Health Reports

Health Utilities Index Mark 3 scores for children and youth: Population norms for Canada based on cycles 5 (2016 and 2017) and 6 (2018 and 2019) of the Canadian Health Measures Survey

by Mariana Molina, Brittany Humphries, Jason R Guertin, David Feeny and Jean-Eric Tarride

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ABSTRACT

Background
Utility scores are an important tool for evaluating health-related quality of life. Utility score norms have been published for Canadian adults, but no nationally representative utility score norms are available for children and youth.

Data and methods
Health Utilities Index Mark 3 (HUI3) data from two recent cycles of the Canadian Health Measures Survey (i.e., 2016 and 2017, and 2018 and 2019) were used to provide utility score norms for children aged 6 to 11 years and adolescents aged 12 to 17 years. Children younger than 14 years answered the HUI3 under the supervision of an adult, while older children answered without supervision. Utility scores were reported as a weighted average (95% confidence intervals [CIs]) and median values (interquartile range). Utility scores were stratified by sociodemographic and medical characteristics of the child or adolescent. Regression analyses were used to identify predictors of utility scores. All results were weighted using sampling weights provided by Statistics Canada.

Results
Among the 2,297,136 children aged 6 to 11 years and the 2,329,185 adolescents aged 12 to 17 years in the weighted sample, the average utility scores were 0.95 (95% CI: 0.94 to 0.95) and 0.89 (95% CI: 0.87 to 0.90), respectively. Approximately 60% of the children and 34% of the adolescents had a utility score of 1.00. Analyses identified several factors associated with utility scores (e.g., age, chronic condition and income levels), although differences were observed between children and adolescents.

Interpretation
This study provides utility score estimates based on a nationally representative sample of Canadian children and youth. Further research examining the determinants of utility scores of children and adolescents is warranted.

Keywords
Utility scores; Canadian Health Measures Survey; Health Utilities Index Mark 3 (HUI3); children and youth

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What is already known on this subject?

- Health-related quality of life is an important endpoint in the evaluation of health status and health care interventions as there is a need to understand changes not only in the quantity of life but also in the quality of life.

- Utility score norms have been recently published for Canadian adults, yet there are no published utility score norms for children and youth at the population level.

What does this study add?

- This is the first study to provide utility score estimates based on a nationally representative sample of a non-adult population (children and adolescents).

- While more than half of Canadian children have a Health Utilities Index Mark 3 score indicating "perfect health," one-third of adolescents reported this perfect score.

- Determinants of utility scores differed between children and adolescents.

Health-related quality of life (HRQoL) is considered to be an important endpoint in the evaluation of health status and health care interventions—there is a need to understand changes not only in the quantity of life but also in the HRQoL (e.g., an intervention for pain management may have no impact on mortality). Utility scores are a measure of HRQoL designed to represent the physical, mental and social functioning degree associated with a specific health state and the satisfaction that patients attach to that health state.[1] By convention, a utility score of 1.00 represents "perfect health," and a score of 0.00 represents a "dead" state. Health states that are "worse than dead" are assigned a negative value.[2,3]

Utility scores provide a single measure of HRQoL that allows for comparing interventions in terms of their impact on HRQoL. To meet the requirement of health technology assessments across the work, HRQoL and utility instruments such as the EQ-5D or the Health Utilities Index (HUI) are commonly used in clinical trials. This method is used because the reimbursement agencies of several countries (e.g., Canada, the United Kingdom and Australia) favour the use of cost–utility analysis (CUA) when evaluating value for money for deciding whether a new therapy should be reimbursed. In CUAs, outcomes are expressed in terms of incremental cost per quality-adjusted life years (QALYs) gained.[4–6] The basic concept of a QALY combines an individual's length and quality of life into a single metric.[7]

Having normative data on utility scores at the population level is critical to facilitate the interpretation of clinical data and inform resource allocation decisions.[8] Normative utility data are required to determine whether an individual or a group has a higher or lower utility than the average for their country, a specific age group or sex.[9] Researchers can use population norms to compare the results obtained from their clinical study sample with population-level data for the purpose of interpreting outcomes, profiling (e.g., comparing outcomes among subgroups) or tracking population trends over time. Decision makers can also use population-level data to inform better decision making surrounding health care resource allocation. The Canadian Agency for Drugs and Technologies in Health (CADTH) recommends that the utility scores included in economic evaluations of technologies being considered for funding be based on the health state preferences of the general Canadian population.[4]

Utility score norms have been published for Canadian adults using the five-level version of EQ-5D[10] or the three-level version of EQ-5D[11] and the HUI Mark 3 (HUI3). Though previous publications of the HUI3 in the Canadian population presented utility data that overlap this study's total population (for adolescents aged 12 to 19 years using data from the Canadian Community Health Survey [CCHS],[12] or aged 15 years and older using the National Population Health Survey and CCHS[13]), no nationally representative utility score norms have been published for a broader population of children and youth (i.e., children and adolescents aged 6 to 17 years) in Canada or elsewhere. While two systematic reviews of children's health utilities were recently published,[14,15] none of the studies included in these systematic reviews were Canadian or presented nationally representative data. Furthermore, these reviews were limited in scope, because they focused on specific populations (e.g., pediatric cancer patients,[14] parasitic diseases, cancer and metabolic disorders[15]). Given the lack of available utility data for non-adult populations, researchers and decision makers often rely on utility data derived from an adult population, an expert opinion or their own assumptions, all of which have methodological limitations regarding the quality, appropriateness and applicability of the utility data.[16–18] It is also important to differentiate children and adolescents when reporting health utilities, for several reasons. First, children and adolescents differ in many aspects of their physical, psychological and social needs.[19] Second, the understanding of health, illness and wellness could also vary between children

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and adolescents,[20] and population-based surveys generally separate children younger or older than 12 years of age in their sampling design.[21]

As the first study to generate utility score norms in children and youth at a population level, this analysis addresses an important gap in the literature. It is also considered an important health outcome when performing economic evaluations to compare either similar or different health conditions. The primary objective was to estimate health utility score norms for children and youth in Canada using data obtained from cycles 5 and 6 of the Canadian Health Measures Survey (CHMS). Data from the most recent years in which utility data were available for the entire population of interest were analyzed. To provide greater insights and useful information for decision making and future CUA in children and adolescents, secondary objectives included conducting subgroup analyses according to relevant sociodemographic and medical characteristics and identifying predictors of utility score values when adjusting for baseline characteristics.

Methods

Survey design and data

Data from cycles 5 (2016 and 2017) and 6 (2018 and 2019) of the CHMS were combined to increase the sample to be studied and the statistical robustness of results.[22] The two cycles were combined using sample weights provided by Statistics Canada when using two or more cycles of the CHMS.[23] The CHMS is an ongoing national survey led by Statistics Canada in collaboration with Health Canada and the Public Health Agency of Canada. Launched in 2007, the survey is administered every two years to a representative sample of Canadians aged 3 to 79 years who are living in one of Canada's 10 provinces.[21] The observed population excludes people living in the three territories, people living on reserves and settlements in the provinces, the institutionalized population, residents of certain remote regions, or full-time members of the Canadian Armed Forces (totalling around 4% of the Canadian population[22]).

Data collection comprises personal interviews using a computer-assisted interviewing method at the participant's home to collect information on household and individual characteristics (e.g., sociodemographic and economic variables, lifestyle habits, chronic conditions, self-rated health, and HRQoL data). In addition, anthropometric, cardiovascular and musculoskeletal data, as well as blood and urine measures, are collected from a physical examination in a mobile examination centre. While adolescents 14 years of age or older answered the CHMS questionnaires without supervision, children aged 6 to 13 years answered the survey questions under the supervision of a parent or guardian. Parents or guardians acted as proxies for younger children (aged 3 to 5 years).[21]

Health Utilities Index Mark 3

Utility scores were assessed using the HUI3 system. The HUI3 has been used in hundreds of studies across many health care settings to document HRQoL.[24] The HUI3 has been shown to be valid, reliable and responsive among clinical or general populations, including children aged 5 years and older.[25,26] The HUI3 combines a preference-based generic health status classification system with a utility scoring system that measures health status and HRQoL.[24] It examines eight health attributes (i.e., vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain or discomfort), with five or six levels per attribute. Utility scores for health states within the HUI3 range from -0.36 to 1.00, with 0.00 representing a dead state and 1.00 representing a perfect health state. The minimum clinically important difference (MCID) for the HUI3 has been estimated at 0.03.[24] Since the 1990s, the HUI3 has been included in many population surveys by Statistics Canada.[24] In the CHMS, children aged 6 to 13 years answered the HUI3 questions under the supervision of a parent or a guardian, while older children answered the questions without supervision.

Statistical analyses

Descriptive statistics (mean, standard deviation, median and interquartile range [IQR]) were used to summarize the sociodemographic and clinical characteristics of the children and adolescents. They include age, sex, household income, measured body mass index (BMI, [kg/m²]) and BMI categories, chronic conditions, and self-rated health. BMI categories were defined according to World Health Organization thresholds.[27] Chronic conditions in the CHMS (i.e., asthma; bronchitis; heart condition; diabetes; mental handicap; and emotional, psychological or nervous difficulties) were defined as long-term health conditions that have lasted or were expected to last six months or more and were diagnosed by a health professional.[21] Data on the severity or duration of the chronic condition were not collected. The proportions of the population with no chronic conditions, one chronic condition, or two or more chronic conditions were computed. Self-rated health was reported on a five-level categorical scale: excellent, very good, good, fair and poor health.

HUI3 scores, which were estimated using a variable derived by Statistics Canada from answers to specific HUI3 instrument questions, were stratified by sociodemographic and clinical characteristics of children or adolescents. HUI3 scores were reported in terms of mean (95% confidence interval [CI]) and median (IQR). In addition, similar to previous work,[8,12] HUI3 scores were presented in relation to self-rated health. Since HUI3 data for children aged 3 to 5 years were not collected, children aged younger than 6 years were excluded from the analyses, as well as children and adolescents without HUI3 information. While the CHMS used a cut-off age of 14 years for children to answer the survey without supervision, a cut-off age of 12 years was used to define the two populations of children (aged 6 to 11 years) and adolescents (aged 12 to 18 years),

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because these age groups corresponded to age group strata included in the CHMS design.

Additionally, HUI3 utility scores were regressed on several covariates using a multivariate ordinary least squares (OLS) technique where the standard errors of the HUI3 utility scores were bootstrapped. Previous simulations have shown that this statistical approach is recommended over alternative methods (e.g., tobit and censored least absolute deviations) to analyze utility data since it generates unbiased estimates, unbiased regression coefficients and valid CIs compared with the other models. This is especially the case when utility scores are bounded above one and when the analysis deals with conditional normality and possible heteroscedasticity.[28] Multivariable logistic regressions were also used to identify the sociodemographic and medical characteristics associated with children or adolescents experiencing an HUI3 score indicating

perfect health (HUI3 equal to 1.00). As an additional sensitivity analysis, a logistic model lowering the threshold to having an HUI3 of 0.973 or higher was explored as a reference.

All statistical analyses (descriptive and regression models) were weighted to estimate HUI3 levels in the non-adult Canadian population and to comply with Statistics Canada vetting rules. The sampling weights used for the descriptive analyses and the bootstrapped weights used to generate 95% CIs were provided by Statistics Canada. Bootstrap techniques were used to calculate 95% CIs for differences associated with the difference in HUI3 scores between groups. Additionally, all survey designs, including the clustered nature of the CHMS, were considered. All analyses were presented separately for children aged 6 to 11 years and adolescents aged 12 to 17 years, following the survey's design.

Table 1

Sociodemographic and medical characteristics of children aged 6 to 11 years and adolescents aged 12 to 17 years

Characteristics	Children				Adolescents			
	Weighted frequency (n)	Relative weighted frequency (%)	95% confidence interval from	to	Weighted frequency (n)	Relative weighted frequency (%)	95% confidence interval from	to
Total	**2,297,136**	...	...	...	**2,329,185**	...	...	...
Sex								
Female	1,112,273	48.42	44.37	52.47	1,172,512	50.34	45.61	55.07
Male	1,184,863	51.58	47.53	55.63	1,156,673	49.66	44.93	54.39
Age, year, mean	...	8.57	8.43	8.71	...	14.54	14.36	14.72
Age group								
(children/adolescents)								
6 to 12	339,976	14.80	11.86	17.74	473,989	20.35	16.56	24.14
7 to 13	345,260	15.03	12.43	17.63	285,558	12.26	9.66	14.86
8 to 14	456,900	19.89	16.34	23.44	375,232	16.11	12.85	19.37
9 to 15	377,649	16.44	13.38	19.50	341,691	14.67	11.94	17.40
10 to 16	372,136	16.20	13.54	18.86	402,483	17.28	13.29	21.27
11 to 17	405,215	17.64	14.47	20.81	450,231	19.33	15.04	23.62
Household income								
Less than $30,000	220,525	9.60	6.63	12.57	159,549	6.85	4.40	9.30
$30,000 to $59,999	390,054	16.98	13.99	19.97	371,039	15.93	11.94	19.92
$60,000 to $99,999	465,170	20.25	17.30	23.20	487,033	20.91	17.30	24.52
$100,000 to $149,999	539,827	23.50	20.23	26.77	501,939	21.55	18.15	24.95
$150,000 and over	670,534	29.19	25.38	33.00	781,674	33.56	28.96	38.16
Chronic condition								
No chronic condition	1,865,504	81.21	78.22	84.20	1,764,823	75.77	72.29	79.25
Physical or mental health condition	289,669	12.61	10.32	14.90	351,474	15.09	12.26	17.92
Asthma	144,490	6.29	4.46	8.12	194,021	8.33	6.44	10.22
One chronic condition	382,243	16.64	13.73	19.55	461,644	19.82	16.57	23.07
Two or more chronic conditions	49,388	2.15	1.35	2.95	102,717	4.41	3.14	5.68
Body mass index, kg/m²	...	17.38	17.14	17.62	...	22.00	21.45	22.55
Categories								
Normal weight	1,597,658	69.55	65.94	73.16	1,569,405	67.38	62.88	71.88
Overweight	410,958	17.89	14.84	20.94	476,318	20.45	16.60	24.30
Obesity	288,520	12.56	10.11	15.01	283,462	12.17	8.92	15.42
Self-rated health[1]								
Poor or fair	22,971	1.00	0.41	1.59	116,459	5.00	1.83	8.17
Good	260,036	11.32	9.04	13.60	665,448	28.57	24.11	33.03
Very good	733,935	31.95	28.27	35.63	1,055,354	45.31	40.60	50.02
Excellent	1,281,802	55.80	51.84	59.76	491,691	21.11	17.42	24.80

... not applicable

[1] Modified variables to comply with vetting rules.

Source: Canadian Health Measures Survey cycles 5 and 6, 2016 and 2017, and 2018 and 2019.

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Table 2

Health Utilities Index Mark 3 utility norms for Canadian children aged 6 to 11 years, by sociodemographic and medical characteristics

| Characteristics | Health Utilities Index Mark 3 | | | | | |
| | Mean | 95% confidence interval | | Median | 95% confidence interval | |
		from	to		from	to
Children						
HUI3 average	0.95	0.94	0.96	0.99	0.93	1.00
HUI3 equal to 1.00 (%)	59.88	55.93	63.83	...	...	...
Sex						
Female	0.95	0.93	0.97	1.00	0.93	1.00
Male	0.95	0.94	0.96	1.00	0.93	1.00
Age group						
6	0.97	0.96	0.98	1.00	0.97	1.00
7	0.95	0.93	0.97	1.00	0.93	1.00
8	0.95	0.93	0.97	1.00	0.93	1.00
9	0.94	0.92	0.96	1.00	0.92	1.00
10	0.94	0.93	0.95	1.00	0.92	1.00
11	0.94	0.92	0.96	0.97	0.93	1.00
Household income, group						
Less than $30,000	0.92	0.89	0.95	1.00	0.92	1.00
$30,000 to $59,999	0.93	0.91	0.95	1.00	0.91	1.00
$60,000 to $99,999	0.94	0.93	0.95	1.00	0.93	1.00
$100,000 to $149,999	0.95	0.94	0.96	1.00	0.93	1.00
$150,000 and over	0.96	0.95	0.97	1.00	0.95	1.00
Self-rated health[1]						
Poor and fair	0.76	0.63	0.89	0.77	0.65	1.00
Good	0.89	0.86	0.92	0.93	0.84	1.00
Very good	0.94	0.93	0.95	1.00	0.92	1.00
Excellent	0.97	0.96	0.98	1.00	0.97	1.00
Chronic condition						
Asthma						
Yes	0.93	0.92	0.94	1.00	0.93	1.00
No	0.95	0.94	0.96	1.00	0.93	1.00
Physical or mental health condition						
Yes	0.88	0.85	0.91	0.93	0.83	1.00
No	0.96	0.95	0.97	1.00	0.93	1.00
Any chronic condition						
Yes	0.90	0.88	0.92	0.97	0.86	1.00
No	0.96	0.95	0.97	1.00	0.93	1.00
One chronic condition						
Yes	0.90	0.88	0.92	0.97	0.87	1.00
No	0.95	0.94	0.96	1.00	0.93	1.00
Two or more chronic conditions						
Yes	0.87	0.82	0.92	0.93	0.84	1.00
No	0.95	0.94	0.96	1.00	0.93	1.00
Body mass index categories						
Normal weight	0.95	0.94	0.96	1.00	0.93	1.00
Overweight	0.95	0.93	0.97	1.00	0.97	1.00
Obesity	0.94	0.93	0.95	1.00	0.89	1.00

... not applicable

[1]Modified variables to comply with vetting rules.

Note: HUI3 stands for Health Utilities Index Mark 3.

Source: Canadian Health Measures Survey cycles 5 and 6, 2016 and 2017, and 2018 and 2019.

Ethics approval

The data were accessed through approved Statistics Canada research data centres (RDCs) at McMaster University following approval of the proposed research by Statistics Canada. All data were deidentified and vetted by an RDC analyst to ensure confidentiality. The use of secondary data from Statistics Canada does not require a review by a research ethics board. Ethics approval was not sought for this secondary data analysis.

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Results

Sociodemographic and clinical characteristics

Respondents to cycles 5 and 6 of the CHMS were weighted to represent a sample of 2,297,136 Canadian children aged 6 to 11 years, as well as 2,329,185 adolescents aged 12 to 17 years.

Table 1 provides the sociodemographic and clinical characteristics of the weighted sample of children and adolescents who had complete responses to the HUI3 (96.3%). Approximately 50% of the sample of children (51.6%) and adolescents (49.7%) were male. The average ages of the children and adolescents were 8.6 years (95% CI: 8.4 to 8.7) and 14.5 years (95% CI: 14.4 to 14.7), respectively. More than half of the households of children and adolescents had an annual

Table 3

Health Utilities Index Mark 3 utility norms for Canadian adolescents aged 12 to 17 years, by sociodemographic and medical characteristics

| Characteristics | Health Utilities Index Mark 3 | | | | | |
| | Mean | 95% confidence interval | | Median | 95% confidence interval | |
		from	to		from	to
Adolescents						
HUI3 average	0.89	0.87	0.91	0.93	0.84	1.00
HUI3 equal to 1.00 (%)	33.60	29.05	38.15	...	...	...
Sex						
Female	0.87	0.85	0.89	0.93	0.80	1.00
Male	0.90	0.88	0.92	0.93	0.87	1.00
Age group						
12	0.89	0.87	0.91	0.93	0.84	1.00
13	0.90	0.87	0.93	0.93	0.86	1.00
14	0.86	0.82	0.90	0.93	0.77	1.00
15	0.88	0.85	0.91	0.93	0.80	1.00
16	0.89	0.86	0.92	0.93	0.87	0.97
17	0.90	0.87	0.93	0.97	0.87	1.00
Household income, group						
Less than $30,000	0.87	0.84	0.90	0.93	0.80	1.00
$30,000 to $59,999	0.88	0.83	0.93	0.93	0.80	1.00
$60,000 to $99,999	0.88	0.86	0.90	0.93	0.83	1.00
$100,000 to $149,999	0.87	0.84	0.90	0.93	0.79	1.00
$150,000 and over	0.91	0.89	0.93	0.93	0.87	1.00
Self-rated health[1]						
Poor and fair	0.74	0.65	0.83	0.77	0.53	1.00
Good	0.85	0.82	0.88	0.91	0.77	0.97
Very good	0.91	0.89	0.93	0.93	0.87	1.00
Excellent	0.93	0.91	0.95	0.97	0.91	1.00
Chronic condition						
Asthma						
Yes	0.89	0.86	0.92	0.93	0.86	1.00
No	0.89	0.87	0.91	0.93	0.84	1.00
Physical or mental health condition						
Yes	0.82	0.79	0.85	0.87	0.74	0.97
No	0.90	0.88	0.92	0.93	0.87	1.00
Any chronic condition						
Yes	0.84	0.82	0.86	0.89	0.77	1.00
No	0.90	0.88	0.92	0.93	0.88	1.00
One chronic condition						
Yes	0.85	0.83	0.87	0.91	0.77	1.00
No	0.90	0.88	0.92	0.93	0.87	1.00
Two or more chronic conditions						
Yes	0.79	0.73	0.85	0.87	0.74	0.97
No	0.89	0.87	0.91	0.93	0.86	1.00
Body mass index categories						
Normal weight	0.89	0.87	0.91	0.93	0.87	1.00
Overweight	0.87	0.84	0.90	0.93	0.78	1.00
Obesity	0.87	0.83	0.91	0.93	0.83	1.00

... not applicable

[1]Modified variables to comply with vetting rules.

Note: HUI3 stands for Health Utilities Index Mark 3.

Source: Canadian Health Measures Survey cycles 5 and 6, 2016 and 2017, and 2018 and 2019.

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Table 4

Ordinary least squares regression model to examine sociodemographic and medical characteristics associated with utility scores, children and adolescents

Characteristics	Children					Adolescents				
	Coefficient	Standard error	p-value	95% confidence interval from	to	Coefficient	Standard error	p-value	95% confidence interval from	to
Sex (female as reference)	-0.002	0.006	0.751	-0.015	0.011	0.028	0.009	0.001	0.010	0.046
Age, year										
(6 or 12 as reference)										
7 to 13	-0.016	0.008	0.053	-0.033	0.001	0.010	0.016	0.558	-0.024	0.044
8 to 14	-0.019	0.008	0.016	-0.036	-0.003	-0.028	0.019	0.152	-0.068	0.012
9 to 15	-0.019	0.007	0.009	-0.034	-0.004	-0.001	0.014	0.946	-0.031	0.029
10 to 16	-0.019	0.007	0.004	-0.033	-0.005	0.007	0.012	0.549	-0.018	0.032
11 to 17	-0.018	0.010	0.060	-0.038	0.002	0.028	0.018	0.128	-0.010	0.066
Any chronic condition (none as reference)	-0.048	0.008	0.000	-0.064	-0.032	-0.055	0.011	0.000	-0.078	-0.032
Self rated health										
(poor or fair as reference)										
Good	0.115	0.062	0.066	-0.014	0.244	0.090	0.051	0.079	-0.016	0.196
Very good	0.159	0.065	0.014	0.025	0.293	0.149	0.049	0.002	0.047	0.251
Excellent	0.179	0.064	0.005	0.048	0.311	0.181	0.047	0.000	0.083	0.278
Household income										
(less than $30,000 as reference)										
$30,000 to $59,999	0.013	0.012	0.258	-0.011	0.037	-0.013	0.029	0.658	-0.074	0.048
$60,000 to $99,999	0.023	0.011	0.034	0.000	0.045	0.002	0.018	0.922	-0.035	0.039
$100,000 to $149,999	0.027	0.012	0.030	0.001	0.053	-0.021	0.020	0.299	-0.062	0.021
$150,000 and over	0.027	0.013	0.039	0.000	0.054	0.007	0.016	0.660	-0.026	0.040
					numbers					
R-adjusted	0.1237	…	…	…	…	0.1419	…	…	…	…
Number of observations	2,297,136	…	…	…	…	2,329,185	…	…	…	…

… not applicable

Source: Canadian Health Measures Survey cycles 5 and 6, 2016 and 2017, and 2018 and 2019.

income greater than $100,000. Most children (81.2%) and adolescents (75.8%) did not have a chronic condition. Among those who reported a chronic condition, a long-term physical or mental health condition (12.6% for children and 15.1% for adolescents) and asthma (6.3% and 8.3%, respectively) were the most frequently reported conditions. Other chronic conditions included in the CHMS—such as bronchitis; a heart condition; diabetes; a mental handicap; and emotional, psychological or nervous difficulties—were not reported as their weighted prevalence was lower than 1%, and, as such, they did not comply with the vetting rules. Approximately 20% of children (17.9%) and adolescents (20.4%) were overweight, and almost 13% were obese (12.6% of children and 12.2% of adolescents). Almost 90% of children self-rated their health as either excellent (55.8%) or very good (31.9%). In contrast, two-thirds of adolescents rated their health as either excellent (21.1%) or very good (45.3%). Because of the small proportion of children and adolescents reporting poor health, and to comply with Statistics Canada vetting rules, poor and fair self-reported health were combined in one category.

Table 2 presents the HUI3 scores for children aged 6 to 11 years for the total population and by individual or household characteristics. The average HUI3 utility score among children was 0.95 (95% CI: 0.94 to 0.96; median: 1.00; IQR: 0.93 to 1.00), and almost 60% of children had an HUI3 score of 1.00 (i.e., perfect health). Clinically important differences in HUI3 scores (e.g., MCID of 0.03) in children were seen between

children aged 6 years (mean HUI3 score of 0.97) and children aged 11 years (mean HUI3 score of 0.94), with a difference of 0.03 (95% CI: 0.01 to 0.05) and between the lowest and highest household income groups (e.g., mean HUI3 score of 0.92 versus 0.96, respectively, with a difference of 0.04 [95% CI: 0.01 to 0.06]). Clinical differences in HUI3 scores were also observed between children living with a physical or mental health condition and those without such a condition (0.88 versus 0.96, a difference of 0.08 [95% CI: 0.05 to 0.10]) or between those living with any chronic condition, with one chronic condition, or with two or more chronic conditions and those without such a condition (e.g., 0.90 with any chronic condition versus 0.96 without any chronic condition, a difference of 0.06 [95% CI: 0.04 to 0.08]). No differences were seen in terms of BMI categories or asthma status.

Compared with children, adolescents aged 12 to 17 years had a lower average HUI3 score (0.89; 95% CI: 0.87 to 0.91), and fewer adolescents reported an HUI3 score of 1.00 (34%), as shown in Table 3. However, similar patterns in HUI3 scores were observed between children and adolescents in terms of the impact of income, self-rated health or having chronic conditions (i.e., lower HUI3 scores associated with the lowest income group, having a physical or mental condition, or having any chronic conditions). Table 2 (children) and Table 3 (adolescents) provide the details, along with the 95% CI values and the median or IQR values associated with the HUI3 scores.

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The results of the regression analyses to identify the determinants of HUI3 scores in children and adolescents are presented in Table 4. Results indicated that the presence of a chronic condition or poor or fair reported health was associated with a lower HUI3 score (p-value < 0.0001) for both populations. Increased age and decreased income levels were statistically associated with lower HUI3 scores for children but not for adolescents. The adjusted R-square was 0.14 for the child model and 0.16 for the adolescent model.

The results of the logistic regressions (Table 5) to determine the factors associated with perfect health (i.e., HUI3 score of 1.00) showed that children and adolescents with at least one diagnosed chronic condition were less likely to report an HUI3 score of 1.00. While increased age was associated with lower odds of reporting an HUI3 score of 1.00 for children, this association was not seen in adolescents. Self-rated health or income levels were not associated with a perfect HUI3 score in either population. The C-statistic associated with this study's models was 0.69 for the child model and 0.65 for the adolescent model.

When a lower threshold was explored for the logistic model as "almost" perfect health (HUI $\leq$ 0.973), no differences were found in the results (see Supplemental material). For example, for children with a chronic condition, the odds ratio for almost perfect health is 0.52 [95% CI: 0.37 to 0.94], which is the same for the model with HUI = 1.

Discussion

For the first time, utility norms for non-adult Canadians were provided, using the most recent population health surveys. Results indicated that the average utility scores for Canadian children aged 6 to 11 years and adolescents aged 12 to 17 years were 0.95 (median: 0.99) and 0.89 (median: 0.93), respectively. In addition to these differences in HUI3 scores, adolescents aged 12 to 17 years were less likely to have a perfect HUI3 score or to self-report good or excellent health. For both populations, meaningful clinical differences in HUI3 scores were observed between low and high household income levels; for self-rated health status; and for respondents living with a physical or mental condition, or with at least one chronic condition. Meaningful clinical differences in HUI3 scores were observed between sexes for adolescents only. Descriptively, there are large differences between the mean and the median HUI3 scores, which can be explained by the skewed nature of the HUI3 data. The results of the multivariate OLS analyses confirmed that for both populations, very good or excellent self-reported health was positively associated with increased HUI3 scores, while having at least one chronic condition was negatively associated with HUI3 scores. However, while age and household income levels were statistically associated with utility scores for children aged 6 to 11 years, age and household income levels did not play a significant role in determining HUI3 scores in adolescents aged 12 to 17 years.

Table 5

Logistic regression analyses associated with the children aged 6 to 11 years and adolescents aged 12 to 17 years experiencing perfect health (Health Utilities Index Mark 3 = 1)

	Children					Adolescents				
	Adjusted odds ratio	Standard error	p-value	95% confidence interval		Adjusted odds ratio	Standard error	p-value	95% confidence interval	
Characteristics				from	to				from	to
Sex (female as reference)	1.03	0.22	0.91	0.67	1.56	1.12	0.21	0.56	0.77	1.63
Age, year										
(6 or 12 as reference)										
7 to 13	0.65	0.16	0.08	0.40	1.06	0.93	0.27	0.79	0.52	1.63
8 to 14	0.59	0.11	0.01	0.41	0.86	0.93	0.26	0.81	0.54	1.62
9 to 15	0.51	0.12	0.00	0.33	0.81	0.86	0.27	0.63	0.46	1.59
10 to 16	0.55	0.12	0.01	0.36	0.84	0.59	0.17	0.07	0.34	1.04
11 to 17	0.36	0.09	0.00	0.22	0.59	1.42	0.35	0.16	0.88	2.29
Any chronic condition (none as reference)	0.52	0.09	0.00	0.37	0.74	0.65	0.12	0.02	0.45	0.93
Self-rated health										
(poor or fair as reference)										
Good	0.95	0.84	0.95	0.17	5.42	0.85	0.72	0.85	0.16	4.43
Very good	1.61	1.58	0.63	0.23	11.08	1.96	0.54	0.02	1.14	3.36
Excellent	3.23	2.97	0.20	0.53	19.66	2.27	0.53	0.00	1.43	3.59
Household income										
(less than $30,000 as reference)										
$30,000 to $59,999	1.38	0.39	0.25	0.79	2.40	1.02	0.50	0.97	0.39	2.67
$60,000 to $99,999	1.13	0.36	0.70	0.60	2.13	1.15	0.43	0.70	0.56	2.40
$100,000 to $149,999	1.30	0.51	0.51	0.60	2.80	1.04	0.38	0.91	0.51	2.13
$150,000 and over	1.67	0.42	0.04	1.02	2.73	1.41	0.54	0.37	0.67	2.98
					numbers					
C-stats	0.6765	...	...	...	...	0.6411	...	...	...	...
Nuber of observations	2,297,136	...	...	...	...	2,329,185	...	...	...	...

... not applicable

Source: Canadian Health Measures Survey cycles 5 and 6, 2016 and 2017, and 2018 and 2019.

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To the best of the authors' knowledge, no studies have reported the utility scores in a country-representative sample of children. As such, it is difficult to compare the results with those of previous studies on health utilities in a population younger than 12 years.[14,15,29] Nonetheless, the results obtained on predictors of HUI3 scores are in line with those of a study conducted by Houben-van Herten and colleagues, which sought to identify potential determinants of HRQoL in a national representative sample for children aged 4 to 11 years living in the Netherlands. In this cross-sectional study, the authors used the Child Health Questionnaire Parental Form 28,[30] Despite using a different instrument for measuring HRQoL, the analyses identified similar determinants of HRQoL as compared with the present study. Notably, variables that describe the number of chronic conditions and the presence of behavioural or learning disabilities were found to be associated with the HRQoL of the child.[31] In the same sense, a meta-analysis for utilities in typically developed children found that, regarding the existence of diseases, utilities change across age, gender and geographic differences of children and adolescents.[29] In the case of adolescents, previous work using HUI3 but with the CCHS found the same results for individuals aged 12 to 19 years (mean HUI3: 0.89; median: 0.93).[12] This is also consistent with reported utility scores for people aged 15 to 24 years in Canada.[32] However, to the best of the authors' knowledge, there are no international studies that have generated utility scores in children using the HUI3, which could be used for comparison.

By defining utility norms for Canada in a non-adult population, this study makes an important contribution to the Canadian and international literature. There are, however, a few limitations associated with these analyses. First, they used a survey that was not designed specifically to collect information on children—unlike, for example, the Canadian Health Survey on Children and Youth, which does not include information on HRQoL, or Statistics Canada's National Longitudinal Survey of Children and Youth (NLSCY), which is focused only on children, their development and their health conditions. However, although it includes information about HRQoL, the NLSCY ceased in 2009, and only the first cycle (1994 and 1995) included

information regarding HRQoL.[33] Second, because of the survey design (not focusing mainly on children and chronic conditions), it was impossible to disclose the impact of certain conditions because of vetting rules (i.e., small cell count). In addition, the CHMS provided no information on the duration and severity of chronic conditions or other potential determinants of utilities. Third, although all individuals answered the HUI by themselves, children younger than 14 years did so under the supervision of a parent. This could introduce some bias since these children could have been influenced by their parents. Nonetheless, a systematic review has shown that the HUI was one of the instruments that best correlated between parents' and children's responses (direct and proxy), compared with the Child Health Utility-9D and the Quality of Well-Being Scale.[34] Fourth, while the utilities generated in this study are representative of the children aged 6 to 11 years and adolescents aged 12 to 17 years per the CHMS study design, the utilities derived across other categories (e.g., income levels and presence of chronic conditions) may not be representative of these subgroups.

Despite these limitations, this study has many strengths. The analyses were conducted using data from a large, nationally representative sample of Canadian children and adolescents, facilitating the generalization of findings. This study is the first to provide utility score estimates based on a nationally representative sample of children and youth. Furthermore, the stratification of utility scores by various sociodemographic and medical characteristics will facilitate the incorporation of subgroup analyses in economic evaluations, which is required by CADTH guidelines.[4] In addition, the rich dataset allowed for a comprehensive evaluation of utility score norms.

To summarize, this study provides the first-time utility score norms among a nationally representative sample of children and adolescents. Further research examining the determinants of utility scores of children and adolescents is warranted.

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