CANPLAY Pedometer Normative Reference Data for 21,271 Children and 12,956 Adolescents

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ABSTRACT

CRAIG, C. L., C. CAMERON, and C. TUDOR-LOCKE. CANPLAY Pedometer Normative Reference Data for 21,271 Children and 12,956 Adolescents. *Med. Sci. Sports Exerc.*, Vol. 45, No. 1, pp. 123–129, 2013. **Purpose**: The mean expected values of pedometer-determined steps per day for children and adolescents have been derived primarily from isolated studies on small or specific populations. The purpose of this study is to provide sex- and age-specific normative values so that researchers, clinicians/practitioners, other childcare workers, and families can compare children's and adolescents' pedometer-determined data to that of their peers. **Methods**: Data were collected between 2005 and 2011 on 21,271 children 5–12 yr and 12,956 adolescents 13–19 yr. Participants were recruited by telephone, logged their pedometer-determined steps per day for 7 d, and mailed back their logs. Normative data were provided in three formats: 1) mean steps per day by single-year age by sex; 2) increments of 5 percentile values for each single-year age by sex, smoothed within and across years; and 3) quintiles (in ascending order: lowest, lower than average, average, higher than average, and highest) for four combined age groups (5–7, 8–10, 11–14, and 15–19 yr) stratified by sex. **Results**: Mean steps per day increased from 11,602 steps per day among 5-yr-olds to a sample peak mean value of 12,348 steps per day among 10-yr-olds, and then declined to 9778–10,073 among 15- to 19-yr-olds. Although not significantly different among 19-yr-olds, mean steps per day were higher among boys than girls at every age. **Conclusions**: CANPLAY data represent the largest and most comprehensive set of sex- and age-specific normative reference data for children's and adolescents' pedometer-determined physical activity to date. A clear assemblage of such values is fundamental for surveillance, screening, comparison purposes, planning strategies, prioritizing efforts and distributing resources, evaluating intervention effects, and tracking change.
Key Words: WALKING, PHYSICAL ACTIVITY, EXERCISE, ASSESSMENT, MEASUREMENT

EPIDEMIOLOGY

The collection of children's and adolescents' pedometer-determined physical activity (typically expressed as steps per day) is growing more and more common place in both research and practice. Until recently, no large representative set of pedometer data existed to provide standards for interpreting values of ambulatory physical activity. Therefore, it could not be determined whether any specific sample of 10-yr-old boys recruited to a physical activity intervention (by way of a single example) were less active than other 10-yr-old boys. A source of expected or normative values is required. An early attempt to describe such values (22) was based on a single relevant study published between 1980 and 2000; the conclusion reached was that 8- to 12-yr-olds were expected to average 12,000 (girls) to 16,000 (boys) steps per day (14).

Since that time, two other reviews (1,21) have compiled the quickly growing body of step-defined physical activity literature, publishing collectively assembled normative data representing the age span of 5- to 19-yr-olds. For children, girls average between 10,000 and 13,000 steps per day and boys average between 12,000 and 16,000 steps per day. In general, the highest values for steps per day culminate before the age of 12 yr, and then appear to deteriorate with each year of adolescence, closing at approximately 8000 to 9000 steps per day before the transition to young adulthood (18). Although useful, these assembled values were culled from literature that might be best described as fragmented (i.e., assorted and missing age groups, various regions and countries, etc.) and disjointed (i.e., diverse instrumentation and technologies used, distinct methods of data collection and treatment, etc.). What is missing from this evolving landscape is a broad and inclusive sex- and age-specific source of normative data

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Submitted for publication May 2012.
Accepted for publication July 2012.

0195-9131/13/4501-0123/0
MEDICINE & SCIENCE IN SPORTS & EXERCISE®

DOI: 10.1249/MSS.0b013e31826a0f3a

collected from a large national sample, in the same manner, using the same instrument. With such a resource, both group-level and individual-level child/adolescent data could be confidently compared with that of representative peers, facilitating interpretation. Such a large data source has recently become available in Canada, and its findings revealed similar age-related distribution of steps per day for boys and girls to that assembled earlier (6).

The Canadian Physical Activity Levels Among Youth (CANPLAY) study is an ongoing child and adolescent surveillance study that has collected pedometer data consistently using the Yamax SW-200 pedometer on more than 34,000 5- to 19-yr-old participants from across Canada between 2005 and 2011. The purpose of this analysis of the CANPLAY data is to provide a comprehensive and sex- and age-specific normative data for children's and adolescents' pedometer-determined physical activity. The potential applicability of such data is broad and includes surveillance, screening, comparison purposes, planning strategies, prioritizing efforts and distributing resources, evaluating intervention effects, and tracking change.

METHODS

Data collection. The CANPLAY data collection protocol has been published previously (7), so only a summary is provided here. Children between 5 and 19 yr were selected by random digit dialing (contacting the household, selecting a parent or legal guardian respondent of children and youth throughout the year, including holiday periods) and a computer-assisted telephone interview was conducted with the parent. After presenting the study requirements during the interview, parents who agreed to their child's participation in the pedometer portion of the study (≅6000 families annually) were sent a data collection kit and prompted as necessary to return the data by mail in a timely manner (see additional details [6]). Specifically, participants were asked to wear the pedometer and log steps for up to seven consecutive days, weekdays and weekend days included. As previously reported, weekday steps were higher than weekend day steps (6). Most logging sheets included 7 d of recorded data with only 3% of boys and 4% of girls reporting 5 d or less (7). In total, 21,271 children and 12,956 adolescents returned completed sheets between 2005 and 2011. Extensive data checking, detailed previously (6,7), was conducted to assure data quality. Written informed consent was received from all participants. All protocols were approved by the Human Participants Review Committee of York University for all survey years and by the Health Canada ethics review board for years 2010–2011.

Data treatment analysis. Data treatment follows procedures that were described in greater detail previously in the original process (6) and descriptive epidemiology papers (7). Briefly, daily step counts less than 1000 and more than 30,000 steps per day were truncated to these limits. For this analysis, all values were included regardless of the number of days logged (as indicated earlier, in >95% of the cases, the pedometer was worn for at least 5 d [6]). The mean and 95% confidence interval (CI) were computed for steps per day (averaging steps taken over logged days) by each single-year age and for both sexes separately and combined.

Percentile values (5 percentile increments) were computed for each single-year age by sex. The percentiles in 5% increments were calculated using the LMS method (LMS Chartmaker Pro Version 2.3; Harlow Printing Limited, South Shields, UK), which uses a Box-Cox power transformation to normalize the data at each year of age. Splines were fitted by maximum penalized likelihood to create three age-specific, smoothed curves termed L (λ), M (median), and S (coefficient of variation). Equivalent degrees of freedom for L, M, and S measured the complexity of each fitted curve, and Q statistics tested for normality in the location, scale, and skewness of the z-scores. Percentile curves were created using the values of L, M, and S at each age along with the normal equivalent deviate. Smoothing constants were chosen to be as small as possible to bring the Q tests for each moment close to normality, therefore creating a parsimonious model. The model was fitted for the entire sample, and the L, M, and S values chosen for the entire sample were then applied to each gender separately. Finally, quintiles (cut by 20th, 40th, 60th, and 80th percentiles) were computed for four combined age groups (5–7, 8–10, 11–14, and 15–19 yr), stratified by sex.

All data were weighted by the sample weights in calculating means, LMS-derived percentiles, and quintiles to reflect the complex sample design and the age–sex distribution of the population. CIs were computed using the Statistical Package for the Social Sciences Complex Sample procedures (version 18; SPSS Inc., IBM, Chicago, IL) to account for the sample design.

RESULTS

In total, 34,227 children and adolescents (17,314 boys and 16,913 girls) participated in CANPLAY. As detailed in Table 1, participation was skewed toward children of younger ages, living in higher education and income level households, who were of normal weight and had parents who reported that they were just as active or more active than their peers. Being classified as overweight or obese and having parents who rated themselves as being substantially more active was more prevalent among boys. A minimum sample size was allocated to each province/territory in the sample design, and participation rates by region reflected this design feature.

Table 2 displays mean, CI steps per day for both sexes by age, and also by each single-year age stratified by sex. Mean steps per day increased from 11,602 steps per day among 5-yr-olds, to a sample peak mean value of 12,348 steps per day among 10-yr-olds, and then declined to 9778–10,073 among 15- to 19-yr-olds. Similarly, the mean values of steps per day increased from 12,049 steps per day among

TABLE 1. Participant characteristics.

		Total			Boys			Girls		
		N	Pct.	(95% CI)	*n*	Pct.	(95% CI)	*n*	Pct.	(95% CI)
Age	5–10 yr	15,492	44.3	43.5–45.2	7842	44.3	43.2–45.3	7650	44.4	43.3–45.5
	11–14 yr	10,870	29.4	28.8–30.0	5545	30.1	29.2–31.0	5325	28.7	27.8–29.6
	15–19 yr	7865	26.3	25.6–27.0	3927	25.7	24.7–26.6	3938	26.9	25.9–28.0
Region	Atlantic	9478	7.4	7.3–7.6	4709	7.2	7.0–7.5	4769	7.6	7.3–7.8
	Quebec	4155	27.2	26.6–27.9	2146	27.5	26.5–28.4	2009	27.0	25.9–28.1
	Ontario	7118	34.3	33.7–34.8	3639	34.6	33.7–35.5	3479	34.0	33.1–34.9
	West	10,770	30.8	30.3–31.4	5391	30.5	29.6–31.3	5379	31.2	30.4–32.1
	North	2706	0.3	0.2–0.3	1429	0.3	0.2–0.3	1277	0.2	0.2–0.3
Parent's education	Less than secondary	2147	5.8	5.3–6.3	1045	5.4	4.9–6.0	1102	6.2	5.5–6.9
	Secondary	6566	18.8	17.9–19.6	3246	18.2	17.3–19.2	3320	19.3	18.3–20.4
	College	10,887	33.1	32.1–34.1	5555	33.4	32.2–34.7	5332	32.7	31.5–34.0
	University	14,044	42.4	41.3–43.4	7154	42.9	41.7–44.2	6890	41.8	40.5–43.1
Household income	<$20,000	1365	3.2	2.9–3.6	692	3.2	2.8–3.7	673	3.2	2.8–3.7
	$20,000–29,999	1992	5.6	5.1–6.1	984	5.6	5.0–6.2	1008	5.6	5.0–6.2
	$30,000–39,999	2471	7.5	6.9–8.1	1257	7.7	7.0–8.5	1214	7.3	6.7–8.0
	$40,000–59,999	5503	17.9	17.0–18.8	2758	17.6	16.6–18.6	2745	18.2	17.1–19.3
	$60,000–79,999	5511	18.5	17.6–19.4	2847	18.3	17.3–19.4	2664	18.7	17.6–19.9
	$80,000–99,999	4358	14.9	14.1–15.7	2194	15.2	14.2–16.2	2164	14.6	13.6–15.6
	≥$100,000	9089	32.4	31.4–33.5	4580	32.4	31.1–33.7	4509	32.4	31.1–33.8
Parent's self-reported PA	Substantially more active	5595	25.0	24.3–25.7	2907	28.1	27.1–29.1	2688	21.8	20.9–22.7
	Slightly more active	9705	28.4	27.7–29.1	4912	29.0	28.0–29.9	4793	27.9	26.9–28.9
	Just as active	12,478	32.0	31.3–32.8	6202	29.2	28.2–30.1	6276	35.0	34.0–36.1
	Slightly less active	4801	11.6	11.1–12.1	2451	11.0	10.4–11.7	2350	12.3	11.5–13.0
	Substantially less active	955	2.4	2.2–2.7	479	2.3	2.0–2.6	476	2.5	2.2–2.9
	Depends on the time of year	64	0.1	0.1–0.2	38	0.1	0.1–0.2	26	0.1	0.1–0.2
Child's BMI classification	Normal weight	18,594	73.8	73.0–74.6	9031	70.7	69.6–71.8	9563	77.0	75.9–78.1
	Overweight	4580	16.5	15.9–17.2	2612	18.8	17.9–19.7	1968	14.2	13.4–15.1
	Obese	2808	9.7	9.2–10.2	1558	10.6	9.9–11.3	1250	8.8	8.1–9.5

5-yr-old boys to a sample peak mean value of 13,030 steps per day among 10-yr-olds, and then declined to 10,189–10,818 among 15- to 19-yr-old boys. For girls, the mean steps per day ranged from 11,095 to 11,638 among 5- to 10-yr-olds and was lower (9231–9476 steps per day) among 15- to 19-yr-olds. With the exception of 19-yr-olds, the mean steps per day were higher among boys than girls at every age. Table 3 presents the five quintile-defined categories (in ascending order: lowest, lower than average, average, higher than average, and highest) for the four combined age groups, stratified by sex. Consistent with the data presented in Table 2, the highest quintile of steps per day for both boys and girls increased between ages 5–7 and 8–9 yr and then appeared to decrease after ages 10–11 yr (Table 3).

LMC curves and detailed single-year age incremental percentiles values for steps per day are presented in Figure 1 and Table 4, stratified by sex. The LMS-generated 20th percentiles (smoothed within and across years) were higher than the "lowest" quintiles in Table 3 for boys 7, 11, 12, and 15 yr and for girls 11, 12, and 15 yr. The LMS-generated 80th percentiles were lower than the "highest" quintiles in Table 3 for boys 6–11 and 15 yr and girls of all ages. These differences reflect the LMS assumptions that differences between consecutive years of age occur uniformly and that the data are distributed normally, whereas a slightly skew quintile values are actually apparent in Table 3.

DISCUSSION

These CANPLAY data represent the largest and most comprehensive set of sex- and age-specific normative values for children's and adolescents' pedometer-determined physical

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TABLE 2. Mean (95% CI) steps per day by child/adolescent age and sex.

	Total			Boys			Girls		
Age	*N*	Steps per Day	95% CI	*n*	Steps per Day	95% CI	*n*	Steps per Day	95% CI
5	1974	11,602	11,393–11,811	1051	12,049	11,741–12,357	923	11,095	10,824–11,366
6	2451	12,033	11,844–12,223	1248	12,435	12,158–12,712	1203	11,627	11,369–11,884
7	2594	12,131	11,935–12,328	1322	12,700	12,419–12,981	1272	11,507	11,242–11,772
8	2765	12,198	12,012–12,384	1378	12,989	12,728–13,249	1387	11,435	11,186–11,683
9	2769	12,269	12,076–12,461	1350	13,097	12,807–13,386	1419	11,490	11,249–11,731
10	2939	12,348	12,160–12,535	1493	13,030	12,742–13,318	1446	11,638	11,414–11,862
11	2886	12,036	11,842–12,230	1412	12,694	12,401–12,987	1474	11,367	11,119–11,614
12	2893	11,391	11,198–11,584	1491	12,211	11,917–12,505	1402	10,510	10,278–10,741
13	2663	11,020	10,829–11,212	1351	11,816	11,541–12,091	1312	10,122	9879–10,364
14	2428	10,577	10,377–10,776	1291	11,114	10,812–11,415	1137	9988	9745–10,231
15	2231	10,073	9860–10,286	1172	10,650	10,340–10,960	1059	9476	9194–9758
16	2062	9778	9560–9995	983	10,344	10,014–10,673	1079	9252	8972–9533
17	1732	9938	9667–10,210	884	10,493	10,071–10,916	848	9343	9026–9660
18	1179	9988	9683–10,293	572	10,818	10,357–11,279	607	9231	8837–9625
19	661	9790	9346–10,234	316	10,189	9508–10,871	345	9439	8888–9990

TABLE 3. Quintile-defined normative categories of steps per day by sex and child/adolescent age group.

Steps per Day, Relative to Peers					
	Lowest	Lower than Average	Average	Higher than Average	Highest
Boys (age group, yr)					
5–7	<9452	9452–11,376	11,377–13,195	13,196–15,574	>15,574
8–10	<9837	9837–11,893	11,894–13,826	13,827–16,120	>16,120
11–14	<8562	8562–10,710	10,711–12,766	12,767–15,246	>15,246
15–19	<7190	7190–9204	9205–11,116	11,117–13,763	>13,763
Girls (age group, yr)					
5–7	<8975	8975–10,647	10,648–12,046	12,047–13,871	>13,871
8–10	<8928	8928–10,559	10,560–12,078	12,079–14,104	>14,104
11–14	<7744	7744–9404	9405–11,058	11,059–13,085	>13,085
15–19	<6439	6439–8251	8252–9812	9813–12,026	>12,026

activity to date and hence serve as an important reference source. They provide a significant improvement over previous attempts to describe expected values, aggregated from the extant literature that is largely based on disparate studies. That being said, the well-known differences (18) between boys' and girls' pedometer-defined physical activity was confirmed, with a single exception apparent for 19-yr-olds. Furthermore, previous reports (1,18,21) illuminating a childhood increase in steps per day, before peaking and subsequently decreasing across adolescence up until the transition to adulthood, was also substantiated with these CANPLAY data.

The mean values of accelerometer-determined steps per day have been previously published for U.S. boys and girls ages 6–19 yr based on 2610 participants with at least 1 d of monitoring in the 2005–2006 cycle of the National Health and Nutrition Examination Survey (20). The ActiGraph 7164 accelerometer was used; however, because it is known to be more sensitive to lower force accelerations than pedometers (10,16), the data were adjusted to provide values congruent with these instruments. These lower technology and lower cost instruments are more likely to be used in clinical and practical applications so adjustments were made in that original study to make the values meaningful on this level. Although useful in terms of providing mean expected values, a full range of percentiles has not yet been published from these data.

The mean accelerometer-determined steps per day collected on 1613 Canadian boys and girls 6–19 yr have also been reported for Canadian children (5), but again, a full range of percentiles have not been published. That smaller study used the ActiCal accelerometer, which has been validated in adults and children as a step counter (9,13); however, the applicability of its output relative to that collected by the Yamax SW-200 pedometer used in CANPLAY is unknown.

Just like there is no single universal value of curl ups, vertical jump, or grip strength performance by which all children or adolescents should be evaluated (3,4,12), these detailed normative reference pedometer data clearly demonstrate that there is no single value of steps per day that can be conveniently used to say what is "average" across both sexes and all ages. Instead, in keeping with the conventional provision of normative reference values for these fitness tests in children and adolescents (3,4), we offer similarly organized pedometer-determined physical activity data. These normative data will be valuable to a range of users (from researchers, to practitioners, to lay people) for a myriad and variety of purposes including surveillance, screening, comparative evaluations, planning strategies, prioritizing efforts and distributing resources, evaluating intervention effects, and tracking change. Uniquely, these data offer, for the first time, child and adolescent-specific values that can be considered indicative of relatively low levels of ambulatory physical activity. For example, from a research perspective, it will be possible to track and compare proportions of children/adolescents who are in the lowest quintile (i.e., falling below the 20th percentile defined by this distribution), just like we track and compare proportions defined as overweight/obese relevant to the 85th percentile of a BMI distribution (11). Determinants research can be used to identify characteristics of individuals and contextual factors external to the individual, which explain the relative position among quintiles. Intervention research can shed light on what behavioral and program elements work best for different ages of boys and girls categorized into different quintiles.

As just a few examples of practical application, researchers planning an intervention to increase steps per day among relatively inactive 10-yr-old boys could compare the baseline steps per day of those recruited to the normative values in

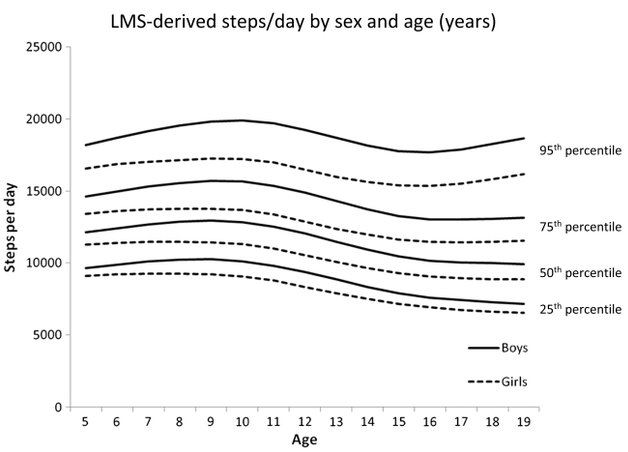

FIGURE 1—LMS-derived steps per day by sex and age (yr).

TABLE 4. Normative steps per day values by child/adolescent age in years and sex (LMS derived).

	5 yr	6 yr	7 yr	8 yr	9 yr	10 yr	11 yr	12 yr	13 yr	14 yr	15 yr	16 yr	17 yr	18 yr	19 yr
Percentiles															
Boys															
95	18,189	18,676	19,140	19,534	19,821	19,897	19,691	19,254	18,694	18,138	17,752	17,666	17,896	18,281	18,673
90	16,847	17,283	17,694	18,033	18,261	18,284	18,041	17,583	17,009	16,435	16,013	15,859	15,981	16,232	16,479
85	15,943	16,347	16,724	17,028	17,221	17,211	16,948	16,480	15,901	15,320	14,880	14,687	14,746	14,918	15,082
80	15,224	15,604	15,956	16,235	16,400	16,368	16,091	15,617	15,037	14,453	14,002	13,783	13,797	13,914	14,019
75	14,608	14,968	15,300	15,558	15,702	15,652	15,364	14,887	14,307	13,724	13,266	13,027	13,007	13,081	13,141
70	14,055	14,398	14,713	14,954	15,079	15,014	14,718	14,239	13,662	13,080	12,618	12,363	12,316	12,355	12,378
65	13,542	13,871	14,171	14,396	14,505	14,427	14,125	13,647	13,073	12,493	12,028	11,762	11,691	11,700	11,693
60	13,056	13,372	13,658	13,869	13,965	13,875	13,568	13,091	12,521	11,945	11,479	11,203	11,112	11,096	11,063
55	12,586	12,889	13,163	13,362	13,444	13,345	13,034	12,559	11,994	11,423	10,958	10,674	10,565	10,526	10,471
50	12,123	12,415	12,677	12,865	12,935	12,827	12,514	12,041	11,483	10,918	10,454	10,163	10,039	9981	9906
45	11,661	11,942	12,193	12,370	12,430	12,313	11,998	11,530	10,978	10,420	9959	9663	9526	9449	9357
40	11,191	11,462	11,703	11,870	11,919	11,796	11,480	11,016	10,473	9923	9466	9166	9017	8925	8817
35	10,706	10,967	11,199	11,356	11,395	11,266	10,950	10,492	9958	9418	8966	8665	8505	8398	8277
30	10,194	10,447	10,669	10,817	10,847	10,712	10,398	9948	9425	8896	8452	8149	7980	7861	7728
25	9643	9887	10,100	10,239	10,261	10,121	9810	9369	8860	8345	7909	7608	7431	7301	7158
20	9029	9264	9469	9600	9614	9471	9165	8737	8244	7745	7322	7024	6842	6702	6551
15	8314	8542	8738	8862	8869	8724	8426	8015	7543	7067	6660	6369	6183	6036	5881
10	7415	7636	7826	7944	7945	7802	7518	7131	6690	6244	5862	5583	5398	5248	5092
5	6084	6303	6491	6607	6608	6475	6219	5875	5486	5092	4753	4501	4327	4182	4035
Girls															
95	16,569	16,851	17,032	17,146	17,239	17,225	16,968	16,479	15,993	15,626	15,392	15,358	15,527	15,823	16,184
90	15,392	15,636	15,785	15,867	15,924	15,876	15,597	15,100	14,604	14,214	13,940	13,842	13,923	14,113	14,355
85	14,599	14,821	14,949	15,012	15,048	14,980	14,689	14,191	13,691	13,289	12,993	12,859	12,889	13,016	13,190
80	13,970	14,175	14,289	14,338	14,359	14,276	13,978	13,480	12,980	12,571	12,260	12,101	12,094	12,178	12,303
75	13,431	13,622	13,724	13,763	13,772	13,679	13,375	12,879	12,380	11,967	11,646	11,467	11,432	11,482	11,569
70	12,947	13,127	13,219	13,249	13,248	13,147	12,839	12,346	11,849	11,434	11,105	10,911	10,853	10,875	10,932
65	12,500	12,669	12,753	12,776	12,767	12,658	12,348	11,858	11,365	10,948	10,613	10,407	10,330	10,328	10,360
60	12,075	12,235	12,313	12,329	12,313	12,198	11,887	11,401	10,911	10,495	10,155	9938	9845	9822	9832
55	11,665	11,817	11,888	11,899	11,877	11,756	11,444	10,963	10,478	10,062	9720	9494	9386	9346	9337
50	11,262	11,406	11,472	11,478	11,450	11,326	11,014	10,538	10,057	9644	9299	9066	8945	8889	8863
45	10,859	10,996	11,057	11,059	11,026	10,898	10,587	10,117	9643	9232	8886	8646	8514	8444	8403
40	10,449	10,581	10,637	10,636	10,599	10,468	10,158	9695	9228	8820	8474	8229	8087	8004	7949
35	10,027	10,153	10,205	10,201	10,160	10,027	9720	9265	8805	8402	8057	7808	7657	7563	7496
30	9583	9703	9752	9745	9702	9567	9263	8818	8367	7970	7627	7375	7216	7111	7033
25	9103	9219	9265	9257	9211	9076	8777	8342	7902	7513	7173	6919	6754	6640	6553
20	8571	8682	8726	8717	8671	8536	8244	7822	7396	7016	6682	6428	6257	6136	6040
15	7951	8058	8102	8094	8048	7916	7633	7229	6819	6452	6127	5876	5702	5574	5472
10	7173	7279	7325	7320	7277	7151	6882	6502	6117	5769	5458	5212	5038	4907	4801
5	6024	6133	6188	6195	6162	6049	5808	5469	5124	4810	4525	4295	4128	4000	3896

Table 2 and determine eligibility of participants according to whether they fell in the 1st or 2nd quintile relative to their peers, or "lowest" or "lower than average." At a population level, characteristics of children and youth who report lower than "average" steps per day could be identified. Strategic plans could then be made to improve steps per day among this segment, and the effectiveness of these plans could be evaluated, tracked, and refined to further improve population levels of ambulatory activity of children and youth. Finally, these data are also available to clinicians and any child/adolescent who has ever worn a pedometer and was curious to know how their data compare relative to normative standards.

Previous attempts have been made to organize children's step data (1,21). Tudor-Locke et al. (23) proposed a sex-specific graduated step index for children 6–12 yr based on their earlier work (17,19), attempting to determine BMI-referenced criterion values for steps per day in 1954 in U.S., Australian, and Swedish children. Values for girls were 1) <7000; 2) 7000–9499; 3) 9500–11,999; 4) 12,000–14,499; and, 5) ≥14,500 steps per day. Values for boys were 1) <10,000; 2) 10,000–12,499; 3) 12,500–14,999; 4) 15,000–17,499; and 5) ≥17,500 steps per day (19). The descriptors assigned to these ranges were "copper" through "platinum." These previous data values are inconsistent primarily in the higher end values relative to the quintile-defined categories defined here, but this likely reflects the difference between a criterion-referenced approach (what children "should" be doing relative to a selected criterion, in this case a healthy BMI) and a normative reference approach (what children actually do, and relative only to each other). Both approaches have their unique advantages and disadvantages (2,8), and thus providing that these additional normative data are not only justified but needed.

Defining categories of activities by steps per day requires some sort of qualitative label to facilitate easy communication. Congruent with an adult graduated step index (20), each of the increasing categories (within each sex) could be interpreted as "sedentary," "low active," "somewhat active," "active," and "highly active." In keeping with calls to use the term "sedentary" only in regard to nonmovement and specifically in reference to sitting behaviors (15), it makes sense to relabel the lowest category "inactive." An alternative choice is to follow convention practiced by the Canadian Physical Activity, Fitness, and Lifestyle Approach to categorize anthropometric

and performance-testing results: "needs improvement," "fair," "good," "very good," and "excellent."(4) There were concerns over potential psychological effects related to such labels, therefore grounded in prevalent approaches to sports awards, there have also been attempts (20) to label children's increasing step-defined physical activity categories as "copper," "bronze," "silver," "gold," and "platinum." Furthermore, value-laden terms such as "good" imply having met a standard such as current physical activity guidelines (emphasizing time and intensity), whereas a consensus regarding step-based guidelines have yet to be achieved. Having carefully considered all options, we settled on a set of qualitative labels that we believe correctly and clearly communicate relative position in a distribution compared with peers: lowest, lower than average, average, higher than average, and highest. We believe that this strategy attempts to describe relative status across levels of a modifiable behavior (that which an individual has the ability to control, at least to some degree). However, we acknowledge that it may be difficult to avoid any potential for stigmatization whatever labels are applied; a lower level naturally implies a neglected behavior, for whatever reasons. Prudent application is advised when used at the individual level. However, we also firmly believe that such data-driven interpretation is necessary on all levels and should not be disregarded in an attempt to be excessively polite instead of proactive.

These data are based on a large representative sample of the household-based Canadian children and adolescents. Although physical ability, learning disabilities, and other such information was not asked in the recruitment interview, it is likely that the data were gathered only from those children/adolescents able to perform ambulatory physical activities. Furthermore, CANPLAY participants are more likely to be younger (5–10 yr), are less likely to live in lower income households, and have parents who are more educated (university graduates) and more active than their peers. Therefore, the application of these data will be most directly appropriate to similar populations. The data were collected using a research-grade (10,16) pedometer, and again, data obtained using similar instrumentation is most comparable. The Yamax SW-200 that has been adopted by CANPLAY is among the most commonly used pedometers in child and adolescents samples (21). There was no need to adjust these data in any manner to make them more applicable. The pedometer used in CANPLAY is a relatively inexpensive instrument (<Can$30), making it an accessible choice to nonresearch users including a full range of childcare workers, parents, and children/adolescents themselves. Although the grand majority of participants provided >5 d of data, we considered any number of days logged. We previously demonstrated no data patterns indicative of reactivity and that even a single day of monitoring is defensible in terms of population monitoring (7).

CONCLUSION

These normative pedometer-determined physical activity data were systematically collected for 6 yr and represent 21,129 children and 12,859 adolescents from across Canada. No other data source is comparable in terms of size or rigor at this time. The percentiles offered herein are of great value to researchers, clinicians/practitioners other childcare workers, and families interested in comparing children's and adolescents' pedometer-determined data to that of their peers.

This study has been made possible through a financial contribution from the Public Health Agency of Canada and the Interprovincial Sport and Recreation Council. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada or the Interprovincial Sport and Recreation Association. Furthermore, the results of the present study do not constitute endorsement by the American College of Sports Medicine.

The authors declare no conflicts of interest.

EPIDEMIOLOGY

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