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Short title: Childcare Arrangements in Canada

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Abstract

This study examines the longitudinal contribution of four different childcare arrangements attended during the preschool years to social behaviors and academic achievement up to age 15 years. Children participating in a Canadian longitudinal survey with available information on childcare attendance between ages 3 to 5 years (N= 6,852) were measured on multiple social behaviors (hyperactivity/inattention, depression/anxiety, disruptive behaviors) and academic outcomes (mathematic skills, academic achievement) across both childhood and adolescence. We conducted a propensity score matching analysis to control the selection bias for childcare attendance and performed generalized estimating equation models for panel data among matched groups. Our results showed no clear social or academic long-term advantage for Canadian children of attending any childcare arrangement in comparison to children being exclusively cared for by their parents. In contrast, children attending daycare centres had higher levels of hyperactivity/inattention until the age of 15 years. Children also had lower mathematic skills if attending daycare centres or informal childcare at preschool age, but this effect dissipated from childhood to adolescence. Interestingly, children from low-income families had higher levels of depression/anxiety if being cared for at home by someone other than their parents or relatives. This finding supports the dual-risk hypothesis suggesting that children from already impoverished families and attending informal childcare in their own home are at greater risk for internalizing difficulties.

Keywords: childcare, hyperactivity/inattention, depression/anxiety, disruptive behaviors, academic achievement, mathematic skills

The (Limited) Contribution of Early Childcare Arrangements to Social and Academic Development Among Canadian Children

Since the adoption of the *Convention on the Rights of the Child* by the United Nations General Assembly in 1989, childcare has been one of the key policy issues discussed by the Canadian Council on Children and Youth (Friendly, 2006). From 1990 to 2017, however, the Canadian government had no strategic plan or policy regarding childcare. As a result, the number of regulated childcare spaces has slightly expanded over the years (Friendly et al., 2018) but access to childcare has remained substantially the same as it was when the *Convention* was introduced, despite the increased proportion of women in the paid labor market (Statistics Canada, 2019; Uppal, 2015). There is however a political will to invest into the creation of an affordable Canada-wide childcare system for children age 0-5 years. The Canadian government recently announced a $30.0 billion investment over the next 5 years into the creation of a national childcare system (Government of Canada, 2021). Investments in such programs are based on evidence that it provides one of the best means to enhance early cognitive and social skills needed to succeed at school and subsequently, in the labor market.

Childcare Arrangements and Children's Cognitive and Social Skills

Comparing the developmental milestones of preschoolers being exclusively cared for by their parents or by relatives to those attending formal childcare (i.e., daycare centres, family daycare) on a regular basis has been the subject of decades of research. Three broad conclusions can be drawn from this body of research. First, although it is indisputable that parents have the most important influence on children's development, previous studies found direct associations between preschool childcare attendance and children's social and cognitive outcomes (Ansari et al., 2018; Gomajee et al., 2018; Phillips & Lowenstein, 2011). Children attending daycare

centres from birth to age 3 had lower emotional difficulties, lower peer relationship problems, and higher prosocial behaviors from ages 5 to 8 years in comparison to children attending informal arrangements (e.g., nanny or a grandmother; Gomajee et al., 2018). Participation in formal childcare programs from 5 months to 4 years (e.g., daycare centres or family home-based setting) also showed modest to large impacts on 6–7-year-old levels of language, reading, and numeracy skills in comparison to children attending exclusive parental care among children of mother with low levels of education (Geoffroy et al., 2010).

Second, the contributions of childcare attendance are heterogeneous and vary across developmental periods (e.g., childhood vs adolescence). While evidence of preschool childcare attendance on school readiness and social outcomes during childhood is convincing (Geoffroy et al., 2010; Gomajee et al., 2018; Loeb et al., 2007), mixed findings preclude from clear conclusion about its long-term benefits. For instance, results from one longitudinal population-based study revealed that children attending daycare centres, family daycare, or informal care as the main childcare arrangement between ages 5 months and 5 years were less shy and less socially withdrawn at school entry, in comparison to children being exclusively cared for by their parents (Pingault et al., 2015). None of these associations were maintained at age 12 years. These results suggest that not attending any form of childcare during the preschool years would only postpone the social group adaptation process occurring when children interact for the first time with a group of children within a formal educational context. Children attending daycare centres or family daycare from birth to 4.5 or 5 years also had more oppositional and aggressive behaviors at school entry (Belsky et al., 2007; Pingault et al., 2015). However, while one study reported no lasting associations through the elementary school years (Pingault et al., 2015), one other showed higher externalizing problems up to age 12 years (Belsky et al., 2007). These

findings highlight the need to investigate the heterogeneous effects of childcare attendance across ages. Fade-out of early educational programs is common but often coexists with persistent effect, depending on measured outcomes (Bailey et al., 2020). While some short-term effects could attenuate or dissipate on the longer run, others could go through a latency period and only emerge later in life.

Third, the contributions of childcare attendance also vary according to family characteristics (Geoffroy et al., 2012; Petitclerc et al., 2017). Children from parents facing economic hardship usually benefit the most from attending formal childcare (Ansari, 2018; Geoffroy et al., 2010; Laurin et al., 2015). For children of low-SES families, attending daycare centres at some point between 5 months to 4.5 years was significantly associated with improved academic performance at age 12 years in comparison to children in other forms of childcare arrangement (Laurin et al., 2015). In comparison with children attending informal childcare at age 4, children attending daycare center, nursery school, or prekindergarten program had lower externalizing behaviors in third and fourth grades (Ansari, 2018), and higher social skills in third grade (Ansari, 2018) if from less economically advantaged homes. Children of mothers with low levels of education and attending formal childcare (i.e., daycare centres or family daycare) also had higher levels of school readiness, receptive vocabulary, reading abilities and number knowledge at ages 6 and 7 years in comparison with those being exclusively cared for by their parents (Geoffroy et al., 2010). Attending formal childcare was, however, not associated with any of these early academic outcomes among children of mothers with higher levels of education (Geoffroy et al., 2010). These results align with the compensatory education theory, according to which childcare attendance is mainly beneficial for children from low stimulating home environment (Watamura et al., 2011).

In light of these conclusions, the current study attempts to address some inconsistencies in the existing literature by considering the contribution of various childcare arrangements attended during the preschool years, and how it might affect children's social functioning and academic achievement during both childhood and adolescence. First, we took advantage of a nation-wide Canadian survey to examine the longitudinal associations between four specific types of formal (i.e., daycare centres, family daycare) and informal (i.e., being cared for at home by non-relatives, being cared for by relatives) childcare arrangement from ages 3 to 5 years, and children's social behaviors (hyperactivity/inattention, depression/anxiety, disruptive behaviors) and academic outcomes (mathematic skills, academic achievement) from ages 6 to 15 years. While numerous studies examined the unique association of formal childcare or regulated daycare centres (versus informal and/ or parental care) with children's social and academic outcomes (Ansari et al., 2018; Geoffroy et al., 2010; Laurin et al., 2015), very few disentangle the contribution of various types of formal and informal childcare arrangement (Pingault et al., 2015). To our knowledge, this study is the first to do so within the Canadian landscape. Investigating the contribution of various types of childcare arrangement is of matter as only 31% of Canadian children attend regulated daycare centres (Statistics Canada, 2019). Moreover, the type of arrangement has been previously associated with the quality of childcare arrangements, based on licensing (i.e., approved by an agency) and regulation. Regulated childcare arrangements such as daycare centres, usually cover the physical environment, record keeping, health, safety and sometimes caregiver training. In some provinces, regulated family daycare are inspected or monitored by a government official who makes regular visits. In others, however, family daycare is not regulated, monitored or approved. Similarly, being cared for at home by a non-relative (e.g., nanny, neighbor, a parent's friend) or being cared for by a relative (e.g., grand-

parent, uncle, brother) are not formally recognized and registered forms of arrangement. In these latter cases, the childcare provider also has no credentials or childcare training (Dowsett et al., 2008). For these reasons, one could expect these arrangements to be of lower quality.

Next, we also aimed to replicate previous findings by testing whether the contribution of childcare arrangements vary across (i.e., are moderated by) household income, children's age and sex. Previous studies in US and the province of Quebec (Canada) have shown clear evidence that enrollment in daycare centres is one way to reduce inequality among children from low-income families, by shaping children's early experiences (Ansari, 2018; Geoffroy et al., 2010; Laurin et al., 2015). Here, we explored if any other form of childcare could also be beneficial for these children on the long run.

Finally, this study overcomes previous limitations by statistically controlling the selection bias for childcare attendance due to initial disparities at the family and demographic-levels, using a propensity score matching procedure. We also controlled for these family and demographic covariates in the prediction of the social and academic outcomes to genuinely estimate the direct contribution of each childcare arrangement. Results from previous studies made it clear that children are not randomly assigned to various forms of childcare (Geoffroy et al., 2012; Petitclerc et al., 2017). In 2019, Statistics Canada estimated that about 60% of Canadian children aged 0 to 5 years were enrolled in some form of childcare arrangement when the parents are at work or studying. Inversely, about 40% of them were cared for at home by one of their parents. For some families, this latter option can be intentionally chosen based on their preference, believes and values. For others, it may stand from a selection process driven by the availability and affordability of childcare arrangements, which depend on multiple family and demographic factors such as the area of living (Geoffroy et al., 2012; Petitclerc et al., 2017), the household

income (Varmuza et al., 2019), the marital status (Pepin et al., 2018), the parent's education (Varmuza et al., 2019), and the work schedule (Breunig et al., 2011; De Marco et al., 2009; Nowak et al., 2013; Varmuza et al., 2019). Therefore, parental decisions of using childcare arrangement or not, or to use one type of care over another, are constrained by the availability and the cost of childcare services, which are driven by the institutional context. Considering variations across both family background (e.g., household income, work status) and demographic factors (e.g., area of living, provinces) appears essential in order to estimate the putative contribution of the childcare arrangements on social and academic outcomes, especially in Canada where childcare policy is under provincial jurisdiction.

Methods

Setting

The National Longitudinal Survey of Children and Youth (NLSCY) is a Canadian probability sample of children, excluding those in the Canadian territories, living on First Nations reserves, and in institutions. This sample was designed while taking into consideration two important requirements. First, a sufficient sample was required in each of the ten Canadian provinces to allow for the production of reliable estimates for all children of 0 to 11 years of age. The sample was derived in such a manner that smaller provinces had a sufficient sample to meet this requirement. A second requirement was to have a large enough sample to produce estimates at the country level by seven key age groups (0 to 1, 2 to 3, 4 to 5, 6 to 7, 8 to 9 and 10 to 11 years) (NLSCY, 1994–1995).

In 1994, 15,579 Canadian households with at least one child aged 0 to 11 years were randomly selected from the Statistics Canada Labour Force Survey. An overall response rate of 86.3% was obtained from these selected households (N= 13,439). Additional children in the

same economic family were selected at random for a maximum of four children aged 0 to 11 years per household, for a total of 22,831 children. Home interviews with the respondent, the person most knowledgeable about the child (the biological mother in 89.9% of cases and the biological father in 7.5% of cases) were undertaken biennially from 1994–1995 to 2008–2009. The respondent provided consent and voluntary responded to this survey.

The NLSCY data collection and storage is overseen by Statistics Canada. The data are available upon request within secure facilities managed by Statistics Canada. Statistics Canada is prohibited by law from releasing collected information that could identify any participant. 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 data from Statistics Canada. No additional institutional ethics committee review and approval were required.

Participants

For the purpose of this study, we selected participating children for whom information on childcare attendance from ages 3 to 5 years was available. Children were included when the childcare arrangement reported by the parents depicted the primary socialization environments of the child. Our final sample included 6,852 children (49.8% girls, n= 3,413) aged 3 (N= 2,710), 4 (N = 3,340) or 5 years (N= 802). Less than 5% also attended part-time pre-kindergarten at some point during the study design. Among participating children, 14.3% of the mothers reported an annual household income lower than 20,000 Canadian dollars per year, 39.8% worked less than 25 weeks per year or were inactive, 29.7% worked on weekend, and 40.0% had at best graduated

from high school. Most of them were born in Canada; only 5.5% were Canadian citizens by naturalisation or were immigrants.

Children's social and academic outcomes were measured from age 6 to 15 years, covering five waves of data collection (data collected at ages 6–7, 8–9, 10–11, 12–13, and 14–15). All participants included in the analyses had at least two assessments out of five. Using a non-monotomic design, non-responding families were removed after two consecutive waves of non-response. Longitudinally speaking, this led to gaps in the response history of the family surveyed, but also reduced the average attrition rate. By ages 14 to 15 years, between 85.0% to 93.6% (N= 5,855 to 6,414) of the participating children were retained in the analyses, indicating an average attrition rate of 1.3% to 3.0% per data collection point (0.6% to 1.5% per year).

Measures and Procedure

Childcare arrangements. When the child was aged 3 to 5 years, the mother was asked to report the main childcare arrangement, that is, the one used for the most hours per week. Mothers who consistently reported not using any form of childcare arrangement for their children were clustered into the exclusive 'parental care' group (n= 2,753, 50.0% girls). This group represents 40.0% of the sample, which is the same proportion as those reporting not using any form of childcare arrangement in 2019 (Statistics Canada, 2019). Children of mothers reporting daycare centre (i.e., licensed or regulated centre-based childcare, including at workplace) as their main arrangement were clustered in the 'daycare centre' group (n= 867, 49.0% girls). Children in the 'family daycare' group included those being cared for outside the home by non-relatives (n= 1,707, 49.5% girls). Children cared for at home by a non-relative (e.g., nanny, neighbor) were clustered into the 'care at home by non-relatives' group (n= 518, 50.0% girls). Children being cared for at home or outside home by relatives (e.g., uncle, aunt, grand-parents, brothers or

sisters) were clustered into the 'care by relatives' group (n= 1,007, 51.0% girls). Figure 1 shows clustering of participating children in exclusive parental care and children attending childcare by types of arrangement.

Children's social outcomes. Children's 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?), and disruptive behaviors (e.g., How often would you say that child is defiant? Gets into many fights?) were rated on a 3-point Likert scale ranging from 0 (never or not true) to 2 (often or very true). Items were selected from the Child Behavior Checklist (Achenbach et al., 1987), the Ontario Child Health Study scales (Offord et al., 1989), and the Children's Behavior Questionnaire (Rutter, 1967). Items were summed for each social behavior.

Data on social outcomes were collected at ages 6–7, 8–9, and 10–11 years by the respondent during a computer assisted personal interview. These same outcomes were self-reported by the child/youth at ages 12–13 and 14–15 years. Table 1 shows a breakdown by outcome measures, informant, child's age at assessment, and instruments including metrics.

Children's academic outcomes. Data on child/youth academic achievement at school and mathematic skills were collected between grades 2 to 10 (ages 7–to 15 years). Teachers rated each child's academic achievement by answering to the following questions: "How would you rate this child's current academic achievement (in reading, writing, mathematics, language, science, and overall achievement)?" Questions were rated on a 5-point Likert scale ranging from 1 (near the bottom of the class) to 5 (near the top of the class). Given the strong correlations

between the different school subjects (between 0.55 and 0.81), an average score of academic achievement was computed across school subjects at each age.

Children's capacity to perform arithmetic including addition, subtraction, multiplication and division operations, and problem-solving exercises was measured with a shortened version of the Mathematics Computation Test of the standardized Canadian Achievement Tests (Canadian Test Centre, 1992; Garon-Carrier et al., 2020). Children had to choose the right answer out of the four available choices within a limited time. This test was administered to children from grades 2 to 10 (ages 7 to 15) and its difficulty level increases as children progress through the grades. Raw scores vary between 0 and 20.

Confounding variables. The following mother/family and demographic variables were collected at the first wave of data collection and were statistically controlled in the analyses: level of family dysfunction (higher score indicating greater level of family dysfunction, scores ranging 0–36; General Functioning Scale of the Family ($\alpha = 0.88$), Byles et al., 1988; NLSCY, 1994–1995), household income (low income if < 20K/year, no low income if > 20K/year), mother's marital status (married, common-law, single/divorced), work status (work most of the year, work < 25 weeks or inactive), work schedule (not working on weekend, working on weekend), educational background (high school diploma or lower, postsecondary education/university), immigration status (Canadian by birth, Canadian by naturalization or immigrants), area of living (rural, urban), and province of living (ten provinces of Canada). Table 2 shows the descriptive statistics of these confounding variables by types of childcare arrangement.

Statistical Analyses

Addressing Selection Biases

A major conceptual and methodological issue when using correlational design studies in research on childcare is the possible selection process of families into some form of childcare arrangements based on initial disparities. To address this selection bias, we conducted a propensity score matching procedure (Rosenbaum & Rubin, 1983). This method is widely used with observational data. It reduces selection bias by matching children receiving a 'treatment' (here, using childcare arrangement) with children who did not (exclusive parental care) but had similar probabilities of attending childcare based on a set of characteristics (Dehejia & Wahba, 2002; Rosenbaum & Rubin, 1983). By applying this matching procedure, we control for at least some family/mother and demographic factors that could predict the type of arrangement attended, and thus, explain differences in social and academic outcomes among children. We performed logistic regression to test the associations between the covariates and the types of childcare arrangement, in comparison to children not attending childcare between ages 3 and 5 (i.e., parental care). We then used results from the logistic models to generate the propensity score for each observation. Once the propensity scores were estimated, we matched children receiving 'treatment' with those who did not. We conducted a balancing test to ensure the quality of the matching (Smith & Todd, 2005), which compares the standardized mean difference of each covariate between the 'treatment' and the 'control' group.

This procedure was conducted four times to match each type of childcare arrangement with the parental care group. Matching was performed with the psmatch2 Stata command using the kernel matching estimator (Leuven & Sianesi, 2003; Li, 2012). The kernel estimator is a nonparametric estimation technique that matches all treated units with a weighted average of all controls (Loeb et al., 2007; Li, 2012). The (biweight) kernel weights are inversely proportional to the distance between the propensity scores of the treated and control groups. This estimator gives

larger weights to controls with smaller distances, and smaller weights to controls located further away from the comparison unit (Li, 2012; Stuart, 2010). Confounding variables were included in the matching procedure, in addition to children's age and sex.

After conducting the propensity score matching procedure, results from the balancing test showed significant decreases in social selection bias between each childcare arrangement and the parental care group. All covariates had an absolute value of standardized mean difference lower than .10 (conservative threshold), which indicates a good covariance balance between each treatment group and the control group (Pan & Bai, 2015). Results are displayed in Supplementary materials, Tables S1 to S4.

Prediction of Social and Academic Outcomes

To examine the longitudinal contributions of each childcare arrangement to social behaviors (hyperactivity/inattention, depression/anxiety, disruptive behaviors) and academic outcomes (mathematical skills and academic achievement), we performed generalized estimating equation (GEE) models for panel data. GEE is a semiparametric method that imposes linear structure on the data generating process but does not specify its distribution. We estimated the population-averaged effects, that is, the average response over the population while accounting for the within-subject covariance structure. The GEE population-averaged model was estimated based on all available observations of each participating children and capture the average effect of the type of childcare arrangement on the outcome throughout development. A population-averaged model was preferred over a fixed-effect or a random-effect model, which was not suitable according to the Hausman test of endogeneity (Hausman, 1978). GEE handle missing data by fitting the model to all non-missing observation, therefore, retaining the maximum of participants.

The contribution of each childcare arrangement to the prediction of social and academic outcomes were tested among paired matched groups, controlling for the covariates on the back end as well. This allowed to eliminate the selection bias for childcare attendance while also removing the contribution of these covariates to the predicted outcome (Phillips et al., 2016). We tested four GEE models among each matched groups and outcome. We first estimated the direct contribution of the childcare arrangement (e.g., daycare centre versus parental care) by conducting a GEE model with weights and covariates as additional controls. To explore the heterogenous effects of the childcare attendance across ages, and as a function of children's sex and household income, three additional GEE models were conducted, each containing one interaction term (group × age, group × sex, group × income). The GEE analyses were performed using Stata 14 (StataCorp, 2015) and included the survey command to incorporate propensity score weights. The descriptive statistics of each outcome at measurement time by types of childcare arrangement are shown in Supplementary materials, Table S5. Analysis code for this study is available by emailing the corresponding author.

Results

Childcare Arrangements and Social Outcomes

Table 3 shows results of the GEE models estimating the longitudinal associations between the types of childcare arrangement and hyperactivity/inattention, depression/anxiety, and disruptive behaviors from ages 6 to 15 years. Results are adjusted by propensity score weights and all confounding variables (see table's footnote). In comparison to those in exclusive parental care, children attending daycare centres from ages 3 to 5 had higher levels of hyperactivity/inattention from ages 6 to 15 years ($b = 0.55$, $p < .001$). Attending other

arrangements, however, did not significantly predict levels of hyperactivity/inattention, and these results were not moderated by the household income, children's sex or age.

Childcare arrangements were also unrelated to levels of depression/anxiety from ages 6 to 15 years. However, one significant interaction with the household income revealed that children from low-income families had higher levels of depression/anxiety if being cared for at home by non-relatives in comparison to those in exclusive parental care ($b = 0.73$, $p = .027$). No significant differences between these groups were detected among children not from low-income families ($b = -0.02$, $p = .857$). Disruptive behaviors were not predicted by childcare arrangements and no significant interactions with the household income, sex or age were found.

Childcare Arrangements and Academic Outcomes

Table 4 shows the longitudinal associations between the types of childcare arrangement with mathematic skills and academic achievement from ages 7 to 15 years. Once again, results are adjusted by propensity score weights and all confounding variables (see table's footnote). In comparison to being exclusively cared for by the parents, attending any type of arrangement was not significantly associated with levels of mathematic skills up to age 15. However, significant interactions with children's age and attendance to daycare centres ($b = 0.10$, $p = .024$), family daycare ($b = 0.07$, $p = .040$), and being cared for at home by non-relatives ($b = 0.20$, $p < .001$) predicted mathematic skills. Simple slope analyses of these interactions presented in Table 5 show that children attending daycare centres had lower mathematic skills at ages 6, 7 and 8 years. This effect was non-significant from age 9 years and over. Children being cared for at home by non-relatives also had lower mathematic skills at ages 6, 7, 8 and 9 years, but this effect was dissipated by age 10 years (see Table 5). At age 15, however, children being cared for at home by non-relatives had higher mathematic skills than those being cared for by their parents

(b = -0.64, p = .034). The results also tended to reveal lower mathematic skills at younger ages for children attending family daycare in comparison to those in parental care, although simple slopes did not reach the threshold for statistical significance. No significant interactions with the household income and the children's sex were found predictive of mathematic skills.

Only one childcare arrangement, being cared for by relatives, was significantly associated with academic achievement. Children being cared for by relatives in comparison to those in exclusive parental care had higher levels of academic achievement from ages 7 to 15 years (b = 0.06, p = .023). Interactions with childcare arrangement and the household income, children's sex or age were not significant in predicting academic achievement.

Discussion

The purpose of this study was to examine the longitudinal contributions of four types of childcare arrangement attended during the preschool years to social behaviors and academic outcomes during childhood and adolescence. Controlling the social selection bias for childcare attendance, as well as the family and the demographic covariates, attending any childcare arrangement did not significantly predict levels of disruptive behaviors from ages 6 to 15 years, in comparison to being exclusively cared for by the parents. Children attending daycare centres had higher levels of hyperactivity/inattention up to age 15 years, and higher levels of depression/ anxiety were found for children from low-income families if being cared for at home by non-relatives. Children attending daycare centres and those being cared for at home by non-relatives also had lower mathematic skills during childhood, but this effect dissipated across childhood. Only children being cared for by relatives had higher levels of academic achievement from ages 7 to 15 years. No conditional effect of children's sex was found in the prediction of social and

academic outcomes, showing roughly equal impacts of childcare attendance for boys and girls (Magnuson et al., 2016).

Overall, our results show no clear social or academic long-term advantage for Canadian children of attending formal or informal childcare arrangement, in comparison to being in exclusive parental care. On the contrary, attending daycare centres was associated with higher levels of hyperactivity/inattention. This study is the first to show such enduring effect of daycare centres on hyperactivity/inattention until adolescence. Interestingly, daycare centres attendance did not predict disruptive behaviors during both childhood and adolescence, unlike other studies showing higher oppositional and aggressive behaviors at school entry (Loeb et al., 2007; Pingault et al., 2015) and higher levels of externalizing behaviors in middle childhood (Ansari, 2018; Belsky et al., 2007).

Our study solely focused on the type of childcare arrangement in comparison to exclusive parental care, but other mechanisms can explain variation in childcare effects such as the quality or the amount of time spent in this arrangement. Indeed, increased hours spent in daycare centres was previously reported to predict higher levels of externalizing behaviors (Ansari, 2018; Belsky et al., 2007; Loeb et al., 2007). Other studies showed that children attending low childcare quality did not differ from those with no childcare experience on their behaviors (Sylva et al. 2011; Vandell et al., 2016). Taking into account the structural or process quality indicators of daycare centres, such as the child-staff ratio or the interactions between the care provider and the child, would be one way to unpack its association (or lack of) with social behaviors. Unfortunately, reliable indicators of quality were not available in this study. Including the dosage of childcare arrangement in our modeling strategy was also not suitable given the comparison with children being exclusively cared for by their parents.

One unexpected finding, however, is that our results did not support enrollment in daycare centres as a protective factor for low mathematic skills or academic achievement (Belsky et al., 2007; Loeb et al., 2007; Vandell et al., 2016). Children attending daycare centres had lower levels of mathematic skills from ages 6 to 8 years, but this effect was dissipated by age 9 onward. Similar findings were also found for children being cared for at home by non-relatives. Here, the pattern of fade-out (i.e., diminishing intervention impacts after the end of treatment) should be considered favorable as attending daycare centres or being cared for at home by non-relatives had detrimental effect on mathematic skills. This fade-out could be explained by exposure to similar learning environment after the preschool age, such as exposure to similar conditions during the elementary school years (Bailey et al., 2020). It should also be noted that we detected a reemergence effect at age 15 years showing higher mathematic skills for children being cared for at home by non-relatives than for those being cared for by their parents. However, because the NLSCY survey did not have assessment of mathematic skills after the age of 15 years, we could not explore whether this trend tended to persist. The replicable nature of this finding with repeated mathematic outcomes measured beyond adolescence should be further investigated in future research.

These results showing lower mathematic skills during childhood for children attending daycare centres or being cared for at home by non-relatives in comparison to children with exclusive parental care could also be explained by factors that were not examined in this study. For instance, despite the fact that we controlled for the level of family dysfunction and a considerable number of other covariates, our study did not include factors such as the amount of cognitive stimulation (Cabrera et al., 2020) and the type of instruction that children are exposed to in daycare centres (Engel et al., 2016; Mashburn et al., 2008). These two factors were found

crucial for mathematic skills (Cabrera et al., 2020; Engel et al., 2016). Similarly, our study did not control for the mother's social support, which could have potentially contributed to understanding why children being cared for by relatives had higher levels of academic achievement until age 15. One explanation for this persistent effect is that children being cared for by relatives were from families with strong supporting social network (i.e., relatives). This could reflect some indirect mechanism through which being cared for by relatives is associated with higher academic achievement. Nonetheless, this shows that when controlling for selection biases, in addition to families and demographic variations, being exclusively cared for by the parents provides with equivalent or greater cognitive/mathematic skills during childhood (Belsky et al., 2007), but with lower academic achievement in comparison to children being cared for by relatives.

One might also have expected a social or academic "boost" for children from low-income families enrolled in formal childcare arrangements, in comparison to those in exclusive parental care. Numerous studies showed that exposure to daycare centres is associated with better academic achievement during middle childhood and adolescence (Laurin et al., 2015; Phillips et al., 2016; Vandell et al., 2016). Interestingly, our results did not show such compensatory effect, but revealed a dual risk of being cared for at home by someone other than the parents. Children from low-income families had higher levels of depression/anxiety if being cared for at home by non-relatives, such as being cared for at home by a nanny or a neighbor. Similar findings were observed for children from both low-quality home and childcare arrangement (Watamura et al., 2011). This dual-risk hypothesis suggests that children from already impoverished families and being cared for in low-quality childcare are at greater risk for internalizing difficulties (Watamura et al. 2011). Here, the dual risk of experiencing both low-quality home environment

and low-quality childcare arrangement is likely to occur as children from low-income families were also cared for in their own home. Several factors may, altogether, be responsible for this finding. First, as previously mentioned, the home/care environment in which children from low-income families were being cared for was potentially of low-quality. Measuring the quality of the home and the quality of provider-child interactions for children being cared for at home by non-relatives would be one way to further test this hypothesis. Second, in addition to the low-quality of the home environment, being cared for by a non-relative provider most likely with no credentials or childcare training (Dowsett et al., 2008) might be another risk factor leading children to higher internalizing difficulties, in comparison to those being cared for at home by their parents. Previous studies showed clear associations between the provider's qualification and children's improvement in academic, social and self-regulatory functioning (e.g., Mashburn et al., 2008; Mashburn et al., 2010; Manning et al., 2019). This explanation would also be consistent with the fact that children being cared for at home by non-relatives had lower mathematic skills during middle childhood.

Policy Implications

This study has implications for childcare policy in Canada. The results showed scarce and inconsistent effects of childcare attendance on social and academic development throughout childhood and adolescence. Ultimately, it revealed that being exclusively cared for by the parents fosters more positive social behaviors and academic outcomes than attending formal or informal childcare arrangements. This resonates with previous studies showing parenting to be a far stronger predictor of social and academic functioning (Belsky et al., 2007). It also suggests that, although essential for single parents and two-parent working households, childcare arrangements in Canada should not be expected to remedy educational inequalities per see.

The childcare system in Canada is under provincial jurisdiction, which is a major difference with the US childcare system. This stratification across the country leads to variations in requirement for childcare arrangements to operate (e.g., regulation, license), the cost and funding (fees, subsidies, public/private, for profit/not for-profit), and the quality of arrangements (e.g., provider's training, credential; Manning et al., 2019). The very unique Quebec's childcare program, unlike the rest of Canada, introduced low-fee, universal childcare in the province in 1996, with the Quebec's Educational Childcare Act. Since then, it has increased the number of women in the workforce (Lefebvre & Merrigan, 2008), as well as the accessibility, the affordability and the quality of childcare (Japel, 2009). The Quebec program has also yielded consistent and unanimous findings in developmental psychology, psychiatry and health about the benefits of this childcare network, so called *Centre de la Petite Enfance* (Geoffroy et al., 2010; Herba et al., 2013; Laurin et al., 2015).

Except for Quebec, where the childcare program has proved effective, we know very little about how childcare sustains children's development at the national level. This study demonstrated that childcare in Canada is far from achieving comparable results to those of countries with similar economic and political features (e.g., Ansari, 2018; Gomajee et al., 2018; Vandell et al., 2016). Since the mid-1990s, the childcare policy landscape has barely changed in terms of accessibility. About 40% of children were exclusively cared for by their parents in our study, which is the same proportion of children reporting not using any form of childcare arrangement in 2019 (Statistics Canada, 2019). In the last few years, some Canadian provinces have moved towards more affordable and higher quality arrangements (Flanagan et al., 2013; Friendly & Beach, 2013; Japel, 2009), better working conditions for childcare providers (Flanagan et al., 2013) and greater credential and training requirement from them (Friendly &

Beach, 2013). Today, children using childcare attend regulated daycare centres in a greater proportion (about 31%; Statistics Canada, 2019) than children in 1995 (about 13%). Despite these qualitative changes, our results imply no overall increase in coverage or use of childcare (vs parental care) across Canada since the last 25 years. This finding calls for investment in childcare programs across Canada, and for further nation-wide study on how childcare attendance, in conjunction with other programs targeting families with young children, could help reducing family and educational inequalities in early childhood.

Limitations and Future Directions

Despite its contribution to the existing literature, this study should be interpreted in the context of its limitations. This study captured the type of childcare arrangement experienced between the ages of 3 to 5 years. It is however possible that children attended another type of arrangement before the age of 3 years. Similarly, we computed mutually exclusive childcare groups based on the main arrangement, that is, the one used for the most hours. However, children could also have experienced other types of arrangement (although not being the main one). This limitation could have potentially diluted the contribution of specific type of childcare arrangement to social and academic outcomes.

Some limitations regarding the study design and our methodological approach should also be acknowledged. First, we cannot rule out the possibility that selection into childcare arrangement result from unmeasured confounds. We controlled for the province of living, but the organization of the childcare system cannot be taken as independent from other sets of policies (e.g., the labour market, parental policies) and province-specific institutions (Kulic et al., 2019). Second, despite our conservative approach to control for family and demographic confounders, this study did not take into account the characteristics of the childcare arrangements such as the

quality and dosage of childcare. The fact that we observed no clear social of academic long-term advantage of using one type of childcare arrangement over exclusive parental care could also potentially be explained by the high variability in quality between the childcare arrangements of the same type across Canada. This heterogeneity should be further investigated in future studies. Third, we chose to conduct GEE models over other models because it uses all available, normal or non-normal observation from each participant, and it accounts for correlations between outcomes across time within the same individual. This model, however, imposes a linear structure on the data, which could have constrained the association between childcare attendance and the children's academic and social skills across time. It is possible that the longitudinal associations between childcare and later outcomes involve a nonlinear association (e.g., Bailey et al., 2017). Future studies should therefore replicate these findings using nonlinear models. Fourth, it is important to mention that this study considered the use of childcare arrangements from 1994–1995 until 1996–1997. These data were selected because the NLSCY is among the few available national data sets that have tracked children's experiences through adolescence, which was required to address the objective of the study. The patterns of childcare attendance (vs parental care) found across Canada, however, suggest that the findings documented herein continue to be relevant today (Statistics Canada, 2019).

Declarations

No funding was allocated to conduct this specific study. The authors report no conflicts of interest or financial disclosures. The first author had full access to all of the data in the study (Statistics Canada survey) and takes responsibility for the integrity of the data and the accuracy. G.G.C conceived the project, conducted and oversaw all aspects of the analyses, and wrote the

paper. V.B. contributed to the interpretation, wrote-up, and reviewed the manuscript. G.G.C. is Tier II Canada Research Chair.

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Figure 1. Flow chart of participating children in exclusive parental care and children attending childcare by types of arrangement

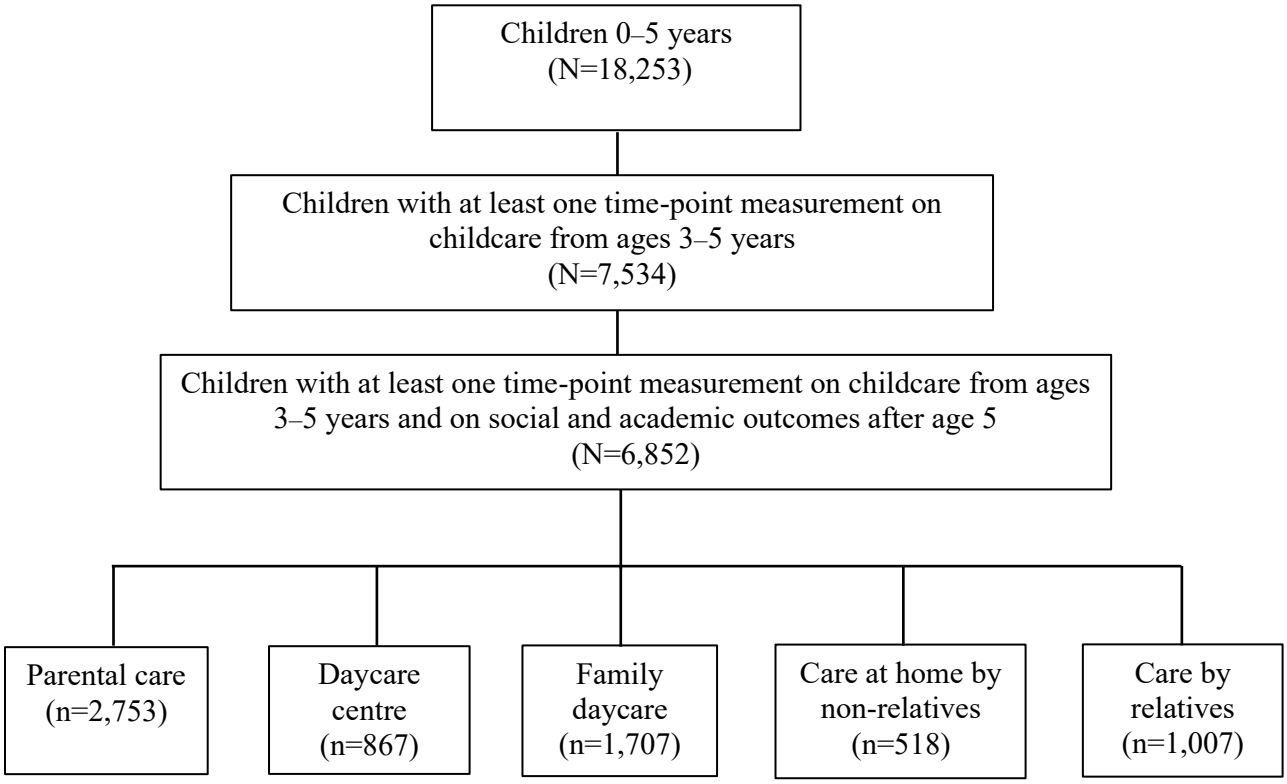

Table 1. Children's outcomes by multi-informants and child's age at assessment

Outcomes	Informant	Child age at data collection	Cronbach alpha	Scales	Items /Method of assessment
Social outcomes (from ages 6 to 15 years)					
Hyperactivity/	Mother	6- to 11	0.838	Child Behavior Checklist,	8 items / CAPI
inattention	Child	12- to 15	0.783	Ontario Child Health	7 items / Self-rated
Depression/anxiety	Mother	6- to 11	0.794	Survey, and	8 items / CAPI
	Child	12- to 15	0.810	Children Behavior	7 items / Self-rated
Disruptive behaviors	Mother	6- to 11	0.770	questionnaire	6 items / CAPI
	Child	12- to 15	0.763		6 items / Self-rated
Achievement outcomes (from ages 7 to 15 years)					
Reading Achievement	Teacher	7- to 11	--	Teacher rating	1 item
Writing Achievement	Teacher	7- to 11	--	Teacher rating	1 item
Math Achievement	Teacher	7- to 15	--	Teacher rating	1 item
Overall Achievement	Teacher	7- to 15	--	Teacher rating	1 item
Language Achievement	Teacher	12- to 15	--	Teacher rating	1 item
Science Achievement	Teacher	12- to 15	--	Teacher rating	1 item
Math computation	Standardized measure	7- to 15	--	Canadian Achievement test	Direct assessment

[a] CAPI: Computer Assisted Personal Interview

Table 2. Children, family/mother, and demographic characteristics by types of arrangement (N= 6,852)

	Valid N	Parental care (40.0%)	Daycare centre (12.7%)	Family daycare (25.0%)	Care at home by non-relatives (7.6%)	Care by relatives (14.7%)
Child's sex (female, n= 3,413)	6,824	50.0%	49.0%	49.5%	50.0%	51.0%
Family dysfunction†	6,848	7.65 (4.91)	8.41 (5.56)	7.72 (5.04)	7.60 (4.98)	8.04 (5.25)
Canadian by birth (n= 6,219)	6,580	93.3%	95.2%	96.5%	97.0%	92.4%
Married status (n= 5,428)	6,822	83.5%	67.5%	80.8%	82.6%	75.4%
Low household income (n= 973)	6,822	18.6%	16.4%	7.6%	10.6%	13.8%
< high school (n= 2,111)	6,794	40.0%	23.4%	22.3%	21.4%	32.4%
Work < 25 weeks (n= 2,702)	6,768	60.6%	29.7%	22.5%	24.4%	29.6%
Work on weekend (n= 1,945)	6,768	23.6%	27.4%	30.2%	37.0%	37.0%
Urban area of living (n= 4,854)	6,822	67.3%	81.5%	73.2%	78.3%	65.8%

† Continuous variable (means and standard deviations are provided).

Table 3. Longitudinal associations between childcare arrangements, hyperactivity/inattention, depression/anxiety and disruptive behaviors from ages 6 to 15 among matched groups

Covariates	Hyperactivity/inattention (N = 6,414)			Depression/anxiety (N= 6,413)			Disruptive behaviors (N= 6,414)		
	b	*p*	95 % CI	*b*	*p*	95 % CI	*b*	*p*	95 % CI
Type of childcare (parental care)									
Daycare centre	**0.55**	**.000**	**0.29; 0.80**	0.17	.069	-0.01; 0.36	-0.07	.297	-0.19; 0.06
Family daycare	0.14	.141	-0.05; 0.33	-0.02	.776	-0.16; 0.12	-0.01	.923	-0.10; 0.09
Care at home by non-relatives	-0.09	.535	-0.38; 0.20	0.03	.799	-0.19; 0.25	0.06	.455	-0.10; 0.21
Care by relatives	-0.15	.138	-0.35; 0.05	-0.02	.787	-0.18; 0.13	-0.08	.163	-0.18; 0.03
Group × household income (low)									
Daycare centre	-0.18	.618	-0.91; 0.54	0.13	.639	-0.42; 0.68	0.17	.422	-0.24; 0.57
Family daycare	0.49	.141	-0.16; 1.15	0.21	.415	-0.29; 0.72	-0.19	.287	-0.55; 0.16
Care at home by non-relatives	0.28	.630	-0.86; 1.42	**0.75**	**.032**	**0.07; 1.43**	-0.00	.980	-0.64; 0.62
Care by relatives	0.21	.480	-0.37; 0.79	0.08	.754	-0.41; 0.56	-0.00	.973	-0.38; 0.36
Group × sex (female)									
Daycare centre	-0.14	.561	-0.62; 0.34	-0.05	.771	-0.41; 0.30	-0.19	.113	-0.41; 0.04
Family daycare	0.16	.372	-0.19; 0.50	0.25	.061	-0.01; 0.52	0.01	.919	-0.17; 0.19
Care at home by non-relatives	-0.00	.991	-0.55; 0.54	0.11	.588	-0.30; 0.53	-0.10	.500	-0.39; 0.19
Care by relatives	0.05	.787	-0.33; 0.43	0.08	.583	-0.21; 0.37	-0.09	.401	-0.29; 0.12
Group × age									
Daycare centre	0.02	.418	-0.03; 0.08	-0.02	.548	-0.07; 0.04	0.02	.195	-0.01; 0.05
Family daycare	0.03	.167	-0.01; 0.07	0.01	.799	-0.03; 0.04	0.01	.482	-0.02; 0.03
Care at home by non-relatives	0.05	.118	-0.01; 0.12	-0.03	.403	-0.09; 0.04	-0.01	.540	-0.05; 0.03
Care by relatives	0.04	.131	-0.01; 0.09	0.03	.299	-0.02; 0.07	0.02	.155	-0.00; 0.05

Bold values indicate statistical significance. CI: confidence interval of the beta coefficient. The regressions include propensity score weights and the following covariates (not shown): child's age, child's sex, family dysfunction, household income, the mother's marital status, work status, work on weekend, educational background, immigration status, area and province of living. Each type of childcare and interaction effects were tested in separated regression models, among matched groups.

Table 4. Longitudinal associations between childcare arrangements, mathematic skills and academic achievement from ages 7 to 15 among matched groups

Covariates	Mathematic skills (N = 5,855)			Academic achievement (N= 6,363)		
	b	*p*	95 % CI	*b*	*p*	95 % CI
Type of childcare (parental care)						
Daycare centre	-0.19	.278	-0.53; 0.15	-0.04	.250	-0.11; 0.03
Family daycare	-0.01	.920	-0.28; 0.25	0.00	.947	-0.05; 0.05
Care at home by non-relatives	-0.18	.372	-0.56; 0.21	0.05	.221	-0.03; 0.12
Care by relatives	-0.13	.384	-0.42; 0.16	**0.06**	**.023**	**0.01; 0.12**
Group × household income (low)						
Daycare centre	0.21	.685	-0.80; 1.21	-0.08	.483	-0.29; 0.14
Family daycare	-0.10	.812	-0.88; 0.69	-0.01	.864	-0.18; 0.15
Care at home by non-relatives	0.42	.390	-0.53; 1.36	-0.03	.779	-0.28; 0.21
Care by relatives	0.77	0.06	-0.03; 1.58	0.13	.102	-0.03; 0.29
Group × sex (female)						
Daycare centre	-0.04	.901	-0.69; 0.61	0.04	.529	-0.08; 0.16
Family daycare	-0.02	.949	-0.52; 0.48	0.01	.802	-0.08; 0.10
Care at home by non-relatives	-0.14	.716	-0.89; 0.61	0.13	.065	-0.01; 0.27
Care by relatives	0.02	.955	-0.55; 0.58	-0.02	.691	-0.12; 0.08
Group × age						
Daycare centre	**0.10**	**.024**	**0.01; 0.18**	-0.00	.827	-0.01; 0.01
Family daycare	**0.07**	**.040**	**0.00; 0.13**	-0.00	.842	-0.00; 0.00
Care at home by non-relatives	**0.20**	**.000**	**0.10; 0.31**	0.01	.092	-0.00; 0.03
Care by relatives	0.02	.670	-0.06; 0.09	-0.00	.580	-0.01; 0.01

Bold values indicate statistical significance. CI: confidence interval of the beta coefficient. The regressions include propensity score weights and the following covariates (not shown): child's age, child's sex, family dysfunction, household income, the mother's marital status, work status, work on weekend, educational background, immigration status, area and province of living. Each type of childcare and interaction effects were tested in separated regression models, among matched groups.

Table 5. Interaction between childcare arrangements and children's age in predicting mathematic skills: Results of the simple slopes tests

Age	**Daycare centre × age**		**Family daycare × age**		**Care by non-relatives × age**	
	b	*p*	*b*	*p*	*b*	*p*
6 years	**-0.67**	**.016**	-0.35	.106	**-1.18**	**< .001**
7 years	**-0.57**	**.020**	-0.28	.142	**-0.98**	**.001**
8 years	**-0.47**	**.029**	-0.21	.209	**-0.78**	**.002**
9 years	-0.38	.052	-0.14	.340	**-0.58**	**.010**
10 years	-0.28	.118	-0.08	.581	-0.38	.065
11 years	-0.18	.295	-0.01	.941	-0.17	.382
12 years	-0.08	.640	0.06	.679	0.03	.886
13 years	0.01	.940	0.12	.404	0.23	.311
14 years	0.11	.603	0.19	.247	0.43	.096
15 years	0.21	.390	0.26	.165	**0.64**	**.034**

Bold values indicate statistical significance.