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Predictors of Early Nap Cessation: Longitudinal Findings from a Large Study of Young Children

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ABSTRACT

Most children cease napping between 2 and 5-years-old, with considerable inter-child variability. We tested the predictors of early nap cessation (i.e., children who cease napping before three years old) using longitudinal data from 5504 Canadian children (51.1% male; 89.8% White) in three cohorts with two timepoints each. Children were 0–1-years-old at baseline ($M = 10.19$ months $SD = 3.95$ months) and 2–3-years-old at follow-up ($M = 30.83$ months, $SD = 4.60$ months). Parents reported on demographic, perinatal, growth, developmental, child and parent functioning, and child sleep variables. At follow-up, 10.9% ± 0.8% had ceased napping. Multigroup multivariate logistic regression was conducted using a model building approach to identify predictors of early nap cessation. Early nap cessation was predicted by older child age (ORs range from 1.15 to 1.24, moderated by cohort), female sex (OR = 1.29; 95% CI: 1.07–1.55), having an older sibling (OR = 1.33; 95% CI: 1.10–1.62), achieving more developmental milestones (OR = 1.08; 95% CI: 1.03–1.13), and longer nighttime sleep duration (OR = 1.06; 95% CI: 1.01–1.11). Non-White ethnicity (OR = 0.41; 95% CI: 0.28–0.60), birthweight < 2500 gs (OR = 0.60; 95% CI: 0.37–0.96), parent working/in school (ORs range from 0.50 to 0.58, moderated by cohort), and the birth mother consuming alcohol during pregnancy (OR = 0.56; 95% CI: 0.40–0.79) were related to a lower likelihood of nap cessation. Findings suggest nap cessation is influenced by developmental and socio-environmental factors.

1. Introduction

Young children vary greatly in the frequency and duration of their daytime naps. Most children stop napping consistently between 2 and 5 years old. Across studies, 1–6% of children have been found to cease napping by 2-years-old, while 23–44% of children cease napping by 3-years-old and 90–97% of children have ceased napping around 5-years-old [1]. Thus, at 2 to 3 years old, there is marked variability in nap cessation. These developmental trends are well-established in Western countries. However, there is limited research into the predictors of why some children may cease napping earlier or later than their peers. A recent meta-analysis on daytime sleeping trends among preschool-age children calls for this research to "extend beyond point-prevalence rates," evaluate social determinants of napping cessation, and apply longitudinal methodologies [1]. Understanding these determinants may aid in the development of daytime sleep policies in childcare and evidence-based recommendations for parents of young children [2].

Research predicting children's nap behavior has yet to test *early nap cessation* as an outcome. This aspect of napping behavior differs from alternative definitions (e.g., duration, frequency, sleep consolidation) as it identifies the age at which children consolidate biphasic sleep into monophasic sleep, which appears to be an important developmental milestone [3,4]. In this study, we considered early nap cessation as a potential marker of advantage for children. For example, some researchers have argued that nap cessation may signal greater development in children's neural control over sleep-wake processes [4,5]. Further, there is evidence that children who have more consolidated sleep (i.e., less daytime sleep) at 1.5-years-old have better receptive language abilities at 5-years-old, than children with less consolidated sleep (i.e., more daytime sleep) [6]. Nap cessation may occur as a developmental milestone [7].

We have operationalized "early nap cessation" as stopping napping before 3-years-old, as this age captures a point in development when nap cessation is more variable and when daytime sleep may no longer be required for children to meet 24-hour sleep requirements [2]. When

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children give up naps may also have implications for understanding their development. Emerging evidence suggests that preschool children who cease napping at an earlier age or who nap for shorter durations may have better behavioral, language, and cognitive functioning than later or longer napping peers [6,8-10]. Thus, we investigated the predictors of early nap cessation in a longitudinal sample of Canadian preschool children.

1.1. Predictors of naps cessation

Children's transition from polyphasic (many short daytime naps and a longer nighttime sleep period) to biphasic (single shorter daytime nap and a longer nighttime sleep period) to monophasic sleep (single nighttime sleep period) is well-documented in Western countries [1,11,12]. However, this transition occurs with considerable variation and few studies have tested concurrent or longitudinal factors predicting children's nap cessation. Previous research has suggested this variation may be due to socioecological effects (e.g., ethnicity, family environment; [1,6,13]). A twin study demonstrated that environmental factors account for more of the variance in preschoolers' nap behavior than genetic factors (e.g., 58% of variance in daytime to nighttime sleep ratio due to shared environmental factors; [13]). However, the specific environmental factors influencing nap cessation are unclear and have usually been limited to sociodemographic factors. A complementary theory suggests nap cessation may be a marker of greater developmental maturity [3,4]. For example, children with developmental delays show similar napping behavior to typically developing children who are 6-months younger [3]. As such, nap cessation may represent greater development in children's neural control over sleep-wake processes [4,5]. Considering these two perspectives on the influences of nap cessation, the present study investigated both socioecological and developmental predictors.

The cessation of daytime naps is likely an interactional process involving the child, parent, and the environment. This process can be conceptualized by applying the Socioecological Model [14] to children's sleep (e.g., [15–17]). The Socioecological Model incorporates proximal and distal levels of influence on behavior (e.g., individual demographic and developmental characteristics, parenting characteristics, and broader environmental factors). The application of this model allows for the incorporation of multiple levels of influence to understand nap cessation. We drew from three areas of previous research that fit within the Socioecological Model to select hypothesized predictors of nap cessation: (1) correlates of preschoolers' nap duration [1,3,11,13,18,19], (2) correlates of nighttime sleep behavior [4,15,20-25], and (3) correlates of general development [4,15,26-29]. Finally, we identified some exploratory factors which fit within this model, such as having an older sibling, child's health, and parental employment status.

Older child age, the child being White, typical developmental status (versus developmental delay), and longer nighttime sleep duration are consistently associated with shorter daytime sleep durations in preschool children [1,3,11,13,18,19]. If we assume that there are common biological and behavioral mechanisms required for sleep onset during the day and night (e.g., sleep homeostasis, circadian rhythms, environmental cues), factors that influence sleep at night would be expected to influence naps, including temperament, positive parenting practices (i.e., positivity and consistency), and parents' mental health [4,15,20-25]. Perinatal factors such as birthweight, gestational age, and maternal alcohol use during pregnancy have been linked to both children's development in general and nighttime sleep functioning [15,26-29]. These factors may also influence neural development, which may be related to nap cessation [4,30].

We identified some exploratory situational factors which may also relate to nap cessation. Children with older siblings may have a preference to cease napping earlier through social learning mechanisms [31]. Given sleep's role in physiological recovery, younger children who are more often in poorer health may continue to be reliant on biphasic sleep. Further, children with parents who work or attend school outside the home may be more likely to attend a childcare program where napping is encouraged, regardless of child preference. These exploratory factors were also examined. As these were secondary data analyses, our variable selection was influenced by the available data and the literature.

1.2. The current study

We investigated predictors of early nap cessation (i.e., before children's third birthday), using the Socioecological Model, in a large, nationally representative sample of Canadian children. Developmental and psychosocial correlates were expected to predict early nap cessation. We hypothesized that older child age, greater socio-motor development, better nighttime sleep functioning, easier temperament, better child health, having an older sibling, and greater positive and consistent parenting would predict a greater likelihood of nap cessation; whereas, being born at a low birthweight, the mother using alcohol during pregnancy, and lower parental mental health would predict a lesser likelihood of nap cessation. Finally, due to the impact of cultural factors, we also hypothesized that a non-White ethnic background may be related to continued napping.

2. Methods

2.1. Data and study population

Data from Cycles 3–6 of the National Longitudinal Study of Children and Youth (NLSCY) were analysed. The NLSCY was a multi-year (1998–2009), nationally representative study conducted by Statistics Canada with the primary purpose of monitoring the development and well-being of Canadian children from infancy to adulthood, in data collection cycles occurring every 2 years. More information about the NLSCY can be found here: https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=4632.

Data were gathered via telephone or face-to-face interviews with the person most knowledgeable (PMK) about the child's functioning (most commonly parents). Cycle 4 was the first cycle to ask about children's nap duration, therefore Cycle 3 was the first available cycle with longitudinal predictors of nap cessation. In the present study, the analyzed cycles: (1) contained the key outcome variable (i.e., nap status) and (2) provided longitudinal data.

The present study constructed three longitudinal cohorts with two cycles of data per cohort (a baseline and follow-up cycle). Cycles refer to a data collection period; for example, Cycle 3 data was collected between 1998 and 1999. Cohort 1 is composed of Cycles 3 (baseline; 1998–1999) and 4 (follow-up; 2000–2001); Cohort 2 is composed of Cycles 4 (baseline) and 5 (follow-up; 2002–2003); and Cohort 3 is composed of Cycles 5 (baseline) and 6 (follow-up; 2004–2005). In baseline cycles, children were 0–1-years-old (M = 10.19 months SD = 3.95 months) and in follow-up cycles, children were 2–3-years-old (M = 30.83 months, SD = 4.60 months).

2.2. Participants and procedure

PMKs provided their informed consent and information on their children (N = 5504; $n_{\text{Cohort 1}}$ = 2663, $n_{\text{Cohort 2}}$ = 1528, $n_{\text{Cohort 3}}$ = 1313). The NLSCY was representative of the Canadian population at the time of data collection [32]. Demographic characteristics are presented in Table 1.

The inclusion criteria and sampling strategy for the NLSCY are detailed elsewhere (e.g., [32]). Briefly, the NLSCY included non-institutionalized civilians who were 0–11 years old at the time of selection and living in Canada's provinces; this survey excluded children who were living on Indian reserves or Crown lands or one of the territories, those living in institutions, and those whose parents were full-time members of the Canadian Armed Forces. In the current study, children

Table 1
Parent, Child, and Family Demographic Characteristics.

Characteristic	Category	% (*n*) or *M* (*SD*)
Parent		
Age	15 to 24 years	18.2% (1000)
	25 to 29 years	30.5% (1679)
	30 to 34 years	31.5% (1732)
	35 to 39 years	15.2% (838)
	40 years or older	4.6% (255)
Marital Status	Married/common-law	88.4% (4866)
	Single, widowed, separated, or divorced	11.6% (638)
Employment Status	Works or attends school	73.1% (4023)
	Does not work or attend school	26.9% (1481)
Relationship with Child	Biological mother	88.6% (4875)
	Biological father	9.9% (545)
	Another female primary caregiver	1.2% (68)
	Another male primary caregiver	0.3% (16)
Education Completed	Less than secondary school or equivalent	12.0% (660)
	Secondary school or equivalent graduate	14.7% (809)
	Some post-secondary school education	18.5% (1017)
	College or university graduate and above	44.3% (2436)
Family		
Income Adequacy	Lowest	2.7% (147)
	Lower-Middle	11.0% (604)
	Middle	28.4% (1561)
	Upper-Middle	38.9% (2140)
	Highest	19.1% (1052)
Province of Residence	Newfoundland	2.3% (127)
	Prince Edward Island	3.1% (172)
	Nova Scotia	6.6% (361)
	New Brunswick	5.9% (327)
	Quebec	18.1% (996)
	Ontario	28.0% (1540)
	Manitoba	8.6% (475)
	Saskatchewan	8.0% (441)
	Alberta	10.2% (559)
	British Columbia	9.2% (506)
Child		
Age (months)	At Baseline Cycle	10.19 (3.95)
	At Follow-Up Cycle	30.83 (4.60)
Sex	Male	51.1% (2815)
	Female	48.9% (2689)
Ethnicity	Arabic	0.9% (50)
	Black	1.4% (76)
	Filipino	0.8% (43)
	Indigenous	2.9% (161)
	Latin American	0.4% (20)
	East Asian	1.9% (105)
	South Asian	2.2% (122)
	Southeast or West Asian	0.3% (17)
	White	89.2% (4907)
	Another ethnicity	0.7% (37)
Siblings	Has an older sibling	54.6% (3007)
	Has a younger sibling	21.0% (1156)

who were (1) 0–1-years-old at baseline and (2) were less than 3-years-old at follow-up and had valid outcome data (i.e., nap status, described below) were included (i.e., families who were lost to follow-up were excluded). Retention rates were 88%, 87%, and 65% for Cohorts 1, 2, and 3, respectively.

At baseline, PMKs reported on demographic variables, perinatal variables, child temperament, parenting practices, and PMK depression. At follow-up parents reported on child age, the presence of older and younger siblings, the child's height and weight, parenting practices, developmental milestones, the child's health, current sleep functioning, and nap status.

2.3. Measures

The survey questions and measures used in the NLSCY were selected by an expert advisory group [32]. These scales are generally established measures, or short-form derivatives generated for the NLSCY. The construct validity of each scale was tested by Statistics Canada [32]. Some item wordings and responses options were consistent Statistics Canada practice (e.g., Census items) at the time of data collection. It should be noted that items, such as ethnicity, have been modified and expanded since this data was collected. Descriptive statistics for predictor variables are presented in Table 1 and Appendix A. The timepoints at which these measures were collected are presented visually in Appendix A.

Statistics Canada has standardized requirements for minimal cell sizes for variables to maintain confidentiality. Thus, some response options had to be aggregated (e.g., maternal alcohol use). For other variables, subgroups were combined to increase the interpretability of ORs in the analyses (e.g., developmental milestones).

2.3.1. Demographic variables

The children's demographic variables included sex, age (months; reported at baseline and follow-up), ethnicity, and whether the child had older and/or younger siblings. The PMKs' demographic variables were marital and employment status (both reported during follow-up cycles), and highest education attained. Income adequacy (PMK-reported income, adjusted for family size and coded into quintiles) indexed families' economic situation. Statistics Canada verified demographic variables using established criteria described elsewhere [32].

2.3.2. Perinatal variables

At baseline, PMKs provided their child's birth weight (in grams) and whether the birth mother consumed alcohol during the pregnancy. For analyses in this study, maternal alcohol consumption during pregnancy was dichotomized as 0 = no alcohol consumed, 1 = alcohol consumed once or more during pregnancy. Maternal alcohol consumption during pregnancy needed to be dichotomized in this study in accordance with Statistics Canada regulations. Statistics Canada verified these perinatal variables using established criteria described elsewhere [32]. For example, birth weight was corroborated using the agreement between birth length, prematurity, and delivery conditions (e.g., multiple birth, specialized medical care).

2.3.3. Child growth

PMKs provided their child's height (centimeters) and weight (kilograms) at follow-up.

2.3.4. Developmental milestones

Developmental milestones were calculated from the Ages and Stages Questionnaire (ASQ; [33]). The ASQ assesses five areas of development: Communication, Fine Motor, Gross Motor, Problem-Solving, and Personal-Social. The ASQ has demonstrated excellent test-retest reliability ($r = 0.92$), sensitivity (87.4%), and specificity (95.7%) for detecting developmental delay across samples and cultures, according to a recent review [34]. The factor structure of the ASQ was evaluated within the NLSCY and its original factor structure was supported [32]. Standardized ASQ scores at follow-up were used for analyses ($M = 100$, $SD = 15$). These norms were based on NLSCY Cycle 1 data (calculated by Statistics Canada analysts). To increase interpretability in the present study, standardized ASQ scores were recoded into half-standard deviation units prior to analyses. Higher scores indicated that more developmental milestones had been achieved.

2.3.5. Child and parent functioning

Child temperament. At baseline, PMKs rated their child's temperament on 10 items using 5-point Likert scales, based on the Infant Characteristics Questionnaire [35]. A single factor was supported using NLSCY Cycle 1 data [32]. Lower scores reflect an easier infant temperament. To increase interpretability for the present study, average temperament scores were recoded into four categories based on the original Likert scale options – Easiest (average score ranged from 1.00 to 1.99), Easy (2.00–2.99), Moderate (3.00–3.99), and Difficult (4.00–5.00). Supplemental Table 1 shows the percentage of cases within each of these groups at baseline.

Child health. At follow-up, PMKs reported on the frequency of which their child was in "good health" on a 5-point scale. Responses were dichotomized for the present study as 0 = "never, sometimes, or about half the time" and 1 = "often or almost all the time" to increase interpretability.

Parenting practices. PMKs reported on their parenting practices on a measure based on the Parent Practices Scale [36]. The baseline scale contained two subscales (positive and ineffective parenting) and the follow-up scale contained three subscales (positive, ineffective, consistent parenting); these subscales were supported by confirmatory factor analyses [32]. The consistent parenting items were not asked of PMKs with children 0–1-years-old. Scale reliabilities ranged from $0.660 \geq \alpha_c \leq 0.808$. Ineffective parenting scores ranged from 0 to 8 and higher scores reflected a greater tendency toward hostile or ineffective interactions. Positive parenting scores ranged from 0 to 20 and higher scores indicated a greater tendency toward positive parenting interactions. Finally, consistent parenting scores ranged from 0 to 20 and higher scores reflected a greater tendency toward consistent parenting.

Parental depression. PMK depression was assessed by the 20-item version of the Center for Epidemiological Studies Depression (CES-D) scale [37] and was completed at baseline. Total scores ranged from 0 to 36, with higher scores indicating the presence of increased depressive symptoms. Confirmatory factor analyses supported a single factor solution, which demonstrated good internal consistency ($\alpha_c = 0.820$; [32]).

2.3.6. Children's concurrent sleep functioning

PMKs completed four indices of children's sleep behavior at follow-up (i.e., 2–3 years old): (i) the number of times their own sleep was interrupted by their child waking over the past month (never vs. once per night or more than once per night); (ii) child's nighttime sleep duration (in hours); (iii) child's nighttime sleep onset latency (≤30 min vs. >30 min), and (iv) whether the child has an extended bedtime routine (i.e., >30 min) on most nights (yes vs. no). Parent reports on questionnaires using similar items are strongly associated with objective measures of sleep such as actigraphy ($r = 0.74$) [38,39].

2.3.7. Outcome: napping status

At follow-up (i.e., 2–3 years old), PMKs were asked: "In general, what is the longest time [child's name] naps during the day?". Response options were: (1) less than 1 hour; (2) from 1 hour to less than 2 h; (3) From 2 h to less than 3 h; (4) From 3 h to less than 4 h; (5) 4 h or more; (6) child does not nap anymore. In the NLSCY, only children who were 0–3-years-old were asked this question. To index whether or not the child had ceased napping by their third birthday, responses were dichotomized. "Child does not nap anymore" was coded as "child ceased napping" (1) and the child napping for any duration was coded as "child still napping" (0).

2.4. Research design and data analyses

Analyses were conducted in Mplus v8 [40]. All analyses were unweighted, as Statistics Canada does not provide normalized weights for longitudinal NLSCY datasets and the usage of population weights would artificially increase power and bias tests of significance.

There were four steps in the analyses. Firstly, the rates of children who were napping or no longer napping were analyzed and reported with 95% confidence intervals across cohorts. Secondly, after screening for violations of statistical assumptions, multigroups logistic bivariate regression analyses (where the groups are the cohorts) in Mplus were used to assess bivariate associations between a predictor and napping status. Thirdly, Wald tests were used to identify prediction relations (i.e., regression coefficients) which differed significantly between cohorts. To model these moderated effects, the regression coefficients of predictors which differed significantly between cohorts in the bivariate models were allowed to take different values in subsequent multivariate models (i.e., moderated by cohort). Multiple groups analyses were used, due to the clustered design of the data (i.e., participants nested within cohorts). The multigroup multivariate logistic regression was conducted using a model building approach, adding predictors in steps. These steps were: (1) demographic variables, (2) perinatal variables, (3) child growth variables, (4) developmental milestones, (5) child and parent functioning variables, (6) current sleep functioning variables.

2.5. Approach to missing data

Missing data for predictor variables was low (<10% for all variables, except child's height at follow-up [26%] and PMK highest education attained [14%]) and were assumed to be missing at random. Missing data were handled using multiple imputation, with 10 datasets imputed. Mplus uses Bayesian analyses to impute missing data. Then, parameter estimates are averaged across the results from these datasets [40].

3. Results

3.1. Preliminary analyses

The assumptions of logistic regression were tested prior to the main analyses (e.g., independence of observations, non-multicollinearity). Two continuous predictor variables were determined to have problematic skewness or kurtosis (i.e., positive parenting practices at baseline, PMK depression). As such, these variables were recoded into percentile groups based on data grouped across cycles. No predictor variables demonstrated evidence of multicollinearity and the remaining continuous predictors appeared to show linearity with the outcome.

3.2. Napping cessation prevalence

Across the three cohorts, 10.9% (± 0.8%, 95% Confidence Interval) of children ($n = 602$) had ceased napping by their third birthday. In the bivariate models, several predictors (unadjusted for other predictors) of nap status emerged and are summarized in Table 2. Bivariate Wald tests demonstrated that the effect size of the relation with nap status differed significantly between cohorts for child age, PMK employment status, and positive parenting practices at follow-up. As such, these variables were moderated by cohort in subsequent models.

3.3. Nap cessation prediction

The results of the multigroup multi-variate logistic regression using a model-building approach are presented in Table 2. Across steps, no variable that was statistically significant at a previous step in the multivariate models became non-significant in a subsequent step, nor did any variable which was non-significant in a previous step become statistically significant at a subsequent step.

In the final model and among **demographic** predictors, children who were female (compared to males; OR = 1.29; 95% CI = [1.07–1.55]) and had at least one older sibling (compared to no older siblings; OR = 1.33, 95% CI = [1.10–1.62]) were more likely to have ceased napping by age 3. For each month of older age, children were about 1.2 times more likely to have ceased napping (moderated by cohort, ORs range from 1.15 to 1.24, all p's < 0.05). Children who had a non-White ethnicity (compared to children with White ethnicities; OR = 0.41, 95% CI = [0.28–0.60]) and whose PMK worked or attended school (compared to children whose PMK's did not work or attend school; moderated by cohort, ORs range from 0.50 to 0.58, all p's < 0.05) were less likely to have ceased napping (i.e., more likely to still nap). Among **perinatal** predictors, children with a birthweight under 2500 gs (compared to children with birthweights ≥2500 gs; OR = 0.60, 95% CI = [0.37–0.96]) and whose birth mother consumed alcohol once or more during pregnancy with the child (compared to those whose mother never consumed alcohol during pregnancy; OR = 0.56, 95% CI = [0.40–0.79]) were less likely to have ceased napping (i.e., more likely to still nap). Children's odds

Table 2
Model building results for the Multiple Groups Logistic Regression Predicting Nap Status.

			Multivariate Model testing					
Predictor	Reference Category/Units	Bivariate Models[1] OR [95% CI]	1 OR [95% CI]	2 OR [95% CI]	3 OR [95% CI]	4 OR [95% CI]	5 OR [95% CI]	Final OR [95% CI]
Demographics								
Child's Sex	Female	**1.26 [1.06–1.49]**	**1.24 [1.04–1.48]**	**1.26 [1.06–1.51]**	**1.29 [1.08–1.55]**	**1.26 [1.05–1.51]**	**1.29 [1.07–1.55]**	**1.29 [1.07–1.55]**
Child age (at follow-up)	Months							
	Cohort 1	**1.15 [1.12–1.17]**	**1.15 [1.13–1.18]**	**1.15 [1.13–1.18]**	**1.14 [1.12–1.17]**	**1.15 [1.12–1.17]**	**1.15 [1.12–1.18]**	**1.15 [1.12–1.18]**
	Cohort 2	**1.20 [1.09–1.32]**	**1.19 [1.08–1.32]**	**1.20 [1.09–1.32]**	**1.19 [1.08–1.31]**	**1.19 [1.08–1.31]**	**1.19 [1.08–1.32]**	**1.19 [1.08–1.31]**
	Cohort 3	**1.22 [1.14–1.31]**	**1.23 [1.15–1.32]**	**1.24 [1.15–1.32]**	**1.23 [1.14–1.31]**	**1.22 [1.14–1.31]**	**1.23 [1.15–1.32]**	**1.24 [1.15–1.33]**
Child's Ethnicity	Non-white	**0.47 [0.33–0.68]**	**0.38 [0.26–0.55]**	**0.37 [0.25–0.54]**	**0.37 [0.25–0.54]**	**0.37 [0.25–0.54]**	**0.39 [0.27–0.58]**	**0.41 [0.28–0.6]**
Has an older sibling	Yes	**1.20 [1.01–1.43]**	**1.25 [1.04–1.51]**	**1.23 [1.02–1.49]**	**1.25 [1.03–1.51]**	**1.29 [1.07–1.57]**	**1.35 [1.12–1.64]**	**1.33 [1.10–1.62]**
Has a younger sibling	Yes	**1.30 [1.07–1.58]**	1.11 [0.89–1.38]	1.10 [0.88–1.37]	1.10 [0.88–1.37]	1.10 [0.88–1.37]	1.10 [0.88–1.38]	1.10 [0.88–1.37]
Marital Status	Divorce, Widowed, Single	1.18 [0.92–1.52]	1.00 [0.75–1.34]	1.01 [0.76–1.35]	1.01 [0.75–1.35]	0.98 [0.73–1.32]	1.01 [0.75–1.35]	1.02 [0.76–1.37]
PMK Employment Status	PMK works or attends school							
	Cohort 1	**0.60 [0.47–0.75]**	**0.60 [0.46–0.76]**	**0.59 [0.46–0.75]**	**0.59 [0.46–0.76]**	**0.59 [0.46–0.76]**	**0.58 [0.45–0.75]**	**0.58 [0.45–0.75]**
	Cohort 2	**0.50 [0.34–0.74]**	**0.52 [0.35–0.78]**	**0.52 [0.35–0.77]**	**0.51 [0.34–0.77]**	**0.51 [0.34–0.77]**	**0.52 [0.34–0.77]**	**0.53 [0.35–0.79]**
	Cohort 3	**0.53 [0.36–0.79]**	**0.51 [0.34–0.76]**	**0.50 [0.33–0.75]**	**0.50 [0.33–0.75]**	**0.50 [0.33–0.75]**	**0.50 [0.33–0.75]**	**0.50 [0.33–0.75]**
PMK Educational Attainment [a]	Less than High School Completed	1.21 [0.93–1.58]	1.10 [0.84–1.44]	1.07 [0.80–1.44]	1.09 [0.81–1.45]	1.07 [0.80–1.41]	1.12 [0.84–1.49]	1.13 [0.84–1.52]
	Secondary School Graduate Only	1.01 [0.77–1.32]	1.02 [0.78–1.34]	0.99 [0.76–1.29]	0.97 [0.74–1.28]	0.98 [0.75–1.29]	0.98 [0.74–1.30]	1.00 [0.75–1.32]
	Some post-secondary, but less than college/university graduate	0.91 [0.71–1.17]	0.950 [0.74–1.22]	0.94 [0.73–1.22]	0.95 [0.74–1.23]	0.93 [0.72–1.20]	0.95 [0.73–1.24]	0.93 [0.72–1.2]
Income adequacy	Quintile increase	**0.89 [0.82–0.97]**	0.92 [0.83–1.02]	0.93 [0.84–1.03]	0.93 [0.84–1.03]	0.93 [0.84–1.03]	0.92 [0.83–1.02]	0.92 [0.83–1.02]
Perinatal								
Low birthweight	<2500 g	**0.54 [0.34–0.86]**		**0.52 [0.32–0.83]**	**0.53 [0.33–0.85]**	**0.58 [0.36–0.94]**	**0.60 [0.37–0.96]**	**0.60 [0.37–0.96]**
Maternal alcohol consumption	Once or more during pregnancy	**0.56 [0.41–0.77]**		**0.54 [0.39–0.76]**	**0.54 [0.39–0.76]**	**0.55 [0.39–0.77]**	**0.55 [0.39–0.78]**	**0.56 [0.40–0.79]**
Child Growth								
Child Height	cm	**1.03 [1.02–1.04]**			1.01 [0.99–1.02]	1.01 [0.99–1.02]	1.01 [0.99–1.02]	1.01 [0.99–1.02]
Child Weight	kg	**1.10 [1.06–1.14]**			1.02 [0.97–1.07]	1.01 [0.97–1.06]	1.01 [0.96–1.06]	1.01 [0.97–1.06]
Child Development								
Developmental Milestones	$\frac{1}{2}$ SD Units	**1.11 [1.06–1.16]**				**1.09 [1.04–1.15]**	**1.08 [1.03–1.13]**	**1.08 [1.03–1.13]**
Child & Family Functioning								
Temperament [b]	"Easy"	1.09 [0.87–1.35]					1.12 [0.89–1.42]	1.14 [0.90–1.44]
	"Mid"	0.98 [0.76–1.26]					0.97 [0.74–1.29]	0.99 [0.75–1.32]
	"Difficult"	1.03 [0.68–1.54]					1.06 [0.68–1.67]	1.10 [0.70–1.74]
Child Health	Good health often/almost all the time	1.11 [0.70–1.76]					1.20 [0.74–1.94]	1.15 [0.71–1.86]

(*continued on next page*)

Table 2 (*continued*)

Predictor	Reference Category/Units	Bivariate Models[1] OR [95% CI]	Multivariate Model testing 1 OR [95% CI]	2 OR [95% CI]	3 OR [95% CI]	4 OR [95% CI]	5 OR [95% CI]	Final OR [95% CI]
Positive Parenting Style (Baseline) [c]	<10th Percentile	0.79 [0.57–1.08]					0.98 [0.70–1.37]	0.96 [0.68–1.36]
	10th – 30th Percentile	0.84 [0.67–1.06]					0.82 [0.64–1.05]	0.81 [0.63–1.04]
	30th – 50th Percentile	1.11 [0.89–1.38]					1.04 [0.82–1.31]	1.03 [0.82–1.30]
Ineffective Parenting Style (Baseline)	Unit increase	**1.10 [1.05–1.16]**					1.00 [0.94–1.06]	1.00 [0.94–1.06]
Positive Parenting Style (Follow-Up)	Unit increase							
	Cohort 1	1.01 [0.96–1.07]					1.03 [0.98–1.10]	1.04 [0.98–1.10]
	Cohort 2	1.08 [0.98–1.20]					1.07 [0.96–1.19]	1.07 [0.96–1.19]
	Cohort 3	**1.12 [1.02–1.23]**					**1.13 [1.02–1.25]**	**1.13 [1.02–1.24]**
Ineffective Parenting Style (Follow-up)	Unit increase	1.00 [0.98–1.03]					1.01 [0.98–1.04]	1.01 [0.98–1.04]
Consistent Parenting Style (Follow-up)	Unit increase	1.03 [0.99–1.06]					1.01 [0.98–1.04]	1.01 [0.98–1.04]
PMK Depression [d]	50th – 70th Percentile	0.91 [0.71–1.16]					0.87 [0.67–1.13]	0.86 [0.66–1.12]
	70th – 90th Percentile	0.85 [0.66–1.09]					0.81 [0.62–1.07]	0.82 [0.62–1.07]
	>90th Percentile	0.95 [0.70–1.28]					0.86 [0.62–1.21]	0.88 [0.61–1.25]
Child's Sleep								
PMK sleep is interrupted by child	Once or more	0.96 [0.80–1.16]						1.13 [0.92–1.38]
Child's nighttime sleep duration	Hours	**1.07 [1.02–1.12]**						**1.06 [1.01–1.11]**
Child's sleep onset latency	>30 min	**0.78 [0.62–0.98]**						0.79 [0.61–1.01]
Child has a long bedtime routine	Yes	1.01 [0.82–1.24]						1.09 [0.87–1.35]

Notes. Significant ORs ($p < .05$) are bolded.
Model 1: Demographic predictors-only.
Model 2: Demographic and perinatal predictors.
Model 3: Demographic, perinatal, and child physical growth predictors.
Model 4: Demographic, perinatal, child physical growth, and developmental milestone predictors.
Model 5: Demographic, perinatal, child physical growth, developmental milestone, and family/child functioning predictors.
Final Model (Model 6): Demographic, perinatal, child physical growth, developmental milestone, family/child functioning, and current sleep functioning predictors.
[1] Refers to preliminary bivariate models with only one predictor (i.e., unadjusted for other predictors). All models account for nesting within cohorts. Predictors with multiple effect sizes per model were moderated by cohort (i.e., Child age, PMK Employment Status, Positive Parenting Style at Follow-up).
[a] PMK Education – "College or university degree or higher" is the reference group.
[b] Temperament – "Easiest" is the reference group.
[c] Positive Parenting (Baseline) – ">50th Percentile" is the reference group.
[d] Depression – "<50th Percentile" is the reference group.

of having ceased napping increased with each half-unit standard deviation increase in **developmental** milestones scores (OR = 1.08, 95% CI = [1.03–1.13]). Children's current **sleep functioning** also predicted nap status at age three; each additional hour of nighttime sleep at follow-up was associated with increased odds that the child had ceased napping (OR = 1.06, 95% CI = [1.01–1.11]).

4. Discussion

This study utilized nationally representative epidemiological data to answer basic questions about the predictors of early nap cessation, informed by the Socioecological Model. Both developmental and socio-environmental factors were found to influence nap cessation by age three. This study provides evidence that nap cessation may be a developmental marker, and that it is influenced by socioenvironmental factors. Several of these effects correspond to small-to-medium effect sizes including child non-white ethnicity, PMK working or attending school, low birthweight, and maternal alcohol consumption [41].

Our demonstrated rate of napping cessation was lower than the range reported in a recent meta-analysis [1]. Children were 2–3 years old at follow-up in the current study and about 11% of these children had ceased napping. Staton and colleagues suggest that between 22.8% to 44.2% will cease napping at this age. However, this meta-analysis suggested rates of napping cessation in this age range may be lower in North America than Europe and our findings are consistent with other representative Canadian data, suggesting some cultural differences [6,13]. Thus, these differences may reflect the culturally attitudes toward napping in Canada. Alternatively, these differences may be explained by napping policies in Canada at the time of data collection. Both these explanations are speculative and require further research.

For example, during the data collection period of the NLSCY, some provinces allowed parents to choose between their child attending part-time kindergarten (for children as young as 3-years-old) or full-day kindergarten through an elementary school. Children may have been in childcare (e.g., in a daycare center or privately), or a mixture of kindergarten and childcare [40]. In one province (Ontario), mandatory nap policies were likely common in childcare settings and flexible nap policies were legislated in kindergartens at the time the data in the NLSCY was collected [40]. To our knowledge, there are no complete records of the napping policies across Canada for the data collection periods of the NLSCY.

Developmental factors that positively predicted early nap cessation included older child age, the absence of perinatal risk factors (i.e., low birthweight and maternal alcohol use during pregnancy), and greater attainment of developmental milestones. Older child age is frequently associated with shorter nap duration worldwide, and it is well-known that most preschool-age children in Western countries will cease napping before 6 years old [1,6,11]. Low birthweight and having a mother who drank alcohol during pregnancy may delay development [26–29]. Notably, maternal alcohol consumption was indexed in this study as having used ***any*** alcohol during pregnancy. It is unlikely that one drink during pregnancy adversely impacted the child's biological maturation (i.e., likely not teratogenic effects). This variable may co-vary with other non-measured variables that may be causally related to a child giving up naps at a later age, such as maternal stress. Low birthweight was statistically significant; however, children's height and weight at follow-up were not. These findings suggest that the growth trajectory from birth to 3-years-old is not relevant for nap cessation. Instead, low birthweight may impact neural development, which in turn may influence nap cessation. These findings support a developmental trajectory of nap cessation.

The individual child factors observed in this study were largely consistent with previous research on predictors of child nighttime sleep and sleep problems, including child's sex, ethnicity, and temperament. Male children tend to nap for longer durations than female children [42,43]. We found that males are also likely to nap later into development than females. This may be related to earlier maturation for females. Females demonstrate a slight advantage in language acquisition skills during early childhood [44]. Non-white children tend to nap more frequently or for longer durations than white children [19,45]. We provide preliminary longitudinal evidence that non-white children nap later into development than white peers, suggesting possible cultural factors in napping behavior. Previous research suggests differences between ethnic groups in parental beliefs about child sleep behavior, including where children should sleep and the perception of sleep problems [46]. Cultural factors also influence the timing of other developmental changes. For example, Black children tend to be toilet trained earlier than White children [47]. In addition, temperament has been found to consistently relate to children's nighttime sleep [15]. However, in the current study, temperament was not a significant predictor of early nap cessation. Others have found that temperament did not differentiate between groups of napping and non-napping 4–6-year-old children [4]. In this previous study and ours, temperament was operationalized as a unidimensional construct. This conceptualization of temperament is limited. Perhaps specific aspects of temperament are relevant to nap cessation, such as rhythmicity and adaptability. These aspects relate to parent-reported child sleep problems [24]. Future research should employ more complex, multi-informant measures of temperament.

Nighttime and daytime sleep are closely linked. We found that longer nighttime sleep duration predicted early nap cessation. Multiple aspects of sleep change during the early years, including increasing nighttime sleep duration and decreased nightwakings [15]. It may be that better-developed nighttime sleep practices cause early nap cessation, as the child's daily sleep needs are satisfied by nocturnal sleep. Alternatively, it may be that nap cessation is part of general developmental processes, which include the ability to self-soothe and initiate and maintain sleep during the night. This relation should be further investigated using more detailed sleep measurement, such as actigraphy or sleep diaries, and short-term longitudinal studies (i.e., 6–12 months). These studies can examine whether changes in nighttime sleep drive changes in daytime sleep, vice versa, or if both change in tandem.

Situational factors such as having an older sibling and the PMK attending work or school predicted early nap cessation, indicating that factors beyond maturation influence nap cessation. Specifically, children whose PMK attended work or school were more likely to still be napping at follow-up and children with an older sibling were more likely to have ceased napping. These findings are novel and require replication. There are several possible mechanisms involved. For example, children with older siblings may prefer to cease napping to emulate their older sibling's behavior. The presence of older siblings also changes the home environment. Young children may find it difficult to initiate sleep during the day if they hear their older siblings playing. Alternatively, parents may have distinct napping preferences for non-firstborn children. Parental nap behavior preferences were not evaluated in this study but may be a proximal process which explains these relations. Parental preferences may include reasons for encouraging or discouraging napping, or personal beliefs related to when children should stop napping. Interestingly and in contrast to the literature on nighttime sleep, parenting practices (e.g., positivity, hostility, consistency) did not predict early nap cessation in our final model. These parenting practices may be relevant for establishing new routines but may not directly relate to nap cessation. For example, parents who show positivity and consistency may be better able to establish new routines. Finally, family factors related to socioeconomic status (i.e., income adequacy and PMK education) were not predictive of early nap cessation. It is likely that more proximal factors, such as childcare attendance and practices would be relevant to nap cessation [48,49]. For example, some childcare centers may have mandatory napping policies in which all children are encouraged to nap, regardless of if they are regularly napping. There is evidence that these policies provide little benefit for non-habitually napping children and may cause harm. Thorpe and colleagues found that mandatory naptimes do not provide post-nap reductions in cortisol [50]. Observational research also suggests that nap times in childcare centers can have less positive and more negative emotional climates than non-sleep times [51]. Further, children that nap after they are ready to cease napping are likely to have longer nighttime sleep onset latencies and shorter nighttime sleep durations, as their napping can decrease their sleep drive [52]; this may be problematic for parents and negatively impact parent-child interactions at bedtime. Finally, the use of mandatory nap time policies may be more likely to occur in lower socioeconomic areas [48], suggesting that children living in these areas may be at greater risk of potential harms from mandatory napping policies.

Our results provide evidence that parents, early childhood care providers, and related practitioners should observe and support, but not actively alter, children's individual nap cessation trajectories. Except for nighttime sleep duration, all of the nap cessation correlates identified in this study are non-malleable. The functional benefits of napping among preschool children are nuanced, domain-specific, and may depend on whether the child is a habitual napper. On the one hand, children who are no longer napping tend to perform better on receptive language and some cognitive tasks than still-napping children [6,8,9], which may reflect nap cessation as a marker of increased maturation. On the other hand, napping has been shown to improve memory consolidation in preschoolers, although this effect tends to hold only for preschoolers who nap regularly [53,54]. Still other tasks, such as word generalization, may be improved by napping regardless of whether the child naps regularly [55]. However, overall, there is little evidence to suggest that encouraging preschool children to nap after they have naturally ceased provides any long-term functional benefits. However, more research on these functional outcomes is needed and should incorporate children's nap cessation timing.

Our findings may have implications for parents, childcare providers, and clinicians. This paper contributes to the literature on normative trends in napping among preschool children (e.g., [1,11]). It is important for parents, childcare providers, and clinicians to be aware of normative trends in nap behavior. These groups can also benefit from understanding the developmental and socioenvironmental factors related to nap cessation, such as achieving more developmental milestones and having an older sibling. As noted above, most the identified factors are non-malleable, suggesting that parents and childcare providers should support, but not actively alter, children's transition out of daytime naps. The extant literature and our findings suggest that flexible napping policies, which respect the developmentally normative transition from biphasic to monophasic sleep among preschool-children, should be adopted. That is, children who nap habitually should have opportunities to nap and children who no longer nap should have alternate activities available (such as quiet time). This recommendation aligns with previous evidence from independent research groups [4,50,51], who have stated that there is a "need to be responsive to the individual changes in [the] need, purpose, and patterns of daytime sleep in developing children" (Smith et al., 2019, p. 33). As discussed above, children who attend childcare programs with mandatory napping policies and non-habitual nappers may experience rises in cortisol and less positive environments, particularly in lower socioeconomic neighbourhoods [48,50,51]. More research is required to solidify these recommendations, including evidence specific to the developmental timing of nap cessation and functional outcomes and further quasi-experimental or experimental studies.

4.1. Limitations & future directions

This study has several strengths including its large and nationally representative sample (at the time of data collection), longitudinal design, and inclusion of multiple cohorts to examine the stability of parameter estimates. However, our findings should be interpreted while considering several key limitations. Firstly, we employed a dichotomous definition of napping status (i.e., napping versus non-napping). Developmental trends suggest children transition from several naps per day, to a single daily nap, to irregular naps, to exclusively nighttime sleep [1,56]. These developmental trends are best captured through repeated-measures designs with short follow-up periods (e.g., 6 months), which are difficult to implement at a national scale. Future research should test our predictive model using these repeated-measures designs. Secondly, our results capture several components of the socioecological model, including child- and parent-level factors. However, the general-developmental focus of the NLSCY did not allow for interactional processes, such as sleep-specific parental attitudes or preferences, which have been demonstrated to influence nighttime sleep behavior [57]. Therefore, there may be additional processes, such as parental beliefs about naps in their children, which further predict nap cessation (Newton et al., Unpublished Results; [58]). Future research should examine these attitudinal factors and their unique contribution to napping cessation prediction.

Thirdly, there are key limitations to our measurement. All measures used in this study were parent-report, and thus may be affected by bias or common measurement issues. However, multi-informant designs are difficult to implement at the scale of the NLSCY. Specifically, many preschool children attend daycares. In this study, we did not measure how often children were in daycare or the napping policies within these specific care-settings. Parents may be unaware of the day-to-day variation in sleep timing and duration while their children attend daycare. Future research should implement multi-method designs, with special attention to childcare [2].

Fourthly, our temperament variable may be oversimplified. Specific subdomains of temperament may have significant impacts on daytime sleep behavior (e.g., rhythmicity, adaptability; [15,24]). Fifthly, our sample underrepresents non-White children in Canada at present. The NLSCY sample was representative of the Canadian population at the time of data collection (1998–2005), but Canadian demographics have since changed. While inclusion of samples that are representative of the current population may be unlikely to change our observed predictive relations, it may alter the prevalence of napping cessation.

This manuscript presents predictors of early nap cessation (i.e., before a child's third birthday). However, the predictors of late nap cessation (e.g., after a child's fourth or fifth birthday) remain untested. Future research should test the predictors of this developmental trajectory, while applying the socioecological model. As noted in the introduction, previous research has largely evaluated nap duration, rather than the developmental timing of nap cessation, in relation to functional outcomes, and the longitudinal implications of children's nap cessation timing remain untested.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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