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A reduced sleep quality in infants is associated with co-sleeping and parental stress during the COVID-19 pandemic

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Résumé

Les habitudes de sommeil des enfants changent et se développent pour atteindre une certaine stabilité au cours de leur développement. Ces schémas de sommeil sont vulnérables aux facteurs biologiques, sociaux et environnementaux. Des études récentes se sont concentrées sur deux facteurs modulant le sommeil des nourrissons, à savoir le stress des parents et le co-sommeil. De même, les stresseurs contextuels ont un impact sur la relation entre le sommeil des nourrissons et la santé mentale des parents. Le confinement dû à la pandémie de COVID-19 est un stresseur contextuel vécu dans le monde entier. Cette étude examine les effets du confinement sur le sommeil des nourrissons, en contrôlant le stress des parents et les arrangements de sommeil des bébés. Nous avons recruté des parents de 352 nourrissons âgés de 0 à 36 mois pour répondre à un questionnaire en ligne. Nous avons utilisé le *Brief Infant Sleep Questionnaire* pour mesurer le sommeil des bébés, ainsi que le *Perceived Stress Scale* et le *Well-Being Index* pour le stress et le bien-être des parents. Nos résultats ont démontré que le stress parental était négativement associé à la qualité du sommeil des nourrissons. De plus, nous avons observé que les enfants qui dormaient avec leurs parents avaient une moins bonne qualité de sommeil

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que ceux qui dormaient seuls. Nous suggérons d'accroître la sensibilisation à la santé mentale, en particulier chez les parents, lors d'événements stressants de vie. De plus, nous recommandons une psychoéducation des parents sur les schémas normaux du sommeil des nourrissons.

Mots-clés : Style parental, Régulation du sommeil, Perturbations du sommeil, Report parental

Abstract

Children's sleep patterns change and develop to reach certain stability within their development. These sleep patterns are vulnerable to biological, social, and environmental factors. Recent studies focused on two factors that modulate infants' sleep, namely parents' stress and co-sleeping. Likewise, contextual stressors influence the relationship between infants' sleep and parents' mental health. Confinement due to the COVID-19 pandemic is a contextual stressor experienced worldwide. The present study investigates the effects of confinement on infants' sleep, controlling for parents' stress and infants' sleeping arrangements. We recruited parents of 352 infants (aged from 0 to 36 months) to answer an online questionnaire. We used the Brief Infant Sleep Questionnaires to measure infants' sleep, as well as the Perceived Stress Scale and the Well-Being Index for parental stress and well-being. Our results demonstrated that parental stress was negatively associated with infants' sleep quality. Furthermore, we observed that co-sleeping infants were showing a poorer sleep quality than infants sleeping alone. We suggest increasing awareness concerning mental health, especially in parents, during stressful life events. Additionally, we recommend psychoeducation for parents about normal patterns of infants' sleep.

Keywords: Parenting style, Sleep Regulation, Sleep disturbances, Parental report

1. INTRODUCTION

1.1. Parental stress and its association with infants' sleep quality

In the past few years, research on infants' sleep aroused interest in scientists, implicating a considerable development in this domain. Interestingly, recent studies on this subject demonstrated associations between sleep disturbances in children and parental mental health (De Stasio et al., 2020; Hiscock & Wake, 2002; Hughes et al., 2015; Ystrom et

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al., 2017). Specifically, mothers with higher psychological distress and poorer self-reported health reported more sleep problems in their children than healthier mothers (Hughes et al., 2015). Thus, the relationship could be explained the other way around. For example, a study demonstrated that frequent nocturnal awakenings in infants lead to increased worrying in their caregivers as well as the perception of feeling overwhelmed (De Stasio et al., 2020).

Ystrom and colleagues (2017) presented models describing a causal relationship between maternal mental health and infants' sleep quality. On one hand, the mother-driven model explains that the maternal characteristics linked to her symptoms of anxiety and/or depression, such as negative affect, lead to increased nocturnal awakenings in infants (Figure 1A). On the other hand, the child-driven model describes how sleep disturbances of infants affect mothers' psychological state through the impact on maternal sleep (Figure 1B). Further, the authors explained the third possibility for impacted sleep and mental health. They suggested that factors commonly associated with mothers and infants, such as contextual stressors, influence the outcome of infants' sleep and maternal psychological states (Figure 1C).

Both the mother-driven model and the child-driven model were shown as relevant in the literature. Indeed, the mother-driven model was confirmed by a longitudinal study, which described that maternal depression and anxiety symptoms significantly predicted infants' nocturnal awakenings at 18 months (Ystrom et al., 2017). Contrarily, the child-driven model was supported by a sleep intervention in infants with sleep problems (Hiscock & Wake, 2002). The behavior intervention about infants' cries showed an improvement in maternal depression symptoms, indicating an association between infants' sleep quality and mothers' mental health.

In conclusion, evidence indicates that infants' sleep quality is positively associated with parental psychological states. Therefore, identifying specific factors interacting with infants' sleep may help preventing sleeping problems in infants or developing specific sleep interventions to improve dysfunctional behaviors.

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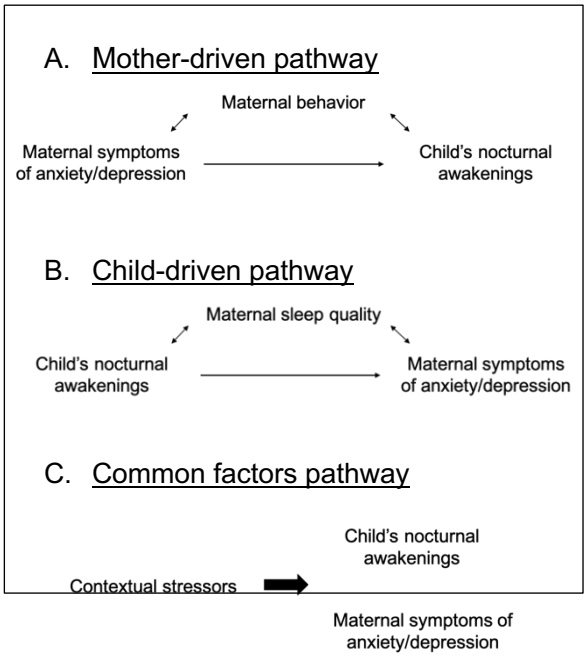
Figure 1.

Mother-driven pathway, child-driven pathway, and common factors pathway



Note. Figure adapted from Ystrom et al. (2017)

1.2. Co-sleeping: a controversial practice

The practice of co-sleeping is described as caregivers sharing the same sleep environment as their children (Mao et al., 2004). In the category of co-sleeping, we distinguish two types: bed-sharing, namely sharing the same bed as the child, and room-sharing, namely sharing the same room as the child.

Controversies arose from this practice, debating whether co-sleeping was affecting the child's health (e.g., increasing risk of sudden infant death syndrome (SIDS); Task Force On Sudden Infant Death Syndrome et al., 2016). In terms of sleep quality, studies indicated that co-sleeping was related to infants' sleep quality (Hysing et al., 2014; Paul et al., 2017). In a longitudinal study measuring nocturnal sleep duration and nocturnal awakenings in infants, researchers demonstrated that bed-sharing predicted a poorer sleep quality in infants at 18 months (Hysing et al., 2014). Room-sharing was also presented as impacting sleep quality, such that infants persistently room-sharing showed less nocturnal sleep duration and sleep consolidation, compared to infants sleeping alone (Paul et al., 2017).

On the other hand, several studies reported no significant association between infants' sleep disturbances and co-sleeping. A study comparing infants sleeping alone and infants co-sleeping with their caregivers reported no significant differences between these two groups in terms of nocturnal sleep duration and nocturnal awakenings (Mao et al., 2004). Similar results were revealed in a study including only Eastern participants

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(Jiang et al., 2007). However, when the authors compared their research to previous Western ones (e.g., Switzerland in Iglowstein et al., 2003), differences in terms of sleep quality occurred. The researchers interpreted this discrepancy as contrasting cultural norms, therefore different habits of co-sleeping (Jiang et al., 2007). Indeed, they explained that Eastern infants are more used to co-sleeping, which is related to fewer reported sleeping problems, compared to Western infants (Jiang et al., 2007; Mindell et al., 2010, 2017).

In conclusion, co-sleeping with infants is a debatable practice. We suggest considering and studying this phenomenon to better understand the underlying processes and prevent negative outcome on infants' sleep quality.

1.3. Context: COVID-19 pandemic

The COVID-19 has been declared as a worldwide pandemic situation in March 2020 (World Health Organization, 2020). Restrictions were imposed on several aspects of individuals' lives, such as working from home, online education due to the closure of schools and kindergartens, restriction of going outside, etc.

These disruptions impacted individuals' health, mainly manifesting as reduced sleep quality and poorer mental health. For example, in Australia, researchers found that psychological distress was associated with specific health behaviors: a reduction in physical activity, an increase in alcohol consumption and smoking, and a decrease in sleep quality were stated to be linked to poorer mental health during the COVID-19 pandemic in adults (De Stasio et al., 2020).

Children have also been impacted by this extraordinary situation. A Chilean study reported that children at the age of 1 to 5 years showed a decrease in physical activity, an increase in general screen time, and a decrease in sleep quality during the confinement, compared to before that period (Aguilar-Farias et al., 2021).

Several studies focused on the association between parental psychological states and infants' sleep quality during the COVID-19 pandemic. A longitudinal study measuring different aspects of children's and infants' sleep, as well as their caregivers' stress demonstrated a significant change from before the confinement to during the confinement (Markovic et al., 2021). Results indicated that children and infants' sleep

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decreased significantly, while parental stress increased significantly during the confinement.

In conclusion, the COVID-19 pandemic is considered as an external stressor impacting both parental mental health and infants' sleep quality. This conclusion was discussed previously with the common factors pathway of Ystrom and colleagues' model (see section 1.1.; Ystrom et al., 2017). To prevent negative health consequences for future potential extraordinary situations, we suggest identifying the impact of confinement on infants' sleep quality and caregivers' stress.

1.4. Research question and hypotheses

With a questionnaire-based approach, we investigated the effects of confinement on infants' sleep quality during the COVID-19 pandemic, in an infant sample between the age of 0 and 36 months. We considered "poor" sleep quality as more nocturnal awakenings and less nocturnal sleep duration, and vice versa for "good" sleep quality. Additionally, we assessed different infants' sleeping arrangements to examine how they relate to their sleep quality.

Hypothesis 1: Infants' sleep quality is associated with subjective parental stress and well-being, specifically, more infants' nighttime awakenings and less nighttime sleep duration are associated with increased parental stress (*H1a*), and decreased parental well-being (*H1b*).

Hypothesis 2: Infants' sleep quality is associated with sleeping arrangements, specifically, infants who sleep in the same bed (*H2a*) and the same room (*H2b*) as their caregivers sleep less and wake up more during the night compared to those infants who sleep alone.

2. METHODS

2.1. Study population

Following the invitation to participate in the study via our social media and personal contacts, a total of 371 infants' data, from 0 to 36 months (M = 17.77, SD = 9.83), were provided by their caregivers. Before data collection, caregivers gave written consent, and non-monetary gifts were sent to the families. This study was approved by the local ethics committee (University of Fribourg, CH).

Data were manually inspected for completeness, coherence, and plausibility,

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resulting in a final sample of 170 girls (48%) and 182 boys (52%).

2.2. Study design and procedure

Data were collected in April 2020, corresponding to the beginning of the global confinement of the COVID-19 pandemic. This investigation included a subset of a larger longitudinal dataset (Markovic et al., 2021).

A link to the online questionnaire was sent to the caregivers. This online questionnaire was created with SoSci Survey (Leiner, 2016), and available in five languages (i.e., English, French, German, Italian, Spanish, in-lab translations). It took around 20 min to be completed.

2.3. Assessment

The Brief Infant Sleep Questionnaire (BISQ; Sadeh, 2004) measures several aspects of infants' sleep via parental ratings. The original version (Sadeh, 2004) was extended with questions concerning naps, sleep aids and bedtime routines. We focused on nocturnal awakenings and nocturnal sleep duration, both variables being commonly used. Participants were asked to rate two different moments: (1) NOW, referring to the time since the confinement; and (2) BEFORE, referring to the time before the confinement. Participants were asked to report the average number of awakenings per night of their child, and their nocturnal sleep duration in hours [*"How much time does your child spend in sleep during the NIGHT (between 7 in the evening and 7 in the morning)?"*].

The Perceived Stress Scale (PSS; Cohen et al., 1983) considers the perception of events from a subjective viewpoint. From the original 10 items that captures thoughts and feelings, we selected two items to assess overwhelmed feelings by life events ["*How often have you felt that you were unable to control the important things in your life*"; "*How often have you felt that things were piling up so high that you could not overcome them*"; ratings from 1 "Never" to 5 "Very often"]. In alignment with the original questionnaire, the mean of both questions was used for analysis. Similarly to BISQ, participants reported two different time points (i.e., NOW and BEFORE).

The Well-Being Index (WBI; Psychiatric Research Unit, 1998) measures positive well-being and is available in the five selected languages (i.e., English, French,

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German, Italian, and Spanish). From the original five items, we included three ["*I have felt cheerful and in good spirits*"; "*I woke up feeling fresh and rested*"; "*Your life has been filled with things that interest you*"; ratings from 0 "At no time" to 5 "All the time"; responses NOW and BEFORE]. A mean score of the three items was computed for analysis.

To capture the effects of the confinement on participants, we quantified parents' fear of being infected with the virus ["*Are you afraid of being infected with COVID-19?*"; ratings from 1 "No fear" to 5 "A lot of fear"]. We also captured the change of stress level during the confinement ["*Did your behavior change across the time that passed since the confinement, such that your level of stress…*"; ratings from 1 "Decreased a lot" to 5 "Increased a lot"].

2.4. Statistical evaluation

Statistical analyses were completed with RStudio (R Core Team, 2019), including descriptive, inferential, and exploratory analyses. The level of significance was set at $\alpha = .05$.

H1 was evaluated using non-parametrical Spearman's correlations, multiple testing was addressed (Benjamini & Hochberg, 1995). H2 was examined with a one-way ANCOVA, with sleeping arrangements as the independent variable and sleep quality as the dependent variable. Age was included as covariate and a one-way ANCOVA, corrected for multiple comparisons (Benjamini and Hochberg method) was implemented.

Additionally, we ran some exploratory analyses that can be found in the supplementary material.

3. RESULTS

3.1. Parental well-being and stress are associated with infants' sleep quality

Several significant associations were discovered confirming the relation between nocturnal awakenings in infants and parental well-being. Firstly, mean well-being was negatively correlated with nocturnal awakenings: the less the child woke up during the night, the higher the parents rated their well-being ($r_s(350) = -.32$, $p < .001$). Also, infant awakenings from sleep were positively correlated with both the mean perceived stress ($r_s(350) = .24$, $p < .001$), and the change in the level of stress ($r_s(350) = .15$, $p = .005$).

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We found no linkage between infants' night awakenings and parents' fear of the virus ($r_s(350) = .02$, $p = .754$).

Additionally, nocturnal sleep duration (hours) was positively correlated with mean well-being ($r_s(350) = .20$, $p < .001$), indicating that the more the infant slept during the night, the more the parents felt in a good state. Negative associations between infants' nighttime sleep duration (hours) and the change in stress level ($r_s(350) = -.23$, $p < .001$), the mean perceived stress ($r_s(350) = -.23$, $p < .001$), and the fear of infection with the virus ($r_s(350) = -.19$, $p < .001$) were discovered. All results are resumed in Table 1.

In sum, these outcomes indicate that increased nocturnal awakenings and decreased nocturnal sleep duration in infants are associated with increased parental stress. Similarly, decreased nocturnal awakenings and increased nocturnal sleep duration of infants are significantly related to increased parental well-being.

Table 1.

Means, standard deviations, and Spearman's correlations (rho values) of infants' sleep and parents' stress/well-being variables

	M	*SD*	Sleep duration	Nocturnal Awakenings
1	10.15	1.26		
2	2.03	2.04		
3	2.9	0.89	-.23**	.24**
4	3.91	0.9	.20**	-.32**
5	3.53	1.1	-.23**	.15*
6	2.55	1.14	-.19**	.02

Note. *M* and *SD* represent mean and standard deviation, respectively. 1. Nocturnal sleep duration; 2. Nocturnal awakenings; 3. Mean perceived stress; 4. Mean well-being; 5. Level of stress; 6. Fear of infection. The mean and standard deviation of nocturnal sleep are in hours. The nocturnal awakenings represent the total number throughout the night. The scales of mean perceived stress, level of stress, and fear of infection are from 1 to 5, whereas mean well-being is from 0 to 5. The significance levels are indicating as *$p < .05$, **$p < .001$. All *p*-values were corrected with the Benjamini-Hochberg method (FDR).

3.2. Infants' sleeping arrangements are related to their sleep quality

We found a significant effect between sleeping arrangements and the number of nocturnal awakenings in infants ($F(2, 308) = 46.61$, $p < .001$, $\eta^2 = .24$; controlling for age). Specifically, infants who sleep alone showed fewer awakenings at night (1.10±0.15, M±SE), compared to infants who share a room (2.28±0.24; $p < .001$), or to infants who share

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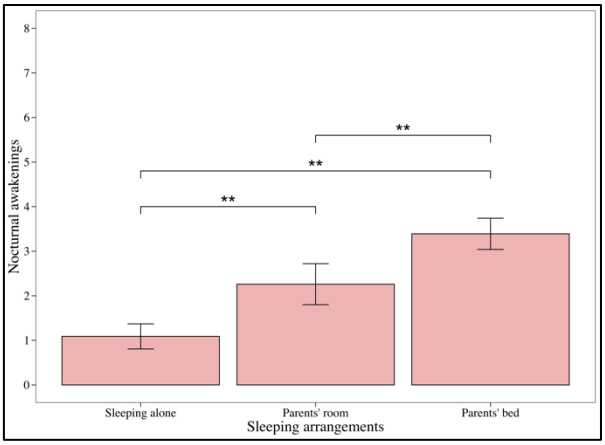
a bed with their caregiver (3.41, ±0.18; p < .001; post-hoc tests) (Figure 2).

Figure 2.

Nocturnal awakenings between sleeping arrangements, controlled for age (ANCOVA test)

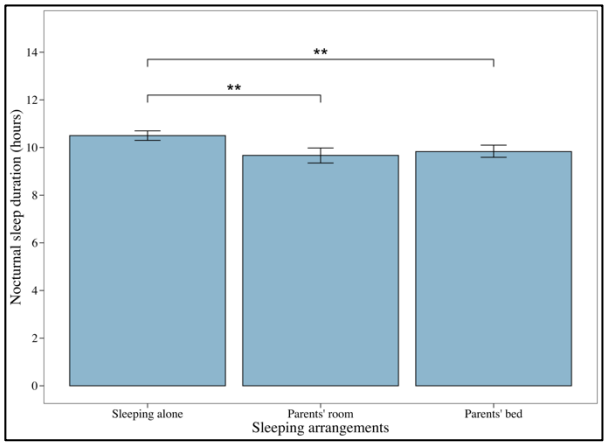


Note. Co-sleeping infants (i.e., room-sharing and bed-sharing) have more nocturnal awakenings than infants sleeping alone. Bed-sharing infants have a higher number of nocturnal awakenings than room-sharing infants. Error bars represent the standard error. Post-hoc tests were used to compare the three categories of sleeping arrangements. The significance levels are indicated as *p < .05, **p < .001. All p-values were corrected with the Benjamini-Hochberg method (FDR).

Moreover, our results indicate a significant effect of the sleeping arrangements on nocturnal sleep duration (hours) (F(2, 308) = 13.74, p < .001, η^2 = .08, controlling for age). Indeed, infants sleeping alone demonstrated longer nighttime sleep duration (10.5±0.10) than infants who share a bad (9.83±0.12, p < .001) and infants who share a room with their parents (9.67±0.16, p < .001; post-hoc tests) (Figure 3).

Figure 3.

Nocturnal sleep duration (hours) between sleeping arrangements, controlled for age (ANCOVA test)



Note. Infants sleeping alone have longer nocturnal sleep duration (hours), compared to room-sharing and bed-sharing infants. Error bars represent the standard error. Post-hoc tests were used to compare the three categories of sleeping arrangements. The significance levels are indicated as *p < .05, **p < .001. All p-values were corrected with the Benjamini-Hochberg method (FDR).

Together, our results confirm that infants co-sleeping, namely bed-sharing and

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room-sharing, demonstrate higher nocturnal awakenings and fewer nocturnal sleep duration, compared to infants sleeping alone.

4. DISCUSSION

The current study investigated the relationship between infants' sleep quality and two possible associated factors, namely parental well-being and co-sleeping. Our results suggest that caregivers' stress is related to infants' decreasing sleep quality (higher nocturnal awakenings and less nocturnal sleep duration) and vice versa for parents' well-being. Furthermore, we discovered that infants who sleep with their caregivers have poorer sleep, compared to infants who sleep alone.

Overall, our research demonstrated that co-sleeping and parental stress are significant factors associating with infants' sleep quality, in a contextual stressor that represents the COVID-19 pandemic.

4.1. Parental stress is closely related to the report of poorer quality of sleep in infants

Our first hypothesis stipulated that infants' sleep quality was associated with parental well-being, which was confirmed.

The first explanation we proposed consider parents' cognitions about their infants' sleep as mediators in the parent-infant relationship. Symptoms of depression and/or anxiety are often associated with decreased interest in life events, fatigue, insomnia, guilt, difficulty concentrating, negative affect, etc. (American Psychiatric Association [APA], 2013). These specific symptoms of psychological distress could affect parents' cognitions towards different aspects of their lives. Accordingly, maternal worries about their infants' sleep quality and maternal depression were found to be associated with the increased report of infants' night awakenings (Teti & Crosby, 2012). Further, fragmented sleep experienced by infants during the first months of life (Iglowstein et al., 2003) could not match parents' expectations, therefore leading to increased anxiety in caregivers. In sum, we propose that parental expectations and cognitions concerning the normal development of their infants' sleep are major mediators of infants' sleep quality and parental stress.

Moreover, we suggest that parental sleep quality needs to be considered as an intermediate factor between infants' sleep and parents' well-being. Since infants experience

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fragmented sleep during the first couple of years (Iglowstein et al., 2003), we expect caregivers to be more vulnerable to the same sleep pattern as their infants. Therefore, sleep-deprived parents are more inclined to develop depressive symptoms. This explanation could be described the other way around; depressed caregivers are more likely to be experiencing fragmented sleep and/or insomnia, therefore being more vigilant about their infants' sleep. In sum, parental sleep quality is a considerate factor that needs to be controlled to better understand the relationship between infants' sleep and caregivers' stress.

Finally, infants' self-soothing capacities are important to consider in the association between infants' sleep quality and parental stress. Typically, a dysfunctional capacity to self-soothe in infants when waking up during the leads naturally to more reported night awakenings by caregivers. Since we reported that sleep fragmentation is generally associated with depressive symptoms, we suggest that parents are more vulnerable to develop depressive symptoms and/or anxiety when their infants are not able to return to sleep by themselves. Consequently, stress and/or anxiety in caregivers could lead to less emotional availability towards their infants, which is known to be closely related to the development of their self-soothing capacities (Dahl, 1996). In sum, we suggest that the ability to return to sleep by themselves is an important mediator between infants' sleep quality and parental stress.

In conclusion, our results demonstrated an association between infants' sleep quality and parental well-being/stress, which was postulated in our hypotheses. We want to underline the importance to consider both infants' characteristics (e.g., self-soothing strategies) and parents' characteristics (e.g., parental sleep) as interacting in the infant-parent relationship.

4.2. Co-sleeping is associated with a poorer infants' sleep

We stipulated for our second hypothesis that co-sleeping, namely bed-sharing (*H2a*) and room-sharing (*H2b*), were associated with infants' sleep quality. These hypotheses were also confirmed.

One possible explanation regarding poorer sleep quality in infants who co-sleep is the proximity between the infant and the parent during the night. Indeed, co-sleeping caregivers are naturally more aware and vigilant to the child's nocturnal awakenings

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due to the proximity, either in the bed or in the room. In comparison, we expect parents sleeping in another room than their infants will report mostly louder cries and agitations. Taken together, this suggests that co-sleeping infants are more likely to have higher nocturnal awakenings than infants sleeping alone due to the proximity to their caregivers.

Further, we suggest that the cultural component of sleeping arrangements is also important to consider. Indeed, we reported that Eastern infants are more used to co-sleeping than Western infants (Jiang et al., 2007), which differentiates them in terms of their sleep patterns (Mindell et al., 2011, 2017). Therefore, we suggest that co-sleeping when not dictated by cultural norms could lead to hypersensitivity and worrying in caregivers about infants' nocturnal awakenings (Teti et al., 2016). Parental reasons for co-sleeping, either culturally imposed or parental choice, could be an important factor to control for in future studies.

4.3. Limitations

Our limitations concern methodology and context, mainly due to the COVID-19 pandemic. The first limitation we would like to underline is the subjectivity of the questionnaires. Indeed, because of the pandemic, we could not meet and/or test participants objectively, therefore we decided to create a questionnaire. Caregivers were asked to report their infants' sleep patterns and their own stress level, which often leads to a subjective bias. However, we assume that our sample size was adequate to overcome these biases, and our sleep variables were estimated as the norm for this population, therefore we consider our results strong enough.

Furthermore, the confinement period was not experienced equally by everyone worldwide. Indeed, restrictions imposed by governments were different depending on the country. Therefore, we suggest that these imposed restrictions lead to a discrepancy in our results, considering the heterogeneity of the nationalities in our sample. However, most of our participants were Swiss, which considerably reduces the risk of heterogeneity.

4.4. Future directions

Our research was one of the first to identify the relationship between infants' sleep quality and parental well-being in the context of a pandemic. To further explore the

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associations regarding these variables, future research is warranted.

First, we suggest adding an objective measure, in addition to the subjective one, to better target the existing relationship. Implementing actigraphy, a method to measure the movements of infants during the night (Meltzer et al., 2012), would be an appropriate choice to better capture the possible differences between the subjective (i.e., questionnaires) and objective (i.e., actigraphy) methods.

Second, we also suggest conducting longitudinal studies with infants to better understand the long-term impacts of confinement throughout their childhood. We propose to annually assess the infants' sleep to better understand its development and compare it to previous cohorts that did not experienced a pandemic.

Finally, concerning the methodology, we would like to expand our sleep variables by adding more precise sleep composites, e.g. Sleep Timing, representing the bed times and sleep times (for further details, see Schoch et al., 2020). We assume that the expanded sleep variables would allow us to better target the associations between infants' sleep quality and parental stress/co-sleeping. In addition, we would further explore the effect of sleeping arrangements on infants' sleep by better targeting the reasons and frequency of co-sleeping in different families.

5. CONCLUSION

Co-sleeping and parental stress were identified as factors associated with infants' sleep quality. These results suggest that infants' sleep is vulnerable to external factors and stressors. We recommend protecting children's sleep by increasing awareness among parents concerning mental health, especially in such circumstances as the pandemic. Furthermore, we propose to implement psychoeducation regarding infants' sleep for caregivers to better understand their offspring's development. Finally, we suggest caregivers to choose sleeping arrangements that fit their lifestyle and that are beneficial for their children.

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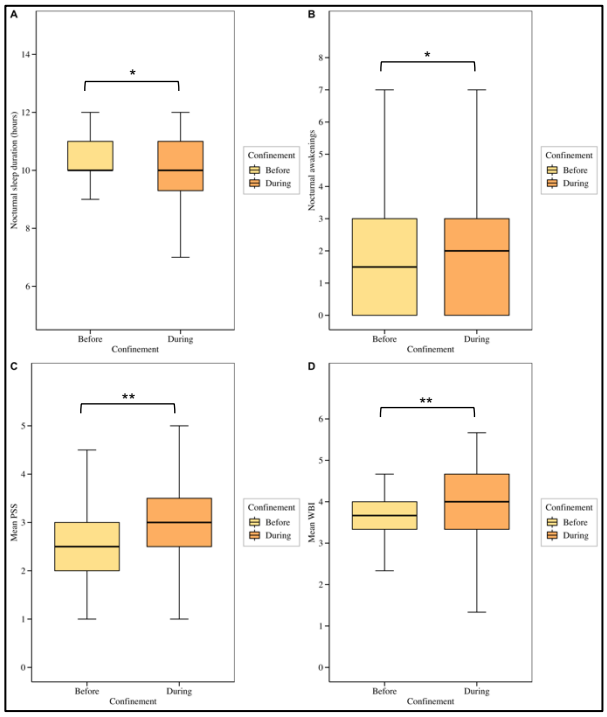
SUPPLEMENTARY MATERIAL

Appendix I

Wilcoxon test: comparing variables before confinement and during confinement



Note. **A**. Significant difference of nocturnal sleep duration (hours) between before confinement and during confinement. **B.** Increase in infants' nocturnal awakenings during confinement, compared to before. **C.** Higher parental perceived stress during confinement, compared to before. **D.** Increase in parental well-being during confinement, compared to before. The significance levels are indicated as *$p < .05$, **$p < .001$.

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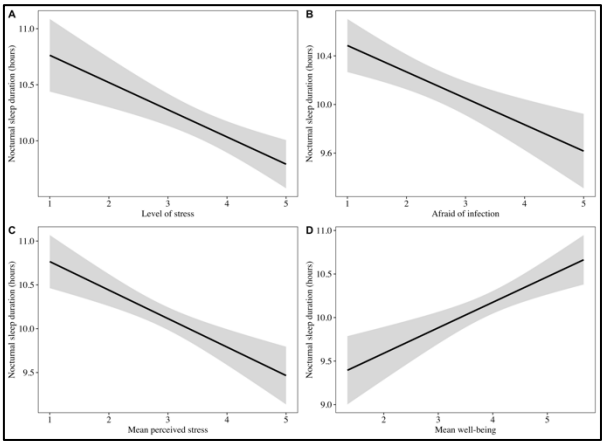
Appendix II

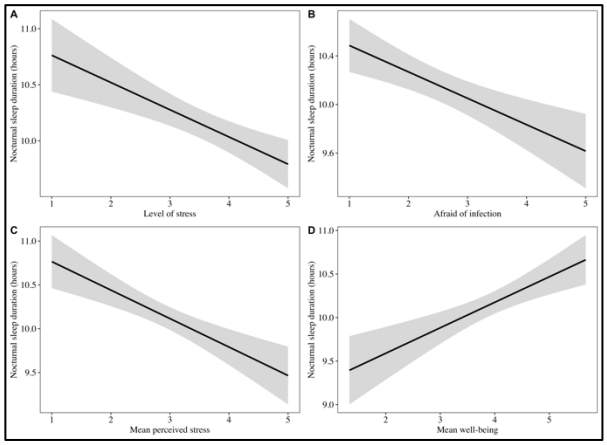
Simple linear regressions: Nocturnal sleep duration



Note. **A.** Parental level of stress negatively predicts nocturnal sleep duration (hours) in infants. **B.** Parental fear of infection is considered a negative predictor of infants' nocturnal sleep duration (hours). **C.** Parental perceived stress predicts shorter nocturnal sleep duration in infants. **D.** Parental well-being is also a significant positive predictor of the nocturnal sleep duration of infants. All these results were significant at p < .001.

Appendix III

Simple linear regressions: Nocturnal awakenings



Note. **A.** Parental level of stress predicts positively infants' nocturnal awakenings, *p* = .002. **B.** Parental fear of infection with the virus is not considered a significant predictor for infants' nocturnal awakenings, *p* = .707. **C.** Parental perceived stress predicts a higher number of awakenings per night in infants, *p* < .001. **D.** Parental well-being is a negative predictor of infants' nocturnal awakenings, *p* < .001.

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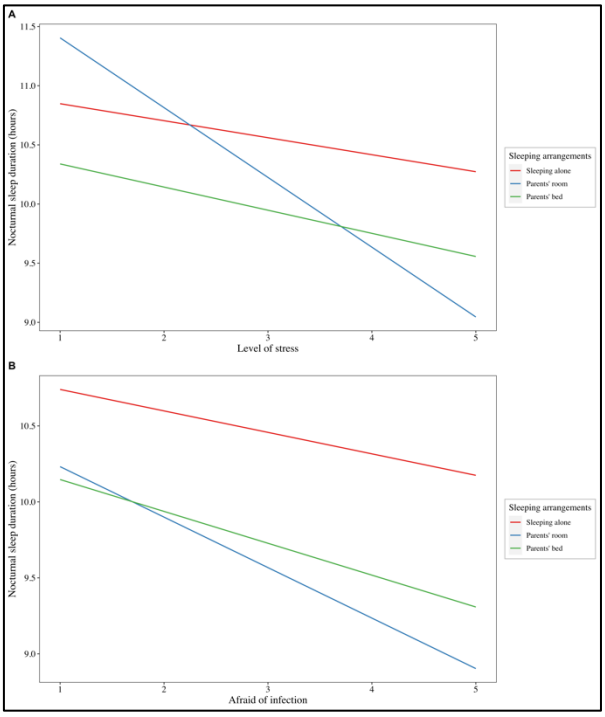
Appendix IV

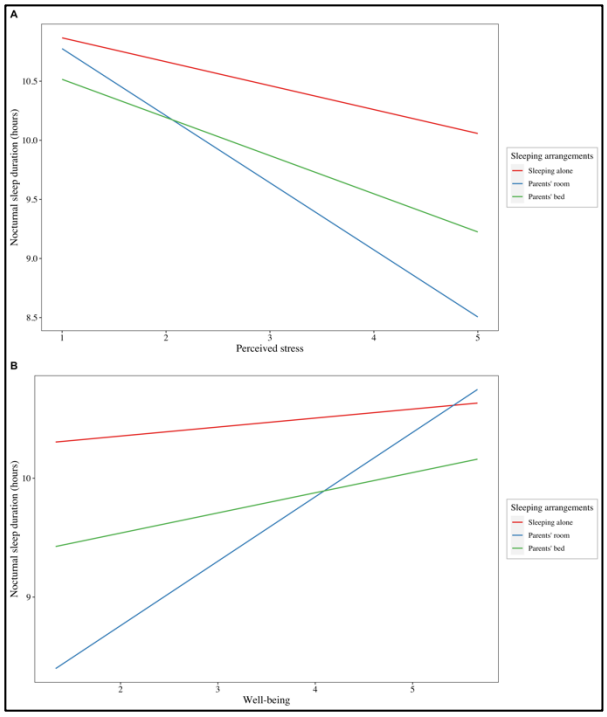
Moderation analysis: interaction between parental level of stress and fear of infection with nocturnal sleep duration (hours), moderated by the sleeping arrangements



Note. **A.** Significant interaction between parental level of stress and infants' room-sharing (blue line), p = .028. **B.** No significant interaction concerning the fear of infection.

Appendix V

Moderation analysis: interaction between parental perceived stress and well-being with nocturnal sleep duration (hours), moderation by the sleeping arrangements



Note. **A.** Interaction effect reaching trend-level significance between parental perceived stress and infants' room-sharing, p = .094. **B.** Significant interaction between parental well-being and infants' room-sharing (blue line), p = .023.

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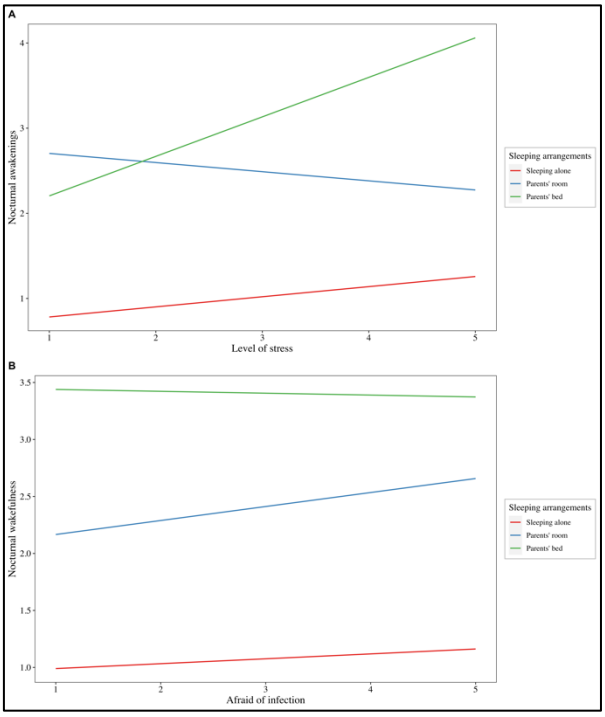
Appendix VI

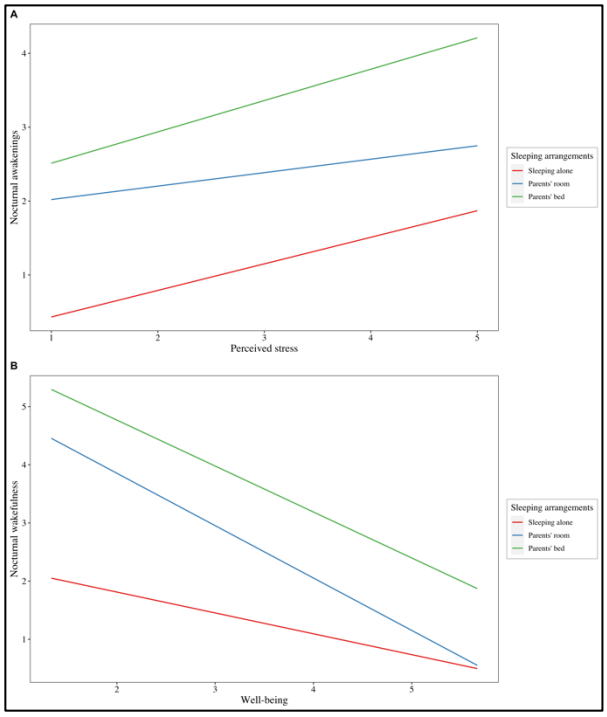
Moderation analysis: interaction between parental level of stress and fear of infection with nocturnal awakenings, moderated by the sleeping arrangements



Note. **A.** Trend-level significance interaction between parental level of stress and infants' bed-sharing, p = .088. **B.** No significant interaction for the fear of infection of parents.

Appendix VII

Moderation analysis: interaction between parental perceived stress and well-being with nocturnal awakenings, moderated by the sleeping arrangements



Note. **A.** No interaction reached significance concerning the parental perceived stress. **B.** Interaction effect reaching trend-level significance between parental well-being and infants' room-sharing, p = .060, and bed-sharing, p = .075.