 13*, 85–90. <https://doi.org/10.1016/j.copsyc.2016.05.008>

- Matsushima, M., & Horiguchi, H. (2020). The COVID-19 pandemic and mental well-being of pregnant women in Japan: Need for Economic and Social Policy interventions. *Disaster Medicine and Public Health Preparedness*, 16(2), 449–454. Advance online publication. <https://doi.org/10.1017/dmp.2020.334>
- Mercer, R. T., & Walker, L. O. (2006). A review of nursing interventions to foster becoming a mother. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, 35(5), 568–582. <https://doi.org/10.1111/j.1552-6909.2006.00080.x>
- Mete Yesil, A., Sencan, B., Omercioglu, E., & Ozmert, E. N. (2022). The impact of the COVID-19 pandemic on children with special needs: A descriptive study. *Clinical Pediatrics*, 61(2), 141–149. <https://doi.org/10.1177/00099228211050223>
- Morrison, I. (2016). Keep calm and cuddle on: Social touch as a stress buffer. *Adaptive Human Behavior and Physiology*, 2(4), 344–362. <https://doi.org/10.1007/s40750-016-0052-x>
- Nepl, T. K., Senia, J. M., & Donnellan, M. B. (2016). Effects of economic hardship: Testing the family stress model over time. *Journal of Family Psychology*, 30(1), 12–21. <https://doi.org/10.1037/fam0000168>
- Nussbaumer-Streit, B., Mayr, V., Dobrescu, A. I., Chapman, A., Persad, E., Klerings, I., Wagner, G., Siebert, U., Christof, C., Zachariah, C., & Gartlehner, G. (2020). Quarantine alone or in combination with other public health measures to control COVID-19: A rapid review. *Cochrane Database of Systematic Reviews*, 2020(4). <https://doi.org/10.1002/14651858.CD013574>
- Ölmestig, T. K., Siersma, V., Birkmose, A. R., Kragstrup, J., & Ertmann, R. K. (2021). Infant crying problems related to maternal depressive and anxiety symptoms during pregnancy: A prospective cohort study. *BMC Pregnancy and Childbirth*, 21(1), 1–11. <https://doi.org/10.1186/s12884-021-04252-z>
- Oppermann, E., Cohen, F., Wolf, K., Burghardt, L., & Anders, Y. (2021). Changes in parents' home learning activities with their children during the COVID-19 lockdown – the role of parental stress, parents' self-f and social support. *Frontiers in Psychology*, 12, 682540. <https://doi.org/10.3389/fpsyg.2021.682540>
- Petzoldt, J. (2018). Systematic review on maternal depression versus anxiety in relation to excessive infant crying: It is all about the timing. *Archives of Women's Mental Health*, 21(1), 15–30. <https://doi.org/10.1007/s00737-017-0771-4>
- Prime, H., Wade, M., & Browne, D. (2020). Risk and resilience in family well-being during the COVID-19 pandemic. *American Psychologist*, 75(5), 631–643. <https://doi.org/10.1037/amp0000660>. <https://content.apa.org/full-text/2020-34995-001.pdf>
- Provenzi, L., Grumi, S., Altieri, L., Bensi, G., Bertazzoli, E., Biasucci, G., Cavallini, A., Decembrino, L., Falcone, R., Freddi, A., Gardella, B., Giaccherio, R., Giorda, R., Grossi, E., Guerini, P., Magnani, M. L., Martelli, P., Motta, M., Nacinovich, R., & Borgatti, R. (2021). Prenatal maternal stress during the COVID-19 pandemic and infant regulatory capacity at 3 months: A longitudinal study. *Development and Psychopathology*, 1–9. Advance online publication. <https://doi.org/10.1017/s0954579421000766>
- Ravens-Sieberer, U., Kaman, A., Erhart, M., Devine, J., Schlack, R., & Otto, C. (2021). Impact of the COVID-19 pandemic on quality of life and mental health in children and adolescents in Germany. *European Child & Adolescent Psychiatry*, 31(6), 879–889. <https://doi.org/10.1007/s00787-021-01726-5>
- Reinelt, T., Samdan, G., Kiel, N., & Petermann, F. (2019). Predicting externalizing behavior problems in early childhood: Evidence from longitudinal studies. *Kindheit und Entwicklung*, 28(1), 19–32. <https://doi.org/10.1026/0942-5403/a000268>
- Samdan, G., Kiel, N., Petermann, F., Rothenfuß, S., Zierul, C., & Reinelt, T. (2020). The relationship between parental behavior and infant regulation: A systematic review. *Developmental Review*, 57, 100923. <https://doi.org/10.1016/j.dr.2020.100923>
- Samdan, G., Reinelt, T., Kiel, N., Mathes, B., & Pauen, S. (2022). *Predicting the development of maternal confidence: The role of prenatal depressive symptoms and social support*. University of Bremen. Unpublished manuscript.
- Sari, N. P., van IJzendoorn, M. H., Jansen, P., Bakermans-Kranenburg, M., & Riem, M. M. E. (2022). Higher levels of harsh parenting during the COVID-19 lockdown in The Netherlands. *Child Maltreatment*, 27(2), 156–162. <https://doi.org/10.1177/10775595211024748>
- Schaal, N. K., Hagenbeck, C., Helbig, M., Wulff, V., Märthesheimer, S., Fehm, T., & Hepp, P. (2021). The influence of being pregnant during the COVID-19 pandemic on birth expectations and antenatal bonding. *Journal of Reproductive and Infant Psychology*, 1–11. Advance online publication. <https://doi.org/10.1080/02646838.2021.1962825>
- Shieh, C., Broome, M. E., & Stump, T. E. (2010). Factors associated with health information-seeking in low-income pregnant women. *Women & Health*, 50(5), 426–442. <https://doi.org/10.1080/03630242.2010.506152>
- Shuffrey, L. C., Firestein, M. R., Kyle, M. H., Fields, A., Alcántara, C., Amso, D., Austin, J., Bain, J. M., Barbosa, J., Bence, M., Bianco, C., Fernández, C. R., Goldman, S., Gyamfi-Bannerman, C., Hott, V., Hu, Y., Hussain, M.,

- Factor-Litvak, P., Lucchini, M., ... & Dumitriu, D. (2021). Association of birth during the COVID-19 pandemic with neurodevelopmental status at 6 months in infants with and without in utero exposure to maternal SARS-CoV-2 infection. *JAMA Pediatrics*, 10032, 1–11. <https://doi.org/10.1001/jamapediatrics.2021.5563>
- Singleterary, B., Schmeer, K. K., Purtell, K. M., Sayers, R. C., Justice, L. M., Lin, T. J., & Jiang, H. (2022). Understanding family life during the COVID-19 shutdown. *Family Relations*, 71(2), 475–493. <https://doi.org/10.1111/fare.12655>
- Spinelli, M., Lionetti, F., Pastore, M., & Fasolo, M. (2020). Parents' stress and children's psychological problems in families facing the COVID-19 outbreak in Italy. *Frontiers in Psychology*, 11, 1713. <https://doi.org/10.3389/fpsyg.2020.01713>
- Spinelli, M., Lionetti, F., Setti, A., & Fasolo, M. (2021). Parenting stress during the COVID-19 outbreak: Socioeconomic and environmental risk factors and implications for children emotion regulation. *Family Process*, 60(2), 639–653. <https://doi.org/10.1111/famp.12601>
- Spinola, O., Liotti, M., Speranza, A. M., & Tambelli, R. (2020). Effects of COVID-19 epidemic lockdown on postpartum depressive symptoms in a sample of Italian mothers. *Frontiers in Psychiatry*, 11, 589916. <https://doi.org/10.3389/fpsyg.2020.589916>
- Suthar, A. B., Schubert, S., Garon, J., Couture, A., Brown, A. M., & Charania, S. (2022). Coronavirus disease case definitions, diagnostic testing criteria, and surveillance in 25 countries with highest reported case counts. *Emerging Infectious Diseases*, 28(1), 148–156. <https://doi.org/10.3201/eid2801.211082>
- Taubman – Ben-Ari, O., Ben-Yaakov, O., & Chasson, M. (2021). Parenting stress among new parents before and during the COVID-19 pandemic. *Child Abuse & Neglect*, 117, 105080. <https://doi.org/10.1016/j.chiabu.2021.105080>
- Topp, C. W., Østergaard, S. D., Søndergaard, S., & Bech, P. (2015). The WHO-5 well-being index: A systematic review of the literature. *Psychotherapy and Psychosomatics*, 84(3), 167–176. <https://doi.org/10.1159/000376585>
- Wade, M., Prime, H., Johnson, D., May, S. S., Jenkins, J. M., & Browne, D. T. (2021) (February). The disparate impact of COVID-19 on the mental health of female and male caregivers. *Social Science & Medicine*, 275(February), 113801. <https://doi.org/10.1016/j.socscimed.2021.113801>
- Wagenmakers, E. J., Marsman, M., Jamil, T., Ly, A., Verhagen, J., Love, J., Selker, R., Gronau, Q. F., Šmíra, M., Epskamp, S., Matzke, D., Rouder, J. N., & Morey, R. D. (2018). Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psychonomic Bulletin & Review*, 25(1), 35–57. <https://doi.org/10.3758/s13423-017-1343-3>
- Wetzels, R., & Wagenmakers, E. J. (2012). A default Bayesian hypothesis test for correlations and partial correlations. *Psychonomic Bulletin & Review*, 19(6), 1057–1064. <https://doi.org/10.3758/s13423-012-0295-x>
- WHO. (1998). Info package: Mastering depression in primary care (version 2.2).
- WHO (2020). WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>
- Wyszynski, D. F., Hernandez-Diaz, S., Gordon-Dseagu, V., Ramiro, N., Basu, A., Kim, H. H., & Koenen, K. C. (2021). Frequency and source of worries in an international sample of pregnant and postpartum women during the Covid-19 pandemic. *BMC Pregnancy and Childbirth*, 21(1), 1–9. <https://doi.org/10.1186/s12884-021-04241-2>

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Reinelt, T., Suppiger, D., Frey, C., Oertel, R., & Natalucci, G. (2022). Infant regulation during the pandemic: Associations with maternal response to the COVID-19 pandemic, well-being, and socio-emotional investment. *Infancy*, 1–25. <https://doi.org/10.1111/infpa.12497>