

Managing childhood obesity in primary care in Canada: What are the odds?

Stefan Kuhle, Rachel Doucette, Helena Piccinini-Vallis, Sara FL Kirk

Background The management of a child presenting with obesity in a primary care setting can be viewed as a multi-step behavioral process with many perceived and actual barriers for families and primary care providers. In order to achieve the goal of behavior change and, ultimately, clinically meaningful weight management outcomes in a child who is considered obese, all steps in this process should ideally be completed. We sought to review the evidence for completing each step, and to estimate the population effect of secondary prevention of childhood obesity in Canada.

Methods Data from the 2009/2010 Canadian Community Health Survey and from a review of the literature were used to estimate the probabilities for completion of each step. A decision tree model based on these probabilities was used to determine the proportion of children with obesity that would undergo and achieve clinically meaningful weight management outcomes each year in Canada. Results: We estimated that the probability of a child in Canada who presents as obese achieving clinically meaningful weight management outcomes through secondary prevention in primary care is around 0.7% per year, with a range from 0.02% to 7.5% per year. The lack of accessible and effective weight management programs appeared to be the most important bottleneck in the process.

Conclusions In order to make progress towards supporting effective pediatric obesity management, efforts should focus on population-based primary prevention and a systems approach to change our obesogenic society, alongside the allocation of resources toward weight management approaches that are comprehensively offered, equitably distributed and robustly evaluated.

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3 Stefan Kuhle, MD, PhD

4 Perinatal Epidemiology Research Unit, Departments of Obstetrics & Gynaecology and

5 Pediatrics, Dalhousie University, Halifax, NS, Canada

6

7 Rachel Doucette

8 Perinatal Epidemiology Research Unit, Departments of Obstetrics & Gynaecology and

9 Pediatrics, Dalhousie University, Halifax, NS, Canada

10

11 Helena Piccinini-Vallis, MD, MSc

12 Department of Family Medicine, Dalhousie University, Halifax, NS, Canada

13

14 Sara F.L. Kirk, PhD (corresponding author)

15 School of Health and Human Performance and Atlantic Health Promotion Research Centre,

16 Dalhousie University Halifax, NS, Canada

17

18 Corresponding Author:

19 Dr. Sara Kirk

20 School of Health and Human Performance, Dalhousie University

21 1318 Robie Street, PO BOX 15000, Halifax, NS B3H 4R2, Canada

22 Phone: 1-902-494-8440

23 Email: Sara.Kirk@dal.ca

25 INTRODUCTION

26 Nearly one third of children in Canada is considered overweight or obese (1). Obesity in
27 childhood often tracks into adulthood (2) and increases the lifetime risk of cardiovascular,
28 respiratory, orthopedic, gastrointestinal, and metabolic disease, among others (3). Further
29 influencing obesity is the obesogenic environment, a complex constellation of factors within the
30 broader environment, that negatively shape individual lifestyle choices, and which cannot be
31 easily addressed through approaches aimed at individuals (4). Examples include the ready
32 availability of energy dense, nutrient-poor foods and increasingly sedentary lifestyles that make
33 it challenging to adopt the behaviors required for weight loss to occur (5). Early identification,
34 diagnosis, and management of childhood obesity are therefore important actions for reducing the
35 burden of chronic disease and disability in adulthood (6). Primary care providers (PCP) play an
36 important role in the diagnosis, education, and management of children who are obese as they
37 commonly constitute the first point of contact within the health care system. A number of
38 guidelines for the identification and management of children (and adults) with excess weight
39 have been published over the last decade, e.g.,(5-8). However, the management of excess weight
40 in childhood is very complex, since the diagnosis may be associated with social stigma and
41 challenging to discuss with the family, interventions are less straightforward than a regular dose
42 of medication, and the evidence for the effectiveness of interventions is still limited (9).

43

44 Based on existing best practice guidelines for pediatric obesity management (5-7, 7, 8), the steps
45 involved in the assessment, diagnosis, and treatment of obesity in children within primary care
46 are typically conceptualized as follows (Figure 1):

47 1. The family has a regular PCP.

48 2. The child sees a PCP.

49 3. The PCP assesses the child's weight status.

50 4. The weight status assessment identifies the child as obese.

51 5. The PCP engages the family in discussion about weight management strategies.

52 6. The PCP initiates office-based weight management or refers the family to a weight
53 management program.

54 7. The child and the family adhere to the intervention and the intervention is effective in
55 changing the child's health behaviors and/or stabilizing/reducing the child's weight.

56

57 In order for a child with obesity to fully benefit from weight management support, all steps in
58 this process should be completed. This raises the question “what are the odds of achieving
59 clinically meaningful weight management outcomes after completion of a weight management
60 intervention in a primary care setting in Canada?”. We sought to review the evidence for the
61 completion of each step of this process, and to estimate the population effect of secondary
62 prevention of childhood obesity in Canada, so as to support decision-making regarding the
63 management of pediatric obesity within primary health care.

64

65 **MATERIALS & METHODS**

66 *Review of available evidence*

67 Given the paucity of available datasets within clinical settings, we used the Public Use Microdata
68 File of the Statistics Canada 2009/2010 Canadian Community Health Survey (CCHS)(10), a
69 representative cross-sectional survey of Canadian residents ages 12 and older (n = 124,188).
70 Analyses were performed in children and youth aged 12 to 17 years to estimate the proportion of

71 children with obesity that have a PCP and the annual incidence of primary care visits (self-
72 reported) in children who are obese (Steps 1 and 2).

73

74 For steps 3-7, we searched the literature using PubMed for English language articles on the
75 assessment, diagnosis, initiation of intervention, and completion of weight management
76 interventions in childhood published between January 2000 and April 2014. PubMed's "Related
77 citations" search was performed on relevant articles to identify additional studies. This process
78 was repeated until no further relevant studies were identified. Studies were deemed relevant if
79 they 1) were performed in Canada; 2) included participants between 5 and 18 years of age; 3)
80 provided rates or proportions for the assessment, diagnosis, management, or treatment of
81 childhood obesity in primary care. The full search strategy is available as a supplementary file.

82

83 *Determination of the population effect of secondary obesity prevention*

84 Probability estimates for completion of each step were calculated as described above (Steps 1
85 and 2) or were extracted or estimated from the existing literature (Steps 3-7) by two of the
86 authors (SK and SFLK). We converted annual rates of physician visits to probabilities using the
87 standard formula $p = 1 - e^{(-rate \times time)}$ (11). In addition to the probability estimate for each step, we
88 also used clinical judgment to choose two probabilities above and below the respective estimate
89 so as to create a best and a worst case scenario. We then created a decision tree model to simulate
90 a child's movement through the steps of primary care weight management using a random
91 process based on the set of transition probabilities determined from the CCHS and the literature
92 search. A simulated cohort of 1000 children with obesity was sent through the model to estimate
93 the proportion that would undergo successful weight management (in this context, defined as

94 completing all 7 steps outlined in Figure 1) each year in Canada. The process was repeated using
95 the worst and best case estimates. All analyses were performed in the statistical software package
96 R(12).

97

98 **RESULTS**

99 *The steps in the weight management process*

100 Step 1: The family has a regular primary care provider

101 Children of families who do not have a regular PCP will likely see PCPs only for acute care and
102 therefore may never enter into the weight management process. According to the CCHS
103 2009/2010, 87% of children who are obese have a regular PCP. We assumed 95% and 80% as
104 best and worst case estimates respectively.

105

106 Step 2: The child sees a primary care provider

107 Children in the CCHS 2009/2010 who were obese reported on average 2 PCP visits over the past
108 year. We assumed 3 and 1 visit(s) per year as best and worst case estimates.

109

110 Step 3: The primary care provider assesses the child's weight status

111 Body mass index (BMI) calculation and comparison to age-related reference values is considered
112 the recommended method to screen for excess weight in children, according to Canadian clinical
113 practice guidelines (6, 8). Self-reported data by Canadian PCPs shows that 60% of pediatricians
114 and 30% of general practitioners use BMI based on measured height and weight to assess weight
115 status in children and youth (13). A review of growth charts of children at five family physicians'
116 offices in Ontario found height and weight recorded in 59% of children between 2 and 6 years

117 but only 39% had more than one BMI entry recorded (14). Other methods to assess body weight
118 include visual inspection, waist circumference, and weight-for-age (15, 16) but there are no
119 estimates available on their frequency of use in Canada. Canadian guidelines for obesity
120 management recommend measuring the waist circumference in adults if the BMI is > 25 and \leq
121 35 kg/m^2 (6) but there is no such recommendation for children, possibly due to a lack of age-
122 related reference values for waist circumference in children of all ages. We assumed that 50% of
123 children would be likely to have their BMI measured at a PCP visit with 60% and 30% assumed
124 as best and worst case estimates. We further assumed that 20% of children would have a visual
125 assessment of their weight status (best case: 30%; worst case 10%).

126

127 Step 4: The weight status assessment identifies the child as obese

128 The current recommendation of the Canadian Pediatric Society is to use the WHO growth charts
129 for BMI (17) to identify obesity (18). However, BMI may not adequately account for the amount
130 of visceral fat, which is more closely associated with cardiovascular disease markers and
131 outcomes. The sensitivity of obesity (based on IOTF, WHO, or CDC cutoffs) for identifying
132 children with excess visceral fat reported in the literature ranges from approximately 70% to
133 95% (19-23). Based on the literature, we therefore assumed an 85% probability of correctly
134 identifying a child with excess visceral fat mass, with 95% and 70% as the best and worst case
135 estimates.

136

137 Step 5: The PCP engages the family in discussion about weight management strategies

138 After a diagnosis of obesity has been established, the PCP needs to raise the issue with the family
139 to explore family attitudes towards and options for weight management. However, advice given

140 during this discussion will likely be limited to the provision of information (what to eat, how
141 much to exercise, etc.) and does not constitute a weight management intervention. A recent
142 Canadian survey of PCPs in Canada showed that 85% of physicians who responded to the survey
143 routinely give parents of children who are obese and overweight advice about diet and physical
144 activity during office visits (13). Since the authors excluded missing responses from the analysis
145 and there is potential for social desirability bias and selection bias, this is likely an overestimate.
146 Therefore we assumed a probability of 60% to be a realistic estimate, with 85% and 40% as the
147 best and worst case estimates for engaging the family in discussion about weight management.

148

149 Step 6: The primary care provider initiates office-based weight management or refers the family
150 to a weight management program

151 Canadian clinical practice guidelines on the management and prevention of obesity recommend a
152 lifestyle intervention that aims at improving diet and physical activity as the first line of
153 management for pediatric obesity (6, 8). An intervention can be administered by the PCP or
154 through enrollment in a weight management program. There is no information available on how
155 many PCPs in Canada have the necessary training for delivering the intervention or how often a
156 structured, tested, and effective approach is used. We estimated that only 20% of PCP has the
157 training, time, and resources to initiate a structured in-office lifestyle intervention (best case
158 50%, worst case 10%).

159

160 The options for referring a child with obesity to a weight management program are very limited.
161 Within Canada, there are 23 childhood obesity management programs registered with the
162 Canadian Obesity Network's Weight Management Registry as of 2014 (24). All programs use a

163 multidisciplinary approach with a combination of behavioral lifestyle interventions, structured
164 exercise plans, energy reduced diets, pharmacotherapy, or bariatric surgery. There is a lack of
165 standardization among intervention components and program structure, and currently few
166 programs have published evaluations (25-27). The 15/23 programs that reported enrollment
167 figures treat between 10 and 3000 patients annually with the mean and median number of
168 patients per program being 304 and 68 (24). The number of children between 5 and 17 years of
169 age in Canada who were considered obese in 2013 was approximately 568,000 (1, 28). We
170 assumed a probability of 0.1% for being referred (and admitted) to a weight management
171 program, and considered 0.15% and 0.05% as best and worst case estimates.

172

173 Step 7: The child and the family adhere to the intervention and the intervention is effective in
174 changing the child's health behaviors and/or reducing or stabilizing the child's weight

175 Weight management interventions have traditionally been evaluated based on participants'
176 reductions in BMI after completion of the intervention. More recently, program evaluations have
177 begun to focus on sustainable changes in health behaviors and markers of chronic disease as
178 indicators of effectiveness. Thus, for the purposes of this study it is difficult to determine from
179 the available literature what proportion of children actually achieve clinically meaningful weight
180 management outcomes after completion of a weight management intervention.

181

182 Evidence on the effectiveness of office-based lifestyle counseling is limited given the often non-
183 standardized approach. As there are no Canadian data on the effectiveness of office-based
184 counseling for children or adults who are obese, we used the "5-2-1-0" strategy developed in the
185 US as a best practice model of a structured approach to office-based lifestyle counseling that has

186 been applied within primary care and is described in the literature (29, 30). This strategy
187 encourages children to meet evidence-based behavioral targets daily within a family focused
188 intervention: eat five servings of fruit or vegetables; limit screen time to less than two hours;
189 participate in physical activities for at least one hour; consume zero or minimal sweetened drinks
190 (30). Data from 12 PCP intervention sites in urban and rural areas of Maine demonstrated
191 behavior changes between 12% to 26% based on parental report (30). Two studies from
192 Minnesota that used the "5-2-1-0" behavioral modification program in primary care reported
193 adherence numbers for the full program of 6/68 (9%) (31) and 40/70 (57%) (32), respectively. In
194 the former study, average BMI reduction was 0.43% of baseline BMI, while decreases in BMI
195 were reported for 28% of the children in the latter study. A recent Cochrane review identified 17
196 interventions for childhood obesity in primary care, 12 of which reported a significant effect
197 immediately following the intervention. Seven out of 17 studies maintained the effect for months
198 to years post intervention (33). Effect sizes ranged from small decreases in dietary sugar intake
199 to substantial drops in overweight prevalence. Based on the above literature, we assumed a
200 probability of achieving clinically meaningful weight management outcomes as a result of a
201 structured or unstructured lifestyle intervention in the PCP office to be 15% with best and worst
202 case estimates of 25% and 5%.

203

204 Four Canadian weight management programs have published evaluations, which demonstrated
205 statistically significant, clinically moderate weight loss effects but high rates of attrition (26, 27,
206 34, 35). The Centre for Healthy Weights Shapedown BC obesity management program reports a
207 significant change from weight gain to weight loss at the end of the program. Measured as
208 monthly percentage weight change, youth in this program went from 0.89% weight gain at the

209 start of the program to 0.37% weight loss at completion. There were also significant
210 improvements in fasting insulin levels, physical activity levels and measures of mental
211 wellbeing. However, only 32.8% of participants (39/119) attended all 10 weekly group sessions
212 (27). A randomized controlled trial of two one-on-one lifestyle interventions in a weight
213 management clinic in Edmonton, Alberta, showed modest short-term decreases in BMI-z scores
214 of 3.9% and 6.5% compared to a wait list control group. Attrition rates in both intervention
215 groups were around 40% over the 16-20 week program, and were highest shortly after the
216 initiation of the program. However, those who completed the program had a high degree of
217 participation (34). A family-focused, behavior-based education program in Calgary had 78%
218 completion rate (271/345) over the course of 8-12 weeks. Participant BMI z-scores on average
219 decreased from 2.14 to 2.08 (26). Program attrition in an interdisciplinary, individualized care
220 weight management program in Edmonton, Alberta, was 49 and 73% at 7 and 11 months, with 8
221 and 5% of children showing BMI decreases at these time-points (35). Given the considerable
222 heterogeneity between studies with regard to sample characteristics, settings, interventions, and
223 outcome measures, we estimated the probability of achieving a healthy weight as a result of a
224 structured or unstructured lifestyle intervention in the PCP office to be 15%, with best and worst
225 case estimates of 25% and 5%.

226

227 *Cumulative probability of successful childhood obesity management*

228 The estimated probabilities from the literature for the completion of each step of the weight
229 management process are shown in Figure 1. We estimated that the probability of a child in
230 Canada who is considered obese achieving a healthy weight through secondary prevention in
231 primary care to be around 0.6% per year, with a range from 0.01% to 7.2% per year. By way of

232 example, out of 1000 Canadian children, on average 117 will be obese (1), and of these, one
233 child (worst case: none, best case: eight children) is estimated to achieve a healthy weight each
234 year through primary care-initiated weight management intervention.

235

236 **DISCUSSION**

237 In this present study, we have examined the process of weight management in primary care and
238 have proposed a model to describe and simulate this process. Based on estimates derived from a
239 review of the literature, the probability of positively changing health behaviors in obese children
240 and/or achieving clinically meaningful weight loss is currently very low. Our study has identified
241 multiple targets for improvement of weight management outcomes but there are some limitations
242 that should be acknowledged. Most importantly, the estimates for successful weight loss
243 presented in this study, while based on evidence available from the literature, may not be
244 accurate as the probabilities for completion of each step were difficult to estimate due to
245 heterogeneity of study populations, interventions, and outcome measures that are currently
246 presented in the literature. The decision tree model used to estimate the net population effect of
247 secondary obesity prevention does not take into account factors that may modify the chance of
248 success, such as actual BMI, existence of comorbidities, age, gender, parental weight status, area
249 of residence, or access to care. Considering these factors would require a more complex
250 microsimulation model, incorporating more detailed data than is currently available and therefore
251 relying on more assumptions. Whether this would change the conclusion reached in our approach
252 - that childhood obesity management under the current primary care model will only help a very
253 small number of children – is therefore not known. The underlying assumption of our process
254 model - that the probabilities for completion of each step are independent from each other - is

255 likely not the case in actuality. However, the paper has further highlighted the complexity of
256 childhood weight management, the potential for failure at multiple points in the process, and the
257 potential for substantial impact on outcomes should all the steps outlined in theory actually be
258 completed in practice.

259

260 Relational continuity of care is critical for the effective and successful management of childhood
261 obesity in primary care as it allows PCPs to integrate the proximal and distal contexts of the
262 child and family into the management plan. For 13% of Canadian families, who access primary
263 care through walk-in clinics, emergency rooms, or who may regularly change GPs, the lack of
264 continuity of care provides the first major barrier for the management of childhood obesity (and
265 other health conditions, for that matter). While the data from the CCHS do not provide
266 information on the reason for attending a PCPs office, visits that are primarily motivated by
267 concerns about the child's weight are likely rare. Data from Canada (36) and other countries (37-
268 39) show that parents are often incorrect in their perception of their child's weight status and tend
269 to underestimate their child's weight, especially if they are overweight or obese themselves (36,
270 37). Jeffery et al. suggested that the lack of awareness may be due to denial or a desensitization
271 to excess weight given the high prevalence of obesity (37). Parents are "critical partners" (37) for
272 PCPs in the management of childhood obesity, and their lack of awareness or concern with their
273 child's weight status constitutes a major barrier to identification of obesity as well as to initiating
274 and sustaining a change in lifestyle behaviors.

275

276 Calculation of BMI based on measured height and weight in children and adults during PCP
277 visits has been recommended by various medical professional bodies and task forces in Canada

278 (6, 8, 15, 40) but the implementation in clinical practice has been limited. Of the children who do
279 have a regular PCP, 60% or fewer will have their weight status measured or recorded during a
280 visit (13, 14). In primary care practices where BMI is not regularly recorded, physicians named a
281 lack of familiarity with BMI, lack of agreement with the use of BMI as a screening tool, limited
282 time during appointment, and skepticism about treatment effectiveness as barriers (41). There is
283 some evidence that rates of BMI measurement may improve through provider education, clinical
284 practice tools, and the use of electronic medical records that prompt for regular weight
285 measurements or automatically calculate the BMI percentile (42-46).

286

287 The most important barrier to managing pediatric obesity in primary care, as identified by more
288 than 70% of respondents in the survey of survey of Canadian PCPs by He et al., was the
289 ‘obesogenic environment’ (13). An obesogenic environment is typically defined as ‘the sum of
290 influences that the surroundings, opportunities, or conditions of life have on promoting obesity in
291 individuals or populations’ (47). Other barriers included time constraints, lack of training,
292 support, and options for referral, parents with obesity who are perceived to be poor role models,
293 lack of patient motivation to change behaviors, and poor compliance with recommendations for
294 change. Physicians were also concerned that they may interfere with family function, contribute
295 to stereotypes, negatively influence a patient's self esteem, or precipitate an eating disorder in a
296 child that is obese (13). These barriers and concerns are echoed in studies from other countries
297 (48-50), highlighting a pressing need for a more holistic approach to obesity management and
298 prevention, that recognizes the complex constellation of factors in its etiology.

299

300 We believe that engaging the family in discussion about the child's weight and initiating office-

301 based counseling are distinct issues and hence we separated the two in our process model. While
302 the majority (85%) of PCPs in the survey by He et al. stated that they routinely give parents of
303 children who are obese advice about diet and physical activity during office visits (13), this
304 likely does not constitute a formal weight management intervention. Our literature search did not
305 identify any studies that provided information on how often a formal office-based behavior
306 modification intervention is initiated by PCPs in Canada. If we use documentation of a diagnosis
307 of obesity, either on the chart or on the billing form, as a proxy indicator for discussing the issue
308 with the family, the actual proportion of obese children that receive an office-based weight
309 management intervention is likely very low. A Canadian study linking a population-based survey
310 with physician billing data showed that only 10% of children aged 10-11 years with a BMI,
311 based on measured height and weight, that identified them as obese received an ICD code
312 diagnosis of obesity during the same year, with a quarter of obese children that did not have an
313 obesity diagnosis having a BMI between 28.5 and 44.0 kg/m² (51). According to US studies,
314 documentation of a diagnosis of obesity on the charts ranged from 18 to 66% of children who
315 were identified as obese based on their measured BMI (52-55). There is also a need to consider
316 whether an additional step be included, given that there is increasing evidence that parents may
317 not accurately perceive the weight status of their child(ren). For example, a recent large meta-
318 analysis (56) revealed that half the parents included in the studies reviewed underestimated their
319 children's overweight/obese status and a significant minority underestimated children's normal
320 weight. This has important implications for the number of children who might even enter into the
321 weight management process.

322

323 One of the main barriers reported by the majority of respondents in the survey of PCPs in
324 Canada was the lack of options for referral (13). The programs registered with the Canadian
325 Obesity Network are distributed in major cities and are mostly associated with hospitals and
326 academic centers, which provides a barrier to access for people living outside the urban core. For
327 example, one in five patients referred to a weight management program in Edmonton, AB, lives
328 more than hour drive away from the program location (57). There are programs in most
329 Canadian provinces, with the exception of Saskatchewan, Nova Scotia, and Prince Edward
330 Island, and there are currently no programs in any of the three territories, highlighting that
331 programs are lacking in regions where they are likely needed the most (58, 59). The limited
332 access to weight management programs in Canada puts the onus on PCPs to initiate lifestyle
333 interventions in the office. It also highlights the need for population health interventions that
334 have a greater chance of impact on the behaviors (i.e., diet and physical activity interventions)
335 that influence health across whole populations rather than focusing on obesity only.

336

337 There are limitations to this approach that should be considered. First, we did not consider
338 pharmacotherapy or bariatric surgery as intervention options in our model as they are only
339 indicated in a small proportion of children with obesity and their long-term success is dependent
340 on concurrent support by an interdisciplinary weight management program (60). The outcomes
341 of the weight management program evaluations reported in the literature vary considerably and
342 include health behaviors, cardiovascular disease markers, and various measures of body fatness,
343 which hampered any meaningful estimation of what could be considered to be a successful
344 outcome. Moreover, we found no consistent definition of what success in pediatric weight
345 management actually means or any studies that considered weight maintenance as an outcome.

346 Moreover, the follow-up period of the studies was often limited to a few weeks or months and
347 since there are no data available on the sustainability of the outcomes of Step 7, the long-term
348 success rates may even be lower than indicated. Although the steps upon which we based our
349 assumptions are derived from existing guidelines and recommendations, they are open to
350 criticism, since there are likely many other approaches to management of obesity in childhood;
351 this is a fast moving field where evidence is emerging constantly. There remain a number of
352 challenges with defining successful weight management for pediatric obesity, and a lack of data
353 to inform this debate. We do not seek to provide the “only approach”, but to illustrate the flaws
354 within the steps that are typically considered on the management pathway for childhood obesity,
355 particularly in Canada, and upon which existing management guidelines are typically based.
356 Other approaches are in existence, e.g., the 4-step approach outlined by Spear et al (61). Ours is
357 just one approach that we hope will stimulate discussion regarding the capacity of the primary
358 (and other components of the) health care system to address pediatric obesity, and to what extent
359 each of the steps listed might be operationalized. We also acknowledge that other countries and
360 jurisdictions may have different experiences that could alter these conclusions, although there is
361 evidence from European studies that suggest similar barriers are encountered within primary care
362 (62, 63).

363

364 **CONCLUSIONS**

365 Within the prevailing model of care, and as outlined in the model described in this paper, we
366 predict that only a very small fraction of children who are obese will achieve a healthy weight
367 through a primary care intervention in Canada. The lack of accessible and effective weight
368 management programs appears to be the most important bottleneck in the process. While the

369 optimal process to manage childhood obesity in primary care remains open to debate, our
370 findings point to the need for greater effort to be focused on population-based primary
371 prevention and a systems approach to change our obesogenic society. There is also a need to
372 allocate additional resources toward evidence-based obesity management initiatives for children
373 that are comprehensively offered, equitably distributed and robustly evaluated.

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547 **FIGURE**

548

549 **Figure 1. The steps involved in the assessment, diagnosis, and treatment of childhood**

550 **obesity in primary care.** Numbers indicate the estimated probabilities (and "worst case"/"best

551 case" estimates) for completion of the respective step based on a literature review.

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Figure 1 (on next page)

Figure 1

