Title: Cohort Profile: Quebec Longitudinal Study of Child Development (QLSCD)

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Accepted version

Abstract

**Purpose.** The Quebec Longitudinal Study of Child Development (QLSCD) was designed to examine the long-term associations of preschool physical, cognitive, social, and emotional development with biopsychosocial development across childhood, adolescence, and young adulthood.

**Methods.** QLSCD is an ongoing prospective cohort including 2120 singletons born in 1997/1998 in the Canadian province of Quebec. So far, data has been collected annually or every two years from child ages 5 months to 21 years. The cohort currently includes 1245 participants. Data available include a range of environmental (e.g., family characteristics, child behaviour, educational attainment, mental health), biological (e.g., hair cortisol, genetic, epigenetic), and administrative data.

**Results.** QLSCD has contributed to the understanding of children’s psychosocial development, including the development of physical aggression and anxiety. QLSCD articles have advanced scientific knowledge on the influence of early childhood factors on childhood, adolescent, and young adult mental health, including the effect of participation in early childcare on cognitive and behavioural development, the developmental origins of adolescent and young adult mental health problems and suicide risk, and the development of interpersonal difficulties (e.g., peer victimisation) from preschool years to adolescence.

**Conclusion.** QLSCD has given major contributions to our understanding of the link between different aspects of child development and biopsychosocial development during the first two decades of life. Unique features include the presence of environmental, biological, and administrative data, long-term follow-up with frequent data collections, and use of data from multiple informants, including teachers, mothers, fathers, and the children themselves.

**Keywords.** Quebec Longitudinal Study of Child Development, cohort profile, longitudinal, developmental psychology, behavioural development
Introduction

The Quebec Longitudinal Study of Child Development (QLSCD) is a population-based representative sample of children in the Canadian Province of Quebec, born between October 1997 and July 1998. The cohort study was designed by a group of investigators who had previously led cohorts of kindergarten children to investigate the development of behaviour problems [1, 2]. Having realized the key influence of early childhood factors on later developmental outcomes, they created a birth cohort in collaboration with a research branch of the Quebec Ministry of Health: Health Quebec (Santé Quebec)[3]. The main objective of the QLSCD was to study the long-term associations of preschool physical, cognitive, social, and emotional development with long-term academic performance and biopsychosocial (i.e., interactions between biological, psychological, and social) development [4]. The study included assessments drawn from the National Longitudinal Survey of Children and Youth in Canada, initiated in 1994-95 (NLSCY: https://crdcn.org/datasets/nlscy-national-longitudinal-survey-children-and-youth). In addition, the QLSCD included more extensive assessments of early cognitive, emotional, and behaviour problems, as well as a wider range of measurements of the quality of childcare environments and children’s behaviour [5, 6].

The QLSCD protocol was initially approved by the Health Quebec ethics committee. Written informed consent was obtained from all participants (parents and children’s assent from age 10 years onward). The planning of the cohort was initially funded by a grant from the Social Sciences and Humanities Research Council of Canada (SSHRC) to principal investigator Dr. Richard E. Tremblay and colleagues. Additional funding was obtained from the Government of the Province of Quebec through different ministries and the Institut de la statistique du Quebec (ISQ). The Lucie and André Chagnon Foundation also made important financial contributions to support the study when the children turned 6 years of age. Over the years, the ISQ and QLSCD scientific committees have jointly led the study. Data collections
have been funded by the ISQ and by grants awarded by SSHRC to principal investigator Dr. Richard E. Tremblay, the Canadian Institutes of Health Research (CIHR) to principal investigators Drs. Sylvana Côté, Marie-Claude Geoffroy, Isabelle Ouellet-Morin, and Richard E. Tremblay, and the Canada Research Chair program to principal investigators Drs. Michel Boivin, Marie-Claude Geoffroy, Isabelle Ouellet-Morin, and Jean-Philippe Gouin (see Supplementary Table 1). The Quebec Research funds for health (FQRS) and for Society and Culture (FQRSC) have funded the research activities of researchers and numerous students.

Methods

Study design and participants

The cohort recruited singletons born between October 1997 and July 1998 in each administrative region of the Canadian province of Quebec (Figure 1), except those born in Northern Quebec, Cree Territory, Inuit Territory, and Native reserves (2.2% of all births). The 1997-98 Master birth register for the province of Quebec was used to create a stratified random sample based on living area and birth rates [3]. Children were included if the mother’s pregnancy had lasted 24 to 42 weeks (i.e., 99.9% of all registered births) and mothers could speak French or English. Extremely preterm (<24 weeks of gestation) and post-term (>42 weeks of gestation) babies were excluded. From the initial 2940 selected families, 2223 families participated in the first data collection when children were 5 months old, representing 94.5% of the target population (Figure 2). This included an over-represented sub-sample of 103 families from one region (Monteregie) to cross-sectionally investigate the impact of a highly disruptive ice storm in January 1998. Only the remaining 2120 families participated in subsequent data collections and constituted the final longitudinal sample. At the time of study inception the Quebec population was 7 million, whereof nearly 20% was rural. French was the first language for nearly 80% of the
population. At the last data collection (child age 20 years), the cohort had retained n=1245 participants, corresponding to 60% of the initial sample (Figure 3). Children of families who dropped out from the study were more likely to be male, to come from socioeconomically disadvantaged and nonintact families, and to have a mother who reported greater alcohol use during pregnancy and experienced higher levels of postnatal depressive symptoms (Table 1; see also Supplementary Table 2 for a summary of participants’ characteristics at selected time points). Reasons for loss of participants included the death of the target child (n=5), permanent relocation outside of Quebec (n=31), and families whom we could no longer locate (i.e., due to change in contact information without notifying the study team) and those who refused or were no longer able to respond to questionnaires [7].

**Data collection**

Data were collected annually or every two years from ages 5 months to 21 years. Data were collected in 4 phases: (i) Phase 1 (1998-2002, ages 5 months, 1½, 2½, 3½, 4½, and 5 years) focused on early social, emotional, behavioural, and cognitive development; (ii) Phase 2 (2003-2010, ages 6, 7, 8, 10, and 12 years) focused on academic achievement, psychosocial development, and health; (iii) Phase 3 (2011-2015, ages 13, 15, and 17 years) focused on school achievement, educational aspirations, work-school-leisure balance, romantic relationships, and a variety of mental health and relational problems, including substance use, suicidal ideation, bullying-victimisation, school violence, and school dropout; (iv) Phase 4 (2016-2023, ages 19, 20, 21, 23, and 25 years) is focusing on the transition into adulthood and includes information on physical and mental health, resilience, post-secondary education, and insertion into the workforce. Information from medical birth records (e.g., birthweight, APGAR score, gestational age) was linked to the dataset. Additionally, funding was obtained to perform a linkage with health-related administrative records via the Quebec Health
Insurance Board and the Ministry of Health and Social Services. Linkage is currently being performed, and data should be available in the years to come.

**Main measures**

A detailed list of data collection instruments used in the QLSCD is presented in Table 2. During the first 17 years of the study, a parent (i.e., the Person Most Knowledgeable about the child, PMK) provided information on the family (e.g., income, composition) and rated child characteristics (e.g., temperament, behaviour). The PMK was the biological mother in most cases (95%). Several aspects, such as parenting practices and child behaviour were assessed by both parents, although mainly mothers completed the assessments. Additionally, each parent reported on their own mental health (depression, anxiety, antisocial behaviours) at different time points. Trained research assistants also reported on the home environment using the Home Observation for Measurement of the Environment [8] when the child was aged 5 and 17 months. This assessment evaluated aspects of the mother-child relationship, such as stimulation of the child and mother’s verbalisation towards the child. Teachers started providing information regarding adjustment to school, physical well-being, and peer relationships at school entry (i.e., from ages 6 to 13 years). At child ages 17 months, 41 months, and 5 years, parents also filled-out questionnaires about the development of a sibling of the target child, including behaviour, nutrition, sleep, and temperament. From age 15 onwards, the adolescents completed questionnaires covering various themes, including academic aspirations and achievement, peer victimisation, suicidal ideation and attempt, mental health, substance use, and parental relations. Between 5 months and 11 years, children were also directly taking part in the assessments through age-specific tasks measuring cognitive development and school achievement, including language, attention and memory, arithmetic, school readiness, writing skills, and physical and motor development (Table 3).

**Biological material**
When the children were 10 years old, biological samples (blood and saliva) were collected on a subsample of the cohort. The children’s DNA was then genotyped using the Illumina Infinium PsychArray-24 which, after appropriate quality control and imputation, yielded accurate information for several million common genetic variants among a total of 950 participants. At 17 years of age, DNA was once more collected from saliva to measure DNA methylation, a stable epigenetic mark that has the potential to inhibit DNA transcription as a result of stochastic changes or environmental influences [9]. The DNA methylation sequencing was done using the Illumina EPIC BeadChip Array (> 850 000 CpG sites), for which a total of 699 participants remained after quality control. During that same wave of data collection (i.e., 17 years), our team sent the participants a collection kit including curved scissors, hair clamps, and instructions on how to collect hair from the posterior vertex area of the scalp at home. A total of 556 participants provided enough hair for cortisol measurement, of whom most also provided saliva for DNA ascertainment. The hair samples were assayed in duplicate after wash and steroid extraction procedures using a luminescence immunoassay [10, 11].

Results

Data obtained from the QLSCD has led to more than 200 peer reviewed journal articles. Highlights of the main findings are summarised below.

**Development of externalising and internalising behavioural problems**

Several QLSCD studies have documented the development of externalising (e.g., physical aggression, opposition, hyperactivity-impulsivity) and internalising (e.g., anxiety, depression, social withdrawal) behaviours from early childhood to adolescence and their associations with later outcomes [6, 12–27, 27–45]. Early developmental trajectories of physical aggression were identified, showing that aggressive behaviours peak between ages 2 to 4
years and decrease thereafter until late adolescence. Boys were overrepresented in atypically high trajectories of physical aggression [25]. Developmental trajectories of internalising problems followed a different temporal trend, with increased levels during early childhood and the beginning of middle childhood [43]. Children following high-chronic trajectories of externalising and internalising behaviours have been shown to be at risk of negative long-term outcomes, including peer victimisation [28, 46], suicidal ideation and attempt [47, 48], and substance use [30, 43, 49].

**Early-life environment and child development**

QLSCD studies have documented that socioeconomic difficulties (e.g., low income, low maternal education)[12, 13, 50, 51], parenting quality (e.g., harsh parenting, maternal depression)[14–20], and maternal risky behaviour (e.g., smoking and alcohol consumption during pregnancy)[21, 22, 52–54] systematically predict higher levels of internalising and externalising behaviours, as well as poor cognitive outcomes.

**Childcare attendance and cognitive and psychosocial development**

The QLSCD has also documented the use of childcare – a Quebec-wide affordable service – and examined its potential benefits for children and families [6, 18, 55–62]. These studies have shown that childcare participation (especially centre-based) is associated with better school readiness and achievement [57, 59] and less infections [56] and disruptive behaviours among children from at-risk families [6, 55, 60]. These predictive associations have been found for both short-term and long-term outcomes [6, 55, 60]. For example, children of depressed mothers who attended childcare showed fewer internalising symptoms at age 5 years than those who did not attend childcare [18]. Similarly, children from disadvantaged socioeconomic backgrounds who attended childcare were less physically aggressive at 9 and 17 years than those who they did not attend childcare. However, this apparent positive effect
of childcare attendance was not detected among children from non-disadvantaged socioeconomic backgrounds [6, 60].

**Peer victimization during childhood**

Several studies have described the developmental trajectories, risk factors, and consequences of peer victimisation across childhood [11, 28, 31, 46, 63–69]. For instance, it was shown for the first time that a small but significant group of children start experiencing stable peer difficulties as early as age 3 years [67]. Furthermore, a recent study distinguished various peer victimisation trajectories from ages 6 to 17 years, including groups of emerging, childhood-limited, and persistent victims [46]. These studies also identified family-level (e.g., insufficient income, harsh parenting) and individual-level (e.g., physical aggression, high body mass index [BMI], internalising behaviours) risk factors of frequent exposure to peer victimisation [31, 46, 66–68]. Finally, short- and long-term negative outcomes associated with peer victimisation include increased risk of internalising symptoms and suicidal ideation/attempt [64, 65, 69], poor educational achievement [28], insomnia [63], victimisation in the workplace [66], and dysregulation of chronic cortisol secretion [11].

**Parenting practices and children’s behavioural development**

A series of QLSCD papers have extensively documented early parenting behaviours and perceptions and described how family (e.g., mother depression) and child (e.g., difficult temperament) risk factors are uniquely associated with different dimensions of parenting [70, 71]. In turn, these aspects of early parenting (e.g., harsh parenting behaviours) have also been found to predict the development of reactive aggressive behaviour [27] and peer relation difficulties [67].

**Cognitive development, school readiness, and educational achievement**

Several QLSCD studies have documented the early development of several aspects of cognitive skills and school readiness and achievement [72]. This work has shown that
preschool cognitive school readiness is highly predictive of school achievement in the early grades [73], and has provided evidence for the central role of early literacy training in accounting for the link between socioeconomic status and school readiness [73]. Information from medical birth records have been used to document how gestational diabetes specifically hinders early language development [74]. A series of papers on number knowledge and achievement have shown that early and persistent delays in numeracy are linked to later difficulties in mathematics in a small but significant group of children [75]. Achievement in mathematics has been found to predict intrinsic motivation in mathematics rather than the reverse [76]. QLSCD papers have also investigated associations between mental health, family characteristics, and participants’ cognitive outcomes. Language deficits in early childhood were positively associated with physical aggression in childhood as well as in adolescence [40], whereas hyperactivity was associated with visuospatial organisation deficits [40]. Another study identified that inattention, rather than hyperactivity, was a modestly significant predictor of reading accuracy and speed during adolescence [77]. Family characteristics (e.g., maternal depression symptoms and IQ) have been found to be associated with lower levels of verbal abilities in middle childhood [78]. Furthermore, language development between 12 and 48 months has been associated with lower frequency of physical aggression [79].

**Suicidal ideation and suicide attempts**

Multiple studies have investigated the epidemiology and risk factors for suicidal ideation and attempt from the perinatal period to adolescence [29, 47, 48, 64, 65, 69, 80–84]. In the QLSCD, lifetime prevalence of passive suicidal ideation (13–17 years old), serious suicidal ideation, and suicide attempt (13–20 years old) are 22.2%, 9.8%, and 6.7%, respectively [82]. Children exposed to perinatal adversity such as poor foetal growth or socioeconomic adversity at the time of birth have been found to be more likely to attempt suicide by age 20.
years [85]. Behavioural characteristics in childhood have also been associated with later suicidal risk. For example, the co-occurrence of high irritability and depressive/anxious mood symptoms in childhood was seen to double the risk for suicidal ideation and/or attempt in adolescence [29, 47, 86, 87]. Exposure to interpersonal violence in adolescence both face-to-face (e.g., peer victimisation) and through the media (cybervictimisation) was also associated with higher odds of suicidal ideation and attempt [64, 65, 69].

**Future directions**

There remain pertinent research questions concerning the impact of the early childhood environment on biopsychosocial development across childhood, adolescence, and young adulthood which can be addressed using QLSCD data. This includes understanding how parenting behaviours, parental mental health, childcare attendance, and other early childhood factors contribute to adolescent romantic relationships, dating violence, educational aspirations, and school dropout rates. Researchers can also further explore the interactions between mental health outcomes investigated so far (e.g., internalising and externalising behaviour problems, suicidal ideation and attempt) and adolescents’ social environments and their transition to young adulthood by using data from the ongoing phase 4 of QLSCD. Additionally, there are opportunities to explore genetic and epigenetic mechanisms of biopsychosocial development using data from biological materials (i.e., blood, sample, hair) collected in a subsample of participants at 10 and 17 years old.

**Strengths and limitations**

The QLSCD cohort has made numerous important contributions to a better understanding of the biopsychosocial developmental changes occurring from infancy to early adulthood, as well as to the associated environmental factors. The main strengths of the QLSCD cohort include (1) its population representativeness, (2) the long-term follow-up (21 years so far) with extensive data collections conducted every year during early childhood and every two
years from middle childhood to young adulthood, (3) the collection of data from multiple informants, including teachers, mothers, fathers, and the children themselves, (4) and a vast and rich range of information on the child from their genes to broader environmental sources of influence, complemented by registry data across multiple domains and direct measures of the children. However, the following limitations should be acknowledged. First, the sample size is relatively small to study rare phenomena. Second, as with comparable longitudinal studies [88], attrition compromised the initial representativeness of the sample. Nevertheless, the remaining sample size still enables well-powered analyses. Finally, prospective information on child maltreatment, abuse, or neglect, which have important influences on child development and health, has not been collected; however, retrospective information will be collected in future data collections.

**Data access**

QLSCD data are accessible to researchers on the premises of the Centre d’accès aux données de recherche de l’Institut statistique du Quebec (CADRISQ) located in Montreal and Quebec City. To access the data, researchers affiliated with an institution in Quebec must create a profile and fill out an access request including, among other things, the purpose and aim of the research project, a summary of the analysis plan, the contact information of any researchers associated with the project, and the location where they want to use the data. Once received, the access request is analysed by the Research Data Access Point team, which makes the necessary follow-up to obtain the required authorisations and communicates the results to the researchers. Researchers receive the necessary support for the submission of their access request and the implementation of their projects. More information can be found on the Research Data Access Point website (https://www.stat.gouv.qc.ca/research/#/accueil).

Numerous international collaborations have been established since the start of the study.
Declarations

**Funding:** None

**Acknowledgment:** For more than 20 years the Quebec Longitudinal Study of Child Development (QLSCD) has relied on the relentless effort and contributions of many professionals and scholars from the Quebec government and universities. Special thanks to Christine Collin, Aline Émond, Daniel Tremblay, and Marc Renaud who believed in the project and helped provide the initial funding, to Mireille Jetté, Bertrand Perron, Nancy Illick, Hélène Desrosiers, and their teams at the Institut de la Statistique du Québec (ISQ) who led the QLSCD data collection over the years, to Lyse Desmarais and her team at GRIP who coordinated the QLSCD grants and the interface with ISQ, and to the many scientists who generously gave their time and expertise to guide the longitudinal assessments; among the many, we wish to thank Lise Dubois, Jacques Montplaisir, Dominique Petit, Jean Séguin, Christa Japel, Mark Zoccolillo, Ginette Dionne, Frank Vitaro, Mara Brendgen, Jean-Philippe Gouin, Gustavo Turecki, and Simon Larose. Many thanks also to Qian Xu, who serves as the main data analyst at the GRIP. Finally, we are deeply grateful to the participating parents, children, and teachers who make this unique endeavour possible.

**Conflict of interest:** The authors declare no conflict of interest

**Availability of data and material:** Not applicable

**Code availability:** Not applicable

**Author Contributions:** MO, CC, and MNA wrote the initial draft; all authors revised and commented the draft for important intellectual contributions, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.
References


Table 1. Significant differences in baseline characteristics between respondents and non-respondents at the 20-year wave of data collection

<table>
<thead>
<tr>
<th>Perinatal, birth, child characteristics</th>
<th>Still in the sample at age 20 years</th>
<th>Nonresponse at age 20 years</th>
<th>P value (Chi-squared)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child female sex</td>
<td>719 (57.8)</td>
<td>321 (36.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Low (&lt;2500 gr) birth weight</td>
<td>40 (3.2)</td>
<td>31 (3.5)</td>
<td>0.772</td>
</tr>
<tr>
<td>Prematurity (&lt; 37 weeks of gestation)</td>
<td>59 (4.7)</td>
<td>45 (5.1)</td>
<td>0.748</td>
</tr>
<tr>
<td>APGAR score 5 minutes &lt; 7</td>
<td>17 (1.4)</td>
<td>10 (1.2)</td>
<td>0.841</td>
</tr>
<tr>
<td>Birth order &gt; 3</td>
<td>197 (15.8)</td>
<td>146 (16.7)</td>
<td>0.638</td>
</tr>
</tbody>
</table>

| Sociodemographic characteristics       |                                 |                           |                      |
| Teenage mother at childbirth           | 29 (2.3)                        | 30 (3.4)                  | 0.168                |
| Low maternal education (no high school diploma) | 190 (15.3)                       | 195 (22.3)                | <0.001               |
| Low paternal education (no high school diploma) | 185 (15.9)                       | 154 (20.0)                | 0.026                |
| Low socioeconomic status (<1st distribution quartile) | 255 (20.6)                       | 268 (31.2)                | <0.001               |
| Nonintact (single parent/blended) family | 208 (16.8)                       | 198 (22.7)                | 0.001                |

| Substance use in pregnancy             |                                 |                           |                      |
| Maternal smoking during pregnancy      | 301 (24.3)                       | 232 (26.6)                | 0.253                |
| Maternal alcohol use during pregnancy  | 489 (39.5)                       | 263 (30.2)                | <0.001               |
| Maternal use of illegal drugs during pregnancy | 15 (1.2)                        | 15 (1.7)                  | 0.433                |

| Parental mental health                 |                                 |                           |                      |
| Maternal depression at child age 5 months | 153 (12.3)                       | 165 (18.9)                | <0.001               |
| Paternal depression at child age 5 months | 58 (5.3)                        | 50 (7.4)                  | 0.099                |
| Maternal antisocial behaviours in adolescence | 236 (19.7)                       | 167 (20.2)                | 0.793                |
| Maternal antisocial behaviours in adolescence | 248 (22.8)                       | 157 (23.3)                | 0.846                |

Data were compiled from the final master file of the Quebec Longitudinal Study of Child Development (1998–2018), ©Gouvernement du Quebec, Institut de la statistique du Quebec
The table reports count and % for each variable. Variables were measured at child age 5 months, except for the perinatal and birth characteristics, which were extracted from the hospital birth records. Socioeconomic status was measured with an aggregate of 5 items regarding parental education, parental occupation, and annual gross income.
Table 2. Summary of data collected in the different phases of the QLSCD

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<tbody>
<tr>
<td></td>
<td>5 m</td>
<td>17 m</td>
<td>29 m</td>
<td>41 m</td>
</tr>
<tr>
<td>Socioeconomic, demographic, family structure characteristics</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Perceived neighbourhood safety</td>
<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td>Family functioning</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Food insecurity</td>
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<tr>
<td>Parental characteristics</td>
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<tr>
<td>Depression</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Substance use in pregnancy</td>
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<tr>
<td>Breastfeeding</td>
<td>x</td>
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<td>Child characteristics</td>
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<tr>
<td>Child behaviour</td>
<td>x</td>
<td>x</td>
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<td>Temperament</td>
<td>x</td>
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<tr>
<td>Stress</td>
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<tr>
<td>Mental health, suicidality</td>
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<tr>
<td>Physical health</td>
<td>x</td>
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<td>x</td>
<td>x</td>
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<td>Diet and weight</td>
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<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Academics and achievement</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Childcare attendance</td>
<td>x</td>
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<td>x</td>
<td>x</td>
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<tr>
<td>Language and literacy</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td>Smoking, substance use</td>
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<tr>
<td>Mental health</td>
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<tr>
<td>Motor and social development</td>
<td>x</td>
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<td>Sleep</td>
<td>x</td>
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<td>Sibling characteristics</td>
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<td>Sibling behaviours</td>
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<tr>
<td>Parental attitudes towards sibling</td>
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<tr>
<td>Relationships</td>
<td>x</td>
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</table>

Data were compiled from the final master file of the Quebec Longitudinal Study of Child Development (1998–2018), ©Gouvernement du Quebec, Institut de la statistique du Quebec
### Table 3. Summary of the main cognitive measures available in the QLSCD

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<td></td>
<td></td>
<td>5 m</td>
<td>17 m</td>
</tr>
<tr>
<td>McArthur Communicative Development Inventory-Short form[89]</td>
<td>Language development</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Imitation sorting task[90]</td>
<td>Working memory</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Block Test Design, from the WPPSI-R[91]</td>
<td>Spatial visualization ability; motor skill</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Visually Cued Recall[92]</td>
<td>Working memory</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Peabody Picture Vocabulary Test[93]</td>
<td>Receptive language</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Number Knowledge Test[94]</td>
<td>Knowledge/understanding of numbers</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Preschool Embedded Figures Test[95]</td>
<td>Field independence/analytical functioning</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Figural Intersection Task[96]</td>
<td>Mental attention</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>The lollipop test[97]</td>
<td>School readiness</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Test of Gross Motor Development[98]</td>
<td>Motor skills</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>K-ABC, reading comprehension and decoding subtest [99]</td>
<td>Reading skills</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Non-word repetition, from the NEPSY[100]</td>
<td>Phonological encoding and decoding</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Mathematical calculation CAT/2 [101]</td>
<td>Numeric knowledge</td>
<td>x</td>
<td></td>
</tr>
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</table>

Data were compiled from the final master file of the Quebec Longitudinal Study of Child Development (1998–2018), ©Gouvernement du Quebec, Institut de la statistique du Quebec

WPPSI-R, Wechsler Preschool & Primary Scale of Intelligence-Revised; NEPSY, A Developmental NEuroPSYchological Assessment; K-ABC, Kaufman Assessment Battery for children
Figure title and legends

Figure 1. The province of Quebec, Canada and the territories from which children of the QLSCD have been sampled

Note: The figure shows the territory of Quebec with all the administrative regions that were excluded from the initial sampling (in red).
Figure 2. Flowchart of participant selection for participation in the QLSCD

Target sample  
N = 2940

- Families not found; n = 172
- Families excluded; n = 93

Reachable families  
N = 2675

- Unreachable families; n = 14
- Refuse participation; n = 438

Participating families  
n = 2223

- Excluded as oversampled due to the 1998 Ice Storm; n = 103

Final longitudinal sample  
n = 2120

Note: Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2018), ©Gouvernement du Québec, Institut de la statistique du Québec
Figure 3. Attrition in the QLSCD

Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2018), ©Gouvernement du Québec, Institut de la statistique du Québec
### Supplementary Table S1. Grants

<table>
<thead>
<tr>
<th>Funding source</th>
<th>Year</th>
<th>Grant</th>
<th>Amount (CAN$)</th>
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<tr>
<td>Fonds de la recherche en santé du Quebec</td>
<td>(1998 - 2000)</td>
<td>Validation d'outils de mesure de l'autorégulation pour l'étude longitudinale des enfants du Quebec (Co-Investigators: Séguin, Jean R.; Zelazo, P.)</td>
<td>70 000</td>
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<tr>
<td>Fonds pour la Formation de Chercheurs et l'Aide à la Recherche - Équipe</td>
<td>(1995 - 2001)</td>
<td>Développement et prévention des difficultés d'adaptation psychosociale chez les jeunes (Co-Investigators: Carbonneau, René; Pagani, Linda; Pihl, Robert O.; Séguin, Jean R.; Vitaro, Frank)</td>
<td>464 300</td>
</tr>
</tbody>
</table>
### Supplementary Table 2. Summary of selected characteristics of the QLSCD participants


**Child age 0-5 months**
- Child female sex, n (%) 1040 (49.1)
- Low (<2500 gr) birth weight, n (%) 71 (3.4)
- Prematurity, n (%) 104 (4.9)
- Teenage mother at childbirth, n (%) 59 (2.8)
- Low maternal education (no high school diploma), n (%) 385 (18.2)
- Low paternal education (no high school diploma), n (%) 339 (17.5)
- Nonintact (single parent/blended) family, n (%) 406 (19.2)
- Maternal smoking during pregnancy, n (%) 533 (25.3)
- Maternal alcohol use during pregnancy, n (%) 752 (35.6)
- Maternal use of illegal drugs during pregnancy, n (%) 30 (1.4)
- Maternal depression at child age 5 months, n (%) 318 (15.0)
- Paternal depression at child age 5 months, n (%) 108 (6.1)
- Maternal antisocial behaviours in adolescence, n (%) 403 (19.9)
- Paternal antisocial behaviours in adolescence, n (%) 405 (23.0)

**Child age 1 ½ - 5 years (N=1216)**
- Aggression score (mother reported) 1.85 (1.07)
- Hyperactivity score (mother reported) 3.82 (1.65)
- Internalizing behavior score (mother reported) 1.20 (0.93)
- Pre-school peer victimization score (mother reported) 1.47 (1.22)

#### Phase 2 (2003-2010) and Phase 3 (2003-2010)

**Child age 6-12 years**
- Peer victimization trajectories (teacher reported)
  - High, n (%) 244 (14.5)
  - Moderate, n (%) 1000 (59.3)
  - Low, n (%) 441 (26.2)
- Irritability trajectories (teacher reported)
  - Persistent, n (%) 69 (5.0)
  - Declining, n (%) 103 (7.4)
  - Rising, n (%) 181 (13.0)
  - Low, n (%) 1040 (74.7)

**Child age 13 years**
- Cybervictimization, n (%) 112 (9.8)
- Depression symptoms score (self-reported, range 0-2) 2.01 (2.15)
- ADHD symptoms score (self-reported, range 0-2) 2.06 (2.04)
- Physical aggression score (self-reported, range 0-2) 1.50 (1.32)

#### Phase 4 (2016-2023)

**Child age 15 years**
- ADHD score (self-reported, range 1-10) 2.94 (1.67)
- Generalized anxiety score (self-reported, range 1-10) 4.10 (2.17)
- Depression score (self-reported, range 1-10) 3.48 (2.25)
- Oppositional Defiant Disorder score (self-reported, range 1-10) 2.35 (1.39)

**Child age 20 years**
- Severe depression, n (%) 77 (6.3)
- Severe anxiety, n (%) 64 (5.3)
- ADHD 362 (29.8)
- Severe cigarettes/day 91 (7.5)
- Cannabis use 3 times/week or more 121 (10.0)
- Suicidal ideation/attempt, n (%) 124 (10.2)