ARTICLE DETAILS

TITLE (PROVISIONAL)  Sleep patterns and intra-individual sleep variability in mothers and fathers at 6 months postpartum: a population-based, cross-sectional study

AUTHORS  Kalogeropoulos, Christopher; Burdayron, Rebecca; Laganière, Christine; Dubois-Comtois, Karine; Béliveau, Marie-Julie; Pennestri, Marie-Helene

VERSION 1 – REVIEW

REVIEWER  Combs, Daniel
University of Arizona Department of Pediatrics

REVIEW RETURNED  31-Jan-2022

GENERAL COMMENTS  This appears to be a well-written and meaningful article comparing paternal and maternal sleep. The article is generally well-written and appears methodologically sound. Unfortunately, the tables are truncated/illegible and it is thus difficult to examine the authors' data to determine if it supports the author's conclusions.

- Was data normally distributed for sleep durations? This should be stated given parametric tests were used.
- Why was 6 hours consecutive sleep used as the definition of consolidated sleep?
- Table 2 appears truncated, for actigraphy, only maternal information is provided, not paternal.
- Throughout the results, for sentences like this “Actigraphy also revealed more sleep fragmentation in mothers with a higher number of nocturnal awakenings \[t(32) = 5.99, p < .001\] and shorter longest consecutive sleep duration \[t(32) = -5.79, p < .001\] than fathers.” Would be more useful to report mean (standard deviation) for each group in the comparison, i.e. Mothers slept more (6 hours ±0.5 hours) than fathers (5 hours ±0.5 hours), p=0.04.
- Table 3 formatting is broken, table is not entirely readable.
- Same issue for table 4.
- Please report total 24 hour sleep duration for mothers and fathers. The authors hypothesize that “mothers likely had more flexible sleep schedules than fathers’, whose opportunities for sleep were restricted to the nighttime.” The 24 hour sleep duration that should be available from actigraphy would address this.
- In regards to this statement in the discussion: “Additionally, mothers on maternity leave (employment status) reported more night awakenings. This supports the notion that mothers on maternity were likely to be the designated parent to attend to their infant throughout the night.” It’s not clear that this finding supports this claim. It could be possible that mothers on leave are spending more time in bed or sleeping during the daytime in an effort to try to catch up on missed sleep, resulting in sleep disruptions that are similar to those with behavioral insomnia that have increased their time in bed to a point that sleep efficiency is decreased.

**REVIEWER**
Zhang, Feng  
Nantong University

**REVIEW RETURNED**
30-Mar-2022

**GENERAL COMMENTS**

Comments on Sleep patterns and intra-individual sleep variability in mothers and fathers at 6 months postpartum: A population-based, cross-sectional study

it is a meaningful research with greatness workload. They measured Thirty-three couples (mothers and fathers) sleep was across 10 consecutive nights using a daily sleep diary and actigraphy. It is commendable that they included the fathers’ Sleep patterns in the research and measure subjectively and objectively. These findings advance our knowledge of how sleep unfolds within the family system.

However, as the author list in limitation, the small sample size may bias the result and its generalizability. Additionally, the Multivariate analysis was not conduct to control the confounding factors.

Please find the detail comments as follows:

1. inclusion criteria. Did the mother or mother enrolled have sleep problems before the birth of the infant?
2. Subjective sleep was assessed by the question “longest consecutive sleep duration,” How did they know that?
3. For 81.80% of mothers reported being on maternity leave, they may have a snap during the day time. Therefore, the day time sleep may influence the nocturnal sleep pattern. The day time sleep data from actigraphy device could be analyzed.
4. Infant health status should be considered.
5. Three objective sleep variables were derived by computing means of the actigraphy data across 10-consecutive nights: (1) nocturnal sleep duration, (2) longest consecutive sleep duration, and (3) number of nocturnal awakenings. Did the three variables reflect the sleep quality? Did the 10-consecutive nights mean that the week day and weekends were included for all parents? What is the difference between them? Was the data of the duration of nocturnal awakenings analyzed?
6. There was something wrong with the typeset, and table 3 and table 4 could not be seen clearly.
7. Multivariate analysis was not conducted to control the confounding factors.
8. The infant sleep pattern should be reported? For example, the infant sleep settling time, sleeping position, way of infant falling asleep, sleep-onset time, numbers of night wakings, nocturnal wakefulness, longest continuous sleep period, nocturnal sleep duration, daytime sleep duration, etc.
9. Lack of sample size calculation.

**VERSION 1 – AUTHOR RESPONSE**

| REVIEWER COMMENTS | AUTHOR'S RESPONSE |
|-------------------|-------------------|
| Reviewer 1        |                   |
| 1. This appears to be a wellwritten and meaningful article comparing paternal and maternal sleep. The article is generally well-written and appears methodologically sound. Unfortunately, the tables are truncated/ illegible and it is thus difficult to examine the authors data to determine if it supports the author's conclusions. | We thank the reviewer for their comment. Unfortunately, there was a formatting error upon submission of the manuscript. This error has been corrected and the tables should be legible upon resubmission. |
| 2. Was data normally distributed for sleep durations? This should be stated given parametric tests were used. | This comment has been addressed in the Statistical analyses section (page 10). “The data was normally distributed; univariate outliers (z>|3.29|) were converted to the nearest non-outlying value (with z |
| 3. Why was 6 hours consecutive sleep used as the definition of consolidated sleep? | In the literature, 6 hours of consecutive sleep has been used as a common criterion of consolidated sleep. This comment has been addressed in the Method section (page 10). “Consistent with previous research, 6 hours of consecutive sleep represents a commonly used criterion for consolidated sleep. 14, 15, 19, 37” Henderson JMT, France KG, Blampied NM. The consolidation of infants’ nocturnal sleep across the first year of life. Sleep Med Rev. 2011;15(4):211-220. https://doi.org/10.1016/j.smrv.2010.08.003 Pennestri M-H, Laganière C, Bouvette-Turcot A-A, et al. Uninterrupted infant sleep, development, and maternal mood. Pediatrics. 2018;142(6):e20174330. https://doi.org/10.1542/peds.2017-4330 Pennestri M-H, Burdayron R, Kenny S, Béliveau M-J. |
Dubois-Comtois K. Sleeping through the night or through the nights? Sleep Med. 2020;76:98-103. https://doi.org/10.1016/j.sleep.2020.10.005

Touchette E, Petit D, Paquet J, Boivin M, Japel C, Tremblay RE, Montplaisir JY. Factors associated with fragmented sleep at night across early childhood. Arch Pediatr Adolesc Med. 2005;159(3):242-9. https://doi:10.1001/archpedi.159.3.242

4. Table 2 appears truncated, for actigraphy, only maternal information is provided, not paternal.

Table 2 formatting has been modified, paternal actigraphy data should now be legible (page 12).

5. Throughout the results, for sentences like this “Actigraphy also revealed more sleep fragmentation in mothers with a higher number of nocturnal awakenings [t(32) = 5.99, p < .001] and shorter longest consecutive sleep duration [t(32) = -5.79, p < .001] than fathers.” Would be more useful to report mean (standard deviation) for each group in the comparison, i.e. Mothers slept more (6 hours ±0.5 hours) than fathers (5 hours ±0.5 hours), p=0.04.

We agree that it would be more useful to report the mean and standard deviation, we thank the reviewer for this suggestion. The presentation of results has been modified (pages 11 and 15-16). Example: “Actigraphy also revealed more sleep fragmentation in mothers with more of nocturnal awakenings (2.46 ± 0.99) than fathers (1.65 ± 0.68; p < 0.001) and shorter longest consecutive sleep duration (299.45 minutes ± 70.83 minutes) than fathers (376.73 minutes ± 63.39 minutes; p < 0.001).” “Mothers engaging in solitary sleep also self-reported a higher percentage of nights sleeping 6 hours consecutively (24.38% ± 25.02%) compared to co-sleeping mothers (7.06% ± 9.85%; p = 0.013.)”

6. Table 3 formatting is broken, table is not entirely readable.

Table 3 formatting has been modified and should now be legible (page 13).

7. Same issue for table 4.

Table 4 formatting has been modified and should now be legible (page 14).

8. Please report total 24 hour sleep duration for mothers and fathers. The authors hypothesize that “mothers likely had more flexible sleep schedules than fathers’, whose opportunities for sleep were restricted to the nighttime.” The 24 hour sleep duration that should be available from actigraphy would address this.

Thank you for outlining this important question. The 24- hour sleep duration was indeed available from actigraphy and has been added in the Results section (page 11). We have integrated this point with our initial statement in the Discussion section to reflect the suggestion made by the reviewer (page 18): Results section (page 11): “Additionally, mothers demonstrated more objective 24-hour sleep duration (512.15 minutes ± 34.86 minutes) than fathers (446.71 minutes ± 44.19 minutes; p < 0.001).” Discussion section (page 18): “Moreover, actigraphy data revealed
that mothers slept more than fathers throughout a 24-hour period. Therefore, mothers likely had more flexible sleep schedules than fathers, whose opportunities for sleep were restricted to the nighttime.

9. In regards to this statement in the discussion: “Additionally, mothers on maternity leave (employment status) reported more night awakenings. This supports the notion that mothers on maternity were likely to be the designated parent to attend to their infant throughout the night.” It’s not clear that this finding supports this claim. It could be possible that mothers on leave are spending more time in bed or sleeping during the daytime in an effort to try to catch up on missed sleep, resulting in sleep disruptions that are similar to those with behavioral insomnia that have increased their time in bed to a point that sleep efficiency is decreased.

Thank you for highlighting this point. We have made changes to reflect this comment in the Discussion (page 20-21). “Additionally, mothers on maternity leave reported more night awakenings than actively working mothers. While mothers on maternity leave likely tended to their infant during the nocturnal period, it is also plausible that they engaged in daytime sleep to compensate for nocturnal sleep disruptions. Increased time in bed throughout the day may have thus interfered with mothers’ nocturnal sleep.

1. It is a meaningful research with greatness workload. They measured Thirty-three couples (mothers and fathers) sleep was across 10 consecutive nights using a daily sleep diary and actigraphy. It is commendable that they included the fathers’ Sleep patterns in the research and measure subjectively and objectively. These findings advance our knowledge of how sleep unfolds within the family system. However, as the author list in limitation, the small sample size may bias the result and its generalizability. Additionally, the Multivariate analysis was not conducted to control the confounding factors.

We thank the reviewer for their comment. We do acknowledge that the smaller sample size may bias the results and generalizability (this is elaborated upon in the limitation section of the manuscript and also in the comments – Editor’s comment #3 and Reviewer 2 comment #10). The confounding factors (mostly family factors) were used to address our second objective: assess associations between parental sleep and family factors. Since the majority of these family factors did not correlate with parental sleep, especially actigraphy data, they were indeed not used as confounding variables in the first objective. Moreover, considering the smaller sample size it would be difficult to add covariables in the first section, that is more a descriptive part.
2. Inclusion criteria: Did the mother or father enrolled have sleep problems before the birth of the infant?

Participants with severe medical health conditions and sleep disorders (using sleep medication) were excluded. However, the goal was to recruit participants from a general population; we did not set specific criteria related to sleep quality. The subjective and objective sleep durations reported in the current sample fall within the range of sleep duration healthy adults should achieve (7 to 9 hours per day; Hirshkowitz et al., 2015; Hunter et al. 2009). As such, there are likely no major health or sleep disorders among the participants in the current research. Inclusion criteria was modified to reflect no self-reported sleep apnea or use of sleep medication (page 6). Hirshkowitz M, Whiton K, Albert SM, et al. National Sleep Foundation’s sleep time duration recommendations: methodology and results summary. Sleep Health. 2015;1(1):40-43. doi:10.1016/j.sleh.2014.12.010

Hunter LP, Rychnovsky JD, Yount SM. A selective review of maternal sleep characteristics in the postpartum period. J Obstet Gynecol Neonatal Nurs. 2009;38(1):60-68. doi: 10.1511/j.1552-6909.2008.00309.x

“The following inclusion criteria were met: (1) English- or French-speaking parents, (2) 18 years and older, (3) no self-reported history of chronic medical illness, (4) no self-reported past or current diagnosed mental health conditions, (5) no self-reported sleep apnea or use of sleep medication, and (6) no parental report of diagnosed medical illness amongst infants.”

3. Subjective sleep was assessed by the question "longest consecutive sleep duration," How did they know that?

We apologize if that aspect was not clear in the manuscript, but the question about longest consecutive sleep duration was not directly asked to the participants. The longest consecutive sleep duration was rather retrieved from the sleep diary. For each night of participation, parents completed a sleep diary that consisted of a visual representation of the night, depicted by a continuous line divided into boxes, with one box corresponding to 1h (which was further divided by lines denoting 15-minute blocks). Parents were instructed to shade in the boxes corresponding to their estimated sleep period every morning to report their nocturnal sleep patterns (unshaded boxes represented wake period during the night).
We subsequently scored their completed sleep diary and obtained an estimate of their longest consecutive sleep duration. This comment has been addressed in the Method section (page 8-9). “The diary consisted of a visual representation of each night with one box corresponding to 1h (which was further divided by lines denoting 15-minute blocks). Parents were instructed to shade in the boxes corresponding to their estimated sleep period every morning to report their nocturnal sleep patterns (unshaded boxes represented wake period during the night). Three subjective sleep variables were then derived by computing means of the sleep diary data across 10-consecutive nights: (1) nocturnal sleep duration, (2) longest consecutive sleep duration, and (3) nocturnal awakenings.”

4. For 81.80% of mothers reported being on maternity leave, they may have a nap during the daytime. Therefore, the daytime sleep may influence the nocturnal sleep pattern. The daytime sleep data Thank you for outlining this important revision. Thanks to the reviewer, we went back to the actigraphy data and were able to retrieve the 24-hour sleep duration. It has now been reported in the Results section (page 11). It has also been addressed in the Discussion as well (page 20-21). Results (page 11): from actigraphy device could be analyzed. “Additionally, mothers demonstrated more objective 24-hour sleep duration (512.15 minutes ± 34.86 minutes) than fathers (446.71 minutes ± 44.19 minutes; p < 0.001).” Discussion (page 20-21): “While mothers on maternity leave were likely the designated parent to attend to their infant throughout the night, it is also plausible that they engaged in daytime sleep to compensate for nocturnal sleep disruptions. Increased time in bed throughout the day may have thus interfered with mothers’ nocturnal sleep.”

5. Infant health status should be considered. Infant health status was considered with regard to our inclusion criteria. That is, only infants with no diagnosed medical conditions were included; this was based on parental report and not an independent physical examination of infants. We have now updated our statement on the inclusion criteria in the manuscript (page 6): “… (6) no parental report of diagnosed medical illness amongst infants.”
6. Three objective sleep variables were derived by computing means of the actigraphy data across 10-consecutive nights: (1) nocturnal sleep duration, (2) longest consecutive sleep duration, and (3) number of nocturnal awakenings.

Did the three variables reflect the sleep quality?

These three objective sleep variables do not necessarily reflect sleep quality. They were measured by actigraphy, which refers to continuous activity monitoring using a wristwatch-like device, worn on the non-dominant arm. It is a naturalistic and non-invasive indicator of sleep patterns in adults, without interfering with the families’ routine (Paquet et al., 2007). Paquet J, Kawinska A, Carrier J. Wake detection capacity of actigraphy during sleep. Sleep. 2007 Oct;30(10):1362-9. doi: 10.1093/sleep/30.10.1362. PMID: 17969470; PMCID: PMC2266273.

Yes, weekday and weekends were included for all parents across the 10 consecutive nights. Although we did not perform this analysis previously, we went back to the actigraphy data, considering the reviewer’s question. We retrieved the individual night-to-night actigraphy data and calculated new distinct means (for the weekdays and for the weekends) for both mothers and fathers for nocturnal sleep duration, night awakenings, and 24-hour sleep duration. Then, we used paired sample t-tests to compare actigraphy sleep variables between weekday and weekends for both mothers and fathers. Mothers: There were no significant differences between mothers’ weekday nocturnal sleep duration (445.73 minutes ± 38.19 minutes) and weekend duration (453.03 minutes ± 45.87 minutes; p > 0.05). There were no significant differences between mothers’ weekday night awakenings (2.48 ± 1.05 minutes) and weekend awakenings (2.40 ± 0.95; p > 0.05). Lastly, there were no
significant differences between mothers’ weekday 24-hour sleep duration (510.74 minutes ± 37.44 minutes) and weekend 24-hour duration (513.63 minutes ± 48.77 minutes; p > 0.05). Fathers: There were no significant differences between fathers’ weekday nocturnal sleep duration (409.60 minutes ± 56.62 minutes) and weekend duration (415.86 minutes ± 80.53 minutes; p > 0.05). There were no significant differences between fathers’ weekday night awakenings (1.65 ± 0.71 minutes) and weekend awakenings (1.63 ± 0.77; p > 0.05). Lastly, there were no significant differences between fathers’ weekday 24-hour sleep duration (455.92 minutes ± 51.98 minutes) and weekend 24-hour duration (459.30 minutes ± 78.57 minutes; p > 0.05). Although we agree with the reviewer that this is an interesting question, there were no significant differences for mothers nor for fathers, for any of the actigraphy variables as described in the two previous paragraphs. Therefore, we do not think it would be useful to include these additional results in the manuscript, considering that there are already an important number of results presented and it would not add any nuance. However, we are open to including these results if the reviewer and Editor think it is necessary.

Was the data of the duration of nocturnal awakenings analyzed?

Night awakenings and consecutive sleep duration were used as measures of sleep fragmentation. Considering the small sample size and the number of different analyses conducted, we tried to limit the number of sleep variables, especially when reflecting the same construct. As an additional note, actigraphy data was analysed this way: an epoch was set at 1 minute, at medium sensitivity (40-activity count threshold). An epoch was scored as an awakening if the number of activity counts was >40 for 1 minute, based on the assumption that there is less movement during sleep and more during wake. This is highlighted in the Method section (page 9).

7. There was something wrong with the typeset, and table 3 and table 4 could not be seen clearly

When the manuscript was uploaded, the formatting for Table 3 and 4 altered. We apologize for this error, all tables should be eligible upon resubmission.
|   |   |
|---|---|
| 8. Multivariate analysis was not conducted to control the confounding factors. | As explained in the first comment (Reviewer 2 comment #1), the confounding factors (mostly family factors) were used to address our second objective: assess associations between parental sleep and family factors. Since the majority of these family factors did not correlate with parental sleep, especially actigraphy data, they were indeed not used as confounding variables in the first objective. Moreover, considering the smaller sample size it would be difficult to add covariables in the first section, that is more a descriptive part. Example: “No associations between mothers’ actigraphy sleep variables and employment status, education level, infant feeding method, infant sleep location, infant nocturnal sleep duration, or infant nocturnal awakenings were found (p > 0.05).” “Employment status, education level, infant feeding method, infant sleep location, and infant nocturnal sleep variables did not demonstrate associations with paternal sleep diary and actigraphy variables (p > 0.05).” |
| 9. The infant sleep pattern should be reported? For example, the infant sleep settling time, sleeping position, way of infant falling asleep, sleep-onset time, numbers of night wakings, nocturnal wakefulness, longest continuous sleep period, nocturnal sleep duration, daytime sleep duration, etc. | Thank you for this important suggestion. While we already had reported on infant feeding method and infant sleep location (which capture elements of infant sleep patterns), we acknowledge that additional infant sleep patterns are also meaningful variables to consider. To address the reviewer’s comment (and although all mentioned variables were not available in our study), we have now also included infant nocturnal sleep duration and infant nocturnal awakenings as additional family factors in the manuscript. This has been reflected throughout the manuscript in the Introduction (page 5), Method (page 6, 7, 10, 11), Results (page 16), and Discussion (page 20). Example: Method (page 6-7) “Regarding infant sleep variables, mean nocturnal sleep duration ranged from 454.50 to 672.00 minutes (M = 576.3 ± 54.80) and mean nocturnal awakenings ranged from 0.70 to 4.90 (M = 2.71 ± 1.04).” |
| 10. Lack of sample size calculation. | Following the reviewer’s comment, we computed a post-hoc power calculation. Considering the effect sizes obtained in the analyses (r between 0.37 and 0.51) and the sample of 33 families, along with an alpha of 0.05, the post-hoc power |
calculation is between 58% and 94%. Some authors suggest that post-hoc power calculation should be calculated mainly to ensure that non-statistical findings are not simply due to a low statistical power (Hoenig & Heisey, 2001). Considering that several significant results were found in the present study, we do not think it is necessary to include these calculations in the manuscript. However, we are open to including these calculations if the reviewers and Editor believe it is necessary. Hoenig JM, Heisey DM. The abuse of power: the pervasive fallacy of power calculations for data analysis. The American Statistician. 2001;55(1):19-24. https://doi.org/10.1198/000313001300339897
Griffith KN, Feyman Y. Amplifying the noise: the dangers of post hoc power analyses. The Journal of surgical research. 2021; 259: 1-5. doi: 10.1016/j.jss.2019.09.075

VERSION 2 – REVIEW

| REVIEWER           | Combs, Daniel |
|--------------------|---------------|
| UNIVERSITY OF ARIZONA DEPARTMENT OF PEDIATRICS |

| REVIEW RETURNED | 11-Jun-2022 |
|-----------------|-------------|

| GENERAL COMMENTS | The revisions have significantly strengthened the manuscript. |

| REVIEWER | Zhang, Feng |
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| UNIVERSITY OF NANTONG |

| REVIEW RETURNED | 23-May-2022 |
|-----------------|-------------|

| GENERAL COMMENTS | It is a meaningful and interesting research. The authors provided subjective and objective instruments to measure sleep patterns between mothers and fathers. The former reviewers have pointed out the shortcomings. The authors have revised them. I think it is OK to accept this article. |