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The Associations Between Child-Care Services During the Preschool Years and High School Graduation: A 20-Year Longitudinal Population-Based Study

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ABSTRACT: *Objective:* Together with family factors, early care and education (ECE) services were shown to improve school readiness in kindergarten. However, it is not clear whether better school readiness at age 6 years translates into higher rates of high school graduation years later. Our objective was therefore to investigate the long-term associations between the use of ECE and high school graduation while considering the sex of the child and the socioeconomic status of the parents as moderators. *Methods:* Participants were children from the Quebec Longitudinal Study on Child Development (QLSCD) born in 1997 to 1998 (N = 2001). Intensity and type of ECE exposure were measured from age 5 months to 5 years. Administrative records were used to determine whether students had obtained a high school diploma by age 20 years. Factors explaining differences in the profiles of ECE users were controlled using propensity score weights. *Results:* Twenty-two percent of students did not have a high school diploma by age 20 years. Compared with children never exposed to center-based care, those exposed early (i.e., before toddlerhood) had better odds of graduating from high school (odds ratio = 1.49) after controlling for confounding factors. Late exposure to center-based care was not related to high school graduation rates. *Conclusion:* Exposure to regulated and center-based ECE on a regular basis from toddlerhood to school entry was associated with higher rates of high school graduation. Regulated center-based ECE at the population level may improve rates of high school graduation.

(*J Dev Behav Pediatr* 00:1–10, 2021) **Index terms:** child care, day care, early care and education, ECE, high school graduation, early childhood, center-based child care, child development.

In North America, approximately 1 in 5 teenagers do not graduate from high school on time (no repeated years or delays).¹ Low educational attainment is a strong predictor of poor health throughout life. It is also associated with other costly problems such as unemployment, substance abuse, and criminality.²

The notion that the path to dropping out of high school begins early in life is widely held.³ However, most studies on the childhood predictors of high school graduation have considered factors taking place after school

entry such as academic achievement in school, intrinsic motivation, and school engagement.^{3,4} Fewer studies have examined early childhood risk and protective factors for school dropout. There is a substantial body of evidence that establishes that early-life deficits and interventions have persistent impacts on lifetime well-being.^{5,6}

Early care and education (ECE) services that care for children (day care center, babysitter, or other provider) during the day while parents are working are an important part of many children's preschool lives. In

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Canada, approximately 60% of children younger than 6 years participated in some form of formal or informal ECE in 2019.⁷ In seminal studies, participation in experimental ECE programs, in which high-quality and structured ECE services were offered, has been shown to increase rates of high school graduation⁸ and years of education.⁹ Much less is known about the effects of widely available ECE, which is generally of lower quality.¹⁰

The studies examining the associations between population-wide ECE and academic outcomes have found mixed results. Some studies found ECE attendance to be linked to better sociocognitive development during childhood.¹¹ For instance, ECE was found to be associated with higher levels of school readiness.^{12,13} Access to ECE might therefore provide children with the necessary knowledge and tools, both cognitively and behaviorally, to succeed once they enter school. Long-term benefits have also been reported.^{11,14,15} For example, Vandell et al.¹⁵ found persistent academic standing and behavioral adjustment benefits of early ECE until age 18 years, even after controlling for extensive measures of family background from early childhood to adolescence. Domond et al.¹⁶ found benefits of ECE for high school completion in a cohort of children attending kindergarten between 1986 and 1988 in the city of Montreal, Quebec, but only for boys. However, some studies have found that although preschool experience increased school readiness, when the quality of the primary schools was not commensurate with the enriched preschool experience, the advantage of the latter faded.¹⁷ In addition, other large-scale longitudinal studies have shown ECE to be associated with suboptimal cognitive development under some circumstances (e.g., initiation in infancy).^{18,19}

The mixed results may be explained by 4 main sets of factors including (1) the conditions under which ECE is delivered, including the type and quality of ECE; (2) the age of initiation and the intensity of use; and (3) the characteristics of the users, such as the socioeconomic status (SES) of the family and the sex of the child. First, studies have compared the putative benefits of center-based ECE with those of family-based ECE. Center-based ECE reflects care provided to a group of children of similar ages in an educational setting by trained educators. Family-based ECE, on the other hand, is usually provided in a homelike setting with less focus on structured activities. Studies have found center-based ECE to be associated with better cognitive and social skills.^{15,19,20} In addition, the provision of stimulating, developmentally appropriate activities has been systematically recognized as one of the most important factors for positive child outcomes, such as better social skills and academic outcomes.^{11,15,21,22}

Second, the role of timing of initiation of ECE is still debated, with some studies reporting negative behavioral outcomes of an early initiation,^{23,24} whereas others report positive sociocognitive outcomes.^{15,20} There are also mixed results regarding the potential consequences of a higher intensity of use of ECE.^{15,20,23} Many ECE

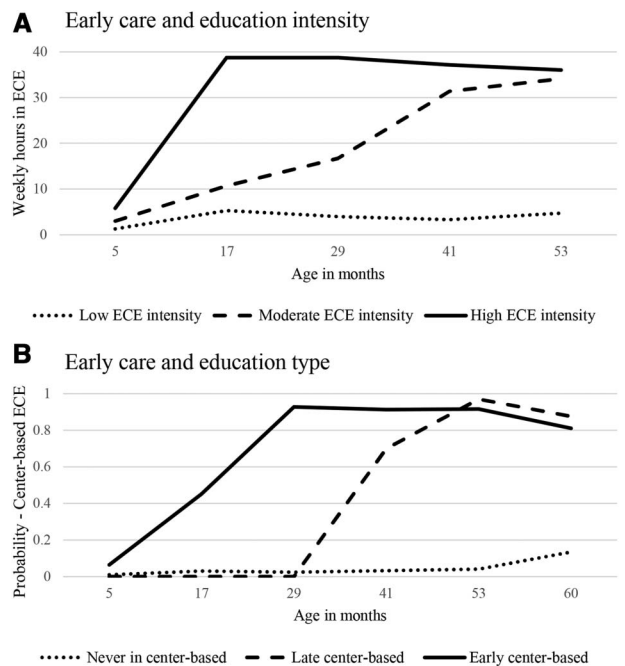


Figure 1. Trajectories of exposure to early care and education (ECE) between age 5 months and 5 years. A, Trajectories of ECE intensity (N = 2057). The first intensity trajectory, “high intensity” (36.5%), is the most common with a sharp increase in number of hours spent in ECE within the first year of life, and that intensity of use remains high as the child gets older (>35 hr per wk). The next trajectory, “moderate intensity” (29.5%), shows a gradual increase in ECE hours over the years. The final trajectory, “low intensity” (34%), is relatively low and stable, with children spending a low number of hours in ECE (<5 hr per wk). B, Trajectories of center-based ECE (n = 2120). The first trajectory, “early exposure to center-based ECE” (18.5%), includes children who have a high probability of attending center-based ECE early (at ~1.5 yrs). In the next trajectory, “late exposure to center-based ECE” (15.5%), children initially have a low probability of being enrolled in center-based ECE until age 17 months and then gradually increase in their enrollment (beginning at ~2.5 yrs). Finally, the “never exposed to center-based ECE” trajectory (66%) shows children having a high probability of never being exposed to center-based care during the preschool years. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2003), Gouvernement du Québec, and Institut de la statistique du Québec.

studies, however, do not take into account that ECE type and intensity of use might vary through time.

Finally, there is evidence that the outcomes of ECE use may vary as a function of family SES.^{25–27} Children from low SES families, those at greatest risk of poor outcomes, might be the ones that benefit the most from ECE. For instance, attending ECE was associated with better school readiness, academic performance, and less disruptive behavior for less advantaged children.^{13,20,28}

Using propensity score weighting analyses, this study investigated the association between ECE attendance and high school graduation. To capture ECE characteristics and how the ECE experience might vary in intensity and type as the child gets older, we used trajectories of intensity of use of ECE and of likelihood of using center-based ECE as a proxy for ECE quality. In all analyses, we tested the putative moderating role of family SES and the sex of the child.

METHODS

Participants

Data from the Quebec Longitudinal Study on Child Development (QLSCD) were used.²⁹ The QLSCD is a longitudinal study of singleton children born in the province of Quebec in 1997 and 1998 that was conducted by the Institut de la statistique du Québec. The Quebec Master Birth Registry of the Ministry of Health and Social Services was used to select a representative sample of 2917 infants. The chosen sample is composed of children from all geographic areas of Quebec with the exception of Northern Quebec, Cree territory, Inuit territory, and Aboriginal reserves (2.2% of all births). Within the chosen sample, 2120 families responded and participated in the first assessment when their child was 5 months old. For this study, we included those who had early care and education (ECE) information and graduation status (for ECE intensity trajectories, $N = 1952$ and for ECE type trajectories, $N = 1993$). Data were collected every year or other year. The QLSCD protocol was approved by the Institut de la statistique du Québec and the St-Justine Hospital Research Centre Ethics Committees, and informed consent was obtained at each data collection.

Measures

Outcome: High School Diploma

We used administrative data from the Ministry of Education to determine whether students had obtained a high school diploma or not at age 20 years. Although students typically obtain a high school diploma at age 17 years in the province of Québec, some students repeat a grade and take longer to finish their schooling. We chose graduation at 20 years instead of 17 years to have a measure that reflected obtaining a high school diploma as opposed to graduating on time, considering that a high school diploma, regardless of how long it takes before obtaining one, is a prerequisite for higher education and for higher-level employment. In this sample, 1560 (78%) students had a high school diploma and 441 (22%) did not have a high school diploma by age 20 years (3 yrs after the expected age of graduation). Graduation data were unavailable for 119 children ($N = 2001$), likely because of families moving to a different province.

Exposure: Early Care and Education

This longitudinal study was initiated during the implementation of ECE at low cost (\$5 per day) to families throughout the province of Quebec. The policy was gradually rolled out so that children in the cohort had access to the reduced fee program when they were 3 to 4 years old. This context led to an increase in the demand for ECE spaces in the cohort members.

In this cohort, ECE included center-based care, which reflects care provided to a group of children of similar ages in an educational setting by trained educators; family-based ECE, which are usually provided in a homelike setting with less focus on structured activities; and informal ECE, which are provided by a nonrelative (such as

a nanny) or relatives (such as grandparents). Although center-based ECE is licensed and quality is regulated, not all family-based ECE services are licensed and regulated. For type of care, we distinguished children exposed to center-based care versus any other type of care (family-based ECE, informal ECE, or parental care). This distinction was used as center-based ECE in Quebec are usually of a higher quality with less variability across socioeconomic neighborhoods.³⁰ Intensity of care and age of initiation varied throughout childhood. To quantify exposure to the ECE environment, trajectory analyses were used to model ECE intensity and type of care over time. The trajectory methods allowed the use of all early childhood developmental data points (5 mo–4.5 yrs).

The ECE intensity variable relied on the mean number of hours per week spent in ECE as reported by mothers. The weekly number of hours ranged from 0 “in parental care” to 60 hours (mode = 40 hr), yielding low-intensity, moderate-intensity, and high-intensity trajectories (KML, R project, modeling published in Ref. 31). Trajectories allowed us to capture how the number of hours spent in ECE changed as the child got older; generally spending more and more time in ECE (Fig. 1A).

Modeling the probability to be exposed to center-based ECE using group-based trajectories yielded 3 trajectories: early onset of center-based ECE, late onset of center-based ECE, and never exposed to center-based ECE (PROC Traj, SAS modeling technique published in Ref. 32). Trajectories allowed us to capture the fact that many children change ECE settings as they get older; generally being more likely to attend center-based ECE as the time goes by (Fig. 1B).

Moderators: Family Socioeconomic Status

Family socioeconomic status (SES) was derived from 5 variables: maternal and paternal education and occupational status as well as household income. The maternal and paternal education variables were their highest achieved diploma. These variables ranged from 1 (no high school diploma) to 4 (university diploma). The annual family income variables assessed the total revenue for the family and ranged from 1 (<\$10,000) to 9 (>\$80,000). The maternal and paternal occupational prestige variables were measured using a modified scale developed by Pineo, Porter, and McRoberts, which relies on the Statistics Canada Standard Occupational Classification.³³ From these variables, an SES indicator was computed and standardized (range $-3 =$ low to $3 =$ high, with mean = 0 and SD = 1). Since ECE use might allow a parent to return to work or to return to their studies and, therefore, increase their income, occupational status, or education level, we chose to include the SES variable at 5 months only to avoid confounding. In this sample, 20% of mothers and 19% of fathers did not have a high school diploma. In addition, 23% of families did not have a sufficient income according to the low-income cutoffs (LICO). LICOs are income thresholds below which a family will likely devote a larger share of its income on the necessities of food, shelter, and clothing than the average family.

Table 1. Sociodemographic Characteristics for the Sample by ECE Trajectories

	Early Education and Care Intensity Trajectories				<i>p</i>
	Overall (N = 1959)	Low ^a (N = 654)	Moderate ^b (N = 580)	High ^c (N = 725)	
Categorical variables, N (%)					
Smoking during pregnancy	503 (25.8)	192 (29.4)	164 (28.3)	147 (20.3)	<0.001
Intact family	1584 (80.9)	513 (78.4)	464 (80.0)	607 (83.7)	0.050
Birth order					<0.001
1	876 (44.7)	249 (38.1)	263 (45.3)	364 (50.2)	
2	778 (39.7)	262 (40.1)	232 (40.0)	284 (39.2)	
3+	305 (1.6)	143 (21.9)	85 (14.7)	77 (10.6)	
Growth delay					0.061
Yes <5e percentile	68 (3.5)	25 (3.8)	22 (3.8)	21 (2.9)	
Yes 5e–9e percentile	92 (4.7)	42 (6.4)	18 (3.1)	32 (4.4)	
No (≥ 10e percentile)	1798 (91.8)	586 (89.6)	540 (93.1)	672 (92.7)	
Continuous variables, mean (SD)					
Socioeconomic status	0.01 (1.00)	−0.44 (0.89)	−0.07 (0.91)	0.47 (0.96)	<0.001
Maternal age (in yr)	28.89 (5.22)	28.47 (5.71)	28.41 (5.18)	29.64 (4.70)	<0.001
Paternal age (in yr)	31.77 (5.61)	31.55 (6.07)	31.51 (5.54)	32.16 (5.22)	0.067
Maternal IQ	8.10 (1.05)	7.96 (1.13)	8.04 (1.00)	8.25 (1.01)	<0.001
Maternal depression	1.38 (1.33)	1.48 (1.36)	1.39 (1.34)	1.28 (1.29)	0.014
Paternal depression	1.00 (0.96)	0.96 (0.93)	0.95 (0.86)	1.07 (1.05)	0.060
Maternal antisocial	0.81 (0.93)	0.84 (0.96)	0.87 (0.96)	0.74 (0.87)	0.027
Stimulation	4.76 (2.36)	4.49 (2.39)	4.73 (2.29)	5.02 (2.34)	<0.001
Verbalization	6.68 (1.62)	6.41 (1.77)	6.76 (1.45)	6.87 (1.58)	<0.001
No. of siblings	0.82 (0.90)	0.97 (1.02)	0.82 (0.89)	0.69 (0.76)	<0.001
Impact	8.41 (1.84)	8.16 (2.01)	8.41 (1.83)	8.62 (1.65)	<0.001
Coercion	1.07 (1.46)	1.00 (1.38)	1.02 (1.48)	1.18 (1.53)	0.040
Overprotection	5.35 (2.41)	5.95 (2.39)	5.32 (2.49)	4.84 (2.23)	<0.001
Affection	9.69 (0.69)	9.63 (0.92)	9.72 (0.54)	9.71 (0.54)	0.040

	Early Education and care type Trajectories				<i>p</i>
	Overall (N = 2001)	Never Exposed ^d (N = 1345)	Late Exposure ^e (N = 332)	Early Exposure ^f (N = 324)	
Categorical variables, N (%)					
Smoking during pregnancy	513 (25.6)	370 (27.5)	67 (20.2)	76 (23.5)	0.066
Intact family	1614 (80.7)	1094 (81.3)	269 (81.0)	251 (77.5)	0.271
Birth order					0.325
1	895 (44.7)	589 (43.8)	156 (47.0)	150 (46.3)	
2	795 (39.7)	531 (39.5)	132 (39.8)	132 (40.7)	
3+	311 (15.5)	225 (16.7)	44 (13.3)	42 (13.0)	
Growth delay					0.056
Yes <5e percentile	70 (3.5)	53 (3.9)	8 (2.4)	9 (2.8)	
Yes 5e–9e percentile	95 (4.7)	75 (5.6)	9 (2.7)	11 (3.4)	
No (≥ 10e percentile)	1835 (91.7)	1216 (90.4)	315 (94.9)	304 (93.8)	
Continuous variables, mean (SD)					
Socioeconomic status	0.00 (1.00)	−0.11 (1.01)	0.07 (0.93)	0.38 (0.95)	<0.001
Maternal age (in yr)	28.86 (5.23)	28.66 (5.31)	28.85 (5.15)	29.71 (4.89)	0.005
Paternal age (in yr)	31.80 (5.63)	31.54 (5.56)	31.85 (5.62)	32.84 (5.79)	0.002

(Table continues)

Table 1. Continued

	Early Education and care type Trajectories				p
	Overall (N = 2001)	Never Exposed ^d (N = 1345)	Late Exposure ^e (N = 332)	Early Exposure ^f (N = 324)	
Maternal IQ	8.10 (1.05)	8.05 (1.07)	8.08 (1.08)	8.27 (0.95)	0.018
Maternal depression	1.39 (1.33)	1.37 (1.30)	1.39 (1.32)	1.45 (1.43)	0.578
Paternal depression	1.00 (0.96)	0.95 (0.90)	1.07 (0.97)	1.14 (1.15)	0.005
Maternal antisocial	0.81 (0.93)	0.81 (0.92)	0.80 (0.92)	0.82 (0.97)	0.946
Stimulation	4.75 (2.36)	4.68 (2.37)	4.89 (2.34)	4.89 (2.32)	0.228
Verbalization	6.66 (1.63)	6.59 (1.64)	6.85 (1.62)	6.75 (1.59)	0.031
No. of siblings	0.82 (0.90)	0.84 (0.93)	0.73 (0.78)	0.81 (0.86)	0.094
Impact	8.40 (1.84)	8.38 (1.89)	8.35 (1.86)	8.51 (1.64)	0.484
Coercion	1.07 (1.46)	1.02 (1.41)	1.17 (1.56)	1.14 (1.54)	0.161
Overprotection	5.36 (2.41)	5.46 (2.40)	5.40 (2.49)	4.95 (1.54)	0.004
Affection	9.69 (0.69)	9.68 (0.74)	9.69 (0.60)	9.71 (0.54)	0.859

The table reports sociodemographic characteristics for the sample by early education and care (ECE) trajectories. *p* values are based on ANOVA for continuous variables or the Pearson χ^2 test (or Fisher exact test, if needed) for categorical variables. *p* values (*p*) in bold (<0.10) highlight the variables selected for the propensity score estimation. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2003), Gouvernement du Québec, and Institut de la statistique du Québec. ^aLess than 5 hr/wk from 5 months to 5 years. ^bThirty to 35 hr/wk by 3½ years. ^cForty hr/wk by 1½ years onward. ^dNo exposure to center-based ECE. ^eExposure to center-based ECE from 30 months to 5 years. ^fExposure to center-based ECE from 5 months to 5 years. ANOVA, analysis of variance; SMD, standardized mean difference.

Moderators: Sex

Studies investigating the impacts of ECE have found a moderating role of the sex of the child. A meta-analysis of 22 preschool education programs reports a greater positive impact of ECE on cognition for girls and a greater positive impact on grades for boys.³⁴ We therefore included sex reported by the parents at 5 months as a potential moderator.

Control Variables Used to Create Propensity Score Weight

As most of ECE research is quasiexperimental in nature, a major issue is the possibility that some form of biased selection of families into ECE services accounts for the association with children’s outcomes.³⁵ Indeed, mothers who are less educated, for example, are less likely to use ECE.^{36,37}

To limit this bias, studies have used propensity score weighting. The aim of this technique is to enable one to compare the outcomes of children exposed to different ECE conditions as if their background characteristics (e.g., mother’s education and SES) were similar. This is achieved by giving a weight to each participant that reflects their likelihood of ECE use estimated from a wide range of background characteristics when the child was 5 months old. Variables were chosen on the basis of availability and relevance regarding ECE use.

We included the child’s birth order, which could be first born, second born, or third born and higher. We also included the number of siblings as a continuous measure, the mother’s and father’s age at childbirth, and intact family status, which was divided into intact, meaning with both biological parents, or nonintact, meaning single parents or within a blended family. We also included the family SES variable described above. For perinatal characteristics, we included smoking during the pregnancy and intrauterine growth retardation (<fifth percentile, 5th–10th percentile, or normal).

We included original measures of 4 aspects of maternal parenting practices: perception of the impact (e.g., My behavior has little effect on the personal development of my baby/twin), coercion (e.g., I have lost my temper when my baby/twin was particularly fussy), affection (e.g., I often feel the urge to kiss my baby/twin), and overprotection (e.g., I can never bring myself to leave my baby/twin with a babysitter) ($\alpha > 0.65$ for all self-reported scales).³⁸ A list of initial items was drawn up, and the validity of their contents was verified by 15 specialists in the field of mother-child interactions. The list was finalized after the items were pretested in a sample of francophone and anglophone mothers in the Étude des Jumeaux Nouveaux-nés du Québec-1995 and the pilot study of QLSCD, which took place in 1996. To reply, the mother selects a response on a 10-level Likert-type scale ranging from “not at all” to “exactly.” In addition, we included maternal verbal responsivity toward the child (e.g., The mother responds to her baby/twin’s vocalization by talking to them) and maternal stimulation of the child (e.g., The mother encourages consciously the development of her baby/twin) which were rated by external evaluators during home visits ($\alpha > 0.80$). The questions in the verbal responsivity and stimulation scales are taken from the Home Observation for Measurement of the Environment (revised edition), developed by Caldwell and Bradley.³⁹ Items were mostly rated on a 5-level Likert scale from never to always and were aggregated together for the final score.

We also included a self-administered maternal verbal competence measure as a proxy of IQ.⁴⁰ Mothers were instructed to read sentences in which a word was left out. After reading the sentence, they had to circle 1 of 4 words they thought made the best, truest, most sensible complete sentence. For example, 1 sentence read: Lemons are sour but sugar is ... With potential answers being bitter, white, fattening, or sweet. Next, we included maternal and

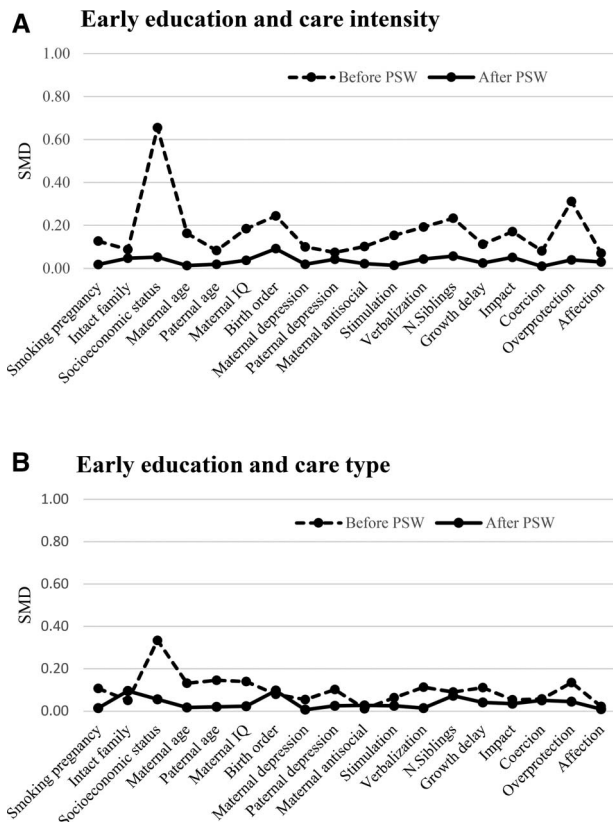


Figure 2. Covariance balance because of propensity score weighting. This figure represents the standardized mean difference (SMD) between the early care and education (ECE) trajectories (ECE intensity trajectories for panel A and ECE type trajectories for panel B) of all the variables used for estimating the propensity score weights (PSW) (x-axis). The dotted line represents the difference before applying the PSW, whereas the solid line represents the difference after application of the PSW. A high value indicates that there is a difference between ECE trajectory groups regarding that variable (at 5 mo), which could bias the results if it is not controlled. Through PSW, we aim to reduce these differences as much as possible. SMDs after PSW were less than 0.1 for all variables, except birth order (SMD = 0.10, $p = 0.33$) and intact family (SMD = 0.10, $p = 0.068$). Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2003), Gouvernement du Québec, and Institut de la statistique du Québec.

paternal depressive symptoms, a 5-level Likert-scale measure comprising an abridged version of the Center for Epidemiologic Studies Depression Scale developed by L.S. Radloff and abridged by M. Boyle of Chedoke-McMaster Hospital. An additional question was added from the Edinburgh Postnatal Depression Scale. Finally, we included maternal antisocial behavior during adolescence, which was a self-reported measure. It was modified from the National Institute of Mental Health Diagnostic Interview Schedule⁴¹ and based on the DSM-III criteria. This scale also reflects the DSM-IV criteria for the diagnosis of conduct disorder and antisocial personality disorder.

Analyses

Propensity Score Weighting

The 18 potential confounding variables were tested for their bivariate association with the intensity of use of ECE (ECE intensity trajectories) and the type of ECE used

(ECE type trajectories). Those significantly associated ($p < 0.10$) were selected for inclusion in the propensity scores (Table 1).

From this analysis, we calculated 2 sets of propensity score weights (PSWs): one for ECE intensity analyses (model 1) and the other for the ECE type analyses (model 2). Covariance balance was assessed using the standardized mean difference before and after propensity score weighting. PSWs were applied to models using inverse probability weighting.

Testing the Association Between ECE Attendance and Graduation

To investigate the association between ECE trajectories and graduation, 2 logistic regression analyses were conducted: one for ECE intensity trajectories and the other for ECE type trajectories. In step 1, we tested the association between ECE trajectories and graduation while controlling for child sex and family SES. In step 2, sex by ECE and SES by ECE interactions were added to the model.

RESULTS

Propensity Score Weighting

Significant differences on child, family, and parents' characteristics were observed between children following different trajectories of ECE intensity and type with the highest differences being for socioeconomic status (SES) (Table 1).

Intensity Trajectories

Propensity score weights (PSWs) significantly reduced the differences in those variables between children in the different ECE intensity trajectories, thus increasing their comparability (Fig. 2A). After propensity score weighting, standardized mean differences were less than 0.1 for all variables. The biggest reduction of differences was for SES and overprotection.

Type Trajectories

Propensity score weights significantly reduced the differences in those variables between children in the different trajectories of ECE type, thus increasing their comparability (Fig. 2B). After PSW, standardized mean differences were less than 0.1 for all variables except birth order (standardized mean difference [SMD] = 0.10, $p = 0.33$) and intact family (SMD = 0.10, $p = 0.068$). The biggest reduction of differences was for SES, maternal age at childbirth, and paternal age at childbirth.

Associations Between Early Care and Education Trajectories and High School Graduation

Table 2 presents the results of the 2 sets of logistic regressions. In the first model, we aimed at comparing the likelihood of graduating according to intensity of ECE use. Those who had information about whether they obtained a high school diploma, ECE intensity trajectories, sex, and SES were included (N = 1952). In step 1 of the first model with ECE intensity trajectories, higher SES and being a girl were associated with higher odds of

Table 2. Association Between Exposure to ECE and High School Graduation

	Graduation		
	B (SE)	p	OR
Model with ECE intensity trajectories			
Step 1			
ECE intensity trajectories			
Low ^a	Reference		Reference
Moderate ^b	-0.02 (0.16)	0.886	0.980
High ^c	0.08 (0.17)	0.638	1.083
SES	1.11 (0.08)	<0.001***	3.034
Sex			
Girls	Reference	Reference	
Boys	-0.86 (0.13)	<0.001***	0.423
Step 2			
Interactions with ECE intensity trajectories			
Moderate vs. low intensity × SES	-0.07 (0.19)	0.707	0.932
High vs. low intensity × SES	-0.02 (0.19)	0.911	0.980
Moderate vs. low intensity × sex	-0.59 (0.32)	0.065	0.554
High vs. low intensity × sex	-0.56 (0.33)	0.090	0.571
Model with ECE type trajectories			
Step 1			
ECE type trajectories			
Never in center-based ECE ^d	Reference	Reference	
Late in center-based ^e	0.01 (0.14)	0.961	1.010
Early in center-based ^f	0.40 (0.16)	0.011*	1.491
SES	1.12 (0.07)	<0.001***	3.065
Sex			
Girls	Reference	Reference	
Boys	-0.85 (0.13)	<0.001***	0.427
Step 2			
Interactions with ECE type trajectories			
Late vs. never in center-based ECE × SES	0.11 (0.17)	0.505	1.116
Early vs. never in center-based ECE × SES	0.08 (0.18)	0.668	1.083
Late vs. never in center-based ECE × sex	-0.20 (0.30)	0.503	0.819
Early vs. never in center-based ECE × sex	-0.42 (0.33)	0.196	0.657

The table reports the regression coefficients (B), standard errors (SEs), p values (p), and odds ratio (OR) for the logistic regression models predicting graduation. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The model is adjusted for sex and socioeconomic status. Inverse probability weighting has been used for all models. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2017), Gouvernement du Québec, and Institut de la statistique du Québec. ^aLess than 5 hr/wk from 5 months to 5 years. ^bThirty to 35 hr/wk by 3½ years. ^cForty hr/wk by 1½ years onward. ^dNo exposure to center-based ECE. ^eExposure to center-based ECE from 30 months to 5 years. ^fExposure to center-based ECE from 5 months to 5 years. ECE, early care and education; SES, socioeconomic status.

graduating from high school. Attending ECE at a high or moderate intensity compared with not attending ECE was not associated with different odds of graduating from high school. Step 2 revealed no significant interactions between ECE and SES or sex.

In the second model, we aimed at comparing the likelihood of graduating according to the type of ECE: in center-based facilities versus in other, less regulated facilities (family-based, nanny) or in parental care. Those who had information about whether they obtained a high school diploma, ECE type trajectories, sex, and SES were included (N = 1993). In step 1 of the second model with ECE type

trajectories, higher SES and being a girl were again associated with higher odds of graduating from high school. In addition, attending center-based ECE early (vs. never) was associated with higher odds of graduating (odds ratio = 1.49). In step 2, no interactions were significant, suggesting similar associations across levels of SES as well as for boys and girls.

Socioeconomic status was used to reduce the number of statistical tests and to have an idea of the overall effect of education, income, and occupational status, but the results were the same when testing sufficiency of income and mother's educational level as moderators.

DISCUSSION

We examined the long-term associations between early care and education (ECE) and high school graduation while accounting for a wide range of variables associated with the likelihood of using ECE that could potentially create selection bias. As expected, children from lower socioeconomic status (SES) families and boys had lower odds of graduating. The results also revealed that attending center-based ECE early (i.e., initiation between age 5 mo and 1½ yrs), when compared to never attending center-based ECE, is associated with greater odds of graduating from high school for both boys and girls, regardless of family SES. The number of weekly hours of ECE, on the other hand, was not associated with the odds of graduation.

There has been a debate in the literature as to whether positive consequences of attending ECE would last in the long term. Many studies on ECE programs that have tracked children beyond the end of the program find that effects on test scores fade over time.³⁴ However, despite this fade-out, there is evidence showing beneficial impacts on a broad set of later-life outcomes such as high school graduation rates.³⁴

Our results are in line with studies that found positive associations between ECE and sociocognitive outcomes lasting well into adolescence.^{11,15,20,28} These results also allow us to expand on the study of Domond et al.¹⁶ by showing associations with high school graduation in the context of the implementation of a province-wide low-fee ECE system. This study also pertains to ECE services that are almost 20 years more recent than the ones in the study of Domond et al.¹⁶ The present findings generate the hypothesis that long-term effects might be dependent on the characteristics of the ECE experience. Specifically, we find positive association between ECE use and graduation rates only in the context of center-based ECE services. This is consistent with the results from Vandell et al.,¹⁵ in which long-term effects were different depending on whether they were measuring the number of hours spent in ECE or the quality of ECE, for example.

Previous studies disentangling predictors of high school graduation focused on middle school and high school predictors (e.g., parent's involvement in school and academic achievement). However, many developmental theories state the importance of early childhood experiences. Theories such as the life course perspective⁴² or the developmental cascade⁴³ all support the idea that predictors in middle school and high school might only be midpoint markers of a lengthy developmental pathway to dropping out. In the context of high school graduation, it means that dropping out can be fully understood only in light of previous childhood experiences and outcomes.⁴² Early childhood is also an important time of brain development during which life experiences have a greater impact on future outcomes.⁴⁴ The results presented in this article are in line with such theories of child development that would hypothesize benefits of good quality ECE in early childhood

for later developmental outcomes such as high school graduation.

The 2 different types of trajectories used in this study allowed us to determine the ECE characteristics that were associated with better outcomes. In line with the scientific literature, center-based ECE yielded better outcomes than did other types of ECE or maternal care. The presence of a more structured and often more educational environment could be more favorable to the development of skills that are essential for school success. Although our study does not allow testing for the role of process quality (e.g., relationships between educators and children and quality of educational practices), 3 other local studies indicate that center-based care has the highest level of quality.^{30,45,46} The higher quality levels for center-based ECE observed in other studies suggest that it may also be among the reasons why center-based ECE attendance was associated with high school graduation. In the context of Quebec ECE, one-third of nonprofit center-based ECEs were of good, very good, or excellent quality, compared with only 10% of unregulated home-based day cares.³⁰

In addition, it is interesting to note the differential association we observe: The intensity trajectories were not associated with high school graduation, but for the type trajectories, an association was only found for an early and sustained use of center-based ECE. This could suggest that the effects of early initiation to ECE might depend on the type of ECE being used. Perhaps early initiation to low-quality types of ECE would yield more negative outcomes, canceling out the positive effects of high-quality type ECE services. This is in line with the results from a study conducted by Huston et al.⁴⁷ in which the association between number of hours spent in ECE and externalized behavior was stronger in low-quality ECE.

A meta-analysis of 22 early education programs detected larger impacts on cognitive achievement for girls and larger impacts on grades for boys.³⁴ However, in our study, we did not find interactions with sex. A wide variety of different circumstances and skills play a role in the likelihood of graduating high school⁴; perhaps ECE benefits girls and boys in different ways that all contribute to better odds of graduating later on. This result should, however, be interpreted with caution, as it approaches significance ($p = 0.065$). Surprisingly, we also did not find interactions between ECE and SES when predicting high school graduation. Other studies that have found moderation effects mostly focused on 1 domain of development. Perhaps ECE influences different domains of development depending on the SES of the child's family, and these benefits balance out when considering high school graduation. We also might not have had the power to detect these moderating effects.

Strengths and Limits

A notable strength of this study is the use of a large prospective population-based birth cohort with repeated measures of ECE intensity and type across early

childhood and the use of a propensity score design to limit selection bias; offering reassurance on the robustness of the findings. In addition, linking this cohort to data from the ministry of education to determine whether students had obtained a high school diploma allowed us to circumvent problems of differential attrition over time typically found in longitudinal studies. However, this study also has limitations. First, propensity score weighting does not account for potential unmeasured confounding factors such as parents' personality, ability to work, working hours, the need for more than 1 job, or health of the child. Second, this study is not causal in nature. Therefore, causality cannot be implied, and these results should be interpreted with care. Third, although the receipt of a high school diploma is an important proxy measure for adult outcomes, it does not fully reflect the range of academic, occupational, and societal outcomes that may be of interest in people's lives. Finally, we also did not directly measure the quality of ECE, which is known to influence ECE outcomes.

CONCLUSION

Altogether, early-onset center-based early care and education (ECE) use was associated with better odds of high school graduation. Many industrial societies have invested in ECE as a way to promote maternal employment and child development. One important policy consideration and debate has been whether societies should invest in ECE for the 0-year-old to 3-year-old children or invest in preschool programs for children aged 3 to 5 years. Considering that the earliest interventions yield the best cost benefit in the long term,⁶ these results, while not causal, are in line with the idea that social policies that promote the early access to center-based ECE are important. Replications of the present results in other sociopolitical contexts are necessary, and future studies should investigate potential mediating variables in this association such as academic achievement and prosocial behavior. It would also be important to better understand the moderating variables that sustain the benefits of ECE in the long term such as later classroom quality.

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