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Research paper

Longitudinal associations between parent, child, family factors and dyssomnias in children from birth to 8 years: The CIKEO study

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ABSTRACT

Background: Dyssomnias, are the most common parent-reported sleep complaints in young children. The present study investigated the prevalence, one-year development (incidence and persistence) of dyssomnia in early childhood, and the parent, child, and family factors associated with dyssomnia.

Methods: Longitudinal data of 700 children aged 0–8, gathered in the CIKEO cohort study in the Netherlands were analyzed. Dyssomnias were defined as the presence of night awakenings ≥3 times per night or sleep-onset latency of >30 min. Least absolute shrinkage and selection operator (LASSO) was used to identify the parental, child, and family factors associated with the incidence and persistence of dyssomnias in children.

Results: The mean age of the children (47 % girls) was 3.2 ± 1.9 years at baseline and 4.4 ± 1.8 years at follow-up. The prevalence of dyssomnias was 13.3 % and 15.4 % at baseline and follow-up, respectively. The incidence and persistence rates of dyssomnias at follow-up were 12.0 % and 37.6 %, respectively. New incidence of insomnia was associated with being a girl, having medical conditions, experiencing stressful life events, and lower parenting self-efficacy at baseline ($P < 0.05$). Higher levels of parental psychological distress were associated with the persistence of dyssomnias in children ($P < 0.05$).

Conclusions: Dyssomnias are common with a moderate persistent rate in young children. Several parental, child, and family factors in relation to the incidence and persistence of dyssomnias were identified. Preventive programs and interventions targeting modifiable factors, particularly parental psychological distress, parenting self-efficacy, and resilience to stressful life events, might benefit child sleep.

1. Introduction

Dyssomnias, characterized as sleep-onset difficulties and frequent night awakening are the most common sleep complaints by parents in young children (Brown and Malow, 2016; Mindell et al., 2010), with estimates ranging from 6.5 % to 36 % of children between the ages of birth and six years (Byars et al., 2012; Mindell et al., 2010; Ottaviano et al., 1996; Petit et al., 2007; Zuckerman et al., 1987). Although these issues regarding sleep generally are considered developmentally appropriate and usually decline with age, studies suggest that they can persist throughout childhood and may be associated with adverse health outcomes (Bruni and Novelli, 2010; Byars et al., 2012; Petit et al., 2007; Quach et al., 2018; Williamson et al., 2019; Zuckerman et al., 1987).

Dyssomnias have shown to be associated with reduced quantity and quality of sleep (children and adolescents aged 0–12 years) (Jiang et al., 2007; Li et al., 2014; Ottaviano et al., 1996; Petit et al., 2007;

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Plancoulaine et al., 2018), more emotional and behavior problems (2–5 years) (Hiscock et al., 2007; Hysing et al., 2016), lower health-related quality of life (4–5 years) (Hiscock et al., 2007), increased daytime malfunctioning (5–12 years) (Li et al., 2014; Velten-Schurian et al., 2010). Simultaneously, it has been reported that parents might also experience lower sleep quality, higher levels of parenting stress, distress, and poor mental health when their child does not sleep well (Martin et al., 2007; Meltzer and Mindell, 2007). Given the high prevalence of dyssomnia symptoms in children and the research findings on the importance of healthy sleep for the development and wellbeing of both the child and the family, it is important to identify groups of children at risk of developing and maintaining dyssomnias as early as possible. Furthermore, more knowledge regarding the factors, especially the modifiable ones that affect child sleep behaviors would benefit the development of more effective sleep education programs.

Despite the high prevalence of dyssomnia in childhood, the tendency of dyssomnia to persist, and the possibility of adverse consequences, there may be still a lack of attention in both health care practice and research (Meltzer et al., 2010). A systematic review by Newton et al. revealed several relevant knowledge gaps regarding the factors associated with sleep disturbances (Newton et al., 2020). First, relatively few studies had focused specifically on dyssomnia in preschool and early childhood. Second, many studies have applied a cross-sectional study design; therefore, insights regarding the development of dyssomnias and their perspective predictors in young children is therefore sparse. Third, the evidence is inconclusive regarding the role of demographic factors and indicators of socioeconomic status (SES).

Therefore, using the data gathered longitudinally in a large community sample of children aged 0–8 years, we aim to 1) describe the prevalence, one-year development (incidence and persistence) of dyssomnia in early childhood and 2) study the parent, child, and family factors associated with dyssomnias.

2. Methods

2.1. Study design and study population

In this longitudinal study, we used data from the CIKEO study (Windhorst et al., 2019). The CIKEO (Consortium Integration Knowledge promotion Effectiveness Of parenting interventions in the Netherlands) study is a community-based cohort study with a baseline and a follow-up measurement (Windhorst et al., 2019).

The CIKEO study investigated the use of (elements of) parenting support and the associations between parenting support and outcomes regarding parenting, family functioning, and child development. Details of the CIKEO study protocol have been previously published (Windhorst et al., 2019). In brief, parents/caregivers with a child up to 7 years old were invited to participate in the study between October 2017 and December 2019. Participants were recruited by two regional preventive youth health care organizations in Rotterdam and Dordrecht, by providers of parenting programs (Part A), and through advertisements on websites about parenting (Part B). All invited parents received project information, an informed consent form, and a baseline questionnaire. Those parents who spent the most time with the child were invited to complete the questionnaire. Parents who provided written informed consent and completed a baseline questionnaire were included. A follow-up measurement was conducted after 12 months of enrollment using questionnaires. A total of 1118 parents responded to the baseline questionnaire, among whom 843 (75.4 %) responded to the follow-up questionnaire. Questionnaires were further excluded when the follow-up questionnaire was not filled out by the same parent (n = 61), or when the questionnaires were not filled out for the same child (n = 15). Participants with missing information on the outcome measurement at baseline (n = 27) and follow up (n = 40) were excluded, leaving a population of 700 parent-child pairs for analysis (Fig. 1).

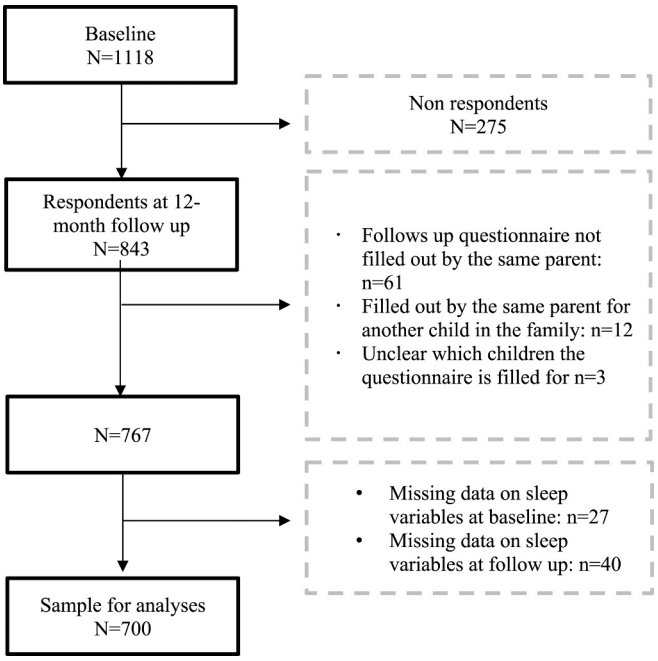

Fig. 1. Flow chart of participants included for analyses.

2.2. Measures

2.2.1. Sleep characteristics

Information on children's average number of night awakenings and sleep-onset latency during the past four weeks were assessed in the parent-report questionnaires, both at baseline and follow-up. For the number of night awakenings, parents were asked to report how often on average their child woke up during the night. Response options ranged from 0, 1, 2, 3, 4, and >4 times. For sleep-onset latency, parents were asked how long on average it takes the child to fall asleep. Response options were <10 min, 10-30 min, 30 min-1 h, 1 h-2 h, and >2 h. At each time point, and in accordance with the literature (Petit et al., 2007; Sadeh and Anders, 1993; Touchette et al., 2009; Wang et al., 2019; Zuckerman et al., 1987), dyssomnias were defined as the presence of night awakenings ≥3 times per night or sleep-onset latency >30 min in our main analysis.

Children were divided into two groups based on the presence of dyssomnias at baseline. Children without dyssomnias at baseline were analyzed for the incidence rate of dyssomnias at follow-up (i.e., children who developed new symptoms), while children with dyssomnias at baseline were analyzed for the persistent rate of dyssomnias at follow up (i.e., children who continued to report symptoms at the time of their follow-up examination) (Supplementary Fig. 1).

2.2.2. Potential correlates of dyssomnias

Based on previous research (Newton et al., 2020) and data availability, the following variables were selected as potential correlates for the development of dyssomnias. Information on these variables was derived from parent-reported questionnaires at baseline and were organized into three domains as described below. A detailed description of the scales can be found in Supplementary Table 1.

2.2.2.1. Parental factors. Parental factors included (1) age (years); (2) sex (3) perceived general health as measured by the first item of the Short Form 12 health survey (SF-12) with a higher score indicating better health (Ware et al., 1996); (4) parenting stress measured by the intensity subscale of Parenting Daily Hassles (PDH) with a higher score reflecting higher parental stress (Crnic and Booth, 1991; Crnic and Greenberg, 1990); (5) psychological distress measured by the Brief

Symptom Inventory 18 (BSI-18) with a higher score indicating more distress (Derogatis, 2000); (6) parenting self-efficacy measured by the efficacy subscale of the Parenting Sense of Competence Scale (PSOC) with a higher score indicating higher parenting self-efficacy (Gibaud-Wallston and Wandersmann, 1978); and (7) parenting style, based on two scales described by Wake through which the parenting style of the parents was classified as authoritative, authoritarian, permissive, or disengaged (Wake et al., 2007).

2.2.2.2. Child factors. Eight child factors were assessed: (1) age (years); (2) sex; (3) general health status; as assessed by the first item of the Child Health Questionnaire (CHQ) on a 5-point Likert scale (Landgraf et al., 1996) with higher scores indicating better health status; (4) gestational age; (5) problem behavior, as measured by Child Behavior Checklist (CBCL 1.5–5 years) (Achenbach and Rescorla, 2000) with higher scores on CBCL indicating more behavior problems; and (6) medical conditions, by parent responding to whether a diagnosis with regard to physical or mental limitations has been made on the focus child.

2.2.2.3. Family factors. Family factors measured included (1) migration status based on the definitions given by Statistics Netherlands (Statistics Netherlands, 2012) that when either the child or one or both parents were born outside the Netherlands, it was categorized as having a migration background; family composition (one-parent/two-parent); (2) employment status of the respondent (yes/no); (3) number of children (one/two or more than two); (4) educational level of the respondent (low, middle and high); (5) household income based on the income tertile in the sample were classified into three categories: low (<€3200), middle (€ 3200–4400) and high (>€4400); (6) family functioning as assessed by the General Functioning Scale of the Family Assessment Device Scale (FAD) with a higher score indicating worse family functioning regarding the overall health/pathology of the family (Byles et al., 1988; Epstein et al., 1983); (7) perceived social support of the respondent, as assessed by the Multidimensional Scale of Perceived Social Support scale (MSPSS) (Pedersen et al., 2009; Zimet et al., 1988), with a higher score indicating higher perceived social support; and (8) experience of stressful life events based on parental reporting of the number of 12 stressful life events in the past twelve months (e.g., parental divorce, financial problems) and categorized into three categories: no (0), low (1), and high (≥2).

2.3. Data analysis

Descriptive statistics were used to describe the sample characteristics. Differences between recruited and drop-out participants were tested by independent *t*-tests or chi square test ($\chi 2$).

The Chi-square test was used to compare the prevalence of dyssomnias at baseline and at follow-up. The incidence and persistence rate of dyssonmias and factors associated with them were analyzed. We applied the least absolute shrinkage and selection operator (LASSO) (Tibshirani, 1996) logistic regression to investigate factors associated with the development of dyssomnias (incidence and persistence) using the "glmnet" package in R (Friedman et al., 2010). LASSO is an effective device for model selection, especially when the number of observations is smaller than the number of predictors and when the predictors are correlated. LASSO selects the best fitting predictors by applying a penalty term to the maximum likelihood method (ML) model and shrinks the ML estimates of the predictors towards the null effect (i.e., beta coefficient = 0). We applied bootstrap with 1000 iterations in a similar way proposed by Bunea et al. (2011) to stabilize the selection. Factors were selected if presented in >50 % of the bootstrap samples and were further tested in multivariate logistic regression (Bunea et al., 2011). We then looked for interactions among the selected predictors (i.e., child age, gender, parental educational level, family income) by adding the interaction terms separately to the full logistic models. The interaction term was considered significant at a level of $p < 0.10$ (Rosnow and Rosenthal, 1989). No statistically significant interactions were found; therefore, combined data were analyzed.

Assumptions of linearity (variance inflation factors: VIF < 3), independence, and constant variance of residuals were not violated. Some variables had missing data, ranging from 0.1 % (parental educational level) to 5.6 % (household income). The missing data were imputed with 5 imputations by applying predictive mean matching through the "mice" package in R (Buuren and Groothuis-Oudshoorn, 2010). All statistical analyses were performed using R version 3.6.2. All tests were two-sided, and a p value of <0.05 was considered significant.

2.3.1. Additional analysis

We repeated the LASSO logistic model to assess the factors associated with sleep-onset difficulties (sleep latency>30 min) and frequent night awakenings (≥3 times/night), respectively.

3. Results

3.1. Non-response analysis

Compared to the non-respondents ($n = 275$), respondents ($n = 843$) were more likely to be Dutch (having no immigrant background), to be from families with higher socioeconomic status (i.e., higher parental education, and family income, $P < 0.05$), to report better family functioning, and to have higher social support ($P < 0.05$). However, they had similar prevalence of dyssomnias when compared to the non-respondents (13.1 % vs 13.6 %, $P > 0.05$). Similar boy/girl ratios were found between those recruited (girls 47.3 %) and drop-out subjects (49.3 %) ($P > 0.05$) (Supplementary Table 2).

3.2. Sample characteristics

Table 1 presents the characteristics of subjects at baseline. The mean age of the children ($n = 700$) was 3.2 ± 1.9 (range: 0.1–6.9) years old, and 47.3 % were girls. The mean age of the parents was 33.9 years (SD = 5.0, range: 0.5–8.1). Children were mainly from parents who are employed (82.5 %), with a high education level (56.9 %), and with a middle (36.7 %) or high income (56.9 %) and had no migration backgrounds (88.2 %). Nearly 75 % of the children had experienced at least one stressful life event in the previous 12 months.

3.3. Prevalence and development of dyssomnias

Fig. 2 presents the prevalence at each time point and the one-year development of dyssomnias in our sample. The prevalence of dyssomnias was slightly higher at follow-up than at baseline (15.4 % vs 13.3 %). The incidence and persistence rates of dyssomnias were 12.0 % and 37.6 % at follow up, respectively. Regarding dyssomnia symptoms, the percentage of children with frequent night awakenings (≥3 times) decreased from 6.9 % at baseline to 5.0 % at follow up. Additionally, the percentage of children who reported sleep-onset difficulties (>30 min) increased from 7.7 % to 11.7 %. The incidence rate for frequent night awakenings was 3.4 % and the persistence rate was 27.1 %, and for sleep-onset difficulties, the incidence rate was 9.9 % and the persistence rate 33.3 %.

3.4. Factors associated with the development of dyssomnias

Table 2 presents the factors associated with the incidence and persistence of dyssomnias. Four factors were significantly associated with the incidence of dyssomnias in children. For parental factors, higher parenting self-efficacy [OR (95%CI): 0.93 (0.87, 0.99)] was associated with lower odds of developing dyssomnias. For child factors, being a girl [OR (95%CI): 1.74 (1.03, 2.95)] and having medical conditions [OR (95%CI): 3.29 (1.20, 9.03)] were associated with higher

Table 1
Sample characteristics of subjects at baseline ($N = 700$).

	All subjects ($n = 700$)	Missing (%)	Dyssomnias at baseline		*P* values
			No ($n = 607$)	Yes ($n = 93$)	
Parental factors					
Age (mean (SD))	33.9 (5.0)	0.1	33.9 (5.0)	33.8 (4.8)	0.893
Sex (n, %)	663 (94.7)	0.0			0.769
Female			576 (94.9)	87 (93.5)	
Male			30 (4.9)	6 (6.5)	
General health status (mean (SD))	70.3 (19.3)	0.3	70.5 (19.1)	68.9 (20.4)	0.453
Psychological distress (BSI-18) (mean (SD))	***5.2 (6.0)***	***1.1***	***4.8 (5.4)***	***7.5 (8.5)***	***<0.001***
parenting self-efficacy (PSOC) (mean (SD))	31.9 (4.2)	0.1	31.9 (4.2)	31.5 (4.2)	0.337
Parenting stress (PDH) (mean (SD))	27.1 (10.0)	3.4	26.9 (10.1)	27.9 (9.9)	0.418
Parenting style (%)		***2.1***			***0.011***
Authoritative	270 (39.4)		229 (38.6)	41 (44.6)	
Authoritarian	136 (19.9)		127 (21.4)	9 (9.8)	
Permissive	140 (20.4)		113 (19.1)	27 (29.3)	
Disengaged	139 (20.3)		124 (20.9)	15 (16.3)	
Child factors					
Age (years/mean (SD))	3.2 (1.9)	0.6	3.3 (1.9)	2.9 (1.9)	0.073
Preschool age (<4y, n, %)	393 (56.5)		332 (55.1)	61 (65.6)	
School age (≥4y, n, %)	303 (43.5)		271 (44.9)	32 (34.4)	
Sex (n, %)	330 (47.3)	0.4			0.895
Girls			288 (47.5)	42 (46.2)	
Boys			318 (52.5)	49 (53.8)	
Child general health (mean (SD))	79.0 (16.3)	0.1	79.4 (16.0)	76.3 (17.9)	0.084
Gestational age (mean (SD))	39.1 (2.0)	1.9	39.1 (2.0)	38.7 (2.1)	0.097
Problem behavior (CBCL) (mean (SD))	***20.1 (16.6)***	***1.3***	***18.5 (15.2)***	***30.6 (21.0)***	***<0.001***
Medication conditions (n, %)	***34 (4.9)***	***0.4***			***0.002***
Yes			***23 (3.8)***	***11 (11.8)***	
No			***581 (96.2)***	***82 (88.2)***	
Family factors					
Parental migration background[a] (n, %)	108 (15.6)	1.0			0.001
Yes			82 (13.7)	26 (28.0)	
No			518 (86.3)	67 (72.0)	
Parental employment (n, %)	***123 (17.6)***	***0.0***			***0.001***
Unemployed			***95 (15.7)***	***28 (30.1)***	
Employed			***512 (84.3)***	***65 (69.9)***	
Parental educational level (n, %)		0.3			0.393
Low	45 (6.4)		37 (6.1)	8 (8.6)	
Middle	256 (36.7)		227 (37.5)	29 (31.2)	
High	397 (56.9)		341 (56.4)	56 (60.2)	
Family composition (n, %)	40 (5.7)	0.4			0.578
One-parent			33 (5.5)	7 (7.5)	
Two-parent			571 (94.5)	86 (92.5)	
Number of children		0.0			
One			177 (29.2)	37 (39.8)	0.051
Two or more			430 (70.8)	56 (60.2)	
Household income (n, %)		5.6			0.161
Low (<3200€)	218 (33.0)		181 (31.7)	37 (41.1)	
Middle (3200–4400€)	264 (39.9)		235 (41.2)	29 (32.2)	
High (>4400€)	179 (27.1)		155 (27.1)	24 (26.7)	
Family functioning (FAD) (mean (SD))[a]	1.4 (0.4)	1.6	1.4 (0.4)	1.4 (0.4)	0.842
Perceived social support (MSPSS) (mean (SD))	5.9 (0.8)	0.3	6.0 (0.8)	5.9 (1.0)	0.273
Stressful life events (n, %)		*4.0*			*0.141*
0	168 (25.0)		*154 (26.2)*	*14 (16.5)*	
Low (1)	187 (27.8)		162 (27.6)	25 (29.4)	
High (≥2)	317 (47.2)		271 (46.2)	46 (54.1)	
Recruitment methods (n, %)[b]	70 (10.0)	0.0			0.054
Part A			552 (90.9)	78 (83.9)	
Part B			55 (9.1)	15 (16.1)	

See Supplementary Table 1 for psychometric properties of the scales; BSI-18 = Brief Symptom Inventory 18 (Derogatis, 2000), *PDH* = Parenting Daily Hassles (Crnic and Booth, 1991; Crnic and Greenberg, 1990), *PSOC* = Parenting Sense of Competence Scale (Gibaud-Wallston and Wandersmann, 1978), *CBCL* = Child Behavior Checklist (Achenbach and Rescorla, 2000), FAD = Family Assessment Device Scale (Byles et al., 1988; Epstein et al., 1983), MSPSS = Multidimensional Scale of Perceived Social Support scale (Pedersen et al., 2009; Zimet et al., 1988).

[a] Higher score indicates worse general family functioning; migration background of the parent who completed the questionnaire was based on the definitions given by Statistics Netherlands (Statistics Netherlands, 2012) that when either the child or one or both parents were born outside the Netherlands, it was categorized as having a migration background.

[b] Part A comprised parents who were visiting the Youth Health care center regularly; Part B comprised parents who were going to participate in some parenting interventions during baseline and follow up. Bold and italic indicates statistical significance at 0.05 level.

odds of developing dyssomnias at follow up. Experience of stressful life events was the only family factor associated with the incidence of dyssomnias. Compared with children who experienced no stress life events, children who experienced one [OR (95%CI): 3.78 (1.62, 8.82)] or two or more [OR (95%CI): 2.17 (1.02, 4.63)] stressful life events had higher odds of developing dyssomnias at follow up. Higher parenting psychological distress at baseline was associated with persistence of dyssomnias in children [OR (95%CI): 1.10 (1.02, 1.18)]. Other parental, child,

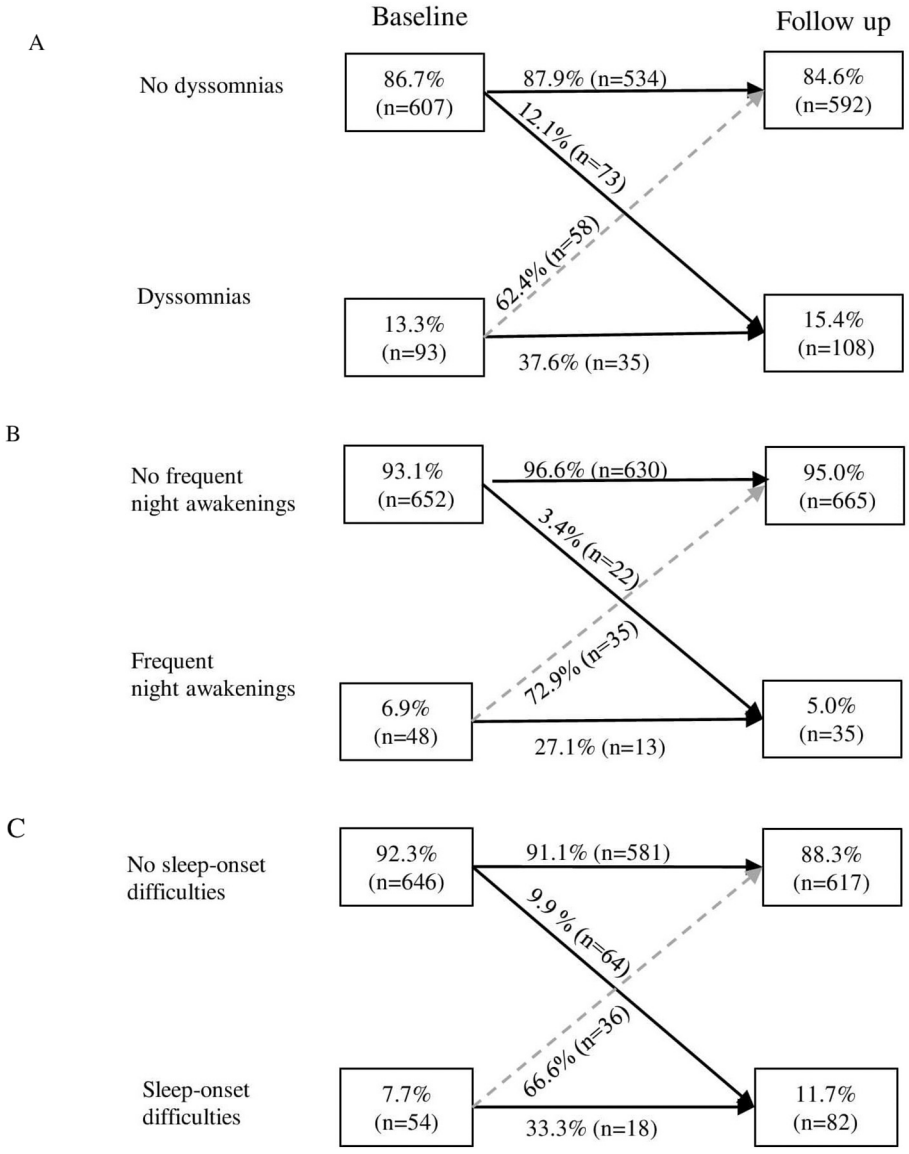

Fig. 2. Prevalence and one-year development of (A) dyssomnias and dyssomnia symptoms (B: frequent night awakenings; C: sleep-onset difficulties) among a group of Dutch children aged 0–8 years. Dyssomnias were defined as the presence of either frequent night awakenings (night awakenings ≥ 3 times) or sleep-onset difficulties (sleep-onset latency > 30 min).

and family factors were not associated with either the incidence or the persistence of dyssomnias in the final model (Table 2).

3.5. Additional analyses: factors associated with the development of sleep-onset difficulties and frequent night awakenings

Factors including having child medical conditions [OR (95%CI): 2.91 (1.04, 8.11)], single parenthood [OR (95%CI): 3.28(1.03, 10.42)], and experience of one [OR (95%CI): 5.31 (1.91, 14.76)] or two or more [OR (95%CI): 3.29 (1.15, 8.95)] stressful life events were associated with a higher incidence of sleep-onset difficulties at follow up, whereas higher parenting self-efficacy [OR (95%CI): 0.91 (0.85, 0.98)] was associated with a lower incidence. Child age was associated with persistent sleep-onset difficulties [OR (95%CI): 1.48 (1.07, 18.02)].

The results from the LASSO regression suggest that the factors that were associated with the incidence of frequent night awakenings were worse family functioning [OR (95%CI): 3.42 (1.04, 11.30)] and having a migration background [OR (95%CI): 3.69 (1.04, 13.08)]. However, older child age [OR (95%CI): 0.70 (0.51, 0.96)] was associated with lower incidence of frequent night awakenings. No association was found for any of the included factors and the persistence of frequent night awakenings (Supplementary Table 3).

4. Discussion

In this study, we investigated the prevalence of dyssomnias in early childhood and described its development (incidence and persistence), as well as the parental, child, and family factors that are associated with this development in a community-based sample of children aged 0–8 years old from the Netherlands. The prevalence of dyssomnias was 13.3 %–15.4 % of children aged 0–8 years old. The incidence and persistence rates of dyssomnias in children were 12.0 % and 37.6 %, respectively. Despite the inconsistency in measurement and definitions of dyssomnias across studies, our findings are within the broad range of reported incidence (6.5 % to 36 %) (Mindell et al., 2010; Ottaviano et al., 1996; Petit et al., 2007) and persistence rates (21 % to 60 %) (Bruni and Novelli, 2010; Byars et al., 2012; Petit et al., 2007; Quach et al., 2018; Williamson et al., 2019; Zuckerman et al., 1987) reported in previous epidemiological studies. Despite the high prevalence of dyssomnias, dyssomnias are largely underdiagnosed (Meltzer et al., 2010).

Table 2
Baseline factors associated with the development (incidence and persistence) of dyssomnias in a group of Dutch children aged 0–8 years ($n = 700$).

	Incidence vs non-dyssomnia (N = 607)		Persistence vs remission (N = 93)	
	Crude OR (95 % CI)[a]	OR (95%CI)[b]	Crude OR (95 % CI)[a]	OR (95%CI))[b]
Parental factors				
Age (years)	0.97 (0.92, 1.02)	–	1.09 (0.99, 1.19)	–
Sex (men vs women)	1.13 (0.38, 3.33)	–	0.81 (0.14, 4.71)	–
General health status	0.99 (0.98, 1.01)	–	0.99 (0.97, 1.01)	–
Parenting stress (PDH)	1.02 (0.99, 1.04)	–	1.03 (0.99, 1.08)	–
Psychological distress (BSI-18)	***1.05 (1.01, 1.09)***	1.02 (0.97, 1.07)	***1.08 (1.01, 1.15)***	***1.10 (1.02, 1.18)***
Parenting self-efficacy (PSOC)	**0.82 (0.87, 0.98)**	***0.93 (0.87, 0.99)***	0.93 (0.83, 1.03)	–
Parenting style				
Authoritative (ref)	1.00 (ref.)	–	1.00 (ref.)	–
Authoritarian	1.05 (0.51, 2.16)	–	1.40 (0.32, 6.14)	–
Permissive	1.20 (0.58, 2.49)	–	1.33 (0.49, 3.61)	–
Disengaged	1.66 (0.87, 3.16)	–	0.64 (0.17, 2.40)	–
Child factors				
Age (years)	0.90 (0.78, 1.03)	0.87 (0.74, 1.02)	1.23 (0.98, 1.54)	1.29 (0.98, 1.71)
Sex (girls vs boys)	1.48 (0.91, 2.43)	***1.74 (1.03, 2.95)***	0.62 (0.26, 1.48)	0.58 (0.21, 1.6)
General health status	0.99 (0.98, 1.01)	–	0.99 (0.97, 1.01)	–
Gestational age (weeks)	1.04 (0.91, 1.19)	–	0.92 (0.75, 1.13)	–
Problem behaviors (CBCL)	***1.02 (1.01, 1.03)***	1.01 (0.99, 1.03)	***1.03 (1.01, 1.05)***	1.02 (0.99, 1.04)
Medical conditions (yes vs no)	***3.49 (1.37, 8.88)***	***3.29 (1.20, 9.03)***	2.19 (0.61, 7.95)	–
Family factors				
Parental migration background (yes vs no)	1.43 (0.36, 1.33)	–	1.31 (0.52, 3.31)	–
Employment (employed vs unemployed)	1.37 (0.65, 2.85)	1.66 (0.75, 3.66)	0.48 (0.19, 1.19)	0.69 (0.23, 2.05)
Family composition (one-parent vs two-parent)	2.04 (0.85, 4.89)	2.60 (0.98, 6.95)	1.27 (0.26, 6.15)	–
Number of children				
1 (ref.)	1.00 (ref)	–	1.00 (ref)	
≥2	***0.58 (0.35, 0.96)***	–	0.81 (0.34, 1.91)	
Educational level				
High (ref)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	
Middle	1.31 (0.79, 2.16)	1.17 (0.68, 2.01)	0.70 (0.27, 1.83)	–
Low	0.69 (0.20, 2.37)	0.77 (0.21, 2.8)	1.55 (0.34, 6.97)	–
Household income				
High (ref)	1.00 (ref)	–	1.00 (ref)	1.00 (ref.)
Middle	1.28 (0.67, 2.47)	–	1.71 (0.52, 5.65)	1.72 (0.46, 6.44)
Low	1.30 (0.65, 2.59)	–	2.97 (0.95, 9.27)	2.05 (0.54, 7.81)
Family functioning (FAD)[c]	1.26 (0.65, 2.41)	–	0.96 (0.30, 3.03)	–
Perceived social support (MSPSS)	0.92 (0.69, 1.24)	–	1.01 (0.69, 1.65)	–
Number of stressful life events				
0 (ref)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	–
1 (low)	***3.92 (1.68, 9.11)***	***3.78 (1.62, 8.82)***	3.99 (0.71, 22.2)	–
≥2 (high)	***2.50 (1.10, 5.68)***	***2.17 (1.02, 4.63)***	4.64 (0.96, 22.41)	–

Dyssomnias were defined as the presence of either frequent night awakenings (night awakenings ≥3 times) or sleep-onset difficulties (sleep-onset latency >30 min).
See Supplementary Table 1 for psychometric properties of the scales; BSI-18 = Brief Symptom Inventory 18 (Derogatis, 2000), *PDH* = Parenting Daily Hassles (Crnic and Booth, 1991; Crnic and Greenberg, 1990), *PSOC* = Parenting Sense of Competence Scale (Gibaud-Wallston and Wandersmann, 1978), *CBCL* = Child Behavior Checklist (Achenbach and Rescorla, 2000), FAD = Family Assessment Device Scale (Byles et al., 1988; Epstein et al., 1983), MSPSS = Multidimensional Scale of Perceived Social Support scale (Pedersen et al., 2009; Zimet et al., 1988).
[a] Results from univariate logistic regressions.
[b] Results from bootstrapped least absolute shrinkage and selection operator (LASSO) logistic regressions, predictors retained if selected in >50 % of bootstrap samples; recruitment methods were adjusted in all models. Bold and italic indicates statistical significance at 0.05 level.
[c] Higher scores indicate worse family functioning.

Prevention programs should focus on educating parents about healthy sleep and dyssomnias in early childhood (Touchette et al., 2009).

4.1. Factors associated with the incidence of dyssomnias

Parental, child, and family factors associated with the incidence of dyssomnias at follow up include low parenting self-efficacy, being a girl, having a medical condition, and experience of stressful life events.

4.1.1. Parental factors

Higher parenting self-efficacy was associated with lower incidence of dyssomnias in our study. Prior studies have suggested that parents with higher parenting self-efficacy are more likely to use positive parenting practices (Albanese et al., 2019), which has been shown to be essential components in promoting optimal sleep in children (Newton et al., 2020). On the other hand, an undesirable psychological state of the parents might increase the chance of dyssomnias in the child (Simard

et al., 2008; Williamson et al., 2019; Ystrom et al., 2017). Parental psychological stress was associated with the incidence of dyssomnias in the univariate analysis. However, the association disappeared when parenting self-efficacy was included in the model, which supports our hypothesis that higher parenting self-efficacy may buffer the adverse impacts of other undesirable psychological states. Promoting parenting self-efficacy appears to be a promising strategy for the promotion of healthy sleep in children.

4.1.2. Child factors

Our results suggest that girls are more likely to have dyssomnia symptoms. Previous studies on sex differences in sleep problems in children have yielded inconsistent findings (see Newton et al. for a review) (Newton et al., 2020). Several studies had explored the timing of sex difference regarding dyssonmia symptoms; the results suggest that the sex differences in dyssomnias may not emerge until adolescence (Calhoun et al., 2014; Falch-Madsen et al., 2020). The exact pathway underlying the differences between girls and boys is unclear but may be partly attributed to hormone changes during the onset of puberty (Calhoun et al., 2014). The observed sex difference in dyssomnias in the period from 0 to 8 years of age in our study should be interpreted with caution. Future longitudinal studies in young children are needed to verify our findings and to understand the role of various factors that can explain the potential sex differences in dyssomnia.

It is not surprising that children with medical conditions had higher risks of dyssomnias. These medical conditions can affect child sleep directly and can also influence sleep indirectly through influence on parenting, for instance, by affecting parenting psychological status, behaviors, and practice (Martin et al., 2019). The association between problem behaviors indicated by CBCL total scores was not associated with dyssomnias in our study. Similar results have been reported in other studies (Quach et al., 2018; Zuckerman et al., 1987), but not for all (Jiang et al., 2007; Kelly and El-Sheikh, 2014). Given the potential bidirectional relationship between problem behaviors and sleep, management of one condition may improve the other (Quach et al., 2018). The CIKEO study includes only one follow-up measurement; two waves of measurements, however, may not be sufficient to obtain significant information about the complexity of the processes change over time (Kenny, 2014). Future studies may apply methods, e.g., cross-lagged panel design studies (Kenny, 2014) with multiple time point measurements to unravel the association between problems behaviors and dyssomnias in children.

Prior studies have indicated that a higher child age could be a protective factor for sleep problems in children (Jiang et al., 2007; Newton et al., 2020; Ottaviano et al., 1996). However, Newton et al. found in a systemaitc review that studies in which age was included as a continuous varaible in the analyses, showed no significant associations between age and child sleep problems (Newton et al., 2020). We, therefore, repeated our analyses with child age entered as a dichotomous variable (preschoolers vs. schoolers); a similar pattern of associations between child age and dyssomnia was observed (Data not shown). Although child age was not independently associated with the incidence of dyssomnias in our final model, we did observe that dyssomnias tended to decrease with older child age. Our findings also suggest that the association between child age and dyssomnias may differ by the type of dyssomnia symptoms. In this study, we observed that the average parent-reported presence of frequent night awakenings decreased when child age increased, while the presence of sleep onset difficulties increased. T However, our results should be interpreted with caution. First, we included children with a broad age range (i.e., 0–8 years old). Factors affecting sleep may vary with age. While the decrease in the presence of frequent night awakenings might be explained by the natural development of the children (e.g., the maturation of circadian rhythms) (A.D. Staples et al., 2015). The increase in the presence of extended sleep latency might be attributed to other factors. For instance, caffeine intake and electronics use prior to sleep onset (Meltzer et al., 2021; Ofcom, 2016). Second, we rely on parent-reported outcomes, while parents become less involved in children's bedtime routines over time, and therefore might underestimate the presence of dyssomnia symptoms in relatively older children (Gehrman et al., 2011). Due to the lack of data, we were unable to further elaborate the impact of these factors. Future longitudinal studies using multiple informants are recommended to verify our findings.

4.1.3. Family factors

Our findings confirm the results of previous research showing that stressful life events may be associated with the onset of dyssomnias (Kajeepeta et al., 2015). Studies have shown that stress caused by these life events may cause greater activation of the hypothalamic pituitary adrenocortical (HPA) axis and the secretion of corticotrophin-releasing hormone (CRH), which subsequently may lead to increased excitability and difficulty in falling asleep (Fernandez-Mendoza et al., 2014; Kajeepeta et al., 2015; Zhang et al., 2014). However, the role of HPA axis activation in dyssomnias in young children remains unclear. While Fernandez-Mendoza et al. reported increased cortisol levels among those insomniac subjects with short sleep duration in young children (5–12 years old) (Fernandez-Mendoza et al., 2014), Zhang et al. reported that the emergence of HPA dysregulation only emerged at late puberty (Zhang et al., 2014). Future prospective studies with multiple measurement waves may help us elaborate on the biological pathways underlying these associations. Apart from its direct effects on children, stressful life events might also influence child sleep indirectly through its adverse effects on parents (e.g., psychopathology and parenting practice) (Platt et al., 2016) and children (e.g., increased emotional and behavioral problems) (Fang et al., 2022). Stressful life events are relatively common. In Europe, about 40.3 % of children age 4–10 years have experienced at least one stressful life event (Vanaelst et al., 2012). Given the high prevalence and the potential impact that stressful life events may have on children's sleep, preventive interventions should be considered to adequately address the needs of children who experience stressful life events (Fang et al., 2022). Studies have shown that children could benefit from the promotion of resilience (Benson and Saito, 2001; Catalano et al., 2004). Therefore, apart from reducing stress, boosting parents' and children's resilience to stressful life events might also help with optimal sleep in children (Fang et al., 2022; Smith and Carlson, 1997). However, more research is needed to investigate the effectiveness of these prevention strategies.

Contrary to previous studies, SES indicators, including parental educational level and family income, were not associated with the incidence of dyssomnias (El-Sheikh et al., 2013; Marsh et al., 2020). Children from lower SES families might be exposed to a more chaotic home environment, and parents from disadvantaged families are also more likely to implement healthy sleeping strategies (Marsh et al., 2020). Nevertheless, the association between these sociodemographic characteristics and the incidence of sleep problems seems less clear in younger children (Jiang et al., 2007; Touchette et al., 2005; Touchette et al., 2009). Participants in our cohort were more likely to have high SES than nonparticipants, thereby restricting the generalizability of our results in low SES children.

Cultural factors, as reflected by country of birth, migration status, or ethnicity, have been related to difference in parental perception of sleep disturbance in children (Mindell et al., 2010; Newton et al., 2020). For instance, Mindell et al. found that parents from predominantly Asian countries were more likely to report child sleep problems than parents from predominantly Caucasian countries (Mindell et al., 2010). Nevertheless, this was not supported by our insignificant findings on immigrant status. The use of a mixture of migrant groups could lead to masked associations. However, as there were only a small number of people with ethnic-minority backgrounds included, we were unable to investigate ethnic, migration, and cultural differences further. Future longitudinal studies using a more heterogeneous study population may provide more information about the socio-economic risk factors for the

development of dyssomnias in children.

4.2. Factors associated with the persistence of dyssomnias

In line with the previous studies (Meltzer and Mindell, 2007; Touchette et al., 2009; Williamson et al., 2019; Zuckerman et al., 1987), our results suggested that parental psychological distress is associated with the persistence of dyssomnias in children. The association between psychological distress (e.g., depressive symptoms) and child sleep problems could also be bidirectional; while parents with higher psychological distress might be more aware of their children' sleep problems, persistent sleep problems in children could also lead to continued psychological distress in parents (Ystrom et al., 2017). Furthermore, parents who experienced high psychological distress are also more likely to experience it over time, resulting in continued difficulty with child sleep (Meltzer and Mindell, 2007). Incorporating strategies to improve parental psychological distress into child sleep programs and interventions might be beneficial. We found no associations between other parental, child, or family factors and the persistence of dyssomnias in our study. Given the size of our sample, we recommend future longitudinal studies with a larger sample size to verify our results.

4.3. Methodological considerations

Strengths of our study include the use of LASSO logistic regression to investigate a large number of potential factors of the progress of dyssomnias, and the use of data gathered longitudinally in a large cohort of children.

There are some limitations. First, we relied on parental self-reported data to assess children's sleep characteristics, including number of night awakenings, and sleep-onset latency. It has been suggested that parents tend to underestimate children's night awakenings and sleep-onset latency (Iwasaki et al., 2010). The use of self-report data may also lead to common method bias. However, all variance inflation factors (VIFs) resulting from a full collinearity test lower than 3.0. Based on Kock (2015), we can consider the model free of common method bias. Despite the potential bias, simple questionnaires are common for screening and surveillance of a large population (Hiscock et al., 2007; Sadeh, 2004). Moreover, mothers and fathers may have different perceptions regarding the sleep of their children. We, therefore, recommend future studies to include both mothers, fathers and other relevant caretakers as informants. In addition to parent-reported data, future studies should also include other measurements such as sleep diaries and accelerometer, where appropriate to get more accurate data and minimize potential bias. Second, instead of investigating diagnostically-confirmed dyssomnias, we focused on parent-report dyssomnias broadly. This broader focus, however, may be more relevant for the development of interventions in the community than in studies that focus on factors associated with diagnostically confirmed dyssomnia only. Third, loss to follow-up may have influenced our results. Non-response analyses showed that children participating in this study were often Dutch (i.e., having no immigrant background), and more often from families with higher SES, better family functioning, and with higher levels of social support compared with non-participants. The factors associated with dyssomnias in children from diverse cultural and economic groups may therefore differ from the findings of this study. Longitudinal studies involving larger and more heterogeneous study populations, especially from the socio-economically disadvantaged families, are recommended to confirm our findings. Finally, our data do not allow causal explanation. Sleep is a complex process: multiple factors at the child, parent, family, and genetic level may interact overtime, contributing to the development and maintenance of dyssomnias in children (Newton et al., 2020; Touchette et al., 2009). We identified a fraction of these factors that co-vary with dyssomnias but not the mechanisms that underlie these associations. Other parental (e.g. parents' sleep and bed routines), child (e.g. daytime naps, and media exposure), and family (e.g. living conditions and room/bed sharing) could also the development of dyssomnias in children (Newton et al., 2020). In addition, genetic factors also play an important role. According to previous studies, the heritability of sleep disturbances ranges from 14 to 38 % in children and adolescents (Barclay et al., 2015; Gregory et al., 2004). However, due to the lack of relevant data, we were unable to explore the influence of these factors. To increase the understanding of the etiology of dyssomnias in children, studies longitudinally examining the interplay of parent, child, family, and genetic factors over time are recommended (Touchette et al., 2009).

5. Conclusion

This study provided information on the prevalence, one-year development (incidence and persistence) and factors associated with the development of dyssomnias in a group of Dutch children aged 0–8 years. Dyssomnia is a common problem with a moderate persistence rate in young children. We identified several parental (i.e., lower parenting self-efficacy), child (i.e., female sex, having a medical condition), family factors (i.e., experience of stressful life events) associated with the incidence of dyssomnias in children; and one parental factor (i.e., higher parental psychological distress) that is associated with the persistence of dyssomnias. Timely intervention and support programs could be highly beneficial for these children. Of note, factors including parenting self-efficacy, psychological distress, and resilience to stressful life events are modifiable; interventions targeting these factors might benefit child sleep. No significant associations were found between the potential factors and the persistence of dyssomnias. Further research is necessary to verify our findings and to examine longitudinally the interplay of family, child factors, and dyssomnias in children.

Abbreviations

CBCL	Child Behavior Checklist
CIKEO	Consortium Integration Knowledge promotion Effectiveness Of parenting interventions in the Netherlands
CI	Confidence Intervals
CHQ	Child Health Questionnaire
CRH	Corticotrophin-Releasing Hormone
FAD	Family Assessment Device Scale
HPA	Hypothalamic Pituitary Adrenocortical Axis
LASSO	Least Absolute Shrinkage and Selection Operator
MSPSS	Multidimensional Scale of Perceived Social Support scale
OR	odds ratio
PDH	Parenting Daily Hassles
PSOC	Parenting Sense of Competence Scale
SES	Social Economic Status

Ethics approval and consent to participate

The Medical Ethics Committee of the Erasmus Medical Center, Rotterdam decided that the rules laid down in the Dutch Medical Research Involving Human Subjects Act (in Dutch: Wet Medisch-wetenschappelijk Onderzoek met mensen) did not apply to this study, that there were no objections to the execution of this study (proposal number MEC-2017-432), and approved those results of the study could be submitted to scientific journals (Letter NL/sl/321518; 24/07/2017). The CIKEO study was registered in the Netherlands National Trial Registry (number: NL7342).

CRediT authorship contribution statement

YF, conceptualization, analysis, writing – original draft; AG, supervision, writing, interpretation of the data, and critical review; DW & IF—Data collection, interpretation of the data, and critical review; HR—Study design, supervision, data collection, interpretation of the data,

and critical review. HJ, CH, MC, WJ, LW — Study design, and critical review. All authors approved the final version.

Conflict of interest

None.

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Consent for publication

Not applicable.

Availability of data and materials

The data are stored at Erasmus MC and will be made available upon request by contacting the corresponding author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2022.12.012.

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