The Journal of Child Psychology and Psychiatry

Journal of Child Psychology and Psychiatry 64:8 (2023), pp 1222–1231 doi:10.1111/jcpp.13797

Validation of the Parental Understanding and Misperceptions about BAby's Sleep Questionnaire using auto-videosomnography

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Background: Previous studies have suggested that parental cognitions about child's sleep may be an important factor underlying pediatric sleep problems. The current study aimed to (a) develop an assessment tool measuring parental understanding and misperceptions about baby's sleep (PUMBA-Q); (b) validate the questionnaire using self-report and objective sleep measures. **Methods:** There were 1,420 English-speaking caregivers (68.0% mothers, 46.8% of children being females, mean age 12.3 months), who has completed online self-reported questionnaires. The PUMBA-Q, which was developed for this study, Dysfunctional Beliefs and Attitudes about Sleep (DBAS) and Maternal Cognitions about Infant Sleep Questionnaire (MCISQ) were included to evaluate participant's thoughts on their own or child's sleep. Insomnia Severity Index (ISI) was collected to access participant's subjective insomnia severity. Brief Infant Sleep Questionnaire-Revised (BISQ-R) was used to assess parental-reported child sleep. Auto-videosomnography was used to record child's sleep. **Results:** Exploratory factor analysis indicated the best fit with a 4-factor model using 23 items (RMSEA = .039). The four subscales were labeled: (a) Misperceptions about parental intervention; (b) Misperceptions about feeding; (c) Misperceptions about child's sleep; and (d) General anxiety of parents. Internal consistency was adequate (Cronbach's alpha = .86). PUMBA-Q scores were significantly associated with MCISQ ($r = .64$, $p < .01$), DBAS ($r = .36$, $p < .01$), ISI ($r = .29$, $p < .01$), BISQ-R ($r = .-49$, $p < .01$), objective child's total sleep time ($r = -.24$, $p < .01$) and objective number of parental nighttime visits ($r = .26$, $p < .01$). **Conclusions:** The results demonstrated that PUMBA-Q 23 is a valid assessment tool for parental cognitions of child sleep. The link between parental cognitions and child sleep highlights the importance of managing parental cognitions about child sleep when treating pediatric sleep problems. **Keywords:** Pediatric sleep; parental cognitions; assessment tool; validation; auto-videosomnography.

Introduction

Pediatric sleep disorders are common, affecting approximately 25% to 40% of children and adolescents (Owens, 2005). Most pediatric sleep disturbances are likely to persist if left untreated (Lam, Hiscock, & Wake, 2003; Meltzer & Mindell, 2006). High prevalence and persistence of pediatric sleep problems are even more serious in consideration of its possible negative impact on a child's mood, behavior, development, learning, and health outcomes (Liu et al., 2016; Mindell & Owens, 2003; Mindell, Leichman, DuMond, & Sadeh, 2017; Sadeh, Tikotzky, & Kahn, 2014; Vriend, Davidson, Rusak, & Corkum, 2015). Pediatric sleep problems may pose a serious challenge to parental and family well-being (Brand, Furlano, Sidler, Schulz, & Holsboer-Trachsler, 2014; Byars, Yeomans-Maldonado, & Noll, 2011; Eckerberg, 2004; Hiscock & Wake, 2002; Moturi & Avis, 2010; Sadeh & Anders, 1993). Considering the possible negative effects and persistence of pediatric sleep, it is critical to investigate factors that contribute to infant sleep problems for targeted early intervention.

Parental cognition about child sleep is recognized as an important factor related to the initiation and perpetuation of pediatric sleep problems. Parental cognition has been suggested to be associated with parental behaviors surrounding children's sleep, ultimately affecting the quantity and quality of both child's and parent's sleep (Morrell, 1999). For example, worrying about the well-being of a child when they are asleep, or catastrophizing infant nocturnal awakenings may shape nighttime parental practice as evidenced by the results demonstrating the mediating role of caregiver's soothing behavior in the relationship between cognition and pediatric sleep problems (Tikotzky & Sadeh, 2009). Another study showed that maternal sleep-related cognitions reflecting difficulties in limiting parental involvement during the night was a significant predictor of fragmented child's sleep (Tikotzky & Shaashua, 2012). Sadeh and Anders (1993) proposed a transactional model to describe the dynamic

Conflict of interest statement: No conflicts declared.

interactions between the children and their social environment, suggesting parental cognitions associated with infant sleep drive parental sleep-related behaviors, which have direct impact on infant sleep (Sadeh & Anders, 1993).

To date, only a few questionnaires have been developed to assess parental cognitions in association with child sleep. The two most widely known questionnaires are the Maternal Cognition about Infant Sleep (MCISQ; Morrell, 1999) and Infant Sleep Vignettes Interpretation Scale (ISVIS; Sadeh, Flint-Ofir, Tirosh, & Tikotzky, 2007), which are commonly used in this field of research (Kahn et al., 2020; Sadeh et al., 2016). These questionnaires were developed based on Western norms of child sleep and parenting practices that assume sleeping separately with the child. Indeed, both MCISQ and ISVIS include items asking parental ability to let the child sleep alone and resist child demands during the night, reflecting the cultural norm of solitary sleeping and minimizing parental presence at bedtime. However, parent–child sleep arrangement differs depending on culture, and while a child's independent sleep and self-soothing are considered ideal in Western cultures (Barry, 2019), co-sleeping is much more common in many other non-Western cultures and certain subcultures within Western societies (Ball & Russell, 2012; Barry, 2021). Since cultural context can lead to differences in parental expectations of infant sleep (Mindell, Sadeh, Wiegand, How, & Goh, 2010), perspectives underlying the existing questionnaires and scoring standard may not be culturally inclusive, which calls for the development of questionnaires that explore parental cognition within various contexts.

The current study aims to address these limitations by developing and validating a new questionnaire evaluating parental understanding and misperceptions about overall infant sleep without assuming that separate child–parent sleeping is the norm. Psychometric properties of the new scale were tested using factor analysis, reliability, and validity tests. Importantly, the scale was also validated with a novel infant sleep assessment device, auto-videosomnography, which provides objective infant sleep metrics and objective parental frequency of nightly check-ins. Finally, the study also hypothesizes that parental misperceptions about child's sleep will also be associated with both the child's and parent's sleep.

Methods

The scale development process and statistical techniques refer to the three main phases that Boateng, Neilands, Frongillo, Melgar-Quinonez, and Young (2018) proposed (a) item generation and assessment of content validity; (b) scale construction (pre-administering the survey, decreasing the number of items, and exploratory factor analysis; EFA); (c) scale evaluation (validity tests) (Boateng et al., 2018).

Item generation

Focus group interviews (FGI) and expert consultation were used for item generation. FGI is a method of qualitative data collection for exploring and understanding an individual's beliefs, feelings, and behaviors (Rabiee, 2004). For the current study, FGIs were conducted with 10 mothers who had children between 6 and 36 months old in South Korea. Participants were recruited online using community posts at various parenting websites in South Korea. Mothers who had Insomnia Severity Index (ISI) scores higher than 16 and reported sleep difficulties with their child were interviewed. All FGIs were semi-structured, hour-long, and facilitated by one sleep expert or one graduate student who was trained in behavioral sleep medicine. The topic covered parental and pediatric sleep problems, focusing on thoughts and beliefs associated with child sleep, bedtime rituals, and difficulties in implementing sleep intervention after a certain age. Each participant was incentivized with KRW 20,000 (equivalent to $15.50 USD) after the completion of the interview. As a result of the current COVID-19 outbreak, FGIs were conducted individually online, digitally audio-recorded, and transcribed verbatim.

The interview data were analyzed using qualitative research analysis based on the phenomenological method (Giorgi, 1997). We analyzed the data based on five concrete steps suggested by Giorgi (1997): (a) Collection of verbal data using verbatim transcriptions of the interview; (b) Reading the data: the researchers read through transcribed verbatim to retain a global sense of the data; (c) Dividing the data into parts: Relevant meaning units are formed by a rereading of the description and the researcher seek the most invariant meanings to denote infant sleep problem out of sentences; (d) Organization and expression of the raw data into disciplinary language: once the meaning units are established, the participant's own everyday language was transformed into disciplinary language to make it more explicit; (e) Expressing the structure of the phenomenon: once each meaning unit was essentialized with proper disciplinary terms, these meaning units were classified into essential vs. non-essential structures of the phenomenon under study. These five steps were mainly led by two independent researchers.

Since the current research takes discovery-oriented approaches to parental thoughts about child sleep problems, the analytic process allowed meanings to emerge without predetermined themes. The final six essential constructs of parental cognitions about child sleep include lack of understanding, the necessity of parental intervention, justifications of maternal sacrifices, worries about child development, fatigue, and negative emotions, and maternal insomnia. Based on six themes that emerged from maternal reports, misperceptions, and beliefs were written in sentences. Besides these themes that emerged from the interviews, two items (fears about child death and common dysfunctional attitudes related to insomnia) were included in the initial questions concerning the previous questionnaire (e.g., MCISQ and DBAS) because those items were speculated to be highly relevant to the constructs.

As a result, an initial 56 items were generated with reference to the emerging topics from FGIs. The initial 56 items, which were measured on 5-point Likert scale ranging from *strongly disagree* (0) to *strongly agree* (4), were reviewed by three sleep experts (SHC, MG, BB). Several items that were deemed unnecessary or duplicated were deleted. Additionally, some expressions were modified by native English speakers. This resulted in 45 items (see Table S1), which were tested statistically to finalize items for the questionnaire (see Appendix S1).[1]

[1]Please request final questionnaire from authors for permission of use.

Participants

Participants were recruited among the parents who had been using NANIT for the personal purposes of accessing their child's sleep during the research period. A total of 2,895 English-speaking caregivers of children between 6 and 36 months old participated in the study. Participants were 68.0% mothers, with the majority of participants (88.5%) between 25 and 40. Children were 46.8% girls and their ages ranged from 6 to 26 months, with a mean of 12.3 (*SD* = 5.5) months. The data for the participants who had both objective sleep measures (obtained by auto-videosomnography) and other self-reported measures, including the 45 items generated for the development of the questionnaire, were used for the analysis (n = 1,420).

Procedures

All participants completed an online self-report survey. Additionally, infant sleep and parental nighttime behavior were measured objectively using auto-videosomnography. Informed consent was obtained from each participant prior to the administration of the research measures and participants consented to the use of recorded video of child for analyzing child sleep parameters. Each participant entered to win a $200 Amazon gift card raffle as an incentive after the completion of the online survey. The study received ethical approval from the Department of Institutional Bioethics Committee of Sungshin Women's University.

Measures

Self-report measures. Socio-demographic Information: Participants answered on demographic information, which included their age, race, education and income level, and marital status.

Maternal Cognitions about Infant Sleep Questionnaire (MCISQ; Morrell, 1999): The MCISQ is a 20-item scale measuring maternal cognitions about infant sleep (Morrell, 1999). Participants were requested to rate their agreement with each statement on a 6-point Likert scale from "strongly agree" to "strongly disagree" responses. MCISQ consists of five subscales: (a) limit setting; (b) anger; (c) doubt; (d) feeding; and (e) safety. Higher scores indicate greater concerns and stronger doubts about the child's sleep (Morrell, 1999). In our sample, the scale demonstrated adequate reliability (Cronbach's alpha = .879).

Dysfunctional Beliefs and Attitudes about Sleep-30 (DBAS; Morin, Stone, Trinkle, Mercer, & Remsberg, 1993): The DBAS-30 was developed to evaluate sleep-related cognitions that interfered with sleep (Morin et al., 1993). In the current research, DBAS was included to measure parent's cognitions about their own sleep (e.g., unrealistic sleep expectations, and misperceptions about the cause and consequences of insomnia). The participants were asked to rate their agreement/disagreement with each statement on an 11-point Likert-type scale from "strongly disagree" to "strongly agree". In our sample, the scale demonstrated adequate reliability (Cronbach's alpha = .880).

Insomnia Severity Index (ISI; Bastien, Vallieres, & Morin, 2001): The ISI is a commonly used 7-item scale measuring participants' perceived insomnia severity (Bastien et al., 2001). In the current research, ISI was included to measure parent's insomnia severity. Individuals rate each item for the past 2 weeks on a 5-point Likert scale from "not at all" to "extremely" with total scores ranging from 0 to 28. Higher scores indicate more severe insomnia. In our sample, the scale demonstrated adequate reliability (Cronbach's alpha = .884).

Brief Infant Sleep Questionnaire-Revised (BISQ-R; Mindell, Gould, Tikotzy, Leichman, & Walters, 2019): The BISQ-R is a revised version of Brief Infant Sleep Questionnaire (Sadeh, 2004), which is a well-validated questionnaire measuring infant's and toddler's (0–36 months) sleep patterns with 33 items. Parent-reported child sleep parameters (total nighttime sleep duration, sleep duration; Wake After Sleep Onset. WASO; Sleep Onset Latency, SOL) were collected using BISQ-R. A single question accessing parental perceived severity of child sleep problems (parental perceived sleep problem) was used from the BISQ-R, and it was assessed with 5-point Likert scale from "no problem at all" to "severe problem". BISQ-R generated the following three subscales: infant sleep; parent perception; and parent behavior. Higher scores reflect better infant sleep quality, positive parental perception about infant sleep, and parental behavior that facilitate independent infant sleep.

Objective measures. Auto-videosomnography: We used a commercial auto-videosomnography device (NANIT, New York, NY) to objectively assess infant sleep based on a sleep monitoring device, which recording the movement of the baby's entire body. Auto-videosomnography has its advantages in measuring infant sleep in their own natural home sleep environment, increasing ecological validity. The nighttime period was predefined by parents. Parents set a 2-hr 'bedtime' window and a 2-hr 'wake-up' period. The movement within the crib is recorded only within the predefined rages for bedtime and wake up time. NANIT algorithms automatically provide an estimate of sleep parameters by estimating sleep or awake states based on movement/stillness as detected by the camera. Similarly, NANIT visit algorithms automatically estimate the number of parental visits throughout the night by detecting a parent entering a predefined 'crib area'. NANIT does not store data if a night has less than 5 hr of sleep during a night. In the current study, only data without any missing values on auto-videosomnography child sleep metrics were used. Besides the limitations not capturing sleep–wake patterns that occur outside of the crib area, there are no false alarms or false signals with Nanit sleep metrics. The derived sleep parameters have been previously demonstrated to be accurate in determining sleep and wake states when compared with actigraphy and polysomnography (Barnett, Glazer, Ivry, Ankri, & Veler, 2019). Auto-videosomnography has been frequently used in recent investigation of infant sleep (Kahn, Barnett, Glazer, & Gradisar, 2021; Kahn & Gradisar, 2021; Schwichtenberg, Choe, Kellerman, Abel, & Delp, 2018). The following variables were used for this study: (a) total nighttime sleep duration (sleep duration); (b) number of awakenings during sleep (NWAK); and (c) the number of parental visits during the night. Participants completed, on average, 12 nights of sleep recordings (*SD* = 3.14). Means from the first to the last night of recordings were used for the analyses.

Ethical considerations

All research participants in Focus group interviews and the online survey provided written informed consent.

Results

Demographic information

The current sample consisted mostly of mothers (68.0%). 88.5% of the respondents were between the

ages of 25 and 40. Demographic information and descriptive statistics of the measures are presented in Table 1.

Item selection

Several analyses were conducted on the initial 45 items to reduce the number of items. Three statistical analyses were used as criteria for item finalization: (a) normality violation; (b) low item-total correlations, and (c) low factor loadings based on factor analysis.

The normality test was performed using kurtosis and skewness because the sample size was greater than 300 (Kim, 2013). One item (7) with kurtosis larger than 2 and skewness larger than 7 was deleted (Curran, West, & Finch, 1996). Nine items (19, 23, 24, 29, 33, 35, 36, 39, 45) were removed by using the cutoff of corrected total-item correlation value (r = .3; Ayvasik & Tutarel-Kislak, 2004; Cristobal, Flavian, & Guinaliu, 2007; Ebrahimi, Samouei, Mousavii, & Bornamanesh, 2013). One more item (16) was also deleted because of low item-total correlation value after deleting the 10 items mentioned above. Subsequently, Bartlett's test of Sphericity was significant (p < .001), and Kaiser–Meyer–Olkin (KMO) measures of sampling adequacy was .939 (>0.5), indicating the sample was adequate and suitable for conducting EFA (Yong & Pearce, 2013). As a result of EFA, 11 items (3, 4, 8, 15, 18, 22, 28, 30, 34, 41, 42) were eliminated because they either had low factor loadings (<.03) or loaded on more than two factors. Based on these criteria, 23 items were finalized. Statistical analysis was conducted using SPSS 26.0 and Mplus (Muthén & Muthén, 2017).

Descriptive statistics and internal consistency of the PUMBA-Q

The final PUMBA-Q included 23 items. Higher scores indicate higher level of misperceptions about child sleep. The mean score of the PUMBA-Q total score was 22.19 (SD = 10.92). Cronbach's alpha value of .86 indicated good internal consistency (Kline, 2013; Nunally & Bernstein, 1978). The item-total correlation coefficients of the items ranged from .30 up to .58 (M = 0.44).

Exploratory factor analysis (EFA) of the PUMBA-Q

The current study used Kaiser criteria to specify a number of factors, which retains factors with eigenvalue greater than or equal to 1 (Kaiser, 1960). The scree plot indicated eigenvalues were 1.443 and 0.962 for four compared to five factors, ultimately indicating an optimal 4-factor model. The 4-factor model fit with 23 items showed significant fit (X^2 = 535.2, p < .001; RMSEA = .039, 90% confidence interval = 0.36–0.43; SRMR = .024). Both

Table 1 Demographic information and socio-demographic status

	n (%) or *M* (*SD*)
Country	
United States	1,121 (78.9)
Canada	208 (14.6)
United Kingdom	38 (2.7)
Others	53 (3.7)
Race	
While/Caucasian	1,119 (78.8)
Asian	119 (8.4)
Hispanic	86 (6.1)
African–American	21 (1.5)
Others	75 (5.28)
Relationship with child	
Mother	966 (68.0)
Father	452 (31.8)
Others	2 (0.1)
Education level	
Less than high school/secondary	2 (0.1)
High school/secondary	96 (6.8)
College/University	771 (54.3)
Graduate	538 (37.9)
Prefer not to answer	13 (0.9)
Income	
More than $200,000	423 (29.8)
$150,000–$200,000	260 (18.3)
$100,000–$150,000	321 (22.6)
$75,000–$100,000	166 (11.7)
Prefer not to answer	129 (9.1)
Others	121 (8.5)
Age (respondent, year)	
25–29	190 (13.4)
30–34	634 (44.6)
35–39	433 (30.5)
40–44	122 (8.6)
Others	41 (2.9)
Sex (Baby)	
Male	753 (53.0)
Female	664 (46.8)
Other	3 (0.2)
Age (baby, month)	12.34 (5.55)
6–12	841 (59.2)
13–24	550 (38.7)
25 and above	29 (2.0)
Parent-report measures	
PUMBA-Q	22.19 (10.92)
MCISQ	24.06 (13.50)
DBAS	3.41 (1.27)
BISQ-R	84.15 (11.77)
ISI	7.37 (5.24)
Child sleep duration (min)	636.42 (90.53)
Child SOL (min)	22.40 (25.86)
Child WASO (min)	25.55 (33.01)
Objective measures (auto-videosomnography)	
Child sleep duration (min)	607.09 (65.79)
Child NWAK	2.77 (1.46)
Number of parental visits	1.11 (1.54)

BISQ-R, Brief Infant Sleep Questionnaire-Revised; DBAS, Dysfunctional Beliefs and Attitudes about Sleep; ISI, Insomnia Severity Index; MCISQ, Maternal Cognition about Infant Sleep Questionnaire; NWAK, Number of awakenings during the night; PUMBA-Q, Parent's Understanding and Misperceptions about BAby's sleep; sleep duration, total nighttime sleep duration; SOL, Sleep Onset Latency; WASO, Wake After Sleep Onset.

CFI (.956) and TLI (.934) were adequate compared to the suggested cutoff value (>.90). EFA was conducted using Geomin rotation, and a 4-factor structure emerged from the final 23 items. The factor loadings of 23 items are presented in Table 2.

Four factors of the scale were labeled: (a) Misperceptions about parental intervention; (b) Misperceptions about feeding; (c) Misperceptions about child's sleep; (d) General anxiety of parents. The first factor (Misperceptions about parental intervention) included items such as 'It is better to sacrifice my sleep than to let my child cry at night (26).' The second factor (Misperceptions about feeding) included item such as 'My child wakes up at night because he or she is hungry (5).' The third factor (Misperceptions about child's sleep) consisted of items such as 'When my child does not sleep at night, I doubt my competence as a parent (21).' The fourth factor (General anxiety of parents) included items such as 'I sleep with my child because I feel anxious (27).'

Convergent validity of the PUMBA-Q

PUMBA-Q and MCISQ total scores showed a positive correlation ($r = .640$, $p < .01$; Table 3), indicating good convergent validity. Correlations between PUMBA-Q scores and subjective/objective measures of infant sleep were evaluated. For subjective reports of infant sleep, PUMBA-Q total scores were significantly associated with child sleep duration ($r = -.250$, $p < .01$), child SOL ($r = .178$, $p < .01$), and child WASO ($r = .198$, $p = .01$), indicating that children of parents who have more misperceptions about child's sleep have worse sleep patterns. The correlations between PUMBA-Q total scores and auto-videosomnography measured child sleep duration ($r = -.242$, $p < .01$), NWAK ($r = .080$, $p < .01$), and the number of parental visits during the night ($r = .261$, $p < .01$) were all statistically significant. The results showed that the associations between parental misperceptions about child sleep and child sleep were found using a video-recording-based new method.

Table 2 Exploratory factor analysis of the PUMBA-Q (23 items)

	Factor loading			
PUMBA-Q (23 items)	1	2	3	4
Factor1. Misperceptions about parental intervention				
Item 13	**.776**	.291	.272	.356
Item 17	**.703**	.254	.134	.213
Item 26	**.699**	.337	.250	.299
Item 32	**.601**	.319	.267	.414
Item 12	**.588**	.283	.404	.470
Item 25	**.533**	.329	.267	.253
Factor 2. Misperceptions about feeding				
Item 5	.338	**.778**	.213	.221
Item 31	.371	**.711**	.256	.312
Item 44	.254	**.550**	.221	.319
Factor3. Misperceptions about child's sleep				
Item 21	.251	.164	**.673**	.288
Item 20	.240	.181	**.580**	.409
Item 14	.427	.334	**.550**	.243
Item 2	.215	.203	**.507**	.456
Item 9	.119	.175	**.463**	.323
Item 10	.255	−.019	**.456**	.246
Item 37	.212	.168	**.406**	.208
Item 38	.149	.269	**.364**	.136
Factor4. General anxiety of parents				
Item 43	.285	.149	.291	**.664**
Item 40	.329	.228	.201	**.624**
Item 27	.246	.217	.307	**.563**
Item 6	.291	.301	.233	**.511**
Item 1	.164	.148	.408	**.499**
Item 11	.332	.148	.362	**.449**

Note: Primary loadings for each variable are in bold.

PUMBA-Q scores and parental sleep

PUMBA-Q scores were positively correlated with ISI scores ($r = .290$, $p < .01$) and DBAS scores ($r = .358$, $p < .01$). Thus, higher level of parental misperceptions of child sleep were associated with higher severity of insomnia symptoms in parents and dysfunctional beliefs and attitudes of the parent's own sleep. Correlates of PUMBA-Q with other self-reported measures are presented in Table 3.

Discussion

The current study developed and validated a questionnaire measuring parental cognitions associated with child sleep. The developed questionnaire, PUMBA-Q, yielded four distinct factors that tapped into important areas of cognition that interfere with the child's sleep. PUMBA-Q scores showed adequate internal consistency and convergent validity, with strengths being that the questionnaire was tested with auto-videosomnography using objective sleep parameters of the child in their own natural environment in addition to parental behavior surrounding their child's sleep at nighttime.

PUMBA-Q as a novel questionnaire for parental cognitions about child sleep

The newly developed PUMBA-Q can be distinguished from previous questionnaires and has the advantage as a new assessment tool for several reasons. PUMBA-Q's item generation process adopting FGI may be one of the strengths of the questionnaire in that each item reflects the caregiver's real-world experience and thoughts. The item development process is distinct from previous questionnaires (e.g., MCISQ), which extract initial items from expert publications (Morrell, 1999). While expert views are informative, including mothers in the process of item development enables researchers to obtain realistic cognitions related to infant sleep.

Another strength of the PUMBA-Q is that the questionnaire does not assume solitary sleeping of the child as a cultural norm and adds a layer of

Table 3 Convergent and discriminant validity of the PUMBA-Q (23 items)

	PUMBA Total	PUMBA Sub1	PUMBA Sub2	PUMBA Sub3	PUMBA Sub4
Demographics					
Baby age in months	−.127**	−.091**	−.281**	−0.022	−0.031
Parental perceive sleep problems	.371**	.247**	.278**	.359**	.217**
Self-report measures					
MCISQ	.640**	.482**	.424**	.523**	.486**
DBAS	.358**	.183**	.169**	.458**	.222**
ISI	.290**	.162**	.172**	.300**	.242**
BISQ-R	−.496**	−.365**	−.313**	−.561**	−.299**
Child sleep duration (min)	−.250**	−.205**	−.198**	−.161**	−.197**
Child SOL (min)	.178**	.144**	.092**	.113**	.198**
Child WASO (min)	.198**	.130**	.202**	.153**	.125**
Objective measures					
Child sleep duration (min)	−.242**	−.253**	−.254**	−.057*	−.198**
Child NWAK	.080**	.066*	.187**	.017	−.005
Number of parental visit	.260**	.260**	.308**	.086**	.156**

Parental perceived sleep problem = a single item from BISQ-R, asking parental perceived severity of child's sleep problems. BISQ-R, Brief Infant Sleep Questionnaire-Revised; DBAS, Dysfunctional Beliefs and Attitudes about Sleep; ISI, Insomnia Severity Index; MCISQ, Maternal Cognition about Infant Sleep Questionnaire; NWAK, number of awakenings during sleep; PUMBA Sub1, Misperceptions about parental intervention; PUMBA Sub2, Misperceptions about feeding; PUMBA Sub3, Misperceptions about child sleep; PUMBA Sub4, General Anxiety of parents; PUMBA Total, PUMBA-Q 23 items total score; sleep duration, total nighttime sleep duration; SOL, sleep onset latency; WASO, wake after sleep onset.
*$p < .05$; **$p < .01$; ***$p < .001$.

inclusiveness regarding parental sleep practices. FGI questions did not intend to persuade parental thoughts or beliefs about co-sleeping. It is reasonable to include parents who live in cultures where co-sleeping rather than infant's solitary sleeping is considered the norm. While PUMBA-Q items were generated with South Korean mothers, MCISQ was developed and validated with a predominantly White sample ($n = 59$). The inclusion of non-Western perspectives in PUMBA-Q may result in differences between the items in PUMBA-Q and MCISQ. Specifically, PUMBA-Q assesses general thoughts about child's sleep in addition to deeply addressing parental underlying specific cognitions related to parenting behavior such as nighttime intervention and co-sleeping. Items such as 'I don't think I should leave my child to cry at night as it will harm them', and 'I am afraid my child might die unexpectedly if I sleep separately with him or her' are examples of asking about reasons of parenting practice of choice. Compared to the PUMBA-Q, the MCISQ focuses on parental ability/difficulty in following parent–child separate sleep practices and minimizing parental intervention during the night.

The culturally inclusive nature of PUMBA-Q should be noted, considering that co-sleeping is not considered the norm of nighttime parenting in many non-western cultures. Parents and child co-sleeping is controversial and often discouraged in Western cultures (Barry & McKenna, 2022), as the American Academy of Pediatrics (AAP) continues to recommend against co-sleeping (AAP, 2011). However, not all medical experts discourage co-sleeping. In the context of controversy on co-sleeping, the possible importance of co-sleeping in relation to parental cognitions about child sleep has not been fully addressed. It is reasonable to speculate co-sleeping may explain important cognitive aspects related to child sleep that have not been formally investigated.

PUMBA-Q's factors on parental anxiety appear to be similar to the MCISQ-safety subscale. However, while the MCISQ-safety subscale evaluates parental fear about child's death, PUMBA-Q attempted to expand this domain to accommodate more general aspects of parental anxiety about child sleep ('I sleep with my child because I'm anxious', and 'The reason my child cries at night is because I did not show him or her enough affection during the day'). General parental anxiety may contribute to strained parental nighttime behavior/interaction with their child as a previous study demonstrated an association between the mother's symptoms of generalized anxiety and challenging parenting behavior and over-involvement (Möller, Majdandžić, & Bögels, 2015). Given the possible linkage between parental anxiety, parenting behavior, in turn, child sleep, considering broader aspects of parental anxiety would enable a deeper understanding of parental cognitions underlying pediatric sleep problems. It is notable that parental worries specifically about child death were not reported by FGI mothers. However, the item was included in the initial 56 items noticing the possible importance of this topic. Indeed, the item showed enough factor loadings from EFA results and therefore included in the final 23 items.

The current study found that the correlation between PUMBA-Q and MCISQ was moderate ($r = .64$). The moderate correlation may indicate that

the two questionnaires access somewhat overlapping constructs, with heterogeneous aspects of parental cognitions on child sleep. Overall, PUMBA-Q is a novel and useful questionnaire, increasing cultural inclusiveness in the research field of pediatric sleep problems and parental cognition. PUMBA-Q is expected to be a good supplementary and broaden the possibility of assessing parental cognitions in the context of pediatric sleep from a different cultural perspective.

Auto-videosomnography as an objective measure of pediatric sleep

Parental cognitions about infant sleep measured by PUMBA-Q showed significant correlations with objective child sleep parameters. Our results verified a significant association between sleep-related cognition and objectively measured sleep using a novel device (auto-videosomnography). To date, most studies used actigraphy to test the association between sleep-related cognitions and objective sleep measures. One study showed that maternal cognitions of emphasizing infant's distress (measured using ISVIS) were associated with actigraphy measured infant night awakening at 6 months (r = .34; Tikotzky & Sadeh, 2009). Another longitudinal study reported significant correlations ($|r|$ = .27–.36) between the MCISQ-limits scale at 12 months and actigraphy measured child NWAK, sleep efficiency, and total sleep time at 4 years old. (Tikotzky & Shaashua, 2012). A similar association found in the current study suggested that auto-videosomnography can be an alternative method for assessing infant sleep. Additionally, significant correlations between PUMBA-Q scores and auto-videosomnography measures add strength to the validity of PUMBA-Q as a useful tool measuring parental cognition which may be closely related to disruption of child sleep. Further studies would be needed to identify mechanisms underlying the relationship between parental cognition and child's sleep.

Association of parental cognitions with child's and parent's sleep

Our results demonstrated links between parental cognitions about child sleep and parental insomnia symptoms. Specifically, higher PUMBA-Q scores were associated with more parental nighttime visits (measured by auto-videosomnography), more frequent nighttime awakenings for the child, higher levels of insomnia severity of the parent, and more dysfunctional beliefs and attitudes toward their own sleep. These results are consistent with previous studies and can be understood in the context of bidirectional nature of parental cognitions and pediatric sleep problems as proposed by transactional model (Sadeh & Anders, 1993).

Using a transactional framework, we can speculate that parental cognitions of child's sleep may also be associated with their own sleep difficulties. Cognitions of parents about child's sleep has shown to be related to parent–child bedtime interaction (Knappe, Pfarr, Petzoldt, Hartling, & Martini, 2020; Tikotzky & Sadeh, 2009). A similar association between parental misperceptions about child's sleep and parental nighttime visits was found in our study. This association can impact parental sleep quality as childcare often disrupts parental sleep opportunity (Bei, Coo, & Trinder, 2015). This may explain the underlying mechanisms between child sleep and parental sleep quality (Eckerberg, 2004; Sinai & Tikotzky, 2012; Tikotzky, Bar-Shachar, Volkovich, Meiri, & Bar-Kalifa, 2022). The directionality of these findings should, however, be interpreted with caution because of the cross-sectional design of this study. Future longitudinal studies will be needed to assess both parental- and child-driven pathways underlying the association between parental cognition, infant sleep, and parental sleep quality.

The results of the current study and supporting evidence suggest the importance of exploring parental cognition to understand the difficulty of initiation and maintenance of pediatric sleep problems. Although future studies would need to closely examine a variety of parental sleep factors and emotions and assess how those factors interact, the findings highlight the possible importance of managing parental cognition as a relevant factor to prevent and improve pediatric sleep problems. Furthermore, given the association between child sleep and parental sleep, the effect of targeting parental cognitions about their child's sleep to improve pediatric sleep problems and parental sleep should be explored.

Limitations

This study has several limitations: (a) It is important to note that parental sleep parameters were not collected in this study. In future studies, parental sleep parameters should be collected to examine direct relationship between parent's cognitions and their sleep. (b) We cannot conclude that parental cognitions caused child's poor sleep or parental nighttime behaviors because this study was correlational and cross-sectional design. (c) The initial items of PUMBA-Q were derived from FGIs in South Korea, but the validation of PUMBA-Q was conducted with the predominantly Caucasian sample. There might be cultural differences in child's sleep-related cognitions between two samples because cultural beliefs can lead differences in parental expectations and perceptions of infant sleep (Mindell et al., 2010). Despite this point, PUMBA-Q showed good validity in our sample. Further research on validating PUMBA-Q with diverse cultural backgrounds will demonstrate the adaptability of PUMBA-Q to different cultures. (d) The sample of

the study might be biased as the participants in this study, users who are able to afford commercial auto-videosomnography devices, were mostly highly educated Caucasians. This highly educated population may have more opportunities of gaining accurate and quality information about infant sleep and parenting practice. This may lead to disparities in infant sleep knowledge based on affiliated subgroups. Thus, the questionnaire needs to be tested on a wider and more diverse sample. (e) Test–retest reliability was not tested in the current study.

Implications

Despite several limitations, the PUMBA-Q is a valid assessment evaluating parental misperceptions about child's sleep with four main factors consisting of misperceptions about parental intervention, feeding, child's sleep, and general parental anxiety. PUMBA-Q has cultural importance as well, bringing up the possibility of assessing and intervening on parental cognition to manage pediatric sleep problems and improving cultural inclusiveness in the field of parenting and infant sleep care.

The inclusion of auto-videosomnography is also an important strength of the current study. The utility of auto-videosomnography is fourfold: (1) Automatic algorithms that provide objective data about infant sleep; (2) Auto-videosomnography takes an algorithmic approach similar to actigraphy, but movement of the entire body is quantified rather than wrist or ankle movement alone (Kahn et al., 2022); (3) Use of non-invasive methods to access infant sleep, and thus minimizing discomfort in the natural environment, increasing ecological validity; (4) Being able to measure parent's nighttime visits, which may be relevant to implementation of sleep interventions for the child. Although this measure is also limited by not capturing sleep–wake patterns that occur outside of the crib, overall, measuring infant sleep through auto-videosomnography could potentially provide more information beyond parental reports and compensate for the possible discrepancy between parental recognition and actual sleep.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1. Summary of the initial PUMBA-Q 45 items.
Appendix S1. Parental understanding and misperceptions about BAby's sleep- Questionnaire.

Acknowledgments

The authors gratefully acknowledge funding from the Sungshin Women's University (Project No. H2020053). The authors have declared that they have no competing or potential conflicts of interest.

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Key points

- Parental cognition is an important factor associated with pediatric sleep problems.
- PUMBA-Q was developed to be a culturally inclusive measure of parental cognition.
- Associations between parental misperceptions about child's sleep and parental nighttime visits were found in our study, and higher frequency of nighttime visits was positively related to the number of awakenings of the child measured by auto-videosomnography. This association can impact parental sleep quality as childcare often disrupts parental sleep opportunity.
- We found that PUMBA-Q has adequate psychometric properties and significant association with child sleep and parental nighttime behaviors using auto-videosomnography.
- Our findings add importance to focus more on assessing and intervening on parental factors to manage pediatric sleep problems.

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Accepted for publication: 24 February 2023