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## ABSTRACT

The family environment is an important influence on the health and behaviours of children. Few large-scale datasets include detailed and objectively measured health data about multiple individuals from the same family who are living in the same household. The Canadian Health Measures Survey (CHMS) is a repeating, cross-sectional survey that selects two members of a household—a child and a randomly selected older member of the household aged 12 to 79 years—with at least one child aged 3 to 11 years in residence. These paired respondent records, available in the CHMS relationship files, provide unique opportunities to researchers interested in examining associations between two members of the same household for health behaviours and outcomes. A range of pairings are captured in the relationship files (e.g., parent and child, siblings, grandchild and grandparent) with birth parent–child pairs being the most common. These paired respondent data are an important analytical asset of the CHMS and enhance the research potential of the survey significantly.

## Keywords

paired respondents, dyad, Canada, parent–child, relationship, survey, health

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Childhood is an important developmental period for establishing healthy lifestyle behaviours. The majority of Canadian children are not meeting the recommended physical activity levels for good health; a low percentage of them meet the screen time recommendations and most consume too much sugar and ultra-processed foods.<sup>1,2,3,4</sup> As a result, children are experiencing unprecedented rates of overweight and obesity, as well as many of the diseases associated with excess weight, including type II diabetes and hypertension.<sup>5,6,7</sup>

The family environment is an important influence on the health and behaviour of children,<sup>8</sup> and the Canadian Health Measures Survey (CHMS) has great analytical potential for the study of the family dynamic. It collects a wide range of health information, including direct physical measures, from two members of a household where at least one child (aged 3 to 11 years) resides. The two members are a child and a second randomly selected older member of their household, such as a parent, sibling or grandparent (aged 12 to 79 years). A subsample of children linked to data for another household member, where the relationship between records is known, is a unique and underutilized asset of the CHMS. These paired data allow for the examination of associations between characteristics and physical measurements of a child in relation to another household member.

Most research exploring the health and health behaviours of parents and their children relies on information provided by a single respondent, e.g., the parent or the child. While data collected from one member of the household can provide important contextual information about the family environment (e.g., income level), data from either a parent or a child may not be sufficient to understand how parental attributes and behaviours influence that child. Data from family or household member pairs provide a more thorough description of the family environment and a more comprehensive picture of the child's health overall, which can help to better understand health-related associations between a child and their parent or between siblings.

Each cycle of the CHMS releases the paired data in the relationship files. Five cycles of CHMS paired respondent data are now available to researchers. By combining cycles of these paired data, the sample is sufficient to support in-depth analysis of the health and well-being of children in relation to that of another family or household member. The main objective of the CHMS relationship files is to provide researchers with information that allows the examination of health-related associations between two members of the same household (e.g., parent and child). Additionally, the use of survey weights provided with the data ensures that conclusions drawn from these data are nationally representative. This paper will highlight the unique features, recommendations for use and research potential of paired data in the CHMS relationship files.

## Data resource description

The CHMS is an ongoing, cross-sectional survey that collects self-reported health and demographic information via a computer-assisted in-person interview. This is followed by a physical health examination that includes a series of direct physical measures (e.g., blood and urine collection) taken at a mobile examination centre (MEC). The target population is Canadian residents aged 3 to 79 years (6 to 79 years in cycle 1; 3 to 79 years in cycles 2 to 6) living in the provinces. Excluded from the survey are residents of the territories, as well as approximately 4% of the population in the provinces, representing those who live in certain remote regions, on reserves or in institutions, or who are full-time members of the Canadian Armed Forces.

As part of the CHMS sampling plan, one or two members of the household are selected to participate in the survey, depending on household composition. In households with at least one child aged 3 to 11 years, two members are randomly selected: one child aged 3 to 11 years and a second person aged 12 to 79 years. If there are no children aged 3 to 11 years living in the household, only one member aged 12 to 79 years is randomly selected.

The CHMS relationship files contain four variables: (1) CLINICID, the unique identifier of each respondent and the variable used to link the records in the relationship files to the other demographic, health and sampling weight files; (2) HHLID, the unique household identifier shared by the two selected household members; (3) REL, the relationship status variable identifying the type of relationship that the selected respondent has with the other randomly selected household member (Table 1); and (4) FULL\_WGT, the full sample weight associated with each respondent.

The CHMS relationship files contain the data from all selected two-person household pairs, on the condition that at least one of the two selected people responded to the survey. Households with both members participating (n=7,247; cycles 1 to 5, combined) comprise dyads, which allow for paired respondent analysis. The small number of two-person households that are missing a second member record (n=661; cycles 1 to 5, combined) are excluded from paired respondent analysis. Notably, the missing member record is not always the second selected member (n=303; cycles 1 to 5, combined); in some cases, the missing record is from the selected child (n=358; cycles 1 to 5, combined).

### Relationship types

There are 18 different relationships captured between the selected child respondents and the second selected household members; they are summarized in Table 1.

Birth parent-child pairs are the most prevalent relationship, accounting for 68% (n=4,919) of all dyads (cycles 1 to 5, combined). Percentages vary depending on age group (82% for preschoolers aged 3 to 5 years and 62% for children aged 6 to

11 years; data not shown). Biological siblings are the second most common relationship (20%; n=1,467) among the pairs. Just over one-quarter (26%; n=1,341) of the selected 6- to 11-year-old child records are paired with a biological sibling record, whereas only 6% (n=126) of preschoolers are in a sibling pair. This may be because the likelihood of a preschool-aged child having a sibling older than 12 years is lower than that of a 6- to 11-year-old, as siblings tend to be closer in age.<sup>9</sup>

### Sex breakdown of paired respondents

Table 2 shows the sex breakdown of the paired respondents for birth parent–child dyads and sibling dyads by cycle. The pairings are presented overall for all children (i.e., mother–child, father–child) and separately by child sex (i.e., mother–son, mother–daughter and father–son, father–daughter). This information may be useful for planning sex-specific paired analyses (see next section).

### Considerations when using Canadian Health Measures Survey subsample files

The dyad—both the paired child and the second member of their household—must have been eligible for, been selected for and responded to the particular question or measure to be included in a paired analysis examining associations of a particular health outcome. All respondents have data for their respective cycle from the two main master CHMS data files: the household questionnaire and the clinic visit. However, additional CHMS data files are provided for a number of subsamples (e.g., fasting blood and activity monitor subsamples), depending on the cycle. These additional data may only have been collected on a

subsample of respondents or may not have been consistently measured in every cycle. For example, the fitness component was collected in cycles 1, 2 and 5 only and on a selected age range of participants (6 to 69 years). For information about which questions and measures are available in which cycle and for which target population, the CHMS user guides or the CHMS Content Summary document are available upon request.<sup>10</sup>

Accelerometers were provided to all respondents to wear for seven days following the MEC visit. Though all subjects were asked to wear the device for all waking hours during those seven days, not all subjects complied. Only those respondents who provided at least four valid days of accelerometer data (three days for preschoolers from cycle 3 onward) were eligible for study of measured physical activity. A file composed of only these “valid” respondents is available for each cycle. Table 3 shows the sample sizes of the respondent pairs with valid accelerometer data by cycle, overall, and for birth parent–child and sibling pairs. There are 3,344 birth parent–child dyads with valid accelerometer data for both dyad members and 983 sibling pairs (of 6- to 11-year-old child respondents and an older sibling) with valid accelerometer data for both dyad members.

A subsample of CHMS households from cycles 1 to 5 was selected to fast for the MEC appointment for the purpose of measuring specific blood markers. For those households with two members selected, excluding those in which the child was aged 3 to 5 years, both respondents were asked to fast. For children aged 6 to 11 years, 2,013 dyads have fasting data (n=1,254 for birth parent–child pairs; n=528 for sibling pairs; Table 3).

**Table 1**  
**Sample sizes of paired respondent children (3 to 11<sup>†</sup> years), by type of relationship, Canadian Health Measures Survey relationship data files, cycles 1 through 5 (2007 to 2017)**

Relationship to child respondent	Cycle					Total dyads (cycles 1 to 5)
	1 <sup>†</sup>	2	3	4	5	
	number					
Birth parent	678	1,119	997	1,062	1,063	4,919
Step-parent	21	29	23	30	23	126
Adoptive/foster parent	17	13	12	18	12	72
Grandparent	16	40	56	37	51	200
Biological sibling	236	306	316	296	313	1,467
Other sibling <sup>a</sup> types	45	75	85	75	81	361
Other relative <sup>b</sup> types	11	18	11	9	15	64
Unrelated <sup>c</sup> 2nd respondent	4	13	11	7	3	38
<b>Total dyads</b>	<b>1,028</b>	<b>1,613</b>	<b>1,511</b>	<b>1,534</b>	<b>1,561</b>	<b>7,247</b>

<sup>†</sup> Age based on the clinic visit

<sup>‡</sup> Subjects aged 3 to 5 years old were not sampled in cycle 1

<sup>a</sup> Includes half, step, adopted and foster siblings, and sibling not defined

<sup>b</sup> Includes cousin, uncle or aunt, other relative, and other related (general)

<sup>c</sup> Includes brother- or sister-in-law, other in-law, and unrelated

Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, 2014 to 2015, 2016 to 2017 Canadian Health Measures Survey, combined.

**Table 2**  
**Sample sizes of paired respondent birth parent–child dyads and biological sibling dyads, by sex, Canadian Health Measures Survey relationship data files, cycles 1 through 5 (2007 to 2017)**

Type of relationship between respondents	Cycle					Total dyads (cycles 1 to 5)
	1 <sup>‡</sup>	2	3	4	5	
	number					
<b>Birth parent–child dyads (3- to 11<sup>†</sup>-year-old child respondents)</b>						
Parent–son	349	581	508	530	541	2,509
Parent–daughter	329	538	489	532	522	2,410
Mother–child	419	662	548	558	560	2,747
Mother–son	227	347	271	275	300	1,420
Mother–daughter	192	315	277	283	260	1,327
Father–child	259	457	449	504	503	2,172
Father–son	122	234	237	255	241	1,089
Father–daughter	137	223	212	249	262	1,083
<b>Biological sibling dyads (6- to 11<sup>†</sup>-year-old child respondents only)</b>						
Brothers	63	70	91	82	75	381
Sisters	69	67	79	66	73	354
Younger brother–older sister	57	75	77	68	80	357
Younger sister–older brother	47	94	69	80	85	375

<sup>†</sup> Age based on the clinic visit

<sup>‡</sup> Subjects aged 3 to 5 years old were not sampled in cycle 1

Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, 2014 to 2015, 2016 to 2017 Canadian Health Measures Survey, combined.

## Weighting

Survey weights are provided with the CHMS data to ensure estimates are representative of the Canadian population. For the relationship files, the respondent weights represent members of Canadian households where a 3- to 11-year-old and a 12- to 79-year-old reside. Note that for a parent-focused analysis, applying parent-assigned weights only represents Canadian parents of 3- to 11-year-olds. Similarly, applying a child-assigned weight ensures that the children in the analytical sample represent Canadian children aged 3 to 11 years who live in households with at least one 12- to 79-year-old. Owing to the complex sampling design, and to ensure that variance is not underestimated, the use of bootstrap weights is required.

## Recommendations for use of the Canadian Health Measures Survey relationship files

The feasibility of using paired respondent CHMS data was examined prior to the release of the CHMS relationship files. This involved an exploration of the different relationship dyads, as well as sample sizes required to produce reliable estimates. It also involved determining which respondent survey weight should be used for representative results and the assessment of bias and generalizability. These and other aspects to consider when conducting paired respondent analyses were identified and described in a full feasibility report that is available upon request.<sup>11</sup> The report includes a number of recommendations for data users, which are summarized briefly in Table 4.

## Data resource use

Three studies using the CHMS relationship files have been published to date, all focused on child-measured outcomes and parent-measured attributes. The first study examined the association between being an obese child (based on the child's measured height and weight data) and having an obese parent (based on measured height and weight data collected from that child's birth parent).<sup>12</sup> Descriptive statistics, Pearson correlation and logistic regression were used to assess relationships in obesity among parent–child pairs. Children with an obese birth parent were found to be at increased risk of being overweight or obese themselves, while girls were at increased risk of being overweight or obese if a birth parent was overweight. Strengths of this study include a nationally representative sample of Canadian children, the use of directly measured height and weight data for children and parents, and a confirmed biological relationship between them.

The other two studies examined the association between being an active child and having an active parent, based on individual-level measured and reported data, including sedentary behaviours and screen time for both the child and the birth parent among 6- to 11-year-olds<sup>13</sup> and 3- to 5-year-olds.<sup>14</sup> Descriptive statistics, Pearson correlation and linear regression

**Table 3**  
**Sample sizes of respondent pairs with valid accelerometer data and fasted subsample data, by type of relationship and age of child, Canadian Health Measures Survey relationship data files, cycles 1 through 5 (2007 to 2017)**

Population sample and age group <sup>†</sup>	Cycle					Total dyads (cycles 1 to 5)
	1 <sup>‡</sup>	2	3	4	5	
	number					
<b>Accelerometer subsample</b>						
<b>Total accelerometer sample</b>						
3 to 11 years	735	1,161	998	969	968	4,831
3 to 5 years	0	388	325	320	337	1,370
6 to 11 years	735	773	673	649	631	3,461
<b>With a birth parent</b>						
3 to 11 years	484	816	674	688	682	3,344
3 to 5 years	0	331	254	283	280	1,148
6 to 11 years	484	485	420	405	402	2,196
<b>With a biological sibling</b>						
3 to 11 years	175	223	207	185	193	983
3 to 5 years	0	21	23	9	15	68
6 to 11 years	175	202	184	176	178	915
<b>Fasted subsample</b>						
<b>Total fasted sample</b>						
3 to 5 years	...	...	...	...	...	0
6 to 11 years	421	440	417	366	369	2,013
<b>With a birth parent</b>						
3 to 5 years	...	...	...	...	...	0
6 to 11 years	274	273	252	228	227	1,254
<b>With a biological sibling</b>						
3 to 5 years	...	...	...	...	...	0
6 to 11 years	93	117	123	91	104	528

... not applicable

<sup>†</sup> Age based on the clinic visit

<sup>‡</sup> Subjects aged 3 to 5 years old were not sampled in cycle 1

Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, 2014 to 2015, 2016 to 2017 Canadian Health Measures Survey, combined.

were used in both studies. For older children (6 to 11 years), a significant association was found between parents' measured moderate-to-vigorous physical activity (MVPA) and children's MVPA. Parents' measured sedentary time was associated with that of their daughters on weekends and that of their sons during the after-school period. For younger children (3 to 5 years), higher parental MVPA, light-intensity physical activity (LPA), sedentary time and screen time were associated with higher MVPA, LPA, sedentary time and screen time among children.<sup>14</sup> An interesting difference between the two studies is that, unlike for the older age group, associations between parental sedentary behaviour and physical activity, and the behaviours of preschool-aged children did not differ by day of the week (weekday vs. weekend), parental sex (mothers vs. fathers) or child sex (sons vs. daughters).

Both studies provide evidence that parents influence their child's physical activity and sedentary behaviours, something that is difficult to study in the absence of measured and reported information from both family members at the same time. All

three studies confirm the importance of a parent's health and health behaviours to those of their children. Now that five CHMS cycles are available, it is likely there are many other research possibilities yet to be explored. The richness of clinic and survey content within the CHMS, combined with the ability to link pairs within a household, offers many unique research opportunities for the future.

## Strengths and weaknesses

### Strengths

The relationship files are a valuable asset of the CHMS and provide many analytical opportunities to better understand health-related associations between paired household members. The most frequently captured pairings and the focus of published research to date are parents and children. Data from paired respondents in the sixth and future cycles of the CHMS will further increase the analytical possibilities of the paired

**Table 4**  
**Summary of recommendations for users of the Canadian Health Measures Survey relationship data files for conducting paired respondent analysis**

Recommendation number	Recommendation topic area/subject/aspect	Recommendation
1	Relationship types	Birth parent–child pairs are appropriate for analysis. Sibling pairs have limited analytical value. Analyses using any other relationship type are not recommended with five (or fewer) cycles of data.
2	Age groups of the child	Data for children aged 3 to 11 years are available for analysis. The two age groups—preschoolers (aged 3 to 5 years; cycle 2 onward) and 6- to 11-year-olds (cycle 1 onward)—can be examined together or separately.
3	Sample sizes	For reliable estimates, approximately 500 or more pairs per analytical subgroup are recommended; however, this depends on the analysis and outcomes of interest. Lower prevalence estimates will require larger sample sizes. Data users are encouraged to combine as many cycles as possible when conducting paired analyses to maximize sample size.
4	Survey weights	The survey weight variable depends on the unit of analysis. If the outcome of interest is for the child, use the child-assigned weight. If the outcome of interest is for the parent, use the parent-assigned weight.
5	Bias	Despite the potential biases related to household composition and specific second member selection or inclusion, children whose second household member is a respondent birth parent are sufficiently representative of children in Canada. However, data users should be aware of the biases when interpreting and
6	Subsample files	In addition to the full sample data, use of the accelerometer subsample file is analytically possible for birth parent–child pairs when three or more cycles are pooled. Analyses of sibling pairs are possible for 6- to 11-year-olds only, using all five cycles of data. The fasting subsample is possible among 6- to 11-year-old children with birth parent–child pairs only, and all five cycles of data should be

**Source:** Langlois K, Bushnik T, Colley RC, et al. *Using the Relationship Files and Paired Respondent Data in the Canadian Health Measures Survey: Feasibility Study—An Update*. Statistics Canada internal document available upon request. February 2020.

data; as the sample size increases, more parent–children and sibling dyads will be captured, as well as other relationship types. Furthermore, increasing sample size will improve the power of statistical associations and may allow for analyses of subsample files and outcomes that are not possible to examine at this time.

While the CHMS data are not the only source of parent–child or sibling data in Canada<sup>15</sup> or elsewhere,<sup>16,17,18,19,20,21</sup> other sources have been conveniently sampled (non-random with limited generalizability), are restricted geographically (not national), include limited covariates or are specific to a single subject area, have comparatively smaller samples, or do not clearly identify the relationship between the paired respondents. For example, the American Third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1994) collected data on a child and an adult from the same household; however, because the relationship between members was not captured during data collection, additional data and assumptions were required to identify birth parent–child pairings.<sup>22</sup> The CHMS relationship files are unique and unmatched, owing to their sample sizes, the inclusion of detailed and objectively measured

health data collected from pairs of individuals in the same household, and the availability of a relationship indicator.

### Weaknesses

Paired data from the CHMS relationship files are best used to describe associations between children and a second member of their household, rather than to estimate the prevalence of a characteristic among children or their parent or sibling. This is a result of the need to combine many years of data in a paired analysis. Users should also be aware that characteristics being available for only one parent likely does not capture the entire family dynamic.

Selection of a subsample of pairs from all paired respondents (e.g., child and their birth parent) necessarily involves the exclusion of other pairs (e.g., siblings), and this has the potential to introduce bias. Despite this, paired-data analyses remain statistically appropriate as the second household member was selected at random, minimizing concerns of bias.

Analysis of a specific relationship beyond birth parent–child is dependent on having an adequate number of paired respondents with that particular relationship type. Analyses of paired



siblings is possible only for the 6- to 11-year-old age group and only if all currently available cycles (1 to 5) are combined. Generalizability is thus limited as these paired children represent a very specific subset, namely 6- to 11-year-olds in households with at least one sibling aged 12 years and older, and therefore may not represent sibling pairs in general. This lack of generalizability to the overall sibling population in Canada is an important caveat for anyone interested in analyzing sibling pairs.

Respondent pairs of children in relationships other than parent-child or siblings (e.g., grandparent-grandchild, step-parent-child) are too few to analyze exclusively, despite combining multiple cycles. Additionally, although the relationship files can be linked to data from any of the CHMS full-sample (master) files and subsample files, not all content lends itself to child paired analyses. Some measures (subsamples) are too small to produce reliable estimates. An important step in a successfully designed paired respondent study is confirmation that the variables of interest—particularly outcomes of interest—and the paired study sample are appropriate, generalizable and sufficiently numerous to produce reliable estimates. (Sufficiently numerous samples can be achieved by combining data from multiple cycles.)

## Data resource access

Because of the nature of the CHMS data, extra attention was given to assessing potential privacy and confidentiality concerns with the paired respondent data. Respondents were informed of possible linkage to other data sources in future, via the following statement: “Statistics Canada may combine your responses from this survey to responses to other surveys or administrative data sources.” The paired respondent data in the CHMS relationship files, which link CHMS respondents internally within the survey, can be accessed only at Statistics Canada’s head office and research data centres (RDCs)<sup>23</sup> or the Federal Research Data Centre with the approval of an RDC application. Researchers applying for access must clearly demonstrate a need for relationship status information via a clearly detailed analytical plan. This plan must indicate which cycle or cycles of the relationship files are required and outline how the data will be used. Information on the RDC Program, including the application process and guidelines, is available at [www.statcan.gc.ca/eng/rdc/index](http://www.statcan.gc.ca/eng/rdc/index).

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