Status report

Childhood overweight and obesity in Canada: an integrative assessment

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Abstract

Introduction: Obesity is a complex risk factor for chronic disease that is associated with a number of socioecological determinants. In this status report, we provide an overview of the socioecological framework that is now guiding our ongoing surveillance efforts in the area of childhood overweight and obesity. This framework considers individual risk and protective factors (sociodemographic, lifestyle, psychosocial and early-life) through the lens of the life stage, levels of influence and environments in which these factors play a role.

Methods: Using data from the Canadian Community Health Survey and the Canadian Health Measures Survey, univariate and bivariate analyses were used to report on behavioural, psychosocial, and early life factors associated with excess weight among Canadian children.

Results: Estimates of early-life (e.g. breastfeeding), behavioural (e.g. physical activity), and psychosocial factors (e.g. sense of community) are presented as they relate to age group, sex, income adequacy and weight status.

Conclusion: Building upon our recent reporting on trends in and sociodemographic factors associated with childhood obesity in Canada, this work illustrates the remaining risk and protective factors shown in our surveillance framework. This analysis supports the shift towards a holistic appraisal of determinants related to healthy weights.

Keywords: *overweight, obesity, children, youth, sociodemographic factors*

Highlights

- The surveillance of overweight and obesity trends in children and youth is important in informing research, programs and policies.
- Early-life, behavioural and psychosocial factors are related to excess weight in childhood.
- A greater proportion of normal weight children report consuming a healthy diet, which is a suggested behavioural protective factor, than obese children.
- A large majority of mothers report breastfeeding their children, which is a suggested early-life protective factor.

Introduction

In recent years, there has been a shift away from the "eat-less-move-more" paradigm of excess weight towards one that recognizes the multifactorial etiology of obesity and the importance of integrating a full socioecological, or integrative, understanding of its associated risk and protective factors.[1] Given the persistently high levels of excess weight among Canadian children and youth,[2] an integrated appraisal of its associated factors may inform our understanding of the health of this population to assist with public health efforts. This broader perspective is one that the Centre for Chronic Disease Prevention has similarly adopted for a variety of Public Health Agency of Canada (PHAC) surveillance initiatives.[3-6]

In this status report, we provide an overview of the socioecological framework that is now guiding PHAC's ongoing surveillance efforts in the area of childhood overweight and obesity. This framework considers individual risk and protective factors (sociodemographic, lifestyle, psychosocial and early-life) through the lens of the life stage, levels of influence and environments in which these factors play a role (Figure 1). Building upon our recent reporting on trends in and sociodemographic factors associated with childhood obesity in Canada,[2] this work illustrates the remaining (lifestyle, psychosocial and early-life) risk and protective factors shown in this surveillance framework. This integrated appraisal of factors also links to childhood obesity reporting included in the Chronic Disease and Injury Indicator Framework (CDIIF),[4] which is an important PHAC resource to guide research, programs and policy in Canada.

Methods

Data and data sources

We analyzed data from two population-based national health surveys for this paper: the Canadian Community Health Survey ([CCHS] Annual Component, 2014[7] and 2011–12,[8] and Mental Health Component, 2012[9]) and the Canadian Health Measures

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Survey ([CHMS], cycle 3, 2012/13[10]). We identified factors associated with excess weight within each survey, according to the levels of influence presented in Figure 1. Lifestyle factors included healthy diet, sugar-sweetened beverage consumption, physical activity, sedentary behaviour and sleep. Psychosocial and early-life factors included mood disorders and depression, self-perceived physical health, happiness, sense of community, trustworthy relationships and breastfeeding. The distribution of each factor according to sex, age group, income adequacy and weight status were examined, except for breastfeeding.

Statistical analyses

We classified weight status (normal, overweight, obese) using the WHO classification system,[11] and adjusted self-reported estimates using a correction factor.[12] We completed descriptive statistics using SAS Enterprise Guide version 5.1 (SAS Institute Inc., Cary, NC, USA). We weighted point estimates to reflect the Canadian household population and calculated 95% confidence intervals using bootstrap resampling methods.

Results and discussion

Lifestyle factors

Eating behaviours

A healthy diet provides the necessary nutrients for growth and development.[13] Healthy eating patterns and behaviours established in childhood form the foundation of lifelong healthy eating.[14] In the absence of detailed and regularly collected measures of healthy eating, surveillance of food consumption and general meal behaviours among children provide our best proxy measures of healthy eating.[15] To that end, national-level data on the consumption of vegetables, fruit and sugar-sweetened beverages provide an indication of eating behaviours among Canadian children and youth.

Vegetable and fruit consumption is a validated proxy measure for diet quality;[15] the consumption of 5 or more servings of vegetables or fruits per day is suggestive of a healthy diet.[15,16] Fewer than half of Canadian children and youth maintain a healthy diet (Table 1). Youth with better income adequacy and weight status consume a healthier diet (Table 1). While meal (breakfast, lunch, dinner) patterns of Canadian children are supportive of healthy dietary behaviours, the prevalence

FIGURE 1
Socioecological surveillance framework of childhood overweight and obesity: individual risk and protective factors, environment and level of influence

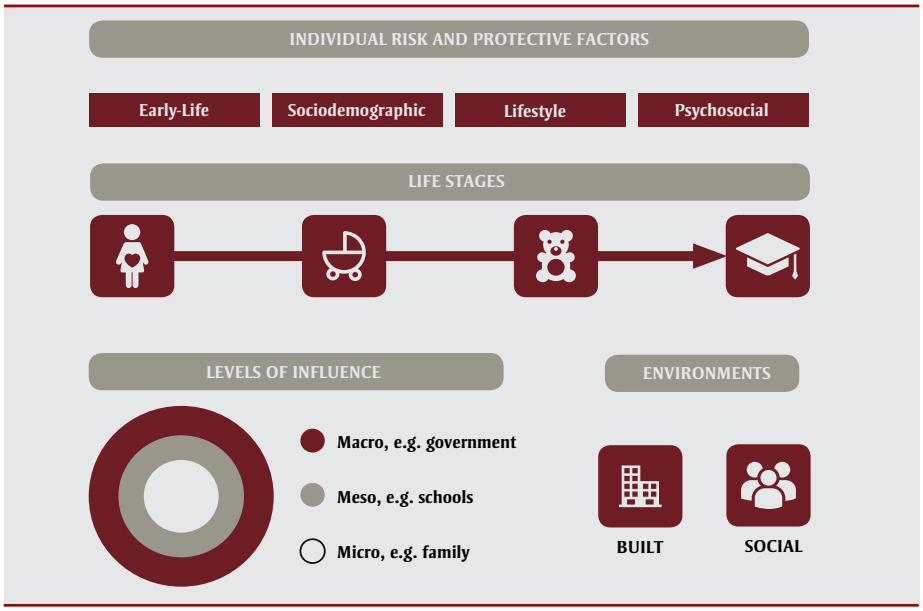

TABLE 1
Lifestyle factors associated with childhood obesity, Canada, CCHS 2014 and CHMS 2012/13

		Prevalence (%)	95% CI
Lifestyle factors			
Eating behaviours			
Healthy diet[a,c]			
Overall		43.6	41.7–45.5
Sex	Boys	39.3	36.7–41.9
	Girls	48.2	45.4–50.9
Income adequacy	Low	40.0	34.3–45.7
	Moderate	39.7	35.0–44.4
	High	48.8	45.9–51.6
Weight status	Normal	46.9	43.9–49.9
	Overweight	44.8	39.9–50.3
	Obese	37.1	30.7–43.5
Sugar-sweetened beverages[b,d]			
Overall		17.2	13.3–21.2
Sex	Boys	20.2	13.9–26.5
	Girls	14.2	9.6–18.7
Age group	5–11 years	13.4	9.7–17.0
	12–17 years	21.3	14.8–27.8
Income adequacy	Low	24.6	17.8–31.4
	Moderate	18.6	13.3–23.8
	High	10.6	5.4–15.9
Weight status	Normal	15.7	10.6–20.9
	Overweight	20.3	15.5–25.0
	Obese	21.5	10.7–32.2

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TABLE 1 (continued)
Lifestyle factors associated with childhood obesity, Canada, CCHS 2014 and CHMS 2012/13

		Prevalence (%)	95% CI
Movement behaviours			
Physical activity[b,e]			
Overall		9.3[E]	5.8–12.8
Sex	Boys	12.6[E]	6.3–18.9
	Girls	5.9	4.1–7.6
Age group	5–11 years	13.5	8.9–18.2
	12–17 years	5.0[E]	2.7–7.3
Income adequacy	Low	5.5[E]	2.3–8.8
	Moderate	11.3[E]	4.9–17.7
	High	10.2[E]	6.2–14.3
Sedentary behaviour[b,f]			
Overall		48.1	42.6–53.6
Overall hours		8.4	8.3–8.5
Sex	Boys	46.0	39.5–52.5
	Girls	50.1	44.1–56.2
Age group	5–11 years	71.1	64.5–77.6
	12–17 years	23.8	17.2–30.4
Income adequacy	Low	47.8	40.6–55.1
	Moderate	45.9	36.9–55.0
	High	49.3	42.4–56.3
Weight status	Normal	52.6	46.6–58.5
	Overweight	41.8	32.5–51.0
	Obese	37.0	24.0–50.0
Sleep[b,g]			
Overall		74.6	70.0–79.2
Overall hours		9.0	8.8–9.1
Sex	Boys	74.8	67.9–81.8
	Girls	74.3	69.2–79.5
Age group	5–11 years	81.8	77.1–86.4
	12–17 years	67.0	60.0–74.0
Income adequacy	Low	77.5	72.3–82.7
	Moderate	73.9	66.6–81.2
	High	61.1	40.6–81.7
Weight status	Normal	77.5	72.3–82.7
	Overweight	73.9	66.6–81.2
	Obese	61.1	40.6–81.7

TABLE 1 (footnotes)

Source: Statistics Canada, CCHS 2014, ages 12–17, and CHMS 2012/13, ages 5–17.

Abbreviations: CCHS, Canadian Community Health Survey; CHMS, Canadian Health Measures Survey; CI, confidence interval.

Note: Estimates of physical activity guideline adherence by weight status were suppressed due to high variability.

[a] Data from CCHS 2014, ages 12–17.

[b] Data from CHMS 2012/13, ages 5–17.

[c] Consumption of 5 or more fruits or vegetables per day.

[d] Consumption of ≥ 1 sugar-sweetened beverage per day.

[e] Adherence based on Canadian Physical Activity Guidelines[20] (60 minutes of moderate- to vigorous-intensity aerobic physical activity every day).

[f] Adherence based on Canadian Sedentary Behaviour Guidelines[19,22] (no more than 2 hours/day of recreational screen time).

[g] Adequate sleep based on National Sleep Foundation Guidelines[21,24] (10–13 hours for children aged 5 years; 9–11 hours for children aged 6–13 years; and 8–10 hours for children aged 14–17 years).

[E] Interpret with caution due to high sampling variability (coefficient of variation between 16.6% and 33.3%).

of breakfast consumption remained stable between 2002 and 2010, with 3 in 5 children between the ages of 11 and 15 years eating breakfast on weekday mornings.[13] Among children aged 11 years, 75% of boys and 69% of girls reported consuming breakfast, compared to 59% and 46% of boys and girls aged 15 years, respectively.[17]

Children often choose snacks in lieu of meals, particularly through adolescence. However, it is encouraging that the percentage of children and youth consuming potato chips and sweets on a daily basis had decreased significantly from 2002 to 2010.[13] Limiting the consumption of sugary drinks is also encouraged as part of a healthy diet.[18,19] A substantial proportion of children and youth (17.2%, 95% CI: 13.3–21.2) are drinking soft drinks, fruit drinks or sports drinks daily (Table 1). Individuals with low income adequacy consume higher levels of such beverages than their higher income counterparts (Table 1).

All-movement behaviours

Over the course of the 24-hour day, people engage in activity of varying intensity: moderate-to-vigorous physical activity, light activity, sedentary behaviour and sleep. An exceptionally low proportion of Canadian children (Table 1) are obtaining the amount of physical activity recommended by Canadian guidelines.[20] Notably, guideline adherence appears to decrease with age (Table 1), while weight increases with age, as described in our earlier article.[2]

Sedentary behaviours, such as watching TV, playing passive video games and using a computer, have been associated with obesity.[21] Canadian children and youth engage in an average of 8.4 hours (95% CI: 8.3–8.5) of sedentary activity each day. Canadian sedentary behaviour guidelines provide cut-offs for screen-based behaviours in children,[22] and recent data[10] suggest that 48.1% (95% CI: 42.6–53.6) adhere to these recommendations (Table 1). Sleep is also associated with obesity in children, with short sleep duration identified as a risk factor for excess weight.[23]

The data[10] suggest that approximately one-quarter of children and youth do not obtain adequate sleep (Table 1) based on the latest recommendations.[24] Furthermore, a significantly higher proportion of young children accumulate adequate sleep than youth (Table 1).

Supportive environments, such as schools, are key venues for physical activity engagement. Between 2006 and 2011, there was a 57% increase in the number of schools in Canada with a fully implemented policy for daily physical education.[25] Active transport, or physically active means of transportation such as walking, can contribute to a child's daily physical activity; however, it is estimated that only one-third (32.5%) of children aged 11 to 15 years used active transportation to get to school.[26] A large majority of school administrators in Canada report that students have access to built environment resources such as bicycle racks (79%), change rooms (75%), outdoor facilities (89%) and gyms (84%) during and outside of school hours.[25] In 2010, approximately 24% of parents cited safety concerns as a barrier to children playing outside.[27] In the same year, 93% of parents said that public facilities and programs were available for their children, but a lower proportion (65%) said that these facilities and programs met their needs.[28]

Psychosocial factors

Internal psychological state and external social (interpersonal) relationships are factors that can precede the development of obesity, as well as outcomes that may arise as a result of weight status.[29,30] As a result, people living with obesity are often affected by fear, anxiety and/or depression.[31] While youth report experiencing mood disorders or depression (4.0%, 95% CI: 3.3–4.8), findings do not demonstrate differences based on weight status (Table 2). Nevertheless, how individuals perceive their appearance, abilities and uniqueness can impact their weight status.[32] Recent data demonstrate that obese youth are less likely to report that they are in good health (Table 2). The stability of happiness across weight categories (Table 2), however, suggests that weight does not associate strongly with self-concept, as might be expected.[33]

With respect to external outlook, although social isolation has been associated with excess weight,[34] when we examined children's reported sense of community and

TABLE 2
Psychosocial and early-life factors associated with childhood obesity, Canada, CCHS 2011-12, 2012 and 2014

		Prevalence (%)	95% CI
Psychosocial factors			
Mental health			
Mood disorder and depression[a]			
Overall		4.0	3.3–4.8
Sex	Boys	2.8[E]	1.8–3.8
	Girls	5.4	4.2–6.5
Income adequacy	Low	6.1	4.1–8.0
	Moderate	3.8	2.6–4.9
	High	3.2	2.1–4.4
Weight status	Normal	3.3	2.3–4.3
	Overweight	4.6	2.5–6.7
	Obese	3.6	1.6–5.7
Internal perceptions of self			
In good health[a]			
Overall		69.9	67.8–72.0
Sex	Boys	70.6	67.9–73.4
	Girls	69.1	66.1–72.1
Income adequacy	Low	60.1	54.8–65.4
	Moderate	66.1	62.3–69.8
	High	76.1	73.6–78.5
Weight status	Normal	75.2	72.6–77.8
	Overweight	67.7	62.4–73.0
	Obese	51.8	45.2–58.5
Happy[b]			
Overall		90.9	89.7–92.1
Sex	Boys	93.0	91.5–94.5
	Girls	88.7	86.8–90.6
Income adequacy	Low	87.9	84.5–91.2
	Moderate	90.7	88.2–93.3
	High	92.4	90.8–94.1
Weight status	Normal	91.0	89.4–92.6
	Overweight	89.3	85.8–92.7
	Obese	90.1	86.2–93.9
External outlook			
Strong sense of community[a]			
Overall		79.6	77.9–81.3
Sex	Boys	77.3	74.7–79.8
	Girls	82.1	79.6–84.5
Income adequacy	Low	78.8	75.3–82.2
	Moderate	79.1	76.6–81.7
	High	81.2	77.4–85.0

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TABLE 2 (continued)
Psychosocial and early-life factors associated with childhood obesity, Canada, CCHS 2011-12, 2012 and 2014

		Prevalence (%)	95% CI
Weight status	Normal	79.6	77.4–81.9
	Overweight	80.3	75.8–84.8
	Obese	80.1	75.3–85.0
Trustworthy relationships[b]			
Overall		96.3	95.5–97.1
Sex	Boys	96.1	94.9–97.2
	Girls	96.6	95.4–97.8
Income adequacy	Low	93.4	91.0–95.9
	Moderate	96.2	94.8–97.6
	High	97.8	97.0–98.5
Weight status	Normal	96.7	95.7–97.7
	Overweight	95.8	93.6–98.0
	Obese	95.0	92.4–97.7
Early-life factors			
Breastfeeding			
Mothers who breastfed their child[c]		89.3	88.0–90.6
Mothers who exclusively breastfed their child for 6 months[c]		26.2	24.1–28.3

Source: Statistics Canada, CCHS—Mental Health Component, 2012; CCHS 2011-12; and CCHS—Annual Component, 2014. Data is for children ages 12–17.

Abbreviations: CCHS, Canadian Community Health Survey; CI, confidence interval.

[a] Data from CCHS—Annual Component, 2014.

[b] Data from CCHS—Mental Health Component, 2012.

[c] Data from CCHS 2011-12.

[E] Interpret with caution due to high sampling variability (coefficient of variation between 16.6% and 33.3%).

having trustworthy relationships, we observed no significant patterns on the basis of weight status (Table 2). Nevertheless, these psychosocial factors are also early-life factors that can affect health and weight at later ages.[29]

Early-life factors

A mother's preconception weight and her weight gain during pregnancy are two important prenatal factors associated with childhood obesity.[35,36] Women with high weight gain during pregnancy were at higher risk of having large-for-gestational-age babies, while those with low weight gain were at high risk for preterm birth and small-for-gestational-age babies.[35] Recent estimates suggest that one-third of Canadian women entering into pregnancy were overweight or obese and slightly less than half (48.7%) of women were gaining more than recommended.[37] In addition, child resemblance to parental (mother or father) body weight has been shown to be a result of complex interactions between environmental and genetic factors.[36,38,39]

Breastfeeding has been associated with lower rates of childhood obesity, and a majority of women who gave birth within a hospital or clinic in Canada were offered help by a health care professional to initiate breastfeeding within a half hour of birth.[35,40] In Canada, a large majority of mothers reported having breastfed their child, with roughly a quarter doing so exclusively for the child's first six months of life (Table 2).

Maternal smoking during pregnancy was also associated with child weight, with a 2.26 (95% CI: 1.23–4.15) odds of childhood obesity.[41] Roughly 10.5% of pregnant Canadian women smoke daily.[35]

Conclusion

Childhood obesity is a complex health issue impacted by a number of socioecological factors. While differences in individual risk and protective factors were not apparent on the basis of excess weight in childhood (except for healthy eating), childhood obesity has been shown to track into adulthood,[42] where these impacts may be more visible. The ongoing surveillance of overweight and obesity in children and youth, as well as the factors impacting them, helps to inform an understanding of population trends that can benefit future health efforts.

Conflicts of interest

The authors declare that there is no conflict of interest.

Authors' contributions

All authors were involved in the conceptualization and interpretation of the study. DPR was involved in the analysis of the data, and DPR, KCR, EK and MTD were involved in the drafting of the manuscript.

References

1. Bronfenbrenner U. Ecological models of human development. In: Gauvain M, Cole M, editors. Readings on the development of children. (2nd ed.) New York City (NY): Freeman; 1993:37-43.

2. Rao DP, Kropac E, Do MT, Roberts KC, Jayaraman GC. Childhood overweight and obesity trends in Canada. Health Promot Chronic Dis Prev Can. 2016; 36(9):194-8.

3. Centre for Chronic Disease Prevention, Public Health Agency of Canada (PHAC). Improving health outcomes: a paradigm shift: Centre for Chronic Disease Prevention strategic plan 2016–2019 [Internet]. Ottawa (ON): PHAC; 2015 Dec [cited 2016 Aug 29]. Available at: http://www.phac-aspc.gc.ca/cd-mc/ccdp-strategic-plan-2016-2019-plan-strategique-cpmc-eng.php

4. Centre for Chronic Disease Prevention, Public Health Agency of Canada (PHAC). Chronic Disease and Injury Indicator Framework: online data tool 2015 edition [Internet]. Ottawa (ON): PHAC; [modified 2016 Sep 19; cited 2016 Jul]. Available from: http://infobase.phac-aspc.gc.ca/cdiif/

5. Orpana H, Vachon J, Dykxhoorn J, McRae L, Jayaraman G. Monitoring positive mental health and its determinants in Canada: the development of the Positive Mental Health Surveillance Indicator Framework. Health Promot Chronic Dis Prev Can. 2016;36(1):1-10.

6. Roberts KC, Kropac E, Butler GP, Rao DP, Branchard B, Jayaraman GC. Bringing to PASS a modernized surveillance system: expanding physical activity surveillance reporting to incorporate sedentary behaviour and sleep. Manuscript submitted for publication.

7. Statistics Canada. Canadian Community Health Survey (CCHS)—Annual Component 2014 [Internet]. Ottawa (ON): Statistics Canada; 2014 Nov 24 [cited 2016 Jul]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function = getSurvey&Id = 164081

8. Statistics Canada. Canadian Community Health Survey (CCHS)—2011-2012. Ottawa (ON): Statistics Canada; 2012.

9. Statistics Canada. Canadian Community Health Survey (CCHS)—Mental Health Survey, 2012 [Internet]. Ottawa (ON): Statistics Canada; 2012 Sep 18 [cited 2016 Jul]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function = getSurvey&SDDS = 5015

10. Statistics Canada. Canadian Health Measures Survey (CHMS)—2012-13. Ottawa (ON): Statistics Canada; 2013.

11. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatr Suppl. 2006; 450:76-85.

12. Connor Gorber S, Shields M, Tremblay MS, McDowell I. The feasibility of establishing correction factors to adjust self-reported estimates of obesity. Health Rep. 2008;19(3):71-82.

13. Freeman J, Coe H, King M. Health behaviour in school-aged children: trends report 1990–2010. Ottawa (ON): Public Health Agency of Canada; 2014 [Catalogue No.: HP15-16/2013E-PDF].

14. Brug J, Tak NI, te Velde SJ, Bere E, de Bourdeaudhuij I. Taste preferences, liking and other factors related to fruit and vegetable intakes among schoolchildren: results from observational studies. Br J Nutr. 2008;99 Suppl 1:S7-S14.

15. Garriguet D. Diet quality in Canada. Health Rep. 2009;20(3):41-52.

16. World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO). Fruit and vegetables for health: report of a joint FAO/WHO workshop, 1-3 September 2004, Kobe, Japan [Internet]. Geneva (CH): WHO; 2004 [cited 2016 Jun] Available from: http://www.fao.org/3/a-y5861e.pdf

17. Currie C, Zanotti C, Morgan A, et al., editors. Social determinants of health and well-being among young people: Health Behaviour in School-aged Children (HBSC) study: international report from the 2009/2010 survey [Internet]. Copenhagen: WHO Regional Office for Europe; 2012 [cited 2016 Jun]. Available from: http://www.euro.who.int/__data/assets/pdf_file/0003/163857/Social-determinants-of-health-and-well-being-among-young-people.pdf

18. Langlois K, Garriguet D. Sugar consumption among Canadians of all ages. Health Rep. 2011;22(3):23-7.

19. Centre for Chronic Disease Prevention, Public Health Agency of Canada. Healthy weights in Canadian children: data blog [Internet]. Ottawa (ON): Public Health Agency of Canada [modified 2016 Sep 16; cited 2016 Sep]. Available at: http://infobase.phac-aspc.gc.ca/datalab/healthy-weights-blog-en.html

20. Tremblay MS, Warburton DER, Janssen I, et al. New Canadian physical activity guidelines. Appl Physiol Nutr Metab. 2011;36(1):36-46.

21. Chaput JP, Leduc G, Boyer C, et al. Electronic screens in children's bedrooms and adiposity, physical activity and sleep: do the number and type of electronic devices matter? Can J Public Health. 2014;105(4):e273-e279.

22. Tremblay MS, Leblanc AG, Janssen I, et al. Canadian sedentary behaviour guidelines for children and youth. Appl Physiol Nutr Metab. 2011;36(1):59-64.

23. Chaput JP, Lambert M, Gray-Donald K, et al. Short sleep duration is independently associated with overweight and obesity in Quebec children. Can J Public Health. 2011;102(5):369-74.

24. National Sleep Foundation. National Sleep Foundation recommends new sleep durations [Internet]. Arlington (VA): National Sleep Foundation; 2015 Feb 2 [cited 2016 Sep]. Available from: https://sleepfoundation.org/media-center/press-release/national-sleep-foundation-recommends-new-sleep-times

25. Active Healthy Kids Canada. Is Canada in the running? The 2014 active healthy kids Canada report card on physical activity for children and youth [Internet]. Toronto (ON): Active Healthy Kids Canada; 2014 [cited 2016 Aug]. Available from: http://dvqdas9jty7g6.cloudfront.net/reportcard2014/AHKC_2014_ReportCard_ENG.pdf

26. Pan-Canadian Public Health Network. Towards a healthier Canada - 2013 progress report on advancing the federal / provincial / territorial framework on healthy weights [Internet]. Ottawa (ON): Pan-Canadian Public Health Network [modified 2013 Oct 23; cited 2016 Nov]. Available from: http://www.phn-rsp.ca/thcpr-vcpsre-2013/images/indicators-data-table-eng.pdf

27. Pan-Canadian Public Health Network. Towards a healthier Canada - 2015 progress report on advancing the federal / provincial / territorial framework on healthy weights [Internet]. Ottawa (ON): Pan-Canadian Public Health Network [modified 2016 Jan 22; cited 2016 Oct] Available from: http://www.phn-rsp.ca/thcpr-vcpsre-2015/infographic-eng.php?pedisable = true

28. Canadian Fitness and Lifestyle Research Institute. Availability, use, and suitability of public facilities and programs. Bulletin 08 [Internet]. Ottawa (ON): Canadian Fitness and Lifestyle Research Institute; 2011 [cited 2016 Jun]. Available from: http://www.cflri.ca/document/bulletin-08-availability-use-and-suitability-public-facilities-and-programs

29. Puhl R, Brownell KD. Bias, discrimination, and obesity. Obes Res. 2001; 9(12):788-805.

30. Torres SJ, Nowson CA. Relationship between stress, eating behavior, and obesity. Nutrition. 2007;23(11-12): 887-94.

31. Puhl R, Latner J. Stigma, obesity, and the health of the nation's children. Psychol Bull. 2007;133(4):557-80.

32. Voelker DK, Reel JJ, Greenleaf C. Weight status and body image perceptions in adolescents: current perspectives. Adolesc Health Med Ther. 2015;6:149-158.

33. French SA, Perry CL, Leon GR, Fulkerson JA. Self-esteem and change in body mass index over 3 years in a cohort of adolescents. Obes Res. 1996;4(1):27-33.

34. Pizzi MA, Vroman K. Childhood obesity: effects on children's participation, mental health, and psychosocial development. Occup Ther Health Care. 2013;27(2):99-112.

35. Public Health Agency of Canada. What mothers say: The Canadian Maternity Experiences Survey. Ottawa (ON): Public Health Agency of Canada; 2009 [Catalogue No.: Cat.: HP5-74/2-2009E -PDF].

36. Zhang Q, Lamichhane R, Chen HJ, Xue H, Wang Y. Does child-parent resemblance in body weight status vary by sociodemographic factors in the USA? J Epidemiol Community Health. 2014;68:1034-42.

37. Kowal C, Kuk J, Tamim H. Characteristics of weight gain in pregnancy among Canadian women. Matern Child Health J. 2012;16(3):668-76.

38. Silventoinen K, Rokholm B, Kaprio J, Sorensen TI. The genetic and environmental influences on childhood obesity: a systematic review of twin and adoption studies. Int J Obes (Lond). 2010;34(1):29-40.

39. Keane E, Layte R, Harrington J, Kearney PM, Perry IJ. Measured parental weight status and familial socio-economic status correlates with childhood overweight and obesity at age 9. PLOS ONE. 2012;7(8):e43503.

40. Gionet L. Health at a glance: breastfeeding trends in Canada. Ottawa (ON): Statistics Canada. 2013 [Statistics Canada; Catalogue No.: 82-624-X].

41. Shi Y, de Groh M, Morrison H. Perinatal and early childhood factors for overweight and obesity in young Canadian children. Can J Public Health. 2013;104(1):69-74.

42. Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into adulthood: a systematic review of the literature. Obes Rev. 2008;9(5):474-88.