A PILLOW MADE OF LOVE AND INNER SAFETY IN MOMENTS OF DEVELOPMENTAL CHANGE: ATTACHMENT INTERNAL WORKING MODELS AND SLEEP QUALITY IN PRESCHOOL AND PREADOLESCENT CHILDREN

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Resumo

O sono é um fenómeno de importância capital na vida humana. Essa asserção é substanciada pelo facto de as crianças, nos primeiros anos, passarem mais de metade do tempo a dormir. Uma vez que o sono das crianças é altamente regulado pelos pais e que as relações de proximidade estabelecem sentimentos de segurança que, por sua vez, favorecem a transição para o sono, o estudo conjunto da vinculação e do sono na infância surge como um assunto de relevância científica.

O primeiro estudo consistiu numa revisão sistemática, que teve o objetivo de integrar os principais resultados da investigação dedicada à relação entre a vinculação e o sono na idade pré-escolar. Foram incluídos 7 estudos (N = 2,344 crianças). A sua análise revela resultados inconsistentes, em estudos caracterizados por uma variedade de instrumentos para avaliar a vinculação e o sono, o os torna difíceis de comparar. Os resultados são discutidos no contexto das potencialidades de cada instrumento à luz dos modelos teóricos existentes.

O segundo estudo teve como objetivo comparar dois dos instrumentos mais utilizados em investigação sobre o sono em Psicologia do Desenvolvimento: a atigrafia e o relato parental (CSHQ). Os participantes foram 46 crianças, entre os 3 e os 6 anos, e os seus pais. Os resultados sugerem uma baixa concordância entre os diferentes métodos, com os pais consistentemente a relatar horários de sono mais precoces, maiores durações totais de sono e menos despertares noturnos que o atígrafo. Contudo, o questionário fornece importantes indicadores comportamentais sobre o sono que não são captados pela atigrafia. Assim, o estudo discute as vantagens de um uso complementar de medidas objetivas e de autorrelato.

O terceiro estudo analisa as relações entre modelos internos dinâmicos de vinculação e o sono avaliado por atigrafia e relato parental em crianças de idade pré-escolar. Além disso, explora o efeito moderador de variáveis sociodemográficas parentais, como a idade, a educação e o número de horas de trabalho dos pais. Participaram no estudo 43 crianças (média de idade = 4 anos e 11 meses) e os seus pais. Os resultados revelam associações significativas entre a vinculação e o sono, em função de variáveis como a idade do pai e a educação da mãe.

O quarto estudo investiga o efeito mediador da qualidade do sono na relação entre representações de vinculação, e auto perceções de bem-estar na pré-adolescência. Participaram no estudo 258 crianças (média de idade = 11.19). Os resultados sugerem que a qualidade do sono, em parte, explica a associação entre as representações de vinculação a ambos os pais e a perceção dos pré-adolescentes sobre o seu bem-estar.

Considerados em conjunto, os estudos afirmam os benefícios de uma avaliação complementar do sono através de medidas objetivas e subjetivas (estudos 1, 2 e 3); e sugerem que a segurança da vinculação se associa à qualidade do sono (estudos 1, 3 e 4), que essa associação pode ser distinta para crianças diferentes (estudo 3) e ter efeitos noutras dimensões do desenvolvimento, como o bem-estar (estudo 4).

Abstract

Sleep is a phenomenon of capital importance in human life. This assertion is substantiated by the fact that children, during the first years, spend more than half of their time sleeping. Since a child's sleep is highly regulated by the parents, and close relationships help establish feelings of safety that, ultimately, favour transition to sleep, the joint study of attachment and sleep arises with scientific relevance.

The first study consisted of a systematic review, to integrate the main results of attachment and sleep research in preschool age. Seven studies were included (N = 2,344 children). Their analyses reveal inconsistent findings, in studies characterized by a variety of attachment and sleep assessment instruments, making them difficult to compare. Results are discussed in the context of each instrument's potentialities, considering existing theoretical models.

The second study had the goal of comparing the two more used instruments in developmental sleep research: actigraphy and parental report (CSHQ). Participants were 46 children, aged between 3 and 6 years, and their parents. Results suggest a low agreement rate between the methods, with parents consistently reporting earlier bedtimes, longer sleep durations and fewer night-wakings than the actigraph. However, the questionnaire provides important behavioral indicators not captured by actigrapy. Thus, the work discusses the benefits of the complementary use of objective and self-report measures.

The third study analyses the relationship between attachment internal working models and sleep, assessed by actigraphy and parental reports, in preschool-aged children. Moreover, it explores the moderation effects of parental sociodemographic variables, such as age, education and working hours. Forty-three children (mean age = 4 years, 11 months) and their parents participated in our study. Results reveal significant associations between attachment and sleep, as a function of variables such as the father's age and mother's education.

The fourth study investigates the mediation effect of sleep quality in the relation between attachment representations and self-representations of well-being in preadolescence. The participants were 258 children (mean age = 11.19). Results suggest that sleep quality partly explains the association between attachment representations about both parents and preadolescents' perceptions of their well-being.

Taken together, our studies affirm the benefits of a complementary assessment of sleep through objective and subjective measures (studies 1, 2 and 3); and suggest that attachment security is associated with sleep quality (studies 1, 3 and 4), and this association may be distinct for different children (study 3) and translate in significant effects in other developmental dimensions, such as well-being (study 4).

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Chapter I:

Introduction and overview

Where billow meets billow, then soft be thy pillow
Ah, weary wee flipperling, curl at thy ease!
Asleep in the arms of the slow-swinging seas.

- Seal Lullaby, Eric Whitacre

Introduction and overview

Ancient myths, local legends, child fairy tales, and lullabies over the course of time had beheld sleep as a quiet and languid state, creating corresponding images in the collective imagination. Notwithstanding, contemporary scientific insights now suggest that sleep should not be regarded as a calm and simple rest state. In all evidence, sleep biology and psychophysiology pinpoints it as extraordinarily active and complex, translating from the beginning into profound implications in physical and emotional development. Since the human baby still has a long maturational way to go, particularly regarding the brain and nervous system, and many of these developmental processes occur during sleep, this alone could help demystify why young children spend more time sleeping than being involved with the outside world.

The twofold influences between sleep and brain development are extensively documented in the literature as parallel and mutually influencing transformations (see Lokhandwala & Spencer, 2022 for a review). For example, the maturation of the pineal body, which secrets melatonin that, in turn, induces sleep in rhythms aligned with the light-dark cycles, links to the evolving of sleep-wake patterns throughout life (Crowley et al., 2006; Haimov et al., 1994). Besides, dramatic growth in synaptic number and connectivity also occurs by large during sleep, and it has been reported to be bound to the reduction of REM sleep duration across the first three years of life (Roffwag et al., 1966). However, the impacts that sleep exerts on child development go far beyond biological aspects, extending across all developmental directions. As such, indicators of troubled sleep have been consistently associated with less-than-ideal child outcomes, while healthy sleep usually predicts better outcomes (see Astill et al., 2012 for a meta-analysis, and Reynaud et al., 2018 for a systematic review). Moreover, good enough sleep quality seems to play a role as a protective moderator in the effects that risk factors such as the presence of traumatic stress, anxiety, or low socioeconomic status exert in diverse developmental outcomes (e.g., Adams et al., 2022; Mesman et al., 2021; Wetter et al., 2020).

The indisputable relevance of sleep in every developmental domain throughout life has led investigators to try and clarify what exactly characterizes healthy sleep (El-Sheikh et al., 2019; Sawyer et al., 2019), as well as the conditions that foreshadow it. However, the scientific dialogues at times become bewildered by the diversity of meanings that the word *sleep* portrays in developmental sleep research – e.g., duration, efficiency, fragmentation, and schedules (El-Sheikh & Buckhalt, 2015). Delimitating a definition that can be simultaneously succinct and complete enough can be hard, particularly considering that sleep is a multifaceted phenomenon. Buysse (2014) defined sleep health as a "multidimensional pattern of sleep-wakefulness, adapted to the individual, social, and environmental demands, that promotes physical and mental well-being" (p. 12), underlying sleep quality's subjective nature. The author then defines sleep quality based on the following key indicators: (1) satisfaction, (2) sleep timing, (3) sleep duration, (4) sleep efficiency, and (5) daytime alertness. Satisfaction (1) with one's sleep consigns the subjective gratification derived from feeling well rested after reparative sleep (e.g., Putilov, 2018). However, by depending entirely on the reporter's interpretation of their own sleep, satisfaction has been pointed out as the most difficult indicator to assess especially in young children (Meltzer et al., 2021). Sleep timing (2) is defined as the placement of sleep within 24-hour period. Among preschool-aged children, later bedtimes predict health issues, such as excessive weight gain (Moreno et al., 2022; Skjåkødegård et al., 2021), depressive symptoms (Ojio et al., 2020) and risky substance consumption in adolescence (Hasler et al., 2017). Sleep duration (3), in turn, is outlined as the total amount of sleep obtained during the 24-hour period and has been one of the most extensively studied sleep variables in the early years (e.g., Córdova et al., 2018; van Veen et al., 2022; Zhang et al., 2021a). The reason inherent to this research focus on sleep duration might be that sleep needs to last for a minimal number of hours in order to be restorative and healthy. Research findings, likewise, show that shorter sleep durations associate with overweight (Zhang et al., 2021b), poor receptive vocabulary (Seegers et al., 2016), lower emotional maturity and prosocial behaviors (Tso et al., 2016, and higher odds of externalizing behaviors (e.g., Scharf et al., 2013). Conversely, increased sleep durations seem to contribute to the reduction of emotional and behavioral problems (Zheng et al., 2021). Sleep efficiency (4) is usually defined as the proportion of time asleep to time in bed during a sleep episode, thus being decreased by long sleep latencies and night-wakings that occur frequently and last in duration, in the case of night sleep. Children who sleep more efficiently show better academic achievements (Diaz et al., 2017), higher levels of emotional knowledge (Vaughn et al., 2011), less negative interactions with peers (Vaughn et al., 2015), and fewer externalizing symptoms (Bélanger et al., 2018). The last dimension, daytime

alertness (5), corresponds to the degree to which the individual experiences pressure to sleep during the day, and it has been shown to impact daytime functioning (e.g., Cerasuolo et al., 2016). Recently, Meltzer and colleagues (2021) added sleep-related behaviors as a broader category of behavioral factors that are thought to promote sleep, such as bedtime routines.

Considering that sleep, as much as all child development, is highly sensitive to every influence emerging from the surrounding contexts and environments, over which the child has minimal control (Meltzer et al., 2021), the theoretical perspective guiding the present work is based on the systems perspective of sleep and development introduced by El-Sheikh and Sadeh (2015). This framework is itself grounded on the ecological systems theory (Bronfenbrenner, 1979; Bronfenbrenner & Ceci, 1994) and on the transactional systems model (Sameroff, 1989, 2000; Sameroff & Fiese, 1990) adapted to sleep (Sadeh & Anders, 1993). The systems perspective (El-Sheikh & Sadeh, 2015) conceptualizes the dynamic interconnections and mutual impacts between the child and her evolving development contexts, according to their level of influence in sleep regulation. The first and more proximal context pertains to the *child* and comprehends the range of internal characteristics or factors that can influence sleep regulation in children. This includes, for example, brain maturation processes that lead to changes in sleep cycles (e.g., Lokhandwala & Spencer, 2002), motor development (e.g., Scher & Cohen, 2015), the presence of chronic or acute physical illness (e.g., Allen et al., 2016), as well as other sources of physical soreness than can impact sleep. Child constitutional dispositions, such as temperament (e.g., Bastien et al., 2020), as well as psychological aspects, like the onset of separation anxiety during the second half of the first year of life (e.g., Schlarb et al., 2016), can also affect sleep onset and continuity. The second level of influence is labelled as *immediate context*, where children's parents or preferential caregivers play a central role in regulating a child's sleep needs, habits, and routines. Thus, all the parent-related variables that potentially interfere with the child's psychological state, routines, or environment are considered (see Tikotzky, 2017 for a review). Child-related and sleep-related parental cognitions (e.g., Cook et al., 2022), parental psychosocial functioning (Bernier et al., 2013), psychopathology (e.g., Hamilton et al., 2020), and marital satisfaction (e.g., Keller & El-Sheikh, 2011) are some examples of *immediate context* factors that can impact child's sleep. The larger *social context* comprises more distal influences, such as the school environment with all its requirements and challenges (e.g., demands for alertness and attention), school caregivers, peers/friends, parental working hours, and income. The *broader cultural context*, in

turn, impacts sleep more indirectly on, since it shapes people's perceptions, norms, and expectations about sleep.

According to the theoretical understanding earlier advanced by Sadeh and Anders (1993) on their transactional systems model of sleep-wake regulation, the dynamic relations between the child's developmental contexts and sleep are mediated by the sphere of parent-child interactions and relationships. This suggestion may be particularly relevant when the sleep of young children is under consideration since sleep regulation necessarily emerges in the heart of a relational space where the child's fears and wishes are communicated to the parents/caregivers and welcomed by them. In all living species, sleep compels an essential loss of awareness and responsiveness to the external environment, limiting both perception and responses to potential external threats (Dahl, 1996). It is then imperative that one can peacefully decrease external awareness, in a calm and unthreatening environment, so as to fall asleep. Somehow conflicting, especially western societies, sleep usually involves being alone in the dark, two conditions described as natural clues to potential danger, carved in the human biological repertoire as activating stimuli (Bowlby, 1973). The young child is then faced with the challenging demand of falling asleep under conditions of darkness and aloneness to which humans and other animals are biologically predisposed to react with fear.

In terms of evolution, conditions of safety, essential to the threat of being caught by predators, were primarily attained through belonging to a protective social group (McKenna & Mack, 1992). Along these lines, it is plausible that the human brain has developed "under conditions in which the sense of social belonging and social connectedness formed the underpinnings of safety" (Dahl & Lewin, 2002, p. 176), turning social and emotional cues into critical hints generating feelings of safety that support sleep.

In the repertoire of human relationships, attachment to a preferential caregiver is the one that is most tightly associated with the survival of the individual and with the consolidation of feelings of safety, since its main function is assuring proximity between a vulnerable, immature child and a protective caregiver (Bowlby, 1969/1982, 1973, 1980). According to the theory of attachment, the child is predisposed to establish a deep strong attachment tie with one or few sensitive and responsive preferential caregivers, to whom she can turn when feelings of uncertainty, related to real or imaginary dangers, arise. The consistency of early experiences of care, while the child, faced with threats, receives adequate and comforting responses from the caregiver, consolidates secure representations of the attachment relationship, as soon as the

child is developmentally and cognitively capable of forming mental representations. Those secure representations shape to a large extent the how the child perceives the world as a safe place where, in case some threat arises, someone will be available to protect her.

As follows, it is expected that children with secure internal representations of attachment are at an advantage, regarding sleep regulation, compared to insecurely attached children. Insecure attachment representations emerge in the context of inconsistent or inadequate caregiving, in which the caregivers' responses leave the child unsure that she will have her needs for relatedness and help facing dangers met. For these children, then, it might be harder to handle night-time separations, possibly leading the child to delay them or to interrupt sleep more often, to re-establish contact with the caregivers. This theoretical relations between attachment and sleep configured the point of departure to the present work, which has the general aim of clarifying how attachment and sleep relate.

As such, the first study constituted a systematic review guided by the goal of gathering empirical data from previous research that tried to uncover the relations between attachment and sleep during preschool age. This study embodies a comprehensive effort erected around three vectors. The first one is anchored in the need to find empirical support for the aforementioned theoretical claims about the inner sense of safety provided by attachment relationships playing a role in bedtime behaviors and sleep quality. Empirical evidence grounded in solid theoretical statements is of utmost importance to move toward the constitution of a theory of attachment and sleep. The second vector comprises a reflective intention about the nature of the phenomena under consideration, in articulation with the instruments that allow us to assess them. Attachment relationships have been assessed through a wide range of observational and representational measures (see Farnfield & Holmes, 2014). The Strange Situation Procedure (Ainsworth et al., 1978) is considered the gold standard of observational methods for assessing attachment patterns by creating a novel environment to observe the dynamic balance between the attachment system and the exploratory system in infants following two brief separations from their mothers (Farnfield & Holmes, 2014; Teti & Kim, 2014). By confronting the child with these situations, the Strange Situation Procedure allows access to the infant's expectations, based on previous experiences, about the mother's responses to child distress. Differently, the Attachment Q-Sort (Watersn & Deane, 1985; Waters et al., 1995) was designed to assess attachment security based on the quality of the young child's secure base behavior in a familiar environment. Representational measures are preferred when the child is verbally capable of communicating her internal working models of

attachment, which content was described to influence the child's behavior towards others, as well as the child's capacity to resolve emerging psychosocial adaptations (Bowlby, 1973). As distinct age periods involve differential manifestations of the attachment phenomenon, it is only fair that the instruments available to assess it can accompany transformations in the organization of attachment across development.

As much as there is a huge variety of attachment measures, the same applies to sleep, with the further obstacle that sleep is hard to define, once it wraps up a multiplicity of neural, physiological, and behavioral phenomena (Sadeh, 2015). Adding to the above-mentioned lack of consensus regarding the definition of good sleep quality, Sadeh (2015) affirms that the answer to this question is dependent on the developmental issue under consideration. It follows that relevant sleep parameters may emerge as meaningful when considering attachment relationships' impacts on sleep that are different when the focus is posed in different developmental matters. However, it has not yet been understood how the qualitative differences among attachment measures can manifest in attachment and sleep research, in interaction with the diversity of sleep parameters that sleep research has been relying on. The first study then proposes to dig deeper into this debate. The last structuring vector of the systematic review was the intent to identify the limitations of the present research to guide the future investigation.

Also important for advancing research in attachment and sleep is to carefully consider and reflect comprehensively upon the dimensions of sleep that different sleep assessment tools can measure. Nowadays, researchers can count on an immense array of sleep assessment methods that range from those typically objective and centered on brain activity indicators (e.g., polysomnography) to those based on subjective perceptions regarding sleep and sleep-related behaviors (e.g., sleep questionnaires). A multi-method approach is valued in developmental research, so it is very common for researchers to combine different sleep assessment methods in the same research protocol (Koopman-Verhoeff et al., 2019; Ordway et al., 2020; Wescott et al., 2019). It should then be a research priority to compare the nature of the information collected by distinct sleep assessment tools, to better document their strengths and limitations. Drawing on this issue, the second study exclusively focused on sleep and sleep assessment, with the aim of comparing two distinct and very often used instruments in developmental sleep research: actigraphy and a sleep problems questionnaire (*Children's Sleep Habits Questionnaire*; CSHQ; Owens et al., 2000).

Actigraphy is a wristwatch-shaped device that, through an incorporated mechanism of activity monitoring, collects objective sleep data for continuous time periods. Otherwise, parental-reported sleep questionnaires are a useful tool through which parents can describe some of the sleep parameters recorded by actigraphy (e.g., sleep schedules, duration, night-wakings), but more typically they provide information on sleep patterns, sleep problems (insomnia, night terrors, snoring, bruxism, etc.), sleep context, and sleep-related behaviors (Sadeh, 2015). Given that both instruments are relevant to child sleep research, we established two principal aims for our second study. The first one was to evaluate agreement rates between actigraphy and parental perceptions of quantitative parameters of child's sleep (i.e., sleep schedules, duration, and night-wakings duration). Since actigraphy provides reliable data regarding the estimation of the mentioned sleep parameters (Ancoli-Israel et al., 2003; Meltzer et al., 2012), we intended to evaluate to what extent a retrospective questionnaire is able to provide information on specific sleep parameters. Although actigraphy has many considerable advantages in sleep assessment, it is also a limited method when it comes to evaluating behavioral sleep dimensions. Thus, for our second goal, we explore the associations between objective sleep parameters and behavioral dimensions of sleep, aiming to expand knowledge about the behavioral manifestations accompanying specific sleep parameters.

The third study's underlying assumptions are strongly rooted in the theoretical contributions of the transactional model of sleep-wake regulation (Sadeh & Anders, 1993) and of the systems perspective (El-Sheikh & Sadeh, 2015), as it throws light on some parental factors that ward off from the child's immediate context: mother's and father's ages, education levels, and the number of working hours. As long as young children are not usually aware or capable of attributing meaning to distal factors as the abovementioned, it is possible that such influences impact sleep development indirectly, through parental interactions with the child (Tétreault et al., 2021). Research findings do support this hypothesis, by showing that diverse sleep dimensions' trajectories – such as sleep duration (e.g., Plancoulaine et al., 2018), night-wakings (Weinraub et al., 2012), and sleep problems (Williamson et al., 2019) – are predicted by some distal parental factors – as maternal education or employment status (Kocevska et al., 2017; Plancoulaine et al., 2018) and family income (Weinraub et al., 2012). As such, the third study aims to explore the role of parental distal factors (age, education, and working hours) as moderators of the associations between attachment representations and sleep parameters, based on the supposition that these relations might differ depending on the presence of moderators. By exploring the moderation role of parental sociodemographic variables in the associations

between attachment and sleep, this study proposes to advance knowledge in the identification of parental factors that associate to individual differences in child's sleep.

Our focus on preschool age across the first three studies is rooted in the several developmental changes that occur during this period, posing new challenges to the child regarding attachment relationships, social development, and sleep regulation. As children transition from early daycare to preschool, they undergo their first real experiences with group-based learning and interactions (Goodrich et al., 2015) in an environment that propitiates challenges to child development in the context of a myriad of learning and playing opportunities (Chien et al., 2010; Goble et al., 2016). The child must balance the fact that she needs to share the teacher's attention with other children with the need to master inhibitory control and cooperate in classroom rules. Although these are not simple demands for a young child, development marches at an appropriate pace to provide the child with the tools she needs.

Among the developmental transformations that occur during preschool age, there are signs of progress in the child's locomotor capacities, communication skills (Marvin et al., 2016), behavior, and emotion regulation (Blair, 2002; Lin et al., 2003; McClelland & Morrison, 2003). By 3 years old, the child's motor development allows her to progressively embrace much of the responsibility in regulating proximity to the attachment figure and balancing it with her wishes for richer and longer exploratory excursions away from the caregivers (Marvin et al., 2016). Simultaneously, the child's communication skills are gradually more sophisticated, improving the range of interactive possibilities, as the child is becoming capable of recognizing, understanding, and expressing a variety of feelings and emotional experiences, as well as understanding the other's inner states (Hughes & Leekham, 2004). The wonders of growing up and engaging in a never-ending world of novelty, however, are likely to confront the child with new difficulties, since there is still a long way to go in developing self-protection capabilities. As such, the attachment system seems to adapt to the ongoing developmental changes, with the emergence of a goal-corrected partnership around age 4 (Bowlby, 1969/1982). Although the child becomes increasingly less dependent on physical proximity and contact with their caregivers to maintain a sense of safety, close relationships are still central to supporting exploration and providing emotional support in response to emerging threats and fears.

Those new challenges the child faces during preschool years, along with an improved capacity for distinguishing between reality and fantasy, may be in part responsible for the appearance of some fears, particularly night-related fears (Zisenwine et al., 2013). Around two

thirds of children between 4 and 12 years of age experience night-time fears related to nocturnal separation, darkness, sleep, and nightmares (Gordon et al., 2007; Muris et al., 2001). These fears possibly represent potential triggers to the attachment system as well.

Changes across preschool age regarding sleep regulation are well documented and pertain to an essential increase in sleep quality and efficiency (Acebo et al., 2005; Scholle et al., 2011) along with a reduction in sleep duration (e.g., Acebo et al., 2005; Tétreault et al., 2019), nap duration (Acebo et al., 2005; Iglowstein et al., 2003; Ward et al., 2008) and night-wakings' duration (Acebo et al., 2005). As the child becomes more self-sufficient regulating her behaviors and emotions, preschool years are critical for the establishment of sleep hygiene habits and bedtime routines (Ward et al., 2008). Therefore, understanding the role played by child-parent attachment is crucial to comprehend sleep phenomena in preschool-age period.

Last, the fourth study extends beyond preschool age, focusing on late middle childhood or preadolescence, another period of great developmental change. The transition to adolescence is an especially delicate developmental period regarding sleep regulation, due to many physical, psychological, and social changes children experience at that time. Some studies suggested that a delay in melatonin release, accompanying the onset of puberty, is responsible for the establishment of later bedtimes (Carskadon et al., 1997; Waldhauser & Steger, 1986). This is congruent with some posterior empirical evidence for a progressive delay in bedtimes starting in late middle childhood (e.g., Laberge et al., 2001). Later bedtimes, associated with early school start times and around 40% less sleep time spent in slow-wave restorative sleep (Carksadon et al., 1980) contribute to higher levels of daytime sleepiness. Besides biological development, cognitive advances pose children more vulnerable to worries, anxieties and ruminations that contribute to hyperarousal which, in turn, leads to delays in sleep onset and wakes after sleep onset (Harvey, 2002; Riemann et al., 2010). Moreover, the desire for independence, investment in extracurricular activities (Carskadon et al., 1998) along with the expansion of the social world and the use of electronic media to communicate with friends before sleep (Moore & Meltzer, 2008) and less parental monitoring of sleep routines (Russo et al., 2007), can also have an impact in sleep quantity and quality.

Challenges to attachment relationships emerge in this age period too, deriving from a need for adjustment in response to new developmental demands (Parrigon et al., 2015). The expansion of the social world, in all its seductiveness and interest, is a striking feature of late middle childhood development. As new wishes for autonomy emerge, children spend more time

away from the parents and trade them by friends and peers as playmates (e.g., Seibert & Kerns, 2009). Simultaneously, children are progressively more able to regulate emotions (Parrigon et al., 2015; Raikes & Thompson, 2005), which enables them to spend more time in exploratory activities as the goal of the attachment system shifts from proximity to the attachment figures to their availability (Ainsworth, 1990). However, parents are still the preferred attachment figures (Kerns & Brumariu, 2016). The wishes for autonomy may be hard to balance with the persisting wishes for proximity, so the child-parent dyads must need to adapt and renegotiate the mutually accepted levels of proximity and autonomy, a new balance for secure base and safe haven support (Kerns et al., 2015).

Since sleep has been related to several indicators of well-being (El-Sheikh & Arsiwalla, 2010; El-Sheikh et al., 2019; Gustafsson et al., 2016; Hestetun et al., 2018; Lo et al., 2018; Lunsford-Avery et al., 2022) and attachment has been shown to play a role in sleep quality and quantity, sleep (Adams et al., 2014; Simard et al., 2017), it is possible that sleep acts as a mediator in the relation between attachment and well-being. The aim of the fourth study was then to investigate how self-reported sleep mediates the associations between attachment to mother and father, separately, and child well-being, an important factor influencing important developmental outcomes, such as prosocial behavior (Reinhardt et al., 2020), mental health (Bell et al., 2019), academic achievement (Bortes et al., 2021) and self-esteem (Holzer et al., 2022).

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Chapter II:

A systematic review on attachment and sleep at preschool age

Chapter based on:

Perpétuo, C., Diniz, E., & Veríssimo, M. (2021). A systematic review on attachment and sleep at preschool age. *Children, 8* (10), 895. https://doi.org/10.3390/children8100895

Abstract

Sleep is a biological process that impacts nearly every domain of a child's life. Sleep-wake regulation influences and it is highly influenced by developmental variables related to parent-child relationships, such as attachment. The main goal of the present systematic review is to analyze and integrate the findings of empirical studies investigating the relations between attachment and sleep in preschool age, a period marked by important developmental changes that challenge both attachment system and sleep-wake regulation. A database search was performed using a combination of relevant keywords, leading to the identification of 524 articles. Nineteen manuscripts were assessed for eligibility and, finally, seven studies (2,344 children) were included. Overall, the findings were not consistent, with some studies reporting significant associations between attachment security and sleep quality, as well as between attachment insecurity and sleep problems, whereas others did not find significant associations. The results are discussed in light of the available theoretical models and integrated in the context of measurement approaches to attachment and sleep heterogeneity, aiming to guide future research on the topic.

Keywords:

Attachment; Sleep; Actigraphy; Parental reports; Preschool age

The storm shall not wake thee, nor shark overtake thee
The moon o'er the combers looks downwards to find us at rest

- Seal lullaby, Eric Whitacre

Introduction

Sleep is a relationally guided biological process, with implications in nearly every domain of child development, holding a core place in every child's life. During early infancy and preschool age, children spend approximately half of their time asleep (Galland et al., 2018; Galland et al., 2012; Iglowstein et al., 2003), suggesting that sleep may be particularly important during periods of greater plasticity, playing a role in neuronal maturation and development (Dahl, 1996; Gómez & Edgin, 2015; Page et al., 2018). However, the influence of sleep in child development goes far beyond biological processes, impacting the child's health and well-being (Matricciani et al., 2019), cognitive and behavioral functioning (Reynaud et al., 2018), affect regulation (Dahl, 1996), and social competence (Foley & Weinraub, 2017; Tomisaki et al., 2018; Vaughn et al., 2015).

Despite the importance of sleep in multiple domains of child development, sleep disorders are highly common, occurring in 20 to 50% of children at some point of their development (Du Mond & Mindell, 2011; Owens, 2007) and persisting through subsequent years in 8.5 to 12% of the cases (Gregory et al., 2005; Simola et al., 2012). Sleep problems may uncover a health issue, considering their associations with negative physical (Simola et al., 2012) and mental health outcomes (Armstrong et al., 2014), pointing to bidirectional links between sleep and health variables. Sleep problems also relate to greater internalizing and externalizing behavioral problems, both concurrently and longitudinally (Conway et al., 2017; Lam & Chung, 2017; Sivertsen et al., 2015), social-emotional problems (Hysing et al., 2016; Jung & Jin, 2019), and poorer executive functioning (Nelson et al., 2015). Given the high prevalence of sleep problems during early childhood and its detrimental impact in child development, efforts have been made in order to expose the factors that influence child's sleep. As such, Sadeh and Anders (1993) theorized the transactional model of sleep-wake regulation (Anders, 1994; Sadeh & Anders, 1993; Sameroff, 1989; Sameroff & Fiese, 1990), conceptualizing how sleep both influences and is influenced by the characteristics of child's developmental contexts, such as culture, environment, and family relationships. According to this model, infant sleep regulation has a dynamic bidirectional relation with: (a) distal

determinants that shape the parent context, affecting infant's sleep secondarily (e.g., cultural and socioeconomic influences); (b) intermediate factors (e.g., parental health, personality, cognitions, and expectations about childhood and sleep); and (c) proximal influences (e.g., infant biomedical and constitutional factors, such as temperament and physiological reactivity, as well as specific parenting interactions) (Sadeh & Anders, 1993). The authors also emphasize the role of child-parent dyadic relationships, particularly attachment, mediating the relations between sleep and the referred contexts during the first years of life. However, given the lack of associations between attachment and sleep before 2 years of age (Simard et al., 2017), possibly due to a high intra-individual variability in sleep patterns, we decided to focus this review on preschool children (2 to 5 years old).

As going to bed constitutes a separation between child and parents, which is frequently experienced with anxiety, and one of the functions of the attachment system is to provide security to the dyad in times of distress, sleep is proposed to act as a trigger to the attachment system. Given the importance of attachment relationships in sleep regulation, the current review will focus on the interpersonal system of the transactional model of sleep-wake regulation. Some theoretical explanations about the connection between attachment and sleep, derived from this model, will be detailed next.

Attachment and sleep

Attachment relationship is conceptualized as the enduring and stable emotional bond between the child and the caregiver, ensuring the latter's proximity in threatening or stressful situations, to provide physical and psychological security to the child (Bowlby, 1969/1982, 1973, 1980). As the child experiences her caregivers as warm, sensitive, and consistent in meeting her needs, or rather as cold, unsupportive, and unpredictable, a secure or insecure attachment is formed correspondingly. Secure attachment bonds relate to better developmental outcomes, such as higher rates of executive functioning (Bernier et al., 2015; Heikamp et al., 2013; Matte-Gagné et al., 2018), language development (Murray & Yingling, 2000), emotional understanding (Zeegers et al., 2019), social competence (Murphy & Labile, 2013; Veríssimo et al., 2014), and resilience (Rasmussen et al., 2019). In turn, insecure attachment relationships are related with less optimal developmental outcomes, such as increased risk of developing disease (Maunder & Hunter, 2008), delayed development of discourse (Kelly, 2015), and socio-

emotional difficulties, measured both cross-sectionally and longitudinally (Cooke et al., 2016; Priddis & Howieson, 2012; Spruit et al., 2020).

The attachment system and sleep-wake regulation have been subject to a considerable amount of theoretical and empirical work that has been trying to reveal how these systems may relate (Anders, 1994; Dahl, 1996; Keller, 2011; McNamara et al., 2003; Morrell & Steele, 2003; Sadeh & Anders, 1993). Some conceptual and theoretical explanations for the relations between attachment and sleep have been advanced and grouped into four distinct models (Keller, 2011). The first one suggests that behaviors expressing symptoms of sleep problems are, underneath, attachment behaviors in reaction to night-time separations (Anders, 1994; Sadeh & Anders, 1993; Scher, 2001). In light of this model, bedtime resistance could be an expression of separation anxiety, while nocturnal wakings would work as a mechanism of proximity seeking directed towards the attachment figure. The second model theorizes sleep problems as a consequence of attachment insecurity. Fears and worries related to bedtime separation can then compromise a child's capacity to relax and downregulate – both physiologically and psychologically – in order to fall asleep (Dahl, 1996; Morrell & Steele, 2003). Conversely, the third model emphasizes the opposite direction, proposing that sleep problems may a source of problems in parent-child relationships, ultimately leading to the consolidation of an insecure attachment. Since sleep problems impact children's emotional regulation (Williams et al., 2017), it may affect the formation of social bonds (McNamara et al., 2003), posing the dyad at a greater risk of developing an insecure attachment. Finally, the last model hypothesizes that inconsistent parenting may underlie both insecure attachment and sleep problems (Morrell & Steele, 2003).

Empirical evidence, however, has not always been consistent in supporting the outlined models, as studies examining attachment and sleep problems are still sparse and insufficient. Besides, studies often generate results that are difficult to compare, namely by assessing distinct age ranges, where attachment and sleep may face different challenges, or by using diverse instruments with different underlying work definitions for attachment and sleep. As follows, studies evaluating the behavioral quality of attachment interactions (e.g., via the Attachment Q-Sort (Waters & Deane, 1985) or by the Strange Situation Procedure (Ainsworth et al., 1978) and its adaptation for preschool age (Cassidy et al., 1992)), or its representation (e.g., via the Attachment Story Completion Task (Bretherton et al., 1990)), may lead to distinct results Madigan et al., 2016). This is particularly significant considering the moderate correlations found between attachment measures (Smeekens et al., 2009; van IJzendoorn et al., 2004),

suggesting some overlap between the assessed dimensions, but also revealing the assessment of possibly distinct aspects of attachment.

Similar challenges are faced in sleep evaluation, with different findings being reported when sleep is assessed through objective (e.g., actigraphy) and subjective measures (e.g., parental report). On the one hand, objective recordings tend to overestimate night-wakings frequency and duration, as well as to miss important behavioral dimensions of the sleep phenomena, such as bedtime resistance and displays of sleep-related anxiety (Meltzer et al., 2012; Owens et al., 2000; Owens et al., 2000; Smeekens et al., 2009). On the other hand, parental reports tend to overrate sleep duration and wake-up time, underestimating bedtime, night-wakings frequency, and duration (Kushnir & Sadeh, 2013; Werner et al., 2008).

Despite the inconsistency of the research findings pertaining the attachment and sleep during infancy, the relations between them across the lifespan have been described in a systematic review (Adams et al., 2014). Those findings suggest the existence of bidirectional relations between attachment and sleep starting in early infancy (0 to 2 years old) and continuing throughout life, in children (2 to 18 years old), adults (18 to 64 years old) and seniors (> 65 years old). One recent meta-analysis also reported positive associations between attachment security and some parameters of sleep in children between 6 months and preschool age (Simard et al., 2017). Specifically, attachment security correlated with higher sleep efficiency and lower rates of sleep problems, while attachment resistance associated positively with maternal related sleep problems. Despite the relevance of these findings, this meta-analysis focused on the comparison between secure and resistant attachment styles, failing to consider conclusions regarding other attachment styles (i.e., avoidant and disorganized). Moreover, it also neglected the studies that adopted continuous measures of attachment security (i.e., Attachment Q-Sort and Attachment Story Completion Task), leaving their relations with sleep understudied.

Study aims

Aiming to overcome some of the limitations of previous reviews (e.g., wide age-range, focus on attachment classifications), in the current review we concentrated on a specific developmental period: preschool age (2 to 5 years old). We decided to disregard younger children because, although sleep consolidation (i.e., longer sleep period during the night and short nap during the day) often takes place at 12 months of age, due to significant individual

variability in this process, complete sleep consolidation does not tend to be considered until two years of age (Acebo et al., 2005; Mindell et al., 2015; Paavonen et al., 2020). Moreover, preschool age is a period when developmental processes (e.g., the transition to day-care and the redefinition of the parent-child relationship into a goal-corrected partnership) along with the constitution of new roles and responsibilities (Li-Grining et al., 2010) may challenge both the attachment relationships and sleep-wake regulation (Ainsworth et al., 1978; Thompson et al., 2004). This, in turn, may hamper the relations between attachment and sleep quality (Vaughn et al., 2015; Trejos, 2004).

Bearing that in mind, as well as the specific contributions of previous reviews, the current review aims to provide a systematized and integrated overview of studies on attachment relationships and sleep quality in preschool children (2 to 5 years old). Specifically, it will examine how different dimensions of attachment may be related to objectively and subjectively assessed sleep dimensions, aiming to illuminate directions for future research.

Method

The present systematic review follows the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) general guidelines (Moher et al., 2009) for reporting data concerning the relations between attachment and sleep in children aged between 2 and 5 years old. Every step of the process of identification and selection of articles is specified below.

Information resources, search strategy, and eligibility criteria

A systematic data search was performed using the following string: sleep AND attachment AND (child* OR toddler* OR preschool* OR years OR months), on titles, abstracts, and keywords, in the following databases: EBSCO (PsycINFO, PsycARTICLES, Academic Search Complete, and Psychology and Behavioral Sciences Collection) and Web of Science. The search covered the period until 21st September 2020 (no starting date limit), resulting in 524 titles. The initial abstracts, identified as potentially relevant articles, were screened by both authors separately, and a total of 505 papers were excluded at this phase. The remaining 19 articles were fully assessed independently, and after disagreements were resolved by consensus, a total of seven articles were included (Table 1).

Articles were included in this review according to the following inclusion criteria: (1) empirical studies with an available abstract, published in peer-reviewed journals; (2) articles written in English, Portuguese, French or Spanish (idioms mastered by the authors); and (3) articles assessing children's sleep between 2 and 5 years old.

Table 1: References of the primary studies

ID	Reference	Participants	Design
#1	Bélanger et al., (2015)	*N* = 62 (30 girls); mostly Caucasian; medium-high SES	Longitudinal
#2	Bernier et al., (2014)	*N* = 63 (27 girls); mostly Caucasian; medium-high SES; intact families	Longitudinal
#3	Pennestri et al., (2015)	*N* = 134 (71 girls); mostly Caucasian; medium-high SES	Longitudinal
#4	Simard et al., (2013)	*N* = 55 (25 girls); mostly Caucasian; medium-high SES; intact families	Longitudinal
#5	Troxel et al., (2013)	*N* = 776 (393 girls); mostly Caucasian; parental education 14 years average	Longitudinal
#6	Vaughn et al., (2011)	*N* = 39 (12 girls); 36% from ethnic minorities, mostly AA	Cross-sectional
#7	Weinraub et al., (2012)	*N* = 1,215. Maternal education 14.3 years average; 13.3% single mothers; 31% low-income families	Longitudinal

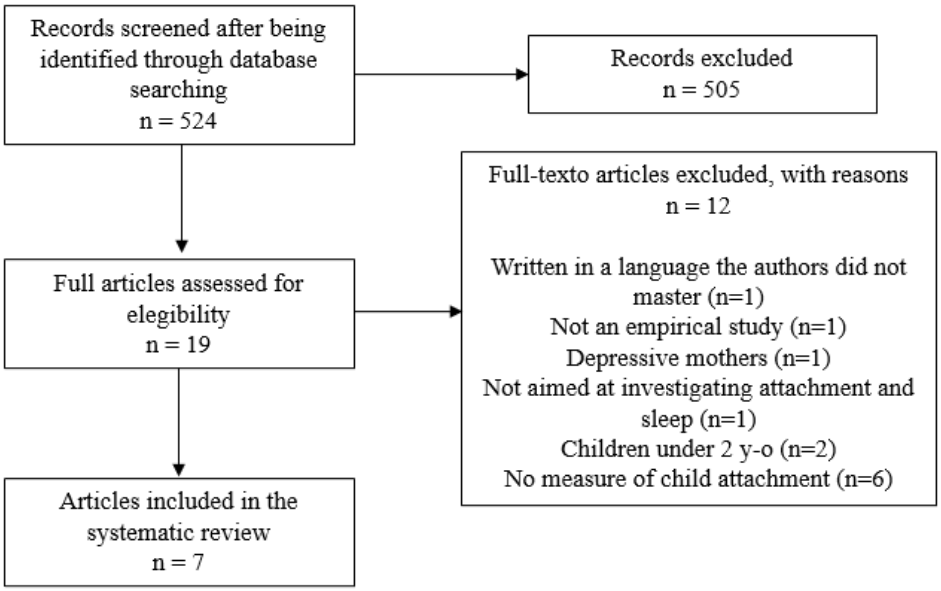
Table caption: SES (socioeconomic status); AA (African-american)

We excluded all the studies in which: (1) children or parents were not living in natural contexts (e.g., institutionalized or hospitalized children, incarcerated parents, etc.); (2) children were premature or diagnosed with some physical or mental illness; (3) the mother or the father were diagnosed with some physical or mental illness; (4) there was not a specific aim to examine the relations between child's attachment and sleep; (5) intervention programs or clinical trials were conducted; (6) there were no precise measures of child attachment and/or sleep. The flow diagram for the identification, screening, eligibility, and inclusion of the studies can be found in Figure 1.

For the purpose of this review, we included studies in which child's sleep was assessed via actigraphy or sleep diaries for sleep parameters related to sleep quantity and quality, as well as validated parental-reported questionnaires for sleep problems and sleep-related behaviors. Given the number of longitudinal designs we found, we excluded studies that evaluated sleep exclusively before 24 months of age, given that, during the first two years of life, children

display great intraindividual variability in sleep patterns, due to maturational processes (Sadeh, 2008).

Figure 1: PRISMA flow diagram for the identification, screening, eligibility, and inclusion of studies



Data extraction and items

A data extraction matrix, to summarize collected data, was developed, identifying: (1) general information about the participants, such as age range, number of participants, country of origin, socioeconomic status, and ethnicity; (2) study design; (3) attachment measure; (4) sleep measure; (5) main findings regarding the relations between attachment and sleep. Data from full papers were extracted by both researchers independently.

Results

General description of the studies: Theoretical perspectives

Most of the included studies are rooted in the perspective that sleep difficulties may partially result from vicissitudes in the attachment relationship (Dahl, 1996; ID#1, 3, 4, 5). This

framework stands that insecurely attached children may experience more intense fears and worries, which might disrupt sleep. In one case, both frameworks of attachment as a predictor of sleep (Dahl, 1996) and of sleep as a predictor of attachment (McNamara et al., 2003) were considered (ID#2). One study (ID#6) drew upon a conceptual framework considering attachment and sleep as dual products of parenting (Morrell & Steele, 2003). Finally, one of the studies did not specify the authors' standpoint regarding the associations between attachment and sleep.

General sociodemographic characteristics of the participants

All the included studies were conducted in North American countries (four in Canada: ID#1, 2, 3, 4, and three in the USA: ID#5, 6, 7), and most of the children were Caucasian (80% across all studies; one stud did not provide information regarding ethnicity). A large proportion of the children belonged to intact families, meaning that 89% lived with both parents in the same household (two studies did not detail parental marital status; ID#3, 6). Overall, children came from well-educated families, with 81% of the mothers having completed high school, and at least 76% holding college degrees (two studies did not provide information on maternal education; ID#3, 6).

Study designs

Most of the studies relied on longitudinal designs, either with attachment and sleep measured at different ages, or with various sleep assessments across distinct time points (ID#1, 2, 3, 4, 5, 7), whereas only one was conceived with a cross-sectional design (ID#6). Although some studies reported on sleep assessments before the child were 2 years old (ID#1, 2, 3, 8), those data were not considered in this systematic review. As such, we analyzed longitudinal data from four studies (ID#1, 3, 4, 7), cross-sectional data from two studies (ID#2, 6), and both cross-sectional and longitudinal data from one study (ID#5).

Empirical processes on attachment and sleep measures

Most of the articles examined sleep as an outcome of the attachment relationship, while only one investigated attachment as an outcome of sleep (ID#2). Moreover, mechanisms

influencing the relations between attachment and sleep are examined by only one study (ID#5), acknowledging the role of a temperamental variable (i.e., negative emotionality). Finally, one study (ID#7) identified how individual (e.g., child's sex, temperament) and mother-related characteristics (e.g., sensitivity, depression) accounted for developmental changes in the relations between attachment and sleep. Details on how attachment and sleep have been conceptualized and measured will be stated next, followed by a description of their main findings.

Sleep and attachment measures across the studies

Sleep has been described as a complex, multifaceted, and multidimensional phenomenon, which can be measured objectively or via parental reports in young children. Sleep assessment ma involve different parameters, such as sleep quantity and quality, and sleep-related behaviors. Table 2 illustrates the type of sleep instruments (i.e., actigraphy, sleep diary, questionnaire) used to assess sleep quantity, quality, or sleep problems.

Parameters of sleep quantity (sleep schedules and duration) and/or quality (sleep efficiency, night-wakings) were the focus of most of the identified research. Sleep parameters of quantity, such as sleep duration across a 24-hour period, or estimates of it (e.g., difference between bedtime and wake-up time) were examined more frequently (ID#1, 2, 3, 4, 6). Sleep quality variables relating to sleep fragmentation, such as sleep efficiency, defined by the proportion of sleep time to total time in bed, or the number of night-wakings were also often assessed (ID# 1, 3, 4, 6, 7).

The assessment of sleep quantity and quality tended to rely both on actigraphy (i.e., objective sleep measure) and on sleep diaries (ID#1, 2, 4). However, one study only used actigraphy (UD#6), and three studies exclusively depended on maternal reported questionnaires (ID#3, 5, 7).

Considering the evaluation of attachment, the Strange Situation Paradigm (Ainsworth et al., 1978) and its modified version, suited for preschool age (Preschool Separation-Reunion Procedure, Cassidy et al., 1992) were frequent procedures to analyze child-mother/parents attachment (ID#3, 4, 7). Other studies relied on Attachment Q-Sort (Waters & Deane, 1985; ID#1, 2, 5) and one assessed attachment representations with the Attachment Story Completion Task (Bretherton et al., 1990; ID#6).

Associations between attachment and parameters of sleep quantity and quality

Table 3 summarizes the main findings of the primary studies. Overall, studies examining attachment and quantitative sleep parameters found inconsistent results. One the one hand, more securely attached children (at 15 months) had longer night sleep durations (at 24 months) than their insecurely attached counterparts, according to actigraphy (ID#1). Moreover, disorganized attachment was related to maternal perceptions of later bedtimes and shorter total sleep durations for their children (ID#3). On the other hand, some studies did not find significant associations between attachment and sleep parameters, such as sleep duration, longest period of uninterrupted sleep, time spent in bed, or wake-up time (ID#2, 3, 4).

Regarding the quality of sleep, children classified as disorganized tended to be described by the mothers as having more fragmented sleep (i.e., longer and more frequent night-wakings) in comparison to children with other attachment classifications (e.g., secure and insecure-ambivalent; ID#3). More resistant attachment behaviors were also related to mothers' reports of longer night-waking durations for children at 24 months (ID#4).

In turn, associations between attachment security and objectively measured sleep quality were inconsistent. Some studies found evidence for secure attachment to be positively correlated with sleep efficiency (ID#1, 6) and negatively with night-waking duration and frequency, as well as with other variables indicative of less sleep quality, such as sleep activity index (ID#6). However, another study relying on objective assessments of sleep did not find significant associations between attachment and sleep (ID#4).

Associations between attachment and parental reports of sleep problems

The relations between attachment and sleep problems were only explored by two studies that, again, had inconsistent findings. Negative correlations between attachment and sleep problems were reported by one study (ID#5), both cross-sectionally (at 24 months) and longitudinally (at 26 months). Furthermore, this study found evidence for the moderating role a temperamental variable in the association between attachment and sleep, meaning that attachment security predicted fewer sleep problems at 54 months for children with high negative emotionality. However, not for children with low negative emotionality (ID#5). However, the other study did not report significant associations between attachment and sleep problems, suggesting that other child variables (e.g., breastfeeding duration, temperament) and

maternal variables (e.g., maternal sensitivity, depression) may impact developmental changes in sleep to a greater extent.

Discussion

The main aim of the present systematic review was to summarize research findings concerning the relations between attachment and sleep in children from 2 to 5 years old. A handful of studies suggest that children with secure attachment relationships have better overall sleep than insecurely attached children. For example, it has been reported that children with insecure (ID#1, 2) and with disorganized (ID#3) attachment relationships sleep for fewer hours (ID#1, 3), wake-up more frequently during sleep and those night-wakings last for longer periods than those of the securely attached (ID#2, 3) who, in turn, sleep more efficiently (ID#1, 6).

One possible explanation for these results calls for attachment and self-regulation theories (Calkins & Leerkes, 2011). Accordingly, secure attachment relationships are built upon a history of repeated experiences of successful dyadic regulation (Bowlby, 1969; Cassidy, 1994; Simard et al., 2017), resulting in the development of a stronger capacity for physiological (Gunnar, 2017) and emotional self-regulation (Stefan et al., 2017). This capacity can manifest at bedtime, when securely attached children may be more able to peacefully self-regulate in order to fall asleep, as well as to settle after a night-waking (Dahl, 1996), increasing total sleep time and sleep efficiency. On the contrary, children with insecure/insecure-ambivalent/disorganized attachment classifications would experience major regulatory difficulties when faced with the transition to sleeping, alone in a dark bedroom (Keller, 2011; Sadeh et al., 2010). Darkness and loneliness are described by the attachment theory as natural clues to danger, defined as stimuli that, although noy inherently dangerous, increase the likelihood of danger. Felt danger, in turn, leads to the activation of the attachment system, which ultimate goal is to increase proximity with the attachment figure (Bowlby, 1973). Insecurely attached children are frequently more prone to intensely experience, and express, separation anxiety than secure children (Cassidy & Main, 1984), even in familiar situations. Accordingly, their emotional reactions when facing night-time separations can increase bedtime resistance, delaying bedtime and shortening total sleep duration and efficiency (Schlarb et al., 2016). Concomitantly, a large proportion of insecure children would be more likely to signal their night-wakings (ID#4) as part of a mechanism to seek proximity with the caregivers. This could end up extending night-wakings' durations and making their parents more likely to notice and

to report sleep problems in retrospective questionnaires (Perpétuo et al., 2020). This explanation is reinforced by the findings showing that mothers of insecure-ambivalent (ID#4) and disorganized (ID#3) children report more frequent and longer night-wakings than mother of securely attached children. Together, these findings may elucidate the abovementioned associations between attachment insecurity and sleep.

Another possible explanation may root in the evidence that parents of securely attached children usually implement more stable bedtime routines, which, in turn, lead to better sleep (Lee et al., 2019; Mindell et al., 2015; Sadeh et al., 2009). Although, to our knowledge, no study has investigated the relations between attachment security and bedtime routines, those have been associated with variables concerning parent-child relationships (Ferreti & Bub, 2017; Fiese & Everhart, 2008; Hale et al., 2009; Ren & Fan, 2018) and parenting styles (Staples et al., 2015). This suggests that the perception of stability originated or reinforced by parental established routines may improve family relationships. However, adopting the framework of attachment theory, suggesting that parents of securely attached children tend to appropriately structure their environment making it stable and predictable, it is plausible to consider that attachment security may have a role in bedtime routines.

Some of the reviewed studies did not find significant associations between attachment and sleep (ID#2, 4, 7), particularly when sleep parameters are measured objectively (ID#2, 4). This lack of associations suggests that attachment may be linked to sleep dimensions that are more easily assessed by maternal reports, such as night-time and sleep-related behaviors, than through objective measures, such as actigraphy (Simard et al., 2017). Hence, different instruments capture distinct dimensions of the sleep phenomenon. While objective measures assess objective sleep duration, timing and quality (i.e., sleep efficiency), and tend to overestimate night-wakings (Meltzer et al., 2012; Sadeh & Acebo, 2002; Sitnick et al., 2008), subjective methods reflect maternal perceptions of the child's sleep that are more limited as the child gets older (Tikotzky & Volkovich, 2019). In that sense, some authors have suggested that relevant sleep parameters must be selected based on developmental considerations (Tétreault et al., 2016). As such, variables like the proportion of night-time sleep and longest period of uninterrupted sleep, that tend to stabilize over time (Acebo et al., 2005) should be considered.

Table 2: Type of sleep instruments and variables measured across the studies

ID	*N*	Attachment variables and instruments	Age at sleep assessment	Measures		
				Sleep quantity	Sleep quality	Sleep problems
#1	62	Attachment Q-Sort (AQS): security and independence	(15 m), 24 m	Actigraphy, sleep diary: sleep minutes at night and over the 24-hr period	Actigraphy: sleep efficiency	-
#2	63	AQS: security	(12 m), 24 m	Actigraphy, sleep diary: night-time sleep duration and proportion of night-time sleep to total sleep	-	-
#3	134	Preschool Separation-Reunion Procedure: attachment classification (secure, ambivalent, avoidant, disorganized)	(6 m, 12 m), 24 m, 36 m	Adaptation of Self-Administered Questionnaire for the mother: bedtime, wake time, sleep latency, nocturnal sleep duration, longest period of uninterrupted sleep	Adaptation of SAMQ: nr of night wakings	Adaptation of SAQM
#4	55	Strange Situation Procedure (SSP): proximity seeking, contact maintenance, avoidance, resistance	24 m	Actigraphy, sleep diary: sleep duration at night, wake duration at night	Actigraphy: nr of nocturnal awakenings	-
#5	776	AQS: security	24 m, 36 m	-	-	Sleep problems subscale of the CBCL
#6	39	Attachment Story Completion Task (ASCT): coherence and security	4-5 y	Actigraphy: sleep duration, total sleep minutes, longest wake episode, sleep latency	Actigraphy: wakings after sleep onset, sleep activity mean, overall activity index, sleep efficiency	
#7	1215	SSP: security; attachment classification; Separation distress	(6 m, 15 m), 24 m, 36 m		Maternal interview: night wakings in the previous week	Sleep problems subscale from CBCL

The ages placed between brackets refer to ages assessed by primary studies that were excluded from the current review. SAQM stands for Self-Administered Questionnaire for the mother and CBCL stands for Child Behavior Checklist.

Table 3: Main findings of the primary studies

ID	Reference	Main findings
#1	Bélanger et al., (2015)	Positive associations between attachment security and: (a) Sleep minutes at night; (b) Sleep efficiency. Negative associations between attachment dependency and sleep minutes at night
#2	Bernier et al., 2014	Secure attachment was unrelated to night-time sleep duration and to proportion of night-time sleep to total sleep. Insecure attachment was related to night-wakings.
#3	Pennestri et al., 2015	Disorganized attachment associated with: (a) shorter duration of nocturnal sleep; (b) more night-wakings; (c) shorter periods of uninterrupted sleep than secure or ambivalent attachment.
#4	Simard et al., 2013	Ambivalent attachment associated with more minutes awake at night as perceived by the mothers, but not according to actigraphy.
#5	Troxel et al., 2013	Attachment security correlated with fewer sleep problems only among children characterized with higher negative emotionality at 6 months.
#6	Vaughn et al., 2011	Secure attachment associated positively with: (a) sleep duration; (b) total sleep minutes; (c) sleep efficiency; and negatively with: (a) nº of sleep episodes; (b) sleep activity index; (c) wake minutes after sleep onset – variables reflecting poor sleep
#7	Weinraub et al., 2012	Infant-mother attachment was not related to sleep problems

These findings point to the relevance of measuring sleep both via maternal reports and objective methods (Perpétuo et al., 2020), assessing developmental relevant sleep variables, in order to account for behavioral and objective dimensions that may be related to attachment in distinct periods.

The reported inconsistency among the findings may mirror not only the variability of the assessed sleep parameters, but also the diversity of attachment dimensions measured across the studies. Attachment was measured in different contexts (i.e., laboratory ID#3, 4, 6, 7, and home environment ID#1, 2, 5) and via distinct coding systems (i.e., typological ID#3, 4, 7, and continuous ID#1, 2, 5, 6). There is evidence that typological approaches used to score attachment behaviors in the Strange Situation Paradigm may not be the best for assessing the variability in the quality of mother-child attachment relationships. Otherwise, instruments yielding continuous scores of security seem to capture more dynamic aspects of the attachment relationship (Fraley & Spieker, 2003), showing excellent variation in low-risk samples (Simard et al., 2017). Moreover, it is possible that different components of the attachment relationship contribute differently to the child dealing with bedtime separations, impacting sleep parameters

distinctively. Some studies found that secure attachment, assessed by the AQS (Waters & Deane, 1985; Waters, 1995) was associated with higher sleep duration and efficiency (ID#1) and with fewer sleep problems (ID#5). It is plausible that the aspects of a child's secure base behavior, measured in a low stress and known home environment (Waters & Deane, 1985; Waters, 1995), are those that help her to bear night-time separations from the caregiver and to fall asleep. Conversely, studies that assessed attachment separation-reunion behaviors through the Strange Situation Paradigm (Ainsworth et al., 1978) reported interesting findings regarding disorganized (ID#3) and insecure-ambivalent (ID#4) classifications. Both groups of children tended to wake up more frequently and for longer periods during the night, and mothers of disorganized children reported shorter sleep durations. Given that bedtime separations and morning or middle-of-the-night reunions are an ecological repetition of the Strange Situation Paradigm, it is credible to think that children who report high levels of separation distress, and cannot calm down easily after reunion, live analogous experiences every day at bedtime.

Although according to the transactional model of sleep-wake regulation (Anders, 1994; Sadeh & Anders, 1993), parent-child relationships are a major factor impacting child's sleep, linking directly to attachment theory, research devoted to attachment and sleep is still sparse and insufficient. As reported in the present review, no study has investigated attachment and sleep at preschool age since 2015, and all studies were conducted in North American countries. This, along with the fact that nearly all the children who participated in the primary studies belonged to well-educated, medium-high socioeconomic status, samples, may compromise generalization. It is possible that attachment, as much as sleep parameters, are less likely to differ significantly in such samples, therefore making the effects harder to detect. Nevertheless, socioeconomic status has been reported to affect both attachment security (Bakermans-Kranenburg et al., 2004; Gedaly & Leekers, 2016; van IJzendoorn et al., 1992) and child's sleep (Buzek et al., 2019; El-Sheikh et al., 2013; El-Sheikh et al., 2010).

Another aspect worth mentioning concerns two assumptions regarding the attachment relationship that should be analyzed carefully: the stability of attachment across time and across distinct relationships. First, the fact that all but one study has a longitudinal design is noteworthy, expressing an effort to uncover how attachment is related to the development of sleep. However, although there is a tendency for attachment stability across the lifespan (Waters, 1978; Waters et al., 2000), it is also known that attachment classification can change in the early years, particularly when assessed via behavioral and representational measures (Pinquart et al., 2013). The absence of control for attachment stability possibly weakens the

studied effects. Second, all of the studies that assessed attachment behaviors (ID#1, 2, 3, 4, 5, 7) focused on mother-child dyads, despite the evidence pointing to modest to moderate correlations between mother-child and father-child attachment (Pinquart et al., 2013; Fernandes et al., 2018). Knowing that the presence of at least one secure attachment relationship to one of the parents buffers the negative impacts of insecure attachment to the other parent (Caldera & Lindsey, 2006), evaluating attachment to one single figure possibly limits the understanding of attachment-sleep relations. Apart from the concordance between child-mother and child-father attachment relationships, it has been established that father-child reciprocal interactions have a unique contribution to child development (Barker et al., 2017; Pleck, 2007; Van Bakel & Hall, 2020), for example, in behavioral regulation (Lindsey et al., 2010). The importance of father-related variables (Benedetta et al., 2020), such as father's mental health (De Stasio et al., 2018; Millikovsky-Ayalon et al., 2015; Ragni et al., 2019), paternal emotional support Bernier et al., 2016), and particularly paternal involvement in child sleep, haven been demonstrated in infants (Tikotzky & Sadeh, 2010), preschool-aged (Bernier et al., 2013), and school-aged children (Keller & El-Sheikh, 2011). However, to our knowledge, none of the studies that investigated the relations between attachment and sleep at preschool age included measures of father-child attachment, undermining the understanding of father-child attachment influence on sleep.

Limitations, strengths, and future directions

Despite the relevance of the systematic review's findings, some limitations should be addressed. First, the number of the primary studies was relatively small, and most of the identified studies collected data from small samples (ID#1, 2, 4, 6). Additionally, most of the children were from middle class western societies and belonged to well-educated families, compromising the generalization of results due to the lack of sample variability and representativity. Secondly, by only including empirical scientific articles, potentially relevant sources of information about the topic published elsewhere (e.g., grey literature, book chapters) were not identified. Third, the use of broad keywords during the article search, such as "sleep", "attachment", or "child", may have left out articles related to the research topic indexed with other terms. Lastly, included studies that used objective sleep measures tended to focus on short spans of time (i.e., 72 hours, ID#1, 2, 4), although the recommended duration for the use of actigraphy is at least seven consecutive days (Acebo et al., 1999). Thus, these findings should be examined carefully.

Paths for future investigation that have been uncovered in the current section are systematized below. First, selected samples should become more heterogeneous regarding sociodemographic and family factors, allowing researchers to study the association between attachment and sleep is moderated by factors that were not included in the primary studies. Despite the evidence suggestive of the role played by factors such as maternal depression (Kim et al., 2020; Liu et al., 2020), maternal anxiety (Dubois-Comtois et al., 2019) in attachment security Bakermans-Kranenburg et al., 2004) and child's sleep (El-Sheikh et al., 2013), these were overlooked by the included studies, ignoring the influence of these factors in the relations between attachment and sleep. Second, attachment assessments should privilege instruments that yield continuous scores of attachment, both to the mother and to the father or other primary caregiver, and consider the possibility of a second assessment if it was first measured before 18 months old. Finally, future studies should focus on capturing sleep phenomena in all their amplitude, using both objective and subjective sleep measures over extended periods, and favoring the assessment of developmental relevant variables.

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Chapter III:

Comparison between actigraphy records and parental reports of child's sleep

Chapter based on:

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Abstract

Given the impact of sleep in several domains of a child's development, the comparison between actigraphy and parental questionnaires is of great importance in preschool children, an understudied age group. While parental reports tend to overestimate parameters like sleep duration, actigraphy boosts the frequency of night-wakings. This study's primary goal was to compare actigraphy data and parental reports (obtained through *Children's Sleep Habits Questionnaire*, CSHQ), regarding bedtime, wake-up time, sleep duration and minutes awake after sleep onset (WASO), using the Bland-Altman technique. Forty-six children (aged 3 to 6 years) and their parents participated in the study. Results suggest that, despite existing associations between sleep schedule variables measured by both methods (from r = .57 pertaining to weekend bedtime to r = .86 regarding weekly bedtime, *ps*), differences between them were significant and agreement rates were weak, with parents overestimating bedtimes and wake-up times compared to actigraphy. Differences between actigraphy and CSHQ were $\pm$ 52 for weekly bedtime, $\pm$ 38 minutes for weekly wake-up time, $\pm$ 159 minutes for total sleep time, and $\pm$ 62 minutes for WASO, indicating unsatisfactory agreement between methods. Correlations between actigraphy data and CSHQ dimensions were also explored. Our study adds on the knowledge of the characteristics of each instrument and documents their biases overestimating or underestimating certain sleep parameters. We conclude that a complementary use of both instruments would better inform clinical practice and child sleep research.

Keywords:

Sleep; Actigraphy; Parental report questionnaire; Bland and Altman method; Preschool age

Close your eyes and I'll close mine
- Goodnight, the Beatles

Introduction

Sleep problems have implications in multiple areas of child development, for example, in health conditions (James & Hale, 2017), behavioral problems (Reynaud et al., 2018), academic outcomes (Sun et al., 2019), and family conflict (Mindell & Williamson, 2018). Considering the high prevalence of sleep disturbance in childhood (20-30%) (Owens, 2008), it is fundamental to expand knowledge about the particularities of distinct sleep assessment methods, as their variability sometimes limit comparisons between the studies.

The "golden standard" of sleep assessment techniques, polysomnography, is based on electrical traces of brain activity and provides detailed information about sleep architecture (Sadeh, 2011a), delivering extremely reliable information about sleep start/end times and frequency of night-wakings. However, the fact that it is an expensive method, and therefore assessments typically occur along 2 single nights, along with the requirements for adjustment ("first night effect") (Sadeh, 2011a) that potentially disrupt child's natural sleep patterns, has stimulated researchers to seek alternative methods. Actigraphy is a validated option that allows continuous data collection across several days in larger samples (Hyde et al., 2007). Being a minimally invasive watch-shaped device, actigraphy can be used over multiple nights in the child's natural environment, conferring ecological validity to collected data (Ancoli-Israel et al., 2003; Sadeh et al., 1995). Nevertheless, actigraphy presents some limitations derived from the estimation of sleep parameters based on activity monitoring (Tyron, 2004). For example, the absence of movement that may be registered during quiet activities can be assumed by the device as a sleep period (Sadeh & Acebo, 2002), while body movements during restless sleep episodes (typical of young children) (Meltzer et al., 2012) can be listed as night-wakings, impacting other sleep parameters' estimations (e.g., sleep duration, sleep efficiency) (Acebo et al., 1999; Sadeh, 2011b; Sitnick et al., 2008). Yet, even after accounting for the referred limitations, objective sleep measures are consistently reported as more accurate than the objective ones (Meltzer et al., 2012; Sadeh et al., 1995).

Subjective measures, such as sleep diaries or parental questionnaires, are also widely used in developmental sleep research, as they are simple and economic. Moreover, subjective measures assess environmental and behavioral dimensions related to bedtime routines that

impact child's sleep and cannot be measured with objective methods (Sadeh, 1996, 2015). However, such instruments are susceptible to response bias since they depend on parental perceptions and memory. Sleep diaries are less prone to those kinds of bias, as they consist of day-to-day reports (usually for 7 days) of sleep parameters. However, the fulfilment of a sleep diary requires commitment and rigor. Subjective sleep assessment methods relying on parental perceptions can sometimes provide limited information, considering that parents may sometimes not be aware of their children's sleep behaviors (e.g., night-wakings), as they depend on children signaling them (Bauer & Blunden, 2008).

Overall, some convergence has been found between actigraphy and parental reports for children's sleep schedules (i.e., sleep onset, wake-up time, sleep duration, time in bed), but not for sleep quality variables (e.g., night-wakings and sleep efficiency) (Dayyat et al., 2011). Some studies using actigraphy along with sleep diaries found significant associations between the methods for bedtime, wake-up time, and sleep duration, both in non-clinical samples (Iwasaki et al., 2010; Kushnir & Sadeh, 2010), and in a sample of children diagnosed with severe nighttime fears (Kushnir & Sadeh, 2013). However, previous studies also reported that parents tend to overestimate sleep duration and wake-up time, as well as to underestimate bedtimes and night-wakings (Hall et al., 2015; Lam et al., 2011; Sekine et al., 2002; Tikotzky & Sadeh, 2001; Werner et al., 2008). Parental overestimation of sleep duration may be explained by the child's increasing self-regulation capacity during the night-wakings. As the child grows on self-regulation, she may not need to request parental intervention when a night-waking occurs, being able to resume sleep autonomously. Concomitantly, actigraphy has been reported to be vulnerable to over-detection of night-wakings in young children, whose sleep is typically more agitated (Tyron, 2004). A distinct pattern of results is reported during a child's first year of life, when parents are more effective reporting sleep schedules and duration, as well as noticing the occurrence and being aware of the duration of night-wakings (Bélanger et al., 2014; Müller et al., 2011; Tikotzky & Volkovich, 2019). Generally, previous findings suggest a higher convergence between actigraphy and sleep diaries than between actigraphy and subjective methods that resort to more global estimates (e.g., questionnaires) (Bélanger et al., 2014; Dayyat et al., 2011; Hall et al., 2015; Sadeh, 2004; Owens et al., 2000).

In a sample of older children (6-10 years old), comparing actigraphy and the *Children's Sleep Habits Questionnaire* (Owens et al., 2000), significant associations were found for bedtime, time spent in bed, and sleep duration (Holley et al., 2010). Besides, actigraphy-derived

sleep duration was negatively associated with night-wakings and parasomnia dimensions, while objective sleep latency correlated with subjective reports of sleepiness (Holley et al., 2010).

Very few studies have investigated the concordance between different sleep measures in preschool age, a period when sleep assessment is highly relevant, as children frequently manifest sleep-related problems, in a developmental context where sleep is crucial for brain maturation, information processing, memory consolidation, and learning processes (Dahl, 1996; Stickgold, 2001). Most often studies compare methods by reporting correlations that do not provide appropriate information about the agreement, as measures can covary and still not be precise.

Study aims

The main aim of the current study is to evaluate the relations between sleep parameters derived from actigraphy and CSHQ parental reporting for preschool-aged children. Specifically, we aim to: (1) describe parental perceptions of children's sleep; (2) characterize sleep patterns based on actigraphy; (3) relate CSHQ behavioral dimensions with actigraphy data; and (4) report the agreement between actigraphy and parental reports according to Bland and Altman method (Bland & Altman, 1999, 2010).

Method

Participants

We contacted 150 Portuguese families from the Lisbon metropolitan area and 54 agreed to participate in our study, conducted between January and October of 2019. Children were excluded from the sample if they had been previously diagnosed with a neurological impairment, a psychological condition, or a learning disability. Three of the 54 families changed residence and one withdrew consent. The final sample included 46 participants (50% girls), with ages between 3 and 6 years (M = 4 years and 10 months, SD = 10.25 months). Nearly half of the participants slept alone in their own bedroom (47%) and 21% were the only child. Children spent 7 to 10 hours per day in daycare facilities (M = 8.35, SD = 5.60).

Instruments

Actigraphy

All the children used the Actiwatch 2 (Philips Respironics, Murrysville, PA) on their non-dominant wrist continuously for 7 days ($M = 6.59$, $SD = 0.72$). Actiwatch is a non-invasive accelerometer that collects data based on the child's motor activity in her typical sleep environment. Retrieved data were coded into sleep and wake in 60-s (s) epochs through a commercially available software (Actiware 6.0.9, Philips Respironics). Movements were scored using a default parameter of a medium wake threshold value of 40 counts per epoch (WTV-40). This level was chosen since night-wakings are underestimated by high sensitivity thresholds and overestimated by low sensitivity ones. This software relies on a validated algorithm to classify epochs as either sleep or wake. Sleep onset was defined as the first period of 10 consecutive immobile minutes (min), while sleep offset was established as the last 10 consecutive immobile minutes between sleep onset and wake-up time. The software's algorithm converted activity data in the following sleep estimates: (1) Bedtime – the start time of the longest rest interval in a 24-hour period; (2) Wake-up time – the end time of the longest rest interval in the 24-hour period; (3) Time in bed – the sum of the durations for all rest intervals in a 24-hour period; (4) Total sleep time – the sum of the total sleep durations in a 24-hour period; (5) Minutes onset latency – the mean of the onset latency for all sleep intervals associated with the 24-hour period; (6) Sleep efficiency – the total sleep time divided by time in bed and multiplied by 100; (7) Wake after sleep onset (WASO) – the total number of minutes scored as awake within the sleep intervals associated with the 24-hour period; and (8) number of night-wakings – the total number of wake bouts within the sleep intervals associated with the 24-hour period.

Parental questionnaire

Children's Sleep Habits Questionnaire (CSHQ) (Owens et al., 2000; Silva et al., 2013) was designed to evaluate behavioral dimensions and symptoms of sleep problems in children between the ages of 2 and 10. The psychometric properties of the instrument are satisfactory (Owens et al., 2000). The questionnaire comprises two kinds of questions: (1) Quantitative – referring to bedtime and wake-up time (for weekdays and weekends), to sleep duration, number and duration of night-wakings; (2) Qualitative – as in the 33 items distributed across the 8 following dimensions: *Bedtime resistance* ($\alpha = 0.75$), *Sleep onset delay* (1 item), *Sleep duration*

(α = 0.67), *Sleep anxiety* (α = 0.46), *Night-wakings* (α = 0.50), *Parasomnias* (α = 0.63), *Obstructive sleep apnea* (α = 0.51), *Daytime sleepiness* (α = 0.51), and a total sleep problems score (α = 0.72). The *Sleep anxiety* dimension was excluded from the analyses due to low Cronbach's alpha. Items were answered on a 3-point Likert scale (1 – rarely, 2 – sometimes [2-4 times a week], 3 – usually [5-7 times a week]). Higher scores are suggestive of a more disturbed sleep.

Results

Before conducting the main analyses, we examined descriptive statistical information regarding all the variables. We analyzed correlations and mean differences for parallel variables (same variable measured by both instruments, i.e., bedtime, wake-up time, sleep duration, and minutes awake after sleep onset (WASO)), as well as correlations between CSHQ dimensions of sleep-related behaviors and actigraphy-measured sleep parameters. We also explored sex and age differences.

To evaluate the agreement rates between CSHQ and actigraphy, we relied on the Bland and Altman method (Bland & Altman, 1999, 2010), a graphical approach that plots the mean differences between the methods (e.g., [CSHQ sleep duration] – [Actigraphy sleep duration]) as a function of the average results described by both methods (e.g., mean sleep duration [CSHQ, Actigraphy]), and provides an interval where 95% of those differences are expected to lie (i.e., limits of agreement). Based on previous recommendations (Werner et al., 2008), we defined agreement rates within intervals smaller than 30 minutes to be satisfactory.

Descriptive analyses of parental reported data

Thirty-seven parents completed the CSHQ, and most of them (78.4%) affirmed that they do not identify their child's sleep as problematic, while 8.1% thought that their child might have a sleep problem and 13.5% of the parents failed to provide an answer to this question. According to the parents, children's sleep durations vary between 8 and 13 hours per day. During the week, children went to bed between 21:00 and 23:30 and woke up between 06:45 and 9:30. On weekends, children go to bed significantly later [t (34) = -9.05, $p < .001$], between 21:30 and 00:00, and wake-up also significantly later [t (35) = -6.79, $p < .001$], between 06:50 and 10:30. Except for weekend wake-up time and minutes awake after sleep onset, no sex differences were

found. Girls, compared to boys, woke up later during weekends [t (35) = 3.11, p < .01] and stayed awake for shorter periods during night-wakings [t (35) = -2.41, p < .05]. Finally, results showed that older children tended to go to bed earlier on weekends (r = -.43, p < .01), to have shorter sleep durations (r = -.38, p < .05), to present lower bedtime resistance (r = -.40, p < .01), to wake up less frequently during the night (r = -.39, p < .05), and to globally present fewer sleep problems (r = -.33, p < .05). Table 1 presents means and standard deviations for parent-reported variables with respect to their child's sleep for the global sample, for boys and girls.

Table 1: Means and standard deviations of parent-reported variables about child's sleep on the CSHQ for the total sample, boys, and girls

		Total		**Boys**		**Girls**	
		M	**SD**	**M**	**SD**	**M**	**SD**
Bedtime (PM)	Week	9:51	00:34	9:55	00:36	9:48	0:32
	Weekend	10:31	00:38	10:24	0:35	10:37	0:39
Wake up time (AM)	Week	7:52	0:35	7:47	0:37	7:57	0:34
	Weekend	8:46	0:56	8:20	0:48	9:12	0:52
Total sleep		10:28	1:06	10:24	1:16	10:31	0:59
Night-waking duration*		0:09	0:11	0:13	0:14	0:05	0:03
Bedtime resistance*		1.73	.53	1.81	.62	1.65	.44
Sleep duration*		1.24	.34	1.21	.34	1.26	.34
Night-wakings*		1.48	.50	1.57	.47	1.40	.53
Parasomnias*		1.33	.30	1.40	.33	1.26	.27
Obstructive sleep apnea*		1.11	.26	1.18	.36	1.05	.12
Daytime sleepiness*		1.66	.32	1.63	.28	1.68	.36
Global score		47.86	7.13	48.5	8.67	47.26	5.48

*CSHQ's dimensional scores vary between 1 and 3, higher scores corresponding to parental perception of higher frequency of sleep-related problems.

Descriptive analyses of the actigraphy data

We obtained valid records for a total of 41 children, who carried the Actiwatch between 5 and 9 days (M = 6.83, SD = .67). Actigraphy data are summarized in Table 2. Results showed that children slept between 6:15 and 9:30 hours per night. Concerning sleep schedules, during the week children went to bed between 9:30 and 00:15 and woke up between 06:45 and 9:15. During weekends, they went to bed significantly later, between 21:45 and 01:00 [t (41) = -4.24,

$p < .001$] and woke up significantly later, between 7:00 and 10:00 [t (41) = -4.64, $p < .001$]. Results also showed that during the week, girls, compared to boys, woke up significantly later [t (39) = 2.48, $p < .05$] and spent more time in bed [t (39) = 2.10, $p < .05$]. A marginal sex effect was found on total sleep time, with girls sleeping more time than boys [t (39) = 1.97, $p = .057$]. A significant and negative correlation was found between time in bed and child's age ($r = -.41$, $p < .05$). Time spent in daycare was significantly and negatively correlated with total time in bed ($r = -.55$, $p < .001$) and bedtime ($r = .38$, $p < .05$).

Table 2: Means and standard deviations for actigraphy-recorded sleep parameters for the total sample, boys and girls

		Total		**Boys**		**Girls**	
		M	**SD**	**M**	**SD**	**M**	**SD**
Bedtime	Week	10:25	00:35	10:25	00:36	10:25	00:36
	Weekend	10:52	00:49	10:47	00:46	10:56	00:51
Wake-up time	Week	08:00	00:37	07:47	00:38	08:14	00:32
	Weekend	08:24	00:44	08:12	00:45	08:35	00:41
Time in bed		09:55	00:35	09:43	00:32	10:05	00:36
Total sleep time		08:03	00:38	07:51	00:37	08:14	00:37
Sleep latency		00:13	00:16	00:11	00:08	00:15	00:21
Sleep efficiency		81%	6%	81%	6%	82%	7%
Wake after sleep onset		01:22	00:28	01:22	00:23	01:21	00:33
Number of night wakings		35.16	6.81	36.85	6.96	33.70	6.48

Associations between actigraphy and CSHQ dimensions

Regarding the 34 children with both actigraphy and parental reported data, we found that actigraphy total sleep time was correlated with CSHQ *bedtime resistance* ($r = -.43$, $p < .05$) and sleep problem *global score* ($r = -.38$, $p < .05$). Actigraphy WASO was significantly and positively correlated with CSHQ *night-wakings* ($r = .44$, $p < .05$). A higher frequency of night-wakings registered by actigraphy was associated with parents' reports of greater *instability in*

sleep duration (r = .36, p < .05) and with more *parasomnias* (r = .35, p < .05). Higher actigraphy sleep efficiency was significantly and negatively correlated with parent reports on *bedtime resistance* (r = -.42, p < .05), *night-wakings* (r = -.45, p <.01), and *global scores* of sleep problems (r = -.45, p <.01).

Correlations, differences, and agreement rates between CSHQ and actigraphy parallel variables

We found positive significant correlations between the methods for bedtime, both during the week (r = .75, p < .001) and the weekend (r = .57, p < .001), as well as for wake-up time (r = .86, p < .001 and r = .64, p < .001, during week and weekend, respectively). Results did not show significant associations between the methods for sleep duration or minutes awake after sleep onset (see Table 3).

One sample *t*-tests were conducted to analyze mean differences between the variables measured by CSHQ and actigraphy. Parents reported earlier bedtimes than actigraphy, both during the week [t (32) = -8.58, p < .001] and the weekend [t (30) = -2.37, p < .05]. According to parental perceptions, compared to actigraphy, children woke up later during the weekends [t (31) = 3.40, p < .01]. Finally, parents tended to overestimate total sleep time [t (31) = -10.55, p < .001] and to report less minutes awake after sleep onset [t (32) = -13.75, p < .001] compared to actigraphy records.

In order to investigate the agreement between parent-reported and actigraphy values, we used the Bland and Altman method (Bland & Altman, 1999, 2010). We calculated the mean differences between the data collected by both methods (i.e., Mean [CSHQ-Actigraphy]) and also the superior and inferior limits of agreement ($\pm$ 1.96 x SD). Figures 1 to 6 plot the mean differences between both methods (CSHQ-Actigraphy) as a function of the average values between both methods (mean [CSHQ; Actigraphy]) for each of the considered parameters (Figure 1: Bedtime during the week, Figure 2: Bedtime during the weekend, Figure 3: Wake-up time during the week, Figure 4: Wake-up time during the weekend, Figure 5: Sleep duration, Figure 6: Minutes awake after sleep onset). Based on previous studies (e.g., Werner et al., 2008), we defined 30 minutes as an acceptable difference between the measures.

Table 3: Associations between parallel variables both recorded by actigraphy and reported by the parents

			Actigraph					
			Bedime		Wakeup time		Total sleep time	WASO
			W	WD	W	WD		
CSHQ	Bedtime	Week	.75**	.58***	.53**	.34	-.22	-.07
		WD	.67***	.57***	.47**	.43*	-.13	.03
	Wakeup time	Week	.49**	.49**	.86***	.59***	.12	.14
		WD	.39*	.28	.76***	.64***	.14	.24
	Total sleep time		.10	-.08	.09	.25	-.08	.33
	WASO		.12	.10	.08	.20	-.07	.28

W – week; WD – weekends; WASO – minutes awake after sleep onset

Figure 1: Graphic representation of the agreement rates between actigraphy and maternal reports for bedtime during weekdays

(A)

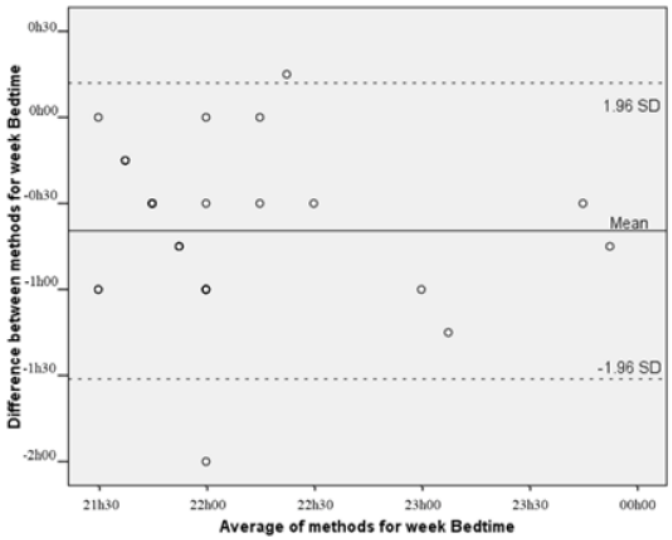


Figure 2: Graphic representation of the agreement rates between actigraphy and maternal reports for bedtime during the weekend

(B)

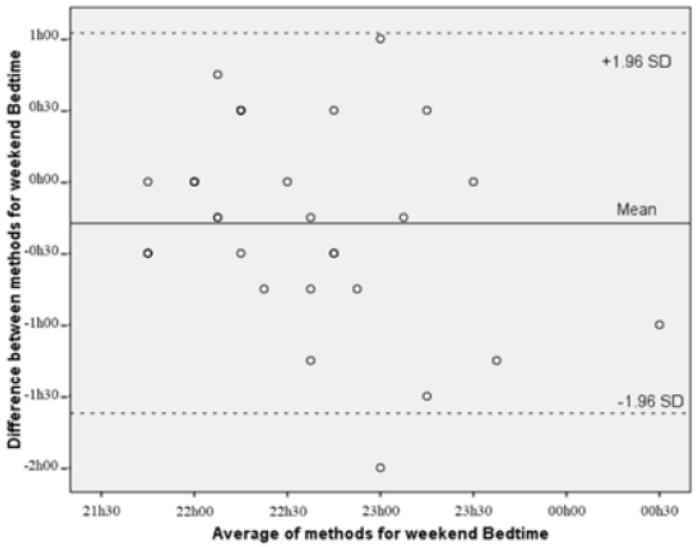


Figure 3: Graphic representation of the agreement rates between actigraphy and maternal reports for wake-up times during weekdays

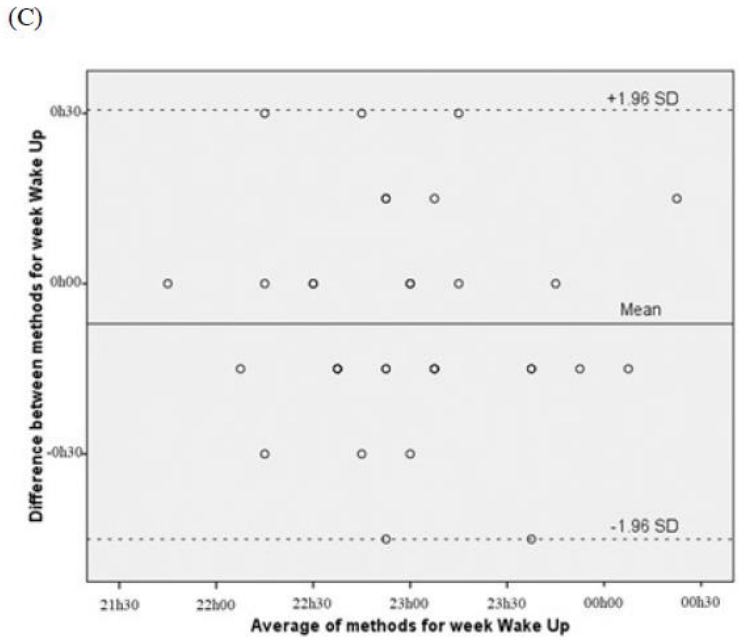


Figure 4: Graphic representation of the agreement rates between actigraphy and maternal reports for wake-up times during the weekend

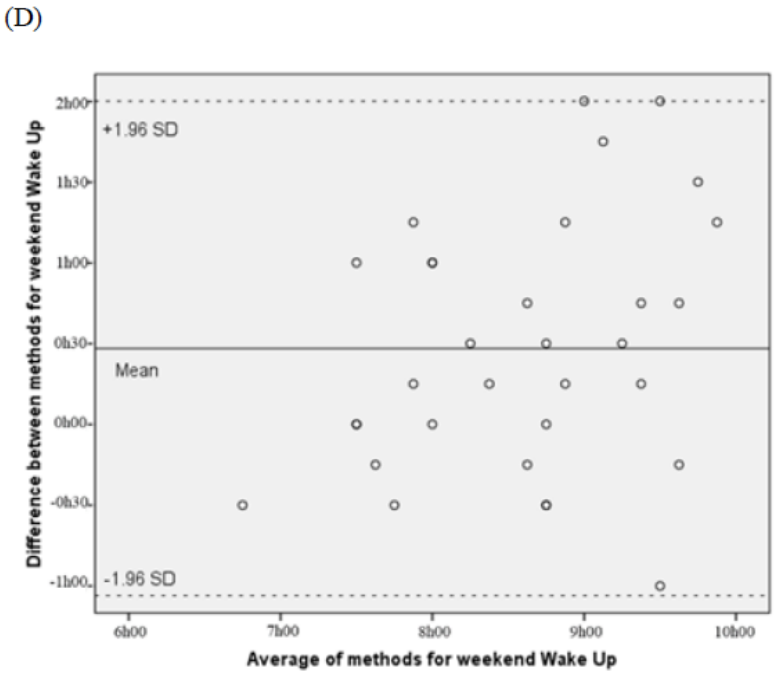


Figure 5: Graphic representation of the agreement rates between actigraphy and maternal reports for total sleep duration

(E)

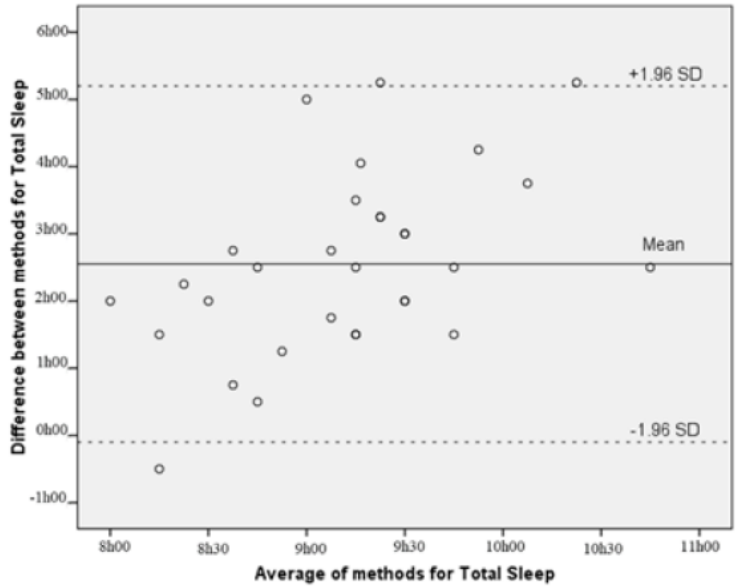
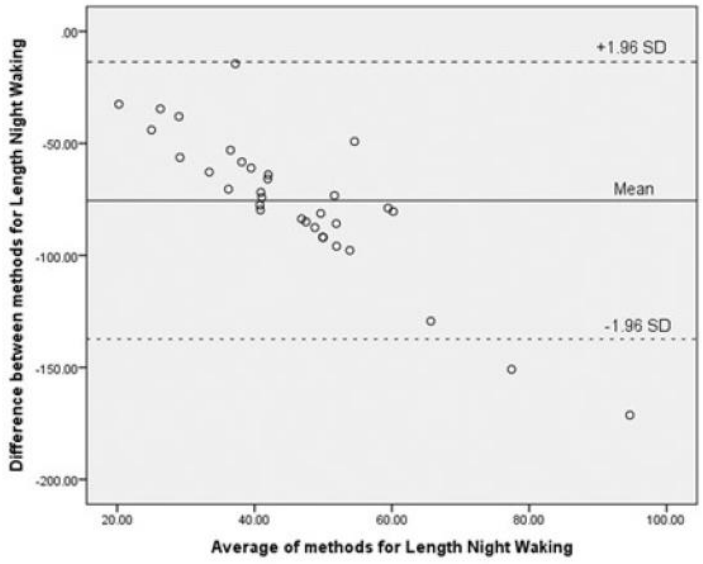


Figure 6: Graphic representation of the agreement rates between actigraphy and maternal reports for minutes awake after sleep onset

(F)



Except for weekly wake-up time (see Table 4), there was no satisfactory agreement between the parental reports and the actigraphy measures. During the week, parents reported a

mean wake-up time occurring 7 minutes earlier (*SD* = 0:19 min) than the mean actigraphy wake-up time. The difference between the methods is higher for weekends, when parents reported wake-up times, on average, 28 minutes (*SD* = 0:47 min) later than the actigraphs (see Table 4).

Table 4: Means of the differences between methods and agreement limits at 95%

		M	**SD**	**Inferior limit**	**Superior limit**	**Interval**
Bedtime	Week	-0:40	0:26	-1:31	0:12	± 0:52
	Weekend	-0:17	0:41	-1:37	1:02	± 1:20
Wake up time	Week	-0:07	0:19	-0:45	0:31	± 0:38
	Weekend	0:28	0:47	-1:04	2:00	± 0:32
Total sleep time		2:33	1:21	-0:06	5:12	± 2:39
WASO		-1:16	0:32	-2:17	-0:14	± 1:02

WASO – minutes awake after sleep onset

Concerning total sleep time and minutes awake after sleep onset, the longer the child slept and the longer the night-wakings lasted, the greater was the difference between both methods (β = .49, p < .01 and β = -.88, p < .001, respectively). Therefore, we detected a linear relation between the average sleep duration and minutes awake after sleep onset, and between-method differences. This represents a serious threat to a parametric Bland and Altman analysis. For this reason, we relied on the non-parametric approach (Bland & Altman, 1999, 2010) for this sleep variables. Results showed that, for total sleep duration, only 6.5% of the pairs of observations showed a difference of 30 minutes or less, while for 25.8% of the pairs the difference was of 1 hour and 30 minutes or less. For 67.7% of the pairs of observations, the differences between parental reports and actigraphy were greater than 01:30. For minutes awake after sleep onset, only 3% of the paired observations had differences smaller than 30 minutes, while for 27% the differences were smaller than 1 hour. For 70% of the paired observations, the differences between methods were greater than 1 hour.

Discussion

The present study aimed to explore sleep patterns in preschool children and to compare results derived from objective (i.e., actigraphy) and subjective (i.e., CSHQ) sleep assessment methods. Beginning with the characterization of sleep parameters, descriptive results were in line with previous literature suggesting that children go to bed and wake up later during weekends than on school nights and days (Fukuda et al., 2019; Gaina et al., 2005; Randler et al., 2012), which might be linked to stricter impositions on wake-up times during the week, determined by school-start times. Conversely, during weekends, sleep routines tend to be more flexible. Although in our sample children go to bed and wake up later than reported on a recent meta-analysis by Galland et al. (2018), their sleep efficiency (81%) lays on the interval established by those authors for children between the ages of 3 and 14. With regards to sleep patterns across different ages, according to the parents, older children presented shorter sleep durations, less bedtime resistance, fewer night-wakings and globally less sleep problems. Actigraphy results show that older children also spend less time in bed. These results reflect the acting maturational processes that occur during the preschool years, ultimately leading to the establishment of more organized, stable, and less disrupted sleep patterns (Holley et al., 2010; Iglowstein et al., 2003; Sadeh, 2000; Silva et al., 2018).

Concerning the exploration of the correlations between objective sleep parameters, and behavioral sleep dimensions, some noteworthy results were found. Children who, according to actigraphy, slept more at night, were described by the parents as having less bedtime-resistant behaviors. Equivalent findings were obtained by Holley et al (2010) in a sample of older children. The higher display of *bedtime resistance* may be both a cause and a consequence of shorter sleep durations among children. On the one hand, a child who sleeps fewer hours, may possibly experience higher levels of daytime sleepiness, then becoming more irritable during the day, and this could be reflected in reluctance going to bed at night (Nathanson & Beyens, 2018). On the other hand, a child who resists going to bed may consequently delay sleep start time, which translates to less total sleep durations (Coulombe & Reid, 2014). Actigraphy results for total sleep duration and sleep efficiency were also associated with parents reporting globally less *sleep problems*, suggesting that these parameters might be important when considering the behavioral quality of sleep problems (El-Sheikh & Sadeh, 2015; Kouros & El-Sheikh, 2017; Owens et al., 2000; 48, 49). Sleep efficiency was also correlated with lesser bedtime resistance, which may indicate that a child who peacefully accepts bedtime may have fewer difficulties initiating and/or maintaining sleep, thus spending asleep most of the time in bed. Finally,

decreased sleep efficiency was associated with a greater occurrence of behavioral manifestations related to *night-wakings*. Children who interrupt their sleep and whose behaviors make parents aware of the night-waking may spend more time awake in the middle of the night, decreasing sleep efficiency.

In the present study, night-wakings were assessed by three different indicators: actigraphy *minutes awake after sleep onset* (WASO), CSHQ night-wakings duration (parents answered to the question: "How long does the child take to fall asleep again after a night-waking?") and CSHQ dimension *night-wakings*, with questions such as if the child moves to another one's bed and if she wakes up repeatedly. Although we found significant differences between actigraphy *minutes awake after sleep onset* and CSHQ typical duration of a night-waking, actigraphy WASO was significantly correlated with the behavioral *night-waking* scale, meaning that the longer a child was awake during the night, the more the parents tended to recognize problematic behaviors around night-wakings. This may be due to the child requesting parental intervention. A longer WASO also associated with parental reports of more *sleep duration instability* and *parasomnias*, suggesting that behavioral aspects linked to this kind of sleep disruption may translate into increased motor activity during the night, reflected on a higher WASO (Holley et al., 2010).

Considering the analyses of the differences between the data collected by both methods in parallel variables, our findings were consistent with the literature. As previously reported, (Tikotzky & Sadeh, 2001), despite the existence of significant correlations between actigraphy and parental reports for sleep schedule variables (i.e., bedtime, wake-up time), the differences between them were also significant, with the parents reporting consistently earlier bedtimes and later wake-up times than actigraphy (Betrocci et al., 2005; Crabtree et al., 2003; Lam et al., 2011). Considering bedtime, this particular trend may indicate that parents generally assume that the child falls asleep as soon as she goes to bed, and they do not consider sleep onset latencies in their estimations of the bedtime.

We also found significant differences between both methods regarding *sleep duration* and *minutes awake after sleep onset*. Parental overestimation of child's sleep duration reflected the occurrence of unnoticed night-wakings and constant reports of earlier bedtimes and later wake-up times when compared to actigraphy (Iwasaki et al., 2010; Lam et al., 2011). The discrepancy regarding *minutes awake after sleep onset* is in line with other studies (Asaka & Takada, 2011; Hall et al., 2015; Holley & Hill, 2010; Werner et al., 2008), even for children

during the first year (Tikotzky & Volkovich, 2019). This discrepancy may be due either to a tendency of actigraphy to mistakenly overestimate night-wakings in the child's sleep is restless (9) or to a parental inability to report then, as the child's growing self-regulation tools allow her to resume sleep without requesting parental intervention. Additionally, given that our participants came from a population without diagnosed sleep problems and their parents tended to evaluate their sleep quality as good, parents may not have felt the need to monitor the night-wakings so closely. This explanatory hypothesis is strengthened by Kushnir and Sadeh (2017), who proposed that the existence of diagnosed sleep problems makes parents more vigilant and sensitive when monitoring and reporting child's sleep than parents of good sleepers.

Regarding the agreement rates between both methods (Bland & Altman, 1999, 2010), we did not find satisfactory agreements for any of the considered variables, except for wake-up times during the week (the difference was near the 30-minute reference interval) (Werner et al., 2008). The few studies evaluating agreement between parallel variables measured by actigraphy and parental reports presented mixed findings (Bélanger et al., 2018; Müller et al., 2008; Tikotzky & Volkovich, 2019; Werner et al., 2008). Tikotzky and Volkovich (2019) obtained satisfactory agreement between actigraphy and questionnaires for children until hey were 18 months old. Werner et al. (2008) attained satisfactory agreement intervals for bedtimes and wake-up times, but not for sleep duration and *wake after sleep onset*, while Bélanger et al. (53), in line with our results, did not obtain concordance for any of the measured patterns. In our study, differences in the nature of actigraphy and CSHQ assessment of sleep may help explain the discordance. Actigraphy recorded motor activity data continuously for 7 days, while CSHQ elicited global parental perceptions about the same 7 days. However, it has been established that parental answers to retrospective questionnaires are often vague and imprecise (Werner et al., 2008), what contrasts with the nature of actigraphy assessment. Simultaneously, actigraphy's registers are continuous, recording phenomena that occur outside parental awareness, particularly night-wakings that are not signalized by the child.

Overall, our results suggest that the complementary use of actigraphy and parental reports may configure an advantage in sleep assessments, both in research and in clinical contexts. Although parental reports can provide relevant reports of behavioral dimensions encompassing child's sleep, actigraphy is able to overcome gaps in parental perceptions estimating sleep parameters that are dependent on parental awareness and child signaling. We believe that the joint use of both kinds of measures is especially relevant at preschool age, a time when sleep regulation becomes less dependent on parents and, therefore, parents may not

be capable of providing a complete and accurate report on child's sleep. Then, exploring to what extent these methods are discrepant from one another might be useful to better understand children's sleep patterns and contexts, as well as for identifying sleep problems.

Limitations, strengths, and future directions

The findings of the present study should be regarded in the context of its limitations. First, our relatively small-sized sample was recruited from a middle-class population, which limits the interpretation and generalization of the results. Second, for the purpose of comparing parallel data collected by objective and subjective instruments, it would have been important to consider data collected via sleep diaries. Sleep diaries pertain to daily registers, and therefore are more easily comparable to actigraphy data. However, we based our comparisons in a questionnaire that invites parents to formulate a generic retrospective answer about the child's sleep schedules (i.e., bedtime and wake-up time), sleep duration, and night-wakings' duration. This could also explain the lack of agreement obtained. We then suggest that future studies should collect data through actigraphy, sleep diaries, and a parental-reported questionnaire in larger and more heterogeneous samples.

Despite these limitations, our study is notable for being the first to evaluate associations between objective sleep parameters and behavioral sleep dimensions associated with sleep habits and routines in preschool-aged children. Making sense of these associations constitutes an important improvement in the understanding of the specific contributions of both methods of child's sleep assessment, in both research and clinical contexts, given the importance of sleep in different domains of cognitive, social and emotional development.

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Chapter IV:

Attachment representations and sleep in preschool age – An exploratory study of parental sociodemographic moderators

Abstract

Although the importance of feeling an inner sense of security has been acknowledged as a fundamental factor facilitating the onset and maintenance of sleep, the relations between secure representations of attachment and sleep quality have been understudied. The inconsistency of the findings suggests that the associations between attachment and sleep may not be the same for all children, as sleep is impacted by inner and external influences. Therefore, the aim of this study is to explore the moderating role of parental sociodemographic factors (i.e., age, education, and working hours) in this association. Forty-three preschool children (53.3% girls; mean age = 4 years and 11 months, SD = 10.2 months) and their parents participated in our study. Children's attachment representations were assessed with the Attachment Story Completion Task (ASCT; Bretherton et al., 1990), and sleep was measured by actigraphy (7 days) and Children's Sleep Habits Questionnaire (Owens et al., 2000). Parents responded to a sociodemographic questionnaire to assess potential moderators. Our results find evidence suggestive of a moderating role of father's age and mother's education in several sleep parameters. The results are discussed considering attachment theory and of the transactional model of sleep-wake regulation.

Keywords:

Attachment; Sleep; Actigraphy; Attachment story completion task; Parental age; Parental education; Parental working hours

Hush, little baby, don't say a word,
Mamma's gonna buy you a mockingbird.
And if that mockingbird doesn't sing
Pappa's gonna buy you a diamond ring.
- Traditional lullaby (U.S.A.)

Introduction

During the early years of life, children devote most of their time to sleep, spending more time asleep than in playing and learning activities, or even interacting with others (e.g., Matricciani et al., 2013). Despite the relevance of sleep for neurodevelopment (e.g., Lokhandwala & Spencer, 2022) and behavioral regulation (e.g., Dahl & Lewin, 2002), sleep-related problems, such as insufficient duration or poor sleep quality (Dewald et al., 2010) are recurrent in childhood, representing a foremost parental concern for which they seek professional help (Bayer et al., 2007; Mindell et al., 2010). Aside from negatively impacting family functioning (Peltz et al., 2016), sleep problems potentially have repercussions in a multiplicity of domains in child development (Schlieber & Han, 2021; Williamson et al., 2021). It is therefore crucial to identify the factors that can affect sleep, to better inform intervention plans to reduce the impacts of sleep problems in child development and later adjustment.

Sleep dimensions and assessment

Sleep duration has been one of the most studied sleep variables (El-Sheikh & Sadeh, 2015; Hirshkowitz et al., 2015), as it has been demonstrated to relate to numerous dimensions of child development (see Chaput et al., 2017 for a review). For example, children with shorter sleep durations tend to have higher body mass indexes and increased risk of being overweight (Zhang et al., 2021), more depressive symptoms (Sivertsen et al., 2021), decreased school readiness (Jackson et al., 2021) and higher rates of socioemotional and behavioral problems (Hysing et al., 2016; Tomisaki et al., 2018; Zheng et al., 2021) than children with longer sleep durations. The wide impact of sleep duration in nearly all dimensions of a child's life can be understood considering the influence sleep exerts in nervous system maturation and brain architecture, such as in prefrontal cortex and other cortical and subcortical areas (Horne, 1993). However, sleep duration is far from being the only relevant sleep variable. Later bedtimes and wake-up times, for example, associate with an increased probability of problematic behaviors (Yakomaku et al., 2008), even though later bedtimes do not necessarily equal shorter sleep

durations. Also, sleep dimensions related to sleep fragmentation, such as number and length of night-wakings, are associated with the emergence of health issues (Hsu, 2017) and with increased risks for behavioral, emotional, and conduct problems (Reynaud et al., 2017; Scher et al., 2005).

Objective sleep assessment instruments, such as actigraphy, allow for reliable measures of sleep start and end times, sleep onset latency, sleep duration and efficiency, as well as frequency and length of night-wakings. Besides, being a minimally invasive device, sleep assessment over multiple nights in the child's natural sleep environment is made possible (e.g., Ancoli-Israel et al., 2003; Sadeh et al., 2005). As such, objectively recorded data are considered more accurate regarding the sleep dimensions than parental reports that, in turn, are dependent on parental awareness and recall (for sleep timing and duration), and on child signaling (for night-wakings) (Acebo et al., 1999). However, parental reports can provide extremely valuable information regarding intertwined environmental and behavioral aspects of sleep (Owens et al., 2000; Sadeh, 2011, 2015), as bedtime resistant behaviors that can result in delayed bedtimes and sleep anxiety that can stimulate the occurrence of night-wakings. Considering the complexity of child's sleep and its closed relations with the family dynamics, a more complete measurement approach combines both objective records and parental reports of child's sleep in complementarity (e.g., Perpétuo et al., 2020).

Given the importance of child's sleep and the high incidence of sleep-related problems during childhood, authors have been concerned in identifying the factors that underlie good sleep quality.

Attachment and sleep

According to attachment theory (Bowlby, 1969/1982, 1973, 1980), attachment relationship is co-constructed and consolidated within continuous dyadic experiences and daily exchanges between the child and one (or few) preferential caregiver(s), usually the parent(s). As a strong and enduring bond, attachment serves the function of ensuring proximity between an immature dependent child and a protective caregiver, who provides the child with the security she needs to explore the world. In turn, when the child feels discomforted as being confronted with uncertainty, threat, or danger, she rapidly returns to the attachment figure(s) for reassurance (secure base phenomenon).

As the child grows older and develops the capacity of forming mental representations, specific attachment representations based on early and continuous interactions with the caregivers – internal working models (IWM) – take shape. Internal working models equip the child with a representational mechanism that operates relationship data based on early established relationships (Vaughn et al., 2019). This means that, as the child experiences the caregiver(s) as consistently providing appropriate responses to her interactive initiatives, interests, and comforting her when needed, she will develop corresponding secure attachment representations. Likewise, she also develops concordant internal working models of herself and the caregivers, that tend to be generalized for others. Likely, the child will see herself as valuable and worthy of love and respect, as the caregiver(s) is(are) seen as available and responsive, and the external world is experienced as generally predictable and benevolent (Vaughn et al., 2019). Otherwise, if the child experiences the caregiver(s) as repeatedly unstable or inappropriate, with diminished interest in the child's activities and lack of acceptance of her immaturity, the child will likely develop corresponding insecure internal working models. The child's self is then seen as unvaluable and unworthy, while the caregivers are experienced as unreliable and unpredictable, therefore others should not be trusted.

Noteworthy, attachment security has been shown to place the child at a more prosper developmental trajectory than attachment insecurity, revealing associations with better developmental outcomes. For example, securely attached children tend to exhibit better health indicators, while the insecurely attached present more sedentary behaviors (e.g., Lamson et al., 2020) and higher levels of salivary inflammatory markers (e.g., Measelle & Ablow, 2018). Attachment also has implications in the development of executive functioning (e.g., Matte-Gagné et al., 2018; Regueiro et al., 2020) and in academic performance (e.g., Dindo et al., 2017; Moss & St-Laurent, 2021). Regarding behavioral regulation and social competence, as insecurely attached children show higher manifestations of internalizing and externalizing behaviors (Deneault et al., 2022; Fearon & Belsky 2011), then being at a higher risk for playing bully roles (Elliot & Cornell, 2009), securely attached children show higher rates of prosocial behavior (Zarella et al., 2016) and better overall social competence (Borowksi et al., 2021; Fernandes et al., 2020).

Research that has tried to uncover the relations between attachment and sleep is sparce and communicates inconsistent results (see Perpétuo et al., 2021 for a systematic review; Simard et al., 2017 for a systematic review and meta-analysis). Some studies found that securely attached children have better overall sleep, sleeping longer and more efficiently as objectively

recorded (Bélanger et al., 2015; Vaughn et al., 2011), and displaying shorter and less frequent night-wakings (Bernier et al., 2014; Simard et al., 2013; Vaughn et al., 2011) than insecurely attached children. Children classified as insecure-ambivalent, in turn, have longer maternal reported night-wakings (Simard et al., 2013), while children with disorganized attachment patterns are reported to have later bedtimes and shorter sleep durations than their securely attached counterparts (Pennestri et al., 2015).

According to the framework developed by Dahl (1996), insecure attachment configures one possible cause of sleep disturbance, posing insecurely attached children at a greater risk of developing sleep problems. Insecurely attached children may experience intense fears of being alone and unable to access a caregiver who meets their needs for care and relatedness, as they tend to see others as untrustworthy and unreliable. In line with this view, these kinds of feelings that constitute threats or worries can contribute to the development of sleep problems as they activate the nervous system, preventing the child being able to relax and fall asleep. This potentially translates in later bedtimes and, consequently, shorter sleep durations. Furthermore, night-wakings can be understood as proximity-seeking behaviors that help the child counterbalance the arousal derived from the night-time separation from the caregivers (Keller, 2011). In contrast, children with secure attachment representations, who believe that their parents will provide adequate care if needed, and therefore develop less relationship-related worries, can find it easier to smoothly transition to sleep, as well as to maintain sleep through the night.

However, not all studies found associations between attachment and sleep. In some studies, actigraphy-recorded dimensions such as sleep duration, longest period of uninterrupted sleep, time in bed or wake-up time (Bélanger et al., 2015; Bernier et al., 2014; Simard et al., 2013) and parental-reported sleep dimensions (Weinraub et al., 2012) did not relate do attachment. One of the reasons that could explain the inconsistency of those results relates to the multiplicity of sleep variables and instruments used to assess them across the studies (Perpétuo et al., 2021). This issue points to questions about the definition and operationalization of what constitutes a good enough sleep (El-Sheikh et al., 2015), as well as to the possibility that attachment relationships can influence some sleep dimensions but not others in different developmental periods. Another possible reason underlying the inconsistency of the findings could be that the links between attachment and sleep are moderated by factors that were not included in previous studies. One study reported that attachment security predicted less sleep problems only among children with high temperamental negative emotionality (Troxel et al.,

2013), stressing that the connections between attachment and sleep may not be homogeneous for all children and the importance of exploring potential moderators in this association.

Parental factors as moderators of the relations between attachment and sleep

According to the transactional model of sleep-wake regulation (Sadeh & Anders, 1993), grounded on the ecological approach to human development (Bronfenbrenner, 1977) and on the transactional systems model (Sameroff, 1989; Sameroff & Emde, 1989), child sleep is highly sensitive to broad family factors. This model proposes a complex etiology to sleep problems, suggesting that they mirror the dynamic interactions between the child and her social environment, that is conceptualized in distinct levels of influence (Sadeh & Anders, 1993). As such, different factors – either more extrinsic and distal (e.g., cultural perceptions and expectations, social norms and demands, parental work and social status), proximal (e.g., parental factors such as personality or psychopathology) or intrinsic (i.e., child's constitutional and maturational factors) – are proposed to impact sleep. This model attributes special relevance to parent-child relationships, specifically attachment relationship, mediating the impacts of the referred factors on sleep regulation. Thus, although being considered a more distal influence, external factors frequently account for differences in developmental outcomes through their impacts on parenting (Bronstein et al., 2003; Floyd & Saitzyk, 1992). The present study is then interested in exploring parental factors, included in the external system, that could moderate the relations between attachment and sleep.

Parental age

During the last decades, childbearing age has been increasing throughout the world (Bui & Miller, 2018; Hamilton et al., 2019) as a result of the improved efficacy in birth control methods, of the greater accessibility to extended education and increasing life expectancy (Denick et al., 2008). Although having older parents seems to place the child in an adverse developmental trajectory regarding physical (Gale-Grant et al., 2020; Shaw et al., 2012; Zondervan-Zwijnenburg et al., 2020) and mental health (Tearne et al., 2015; Tearne et al., 2016), this trend seems to follow the opposite direction to most of the child outcomes. For example, children of older mothers tend to have better performances in cognitive tasks, while children of mothers younger than 24 years tend to perform poorer (Du et al., 2022).

Correspondingly, younger maternal age is associated with a higher frequency of child behavioral problems (Du et al., 2021; McGrath et al., 2014), while older maternal age associates with less conduct problems (Tearne et al., 2015) and fewer socio-emotional difficulties (Trillingsgaard & Sommer, 2018). Some studies found an U-shaped relation between parental age and child outcomes as attention problems, educational achievement (Veldkamp et al., 2020) and psychopathology (Merikandas et al., 2017), disfavoring the children of both the youngest and of the older parents.

Psychosocial explanations have been advanced, suggesting that older parents generally hold more positive affects towards parenting (Sommer, 2001; Trillingsgaard & Sommer, 2018) and take on more benevolent parenting behaviors (Ragozin et al., 1992). Furthermore, older maternal age associates with greater personal maturity (Camberis et al., 2014), emotional stability (Carstensen et al., 2011) and to maternal sensitivity (Camberis et al., 2016; Scholmer & Belsky, 2012), essential for the development of secure attachment relationships (Bernier et al., 2010; Bornstein et al., 2011).

Parental age may also affect sleep, as suggested in a recent systematic review (Newton et al., 2020). However, the results are sparse and inconsistent. One study reported an U-shaped function describing the relations between maternal age and sleep. As such, children of younger and older mothers tended to sleep for fewer hours than children of mothers aged between 25 and 34 years (Costanian et al., 2017). Other study found younger maternal age, but not older, predicted more sleep problems when the child was 18 and 30 months old (O' Connor et al., 2017). In turn, older mothers seem to describe more night-wakings in their children than younger mothers (Pollock, 1994).

Parental education

Parental educational attainment concerns a set of subjective resources, such as levels of acquired knowledge, cultural preferences, and lifestyle habits (Grandner et al., 2015; Liberatos et al., 1988). It has then been recognized as a robust indicator of the family's socioeconomic status (Bradley et al., 1989), with an important role in the prediction of parent-related behaviors (Currie & Moretti, 2003) and sleep problems (see Newton et al., 2020 for a systematic review). Research suggests that children of parents with lower levels of education are more likely to sleep for less hours (e.g., Chang & Chiang, 2020; McDonald et al., 2014) and to experience longer and more frequent night-wakings (Simard et al., 2013; Warren et al., 2006). This could

be a result of parents with higher educational attainments being commonly more aware of the importance of sleep, and consequently being more proactive promoting healthier patterns of sleep behaviors and dealing with sleep disturbance (El-Sheikh et al., 2013). Moreover, parents with higher educational levels seem to more emotionally and verbally responsive to their children, allowing them more opportunities for adequate stimulation and a greater variety of play materials (Bradley & Corwyn, 2002). This, in turn, could possibly contribute to the establishment of secure attachment relationships.

Parental working hours

Following the same trend as education, maternal employment has increased dramatically over the last years (Pilkauskas et al., 2018), raising the number of working couples. Most of the studies have been focusing on maternal employment status rather than in parental working hours (see Goldberg et al., 2008 for a meta-analysis). Research findings indicate, for example, that having both parents unemployed poses children at a higher risk for problem behaviors than if on or both parents are employed (Hope et al., 2014). In turn, maternal employment seems to render favorable outcomes for children, being associated with positive changes in academic progress and social development (Schmitt et al., 1999).

Although research have been focusing on maternal employment status, the number of hours the parents spend at work emerges as a relevant factor to be studied, particularly in societal contexts were both parents are working during their offspring's childhood. In Portugal, most of the couples work full-time, depicting a challenge for parenting, as parents must match their work schedules with the ones of childcare institutions. Parents that work for more hours spend more time away from parenting and from the child who, in turn, spend more time under the care of others. Research on this topic suggests that children of mothers who work full-time seem to have more cognitive difficulties (Brooks-Gunn et al., 2010) and to display more behavioral problems (Hadzic et al., 2013). This might be attributable to the presence of higher levels of fatigue in parents working for long shifts, making them less able to monitor their preschool children's needs and behaviors than those who work for less hours (Cabrera et al., 2014). However, it has also been established that work has a positive impact in adult like, as it brings self-fulfillment and financial return which, consequently, proportionate more favorable living environments and diverse benefits for children (Coley et al., 2007). This may help to understand the reason why some studies found that full-time work relates to enhanced child

cognitive and behavioral functioning (e.g., Lombardy & Coley, 2013). Maternal part-time work seem to be the best arrangement for children, as mothers working in part-time jobs are found to be more sensitive (Buehler et al., 2014), to be warmer and to adopt more sensitive parenting practices (Hadzic, et al., 2013), while their children show enhanced motor and social development (Lightbody & Williamson, 2017).

Study aims

The primary goal of the present study was to contribute to the understanding of the relations between attachment and sleep in preschool-aged children. The first aim, specifically, was to investigate the associations between preschoolers' representations of attachment and diverse objective and subjective sleep parameters. We also characterized child's sleep, exploring correlations among sleep dimensions. Objective parameters related to the quantity and quality of sleep were recorded via actigraphy, while parental perceptions of child's sleep problems were assessed by the Children's Sleep Habits Questionnaire (Owens et al., 2000). Next, we examined the associations between attachment representations, sleep, parental age, education and working hours. Considering that both parents play a crucial role in child development, parental age, education and working hours were assessed for both mothers and fathers. Last, we explored the role of those sociodemographic variables as moderators of the associations between attachment and sleep. No *a priori* directions of the effects were established.

The focus on the developmental period of preschool age comprises the nature of the phenomena intended to study. The transition from the usual family environment to an increasingly less supportive preschool context, where the adults' attention is divided by the child and his/her peers may pose a challenge for the attachment system (Vaughn et al., 2011). Concomitantly, the redefinition of the parent-child relationship into a goal-corrected partnership, made possible by the constitution of internal working models of attachment, allows securely attached children to tolerate longer separations from the caregivers. Otherwise, the insecurely attached, who may find separations from the caregivers more frightening and painful, may struggle during this period, as well as in night-time separations, when the child is required to stay alone in the dark for the night. Furthermore, although at preschool age sleep is generally consolidated (Acebo et al., 2005; Mindel et al., 2015; Paavonen et al., 2020), it is also

increasingly subjected to the adult schedules and daycare timings and routines, posing new demands and further adjustments to sleep regulation.

Method

Participants

The participants of the present study were 43 children (53.3% girls), who lived and attended preschool care in Lisbon area, and their parents. The study protocol was approved by the preschool care institutions where the children were recruited by our university's research ethics committee. Written informed consent was provided by the parents. Children's mean age was 59 months (4 years and 11 months; *SD* = 10.2 months; *min*. = 39 months, *max*. = 79 months) at the moment of data collection and they spent an average of 8.34 hours per day in preschool (*SD* = .834, *min*. = 7 hours, *max*. = 10 hours). Most of the children come from intact families (87.2%), with both parents living in the same household as a couple, and 51.4% were first borns.

Upon recruitment, maternal age varied between 23 and 46 years (*M* = 37.67, *SD* = 5.01) and the age of the father varied between 26 and 52 years (*M* = 38.97, SD = 5.38). Maternal education was on average 15.40 years (*SD* = 3.58, *min.* = 6, *max*. = 21), and parental education was 13.32 years (*SD* = 3.34, *min*. = 6, *max* = 17). Specifically, 11.1% of the mothers (vs. 21.6% of the fathers) concluded less than the 10^{th} grade, 19.4% (vs. 35.1%) had completed high school, 19.5% (vs. 5.4%) hold a college degree and 50.1% (vs. 37.8%) were post-graduated. The bulk of the parents are employed (92.3% of the mothers and 97.4% of the fathers). The mothers worked on average for 34.62 weekly hours (*SD* = 11.89), approximately corresponding to 7 hours per day, and fathers worked a mean of 38.64 hours per week (*SD* = 9.14, approximately 8 daily hours).

Instruments

Attachment Story Completion Task

The Attachment Story Completion Task (ASCT; Bretherton et al., 1990) was used to assess representations of attachment that are relevant to use the caregivers as a secure base to explore, and as haven of safety to return to in times of distress. The children were invited to accompany one researcher to a quiet room at the school, with a child-size table, where the ASCT

was administered individually to each child. A brief explanation convened that, first, the child would listen to the beginning of a story and, then, she would tell the rest while playing with the aid of wooden family figures (two children, mother, father, and a female neighbour) and props (e.g., furniture, car). The child figures were named by the child and matched by her gender. After these first instructions, the session began with a birthday-party themed warm-up story, followed by 5 attachment-relevant story stems designed to elicit attachment representations (*Spilled juice*, *Hurt knee*, *Monster in the bedroom*, *Separation*, and *Reunion*). For this study, three stories were considered for scoring. The *Monster in the bedroom* story depicts a scene where the family is watching television in the evening, and when the child goes to sleep, it suddenly gets dark and finds a monster in the bedroom. The *Separation* and *Reunion* stories were presented in a sequence, where the parents were going on a small trip and returning the next day. Meanwhile, the children were left at home under the care of a neighbour, who would watch them overnight.

After being presented with each story stem, the child was asked to enact the resolution through the instruction *"Show me and tell me what happens next*". In order to clarify some secure base script aspects, some prompts could be introduced by the researcher, formulated as not to suggest specific responses, such as: clarifications about the correspondence between the situation and the experienced affect (e.g., *How did he/she feel when he/she found a monster in the bedroom?*); redirecting on the story issue when the child failed to produce a response (e.g., *What happened after daddy and mommy left?*); eliciting elucidation when the child spoke of undefined characters (e.g., *Who sent the monster away?*); evoking a resolution when the child diverts from the story sequence (e.g., *How does the story end?*).

The session was videotaped and later coded by an independent researcher from the team for the presence and quality of the secure base script (Vaughn et al., 2019; Waters & Waters, 2006). The scores ranged from 1 to 7. A score of 1 resembles unusual or aberrant stories that might include role reversals, overt failure of the attachment figure to protect the child and/or the child being unable to perceive the attachment relevance of the elements rendered by the narrative. Oppositely, a score of 7 is assigned that implies a secure base exploration and a safe haven when required, with any signs of ambivalence of anger between the child and the attachment figure. A score of 3, in turn, indicates that the narrative lacks a secure base theme, but ambivalence and/or anger between the child and the attachment figure is also absent. A single score was attributed to the set of all three narratives that condenses the child's access and use of the secure base script.

Wecshler Preschool and Primary Scale of Intelligence

Aiming at controlling for potential effects of plausible differences in lexical capacity and verbal comprehension on the narrative quality, the verbal subscale of the *Wecshler Preschool and Primary Scale of Intelligence* (WPPSI; Portuguese version Seabra-Santos et al., 2003).

Actiwatch 2 Philips Respironics

Sleep parameters were recorded in child natural sleep environment by the Actiwatch 2 (Philips Respironics, Murrysville, PA), a watch-like shaped device that the children wore continuously for 7 days in their non-dominant wrist. The actiwatch is equipped with an accelerometer that gathered motor activity data that is then automatically coded into sleep and wake in 60 seconds epochs by the embedded software (Actiware 6.0.9, Philips Respironics). The scoring was made using a default parameter of 40 counts per epoch, considered a medium sensitivity, since night-wakings are underestimated by high sensitivity and overestimated by low sensitivity.

A validated algorithm classifies sleep onset as the first period of 10 consecutive immobile minutes and sleep offset as the last of the final 10 consecutive immobile minutes, allowing the estimation of a variety of sleep parameters. In the present study, we focused on: (a) bedtime – the start time of the largest sleep interval in a 24-hr period; (b) sleep onset latency – the interval that goes from the time the child goes to bed (known by the pressing of an event marker button on the actiwatch) to the time of sleep onset; (c) wake-up time – the end time of the largest rest interval in the considered 24-hr period; (d) time in bed – the time spent in bed by the child (not necessarily sleeping); (e) total sleep time – time interval between sleep onset and sleep offset; (f) sleep efficiency – calculation of the total sleep time divided by the time in bed, then multiplied by 100; (g) wake after sleep onset (WASO) – the total number of minutes scores as wake within the sleep intervals in a 24-hr period; (h) number of night-wakings – the total number of wake bouts within the sleep intervals in a 24-hr period.

Children's Sleep Habits Questionnaire

Parental perceptions of child sleep were assessed by the Children's Sleep Habits Questionnaire (CSHQ; Owens, Spirito, & McGuinn, 2000; Portuguese version Silva, Silva,

Braga, & Neto, 2013). The scale was designed to access sleep problems in children aged between 2 and 10 years. Aside from some items about bedtime, wake-up time, total sleep time, number and duration of night-wakings in a typical week, the questionnaire comprises a 3 point-Likert scale describing sleep-related behaviors distributed in 7 dimensions: *Bedtime resistance* (α = .14), detailing behaviors that delay bedtime, requiring parental presence to fall asleep, etc.; *Sleep duration* (α = .56), comprising parental perception about how satisfactory is the amount of sleep that the child is getting; *Sleep anxiety* (α = -.03), expressing night-related fears; child behaviors during *Night-wakings* (α = .96); *Parasomnia* (α = .85), depicting specific symptoms, such as wetting the bed, grinding the teeth, night terrors, etc.; symptoms of *Sleep Disordered Breathing* (α = .80) and behaviors that suggest *Daytime sleepiness* (α = .86). The total sleep problem score (α = .94) was used in the analyses. Parents were asked to answer about the frequency of their occurrence in a typical week (1 – rarely, 2 – sometimes [2-4 times per week], 3 – usually [5-7 times per week]), with higher scores indicating a more disturbed sleep.

Procedure

A telephonic contact was established with the childcare institutions and, following a brief outline on the project, a meeting was scheduled. After, a letter of presentation of the project and the informed consents were placed in the children's schoolbags. Data collection for each child started with the administration of the WPPSI and the ASCT session was scheduled to happen no more than a week apart. Each individual session lasted between 20 and 30 minutes. In the day previous to the ASCT application, a researcher contacted the caregiver by the telephone contact provided in the informed consent. The researcher notified the parents that the actigraph would be lodged in the child's wrist the next day by a member of the team and instructed them on how to fulfil a sleep diary, calling their attention to the importance of reporting any unusual occurrence (e.g., later bedtime due to birthday party, medication intake, long car ride, flu, etc.). Parents were also asked to complete a sociodemographic questionnaire and the Children's Sleep Habits Questionnaire. One last phone call was made on the 6th day of actigraphy assessment to remember that the actiwatch, as well as the questionnaires, would be picked during the next day, and to thank them for the participation in person. A brief report of the child's sleep parameters was delivered to the families as an appreciation gesture.

Results

Descriptive statistics

The secure base script scores ranged from 1 to 7 (M = 4, SD = 1.85), with 54.8% of the children holding secure base script representations. For 45.2% of the children, the secure base script was considered absent. No differences were found between girls and boys for attachment representations ($t(40)$ = -.66, p = .51). Means, standard deviations, and range of scores for actigraphy recorded data and parent-reports on sleep parameters and sleep problems scores are presented in Table 1.

Table 1: Means, standard deviations, and range values for sleep parameters and sleep problem scores

		M	SD	Min	Max
Actigraphy	Bedtime (hr)	22:23	00:37	20:43	24:15
	Wake-up time (hr)	08:06	00:45	05:49	09:14
	Time in bed (hr)	09:43	00:45	08:26	11:17
	Total sleep time (hr)	07:58	00:46	06:31	10:11
	Sleep onset latency (min)	6.8	5.6	.1	20.3
	Sleep efficiency (%)	82	5.4	69.6	92.4
	Minutes awake after sleep onset	83.6	29.0	36.0	159.4
	Nº night wakings	34.0	6.9	18.9	52.9
CSHQ	Bedtime (hr)	22:04	00:31	21:00	23:30
	Wake-up time (hr)	07:21	00:44	06:45	10:30
	Total sleep time (hr)	10:30	01:06	08:00	13:00
	Minutes awake after sleep onset	9.94	11.24	1	60
	Sleep problem score	87.32	18.61	69	186

Intercorrelations between sleep parameters and scores and correlations among the study variables

Attachment security was correlated to the verbal IQ score (r = .40, p = .012), so this was accounted as a covariate in the moderation analyses. However, attachment security did not

associate with any of the study variables. Intercorrelations among the sleep parameters are presented in the Table 2, showing that generally, children who go to bed later tend to take more time to fall asleep, wake-up later, but sleep for less hours and less efficiently, waking up more frequently and for longer periods during the night.

Table 3 shows the associations between sleep parameters and parental sociodemographic variables. Maternal age associated marginally with the actigraphy recorded minutes awake after sleep onset (WASO) (r = -.29, p = .089), meaning that children with older mothers tend to resume sleep more quickly after a night-waking, and with parental reported sleep duration (r = -.36, p = .054), meaning that older mothers tend to report shorter sleep durations for their children. Father age correlated to several sleep parameters, indicating that children of older fathers tend to wake-up earlier in the morning when wake-up time is objectively estimated (r = -.35, p = .038), tend to have lower sleep efficiency (r = -.31, p = .072). However, they also tend to wake-up fewer times (r = -.31, p = .069) and to resume sleep more rapidly than children of younger fathers, both when the length of the night-wakings is objectively recorded (r = -.29, p = .095) and subjectively reported (r = -.42, p = .011). Regarding parental education, higher levels of mother schooling are marginally associated with later bedtimes (r = .33, p = .065). Furthermore, both maternal and paternal education are positively and significantly associated with higher levels of sleep efficiency (r = .45, p = .009; r = .45, p = .008, correspondingly). Last, longer maternal working hours associated marginally with shorter sleep onset latencies (r = -.29, p = .100) and earlier parental reported wake-up times (r = -.31, p = .068).

Moderation models

Analyses of moderation were conducted using the PROCESS macro extension of SPSS. Several models were tested, considering attachment secure base script as the predictor variable, controlling for the verbal IQ. All sleep parameters were tested as outcome variables and the six referred sociodemographic variables were inserted as moderators. Johnson-Neymann technique was applied to determine the upper and lower boundaries of the region of significance (Preacher, Curran, & Bauer, 2006). Figure 1 illustrates the tested models.

Table 2: Intercorrelations among actigraphy and parent-reports of sleep

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1.Bedtime[(a)]	1												
2.Wake time[(a)]	.41**	1											
3.Time in bed[(a)]	-.42**	.66**	1										
4. Total sleep time[(a)]	-.45**	.45**	.72**	1									
5.Sleep latency[(a)]	.27©	.30©	.08	-.07	1								
6.Sleep efficiency[(a)]	.38*	.35*	.04	.58**	.05	1							
7.WASO [(a)]	-.06	.35*	.40*	-.33*	.01	-.34*	1						
8.Night-wakings[(a)]	.02	.45**	.44**	-.13	.01	-.03	.78**	1					
9.Bedtime[(b)]	.49**	-.23	.20	.13	-.32©	-.05	.12	.04	1				
10.Wake time[(b)]	.29	.11	-.14	-.39*	.24	-.21	.33©	.33©	-.15	1			
11. Sleep duration[(b)]	-.10	.16	.23	-.06	-.11	-.36©	.42*	.17	.12	.18	1		
12. WASO[(b)]	-.22	-.32©	-.12	.06	-.25	-.03	-.21	-.05	-.02	-.01	-.040	1	
13. Sleep problem score[(b)]	.20	.31©	.14	.21	-.11	.18	-.01	.33©	.07	.10	-.05	-.14	1

(a) Assessed by actigraphy; (b) assessed by parental reports; WASO – minutes awake after sleep onset; ***p*< .01, **p*< .05, ©*p*< .10

Table 3: Correlations between sleep indicators and parental sociodemographic variables

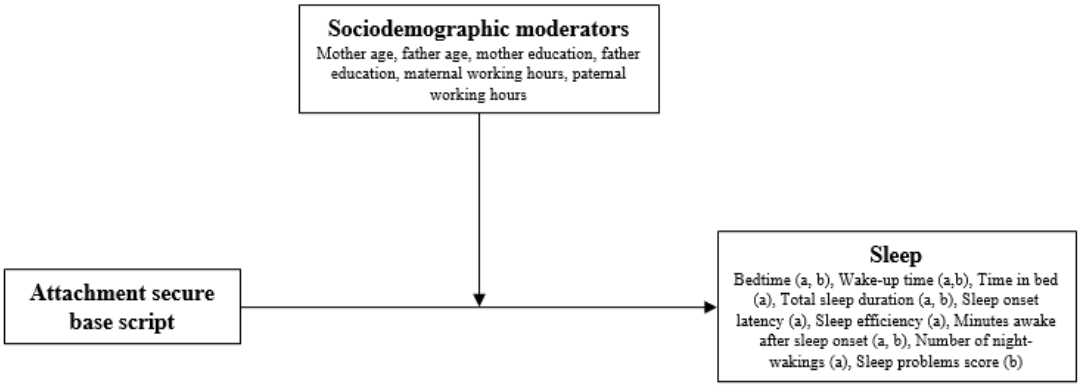
	Mother age	Father age	Mother education	Father education	Mother working hours	Father working hours
Bedtime (a)	.09	-.08	.33(c)	.21	-.21	-.02
Wake time (a)	-.04	-.35*	.12	-.04	-.22	-.14
Time in bed (a)	-.11	-.27	-.16	-.22	-.04	-.12
Total sleep time (a)	.07	-.10	-.11	-.05	.03	.08
Sleep latency (a)	.21	.11	.05	-.08	-.29(c)	.01
Sleep efficiency (a)	.22	-.31(c)	.45**	.45**	-.05	-.15
WASO (a)	-.29(c)	-.29(c)	-.12	-.22	-.07	.02
Night-wakings (a)	-.15	-.31(c)	.17	-.10	-.07	.07
Bedtime (b)	-.06	-.07	-.02	-.11	-.03	-.16
Wake time (b)	.06	-.01	.04	.08	-.31(c)	-.07
Sleep duration (b)	-.36(c)	-.15	-.19	-.20	-.01	-.12
WASO (b)	-.26	-.42*	-.20	-.04	-.07	-.01
Sleep problems score (b)	.19	.21	.07	-.03	-.11	.19

(a) assessed by actigraphy; (b) assessed by parental questionnaire; ** $p < .01$; * $p < .05$, (c) $p < .10$. WASO stands for minutes awake after sleep onset

Maternal age as a moderator

Maternal age was a significant moderator of the relation between attachment and *minutes awake after sleep onset* reported by the parents (Table 4). The association between attachment and the duration of the night-wakings is illustrated in Figure 2, where it shows to be significant only for mothers younger than 33 years old and for mothers older than 43. For the

Figure 1: Diagram of the moderation models with attachment as the predictor variable, sociodemographic variables as moderators and sleep as the outcome variable



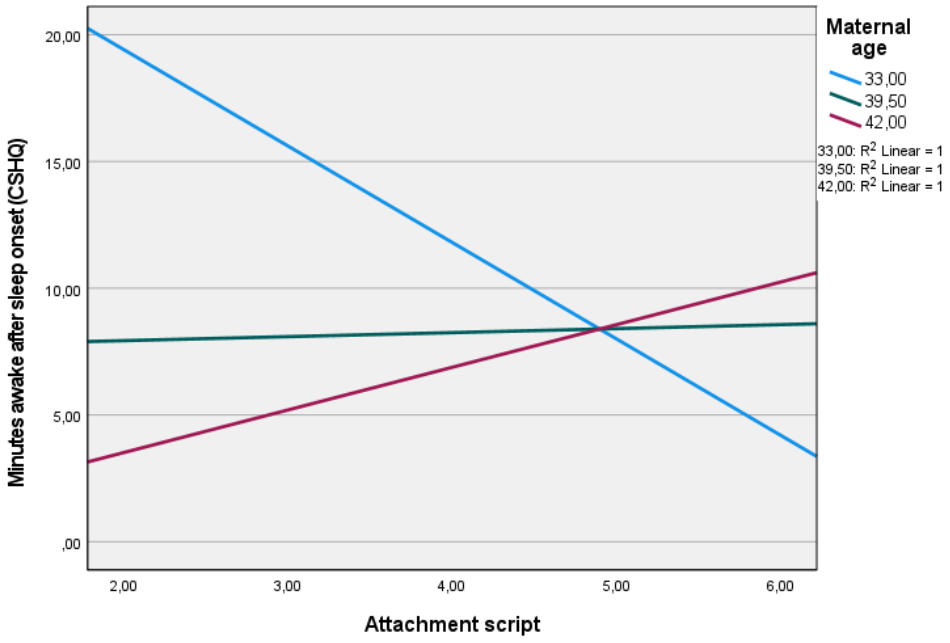
(a) for actigraphy-recorded variables; (b) for parental reported variables

younger mother-age group, insecure attachment associates with longer night-wakings, while securely attached children show shorter parental-reported night-wakings. However, in older mother age group (age > 43 years), the trend is opposite. Children with secure attachment representations are reported to have slightly longer night-wakings than children with insecure attachment representations.

Table 4: Results from the regression analysis examining the moderation of the effect of attachment security on parental-reported duration of night-wakings by maternal age

	Coeff.	SE	*t*	*p*
Constant	107.05	37.16	2.88	.007
Attachment (X)	-23.89	9.53	-2.51	.018
Maternal age (W)	-2.08	1.02	-2.93	.007
Attachment x Maternal age (XW)	.61	.24	2.49	.019
Verbal IQ (covariate)	.17	.14	1.26	.217
			R^2 = .25, *MSE* = 114.22	
			F (4, 29) = 2.35, *p* = .07	

Figure 2: Graphic representation of the moderation effect of the relations between attachment secure base script and parental reported minutes awake after sleep onset by maternal age



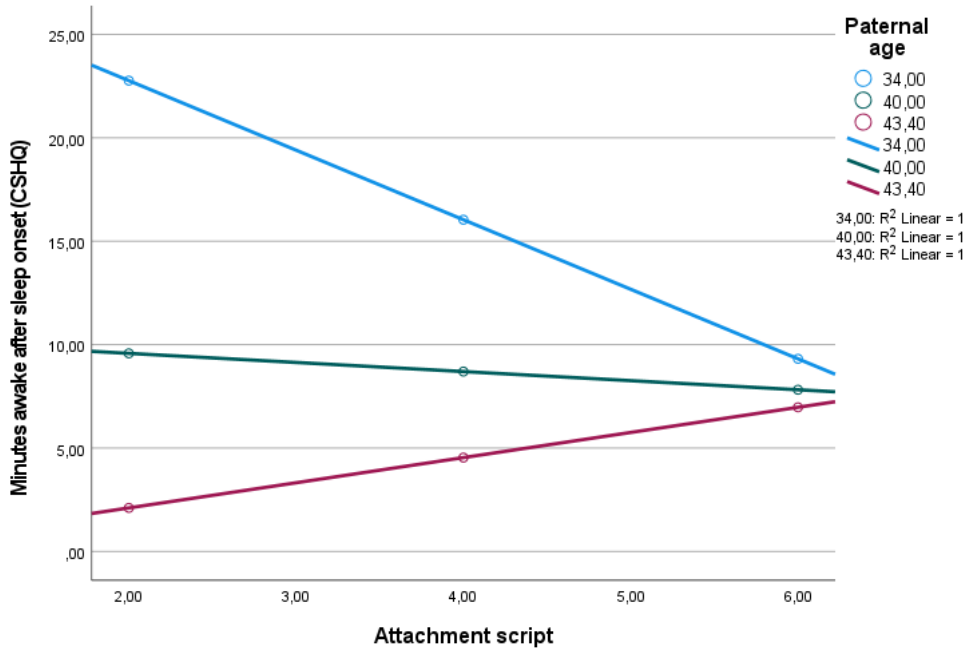
Paternal age as a moderator

Similarly, the age of the father was also a significant moderator of the relation between attachment and parental reported minutes awake after sleep onset. This association is significant only for fathers younger than 35-years old and older than 49 (Table 5). For the younger group, insecure attachment representations associate with longer night-wakings, while secure attachment relates to shorter night-wakings. However, in the older paternal age group (> 49), the trend is inverse. Children with secure attachment relationships and older fathers have slightly longer night-wakings than children with insecure attachment representations. The moderation effect is pictured in Figure 3.

Table 5: Results from the regression analysis examining the moderation of the effect of attachment security on parental-reported minutes awake after sleep onset by paternal age

	Coeff.	SE	*t*	*p*
Constant	121.97	35.38	3.45	.002
Attachment (X)	-19.92	7.32	-2.72	.011
Paternal age (W)	-3.17	.89	-3.57	.001
Attachment x Paternal age (XW)	.49	.18	2.69	.012
Verbal IQ (covariate)	.14	.12	1.19	.245
			R^2 = .36, *MSE* = 96.74	
			F (4, 29) = 2.35, *p* = .009	

Figure 3: Graphic representation of the moderation effect of the relations between attachment secure base script and parental reported minutes awake after sleep onset by paternal age



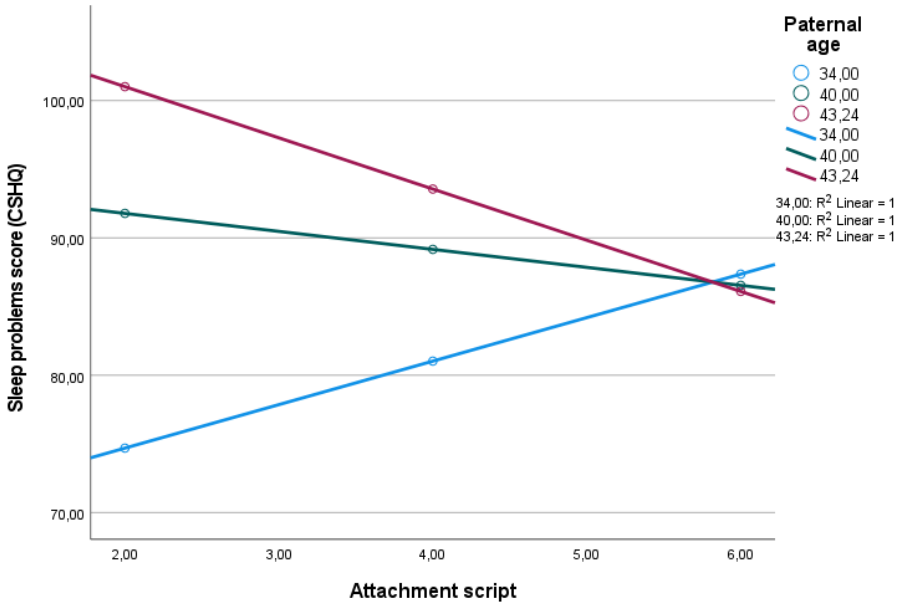
Paternal age was also a significant moderator of the relation between attachment representations and parental reported sleep problems (Table 6). The association between attachment security and parental reported sleep problems is only significant for children of

fathers older than 44-years old. For this group, children with secure attachment representations have less sleep problems than children for whom the secure base script is absent. However, the trend is inverse for children of younger fathers. Figure 4 reports the described relations.

Table 6: Results from the regression analysis examining the moderation of the effect of attachment security on parental-reported sleep problems by paternal age

	Coeff.	SE	*t*	*p*
Constant	-41.81	62.10	-.67	.506
Attachment (X)	28.54	12.90	2.21	.035
Paternal age (W)	4.34	1.56	2.78	.009
Attachment x Paternal age (XW)	-.75	.32	-2.34	.026
Verbal IQ (covariate)	-.34	.20	-1.69	.101
			R^2 = .28, *MSE* = 299.91	
			F (4, 30) = 2.88, *p* = .039	

Figure 4: Graphic representation of the moderation effect of the relations between attachment secure base script and parental reported sleep problems by paternal age

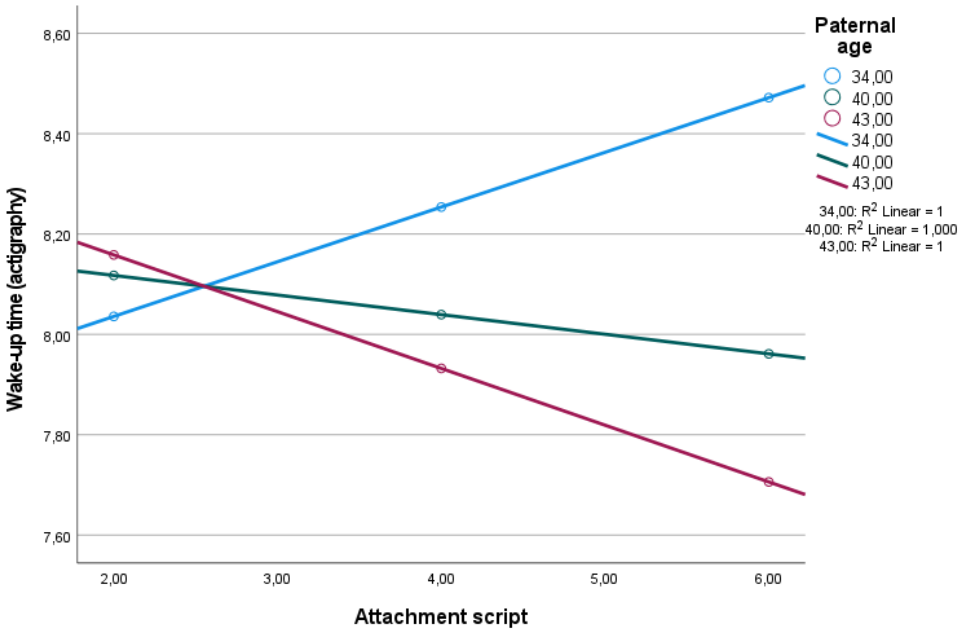


Besides, paternal age marginally moderated the association between attachment and actigraphy-recorded wake-up time (Table 7), meaning that for fathers older than 44 years old, children with secure attachments tend to wake-up earlier than children with insecure attachments. Figure 5 shows these relations.

Table 7: Results from the regression analysis examining the moderation of the effect of attachment security on actigraphy-recorded wake-up time by paternal age

	Coeff.	SE	*t*	*p*
Constant	6.34	2.46	2.56	.016
Attachment (X)	.95	.53	1.78	.087
Paternal age (W)	.06	.07	.97	.339
Attachment x Paternal age (XW)	-.03	.01	-1.89	.069
Verbal IQ (covariate)	-.01	.01	-.62	.541
			R^2 = .24, *MSE* = .53	
			F (4, 28) = 2.22, *p* = .093	

Figure 5: Graphic representation of the moderation effect of the relations between attachment secure base script and actigraphy-recorded wake-up time by paternal age

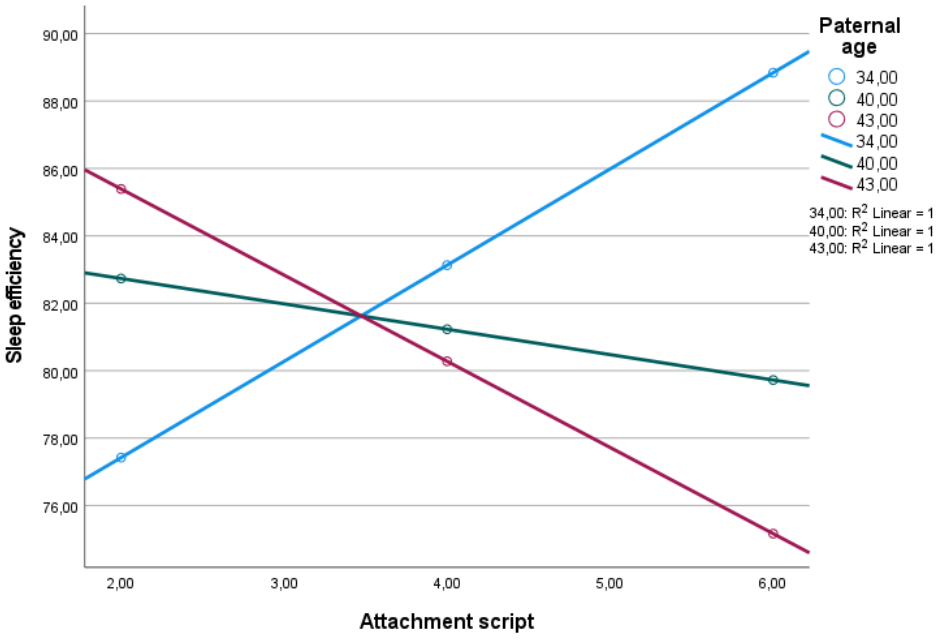


Finally, paternal age moderated the association between attachment and sleep efficiency (Table 8). More secure attachment representations link to higher sleep efficiency only for children of younger parents. In the case of older parents, higher attachment security relates to lower sleep efficiency. Figure 6 illustrates the moderation effect.

Table 8: Results from the regression analysis examining the moderation of the effect of attachment security on actigraphy recorded sleep efficiency by paternal age

	Coeff.	SE	*t*	*p*
Constant	7.04	27.55	.26	.800
Attachment (X)	23.30	5.98	3.90	.001
Paternal age (W)	2.09	.73	2.88	.008
Attachment x Paternal age (XW)	-.60	.15	-4.11	<.001
Verbal IQ (covariate)	-.06	.11	-.53	.600
			R^2 = .46, *MSE* = 66.55	
			F (4, 28) = 5.95, *p* = .001	

Figure 6: Graphic representation of the moderation effect of the relations between attachment secure base script and sleep efficiency by paternal age



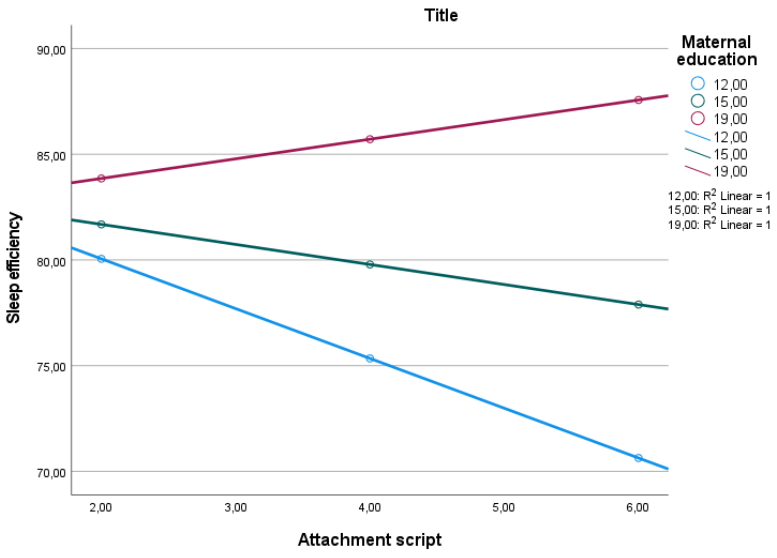
Maternal education as a moderator

Maternal education was found to moderate the association between attachment representations and sleep efficiency (Table 9). For highly educated mothers, attachment security is associated with better sleep efficiency, but not for mothers with less education. Figure 7 shows the graphic representation of the effect.

Table 9: Results from the regression analysis examining the moderation of the effect of attachment security on actigraphy recorded sleep efficiency by maternal education

	Coeff.	SE	*t*	*p*
Constant	106.08	14.09	7.53	<.001
Attachment (X)	-7.98	3.08	-2.59	.016
Paternal age (W)	-.40	1.05	-.38	.709
Attachment x Maternal education (XW)	.47	.21	2.29	.031
Verbal IQ (covariate)	-.15	.12	-1.27	.216
			R^2 = .51, *MSE* = 62.88	
			F (4, 26) = 6.65, *p* = .001	

Figure 7: Graphic representation of the moderation effect of the relations between attachment secure base script and sleep efficiency by maternal education



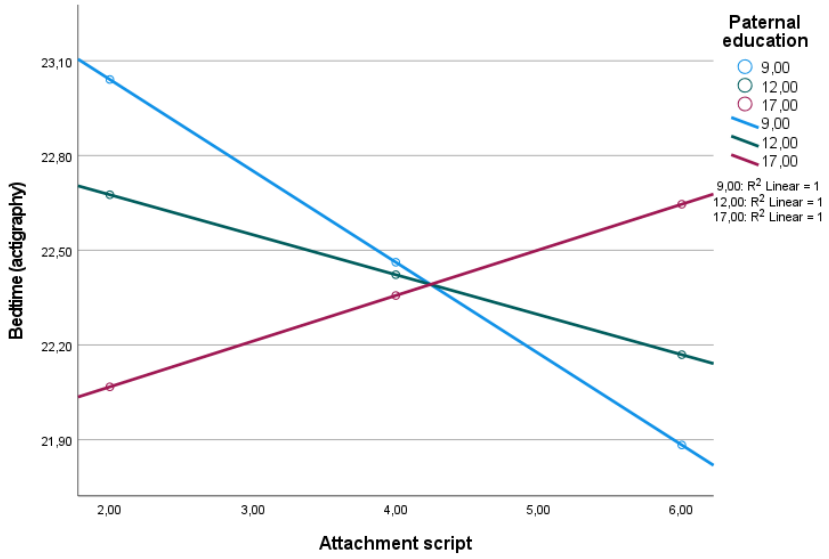
Paternal education

Paternal education was found to moderate the association between attachment and actigraphy-recorded bedtime (Table 10). The association is significant only for fathers with less education. In this group, higher attachment security associates with earlier bedtimes. Figure 8 depicts the effect.

Table 10: Results from the regression analysis examining the moderation of the effect of attachment security on actigraphy recorded bedtime by paternal education

	Coeff.	SE	*t*	*p*
Constant	25.13	1.34	18.82	<.001
Attachment (X)	-.78	.26	-2.97	.006
Paternal education (W)	-.23	.10	-2.32	.028
Attachment x Paternal education (XW)	.05	.02	2.77	.010
Verbal IQ (covariate)	.01	.01	.64	.527
			R^2 = .28, *MSE* = .36	
			F (4, 27) = 2.64, *p* = .056	

Figure 8: Graphic representation of the moderation effect of the relations between attachment secure base script and actigraphy recorded bedtime by paternal education

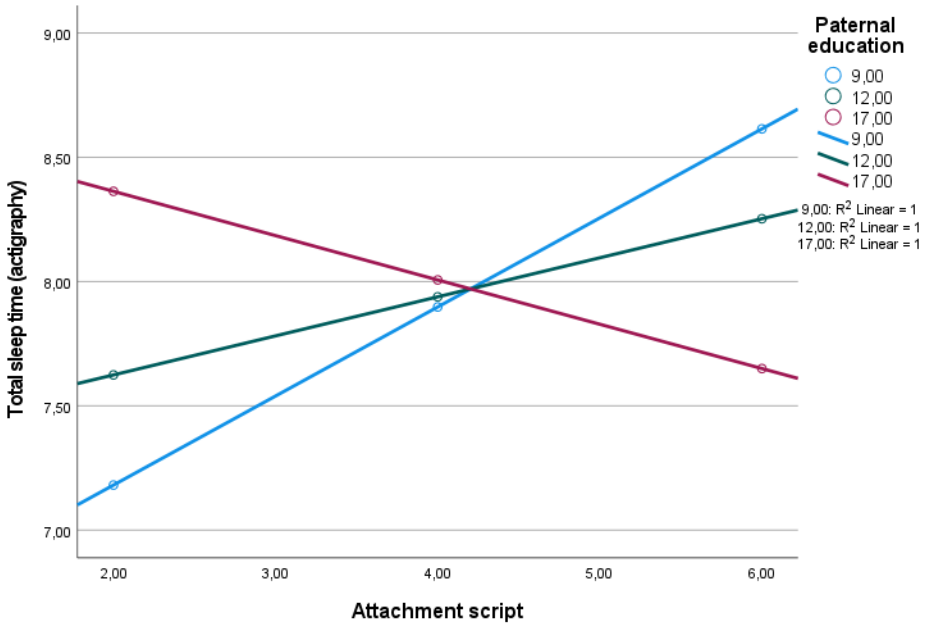


Paternal education was also found to moderate the association between attachment and objectively estimated total sleep time (Table 11). The relation was only significant for children whose fathers had lower education levels, with secure attachment representations being associated to longer sleep durations. Figure 9 depicts the relations.

Table 11: Results from the regression analysis examining the moderation of the effect of attachment security on actigraphy recorded total sleep time by paternal education

	Coeff.	SE	*t*	*p*
Constant	4.87	1.85	2.63	.014
Attachment (X)	.96	.39	2.47	.021
Paternal age (W)	.28	.14	2.08	.048
Attachment x Paternal education (XW)	-.07	.03	-2.34	.028
Verbal IQ (covariate)	-.01	.01	.83	.416
			R^2 = .20, *MSE* = .60	
			F (4, 26) = 1.60, *p* = .203	

Figure 9: Graphic representation of the moderation effect of the relations between attachment secure base script and actigraphy recorded total sleep time by paternal education



Discussion

Preschool age has been described as a period when prominent changes occur in sleep regulation, both structurally, with increases in non-REM sleep episodes (Lopp et al., 2017) and slow-wave activity being progressively replaced in frontal areas (Kurth et al., 2010), and behaviorally, with increases in total sleep duration (Bernier et al., 2019), sleep consolidation (Sheldon, 2006), and sleep efficiency (e.g., Schoelle et al., 2011). Adjustments in sleep architecture, along with important developmental (e.g., attachment relationships turning into goal-corrected partnerships) and contextual changes (e.g., transition to preschool) frame this period as particularly vulnerable to the emergence of sleep-related issues. Therefore, it is important for researchers to establish mechanisms that allow the clinicians to properly assess child sleep dimensions, as well as to understand the relational and ecological underpinnings of children's sleep quality.

Characterization of child's sleep

Following recommendations of recent studies (e.g., Perpétuo et al., 2020), in the present work child sleep was assessed objectively via actigraphy and subjectively through parental reports, in a complementary fashion. The obtained data raised at least two issues worth mentioning. The first one concerns the notable differences between the data collected by both assessment methods. Parents reported earlier bedtimes and wake-up times, as well as longer sleep durations, than actigraphy objectively recorded. Although a systematic comparison between different sleep assessment methods lies beyond the scope of the present work, we highlight the notorious gap between the average actigraphy total sleep duration of 07:58 and the parental report of 10:30 for the same variable. Considering that actigraphy allows a valid estimate for total sleep duration (e.g., Hyde et al., 2007), it is plausible that parents overestimated their offspring's sleep duration, as reported in previous studies (e.g., Kushnir & Sadeh, 2013; Tikotzky & Sadeh, 2001; Werner et al., 2008). The reasons behind this overestimation could be attributed to the retrospective nature of the inquiring, that in turn increases the odds of memory biases, and to social desirability biases. It is also possible that parents are not fully aware of the child's sleep duration, underestimating sleep latency and night-wakings. This issue is worth addressing once that parental overestimation of sleep durations may prevent them for noticing and/or seeking help for child sleep problems or adjusting sleep hygiene habits. The second issue concerns the seemingly insufficient amount of

sleep hat children are getting in the present sample, that is below the average sleep duration reported by a previous meta-analysis (Galland et al., 2018). The National Sleep Foundation states that, for preschool-aged children, an adequate sleep duration ranges from 10 to 13 hours, and considers sleep durations inferior to 8 hours to be insufficient for optimal development (Hirshkowitz et al., 2015). However, according to parental reports, the average sleep duration falls within the optimal range, so it may be useful to try to uncover how parental perceptions of child sleep associate with the presence of unnoticed sleep problems in future research.

One advantage of using actigraphy and parental reports jointly pertains the multiplicity of variables assessed. Their combined analysis allows a more detailed comprehension of the sleep phenomenon and of how sleep dimensions associate and clarify each other. Actigraphy recorded bedtimes and wake-up times appeared positively and significantly related, indicating that children who go to bed later tend to wake-up later. Besides, children who wake up later also tend to display longer actigraphy reported sleep latencies, more frequent and longer actigraphy recorded, and parental reported night-wakings. Thus, waking up later may configure a mechanism for compensating for difficult nights, characterized by later bedtimes and sleep onset times, that can be due to heightened bedtime resistance and uneasy settling, or by longer and frequent night-wakings. However, most of the children may not have the chance for compensating for a troubled night by extending wake-up times, given that rise times are mostly determined by school start times and parental work schedules during the week. This could help explain the association between later actigraphy bedtimes and shorter sleep durations.

Attachment and sleep

A robust body of literature had proposed that an inner sense of security would be crucial for the child to be able to fall and stay asleep through the night (e.g., Dahl, 1996). Following from that, we expected to find some associations between child attachment representations and sleep dimensions. However, the correlational analyses did not find any significant associations. Although some previous studies did not find significant associations either, between attachment security and actigraphy estimated sleep parameters (Bernier et al., 2014; Simard et al., 2013) or sleep problems (Weinraub et al., 2012), other studies did. One study found attachment security measured by the AQS (Waters & Deane, 1985) was positively related to actigraphy sleep minutes and efficiency (Bélanger et al., 2015). Two other studies found associations between ambivalent (Simard et al., 2013) and disorganized attachment (Pennestri et al., 2015) and the

frequency of night-wakings. Finally, one study that, such as the present one, assessed attachment representations in preschool-aged children with the ASCT (Bretherton et al., 1990), found positive associations between attachment security and sleep quantity variables (e.g., sleep duration) and sleep efficiency; and negative associations with variables indicative of poor sleep quality (e.g., minutes awake after sleep onset) (Vaughn et al., 2011).

In theory, these associations are in fact expectable, considering that secure attachment representations are thought to provide the child with a sense of inner security that may alleviate the stress raised by night-time separations (Anders, 1994) and facilitate the transition to sleep (Dahl, 1996). The absence of associations in the present data could then be understood since that the presence of unnoticed moderators may obscure the associations when the total sample is under consideration.

Attachment, sleep, and parental sociodemographic factors

Aiming to reach some insight about the effect of potential moderators, this study explored the role that parental sociodemographic variables – age, education and working hours – may play in the associations between attachment representations and sleep. Sociodemographic variables are usually accounted for as confounding factors, limiting the possibility to draw conclusions about their impacts in child's sleep. First, we started by investigating the correlations among those variables.

Again, attachment was not significantly correlated with any sociodemographic variable. Regarding maternal age, previous results are mixed. In some studies, maternal age did not emerge as a significant predictor of maternal factors that are known to be linked to the development of attachment security (e.g., DeWolff & van IJzendoorn, 1997), such as maternal sensitivity (Pederson et al., 1990) or maternal representations of their relationship to the child (Button et al., 2001). However, another study found that mothers who themselves hold secure attachment relationships tend to be older and more educated than their insecurely attached counterparts (Crandell et al., 1997). Although it is plausible that older and more educated mothers may benefit from greater psychological preparedness, life experience and resources (Camberis & McMahon, 2016), potentially facilitating the establishment of secure attachment relationships with the child, those findings surely require replication.

Parental working hours did not associate to attachment representations in our sample either. Some authors have suggested that parental employment, particularly maternal employment, may negatively impact the establishment of a secure attachment relationship (Belsky, 1988), as it reduces physical proximity between mother and infant during working hours (Kim & Wickrama, 2020) and reduces opportunities for the mother to learn about her child's signals and develop appropriate reciprocal interactions (Huston & Aronson, 2005). These studies, however, focus on younger children, for whom the continuous physical proximity to the mother is important for the establishment of a secure attachment relationship. During preschool age, as in our study, having formed internal working models of attachment, it is possible that sensitivity and daily consistency are more important to the maintenance of attachment security than the actual amount of time spent in the presence of the caregiver. Besides, when parents are working, children stay under the care of other familiar and trustable adults, such as grandparents and preschool caregivers, with whom they establish significant trust relationships as well. On the other hand, other parental work-related variables could be included in future studies, such as parental working schedules (e.g., irregularity, presence of night shifts, etc.).

Regarding sleep, maternal age was only marginally, and negatively, associated to actigraphy estimates of the minutes awake after sleep onset and parental reported sleep durations. Older mothers can be speculated to be more thorough while reporting sleep duration, in a way that the subjective overestimation of sleep duration is less pronounced. Older father age, in turn, related to earlier objectively reported wake-up times and shorter parental reported minutes awake after sleep onset. Both mother and father education associated with higher sleep efficiency. Maternal education has lately been linked with better child developmental and health outcomes (Bornstein et al., 2003; Currie & Moretti, 2003; Duncan et al., 2015; Prickett & Augustine, 2016), due to higher quality interactions between mother and child (Hoff et al., 2002) and greater knowledge about child health and development (Boyle et al., 2006; Ertem et al., 2007). It can be wondered that higher parental education renders parents to be more able to create conditions and routines that favour child sleep, deal with night-wakings and with child's sources of stress.

Parental age, education, and working hours as moderators

After the primary correlational analyses, we performed several moderation analyses to explore if parental sociodemographic variables stand out as significant moderators in the association between attachment and sleep. The associations between secure attachment representations and parental reported duration of night-wakings was significant only for children whose parents were older. For those, secure attachment representations related to longer parental reported night-wakings. Noteworthy, this effect did not emerge for actigraphy recorded night-wakings' number or duration. It is then possible that having a securely attached child and being an older parent tunes the parents to be more attentive to the occurrence of night-wakings. It is also conceivable that older parents are more affected by the effects of lack of sleep, rendering them more aware to night-waking events.

Secure attachment representations related to less parental reported sleep problems and earlier actigraphy wake-up times for children of older fathers. Older parental age has been proposed to exert a powerful influence in parental capacity to adequately deal with stressors (e.g., Plagnol, 2010) and to associate to a greater display of affection, along with fewer negative behaviors, towards the child (Conger et al., 1984). Then, older fathers of children that are securely attached may be more able to successful implement stable sleep habits and routines, and to dealing with sleep problems. It is not clear, however, why this pattern did not emerge for mother's age. Surprisingly, the security of attachment was associated with higher sleep efficiencies, only for children of younger fathers. One of the reasons behind this finding and for the absence of association for children of older fathers may be that depending on the father's age, different factors can impact child's sleep efficiency. In line with the literature suggesting that younger parents may be less mature and resourceful (e.g., McAdams & Olson, 2010) to dealing with child sleep, attachment security may become more important in the prediction of sleep efficiency. In turn, older parents could influence child's sleep efficiency providing a sense of security through factors other than attachment security. The interpretation of these results is, however, mostly speculative and demands further replication.

Attachment security showed to be associated with higher sleep efficiency only for children whose mothers had higher education levels, suggesting that attachment security along with maternal personal resources may jointly help children to improve sleep efficiency. The educational level of the father did not seem to interact with attachment security representations the same way as did maternal education. Attachment security correlated with earlier bedtimes

and longer total sleep times only for the group of children whose fathers were less educated. As we suggested for the younger parental age, it is possible that lower parental education, being a risk factor for the development of sleep-related problems, strengthens the relation between attachment and sleep. In turn, for fathers with higher educational attainments, other dimensions predictive of sleep quality may emerge, obscuring the influence of attachment security.

Limitations, strengths, and future directions

The results of the present work should be regarded in the context of its limitations. First, the sample size was too small, compromising the statistical power of the analyses and the generalization potential. However, concerning heterogeneity, data were collected in two schools that are representative of two different social and cultural backgrounds, conferring diversity to the sample.

Although using a multi-method and multi-informant approach to the assessment of child's sleep during a 7-day evaluation period with actigraphy, parental logs and a parent-report questionnaire, some limitations regarding sleep measurement need to be considered. First, although parental sleep diaries accompanied the actigraphy evaluation of sleep, the data collected by the sleep diary was not included in the present study. It would be useful to account for parental daily reports for variables such as bedtime, wake-up time, sleep duration and duration of night-wakings relying, instead of only one estimate for each variable assessed by the questionnaire. However, as we considered that the sleep diaries were built in a way provided a margin of error of one hour, we decided not to include those data in the analyses. Other issues regarding sleep assessment were that the present study did not assess daytime sleep parameters, that can impact and be impacted by night-time sleep parameters, and we also did not differentiate between week and weekend sleep. Future research should draw on these gaps, including data from sleep diaries, and obtaining information about daytime sleep and differences between week and weekend sleep.

Despite of the limitations, this study has also some notable strengths, as considering parental sociodemographic variables, that are usually considered as confounding variables, as potential moderators of the associations between attachment representations and sleep dimensions. This could represent a new direction in attachment and sleep research, given that previous studies have not yet made it possible to understand the impact of parental age, education and working hours in the relations between attachment and sleep. Last, the present

study considered mother and father age, education and working hours separately and found some actual differences between both, while most of the studies use a cumulative index combining maternal and paternal variables (Tétreault, Bernier, & Matte-Gagné, 2021). It can be thought that parental age, education and work may affect mothers and fathers differently, translating in distinct results for child outcomes. However, we are aware that although isolating the variables may be useful in an exploratory phase of research, the truth is that all the studies variables occur together and influence each other in a way that was impossible to assess with this study.

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Chapter V:

Attachment to mother and father, sleep, and well-being in late middle childhood

Abstract

Attachment relationship has been related to several developmental outcomes, such as the absence of sleep problems and diverse facets of well-being. However, few references in the literature concern the associations between attachment dimensions to both parents, sleep, and well-being in late middle childhood. Our study aims to expand knowledge in this area, clarifying the above-mentioned associations, considering secure base and safe haven dimensions of attachment. We also investigate the role of sleep as a mediator of the relations between attachment and well-being. The 258 participants (49.2% girls, mean age = 11.19, *SD* = .85) completed self-report questionnaires regarding attachment (KSS), sleep (SSR), and well-being (CHIP-CE). The results show significant associations between attachment to both parents (.40** $\leq r \leq$ .61**) and between attachment security, sleep (-.21** $\leq r \leq$ -.35**) and child well-being (.42** $\leq r$ .47**). Besides, sleep quality partially mediated the relations between all attachment dimensions to mother and father, and well-being. The results are discussed in light of the attachment theory, focusing on the comparison between attachment to mother and father, as a valid framework to unravel differences in child-well-being, with sleep as a process that can help to explain the mechanisms through which attachment security enable subjective perceptions of well-being.

Keywords: Attachment; Secure base support; Safe haven support; Sleep quality; Well-being; Late middle childhood

Mother, oh, and your father
Might get if I stay here too long
One kiss in the dark
And I'll be going
- Goodnight Sweetheart, The Spaniels

Introduction

Child well-being is an umbrella term covering a sense of subjective satisfaction with both general and specific domains of life (Navarro et al., 2015; Tay & Diener, 2011), such as social adaptation, mental/psychological and physical health. Considering the implications of well-being in child development (e.g., health, longevity, academic performance; Diener & Chan, 2011; Suldo & Shaffer, 2008; Suldo et al., 2011; Xu & Roberts, 2010), the concept's definition and operationalization is a priority in child development research. However, the multidimensional nature of the construct makes it difficult to measure and operationalize, allowing for different conceptualizations (Altshuler & Poertner, 2002). While some authors define it in terms of a latent construct measured, for example, by indexes of mental health (e.g., Busseri & Sadava, 2011) or psychological functioning (e.g., Ryff, 1989), others conceptualize it in broader terms to include physical, social, and environmental aspects (e.g., Keifer, 2008). However, across the variety of suggested child well-being definitions, White (2010) noted some consistency regarding a positive approach (e.g., capacity for experiencing positive emotions, positive interactions with others, social, and academic adaptation; Amato & Keith, 1991; Massé et al., 1998; and absence of negative affect or symptoms of mental distress; e.g., Brannan et al., 2013; Proctor et al., 2009), a holistic emphasis considering the interaction of the different elements and the value attributed to the subjective perceptions. In fact, the inherently subjective nature of well-being has led the authors to privilege self-report measurement approaches from middle childhood on (Bureau et al., 2020; Casas et al., 2013; Cremens et al., 2006; Moss et al., 2006). In our study, we relied on a well-established measure of well-being (CHIP-CE; Riley et al., 2004; Portuguese version Rodrigues & Apóstolo, 2010) that assessed satisfaction, self-esteem, physical symptoms, mental health, academic achievement, resilience, among others.

Late middle childhood or preadolescence (10-12 years) is a developmental period spanned by multiple changes that render children particularly vulnerable to stressors (e.g., Hostinar & Gunnar, 2013), potentially altering their own subjective perceptions of well-being. Accordingly, decreases in the subjective perception of well-being have been reported as the child enters preadolescence (e.g., Dodge & Sherril, 2006; Lin & Yi, 2018; Shoshani & Slone,

2012). At a bodily level, anatomic and physiological transformations accompanying the onset of puberty are triggered by neurochemical and hormonal processes that translate, for example, in changes in sleep cycles (e.g., Campbell et al., 2017; Carskadon, 2011), self-esteem (e.g., Dumontheil, 2016; Harter, 2012; Steinberg, 2005), and mood (e.g., Burkhart et al., 2017). At a social-relational sphere, the child's social world expands (e.g., Crosnoe & Johnson, 2011; Kerns & Brumariu, 2016) and a sense of autonomy from the primary figures increases, potentially altering attachment relationships with the parents. As dependency decreases and exploration of the environment takes a central role, the parents may need to adapt, balancing their control and guidance, and renegotiating the mutually acceptable levels of autonomy and relatedness in the relationship (Ammantini et al., 2000; Hay & Ashman, 2003; Kobak et al., 1993; Morris et al., 2007). Researchers agree that the relationships with the parents, often operationalized in terms of attachment relationships, are a determinant factor predicting child well-being, during late middle childhood, and future adjustment (Ainsworth et al., 1978; Barrera, 1986; Bugental & Grusec, 2006; Sroufe & Waters, 1977).

Attachment to parents and child well-being

Attachment theory has a highly relevant and well validated framework explaining individual differences in adjustment across the lifespan (e.g., Grossman et al., 2006; Mikulincer & Shaver, 2007) as a determinant factor in child physical/mental health and well-being (Hunter & Maunder, 2001; Mikulincer & Shaver, 2007; van IJzendoorn & Bakermans-Kranenburg, 1996). Empirical evidence suggests that attachment security associates with fewer psychiatric symptoms (Kerstis et al., 2018; Madigan et al., 2016), fewer adjustment, behavioral, internalizing, and externalizing problems (Fearon et al., 2010; Groh et al., 2012; Madigan et al., 2016; Sroufe, 1988). In a study with early adolescents and adolescents, attachment security was associated with a decreased vulnerability to negative affect and to feelings of loneliness (Al-Yagon, 2011). Regarding academic and peer competence, attachment security in late middle school children was associated with better scholastic, emotional, and total adjustment to school (Granot & Mayseless, 2001), socioemotional competence (Ranson & Urichuk, 2008), emotional understanding (Cooke et al., 2016), and to a better ability to tolerate frustration deriving from academic tasks without becoming overwhelmed (Kerns et al., 2000). Otherwise, insecure attachment associated with dysregulation of stress response (Gallo & Matthew, 2006), physiological hyperarousal (Anderson & Hines, 1994), less self-regulatory abilities (Heylen et

al., 2016), and to a non-specific vulnerability to stress together with maladaptive strategies to regulate dysphoric affect (West et al., 1986). Taken together, attachment security is negatively associated with multiple domains of well-being.

The competence hypothesis of attachment theory offers a comprehensive framework on the relations between attachment and well-being, suggesting that a secure relationship with primary caregivers place the child on a more positive developmental trajectory (Weinfield et al., 2008). This could impact child well-being in at least three ways. First, securely attached children form more positive relationships with peers, cooperate more with adults, and feel more confident about themselves, which frees up their internal resources for a confident exploration of the environment, one of the main developmental tasks of preadolescence (Kerns, 2008; Thompson, 2008; Weinfield et al., 2008). Second, because of their secure internalized models of relationships and of the others, securely attached children are better able to acknowledge stress and trust others enough to seek help when needed, then providing a sense of well-being. Last, internalized experiences of dyadic regulation allow the child to self-regulate emotions more effectively, impacting the way in which life events are appraised.

Although traditionally, developmental research has focused more on the role of the mother in child development, the importance of the father has consistently been shown empirically (e.g., Cardenas et al., 2022; Gniewosz et al., 2022; Meuwissen & Carlson, 2018; Steenhoff et al., 2021; van Lissa et al., 2019). However, few studies have been dedicated to understanding the role of child-father attachment in child development beyond the early years (e.g., Kamza, 2019; Psychogiou et al., 2018). Although security of attachment to mothers and fathers has shown to be significantly related (e.g., Fox et al., 1991), it is also true that children can be securely attached to one parent and not to the other (e.g., Bretherton, 1985; Dagan & Sagi-Schwartz, 2018) and that attachment to mothers and fathers can play distinct roles. For example, attachment to the mother seems to play a relevant role in emotional understanding, as well as in the integration of positive and negative feelings (Steele & Steele, 2005), in concordance with the attachment safe haven support function. In turn, attachment to the father seems to play a major role in supporting child's exploration of the environment (Grossman & Grossman, 2019), in line with attachment secure base support function (Bretherton, 2010; Verschueren, 2019). Therefore, we relied on an instrument capable of distinguishing attachment to mother and to father in the secure base and safe haven functions (Kerns et al., 2015) to study their independent contributions to child well-being. In preadolescence, the exploration of the environment is one major developmental task, however the needs for close emotional

connectedness are still very important, what may involve a renegotiation of the mutually accepted levels of proximity in the dyads (Kerns, 2008).

Sleep as a mediator of relations between attachment and well-being

Sleep is a complex bioregulatory system that is influenced by biological, familial, and broader societal factors (El-Sheikh & Sadeh, 2015; Sadeh & Anders, 1993). There is a recognized need in the field to examine sleep as a mediator of the associations between family relationships and child well-being (El-Sheikh & Kelly, 2017). Since attachment serves self-regulatory functions (Troxel et al., 2007), advancing research in this direction may extend understanding about the role of relationship factors in child development, particularly in health and well-being. Specifically, it would be important to understand how attachment relationships affect bioregulatory processes, such as sleep, and to what extent this could configure a mechanism through which attachment relationships impact well-being.

Using a well-established measure (SSR; Owens et al., 2000; Portuguese version Silva et al., 2013), the present study assesses multiple dimensions of sleep and its context through self-report: consistency in the timing of sleep (e.g., falling asleep around the same time each night), factors of the sleep environment (sleeping alone or co-sleeping with family members), sleep satisfaction (feeling that one obtains enough sleep), and daytime sleepiness (Owens et al., 2000). Based on common practice (Owens, 2000), a total score was used and is generally thought to reflect sleep quality.

Poor sleep quality is prevalent and confers risk for youths' well-being, mental health, cognitive, and academic functioning (El-Sheikh et al., 2019a, 2019b; Gradisar et al., 2011; Orchard et al., 2020). Importantly, both objective and self-reported sleep quality have significant consequences for adolescent outcomes, even beyond those of sleep duration. For example, poor sleep quality was associated with worse adjustment for adolescents and adults, even for those who had longer sleep duration (Lallukka et al., 2018). Additionally, when considered with other sleep parameters, self-reported sleep quality has emerged as a robust predictor of physical and mental health (Muzni et al., 2021). When measured appropriately, health takes into account not only the absence of disease, but the presence of wellness (Buysse, 2014). Sleep health, by extension, provides an opportunity for us to demonstrate what happens when sleep goes "right" – that is, to enumerate the positive outcomes, such as psychological

well-being, that may be accrued from sufficient, high-quality sleep among youth (Buysse, 2014; Kalak et al., 2014).

The associations between sleep and multiple facets of adjustment in preadolescence are well-established in the literature, indicating that good sleep quality is linked to many developmental outcomes. Specifically, longer sleep duration and better sleep quality are associated with higher levels of well-being, measured as psychological attitudes towards life, future, recent events, family life and friendships, both cross-sectionally and 6 months later (Kalak et al., 2014; Thumann et al., 2019). Conversely, shorter sleep durations predict lower self-esteem (Fredriksen et al., 2004), mental health problems (Alonzo et al., 2021; So et al., 2021) internalizing and externalizing problems (Kelly et al., 2022; Schochat et al., 2014), risky behaviors (Lai & Ma, 2019), somatic complaints (Norell-Clarke & Hagquist, 2018; Paiva et al., 2015) and poorer academic functioning (Short et al., 2018). Even minor sleep disturbances reflect in poorer well-being, defined as health-related quality of life in physical, emotional, social, and school domains in children between 10 and 11 years old (Magee et al., 2017).

Among the factors that can influence sleep quality, those associated with family processes are considered crucial (Dahl & El-Sheikh, 2007), including children's emotional security associated with parents' marital conflict (Keller & El-Sheikh, 2011). Attachment security to parents has been considered as one of the factors that can impact sleep quality throughout life (Adams et al., 2014; Keller, 2011). According to Dahl's framework (1996), sleep and vigilance are opposing processes. While the ability to relax is required to fall asleep, one must be awake to maintain awareness to threats/dangers. It follows that the high intensity of negative affect provoked by feelings of worry, characteristic of insecurely attached children, such as fears of being alone with no reliable others to provide care when needed, may compromise the ability to relax at night. It therefore can translate in problems falling and staying asleep. Conversely, attachment security would create a state of inner safety that would facilitate sleep. These theoretical claims have found empirical support in infancy, childhood, and adulthood (Adams et al., 2014; Simard et al., 2017). However, only few studies have investigated the relations between attachment and sleep in middle childhood (El-Sheikh et al., 2007; Keller & El-Sheikh, 2011). One of the studies found a negative association between attachment to mother and self-reported sleep problems in children aged between 8 and 9 years old. However, sleep problems did not mediate the association between child-mother attachment and academic achievement (El-Sheikh et al., 2007). The other stud found that greater child-mother security predicted decreased daytime sleepiness in children and fewer sleep problems

in boys, while child-father attachment security predicted increased sleep duration for girls from 3rd to 5th grade (Keller & El-Sheikh, 2011).

Study aims

Although attachment security has been shown to play a role in sleep quality and in several dimensions of well-being, less is known about the relations between attachment security to both parents, sleep, and well-being in late middle childhood. Hence, the first goal of present study is to clarify the referred associations. In addition to examining direct effects among these constructs, for the second goal we hypothesized that sleep quality serves as a mediator of relations between attachment security to both parents and child well-being.

Method

Participants

A sample of 258 fifth and sixth graders (49.2% girls, mean age = 11.19, *SD* = .85) was recruited from two public schools in Lisbon area (Portugal), integrating a larger project about sleep and socioemotional development. From 1,200 letters initially sent to the families of children attending to these schools, 477 agreed to participate in our study. The final sample of 258 corresponds to participants who had complete data for variables of interest in this study.

Most children belonged to intact families (73.5% vs. 26.5% with divorced/separated parents) and had full-time working parents (86.7% of the mothers worked full-time vs. 95.6% of the fathers). The majority of the children had one (36.2%) or two (28.3%) siblings, while 15.7% had three or more and 19.7% were the only child. Maternal age varied between 26 and 57 years (*M* = 41.21, *SD* = 5.42) and paternal age varied between 28 and 69 (*M* = 43.34, *SD* = 6.17). Regarding maternal education, 41.6% completed a college degree, whereas 29.8% finalized 12th grade and 28.6% achieved the 11th grade or less.

Procedure

We contacted the director of a preparatory public school in the area of Lisbon in March of 2018, and after a first meeting, we were allowed to contact the parents of the children who

attended the classes ministered by the teachers who agreed to collaborate in our study. A cover letter of the project and the consent form were sent to the parents, explaining that their child's participation would consist of answering some questionnaires related to sleep habits and child development in a classroom context. Data were collected between April and June of 2018 and each child took 3 weeks to complete our questionnaires in 45-minutes weekly sessions. During the first week, children reported on their attachment relationships with both parents (KSS), and on the following weeks they answered questionnaires about their sleep quality (SSR) and general health and well-being (CHIP-CE). The decision to extend the data collection for three weeks was meant to help the children read and answer the questions carefully without feeling overwhelmed.

Instruments

Kerns Security Scale (KSS; Kerns et al., 2015; Portuguese version)

This scale assesses children's perceptions of parent-child attachment and has been frequently used with 9-14-year-old children (see Kerns et al., 2000; Van Ryzin & Leve, 2012). For each question, the child is presented with two different types of children, and then has to decide which is more similar to him or her, e.g., "Some kids wish their mom would help them more with their problems BUT other kids think their mom helps them enough". After picking which kids they are more like, the child specifies whether they are "sort of like" or "really like" the child in the question. The KSS evaluates the attachment relationship between a child and her/his mother and father separately in two different dimensions (α varies between .72 and .84 in all the subscales). The *Safe Haven Support* subscale (SHS; 14 items) evaluates open communication about needs and emotions and whether a child trusts in her/his parent(s) to provide protection and emotional care in times of distress, for example *"going to a parent when upset".* The *Secure Base Support* subscale (SBS; 6 items) assesses parents' encouragement and support of exploration and decision-making, for example *"encouraging the child to be themselves or to try new things"*. Each item is measured on a 4-point scale, resulting in average scores for *SHS* and *SBS* for both mother and father (higher scores reflecting greater security).

Child Health and Illness Profile – Child Edition (Riley et al., 2004; Portuguese version Rodrigues & Apóstolo, 2010)

Children's reports of health and well-being were obtained through their responses to CHIP-CE, a self-report 5-point Likert (1 – *Never*, 5 – *Always*) scale designed for children aged from 6 to 11 years-old. The questionnaire assesses the following domains: Satisfaction (9 items, α = .87), describing the child's assessment of his or her well-being and self-esteem; Comfort (12 items, α = .74), assessing the degree to which physical and emotional symptoms and their associated activity limitations are endorsed by the child; Resilience (8 items, α = .73) characterizes the child's states and behaviours that are likely to enhance future health; Risk avoidance (8 items, α = .77) is the child's perception about how often he/she engages in behaviours that may be a risk to future health or development; Achievement (8 items, α = .77) addresses how well the child feels he/she performs both academically and socially with peers. For each item, two cartoon illustrations that depict the appropriate extreme state of health (e.g., for the item *In the last four weeks, how many times did you cry a lot?*, a child cartoon depicting a neutral face was placed near the option 1 – *Never*, and a crying cartoon near the option 5 - *Always*) are presented, and 5 possible response circles are given, graduated in size to indicate increasing/decreasing frequency or amount, with item wording placed beneath. The global score (alpha = .91) is obtained by adding the item scores for each of the five subscales, and higher scores indicate better health and well-being.

Sleep Self Report (SSR; Owens et al., 2000; Portuguese version Silva et al., 2013).

Children completed the SSR, a one-week retrospective questionnaire used to assess the subjective perception of multiple sleep dimensions, collectively referred to as quality. The questionnaire comprises three initial questions that are not considered in the scale global score (*1. Who establishes sleep schedules at home?; 2. Do you think you have a sleep problem?; 3. Do you like sleeping?*). For the next questions, children are asked about the frequency of occurrence of events related to different sleep domains – such as consistency of bedtime, difficulty initiating or maintaining sleep, satisfaction with their sleep, and daytime sleepiness (α = .70). The SSR's 23 items are answered in a three-point Likert scale: 1 (*"Rarely"*; 0-1 times a week), 2 (*"Sometimes"*; 2-4 times a week) or 3 (*"Usually"*; 5-7 times a week), with higher scores indicating lower sleep quality.

Results

Descriptive statistics

Table 1 depicts the mean scores for the whole sample and by gender for primary study variables. We started by exploring the perceptions of secure base and safe haven dimensions of attachment to mother and father. Overall, children in our sample reported secure attachment both to mother and father (mean scores vary between 3.22 (*SD* = .58) in safe haven to father and 3.47 (*SD* = .47) in secure base to mother). However, we found significant differences in secure base and safe haven scores between mother (M_{SBS} = 3.47, *SD* = .47, M_{SHS} = 3.44, *SD* = .45) and father (M_{SBS} = 3.38, *SD* = .54, M_{SHS} = 3.22, *SD* = .58), meaning that children tended to attribute higher secure attachment scores to their mothers, reflected in both the secure base score ($t(254) = 3.06$, $p = .002$) and the safe haven score ($t(254) = 7.40$, $p = .000$). We also found that children attributed significantly higher scores of secure base support than safe haven to the father (t (254) = 5.70, $p = .000$), however, we did not find differences between scores attributed to the mothers ($t(257) = 1.29$, $p = .199$). Regarding gender differences in attachment security, boys perceive themselves receiving greater secure base support (*M* = 3.58) and safe haven support (*M* = 3.51) from their mothers than the girls (*M* = 3.35, *SD* = .04 and *M* = 3.35, *SD* = .04, respectively, $F(1,256) = 14.24$, p = .000, eta = .05; $F(1,256) = 9.39$, p = .002, eta = .04). No differences were found on how girls and boys report on paternal secure base ($F(1,253) = 2.77$, $p = .097$) and safe haven support ($F(1,253) = .01$, $p = .912$).

Partial correlations among the study variables

Partial correlation coefficients between the variables are displayed in Table 2. Attachment dimensions correlated significantly with each other, meaning that children who perceive one parent as a source of secure base support, tend to classify him/her also as a safe haven in times of distress ($r = .64$, $p < .05$ for the mother, $r = .68$, $p < .05$ for the father) and to classify the other parent accordingly ($r = .58$, $p < .05$ for the secure base support between the parents and $r = .61$, $p < .05$ for the Safe Haven Support between the parents). Further, the more the children perceive their parents as a secure base support and as a safe haven in times of distress, the fewer sleep problems reported (the correlation coefficient varies between $r = -.21$, $p < .05$ for maternal secure base support and $r = -.35$, $p < .05$ for paternal safe haven support) and better overall health and well-being children tend to experience (the correlation coefficient varies between $r = .42$, $p < .05$ for maternal secure base support and $r = 4.72$, $p < .05$ for paternal

Table 1: Mean scores obtained in the total sample, girls, and boys, for attachment dimensions, sleep quality, and overall well-being

Variable	Total	Girls	Boys
SBS_M	3.47 (.47)	3.35 (.04)	3.58 (.04)
SHS_M	3.44 (.45)	3.35 (.04)	3.51 (.04)
SBS_F	3.38 (.54)	3.32 (.05)	3.43 (.05)
SHS_F	3.22 (.58)	3.22 (.05)	3.21 (.05)
Sleep quality	1.55 (.22)	1.56 (.23)	1.53 (.22)
Well-being	4.07 (.40)	4.03 (.04)	4.11 (.04)

SBS_M: Maternal secure base support; SHS_M: Maternal safe haven support; SBS_F: Paternal secure base support; SHS_F: Paternal safe haven support

secure base support). In turn, children who experience lower sleep quality tend to experience worst general health and well-being (r = -.45, p < .05).

Table 2: Partial correlations between maternal and paternal secure base support (SBS_M, SBS_F) and safe haven support (SHS_M, SHS_F), sleep, and well-being

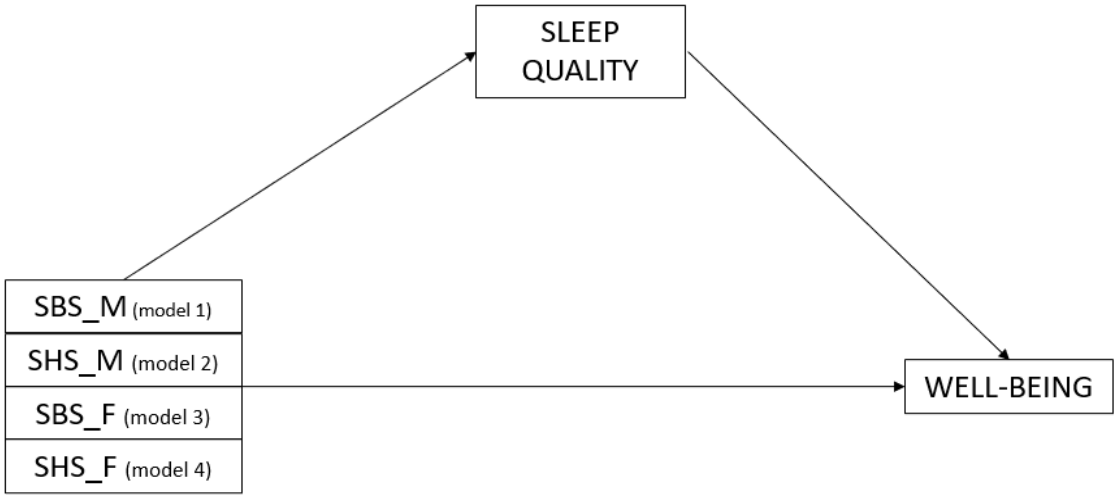
	1.	2.	3.	4.	5.	6.
1. SBS_M	1					
2. SHS_M	.64**	1				
3. SBS_F	.58**	.55**	1			
4. SHS_F	.40**	.61**	.69**	1		
5. Sleep	-.21**	-.31**	-.28**	-.35**	1	
6. Well-being	.42**	.46**	.47**	.45**	-.45**	1

**p < .05

Mediation models

We tested four mediation models, as well as direct effects, using PROCESS macro, for the role of sleep quality as a mediator of the effects in the relation between attachment (each one of the four models included one of the attachment dimensions, as in Figure 1) and child well-being. To test the significance of the indirect effects, bootstrapping was used; around 2,000 bootstrapped samples were used with 95% bias-corrected confidence intervals using the maximum likelihood function.

Figure 1: Representation of the four mediation models with the designations of the variables



SBS_M: secure base support (mother); SHS_M safe haven support (mother); SBS_F: secure base support (father); SHS_F safe haven support (mother)

Secure base support (mother), sleep, and well-being

The first model (Table 3), testing for sleep quality as a mediator of the links between maternal secure base support and child perceived well-being, was significant [F (2,255) = 57.11, p < .001, R^2= .31]. Findings indicated that secure base support of the attachment relationship with the mother had a direct positive association with a sense of well-being. As expected, there was also a significant indirect association between secure attachment and well-being. Direct effects show support for a significant pathway from secure base support from mother to sleep quality (β = -.10, p < .001), and sleep quality to overall well-being (β = -.67, p < .001). Attachment security accounted for 5% of the variance in sleep quality, and attachment

security and sleep quality explained 31% of the variance in overall well-being. The indirect effect remained significant after the inclusion of the mediator in the model, indicating partial mediation (Table 4).

Table 3: Mediation effect of the sleep quality in the link between secure base support from the mother (SBS_M) and overall well-being

		Consequent						
		M (Sleep)				γ (CHIP-CE)		
Antecedent		Coeff.	SE	*p*		Coeff.	SE	*p*
X (SBS_M)	a	-.10	.03	<.001[(1)]	c	.29	.05	<.001[(3)]
M (Sleep)		-	-	-	b	-.67	.09	< .001[(2)]
constant	i_M	1.90	.10	<.001	i_γ	4.10	.24	<.001
		R^2 = .05				R^2 = .31		
		F (1, 256) = 12.17, *p* < .001				*F* (2, 255) = 57.11, *p* < .001		

Indirect effect = ab = -.10 x -.67 = .07

Table 4: Indirect effect of the secure base support from the mother (SBS_M) on sleep quality

	Effect	BootSE	BootLLCI	BootULCI
Sleep	.07	.02	.03	.12

Safe haven support (mother), sleep, and well-being

The second model suggested that sleep quality significantly mediates the links between the safe haven support function of the attachment relationship with the mother and overall well-being [F (2,255) = 58.64, p < .001, R^2 = .32] (Table 5). A direct effect of safe haven support from the mother on well-being (β = .32, p < .001), as well as an indirect effect, via sleep quality, were observed (Table 6), suggesting partial mediation. We also found significant direct associations between maternal safe haven support and sleep (β = -.16, p < .001), and between sleep and well-being (β = -.60, p < .001). Attachment safe haven support from the mother

accounted for 10% of the variance in sleep quality, and attachment and sleep together explained 32% of the variance in well-being.

Table 5: Mediation effect of the sleep quality in the link between safe haven support from the mother (SHS_M) and overall well-being

		Consequent						
		M (Sleep)				γ (CHIP-CE)		
Antecedent		Coeff.	SE	p		Coeff.	SE	p
X (SHS_M)	a	-.16	.03	<.001(1)	c	.32	.05	< .001(3)
M (Sleep)		-	-	-	b	-.60	.10	< .001(2)
constant	i_M	2.09	.11	<.001	i_γ	3.90	.26	< .001
		R^2 = .10				R^2 = .32		
		F (1, 256) = 26.88, p < .001				F (2, 255) = 58.64, p < .001		

Indirect effect = -.16 x -.60 = .10

Table 6: Indirect effect of the safe haven support from the mother (SHS_M) on sleep quality

	Effect	BootSE	BootLLCI	BootULCI
Sleep	.10	.03	.05	.15

Secure Base support (father), sleep, and well-being

Regarding attachment to father, the model testing for the mediation role of sleep quality in the relation between paternal secure base support and well-being was significant [F (2,252) = 60.29, p < .001, R^2 = .32] (Table 7) and the indirect effect was indicative of partial mediation (Table 8). Direct effects suggest a significant path from paternal secure base support to sleep quality (β = -.12, p < .001) and from sleep quality to well-being (β = -.58, p < .001). Secure base support from the father explained 8% of the variance in sleep quality, and together with sleep quality, accounted for 32.4% of the variance in overall well-being.

Table 7: Mediation effect of the sleep quality in the link between secure base support from the father (SBS_F) and overall well-being

		Consequent						
		M (Sleep)				γ (CHIP-CE)		
Antecedent		Coeff.	SE	p		Coeff.	SE	p
X (SBS_F)	a	-.12	.025	< .001(1)	c	.28	.04	< .001(3)
M (Sleep)		-	-	-	b	-.58	.10	< .001(2)
constant	i_M	1.94	.085	< .001	i_γ	4.04	.22	< .001
		R^2 = .08				R^2 = .32		
		F (1, 253) = 21.42, p < .001				F (2, 252) = 60.29, p < .001		

Indirect effect: -.12 x -.58 = .07

Table 8: Indirect effect of the secure base support from the father (SBS_F) on sleep quality

	Effect	BootSE	BootLLCI	BootULCI
Sleep	.07	.02	.03	.11

Safe haven support (father), sleep, and well-being

Finally, similar to findings for secure base, the last model (Table 9), that examined sleep quality as a mediator of the link between paternal safe haven support and child perceived well-being, was significant [F (2,252) = 51.92, p < .001, R^2 = .29]. Safe haven function of the attachment relationship with the father had also a direct effect on well-being, such that greater safe haven support was associated with greater sense of well-being. Safe haven support from the father explained 12% of the variance in sleep quality, and together with sleep quality, accounted for 29% of the variance in overall well-being. Both the direct effects of paternal safe haven support in sleep, and of sleep in well-being were significant (β = -.14, p < .001, and β = -.56, p < .001, respectively), as well as the indirect effect, pointing to partial mediation (Table 10).

Table 9: Mediation effect of the sleep quality in the link between safe haven support from the father (SHS_F) and overall well-being

		Consequent						
		M (Sleep)				γ (CHIP-CE)		
Antecedent		Coeff.	SE	p		Coeff.	SE	p
X (SHS_F)	a	-.13	.02	< .001(1)	c	.23	.04	< .001(3)
M (Sleep)		-	-	-	b	-.56	.10	< .001(2)
constant	i_M	1.99	.08	< .001	i_γ	4.18	.23	< .001
		R^2 = .12				R^2 = .29		
		F (1, 253) = 35.51, p < .001				F (2, 252) = 51.92, p < .001		

Indirect effect = .08

Table 10: Indirect effect of the safe haven support from the father (SHS_F) on sleep quality.

	Effect	BootSE	BootLLCI	BootULCI
Sleep	.077	.019	.043	.118

Discussion

The present study aimed to examine a bioregulatory system – sleep – through which children's perceptions of their attachment to their mothers and fathers predict their overall sense of well-being. We hypothesized that sleep quality would mediate the association between the dimensions of safe haven and secure base support in the attachment relationship with the parents and children's overall well-being. Our results supported the hypotheses establishing that sleep problems partially mediate the relations between attachment to both parents and child's subjective perception of well-being. The effects of attachment security in well-being, directly and via its impact in sleep, will be discussed considering attachment relationship to mother and father as both a secure base from which the child can confidently explore the world and receive a haven of safety in times of distress.

Attachment functions and figures

Results show that children who perceive one of the parents as a source of secure base support, encouraging and supporting exploration and novelty, tend to perceive the same parent as a safe haven in times of need, being available and responsive to the child. The relatedness of these two components is in line with attachment theory, that defines attachment as a relationship that both facilitates exploration of the environment and comforts the child when distressed (Kerns et al., 2015). Thus, the two aspects of attachment representation are expected to be related (Ainsworth, 1989; Bowlby, 1982; Bretherton, 2010; Grossmann et al., 2008), as recent studies point out (Fernandes et al., 2020; Kerns et al., 2015), considering they are "two sides of the same attachment coin" (Keizer et al., 2019, p. 2).

Besides, children who report obtaining higher secure base and safe haven support from the mother, tend to see the father as a source of secure base and safe haven support too, suggesting that both mothers and fathers continue to serve as attachment figures in late middle childhood (Bowlby, 1982; Bretherton, 2010), and that the child's working model of attachment is somewhat consistent across relationships. Previous research had already pointed in this direction, indicating that attachment to mother is not independent from attachment to father (e.g., Fox et al., 1991; van IJzendoorn & De Wolff, 1997), meaning that, in terms of attachment functions, children tend to perceive mother and father in a similar way, although not necessarily identical.

Although secure base and safe haven support from mother and father were moderately correlated, some significant differences were also found. Mothers obtained higher attachment security scores than the fathers, indicating that security levels in the attachment relationship with the mother tend to be higher than with the father. Previous results are mixed, some also suggests that attachment to female attachment figures is of higher quality than to male attachment figures (e.g., Buist et al., 2002; Paterson et al., 1994). While mothers in late middle childhood are still the main attachment figure for girls and boys, we found that boys classify their attachment to the mother with higher security than girls. Even though sex differences are not contemplated by attachment theory (Bowlby, 1973, 1969/1982), some studies suggest that the emergence of sex differences in late middle childhood is possibly related to the reorganization of the endocrine mechanisms that impact brain development, triggering sex-specific psychological trajectories (Del Giudice, 2009, 2015). Other authors (e.g., Holmbeck, 1996; Steinberg, 1987; Steinberg & Morris, 2001) report a decrease in closeness, an increase in

conflict and in emotional distance between parents and children as they approach adolescence. Given that girls approach preadolescence earlier than the boys, showing more precocious signs of deidealization of the figures of primary identification (Steinberg, 2001), they may in consequence see their mothers as more distant emotionally than the boys. Despite the differences between girls and boys regarding attachment to the mother, they seem to see the father very similarly. The fathers have been described more as a source of secure base than of safe haven support. This is in line with previous findings, indicating that the child's explorative behavior may be particularly encouraged within the relationship with the father (Bretherton, 2010; Kerns et al., 2015), in which children are exposed to more challenging, risk-taking, games and activities (Cabrera et al., 2014; Dumont & Paquette, 2013). Given that exploration and expansion of the social world are the main tasks of late middle childhood and preadolescence, father attachment may become particularly salient during this phase.

Attachment and well-being

Our results show that both the dimensions of attachment relationships to mother and father correlate significantly with overall well-being. Attachment theory has been shown to be a powerful framework in the prediction of child well-being, with previous studies reporting consistent results with socioemotional adaptation (e.g., Bureau et al., 2020), self-regulation (Heylen et al., 2017); psychological well-being (Kenny et al., 1998), life satisfaction (Lucktong et al., 2017). One of the mechanisms involved in this association concern the links between attachment and self-confidence, predicting that securely attached children, by having a strong secure base support, tend to be more participative and active facing middle childhood challenges and activities, which makes them feel happy and satisfied. Moreover, securely attached children, who experience a strong safe haven support, may be more effective activating the stress response, seeking help and feeling comforted in stress situations, resulting in an increase in overall well-being.

The role of sleep

Our study also added understanding about how secure base and safe haven functions of the attachment relationships with mother and father impact well-being through their effects in sleep quality. We found evidence for a partial mediation of sleep quality, suggesting that

attachment relationships with the caregivers is connected sleep quality, which can ultimately explain the link with well-being. The present study introduces an exploration of preadolescents' sleep, with sleep quality perceptions assessed through a self-report, as a mechanism through which attachment to mother and father (secure base and safe haven support) impacts the child's overall well-being. Specifically, the more the child perceives her relationship with their parents as a source of secure base and safe haven support, the less sleep problems she is likely to experience, which, in turn, translates in higher self-reported subjective well-being.

Research has previously suggested that attachment security relates to maternal reports of longer nocturnal wakings (Simard et al., 2013), actigraphy sleep durations and efficiency in toddlers (Bélanger et al., 2015), and actigraphy indices of sleep quality in preschoolers (Vaughn et al., 2011). In turn, children with insecure attachment relationships tended to sleep more poorly (e.g., Bai et al., 2022), waking up more often during sleep (Zentall et al., 2012) in infancy. Particularly, children with disorganized attachments show shorter sleep durations, later bedtimes, and longer night-wakings as reported by the mothers (Pennestri et al., 2015). Although most studies used samples of younger children (between 6 months and 5 years), some research findings have been reported for middle childhood, suggesting negative associations between child attachment to mother and self-reported sleep problems in children aged between 8 and 9-years-old (El-Sheikh et al., 2007). The links between sleep quality and child well-being have also found empirical support in previous studies, relating shorter sleep durations to lower health-related quality of life (Gustafsson et al., 2016; Paiva et al., 2015) higher odds of externalizing behavior (E-Sheikh et al., 2019a), depression (El-Sheikh & Arsiwalla, 2010), and mental health problems (Hestetun et al., 2018; Horiuchi et al., 2021). In turn, longer sleep associated with delayed school start times predicted fewer depressive symptoms, lower levels of daytime sleepiness, and less negative mood (Lo et al., 2018).

Limitations and future directions

Our study has some limitations that call for careful interpretations of the results. First, as most of the participants were raised by both parents, generally well-educated and full-time workers, living in the metropolis and its surroundings, we cannot be sure that these results generalize to populations from more diverse backgrounds. Therefore, future studies should include participants with alternative household configurations and different socioeconomic environments. Second, the cross-sectional nature of our findings does not allow to draw

conclusions about the potential underlying causal processes of the associations. Although we have a strong theoretical framework suggesting the plausibility of the discussed direction of the results, future studies should consider longitudinal designs to explore the direction of the associations. Third, the exclusive use of self-report measures to assess attachment security, sleep quality, and well-being, may boost positive results due to shared method variance. Despite being widely accepted and reliable compared to others' reports, middle school aged children's self-reports should be used in addition to experimentally-based, observational and interview measures. Last, there are other factors that could also mediate the relationship between attachment security and well-being, such as family sleep routines and marital conflict, should be investigated.

The limitations should be considered in the context of the strengths and implications of our work. We focused on a global construct of well-being, that is believed to be adequate in late middle childhood. However, it would be interesting to investigate to what extent the attachment relationships with mother and father play different roles in the development of distinct aspects of well-being. Our study considers the mediating role of sleep quality in the association between attachment and well-being. Taking both dimensions of attachment to mother and father in consideration emphasizes not only the importance of including both figures in research designs, but also in therapeutic interventions for children with problems associated with sleep and well-being. Finally, understanding how sleep is related to well-being and attachment relationships in late childhood is of clinical relevance, since difficulties associated with sleep can be a precocious and sensitive marker to help parents and health professionals to identify emerging physical and mental health problems.

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Chapter VI:

General discussion

May the road rise to meet you,
May the wind be ever at your back,
May the sun shine warm upon your face
- Celtic song

General discussion

The studies comprising the present work were guided by the essential aim of exploring sleep phenomenon in the context of parent-child attachment relationships. The consolidation of attachment relationships by the second half of the first year of life (Bowlby, 1969/1982, 1973, 1980) overlaps with the stabilization of sleep patterns around 12 months of age (e.g., Anders, 1994). Since both developmental events are framed by parent-child interactions, uncovering their associations became the goal of this whole entire work.

The last chapter overviews the main findings of the four studies that were conducted and concatenates them with the existing literature on attachment and sleep. We will start by presenting the first study, that aimed to systematically review previous research that investigated the associations between attachment and sleep during the preschool years. The outlined findings guided the formulation of the research questions that piloted the subsequent studies. The constitution of the studies' aims was then the result of a dynamic process, where the issues raised by one work determined the directions of the following. The reassessment of the studies' key findings will then focus on some significant aspects highlighted across the present work, pertaining to considerations about developmentally appropriate attachment and sleep assessment methods. We will also address the emergence and differentiation of attachment representations and their relations to sleep in two distinct developmental periods: preschool age and late middle childhood. The major limitations that hinder the conclusions, along with some substantial strengths and practical implications of the present work are brought to the surface at the end of this chapter.

Ties between attachment and sleep revealed by previous research

With the goal of providing a critique analysis of the findings reported by the studies that investigated the relations between attachment and sleep at preschool age, a systematic review was conducted. Three central aspects stood out. The first one, that emerged in the precocious phase of data gathering, was the scarcity of research aiming to uncover how attachment and sleep relate to each other. We only detected 7 titles that met our inclusion criteria and the more

recent ones dated from the year of 2015. Theoretical arguments corroborating the existence of intimate connections between attachment and sleep seem to be robust. Attachment security is thought to yield an inner sense of safety, providing a capacity to relax that promotes the transition to sleep (e.g., Anders, 1994; Dahl, 1996), mediating the impact of other contextual variables on sleep (e.g., Sadeh & Anders, 1993).

However, recent research has been interested in other family-related predictors of sleep, like maternal depressive symptoms (e.g., de Jong et al., 2016; Kim et al., 2020; Toffol et al., 2019; Warren et al., 2006; Ystrom et al., 2017), maternal sensitivity and responsiveness (e.g., Cimon-Paquet et al., 2022; Tétreault et al., 2017), parental psychosocial functioning (Bernier et al., 2013), parenting styles (e.g., Teti et al., 2015), household routines (e.g., Koopman-Verhoeff et al., 2019), and parental presence at bedtime (see Newton, Honaker, & Reid, for a systematic review). Second, despite previous research findings that stated the preponderance of father-child relationships in child's sleep regulation (e.g., Staples et al., 2015), along with increasing parental involvement at bedtime (e.g., Tikotzky, Sadeh, & Glickman-Gavrieli, 2011), none of the studies included measures of father-child attachment.

The inconsistency of the studies' findings was the last evident aspect made visible by the systematic review. Although some studies reported significant associations between higher attachment security and actigraphy sleep parameters indicative of better sleep quality (Bélanger et al., 2015; Vaughn et al., 2011), others did not (Bernier et al., 2014; Simard et al., 2013). Furthermore, attachment insecurity and disorganization were associated with worse maternal reported sleep outcomes in some studies (Pennestri et al., 2015; Simard et al., 2013), but not in others (Weinraub et al., 2012). Moreover, one study found secure attachment to be associated with maternal reports of better sleep quality only for children whose temperament was characterized by high negative emotionality (Troxel et al., 2013).

Conceptualizations of attachment and their relations to sleep

A concerted interpretation of these inconsistent research findings should pay careful attention to the nature of attachment and sleep assessment methods used across the studies. The constructs were assessed by different instruments, with distinct underlying operational definitions, shedding light on different, yet related, aspects of attachment and sleep phenomena, thus possibly yielding inconsistent results. Three studies relied on separation-reunion procedures (i.e., Strange Situation Procedure – Ainsworth et al., 1987; Preschool Separation-

Reunion Procedure – Cassidy et al., 1992) to draw attachment classifications (i.e., secure, insecure-ambivalent, insecure-avoidant, disorganized) through a standardized laboratory procedure, designed to elicit mild to moderate stress as a consequence of the child's separation from her attachment figure. Separation from the caregiver, being a natural clue to danger, can activate the attachment system and start attachment behaviors of variable intensity (Bowlby, 1973). Although night-time separations are frequent and even predictable in western cultures, children are biologically programmed to react with discomfort to being alone in the dark. As such, children whose reactions to the Strange Situation Procedure's separations place them in insecure attachment classification, may also have a harder time facing night-time separations (Keller, 2011), feeling heightened anxiety, resisting going to bed and/or waking up in the middle of the night as it turns into an opportunity for re-establishing contact with the attachment figure. This is in accordance with the studies where children classified as insecure-ambivalent and disorganized had worst maternal reported sleep, as they woke up more frequently at night, had shorter periods of uninterrupted sleep and overall shorter sleep durations (Pennestri et al., 2015; Simard et al., 2013).

Three other studies estimated attachment security via the AQS (*Attachment Q-Sort*; Waters & Deane, 1985), a measure that retains much behavioral detail and allows for a higher descriptive specificity, by covering a vast range of secure base behaviors occurring in familiar, low-stress environments. This may help in understanding why AQS attachment security – more than insecurity – is associated with objective sleep parameters indicative of better sleep quality, such as longer sleep durations and higher sleep efficiency (Bélanger et al., 2015; Bernier et al., 2014). However, some null findings were also reported (Bernier et al., 2012).

Particularities of sleep assessment methods and their relations

If at this point it became fair that distinct attachment operationalizations can relate to sleep differently, we could also conjecture that specific sleep variables may associate in their own way with attachment. The main instruments used in developmental sleep research are actigraphy devices, sleep diaries, and sleep questionnaires (Sadeh, 2011). These instruments can be distinguished considering the nature of the sleep variables assessed and the degree of subjectiveness involved in the assessment. While some variables measured via actigraphy and sleep diaries overlap – such as sleep schedules and duration, frequency and length of night-wakings –, others are specifically obtained through actigraphy – such as sleep onset latency,

sleep efficiency, or sleep motor activity. In turn, sleep questionnaires typically assess sleep behavioral dimensions, such as sleep arrangements, bedtime routines, emotional reactions to sleep, parasomnia, daytime sleepiness, etc. Concerning the degree of subjectiveness, both sleep diaries and sleep questionnaires are completed by the child's caregivers, since children are uncapable of providing self-reports at such a young age. Parental reports thus correspond to their subjective perceptions, which can be influenced by multiple factors, whereas actigraphy registers are purely objective. Sleep variables cover different parts of sleep phenomenon and thus may be connected to attachment differently. Accordingly, one study found associations between attachment security and maternal-reported sleep variables, but not with actigraphy (Simard et al., 2013).

The questions raised about the differences between actigraphy records and parental reports of child's sleep led to the second study, with the fundamental aim of comparing empirical data on child's sleep collected via actigraphy with parental reports attained through the widely used Children's Sleep Habits Questionnaire (Owens et al., 2000). We intended to explore associations between objective sleep parameters and behavioral sleep measures of child's sleep in order to clarify how sleep behaviors contribute to the understanding of sleep parameters. Furthermore, we explored agreement rates between overlapping ("parallel") sleep variables across the instruments, such as sleep schedules and duration, frequency and length of night-wakings.

The results of our second study suggested that the use of a sleep questionnaire can certainly add to the meaning of objective sleep parameters, contributing to a more detailed analysis of sleep. For example, actigraphy total sleep time correlated negatively with the scores of bedtime resistance, indicating that children who refuse and fight going to bed show shorter sleep durations. This association can either mean that bedtime resistance delays bedtime, shortening total sleep duration, or that shorter sleep durations can render the child more irritable and oppositional, refusing to follow bedtime routines. Another interesting result showed that sleep efficiency correlated negatively with bedtime resistance, night-wakings and global sleep problems scores, suggesting that those behavioral indicators are important when considering the proportion of sleep time in relation to time in bed. Concerning the agreement analyses, we found a general lack of concordance between parental reports and actigraphy records, characterized by differences in the assessment of sleep dimensions of over than 30 minutes for all sleep parameters, except for wake-up times during the week. This finding was controversial, because during preschool age, sleep schedules and routines are still primarily regulated by the

parents, making it expectable for them to be more aware of child's sleep. Although the results should be interpreted with precaution, due to small sample size and comparing different instruments, the results are consistent with previous findings (e.g., Werner et al., 2008) that refer the tendency of the parents to overestimate child's sleep duration and wake-up time, and to underestimate bedtimes and the frequency and duration of night-wakings.

We find this topic, with the underlying questions about the validity of parental reports on child's sleep against actigraphy, to be of compelling importance. In the first place, parents of preschool children still play a crucial role in child's sleep regulation, by establishing bedtime routines, based on their subjective evaluations of child's sleep (Cook, Appleton, & Wiggs, 2022; Shetty, et al., 2022). Second, children's parents are the ones to make the decision to seek professional help and guidance when they identify problematic sleep patterns (Sadeh et al., 2011). Lastly, parental perceptions of child sleep are important because child sleep interventions are ultimately implemented through the parents (e.g., Hammersley et al., 2019; Taylor et al., 2018; Tinker et al., 2020).

Attachment representations and their relations to sleep

Based in early evidence suggestive of differential relations between attachment security and the whole range of objective and subjective sleep variables, the third study was drawn. The first goal was to explore the associations between attachment and child's sleep, obtained via actigraphy and parental reports. Contrasting with most of the previous studies, we focused on attachment representations.

According to attachment theory (Bowlby, 1969/1982, 1973, 1980), by the time the child is 3 years old, she has built internal working models of attachment relationships, firmed on the history of early caregiving experiences. Those internal representations allow the child to interpret and predict the attachment figure's behavior and to plan future responses (Bowlby, 1973). Besides, during this developmental period, attachment behaviors are expected to decrease in both frequency and intensity, because of the child's improved capacity to form and manage mental representations. Simultaneously, language development makes attachment representations accessible through diverse research procedures. As such, we relied on a widely used and well validated story-stem procedure – Attachment Story Completion Task (ASCT; Bretherton, Ridgeway, & Cassidy, 1992) – designed to elicit the emergence of individual differences in children's enactment of attachment-related issues, thus discovering their internal

working models of attachment. Attachment IWM's can be regarded as secure base scripts, defined as enduring cognitive structures that summarize commonalities across sequences of action, derived from actual parent-child relationships (Bretherton, 1991; Waters & Waters, 2006), that constitute "interpretive filters" (Thompson, 2008). As such, we relied on the recent developed secure base script scoring (Vaughn, Posada, & Veríssimo, 2019) for assessing secure base scripts that, having a regulatory function (Thompson, 2008), were expected to associate with variables indicative of sleep quality. However, contrary to our prospects, no significant associations emerged between attachment and any of the studied sleep variables.

The absence of associations was already reported in some previous studies (e.g., Simard et al., 2013; Weinraub et al., 2012), so, although unexpected, those findings are not surprising. The second goal of the third study tries to dig deeper into the associations between attachment and sleep by testing the moderating effect of some parental-related variables, since the relations between attachment and sleep may not be the same for all children.

Parental sociodemographic moderators in the relations between attachment representations and child's sleep

Then, as a second goal, we explored the moderating role of some parental sociodemographic variables – as age, education and working hours. We opted for parental, and not child-related moderators because we were interested in exploring the role of more distal variables that can interact with attachment security in the prediction of sleep quality. Some interesting conflicting findings emerged. For example, older paternal age interacted with secure attachment to predict worse sleep outcomes, such as longer parental-reported night-wakings, and, paradoxically, lower sleep problem scores. It is possible that fathers of securely attached children who are older remain attentive and sensible to the night-wakings, but it does not mean that they consider sleep to be problematic. Parental education as a moderator also yielded contradictory results. Higher maternal education interacted with secure attachment to predict higher sleep efficiency, indicating that higher sleep efficiency was obtained by children who had secure attachment representations and mothers with higher education. However, in the case of father education, children with secure attachments whose parents have less education seem to go to bed earlier and have longer total sleep times. Although this is a preliminary exploratory study, limited by the small sample size, which findings surely require replication, we believe that this adds on the direction to identify moderators of the associations between attachment

and sleep. This could be very important in attachment-based sleep, specifically, or health, in general, interventions, to previously identify protective factors in the child's environment, as well as children who may require extra accompaniment due to non-alterable external conditions.

Although the findings of our third study need replication, as they can be impacted by the small sample size, we believe that this exploratory study finds its major strength by possibly mapping future research. The identification of moderators in the association between attachment and sleep could, in the future, contribute to informing attachment-based sleep interventions by stating some risk and protective factors.

Attachment representations and sleep beyond preschool age

In our last study, we focused on the relations between attachment and sleep in the period of late middle childhood or preadolescence (10-12 years old). As for preschool age, preadolescence condenses some unique developmental aspects that may pose significant challenges to attachment relationships and sleep regulation. At this age, physiological and bodily transformations accompany the complexification of the child's social world that preclude new wishes for autonomy (e.g., Kerns & Brumariu, 2016). In this context, the needs for independent exploration of a renewed world along with the fluctuant longings for proximity may lead to important renegotiations in the attachment relationships (Ammantini et al. 2000; Morris et al., 2007). Besides, brain development is responsible for the beginning of delayed sleep onset (e.g., Colrain & Baker, 2011), which is stimulated by the presence of electronic devices with access to the internet that children use before bedtime, guiding them to later bedtimes (e.g., Charmaraman et al., 2021).

The assessment of the attachment representations relied on Kerns Security Scale (KSS; Kerns et al., 2015), an instrument that estimates the degree to which children consider an attachment figure as: responsive, available, and as open to emotional communication and to provide protection in times of distress (safe haven support) (Kerns et al., 1996); and encouraging of exploration and decision making (secure base support). Besides, this instrument allows the assessment of safe haven and secure base support in both mother and father, thus providing an opportunity for analyzing them separately.

As expected, we found significant negative associations between the security of attachment representations, for both mothers and fathers, and sleep problem scores. Those correlations were of stronger magnitude for safe haven than for secure base support, suggesting that the dimensions of trust in the availability and responsiveness of the attachment figure to provide care in times of distress may help children to relax, fall asleep and maintain a reparative sleep through the night. Interestingly, safe haven support from the father got the highest magnitude. Although the reasons are not yet clear, this result advises future studies to include the father figure in attachment and sleep research.

Attachment, sleep and well-being

The second goal of the fourth study was to test if sleep quality mediates the associations between attachment and a fertile construct of child well-being. Self-perceptions of well-being have been widely studied in the last years, showing associations to other important developmental outcomes (Diener & Chan, 2011; Suldo & Shaffer, 2008; Suldo et al., 2011; Xu & Roberts, 2010). We found evidence for partial mediations where the associations between attachment and child well-being are partially explained by attachment's effects on sleep. Research devoted to stress suggests that stressor accumulation predicts negative affective states, above and beyond the occurrence of single stressors (Schilling & Diehl, 2014). This assumption can clarify how children with insecure attachment relationships, who may feel heightened levels of stress because of not being able to rely on their parents to obtain safe haven and secure base support, may experience less sleep quality and, therefore, lower levels of well-being.

Limitations and future directions

The current research presents some important limitations that potentially constraint the conclusions to be drawn from its findings. Hereupon, we address some of them, expecting to illuminate directions for future research.

Small sample sizes and cross-sectional designs

The short number of participants, especially for the second and for the third studies, may restrict the statistical power of the conducted analyses and compromise the external

validity of the findings. Hence, these studies should be replicated in larger samples. One of the major limitations of the present work rests upon its reliance in cross-sectional research designs, precluding causal inference or exploration of bidirectional effects. From our theoretical framework (Bowlby, 1969/1982, 1973, 1980; Dahl, 1996; Sadeh & Anders, 1993) it is plausible to suggest that attachment relationships, having an enduring organizing function in development, have a predictive role in sleep quality. However, by failing to demonstrate temporal precedence of attachment security, our findings cannot empirically support this assumption. Although some previous studies find theoretical arguments and empirical evidence in favour of attachment predicting sleep outcomes (see Keller, 2011 for a review), other studies focusing on infancy have reported that sleep problems can precede the insecurity of attachment (McNamara et al., 2003). Future research should undoubtedly be drawn from longitudinal designs, preferable with repeated assessments of both attachment and sleep across different time points to explore both causality and reciprocal effects.

Organization of attachment

From its very beginning, attachment theory has made clear that distinct attachment relationships can be formed, rooted on continuous and stable patterns of interaction between the child and different attachment figures (Bowlby, 1973, 1982). Empirical evidence has long been supporting this claim, by suggesting that attachment to mother and father can have different developmental implications (e.g., Fernandes et al., 2020; Grossman et al., 2002; Kuo & Braungart-Rieker, 2022; Lamb et al., 1977; Witte et al., 2021). Therefore, to better comprehend the associations between attachment and sleep, researchers should be able to distinguish how different attachments relate to sleep. The paucity of a theoretical framework able to discern the combined and independent effects of child's attachment to both parents had been proposed to have produced mixed findings and theoretical inconsistencies regarding how attachment associates to developmental outcomes (Dagan & Sagi-Schwartz, 2018). This may also be the case for attachment and sleep research.

Applying the integrative hypothesis of attachment (van IJzendoorn, Sagi, & Lambermon, 1992) to attachment and sleep research can be beneficial to address relevant questions that remain. Do attachment relationships with each parent lead to different sleep outcomes? Do two secure attachments predict better sleep outcomes than one secure attachment? Or, otherwise, the presence of one secure attachment buffers the potential

prejudicial effects of one insecure attachment relationship in sleep? Or, finally, is the security of attachment to one parent more determinant in the prediction of sleep outcomes than the security of attachment to the other?

Unfortunately, our studies could not yet answer to any of these questions. In our third study, we assessed attachment representations, operationalized as secure base scripts, through a coding procedure that, in spite of all its advantages (Vaughn, Posada, & Veríssimo, 2019), cannot assess attachment representations to separate figures. In our fourth study, even though we measured the security of attachment to both parents, the modest sample size did not allow us to run specific statistical analyses could help understand how distinct attachment configurations associate to sleep.

Sleep assessment across the studies

Empirical evidence has been converging to the assertion that a more thorough sleep measurement approach should rely both on objective measures, such as actigraphy, and on subjective reports, such as sleep diaries and parental-report or subjective-report questionnaires. However, we were not able to use this approach in our studies.

In the second study, we did not analyze data collected via sleep diaries. Instead, we relied on a questionnaire (CSHQ; Owens et al., 2000) to attain general estimates of sleep schedules and night-wakings, based on the child's usual sleep behavior across a "typical" week. This kind of solicitation elicits answers that are often vague and imprecise (Werner et al., 2008), contrasting with the specificity of actigraphy data. The use of sleep diaries could certainly have helped to clarify the relations between actigraphy and parental reports of child's sleep.

We could not use sleep diary data for the third study either, making parental perceptions regarding concrete sleep parameters during the actigraphy assessment week left lacking. For the last study, we relied exclusively on subjective reports of sleep quality. Future research, as much as possible, should adopt a sleep measurement approach that includes actigraphy, sleep diaries and a sleep-behavior questionnaire to gain an ampler understanding of child's sleep phenomenon.

Besides, our studies also failed to collect data about other important sleep-related variables, such as the consistency of sleep parameters across the seven days of the week

(weekends included), weekend catch-up sleep, daytime napping and sleep arrangements (i.e., bedsharing, room sharing, etc.).

Strengths and practical implications

Taken together, the body of work presented in this dissertation has notable strengths that we find fair to address. This work brings to discussion the forgotten topic of attachment and sleep during preschool years and the transition to adolescence. We also stated the relevance of the topic and referred to some relevant questions that still need clarification.

Based on empirical data (study 2), we suggest a sleep assessment approach focused on actigraphy, sleep diaries, and a sleep behavior questionnaire. We believe that a combined assessment can help both researchers and practitioners to gain a more complete picture of the child's sleep. The presence of actigraphy – an objective, minimally intrusive, and ecologically valid instrument – can help to undercover sleep issues that frequently remain out of parental awareness. Extended sleep onset latencies, short sleep durations, frequent night-wakings, short sleep efficiencies and early wakings are some examples. Assessing the same sleep parameters concomitantly via sleep diaries can not only validate actigraphy data, but also help to address sleep problems that parents are frequently not aware of. Last, sleep behavior questionnaires can, as we showed, add to the understanding of the behavioral manifestations during, immediately after and before the occurrence of objective sleep events captured by actigraphy and sleep diaries. The information obtained via this multi-method and multi-informant approach could be used both in research and in clinical settings to deliver information about the child's sleep, increase parental knowledge on sleep issues, raise interest in child's sleep and drive parental attention to relevant manifestations of sleep problems. We believe that this approach, covered by evolutive feedback, could enhance parental confidence in seeking professional help for child sleep problems. This could be part of the solution to help parents ask for professional guidance, as they frequently disclaim fears of being judged and not finding adequate answers for child sleep problems (Cook et al., 2018).

By exploring potential moderators of the relations between attachment and sleep, our study sets a new research direction for an unsettled issue. We find it crucial to identify under what circumstances attachment affects sleep. Attachment does not consist of a set of behaviors that are continuously and uniformly operative (Dagan & Sagi-Schwartz, 2018), so we believe that the identification of moderators in this relation could both build theoretical knowledge and

inform attachment-based sleep interventions. Finally, our study adds to attachment and sleep research by suggesting that the effects of attachment on health and well-being-related outcomes can be partially explained by the effects of attachment on sleep.

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