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Early Childcare Enrollment and the Pursuit of Higher Education: A Canadian Longitudinal Study

Short title: Childcare Enrollment and Higher Education

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Abstract

This study examined the associations between childcare attendance among 550 children from 24 to 36 months of age and their enrollment in higher education in young adulthood. We conducted a propensity score matching analysis to control the selection bias for childcare attendance and estimated the average treatment effect for the treated on the odds of enrollment in higher education. Children who attended informal childcare (i.e., with a relative or nanny) were more likely to pursue higher education in young adulthood relative to children in formal childcare (i.e., center-based or licensed home-based childcare). However, heterogeneity in our sample revealed that attending formal childcare increased the probability of enrollment in higher education for children from low-income and non-employed families. This study suggests that attending informal childcare in Canada in 1994–1995 benefited all children over 20 years later, whereas attending formal childcare appears to be protective for children from more disadvantaged families.

Keywords: childcare, early childhood education, higher education, longitudinal study

1. Introduction

The pursuit of higher education represents a key milestone for young adults (Bailey et al., 2010). Higher education encompasses enrollment in a university diploma or certificate program, as well as enrollment in trade or technical schools, and apprenticeships. Importantly, enrollment in higher education is predictive of positive life outcomes, including better employment, greater job satisfaction, higher earnings, elevated social status, increased civic engagement, healthier lifestyle, and improved life satisfaction (Ma et al., 2016).

1.1 Early childhood environment and later achievement

Children that are less prepared to learn and follow teacher instructions at the start of their academic journey in kindergarten are at greater risk of foregoing higher education (Anonymous et al., 2020). Experimental and quasi-experimental studies have also shown that children exposed to cognitively and linguistically stimulating childcare settings develop the skills they need for school entry (Magnuson et al., 2007) and experience better long-term educational prospects (McCoy et al., 2017). In contrast, lower quality learning environments in early childhood have been linked to poorer academic performance and a greater risk of dropping out of high school (Anonymous et al., 2020).

In light of this research, the Canadian government recently announced a \$30.0 billion investment, over the next 5 years, into the creation of an affordable publicly funded Canada-wide childcare system (Government of Canada, 2021). This is in addition to a previous investment of \$7.5 billion between 2015 and 2026. Investments in social programs are based on evidence of their effectiveness for enhancing individual outcomes (e.g., higher education) that also benefit society (e.g., better economy via highly skilled workers). As such, our study aims to examine

how childcare attendance is linked to enrollment in higher education within the Canadian landscape.

1.2 Formal and Informal Childcare Arrangements and Higher Education

Scaled-up, provincially run childcare programs in Canada include childcares that are formally recognized on the basis of them meeting licensing and regulation requirements. These formal arrangements usually encompass center-based and home-based childcares with accredited educators. Formal childcares are required to meet regulations with regards to their physical environment, record keeping, health and safety standards and at times, childcare provider training. They are also inspected and monitored by government officials who makes regular visits to verify compliance with provincial/territorial legislation. Other forms of childcare, such as care provided by a nanny or by relatives, are also commonly used by families with young children (Statistics Canada, 2021). This form of arrangements, so-called informal childcare, are not required to be accredited, regulated, or monitored. Furthermore, these childcare providers are not required to receive accreditation or specific training (Dowsett et al., 2008). For these reasons, formal and informal childcare arrangements are considered as distinct settings in the Canadian context.

Evaluations of formal and informal childcare programs on adult outcomes have been limited (e.g., Domond et al., 2020; Vandell et al., 2016). A recent study found that attending formal childcare is associated with a greater chance of high school completion and reduced risk of adult poverty for boys, but not for girls (Domond et al., 2020). Another study found that more experience in center-based childcare is associated with higher class rank and a greater educational aspiration to attend selective colleges after high school (Vandell et al., 2016). This study, however, did not measure whether or not the participants eventually did enroll in higher

education. In contrast, other studies have documented that the benefits of formal childcare diminish over time (Anonymous et al., 2018; Puma et al., 2012), though they may reemerge in young adulthood (Dodge et al., 2015; Bailey et al., 2020). Investigating the contribution of formal and informal childcare attendance and later enrollment in higher education therefore warrants clarification and replication in a more contemporary setting. Accordingly, we examined whether participation in formal (i.e., center-based and licensed home-based childcare) and informal (i.e., relative or nanny) childcare forecast enrollment in higher education in early adulthood.

Over the past decade, the use of statistical methods, such as propensity score weighting and instrumental variables have strengthened the possibility of drawing causal inferences on the long-term outcomes of childcare. This study therefore addresses the benefits of formal and informal childcare for higher education while controlling for selection bias due to child, maternal/family and demographic confounding variables. This is especially important in Canada where childcare policy is under provincial jurisdiction. Parental decisions to use one type of childcare services over another are driven by the availability and accessibility of childcare services, which are constrained by family and demographic characteristics (Geoffroy et al., 2012; Kim & Yang, 2019; Petitclerc et al., 2017).

This study also aims to better understand heterogeneity in childcare effects by considering the moderating role of child and family-wide characteristics on the association between childcare attendance and enrollment in higher education. This aim will help us better understand whether children from diverse backgrounds respond differently to childcare arrangements.

1.3 Moderators of Childcare Outcomes

Children enter school with wide-ranging differences in personal and sociocultural experiences that can either be built on by their teachers or hinder their transition of early schooling. As such, it remains important to consider whether the effects of childcare on higher education enrollment is the same for all children, or only for a subset. Although this question has not been explored in the prediction of higher education enrollment, a handful of studies have previously examined the conditional effects of childcare on academic and social outcomes according to child sex (Anonymous, 2018; Magnuson et al., 2016), and family characteristics such as household income (Anonymous, 2018; Laurin et al., 2015), and parental education (Geoffroy et al., 2010). Studies have tended to find that childcare programs have a compensatory effect, whereby children from low-income families experience greater academic gains as a result of childcare attendance than children from middle- and high-income families (Laurin et al., 2015). Some scholars have also found that boys benefit more from childcare than girls when examining outcomes such as grade retention and placement in special education (Magnuson et al., 2016). In contrast, others have found no evidence of sex differences (Anonymous, 2018).

Another potentially important moderator of the association between childcare and later educational attainment is dosage. Correlational studies have yielded mixed evidence with regards to childcare dosage (i.e., number of hours spent in childcare per week). Several studies from the United States have found that children spending more hours in early childcare exhibit less optimal psychosocial development (e.g., Anonymous, 2018; NICHD Early Child Care Research Network, 2006), whereas others have found no such effect as a function of childcare dosage (Dearing & Zachrisson, 2017, for a review). One study of American children who spent fewer hours in formal type of childcare found that they had higher aspiration to attend selective colleges after high school (Vandell et al., 2016). Another study conducted in the UK found that

children attending part-time (10h to 30h/week) or full-time (30h or more/week) formal childcare had an increased likelihood of graduating from high school (Larose et al., 2021). Together these studies suggest that childcare dosage may be an important moderator of the impact of childcare on later academic outcomes.

Better understanding the moderating role of home and childcare contexts could help policy makers define better nuanced guidelines to help parents make informed decisions about childcare. In particular, attending childcare might have a compensatory effect for some children (Laurin et al., 2015), but may lead to a lost-resource effect for others, whereby more time spent in childcare reduces the probability of pursuing a higher education. A lost-resource effect occurs when home environments are rich in protective factors (e.g., parental education, high household income) and risk factors are present within childcare settings (e.g., low-quality of care). For instance, according to one study, children who experienced many hours in center-based childcare prior to school entry were more likely to develop externalizing behavior problems when they were from high-income homes (Huston et al., 2015).

1.4 The Current Study

This study draws on secondary data from the National Longitudinal Survey of Children and Youth (NLSCY), a Canadian cohort survey which was linked to participants' tax records for the purpose of this study. We conducted a propensity score matching analysis to control the selection bias for childcare attendance. Previous research has addressed differences between children in parental care exclusively to children in formal childcare (e.g., Geoffroy et al., 2010; Pingault et al., 2015). Since families that use services in the form of either informal or formal childcare are likely to differ systematically from families who rely exclusively on parental care, we have opted to compare children in formal vs informal childcare settings. Moreover, by

comparing children attending formal and informal childcare settings, we can provide a more ecologically valid examination of the consequences of childcare arrangement on higher education, that is generalizable to service users. Here, we estimated the contribution of formal and informal childcare from 24 to 36 months of age to enrollment in higher education because childcare attendance by Canadian children is most frequent at these ages (Statistics Canada, 2021). Finally, we aim to explore heterogeneity in childcare effect on enrollment in higher education as a function of child sex, household income, maternal education, work schedule, work status and working conditions, as well as geographical location (i.e., urban vs rural) and childcare dosage. Based on prior evidence, we hypothesize that formal childcare will be positively associated with the pursuit of higher education, especially for children of vulnerable families (i.e., low-income families, irregular work schedule).

2. Methods

2.1 Data collection procedure

The NLSCY is a Canadian probability sample. Children living in Canadian territories or on First Nations land, and in institutions were excluded for feasibility reasons. Additional information on the NLSCY can be found on the [Statistics Canada website](#). Families participating in the NLSCY were randomly selected from the Labour Force Survey (LFS) sample of respondent households. The LFS is a monthly survey carried out by Statistics Canada in approximately 59,000 households throughout the country. An important advantage of using the LFS frame to recruit participating families in the NLSCY is that it yields a representative sample of Canadians.

In 1994, 15,579 Canadian households with at least one child aged 0 to 11 were randomly selected from the LFS. An overall response rate of 86.3% was obtained for these selected

households to participate in the NLSCY survey. Home interview was conducted with the person most knowledgeable about the child (the biological mother in 90% of cases, and the biological father in 7.5% of cases). These interviews were conducted biennially between September and May from 1994-95 to 2008-09, resulting in eight waves of data collection. Mothers provided consent and voluntarily responded to this survey.

For the purpose of the present study, participating families in the NLSCY were linked to their family tax file (T1FF). T1FF data are collected primarily from income tax returns submitted to the Canada Revenue Agency and are intended to provide income and demographic information by geographic area. Data are obtained from all individuals who completed an income tax return for a given calendar year or who received the Canada Child Tax Benefit. To collect information about postsecondary education, we used T1FF files from 2010 (ages 19–20) to 2015 (ages 24–25).

The NLSCY and T1FF data collection and storage is overseen by Statistics Canada. The data are available upon request within secure facilities managed by Statistics Canada. Various confidentiality rules are applied to all data that are made available to researchers to prevent the publication or disclosure of any information deemed confidential. This study was not preregistered, but the first author submitted a description of the research project (including hypotheses, variables and the planned analyses), and received approval to use the NLSCY and T1FF data from Statistics Canada. No additional institutional ethics committee review and approval were required.

2.2 Participants

Participating children that were 24 to 36 months of age at the first wave of the NLSCY data collection were selected for the present study. Among these participating children, 51.0% of

them ($n= 573$) were not attending any form of childcare arrangement (exclusive parental care). Children not attending childcare had lower SES, were more likely to have mothers with irregular work schedules, work on weekend and/or work less than 25 weeks per year than children attending formal or informal childcare. These statistics are consistent with recent data suggesting that childcare affordability is a key barrier to service use by parents (Statistics Canada, 2019).

This study included children attending formal or informal childcare ($N= 550$ children, 49.0% of girls). Among our retained sample, 6.5% mothers reported an annual household income inferior to 20,000 Canadian dollars per year, 14.5% worked less than 25 weeks per year or were unemployed, 24.3% had worked irregular hours, 29.5% worked on weekends, and 20.0% reported having earned a high school diploma or lower as their highest degree. Most were born in Canada, with only 3.7% reporting being Canadian citizens by naturalization or immigration.

2.3 Measures and Procedure

Childcare arrangement and confounding variables were collected at the first wave of the NLSCY when children were 24–36 months of age. Information about youth's enrollment in higher education was derived from the T1FF. Table 1 provides information on our measures.

2.3.1 Childcare Arrangement

Mothers reported whether children attended childcare or not between the ages of 24 to 36 months of age. Mothers who reported using childcare services, also reported the amount of time spent in different types of childcares by answering the following question: “For about how many hours per week is that?”. The main childcare arrangement, defined as the childcare type attended by the child for the most hours per week, was then derived by Statistics Canada. All children spent at least 5 hours per week in their main childcare type. Children being cared for in licensed center- ($n= 97$) or home- ($n= 243$) based settings by an accredited childcare provider were

categorized as attending ‘formal childcare’ ($n= 340$). Children being cared for in their own home by a non-relative (e.g., nanny, neighbor, a parent’s friend; $n= 80$) and those being cared for by a relative (e.g., uncle, aunt, grand-parents, brothers or sisters; $n= 130$) were categorized as attending ‘informal childcare’ ($n= 210$).

2.3.2 Pursuit of Higher Education

Since enrollment in higher education provides Canadians with a tax credit, it was possible to derive this variable directly from income tax reports. More specifically, tax reports indicated whether a tax deduction for part-time or full-time studies was awarded. Participants claiming tuition fees for themselves were thus deemed as being enrolled in higher education. The above was computed annually from 2010, when participants were 19–20 years of age, to 2015 when participants were 24–25 years of age. For our analyses, we derived a binary variable indicating either *no higher education* (17.0%) or *one or more years of higher education* (83.0%; see Frenette et al. 2017, for details of this approach).

2.3.3 Confounding Variables

Child hyperactivity/inattention (e.g., How often would you say that child can’t sit still, is restless or hyperactive? Is distractible, has trouble sticking to any activity?); *depression/anxiety* (e.g., How often would you say that child seems to be unhappy, sad or depressed? Is too fearful or anxious?); *disruptive behaviours* (e.g., How often would you say that child is defiant? Gets into many fights?), and *separation anxiety* (e.g., Clings to adults or is too dependent? Gets too upset when separated from parents?) were rated by parents on a 3–point Likert (0 = never or not true; 2 = often or very true). Items were selected from the Child Behaviour Checklist (Achenbach et al., 1987), the Ontario Child Health Study scales (Offord et al., 1989), and the Children’s Behaviour Questionnaire (Rutter, 1967). We also measured family dysfunction with the General

Functioning Scale of the Family (Byles et al., 1988; NLSCY, 1994–1995), with scores ranging from 0 to 36 (higher scores indicate greater dysfunction). The hyperactivity/inattention (7 items, $\alpha=0.73$), depression/anxiety (6 items, $\alpha=0.64$), disruptive behaviors (8 items, $\alpha=0.72$), separation anxiety scales (5 items, $\alpha=0.58$), and family dysfunction (12 items, $\alpha=0.88$) were included to control the selection bias for formal and informal childcare attendance.

The following variables were also covariates to control the selection bias for formal and informal childcare attendance, and moderators of the association between childcare and the pursuit of higher education. This includes the child sex (0=male, 1= female) and the household income dichotomized as either not low income =0 (if > 20K/year) or low income =1 (if < 20K/year). Maternal educational background was dichotomized as high school diploma or lower =0, or postsecondary education/university =1. Mother's work schedule was dichotomized as either regular/daytime =0 or irregular schedule =1. Work status was categorized as work most of the year =0 or work < 25 weeks or unemployed =1. Mother's weekly work status was dichotomized as not working on weekends =0 or working on weekends =1, and geographical location was scored as rural =0 or urban =1. At last, since mothers could report multiple form of childcare arrangements used, we also controlled for (and examined the moderating role of) the total number of hours per week spent in all form of childcare arrangement (*childcare dosage*; mode= 40h/week [min=5h, max=60h]).

2.4 Analytical Strategy

2.4.1 Propensity Score Weighting

We performed propensity score matching to reduce selection bias by matching individuals who attended formal childcare with children attending informal childcare (Dehejia & Wahba, 2002). This method assumes that attending formal or informal childcare is not random,

and that some child-, family- or demographic-level factors might predict the type of childcare arrangement. Propensity score estimates the predicted probability of group membership (in our case attending formal childcare) from observed covariates. This allows to match treated (formal childcare) with untreated (informal childcare) individuals, such that matched individuals have similar values of the propensity score.

Matching was performed with the `psmatch2` Stata command using the kernel matching estimator (Leuven & Sianesi, 2003; Li, 2012). This estimator gives greater weight to comparison units with smaller distances, and smaller weight to comparison units located further away from the treatment group (Li, 2012). Confounding variables were selected for empirical and theoretical reasons (Geoffroy et al., 2012; Petitcherc et al., 2017) and were included in the matching procedure. Additional matching variables include the maternal immigration status (0= Canadian by birth, 1= immigrants) and provinces of residence. After conducting the propensity score matching, results from the balancing test showed significant decreases in selection bias between childcare groups. All covariates had a standardized mean difference less than $|\cdot 10|$, indicating minimal group differences (Pan & Bai, 2015; see supplementary materials, Table S1).

2.4.2 Main Analyses

To estimate the extent to which attending formal childcare predicts higher education, we estimated the average treatment effect for the treated (ATT). The ATT is typically used to estimate the causal effect of a program, i.e., for children that attend or would have attended formal childcare. It allows us to estimate the average benefit of participating in formal childcare. ATT provides several advantages over the average treatment effect (ATE). First, it relaxes the conditional independence assumption, that treatment assignment (formal childcare) is independent of the outcome (higher education) after conditioning for observed covariates.

Second, it relaxes the overlap assumption in which all participants have a positive and equal opportunity of being assigned to the treatment or control group.

We computed the ATT for children attending formal childcare to compare them to those attending informal childcare, on the odds of enrollment in higher education in early adulthood. ATT was estimated using propensity score (Imbens, 2004). A significant positive ATT estimate would indicate that formal childcare attendance increases the probability of enrollment in higher education in comparison to informal childcare. The analyses were performed with Stata (StataCorp, 2015). We bootstrapped the sample 1,000 times to derive design-based variance estimates of the ATT.

To explore sample heterogeneity in the association between childcare arrangement and the pursuit in higher education, we re-estimated the above models with interaction terms. More specifically, we examined interactions between childcare arrangement and child sex, childcare dosage in weekly hours, maternal education, work status, schedule, weekend work, household income and geographical location. The contribution of interaction terms to the outcome were tested among paired matched groups, by performing a logit model with weights and covariates as additional controls. This allowed us to eliminate the selection bias for childcare arrangement while also removing the contribution of these covariates to the predicted outcome (Phillips et al., 2016). The interaction terms between childcare and the eight covariates were tested one at a time, applying Bonferroni correction to account for type 1 error. Associations between the interaction terms and higher education were therefore deemed significant if they were below the threshold alpha of <0.006 ($0.05/8$).

3. Results

On average, 83.0% of participants completed at least one year of higher education (79% of children in formal childcare and 89.0% of children in informal childcare). More girls than

boys pursued higher education, $\chi^2(1,550)= 13.10, p< .001$. Youth enrolled in higher education also had better educated mothers ($\chi^2(1,547)= 35.59, p< .001$) and lower levels of family dysfunction ($t(535)= 3.15, p= .002$). As children, they also displayed lower levels of hyperactivity ($t(543)= 3.11, p= .002$) and disruptive behaviors ($t(532)= 2.41, p= .016$). Table 2 shows descriptive for these variables, stratified by childcare arrangement.

3.1 Childcare Arrangements and Higher Education

To examine the association between childcare attendance and the pursuit in higher education, ATT was estimated and adjusted with propensity score weights. Counter to our prediction, results revealed a significant difference between formal and informal childcare (ATT= -2.89; $\beta= -0.100$ [CI: -0.165; -0.035], $p= .003$), such that attending formal childcare in 1994-1995 *decreased* the probability of pursuing higher education 20 years later relative to informal childcare attendance.

3.2 Heterogeneity in Childcare Attendance

Having established the overall association between childcare enrollment and higher education, we next considered heterogeneity in the outcomes of childcare. The main effect estimates are from a model without interactions. Each interaction was tested separately in regression models. Of the eight interactions estimated (see Table 3), household income (see Figure S1a) and the mother work status (see Figure S1b) were found to be significant moderators of the pursuit in higher education. Specifically, according to the simple slope analyses of these interactions, children of families with middle to high income and children from mother working most of the year were *more* likely to pursuit higher education if they attended informal childcare (respectively, $b= 0.83$ [CI: 0.79; 0.86]; $b= 0.82$ [0.79; 0.85]) relative to formal childcare ($P_s > .05$). Children from low-income and non-working families were also *more* likely to be enrolled

in higher education if they attended informal childcare (respectively, $b = 0.99$ [0.99; 1.00]; $b = 0.99$ [0.99; 1.00]) relative to formal childcare (respectively, $b = 0.69$ [0.44; 0.94]; $b = 0.80$ [0.65; 0.95]). However, attending childcare, whether it is formal or informal, was overall associated with higher probability of pursuing higher education among children from low-income and non-working families. Put another way, informal childcare attendance increased the probability of pursuing higher education *for all children*, whereas attending formal childcare only increased the probability of pursuing higher education for children from low-income and non-working families.

3.3 *A posteriori analyses*

Given our counter intuitive findings with regards to the negative association between formal childcare attendance and the pursuit of higher education, we further examined heterogeneity within formal childcare. Specifically, we examined whether grouping our sample in three groups (center-based, licensed home-based, informal) instead of two (formal, informal), changes the predictive association with the pursuit of higher education. We applied a 3-level treatment group to control the selection bias for attending these childcare arrangements. Results indicated no significant differences between the two licensed settings (center-based and home-based) on the probability of higher education enrollment ($ATT = -1.20$; $\beta = -0.077$ [CI: -0.220; 0.065], $p = .289$). In contrast, similar to our previous findings, children attending informal childcare were more likely to pursue higher education than children attending center-based or licensed home-based childcare. These results are presented in Supplementary materials, Tables S2 to S5.

4. Discussion

The purpose of this study was twofold. First, we investigated whether the type of childcare attended by children forecasts later enrollment in higher education. Second, we explored possible heterogeneity in these associations by examining the contribution of individual differences such as child sex, childcare dosage, and family and demographic factors. Contrary to our hypothesis, children attending informal childcare in early childhood were more likely to pursue higher education as young adults than children who attended formal childcare. This finding was also reinforced by a posterior analysis showing similar results. The present investigation also indicated that children from middle to high income families and with mothers who worked more regularly throughout the year, were more likely to be enrolled higher education if they had attended informal childcare. In contrast, children whose families faced higher levels of vulnerability such as low household income and unemployment, were more likely to be enrolled in higher education if they were enrolled in formal childcare. This suggested that formal childcare attendance mitigated disparities in pursuit of higher education.

4.1 Childcare Arrangements and Higher Education

Unlike studies supporting the long-term benefits of formal childcare for improved life outcomes in young adulthood (Domond et al., 2020; McCoy et al., 2017; Vandell et al., 2016), our results suggest that benefits of formal childcare may be limited to vulnerable children. In contrast, informal childcare (e.g., being cared for by a nanny, or by relatives) appeared to provide more universal benefits for youth academic perseverance, after controlling for selection bias. These results suggest that children benefited from attending informal childcare over 20 years later, regardless of individual vulnerability.

One possible explanation for these findings is that the needs of children attending childcare might vary according to their age and developmental stage. Young children of 24 to 36

months of age may benefit more from informal arrangements that offer more individualized care and home-like environments. Older preschoolers of 4-5 years, however, may benefit from formal settings that provide social experiences in larger groups and emphasizes early childhood pedagogy. Therefore, the contribution of formal and informal childcare might differ according to the age and developmental stage of children.

Another potential explanation for this finding is that childcare arrangements were measured between 1994–1995. These data were selected because the NLSCY is among the few available national data sets that have tracked children’s experiences through young adulthood. Furthermore, these data have been linked to participants tax files, allowing us to obtain valid and reliable measures of postsecondary education enrollment. Nevertheless, it is important to consider that several changes have occurred since the mid-1990’s in the Canadian childcare policy landscape, particularly with regards to improvements in the quality of formal childcare services (Flanagan et al., 2013; Friendly & Beach, 2013). Provincial/territorial governments have increased their involvement and oversight of formal childcare programs (Flanagan et al., 2013). They have also introduced early childhood curriculum frameworks in formal childcare settings (Friendly & Beach, 2013). Finally, policies regarding the recognition of postsecondary early childhood credentials and funding initiatives have improved the working conditions of childcare providers (Flanagan et al., 2013).

The association between childcare and higher education could also be accounted for by factors not measured in the present study. For instance, the supportiveness of the family social network could reflect a mechanism through which the availability of informal childcare, through family members, is associated with higher education enrollment. The use of informal childcare is also associated with lower levels of parenting stress (Craig & Churchill, 2018). That is, informal

arrangements can be more flexible and accommodating than formal childcare (Adamson & Brennan, 2017), potentially reducing stress for parents working full-time. Low parental stress, in turn, has been associated with improved parent-child interactions (Neece et al., 2012; Booth, et al., 2018) and relationships between mothers and fathers (Debrot et al., 2018). Other unmeasured factors such as child/youth's cognitive skills (e.g., executive function, self-regulation, self-discipline; McClelland et al., 2013), parental involvement and aspirations for their child's education (Spera et al., 2009), teacher-child relationship quality (Maldonado-Carreño & Votruba-Drzal, 2011), or school mobility could also explain the aforementioned associations. As such, future studies should explore these possible mechanisms.

Our results also suggest that children from higher income families and with fully-employed parents, faced reduced chances of enrollment in higher education if they attended formal childcare. This finding supports the lost-resource effect (Desai et al., 1989) by which children with cognitively and linguistically stimulating home environment may be comparatively deprived of learning opportunities when receiving formal out of home childcare. However, this was not the case for children from impoverished families for whom childcare attendance (informal or formal) *increased* the probability of enrollment in higher education. This later finding underscores childcare as a protective factor and also supports the compensatory hypothesis which suggests that childcare may be particularly beneficial for children from low-income families (Laurin et al., 2015).

4.2 Strengths and Limitations

This study was the first to examine how childcare attendance forecasts the pursuit of higher education among Canadian children. Strengths of this study include the use of a prospective longitudinal cohort study and the use of propensity matching to reduce the effect of

social selection bias to childcare arrangements. We also helped clarify some of the conditions under which benefits of childcare on later educational attainment can emerge. Finally, it was possible for us to directly derive higher education enrollment from tax records, this reducing the chances of shared measurement error.

Despite our contribution to the existing literature on the benefits of childcare, this study should be interpreted in the context of its limitations. As previously stated, childcare attendance was measured in the mid 1990's and the quality are likely to have changed since then. Participating families may also not reflect the current diversity of the Canadian population, which could reduce the generalizability of our findings. Furthermore, this study only considered childcare attendance between the ages of 24 to 36 months. Children were possibly exposed to different arrangements before and after this age, which could introduce omitted variable bias. Similarly, we computed mutually exclusive childcare groups based on the most frequented setting. However, children may have experienced multiple childcare arrangements.

Some additional limitations regarding the study design and our methodological approach should also be acknowledged. First, we cannot rule out the possibility that selection into childcare resulted from confounding variables not considered in our propensity matching approach. We controlled for several child, maternal/ family and demographic confounders. However, the childcare settings are also dependent on social policies (e.g., the labor market, parental policies) and province-specific institutions (Kulic et al., 2019). Second, it should be noted that despite our conservative approach to control for confounders, this study did not consider characteristics of childcare settings such as structural and process quality, because they were not available in the database. Similarly, our measure of pursuit in higher education was limited to years of postsecondary enrollment, and therefore was unable to inform on program

type (i.e., university certificate/diploma, apprenticeship, trade or technical school), academic grades (i.e., type, duration for a specific qualification, etc.), graduation, or highest degree completed. Third, it was not possible to assess similarities within each of the childcare settings. Within-group heterogeneity may have diluted the specific contribution of childcare type on youth's higher education enrollment. Lastly, even though our study sample of 550 children was sufficiently powerful to detect significant main effects, it was modest in size. This limited our ability to examine the individual contributions of specific types of childcare to higher education. As such, future studies should replicate our work with larger sample sizes to generate greater confidence in their generalizability.

4.3 Conclusion

Ensuring that youth pursue higher education is a promising strategy for promoting the economic, personal, and societal wellbeing of future generations. In particular, it remains the primary means for individuals to secure employment and increase their participation in the economy. The path to attaining a higher education may be rooted in early childhood, a time during which individuals are most responsive to interventions. The results of the present study reveal that childcare attendance may be especially important for children facing vulnerabilities and supports the importance of available, affordable high-quality childcare for families with young children.

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Canada survey) and takes responsibility for the integrity of the data and the accuracy. [Blinded] conceived the project, conducted and oversaw all aspects of the analyses, and wrote the paper.

[Blinded] contributed to the interpretation, wrote-up, and reviewed the manuscript.

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Table 1.
Description and characteristics of study variables

Variables	Source of data	Age at data collection	Informant	Cronbach alpha	Scales	Items / assessment
Childcare attendance						
Main childcare arrangement	NLSCY	2–3	Mother	--	--	1 item
Enrollment in higher education						
Postsecondary education	T1FF	19 to 25 years (yes/no)	Administrative data	--	Tax deduction for part-time or full-time studies	
Confounding variables						
Hyperactivity/inattention	NLSCY	2–3	Mother	0.727	Child Behavior Checklist,	7 items / CAPI
Depression/anxiety	NLSCY	2–3	Mother	0.638	Ontario Child Health Survey,	6 items / CAPI
Disruptive behaviors	NLSCY	2–3	Mother	0.723	Children Behavior Questionnaire	8 items / CAPI
Separation anxiety	NLSCY	2–3	Mother	0.579	General Functioning Scale of the Family	5 items / CAPI
Family dysfunction	NLSCY	2–3	Mother	0.880		12 items/CAPI
Sex of the child	NLSCY	2-3	Mother	--	--	1 item
Household income	NLSCY	2–3	Mother	--	--	1 item
High school diploma	NLSCY	2–3	Mother	--	--	1 item
Irregular work schedule	NLSCY	2–3	Mother	--	--	1 item
Work < 25 weeks	NLSCY	2–3	Mother	--	--	1 item
Work on weekend	NLSCY	2–3	Mother	--	--	1 item
Urban area of living	NLSCY	2–3	Mother	--	--	1 item
Childcare dosage	NLSCY	2–3	Mother	--	--	1 item

NLSCY: National Longitudinal Survey of Children and Youth; T1FF: T1 Family tax File; CAPI: Computer assisted personal interview

Table 2.

Children, family/mother, and demographic characteristics according to childcare arrangement

	Valid N	Formal childcare (n=340)	Informal childcare (n=210)	P
Child sex (female, <i>n</i> = 269)	550	49.0%	48.0%	.764
Low household income (<i>n</i> = 36)	550	6.2%	7.1%	.656
< high school (<i>n</i> = 110)	547	20.0%	20.2%	.970
Irregular work schedule (<i>n</i> = 126)	518	19.8%	31.5%	.003
Work < 25 weeks (<i>n</i> = 79)	546	15.3%	13.0%	.459
Work on weekend (<i>n</i> = 161)	546	27.1%	33.3%	.124
Urban area of living (<i>n</i> = 390)	550	71.2%	70.5%	.861
Childcare dosage†	550	28.45h (0.74)	26.99h (1.00)	.239
Hyperactivity/ inattention†	545	4.44 (0.16)	3.99 (0.20)	.088
Depression/anxiety†	546	1.16 (0.08)	1.02 (0.09)	.266
Disruptive behaviors†	534	5.21 (0.16)	4.82 (0.21)	.141
Separation anxiety†	547	2.69 (0.10)	2.67 (0.15)	.909
Family dysfunction†	537	7.56 (0.29)	8.07 (0.32)	.263

† continuous variable (means and standard deviations are provided). P-value from chi-square or t-test comparing formal and informal childcare. Results from the propensity score matching score can be found in Table S1 in supplementary materials.

Table 3.

Heterogeneity in associations between participation in formal and informal childcare at ages 24 to 36 months and higher education using matched data

Covariates	Higher education enrollment (yes/no) (N=469)			
	Coeff	OR	<i>p</i>	95 % CI
Formal childcare (vs informal)	-.888	.411	.004	-1.49; -.289
Sex of the child (female)	1.33	3.78	.000	.722; 1.94
Low income (< 20K/year)	-.309	.734	.612	-1.50; .886
> high school diploma	1.01	2.75	.001	.394; 1.63
Irregular work schedule	-.280	.755	.483	-1.06; .503
< 25 weeks of work/unemployed	.535	1.71	.325	-.531; 1.60
Work on weekend	-.439	.644	.220	-1.14; .262
Urban area of living	-.213	.808	.489	-.817; .391
Childcare dosage	-.038	.962	.001	-.060; -.016
Childcare × sex of the child	-1.11	.328	.150	-2.63; .402
Childcare × household income	-14.81	0.00	.000	-16.64; -12.97
Childcare × educational background	-.603	.547	.354	-1.87; .672
Childcare × irregular work schedule	.483	1.62	.472	-.833; 1.80
Childcare × work status/ unemployed	-16.03	0.00	.000	-17.66 -14.39
Childcare × work on weekend	.855	2.36	.173	-.374; 2.08
Childcare × area of living	-1.06	.346	.085	-2.27; .147
Childcare × childcare dosage	-.460	.631	.943	-1.09; .169
<i>Constant</i>	2.48	12.00	.000	1.14; 3.83

The main effect estimates are from a model without interactions. Each interaction was tested separately in regression models. Bolded coefficients were statistically significant at $p < .006$ (0.05/8).

Supplementary materials

1) Results from analyses with two childcare categories: formal (center-based and licensed home-based) vs informal childcare

Table S1. Covariate estimates before and after propensity score weights between formal and informal childcare (N= 484)

	Formal care	Informal care	Before PSW		After PSW	
			<i>p</i>	SMD	<i>p</i>	SMD
Child's sex (female)	.513	.521	.858	.017	.664	.036
Low household income	.046	.059	.528	.058	.685	.030
Unregular schedule	.200	.315	.004	.265	.636	.036
Work on weekend	.293	.326	.449	.071	.537	.050
< 25 weeks of work/inactive	.093	.119	.358	.085	.757	.024
Postsecondary education	.796	.798	.953	.006	.844	.016
Canadian by naturalization/ immigrants	.033	.027	.705	.036	.893	.012
Urban area of living	.713	.684	.506	.062	.665	.036
Provinces (Newfoundland)						
Prince Edward Island	.023	.032	.541	.056	.981	.002
Nova Scotia	.043	.076	.128	.138	.661	.003
New Brunswick	.060	.097	.124	.140	.860	.013
Quebec	.233	.173	.120	.148	.708	.033
Ontario	.250	.244	.893	.013	.976	.003
Manitoba	.106	.103	.906	.011	.888	.012
Saskatchewan	.136	.065	.014	.238	.525	.056
Alberta	.070	.043	.234	.115	.940	.007
British Columbia	.060	.065	.818	.021	.812	.020
Family dysfunction†	7.57	7.84	.566	.055	.881	.013
Hyperactivity/inattention†	4.37	3.99	.169	.129	.883	.012
Disruptive behaviours†	5.17	4.74	.128	.143	.882	.013
Separation anxiety†	2.63	2.58	.802	.023	.531	.051
Depression/anxiety†	1.10	1.00	.431	.074	.871	.012
Childcare dosage†	29.08	27.34	.164	.131	.723	.029

† Means for continuous variables; % for categorical variables; SMD, standardized mean difference; * $p < .05$.

Absolute values of SMD < .10 (conservative threshold) indicate sufficient balance. Covariance balance among formal and informal childcare shows SMD < .10 for all the confounders after applying propensity score weights, which indicates a good matching. The mean SMD after matching is .024 (mean bias of 2.4%). Results indicate that attending formal childcare decrease the probability of enrollment in higher education in comparison to attending informal childcare (ATT= -2.89; β = -0.100 [CI: -0.165; -0.035], p = .003).

Childcare and Higher Education

Figure S1a).

Interaction between childcare arrangement (formal vs informal) and household income (low vs no-low income) in predicting the pursuit of higher education.

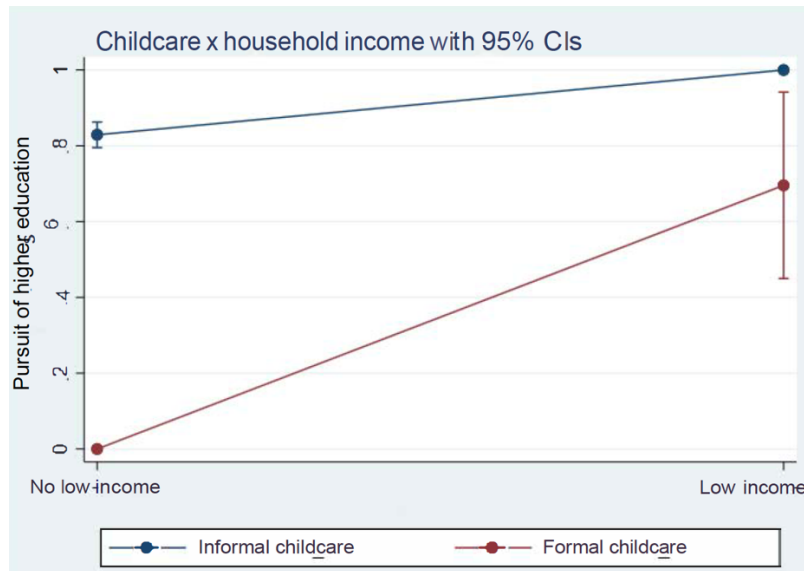
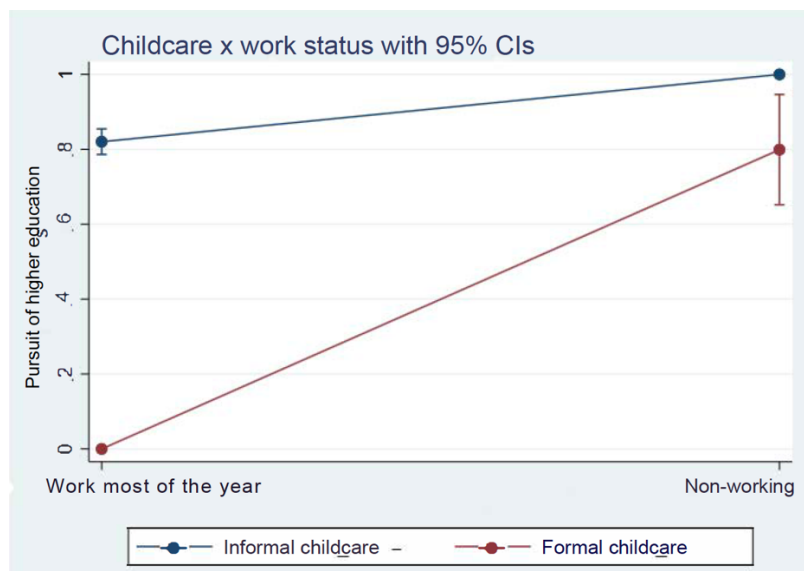


Figure S1b).

Interaction between childcare arrangement (formal vs informal) and the mother work status (working most of the year vs working < 25 weeks or unemployed) in predicting the pursuit of higher education.



2) Results from analyses with three childcare categories: a) center-based, b) licensed home-based, c) informal childcare

Table S2. Children, family/mother, and demographic characteristics according to childcare arrangement

	Valid N	Center-based (n=97)	Home-based (n=243)	Informal childcare (n=210)	<i>P</i>
Child sex (female, <i>n</i> = 269)	550	49.5%	49.4%	48.0%	.956
Low household income (<i>n</i> = 36)	550	11.3%	4.1%	7.1%	.047
< high school (<i>n</i> = 110)	547	23.7%	18.6%	20.2%	.568
Irregular work schedule (<i>n</i> = 126)	518	16.5%	21%	31.5%	.007
Work < 25 weeks (<i>n</i> = 79)	546	21.6%	12.8%	13.0%	.085
Work on weekend (<i>n</i> = 161)	546	18.6%	30.6%	33.3%	.028
Urban area of living (<i>n</i> = 390)	550	77.3%	68.7%	70.5%	.285
Childcare dosage†	550	31.07h (12.17)	27.40h (14.13)	26.99h (14.62)	.047
Family dysfunction†	537	8.07 (5.89)	7.37 (5.28)	8.07 (4.58)	.282
Hyperactivity/ inattention†	545	4.48 (3.19)	4.43 (2.92)	3.99 (2.90)	.232
Depression/anxiety†	546	1.43 (1.58)	1.05 (1.34)	1.02 (1.35)	.043
Disruptive behaviors†	534	5.28 (3.07)	5.19 (2.96)	4.82 (2.99)	.329
Separation anxiety†	547	2.94 (1.95)	2.60 (1.93)	2.67 (2.10)	.367

Note. † Continuous variable (means and standard deviations are provided). P-value from chi-square or ANOVA with pairwise comparison.

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Table S3. Covariate estimates before and after propensity score weights between center-based and licensed home-based childcare (N= 293)

	Center-based	Home-based	Before PSW		After PSW	
			<i>p</i>	SMD	<i>p</i>	SMD
Child's sex (female)	.513	.512	.986	.002	.937	.013
Low household income	.051	.042	.730	.045	.837	.036
Unregular schedule	.179	.204	.634	.064	.961	.007
Work on weekend	.218	.320	.088	.233	.894	.021
< 25 weeks of work/inactive	.103	.088	.712	.048	.625	.087
Postsecondary education	.769	.814	.398	.110	.918	.018
Canadian by naturalization/ immigrants	.013	.042	.228	.178	.998	.000
Urban area of living	.808	.679	.031	.297	.661	.071
Provinces (Newfoundland)						
Prince Edward Island	.000	.000	--	--	--	--
Nova Scotia	.077	.033	.104	.195	.920	.019
New Brunswick	.115	.042	.020	.274	.477	.135
Quebec	.269	.228	.465	.095	.819	.041
Ontario	.282	.246	.539	.080	.515	.111
Manitoba	.077	.121	.287	.147	.743	.053
Saskatchewan	.038	.176	.002	.456	.880	.017
Alberta	.051	.079	.417	.112	.803	.037
British Columbia	.051	.065	.664	.059	.855	.029
Family dysfunction†	7.94	7.49	.081	.534	.866	.028
Hyperactivity/inattention†	4.22	4.43	.587	.071	.597	.087
Disruptive behaviours†	5.01	5.23	.582	.073	.849	.031
Separation anxiety†	2.74	2.62	.637	.063	.629	.082
Depression/anxiety†	1.23	1.07	.400	.110	.781	.046
Childcare dosage†	31.95	27.86	.022	.316	.941	.012

† Means for continuous variables; % for categorical variables; SMD, standardized mean difference; **p* < .05.

Absolute values of SMD < .10 (conservative threshold) indicate sufficient balance. Covariance balance among formal and informal childcare shows SMD < .10 for all the confounders after applying propensity score weights, which indicates a good matching. The mean SMD after matching is .004 (mean bias of 4.5%). Results do not indicate a significant difference between center-based and home-based childcare on the probability of enrollment in higher education (ATT= -1.20; β = -0.077 [CI: -0.220; 0.065], *p*= .289).

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Table S4. Covariate estimates before and after propensity score weights between center-based and informal childcare (N= 256)

	Center-based	Informal	Before PSW		After PSW	
			<i>p</i>	SMD	<i>p</i>	SMD
Child's sex (female)	.513	.528	.823	.030	.905	.019
Low household income	.051	.056	.875	.022	.872	.025
Unregular schedule	.179	.315	.026	.316	.844	.028
Work on weekend	.218	.325	.081	.243	.570	.088
< 25 weeks of work/inactive	.103	.124	.632	.066	.666	.070
Postsecondary education	.769	.798	.608	.069	.743	.055
Canadian by naturalization/ immigrants	.013	.022	.609	.073	.973	.005
Urban area of living	.808	.685	.044	.283	.916	.016
Provinces (Newfoundland)						
Prince Edward Island	.000	.000	--	--	--	--
Nova Scotia	.077	.079	.962	.060	.637	.071
New Brunswick	.115	.101	.734	.046	.689	.069
Quebec	.269	.179	.105	.215	.871	.028
Ontario	.282	.253	.626	.066	.888	.023
Manitoba	.077	.107	.461	.103	.515	.105
Saskatchewan	.038	.067	.366	.129	.894	.018
Alberta	.051	.045	.826	.029	.926	.015
British Columbia	.051	.067	.625	.068	.908	.017
Family dysfunction†	7.94	7.84	.884	.019	.861	.028
Hyperactivity/inattention†	4.22	4.01	.611	.068	.774	.046
Disruptive behaviours†	5.01	4.75	.530	.085	.713	.060
Separation anxiety†	2.74	2.54	.442	.106	.796	.042
Depression/anxiety†	1.23	0.94	.117	.207	.662	.073
Childcare dosage†	31.95	27.60	.013	.347	.871	.024

† Means for continuous variables; % for categorical variables; SMD, standardized mean difference; * $p < .05$.

Absolute values of SMD $< .10$ (conservative threshold) indicate sufficient balance. Covariance balance among formal and informal childcare shows SMD $< .10$ for all the confounders after applying propensity score weights, which indicates a good matching. The mean SMD after matching is .118 (mean bias of 11.8%). Results indicate that attending center-based childcare decrease the probability of enrollment in higher education in comparison to attending informal childcare (ATT= -2.94; β = -0.174 [CI: -0.300; -0.048], p = .007).

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Table S5. Covariate estimates before and after propensity score weights between licensed home-based and informal childcare (N= 406)

	Home-based	Informal	Before PSW		After PSW	
			<i>p</i>	SMD	<i>p</i>	SMD
Child's sex (female)	.514	.522	.869	.016	.833	.020
Low household income	.045	.059	.506	.066	.390	.071
Unregular schedule	.207	.315	.013	.247	.478	.063
Work on weekend	.319	.326	.893	.013	.438	.073
< 25 weeks of work/inactive	.090	.119	.333	.096	.820	.021
Postsecondary education	.806	.798	.853	.019	.668	.041
Canadian by naturalization/ immigrants	.040	.027	.464	.074	.829	.024
Urban area of living	.680	.685	.921	.010	.403	.081
Provinces (Newfoundland)						
Prince Edward Island	.032	.032	.951	.060	.785	.027
Nova Scotia	.032	.076	.044	.198	.921	.007
New Brunswick	.041	.098	.021	.227	.918	.008
Quebec	.220	.174	.241	.118	.637	.049
Ontario	.238	.244	.892	.014	.895	.013
Manitoba	.117	.103	.659	.044	.632	.049
Saskatchewan	.171	.065	.001	.332	.367	.093
Alberta	.076	.043	.168	.139	.892	.015
British Columbia	.063	.065	.930	.009	.987	.002
Family dysfunction†	7.44	7.85	.418	.081	.710	.036
Hyperactivity/inattention†	4.43	3.99	.136	.149	.805	.024
Disruptive behaviours†	5.23	4.74	.105	.162	.696	.040
Separation anxiety†	2.59	2.59	.969	.004	.613	.048
Depression/anxiety†	1.06	1.00	.669	.043	.572	.053
Childcare dosage†	28.08	27.35	.587	.054	.846	.019

† Means for continuous variables; % for categorical variables; SMD, standardized mean difference; * $p < .05$.

Absolute values of SMD $< .10$ (conservative threshold) indicate sufficient balance. Covariance balance among formal and informal childcare shows SMD $< .10$ for all the confounders after applying propensity score weights, which indicates a good matching. The mean SMD after matching is .004 (mean bias of 3.8%). Results indicate that attending licensed home-based childcare decrease the probability of enrollment in higher education in comparison to attending informal childcare (ATT= -1.87; β = -0.071 [CI: -0.140; -0.001], p = .046).