Received: 19 September 2021 | Revised: 13 June 2022 | Accepted: 10 July 2022

DOI: 10.1111/fare.12759

RESEARCH

Family Relations
Interdisciplinary Journal of Applied Family Science

Do family members sleep alike? Sleep features among mothers, fathers, and adolescents

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Funding information
This study is a part of the Miracles of Development research project (https://projects.tuni.fi/kehi/) granted by the Academy of Finland (#308 988 and #323845) and was also supported by the Juho Vainio Foundation.

Abstract

Objective: To identify within-family groups according to sleep schedule, problems, and impact, reflecting similarities or differences in adolescents, mothers, and fathers and to examine how mental health and attachments associate with these triadic sleep groups.

Background: Family relationships shape sleeping, but within-family research in adolescence is scarce.

Method: Adolescents (17–18 years; 60% girls; $n = 438$), mothers ($n = 448$), and fathers ($n = 358$) filled in the Pittsburgh Sleep Quality Index. The adolescents reported mental health problems by the Behavior Assessment System and the parents by the General Health Questionnaire. All reported attachments by the Experiences in Close Relationships.

Results: Cluster analysis identified four triadic sleep groups: "Good family sleep" (47%), "Poor adolescent and maternal sleep" (29%), "Poor paternal sleep" (16%), and "Poor family sleep" (8%). Adolescents in the "Poor family sleep" group had more mental health problems than they did in other groups, and fathers in the "Poor paternal sleep" group showed higher psychiatric symptoms than in the "Good family sleep" or "Poor adolescent and maternal sleep" groups. Adolescents in the "Poor family sleep" group reported higher insecure–anxious attachments than they did in other groups, and fathers reported higher insecure–avoidant and insecure–anxious attachments in the "Poor paternal sleep" than they did in other groups.

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Conclusion: A family systems approach provides new insight into sleep, mental health, and attachments.
Implications: Interventions to improve sleep quality should consider family dynamics that may underlie potential sleep problems, and sleep as a public health issue can benefit from knowledge about family mental health and attachments.

KEYWORDS
adolescence, attachment, family systems, mental health, sleep quality

Do parents and their children share similar sleep features, and if so, why? From the perspective of *family systems theories*, the response would be affirmative and emphasize interdependency among family members, as their well-being, stress, and emotional expressions reciprocally influence how each functions in multiple ways (Bowen, 1990; Cox & Paley, 1997), including in terms of sleep schedules and sleep problems (El-Sheikh & Kelly, 2017; Peltz et al., 2016). *Attachment theory* would particularly emphasize mutuality of early experiences of emotional sharing between parents and children and the essential role that attachment security plays in shaping children's psychophysiological–hormonal regulation, which also pertains to sleep patterns and stabilization of the circadian and homeostatic rhythm (Adams et al., 2014). *Sleep research* would suggest similarities in family members' sleep features because sleep disorders in adults (hypersomnia, insomnia, and parasomnia) and children (sleepwalking, sleep paralysis, and night terror) run in families and may co-occur among monozygotic twins (Crocker & Sehgal, 2010). Family members also resemble each other in their sleep architecture in terms of the duration and proportion of sleep stages (1–2 light waves and 3–4 slow waves in non–rapid eye movement and rapid eye movement sleep), as well as in chronotypes of diurnal preferences for early morning "larks" or late evening "owls" (Sehgal & Mignot, 2011).

According to the ecological theory of children's sleep (El-Sheikh & Sadeh, 2015), parents' and children's problems of initiating and maintaining sleep and sleep schedules (sleep duration, eveningness and morningness) are closely intertwined and reciprocally affect the well-being of all family members. There is ample evidence to confirm concordance between infants' and toddlers' sleep problems, unstable circadian rhythm, and parental (especially maternal) poor sleep quality (Meltzer & Montgomery-Downs, 2011; Peltz et al., 2016). In adolescence, multiple significant developments occur, especially in sleep schedules, characterized by delayed circadian rhythm (high eveningness and morningness), increased sleep homeostasis pressure, decline in slow-wave sleep, and more negative impact of poor sleep on daytime functioning (Carskadon, 2011; Crowley et al., 2018). Therefore, it is important to know how adolescents' and their parents' sleep features intertwine and embed, which is the contribution of the current study.

Knowledge about family members' shared sleep features is based on correlations and separate comparisons—for example, between sleep duration, waking up, and chronotypes (Bajoghli et al., 2013; Fuligni et al., 2015; Kouros & El-Sheikh, 2017). However, sleeping is embedded in the family context, involving reciprocal interactions of complex relational subsystems (e.g., marital, parental, and siblingship) aiming at homeostasis and adaption to multiple external and internal demands (El-Sheikh & Sadeh, 2015). Therefore, to fully comprehend family members' mutual sleep dynamics, the current study applies the family systems approach (Bowen, 1990; Cox & Paley, 1997) to seek unique within-family sleep types by identifying triadic sleep groups based on similarities and differences among adolescents', mothers', and fathers' sleep features. The ecological theory of children's sleep underscores how mental

health and relationships among family members are inextricably intertwined in influencing their sleep features (El-Sheikh & Kelly, 2017), and therefore the current study analyzed adolescents' and parents' mental health and attachment relationships in the identified triadic sleep groups.

FAMILY SLEEP CONCORDANCE

Family systems theories emphasize the shared emotional and everyday environment (Bowen, 1990), which helps us better understand within-family sleep similarities and differences, conceptualized as concordance between family members' sleep features. Sleep demands down-regulating of alertness and arousal, and family environment is related to both practical (light, stimuli, and noise) and psychological (sense of security, trust, and harmony) preconditions. Family members share everyday waking experiences, emotions, and interactions, and thus, apparently, their sleep features may also be interdependent. Considering concordance between family members' sleep, research has shown stronger associations between adolescents' and their mothers' sleep schedules and problems than those between adolescents and their fathers. For instance, one study found significant concordance between children's (M_{age} = 10.45) and mothers', but not fathers', sleep duration, sleep efficiency, length of nighttime wake-ups, and morningness across a 7-night assessment based on actigraphy (Kouros & El-Sheikh, 2017). Similarly, a questionnaire study confirmed significant correlations between adolescents' (M_{age} = 14.15) and mothers', but not fathers', onset of sleep, duration, and nighttime wake-ups (Bajoghli et al., 2013). Further, Kalak et al. (2012) showed a more comprehensive concordance between adolescents' (M_{age} = 16.25) and their mothers' sleep features than those of their fathers in a 1-night sleep electroencephalogram assessment. Significant correlations were found between adolescents' and mothers' sleep duration, onset latency, eveningness and morningness schedule, nighttime wake-ups, and sleep architecture (timing of decreased light-wave sleep and increased slow-wave sleep), whereas only adolescents' and fathers' sleep duration and nighttime wake-ups were significantly correlated.

However, there is also evidence of concordance between adolescents' and both parents' sleeping. One study showed high concordance between mothers', fathers and their adolescents' (M_{age} = 15.03) sleep duration and evening, morning, and intermediate chronotypes, assessed from a sleep-diary over a 2-week period (Fuligni et al., 2015), and a 1-year follow-up of the same families' sleep specified high contemporaneous correlations between adolescents' and both parents' chronotypes (Bai et al., 2021).

Finally, one study found significant concordance only between adolescents' (M_{age} = 17.55) and their fathers' sleep, based on a 7-night sleep diary (Brand, Gerber, et al., 2009). Fathers' short sleep duration, long sleep onset latency, multiple nighttime wake-ups, and daytime dysfunction were directly associated with adolescents' sleep. Instead, mothers' poor sleep was associated with adolescents' corresponding sleep problems only through unsupportive and harsh parenting styles.

FAMILY MENTAL HEALTH AND SLEEP

Family systems theories conceptualize the family as an emotional unit functioning as a complex system of marital, parenting, parent–child, and sibling subsystems (Bowen, 1990; Cox & Paley, 1997). Concerning sleep, the influences of these subsystems may be compensatory or additive, contributing to the homeostatic purpose of promoting the cohesiveness and cooperation that families require to protect and enhance the well-being of their members. Research has

confirmed that parental mental health problems influence adolescent sleep features, which in turn reciprocally influence both parental and adolescent mental health. For example, a 7-night actigraphy triadic study by El-Sheikh et al. (2012) found that fathers' depressive symptoms were directly associated with their children's ($M_{age} = 9.44$) short sleep duration. Mothers' depressive symptoms were in turn indirectly associated with their children's short sleep duration, multiple nighttime wake-ups, and excessive weekend sleep, mediated through severe family conflict emerging between both spouses and parents and children.

Other studies have instead found direct associations between maternal depression and adolescents'—especially boys'—inadequate sleep duration, referring to both too little and excessive sleep (Stearns et al., 2020). Also, maternal perceived stress was associated with adolescents' poor sleep, indicated by long onset latency, short duration, and negative impact of sleep (Bajoghli et al., 2013). Illustrating the reciprocal nature of family members' sleep and mental health, research has confirmed that children's poor sleep, such as long sleep onset latency, multiple nighttime wake-ups, and daytime sleepiness, were associated with maternal perceived stress, anxiety, and depression (Martin et al., 2021; Schultz et al., 2020). Finally, a sleep diary study found that adolescents' poor sleep quality and short sleep duration mediated the association between chaotic family environment and their own depressive and anxiety symptoms (Peltz et al., 2019).

ATTACHMENT RELATIONSHIPS AND FAMILY SLEEP

According to family systems theories, family relationships contribute greatly to both preconditions and features of sleep, and these multiple and reciprocal relationships are dynamic, including triangulation, emotional transfer, and behavioral spillover dynamics (Bowen, 1990). Secure, trusting, and harmonious family relationships are crucial for shaping optimal sleep, as they create the safety needed for sleep (El-Sheikh & Kelly, 2017; Meltzer & Montgomery-Downs, 2011). The current study conceptualizes adolescents' and parents' relationships according to attachment theory (Bowlby, 1988). Attachment refers to representations of the self, others, and environment that infants develop in their close relationships based on the sensitivity and availability of caregivers. With sensitive parents, they develop secure attachment characterized by a sense of being valued and cared for and by trust in others, whereas children of less sensitive and unavailable parents develop insecure attachments. These early attachments contribute to later socioemotional development (Groh et al., 2017), and in adolescence and adulthood, insecurity emerges as attachment avoidance and anxiety (Ainsworth, 1989; Fraley et al., 2011). Individuals high in attachment avoidance do not easily rely on others or have others depend on them, and those high in attachment anxiety are easily preoccupied and worried about others' availability and affection. Individuals with secure attachment are low on both attachment avoidance and anxiety; they trust in others' availability and in their own worthiness in close relationships.

We did not find studies analyzing the role of attachments in relationships in the concordance between children's or adolescents' and their parents' sleep features, but research is available on attachments and sleep quality. A meta-analysis showed that secure attachment relationships associate with optimal sleep features, such as lack of sleep problems and nighttime wake-ups, and insecure, especially anxious, attachment with sleep problems among young children and adults (Adams et al., 2014). Moreover, research is available on associations between general family relationships and sleep quality. Marital conflicts and aggression predict more sleep problems, longer sleep onset latency, and more nighttime wake-ups among children (Kelly & El-Sheikh, 2011, 2013), and restrictive and inconsistent parenting correlates with adolescents' negative morning mood and daytime sleepiness (Brand, Hatzinger, et al., 2009).

Instead, monitoring and supportive parenting predicts optimal sleep features of long sleep duration, low eveningness, and lack of daytime sleepiness (Meijer et al., 2016), and warm and sensitive parenting long sleep duration (Vazsonyi et al., 2015). We found one study focusing on family relationships and concordance between family members' sleep, which revealed that families with high interpersonal support and low conflict show higher concordance between adolescents' and parents' sleep chronotypes (Fuligni et al., 2015).

AIMS OF THE STUDY

Earlier studies have assessed the similarities and differences between adolescents' and their parents' sleep schedules, problems, and chronotypes using regression models or correlations. In the spirit of family systems theories, we expect to find unique family types reflecting sleep features in triads of adolescents, mothers, and fathers. Accordingly, the first task is to identify family sleep triadic groups based on sleep onset latency, duration, perceived quality, eveningness, morningness, sleep problems, medication, and impact on daytime functioning. Given that the ecological theory of children's sleep (El-Sheikh & Sadeh, 2015) emphasizes the comprehensive influence of family members' well-being and relationships on within-family sleep, the second aim is to examine how adolescents', mothers', and fathers' mental health problems (e.g., depressive or anxiety symptoms) and attachment relationships are associated with the identified triadic family sleep groups.

METHODS

Participants and procedure

The study consists of follow-up data comprising 438 late adolescents (17–18 years; 60% girls and 40% boys), 449 mothers, and 358 fathers. The original sample of couples ($n = 885$) was recruited in pregnancy, and half of the couples had had an infertility history with successful assisted reproduction treatment (ART), whereas the other half had natural conception (NC; Vilska et al., 2009; https://projects.tuni.fi/kehi/). During the children's late adolescence, the families' addresses were obtained from a population registry, and letters were mailed separately to adolescents, mothers, and fathers informing them about the purpose of the follow-up study. If interested, they returned their signed informed consent in a prepaid envelope and thereafter filled in separate e-form questionnaires. The participating families differed from nonparticipating families in higher parental education in pregnancy, mothers $\chi^2(4,790) = 11.61$, $p = .021$; fathers $\chi^2(4,751) = 15.28$, $p = .004$, and higher parental age, mothers $t(764) = -2.40$, $p = .016$; fathers: $t(747) = -3.49$, $p = .001$. Further, more girls than boys participated, $\chi^2(1,770) = 5.44$, $p = .020$.

The project complied with the Code of Ethics of the World Medical Association Declaration of Helsinki 1964–2014. The Ethical Board of Helsinki University Central Hospital approved the project method and procedure. The study has not been preregistered. The data that support the findings are available only on request due to privacy and ethical restrictions.

Measures

Demographic and health variables

Adolescents reported their gender (1 = girl, 2 = boy, 3 = other), age (years), education (1 = high school, 2 = vocational school, 3 = middle school, 4 = other), living arrangements (1 = nuclear

family, 2 = living with mother, 3 = living with father, 4 = in turns with each parent, 5 = other), and relationship status (1 = single, 2 = in a romantic relationship). However, in the analyses, the adolescent sex (1 = girl, 2 = boy) was used, derived from birth information. Mothers and fathers reported their age (years), socioeconomic status (SES; 1 = high professional, 2 = low professional, 3 = skilled worker, 4 = unskilled worker, student, or unemployed), education (1 = basic school, 2 = high school, 3 = vocational school, 4 = polytechnics, 5 = bachelor's degree, 6 = master's degree), family size, family's monthly income (sum in Euros), and marital status (1 = married, 2 = cohabitant, 3 = separated or divorced), as well as whether they were in shift work (0 = no, 1 = yes; if yes: 1 = two shifts, 2 = three shifts, 3 = irregular work shifts).

Parental and adolescent sleep features

The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) was used to assess parents' and adolescents' sleep features. The PSQI is a 19-item self-report questionnaire for evaluating sleep quality and disturbances over the previous month. The adolescents, mothers, and fathers responded to open questions or evaluated using various-range Likert-type scales how well the description of sleep habits fitted them. The PSQI assesses eight domains: (a) sleep onset latency (How many minutes before falling asleep? How often has falling asleep taken more than 30 minutes?—1 = *not at all* to 4 = *three or more times a week*); sleep schedule comprising (b) eveningness (What time did you go to sleep?) and (c) morningness (What time did you wake up?); (d) sleep duration (How many hours were you really in sleep during the night?); (e) perceived sleep quality (1 = *very good* to 4 = *very poor*); (f) sleep disturbances (nine items: nighttime waking, waking too early, difficulties in breathing, coughing, and snoring, freezing or too cold, sweating or too warm, woke up due to nightmare, woke up due to pain, and disorientation while waking up: 1 = *not at all* to 4 = *three or more times a week*); (g) use of sleep medication (1 = *not at all* to 4 = *three or more a week*); and (h) daytime dysfunction (difficulty staying awake in a social situation, while eating, and while driving: 1 = *not at all* to 4 = *three or more a week*; severity of problems in motivating oneself to perform daily responsibilities: 1 = *not at all* to 4 = highly severe problem).

Adolescent and Parental Mental Health Problems

Adolescent mental health problems were measured by six scales of the Behavior Assessment System for Children, Third Edition (BASC-3; Reynolds, & Kamphaus, 2015): *Depression* (12 items; e.g., "I don't seem to do anything right"), *Anxiety* (13 items; e.g., "I worry but I don't know why"), *Somatization* (seven items; e.g., "I have trouble breathing"), *Attention problems* (eight items; e.g., "I am easily distracted"), *Hyperactivity* (eight items; e.g., "I have trouble sitting still"), and *Anger control problems* (10 items; e.g., "When I get angry, I want to hurt someone"). The adolescents reported whether (*1 = True* or *0 = False*) or how often (from *0 = Never* to *3 = Almost always*) they had had the problem during the past month. Averaged scores (with higher scores indicating more severe symptoms) were computed for depression ($\alpha = .91$), anxiety ($\alpha = .92$), somatization ($\alpha = .74$), attention ($\alpha = .87$), hyperactivity ($\alpha = .79$), and anger control ($\alpha = .79$).

Parents' mental health problems were measured by the 12-item General Health Questionnaire (GHQ-12; Goldberg & Williams, 1988). They evaluated how much they had had described symptoms and behaviors recently on a 4-point Likert-scale (*0 = not at all*; 3 = *much more than usual*). Averaged scores were constructed for mothers ($\alpha = .89$) and fathers ($\alpha = .88$).

Adolescents' attachment relationships

The Experiences in Close Relationships: Relationship Structures (ECR-RS; Fraley et al., 2011) was used to assess adolescents' attachment relationships. The nine-item ECR-RS self-report questionnaire assesses attachment relationship with mother, father, best friend, and romantic partner (36 items). It covers dimensions of *Avoidance* (six items, e.g., "I prefer not to show this person how I feel deep down") and *Anxiety* (three items, e.g., "I'm afraid that this person will abandon me"). Adolescents responded how well each description fitted each relationship on a 7-point Likert-scale (1 = *strongly disagree*; 7 = *strongly agree*). Separate averaged scores were computed for avoidant attachment (mother $\alpha = .90$, father $\alpha = .90$, friend $\alpha = .88$, and romantic partner $\alpha = .87$) and anxious attachment (mother $\alpha = .88$, father $\alpha = .89$, friend $\alpha = .91$, and romantic partner $\alpha = .93$). High avoidant and anxious scores reflected high insecure attachment, and low scores reflected secure attachment. The validity of ECR-RS has been shown among Danish adolescents (Donbaek & Elklit, 2014).

Parents' attachment relationships

The Experiences in Close Relationships—Revised (ECR-R; Fraley et al., 2000) was used to measure parents' attachment relationships. The 36-item self-report questionnaire covered (a) *Avoidance* (18 items, e.g., "I get uncomfortable when my partner wants to be very close") and (b) *Anxiety* (18 items, e.g., "I often worry that my partner will not want to stay with me"). Parents answered on 7-point scale (1 = *strongly disagree*; 7 = *strongly agree*) how well the descriptions fit them. Averaged sum variables were constructed for parents' anxious and avoidant attachment relationships (mother anxious $\alpha = .84$, father anxious $\alpha = .85$, mother avoidant $\alpha = .84$, and father avoidant $\alpha = .83$). The ECR-R is considered a reliable and valid method for measuring attachment relationships (Graham & Unterschute, 2015).

Statistical analysis

The analyses were conducted with SPSS 25.0 (IBM Corporation, Armonk, NY) for Windows, proceeding from an inspection of outliers and missing data to assessing sleep feature distributions and correlations using the whole data and cluster analysis using only complete triadic data. Outliers were set to >3 *SD* from the mean for all variables and replaced by missing values. Full information maximum likelihood, which assumes missing at random, was used to impute single variables. There were 260 families with complete triadic sleep data from the same family and thus eligible for within-family cluster analysis to identify groups differing in the sleep concordance. The noncomplete within-family sleep features data included responding mother and adolescent dyads (father missing, $n = 110$), father and adolescent dyads (mother missing, $n = 31$), and both parents (adolescent missing, $n = 32$).

Cluster analysis was used to identify distinct triadic family sleep groups based on the eight variables of adolescents', mothers', and fathers' sleep features (onset latency, duration, perceived quality, eveningness, morningness, sleep problems, medication, and impact on daytime functioning), and thus 24 variables together. Before running the cluster analyses, the variables were standardized into z-scores to avoid biases due to scale differences. Cluster analysis identified groups of similar family members' sleep features, formally, forming groups so that (a) within groups the features are most similar to each other and (b) between groups the features are most dissimilar to each other. The fundamental information that is used in clustering is *distance*; thus, cluster analysis methods work from *dissimilarity* measures (e.g., distance matrix; Mirkin, 2015). We used the hierarchical method first to evaluate the optimal number

of clusters and produce starting seeds for subsequent analysis and then the nonhierarchical k-means method to determine final case location in the separate clusters or groups. In the hierarchical clustering, Ward's minimum variance criterion was used to minimize the total within-cluster variance through multiple steps, where at each step the criterion would find the pair of clusters that would lead to a minimum increase in total within-cluster variance after merging the elementary clusters (nodes). This increase was a weighted squared distance between cluster centers. The decision for the number of clusters was based on inspection of a binary tree (dendrogram) that visually showed the largest distances between clusters (nodes). The k-means clustering produces a cluster center (centroid) initialization and squared Euclidean distance measure to search the location of each case (participant) in the predefined number of clusters. The assignment of cases to clusters is based on maximizing the difference among the means of the clusters on all sleep feature variables and minimizing the difference within the clusters—namely, triadic sleep groups. Because the k-means clustering begins the iterations with a random cluster assignment, different starting points can lead to unstable solutions. The clustering was repeated 30 times (recommendation: 25–50 times) to ensure stable and meaningful groups.

To describe the contents of the identified clusters, we ran multivariate analysis of variance (MANOVAs) with univariate analyses and Waller–Duncan post hoc tests (due to different group sizes), using the triadic sleep groups as independent variables and the eight sleep features of adolescents, mothers, and fathers as dependent variables. Further, the associations between demographic variables and triadic sleep groups were analyzed by cross-tabulation and χ^2 tests.

To analyze how mental health problems and attachment relationships are associated with the triadic sleep groups, we ran MANCOVAs of the triadic sleep groups on (a) adolescents' depressive, anxiety, and somatic symptoms and hyperarousal, inattention, and anger control problems; (b) mothers' and fathers' psychiatric symptoms; (c) adolescents' avoidant and anxious attachment relationships with their mother, father, best friend, and romantic partner; and (d) fathers' and mothers' avoidant and anxious attachment relationships. The MANCOVAs were followed by univariate analyses and Duncan–Waller post hoc tests.

The theory-based covariates were adolescent gender and mother's and father's shift work (dummy variables 1 and 0). The empirical criteria for demographic covariates were the significant associations with both dependent variables (mental health problems and attachment relationships) and independent variables (triadic sleep groups). We used Benjamini and Hochberg's (1995) false discovery rate (set to 0.25) to correct for multiple MANCOVA tests. The significant results were reported as p values equal to or less than .050 statistical level. The effect sizes were indicated in terms of partial eta squared (η^2), with $0.01 \leq \eta^2 \leq 0.059$ indicating small, $0.06 \leq \eta^2 \leq 0.139$ indicating medium, and $0.14 > \eta^2$. indicating large effect sizes.

RESULTS

Descriptive statistics

Supplementary Table SI, available in the supplemental material, presents the demographic characteristics of the adolescents, showing that 59% were girls and 72% were aged 18 years (18.20 years $\pm$ 0.40). Two thirds lived in a nuclear family, and for 28%, the living arrangement reflected parental divorce, such that the adolescents lived either with their mother or father or alternated between both parents. Three quarters (76%) were high school students, and the rest studied in vocational schools or were working. About a half (54%) of the adolescents had sometimes dated, and a third (30%) were currently in a relationship.

Supplementary Table SII, available in the supplemental material, presents family demographics reported by mothers and fathers. A total of 70% of the mothers and 73% of fathers were aged 50 to 59 years; they were largely well educated (42% with both parents having a master's degree) and working in a permanent job (76% and 83%, respectively). About a third (36%) of mothers and 45% of fathers reported a family monthly income of €7,500 or more. About a half (46%) of families had two children, and about a quarter (28%) had three. Of the parents, 27% were divorced, of whom 63% of fathers and 45% of mothers lived in a reconstituted family. Thirteen percent of mothers and 10% of fathers did shift work.

The subsample of 260 complete within-family triads differed from the noncomplete data in less parental divorce, $\chi^2(1, 449) = 29.74$, $p < .0001$; 18.3% versus 39.8%, more nuclear families, $\chi^2(4, 438) = 53.96$, $p < .0001$; 79.6% versus 50.6%, and adolescents more in high school, $\chi^2(1, 438) = 13.76$, $p = .008$; 81.7% versus 66.9%. The subsample did not differ in adolescent gender, age, general health status, or dating relationship status. In the subsample of complete triads, mothers had a higher education, $\chi^2(5, 444) = 20.84$, $p = .001$; master's degree = 48.4% versus 32.8%, and fathers more often had a permanent job, $\chi^2(1, 353) = 7.01$, $p = .008$; 79.8% versus 66.3%. There were no differences in ART versus NC, family income, family size, mother's work situation, or father's education.

Supplementary Table SIII, available in the supplemental material, shows the means and percentages of sleep features among adolescents, mothers, and fathers. The repeated-measures MANOVAs revealed significant differences between the three family members in all sleep features, except perceived sleep quality. The difference–contrast analyses (Table SIV in the supplemental material) specified that adolescents differed from their both parents, but mothers and fathers did not differ from each other in any sleep features. Adolescents reported a longer onset sleep latency, higher eveningness and lower morning-ness, longer sleep duration, and more daytime dysfunction than their parents. However, adolescents reported fewer sleep problems and used less sleep medication than their parents. Parents more often reported nighttime wake-ups (mothers 82.5%, fathers 86%, and adolescents 66.3%), whereas adolescents more commonly reported nightmares (40%) than mothers (28%) and fathers (29%).

The correlation analyses in Table SV in the supplemental material show that the sleep onset latency, duration, and daytime dysfunction correlated most comprehensively with other sleep features among adolescents, mothers, and fathers. For instance, long sleep onset latency correlated significantly with poor perceived sleep quality and with high levels of sleep problems and medication among the three family members. Short sleep duration, together with poor perceived sleep quality and high levels of sleep problems, correlated significantly with daytime dysfunction. Concerning triadic results, adolescents' long sleep duration correlated significantly with mothers' long sleep duration and short sleep onset latency. Adolescents' high sleep problems correlated significantly with fathers' poor perceived sleep quality and high use of sleep medication. Parents' eveningness, sleep problems, and daytime dysfunction correlated significantly.

The empirical criteria for covariates were significant associations with both mental health problems/attachment relationships and triadic sleep groups. Only adolescents' living arrangements was associated with their own mental health problems, $F_{\text{Roy's largest root}}(6, 397.71) = 5.94$, $p = .021$, $\eta^2 = .08$, and with fathers' psychiatric symptoms, $F(4, 293) = 5.25$, $p < .0001$, $\eta^2 = .08$), indicating lowest levels of mental health problems in a nuclear family. Similarly, only adolescents' living arrangements was associated with their own multiple attachment relationships, $F_{\text{Wilks's lambda}}(32, 1571.288) = 2.84$, $p < .0001$, $\eta^2 = .05$, and parents' attachment relationships, $F_{\text{Wilks's lambda}}(4, 842.000) = 5.02$, $p < .0001$, $\eta^2 = .09$, indicating that adolescents and fathers in nuclear families had lower levels of anxious and avoidant attachment than those in other living arrangements.

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TABLE 1 Means, standard deviations, and one-way analyses of variance in four clusters and original sleep variables in family triads

	Good family sleep (n = 123)		Poor paternal sleep (n = 41)		Poor adolescent and maternal sleep (n = 75)		Poor family sleep (n = 21)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*(3, 257)	η^2
Adolescents										
Sleep onset latency	1.13^{A}	1.28	$1.58^{A,B}$	1.16	2.70^{C}	1.68	$2.33^{B,C}$	1.93	19.24****	.17
Eveningness	$23{:}12^{A}$	0:87	$23{:}10^{A}$	0:72	$24{:}00^{B}$	1:16	$1{:}15^{C}$	1:94	26.51****	.24
Morningness	$07{:}19^{A}$	0:48	$7{:}12^{A}$	0:50	$7{:}29^{A}$	1:01	$10{:}27^{B}$	1:55	60.81****	.42
Sleep duration	7.79^{A}	0.86	7.36^{A}	0.75	6.62^{B}	0.88	8.98^{C}	1.37	46.34****	.36
Perceived sleep quality	0.64^{A}	0.53	1.05^{B}	0.51	1.32^{B}	0.58	1.19^{B}	0.60	26.39****	.24
Sleeping problems	3.34^{A}	2.65	4.11^{A}	2.59	5.17^{B}	2.85	8.12^{C}	4.91	18.37****	.18
Sleep medication	0.07^{A}	0.29	0.13^{A}	0.41	0.17^{A}	0.47	1.14^{B}	1.31	26.08****	.24
Daytime dysfunction	1.44^{A}	0.99	2.28^{B}	1.25	$3.01^{B,C}$	1.15	2.59^{C}	1.27	33.94****	.29
Mothers										
Sleep onset latency	0.93^{A}	1.07	0.97^{A}	1.33	1.84^{B}	1.67	0.81^{A}	0.82	9.07****	.10
Eveningness	$22{:}36^{A}$	0:48	$22{:}39^{A}$	0.49	$23{:}06^{B}$	0:48	$22{:}45^{A,B}$	0:41	6.15****	.07
Morningness	$6{:}31^{A,B}$	0:48	$6{:}23^{A}$	0:39	$6{:}54^{B,C}$	0:51	$6{:}59^{C}$	1:01	5.71***	.06
Sleep duration	7.19^{A}	0.88	7.13^{A}	0.86	6.56^{B}	0.93	7.40^{A}	0.66	9.94****	.11
Perceived sleep quality	0.93^{A}	0.47	$1.05^{A,B}$	0.45	1.26^{B}	0.62	0.90^{A}	0.54	6.72****	.07
Sleeping problems	5.93^{A}	3.60	$7.71^{A,B}$	4.12	8.01^{B}	3.90	$7.37^{A,B}$	3.57	5.52***	.06
Sleep medication	0.15^{A}	0.58	$0.54^{A,B}$	0.97	0.72^{B}	1.06	0.69^{B}	1.10	7.93****	.09
Daytime dysfunction	0.70^{A}	0.71	1.76^{B}	1.28	1.29^{B}	1.05	1.53^{B}	0.98	16.31****	.16
Fathers										
Sleep onset latency	0.84^{A}	0.98	2.54^{B}	1.71	0.70^{A}	0.82	$1.05^{A,B}$	1.20	27.49****	.25
Eveningness	$22{:}45^{A}$	0:48	$23{:}22^{B}$	1:03	$22{:}38^{A}$	0:57	$22{:}55^{A}$	1:18	7.12***	.08
Morningness	$6{:}30^{A}$	0:55	$6{:}45^{A,B}$	1:25	$7{:}13^{B}$	1:15	$6{:}39^{A,B}$	0:54	6.40****	.07
Sleep duration	7.16^{A}	0.82	6.16^{B}	1.03	7.20^{A}	0.89	7.06^{A}	0.79	14.73****	.15
Perceived sleep quality	0.80^{A}	0.40	1.67^{B}	0.58	0.78^{A}	0.48	1.10^{C}	0.54	38.90****	.32
Sleeping problems	5.38^{A}	2.92	8.91^{B}	3.11	5.65^{A}	3.18	6.24^{A}	4.16	13.02****	.13
Sleep medication	0.08^{A}	0.38	1.13^{B}	1.34	0.11^{A}	0.31	0.52^{C}	1.12	25.62****	.23
Daytime dysfunction	0.88^{A}	0.80	1.77^{B}	1.06	1.00^{A}	0.91	1.29^{B}	1.19	10.04****	.11

Note: The univariate analyses are based on significant multivariate analysis of variance of triadic sleep groups on sleep features, $F_{\text{Wilks's lambda}}$ (72, 685,22) = 17.01, $p < .0001$, $\eta^2 = .64$. The mean values with different superscript capital letters on rows differ statistically significantly at $p < .05$.
*$p < .05$. **$p < .01$. ***$p < .001$. ****$p < .0001$.

Identifying triadic sleep groups

Four clusters were identified reflecting distinct sleep features among adolescents, mothers, and fathers. The MANOVA confirmed significant differences between the identified triadic sleep groups in all the sleep features (onset latency, duration, perceived quality, eveningness, morningness, sleep problems, medication, and impact on daytime functioning) of adolescents, mothers, and fathers, $F_{\text{Wilks's lambda}}(72, 685{,}22) = 17.01$, $p < .0001$, $\eta^2 = .64$. Table 1 presents the univariate analyses and post hoc tests between the four triadic sleep groups and original mean values of sleep features. The supplementary material illustrates each triadic sleep group separately, based on z-standardized scores (Supplementary Figures 1–4).

The largest (first) cluster, labeled the "Good family sleep" group, comprised almost a half (47.3%, $n = 123$) of the data and was characterized by optimal sleep features among adolescents, mothers, and fathers. The second largest (third) cluster, labeled the "Poor adolescent and maternal sleep" group, comprised more than a quarter (28.8%, $n = 75$) of the data and was characterized by high levels of problematic sleep features among adolescents and mothers, but not among fathers. The third largest (second) cluster, labeled the "Poor paternal sleep" group, comprised 15.8% ($n = 41$) of the data and was characterized by high levels of problematic sleep features among fathers but not among adolescents or mothers. The smallest (fourth) cluster, labeled the "Poor family sleep" group, comprised 8.1% ($n = 21$) of the data and involved very high levels of adolescent and relatively high levels of parental problematic sleep features.

Concerning demographic factors, the triadic sleep groups differed in adolescents' living arrangements, $\chi^2(12, 260) = 33.68$, $p = .002$, and mother's work situation, $\chi^2(3, 260) = 8.78$, $p = .032$. In the "Good family sleep" group, a majority of adolescents were living in a nuclear family (83.7%), whereas their share in the "Poor family sleep" group was 66.7%. Instead, only 3.3% of the adolescents in the "Good family sleep" group, but 28.6% in the "Poor family sleep" group, lived only with their mothers. In the "Good family sleep" group, a majority (87.6%) of mothers had a permanent job, whereas the share was 71.4% in the "Poor family sleep" group. No differences were found between the triadic sleep groups in ART compared with NC, adolescent sex, family income, divorce, family size, parental education, father's work situation, or parents' shift work.

Mental health and triadic sleep groups

Our second aim was to examine the associations among adolescent, maternal, and paternal mental health problems and the identified triadic sleep groups. The covariates were adolescent sex, parental shift work, and adolescents' living arrangements. For adolescents, a significant MANCOVA indicated general associations between mental health problems and triadic sleep groups, $F_{\text{Wilks's lambda}}(18, 682{,}135) = 3.95$, $p < .0001$, $\eta^2 = .08$). The results in Table 2 show that adolescents in the "Poor family sleep" group reported higher levels of depressive, anxiety, and somatization symptoms and anger inhibition problems than they did in the "Good family sleep" and "Poor paternal sleep" groups, but they were not different from the "Poor adolescent and maternal sleep" group. Further, adolescents in the "Poor family sleep" group reported higher levels of inattention and hyperarousal problems than they did in any other triadic sleep groups.

For parents, a significant MANCOVA indicated general associations between their psychiatric symptoms and the triadic sleep groups, $F_{\text{Wilks's lambda}}(6, 452{,}000) = 6.58$, $p < .0001$, $\eta^2 = .08$, yet univariate analyses with the post hoc tests were significant only for fathers (Table 2). Fathers in the "Poor paternal sleep" group showed a higher level of psychiatric symptoms than they did in the "Good family sleep" and "Poor adolescent and maternal sleep" groups, but they did not differ from the "Poor family sleep" group.

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TABLE 2 Family sleep clusters and adolescent and parental mental health problems: means, standard deviations, and univariate analyses of variance

	Good family sleep ($n = 122$)		Poor paternal sleep ($n = 40$)		Poor adolescent and maternal sleep ($n = 75$)		Poor family sleep ($n = 20$)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*(3,253)	η^2
Adolescents										
Depressive symptoms	4.25^{A}	5.08	$6.29^{A,B}$	5.19	$8.38^{B,C}$	7.18	9.24^{C}	8.59	9.52****	.10
Anxiety symptoms	7.73^{A}	6.32	$11.21^{A,B}$	6.88	$12.98^{B,C}$	7.80	15.39^{C}	8.64	14.34****	.15
Somatization symptoms	2.10^{A}	2.14	$3.10^{A,B}$	3.10	$3.72^{B,C}$	3.45	4.75^{C}	3.72	8.46****	.09
Attention problems	4.55^{A}	3.90	$6.06^{A,B}$	4.54	$8.22^{A,B}$	4.51	9.68^{C}	4.53	15.78****	.16
Hyperarousal problems	2.90^{A}	2.94	2.79^{A}	2.33	4.1^{A}	3.27	5.67^{B}	4.21	6.15****	.07
Anger inhibition problems	4.44^{A}	3.08	5.41^{A}	3.69	$6.16^{A,B}$	3.64	7.64^{B}	4.28	7.22****	.08
Parents										
Mothers psychiatric symptoms	21.98	3.51	24.49	5.27	24.13	5.41	22.90	5.67	4.49**[a]	.06
Fathers psychiatric symptoms	21.17^{A}	3.06	24.57^{B}	4.43	21.51^{A}	3.41	$22.79^{A,B}$	4.53	9.55****	.11

Note: Covaried for adolescence sex, mothers' and fathers' shift work and adolescents' living arrangement. The mean values with different superscript capital letters on rows differ statistically significantly at $p < .05$ (Waller-Duncan post hoc test).

[a]Benjamini–Hochenberg corrections define the nonsignificant p value.

**$p < .01$. ****$p < .0001$.

TABLE 3 Family sleep clusters and adolescent and parental insecure attachment relationships: means, standard deviations, and univariate analyses of variance

	Good family sleep ($n = 121$)		Poor paternal sleep ($n = 39$)		Poor adolescent and maternal sleep ($n = 74$)		Poor family sleep ($n = 21$)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*(3,252)	η^2
Adolescents										
Avoidance to mother	4.66	0.61	4.68	0.59	4.45	0.64	4.66	0.82	1.9	.02
Avoidance to father	4.33	0.73	4.36	0.62	4.07	0.64	4.19	1.09	2.40	.03
Avoidance to friend	4.73	0.69	4.67	0.51	4.87	0.49	4.61	0.95	1.57	.02
Avoidance to partner	4.80	0.63	4.93	0.40	4.79	0.54	4.79	0.55	0.62	.01
Anxious to mother	1.19^{A}	0.57	1.25^{A}	0.68	1.44^{A}	1.03	1.99^{B}	1.65	5.39***	.06
Anxious to father	1.33^{A}	0.81	1.38^{A}	0.75	$1.64^{A,B}$	1.04	1.95^{B}	1.67	3.21*[c]	.04
Anxious to friend	1.83^{A}	1.28	$2.21^{A,B}$	1.52	$2.32^{A,B}$	1.33	2.82^{B}	1.91	3.91**	.05
Anxious to partner	1.99^{A}	1.47	1.71^{A}	1.06	2.24^{A}	1.57	2.96^{B}	1.80	3.56**	.04
Parents										
Mothers avoidant	2.53	0.96	2.92	1.01	2.56	0.95	2.70	0.93	1.63	.02
Mothers anxious	2.27	1.04	2.71	1.11	2.22	0.96	2.55	0.99	2.62*[a]	.04
Father avoidant	2.73^{A}	0.87	3.33^{B}	0.86	2.63^{A}	1.01	2.78^{A}	0.95	4.79**	.07
Father anxious	$2.33^{A,B}$	0.81	2.78^{B}	0.99	2.28^{A}	0.91	$2.75^{A,B}$	0.85	3.79**	.05

Note: Covaried for adolescence sex, mothers' and fathers' shift work and adolescents' living arrangement. The mean values with different superscript capital letters on rows differ statistically significantly at $p < .05$ (Waller-Duncan post hoc test).
[a]Benjamini–Hochenberg corrections define the nonsignificant *p* value.
*$p < .05$. **$p < .01$. ***$p < .001$. ****$p < .0001$.

Attachment relationships and triadic sleep groups

Finally, we examined how family members' attachment relationships were associated with the triadic sleep groups. The covariates were adolescent sex, parental shift work, and adolescents' living arrangements. A MANCOVA showed significant associations between adolescent attachment relationships and triadic sleep groups, $F_{\text{Wilks's lambda}}(24, 687.973) = 1.93$, $p = .005$, $\eta^2 = .06$, and Table 3 specifies these associations only in anxious but not in avoidant attachments. Adolescents in the "Poor family sleep" group showed more anxious attachments with mothers and romantic partners than they did in the "Good family sleep," "Poor adolescent and maternal sleep," and "Poor paternal sleep" groups. Adolescents in the "Poor family sleep" group also showed more anxious attachment with best friends than they did in the "Good family sleep" group, but they did not differ from the "Poor paternal sleep" or "Poor adolescent and maternal sleep" groups. Adolescents' attachment to their father did not differ according to the triadic sleep groups.

A significant MANCOVA indicated general associations between maternal and paternal attachments and triadic sleep groups, $F_{\text{Wilks's lambda}}(12, 627.000) = 1.99$, $p = .038$, $\eta^2 = .04$. Univariate analyses confirmed significant association only between fathers' attachment relationships and triadic sleep groups, but mothers' attachment relationships did not differ according to the triadic sleep groups. Fathers in the "Poor paternal sleep" group showed more avoidant attachment than they did in any other triadic sleep groups, and they showed more anxious attachment than fathers in the "Poor adolescent and maternal sleep" group.

DISCUSSION

Our aim was to identify triadic family groups reflecting differences and similarities between adolescent, maternal, and paternal sleep. The results showed a high triadic concordance in optimal sleep features, whereas more diversity was present in families with poor sleep. Almost half of adolescents with both their parents belonged to the "Good family sleep" group, whereas a small minority belonged to the "Poor family sleep" group. Other groups characterized by poor sleep features involved either solely fathers in the "Poor paternal sleep" group or adolescents together with mothers in the "Adolescents and maternal poor sleep" group.

Our results on family mental health and sleep are in accordance with abundant evidence of mental health problems associating with poor sleep quality among adolescents (Blank et al., 2015) and adults (Baglioni, 2016). Adolescents showed higher levels of both internalizing and externalizing symptoms in the "Poor family sleep" group than they did in the "Good family sleep" or "Poor paternal sleep" groups. Fathers showed more psychiatric symptoms in the "Poor paternal sleep" group than they did in the "Good family sleep" or "Poor adolescent and maternal sleep" groups, whereas mothers' mental health was not as vulnerable to poor family sleeping.

In line with the ecological theory of children's sleep (El-Sheikh & Sadeh, 2015), which emphasizes the requirement of safety and emotional security for good sleep, adolescents in the "Poor family sleep" group showed more insecure–anxious attachments with significant others than they did in the "Good family sleep" group, and fathers in the "Poor paternal sleep" group showed more insecure–avoidant attachments than they did in any other triadic sleep groups and more insecure-anxious attachment than in "Poor adolescent and maternal sleep" group. Mothers' attachment security did not differ between family sleep triads. Our results point out the dynamic and reciprocal nature of sleep features among mothers, fathers, and children in late adolescence.

Dynamic family sleeping

The identified triadic sleep groups are in accord with ecological and family systems theories in conceptualizing sleep as a dynamic individual, interrelational, and whole-family phenomenon (Bowen, 1990; Cox & Paley, 1997; El-Sheikh & Sadeh, 2015). The groups that emerged reflect both differences and similarities among adolescents, mothers, and fathers in their sleep schedule as well as problems with and the impact of sleep. The triads that slept well constituted almost half the families in the "Good family sleep" group (47%), whereas the shares of poorly sleeping triads varied greatly, with the "Poor family sleep" group incorporating 8% and the "Poor paternal sleep" group incorporating 16% of families. Nevertheless, almost a third (29%) belonged to the "Adolescents and maternal poor sleep" group.

Evolutionary theories may explain why, in our within-family sleep distribution, there was only one positive triadic group involving homogenously similar optimal sleep features for all family members, whereas multitude and repertoire were typical in triadic groups with poor sleep. These theories emphasize meaningfulness of diversity, whether biological, cultural, or psychological. A multitude of different strategies—here, different familial sleeping patterns—provide a more effective repertoire for coping with various life demands, higher probability of goodness-of-fit between sleep features and unique family environment, and access to more resources (Frankenhuis et al., 2016). Also, of the basic emotions, only one is positive (joy), whereas the repertoire of negative emotions guarantees adaptive responses that fit different experiences, such as fear of threat, sadness about loss, or anger at injustice (Ekman, 1992).

According to family systems theories, the general function of family relationships is the pursuit of homeostasis to provide family members with steady, consistent conditions, while

simultaneously adapting and making changes that protect the family unit when facing various environmental demands (Bowen, 1990; Cox & Paley, 1997). The diversity of problematic within-family sleeping patterns can function as stabilizers in seeking adaptive resolutions. Family systems theories also emphasize a variety of ways in which stressed, suffering, and problematic families attempt to solve their problems and cope with difficulties, whereas the habits and actions of trouble-free families that maintain happiness are considered more consistent (Boss et al., 2016).

This dynamic is depicted in the famous opening sentence of the novel *Anna Karenina* by Leo Tolstoy: "Happy families are all alike; every unhappy family is unhappy in its own way." Analogously, our results reveal that each of the three triadic groups of poor sleepers was problematic in its own, unique way, whereas there was only one relatively large uniform group of good sleepers. In the "Poor adolescent and maternal sleep" group, adolescents and mothers showed a high number of sleep problems, long onset latency, and poor perceived sleep quality. In contrast, in the "Poor paternal sleep" group, only fathers suffered from these various problematic sleep features. In the "Poor family sleep" group, adolescents showed comprehensively and severely problematic sleep, and both parents reported high use of sleep medicine and daytime dysfunction.

Our study is the first to apply a systemic, person-oriented clustering approach to family members' sleep. Therefore, we cannot directly compare the results of the triadic sleep group distribution with earlier literature. Nevertheless, and similar to previous studies, we found a stronger concordance between adolescents' and their mothers' sleep features than those of their fathers (Bajoghli et al., 2013; Kouros & El-Sheikh, 2017; Peltz et al., 2019), illustrated by the emergence of a relatively large group of adolescents and their mothers suffering from poor sleep. Studies confirming mother–child sleep concordance have mainly involved young children (Kouros & El-Sheikh, 2017), with only a few focusing on adolescents (Brand, Gerber, et al., 2009; Brand, Hatzinger, et al., 2009). Parental gender roles in evening rituals, focus on warmth and comforting in mother–child dyads, and maternal sensitivity to children's stress and arousal (Meltzer & Montgomery-Downs, 2011; Peltz et al., 2016) may explain the concordance between young children and mothers. Our findings concerning shared sleep features agree with the observation that mothers sustain their central relational role until late adolescence, together with the increasing significance of peers, friends, and romantic partners (Kobak et al., 2007).

Concerning the role of demographic factors, the triadic sleep groups differed only in mothers' work status and adolescents' living arrangements. Mothers in the "Good family sleep" group more often had permanent work than those in the "Poor family sleep" group. The results concur with epidemiological research showing that permanent work status associates with low sleeping problems, reflecting access to socioeconomic resources that contribute to good sleep (Grandner et al., 2010).

Although parental divorce did not influence triadic sleeping, adolescents' living arrangements were important. Adolescents in the "Good family sleeping" group more often lived in a nuclear family, whereas those living either only with their mother or father belonged more often to the triadic groups of poor sleep. The results concur with studies evidencing that single parenting can deteriorate adolescents' sleep quality (Troxel et al., 2014). The insignificance of divorce in triadic family sleep may relate to findings that marital conflict, hostility, and family fights interfere with the development of children's optimal sleep patterns (El-Sheikh et al., 2006), and divorce can thus calm the sleeping environment. Late adolescence is a critical period for stabilizing an optimal sleep schedule and securing good daytime functioning (Carskadon, 2011), both of which are crucial for future independent living (Arnett, 2004). Therefore, more thorough research is vital on family relationships, sleeping arrangements, and adolescent sleep.

Mental health and family sleep

Mental health problems of depression and anxiety form severe risks for poor sleep quality, involving long sleep onset latency, short duration, and sleep problems (Baglioli et al., 2016; Blank et al., 2015). Our findings show that in addition to these internalizing symptoms, adolescents' anger control problems, and especially inattention and hyperactivity as a reflection of externalizing symptoms were also associated with poor triadic sleep. In internalizing symptoms, adolescents direct their pain, distress, and concerns "inside" themselves and are overwhelmed by negative emotions and unpleasant social encounters. In externalizing symptoms, they in turn manifest distress and frustration by acting out (e.g., hurting or insulting others; behaving impulsively; Reynolds & Kamphaus, 2015). It is thus possible that adolescents' internalizing and externalizing symptoms associate with poor sleep quality through different underlying mechanisms, such as certain chronobiological factors or ineffective emotion and stress regulation.

Models of chronobiology can contribute to understanding the associations between family members' mental health and sleep. Circadian functioning influences mood states and alertness, which, together with multiple other factors, such as body temperature, cortisol and melatonin release, and rapid eye movement sleep propensity, influence the core rest–activity and sleep–wake cycles. Chronobiological anomalies underlying depression include diurnal fluctuations, especially early morning awakening, that can mark pathologically advanced timing in the sleep rhythm (Zaki et al., 2018).

Dysfunctional emotion regulation implies failure to modify the intensity, duration, and expression of emotions, possibly manifested in hyperregulation (e.g., excessive inhibition) or hyporegulation (e.g., rumination), both increasing risks for mental health problems (Gross, 2015). Adolescents with internalizing symptoms typically show rumination and preoccupation with negative experiences, which may result in long sleep onset latency or nighttime wake-ups. Externalizing symptoms in turn may manifest as difficulties in calming down and attuning high arousal and excitement. Research on adults shows that general emotion regulation difficulties mediate the association between mental health problems and sleeping difficulties (Predatu et al., 2020).

These associations can also involve reciprocal phenomena whereby adolescents' dysfunctional emotion regulation, characterized by heightened neural and physiological arousal, leads to poor sleep (Baglioni et al., 2016), and insufficient and poor-quality sleep in turn associates with bad mood, uncontrollable arousals, and inability to attune excessive feelings (Peltz et al., 2019). Our study setting was cross-sectional and thus unable to reveal the directionality of associations between family members' mental health and triadic within-family sleeping patterns.

Attachment and family sleep

We further analyzed how the nature of family relationships, conceptualized as attachments, would associate with the triadic sleep groups. The results reveal that the nature of adolescents' insecure attachment, whether anxious or avoidant, was decisive for the triadic within-family sleep and that the role of attachment relationships and sleep greatly differed between fathers and mothers. Adolescents with insecure–anxious attachments were typically members of family triadic groups of poor sleepers, whereas avoidant attachment was not important to their sleep. Fathers with both kinds of insecure attachments—namely, anxious and avoidant—belonged more commonly to the triadic groups of poor sleepers, whereas, interestingly, mothers' attachment security or insecurity was not associated with triadic sleep. Anxious attachment relationships are rooted in inconsistent and arbitrary caregiver behavior, to which the infant responds by clinging to the caregiver, seeking assurance of safety, protection, and feelings of worthiness, often resulting in failure of gaining the desired sense of security (Ainsworth, 1989; Bowlby, 1988). Adolescents with anxious attachment are correspondently worried about others'

ability and willingness to provide them sufficient support and closeness, preoccupied with others' acceptance, and vulnerable to disappointments (Fraley et al., 2011; George & West, 2012). They tend to exaggerate perceived threats, intensify fear of loss, and hyporegulate overwhelming emotions. Subsequently, anxiously attached adolescents face difficulty in calming down and are highly aroused and reactive to bodily, psychological, and social stimuli, which may lead to sleep difficulties. Instead, withdrawal, hyperregulating emotions, and denial of neediness for others' support, which are characteristics of avoidant attachment, may not disturb the initiation and maintenance of sleep (Adams et al., 2014). However, studies also suggest that both insecure attachment relationships are associated with poor sleep quality, whereas people with secure attachments are good sleepers (McNamara et al., 2011), which is in line with our results concerning fathers in the "Poor paternal sleep" group.

Neither mothers' mental health nor attachment relationships were associated with membership of sleep triadic groups, and thus they were different from fathers and adolescents. The reason for this may lie in different roles of adolescents' fathers and mothers and family systems dynamics. Traditionally, mothers provide warmth and comfort, whereas fathers challenge children, and thus together they contribute to their socioemotional skills and well-being (Majdandžić et al., 2016). Mothers may thus be more motivated to protect family sleep from their own problems. The influence of a parental subsystem on family sleep can also be compensatory rather than additive, which helps maintain the homeostatic purpose to promote the family's cohesiveness and enhance the well-being of its members (Bowen, 1990). According to El-Sheikh et al. (2012), fathers' depressive symptoms are directly associated with their children's sleep, whereas mothers' depressive symptoms' influence is indirect, mediated by severe family conflict. There might thus be parent-specific mechanisms of mental health and attachment influencing family sleep that our research setting was not able to highlight.

Limitations of the study

This study deserves criticism for reliance on self-reports of adolescents', mothers', and fathers' sleep features, as well as their mental health problems and attachment relationships. Objective polysomnographic methods are the gold standard for sleep assessment because they more accurately register sleep latency, duration, and schedule (Buysse et al., 2010). Clinical interviews on mental health problems are superior to self-reports, which involve risk of exaggerating or downplaying suffering. To study triadic attachments relationships, it would have been preferable to choose the theoretically sophisticated Adult Attachment Interview (George et al., 1984–1996), which provides narrations of early relationships, responses to upsets and hardships, and dynamic coherence dimensions, or the Adult Attachment Projective tool, which provides nuanced information about activation of attachment representations (George & West, 2012). However, considering the sample size, self-reports were the most economical method to study the attachment of mothers, fathers, and adolescents.

Criticism can further be targeted to our choice of performing the cluster analysis only on the complete triadic data, despite availability of sophisticated imputation methods. One may further argue that it is not meaningful to analyze triadic sleep in families whose members live apart. A counterargument would be that divorce does not necessarily break parent–child relationships. Adolescents' living arrangements were used as covariates in the analyses of the role of mental health and attachment relationships in within-family sleep.

Finally, our study sample was not nationally representative because the families had relatively high incomes and high school students were overrepresented. Also, half of the sample consisted of families with an infertility history and who had conceived through ART, which restrains the generalizability of the findings. Nevertheless, the cluster analysis did not show ART-specific groupings, suggesting that there were no differences in sleep between NC and ART families.

Practical implications

Our study provides evidence of the dynamic and interrelated nature of family sleep among mothers, fathers, and late adolescents. Importantly, triadic sleep was associated with adolescents and fathers' mental health and attachment relationships. These results have practical implications for improving adolescents' sleep and applying a family systems approach to treat sleep problems such as insomnia. Further, the results encourage clinical professionals to be aware of the importance of triadic family sleep habits in contributing to adolescents and fathers' mental health problems, such as depression or anger regulation difficulties. Also, the associations between attachment and a family's sleep quality can be helpful in treating family and parent–adolescent conflicts or adolescent developmental difficulties. Adolescents' sleep development involves significant changes, increasing the risk of persistent sleep difficulties and mental health problems (Carskadon, 2011). Guidelines recommend cognitive–behavioral therapies for both adolescent and adult insomnia as the first-line treatment (Mitchell et al., 2012). However, our study provides support for the application of a family systems approach and family therapies for adolescent and family sleep problems. Applying both attachment and family therapeutic tools may be especially effective given that sleep is embedded in family relationships and their histories.

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How to cite this article: Punamäki, R.-L., Flykt, M., Lindblom, J., Tiitinen, A., Poikkeus, P., & Vänskä, M. (2022). Do family members sleep alike? Sleep features among mothers, fathers, and adolescents. *Family Relations*, 1–20. https://doi.org/10.1111/fare.12759