Eating Away from Home: influences on the Dietary Quality of Adolescents with Overweight or Obesity

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ABSTRACT

Purpose: To examine the influence of peers and the source of meals and snacks on the dietary quality of adolescents seeking obesity treatment.

Methods: Baseline surveys were completed by 173 adolescents with overweight or obesity (11–16 years old) enrolled in an e-health intervention in Vancouver, British Columbia. Dietary quality was assessed with three 24-h dietary recalls used to compute a Healthy Eating Index adapted to the Canadian context (HEI-C). Multiple linear regression examined associations between HEI-C scores and the frequency of: (i) meals prepared away from home, (ii) purchasing snacks from vending machines or stores, (iii) eating out with friends, and (iv) peers modeling healthy eating.

Results: Adolescents reported eating approximately 3 lunch or dinner meals prepared away from home and half purchased snacks from vending machines or stores per week. After adjusting for socio-demographics, less frequent purchases of snacks from vending machines or stores (β = −3.00, P = 0.03) was associated with higher HEI-C scores. More frequent dinner meals prepared away from home and eating out with friends were only associated with lower HEI-C scores. The HEI-C was significantly lower among adolescents who frequently purchased snacks from vending machines or stores, and spent more time eating at restaurants.

Conclusions: Snack purchasing was associated with lower dietary quality among obesity treatment-seeking adolescents. Improving the healthfulness of foods obtained away from home may contribute to healthier diets among these adolescents.

RÉSUMÉ


Méthodes : Un total de 173 adolescents obèses ou en surpoids (âgés de 11 à 16 ans) prenant part à une intervention en cybersanté à Vancouver, en C.-B., ont été invités à participer à des sondages au début de l’étude. La qualité de l’alimentation a été évaluée à l’aide de trois rappels diététiques de 24 heures utilisés pour mettre au point un indice de saine alimentation adapté au contexte canadien (ISA-C). Une analyse de régression linéaire multiple a permis d’examiner les associations entre les scores de l’ISA-C et la fréquence de : (i) consommation de repas et collations à l’extérieur de la maison; (ii) achats de collations dans des distributeurs automatiques ou en magasin; (iii) sorties au restaurant avec des amis; et (iv) auto-modélisation des habitudes de saine alimentation des pairs.

Résultats : Les adolescents ont indiqué manger environ trois dîners ou soupers préparés à l’extérieur de la maison et la moitié ont acheté des collations dans des machines distributrices ou en magasin chaque semaine. Après ajustement pour les données sociodémographiques, l’achat de collations dans des distributeurs automatiques ou en magasin (β = −3.00; p = 0.03) était associé à des scores moins élevés de l’ISA-C. Une fréquence plus élevée d’achats de soupers à l’extérieur de la maison et de sorties au restaurant avec des amis était uniquement associée à des scores d’ISA-C inférieurs dans les modèles non ajustés.

Conclusions : L’achat de collations était associé à une moins bonne qualité de l’alimentation chez les adolescents traités pour des problèmes d’obésité. Améliorer la valeur nutritive des aliments proposés à l’extérieur de la maison pourrait contribuer à rendre l’alimentation de ces adolescents plus saine.

INTRODUCTION

Obesity in adolescence is a critical public health concern in Canada. One-third of Canadian adolescents are overweight or obese, which represents a tripling over the last 3 decades [1, 2]. Some evidence suggests that this increase has coincided with a rise in unhealthy eating behaviours [3]. Canadian studies have shown that consumption of energy-dense, nutrient-poor foods and beverages increases during adolescence (e.g., sugary drinks, fast foods, and snacks) [4–6] and may be of concern if behavioural patterns acquired during this period continue into adulthood. Promoting a healthy diet is currently a pillar of adolescent obesity-treatment programs; however, success in improving dietary quality has proven difficult [7].

A better understanding of the behavioural aspects of diet (e.g., where are meals and snacks obtained and who are they eaten with) may help to better tailor intervention components and improve effectiveness.

Meals and snacks prepared outside the home (e.g., lunch purchased at school as opposed to prepared at home) are “away from home” behavioural dietary factors that may be particularly relevant for adolescents who are the target of obesity treatment interventions. These are relevant factors because adolescents experience growing independence from family, they are likely to make more eating decisions outside the home [8], and there is evidence that eating away from home is associated with lower dietary quality and weight.
Current trends in Canada reveal that fast-food intake is highest among adolescents, those with lower dietary quality, and those who are overweight [9]. In addition, a Canadian study of high school students found that lunches from home were associated with greater fruit and vegetable consumption, purchased lunches from food outlets were associated with more frequent sugar-sweetened beverage intake, and lunches from school were associated with both greater sugar-sweetened beverage intake and fruit and vegetable intake [10].

In addition to the source of meals and snacks away from home, peers further influence diet while away from home through social norms and modeling [11]. For adolescents who are overweight and seeking treatment, the influence of peers may be complicated by atypical relationships arising from stigma, low self-esteem, and social isolation due to their body weight [12, 13]. Moreover, experimental studies have shown that adolescents with overweight are more susceptible to peer influence than adolescents with normal weight, and they eat more food when in the presence of peers [14]. Peer influences and the source of meals or snacks are aspects of eating away from home that have not been examined in Canadian adolescents seeking obesity treatment, yet this may provide useful information for how to better target intervention strategies and counsel these youths.

Given the urgent need to improve the dietary quality of Canadian adolescents who are overweight and to better target dietary interventions delivered to this population, the aim of this study was to identify which of the following eating away from home factors are associated with dietary quality among adolescents presenting for obesity treatment: (i) number of meals prepared away from home, (ii) frequency of snack purchases, (iii) frequency of snacking with peers, and (iv) peer modeling. It was hypothesized that more meals or snacks away from home and consumed with friends would be associated with lower dietary quality, whereas exposure to healthful eating by peers would be associated with higher dietary quality. The factors identified as being associated with dietary quality in this study may be important to target in obesity treatment programs.

**METHODS**

**Participants and procedures**

The present cross-sectional study utilized baseline data collected from a convenience sample of adolescent–parent pairs prior to an 8-month e-health lifestyle intervention in Vancouver, British Columbia. Eligible families were recruited via newspaper advertisements (n = 109; 62%), invitations sent to previous patients of the Children’s Hospital Endocrinology and Diabetes Unit (n = 23; 13%) and healthy weights clinic (n = 27; 15%), and other sources (word of mouth, parenting magazine, Facebook) (n = 17; 10%). To be included adolescents had to be overweight (defined as a body mass index (BMI) z score >1 standard deviation, based on World Health Organization (WHO) cut-offs [15]), which encompasses adolescents with overweight and obesity. Additional inclusion criteria were adolescents between the ages of 11 and 16 years, living in the Greater Vancouver Area, with English literacy, and a parent who is the primary caregiver at least half of the time. Exclusion criteria included adolescent comorbidities (e.g., physical disability) that affected their ability to be active or eat a normal diet and not having access to a computer. Of the 183 adolescents who were recruited and completed the baseline study visit, 7 were ineligible and 3 did not complete at least 1 dietary recall, resulting in a sample of 173 adolescents for this study.

Adolescents had their height and weight measured and were administered a computer-based questionnaire on their household environment, peer influences, eating habits, and demographic information at the baseline visit. In a separate room, parents completed a similar questionnaire with socio-demographic questions. Adolescents could ask their parent for help answering the questions if they wished. Finally, participants were instructed to complete 3 online 24-h dietary recalls (1 at the baseline study visit and 2 more at home over the following week). Participants were instructed to complete 2 weekdays and 1 weekend day. This protocol was approved by the University of British Columbia and University of Waterloo behavioural research ethics boards.

**Measures**

**Outcome.** The outcome of interest was the Canadian version of the Healthy Eating Index (HEI-C) score derived from the average of 3 computer-based 24-h dietary recalls (Waterloo Eating Behaviour Questionnaire) [16]. Each recall collected information on all the foods and beverages consumed the previous day. Over 900 brand-name or generic food items were available and participants were instructed to substitute food not found with a similar item (20% of recalls had >1 food item substituted). Participants had 3 opportunities to review and modify the foods and beverages selected at each meal. Photographs depicted measured portion sizes to help estimate amounts consumed and prompts asked about common toppings associated with particular foods (e.g., spreads on toast). This tool was found to have adequate validity against a dietitian-administered dietary recall using portion-size food models in a diverse sample of 11–14 year olds [16]. The participants’ food intake was processed with The Food Processor software package (version 8.0, ESHA Research, Salem, Oregon, 2002) and the 2007 Canadian Nutrient File to calculate nutrient and food group estimates [17]. Mean dietary intake values were based on a single recall (n = 43; 25%) or averaged across 2 (n = 43; 25%) or 3 (n = 87; 50%) dietary recalls, where available. Mean nutrient and food group intakes were used to compute the HEI-C score.

Criteria for calculating HEI-C scores appropriate for the Canadian context have been described in detail elsewhere [18, 19]. In short, the HEI-C is based on recommended intakes
of 11 dietary components in Canada’s Food Guide: total fruits and vegetables, whole fruit, dark green and orange vegetables, total grains, whole grains, milk and alternatives, meat and alternatives, unsaturated fats, saturated fats, sodium, and other foods. For the “other food” component in this analysis, saturated and trans fats were used as a proxy for solid fats, and total sugar was used as a proxy for added sugar.

**Independent variables.** Five variables were used to assess eating away from home.

**Frequency of lunch prepared away from home.** Adolescents were asked 2 items about their source of lunch over the past week. They were asked (i) how many days they ate lunch and (ii) how many days they ate a lunch that was prepared at home (0–7 days). To derive the number of lunches prepared away from home, the number prepared at home was subtracted from the total number of lunches. Lunches prepared at home but taken to school would be counted as meals prepared at home.

**Frequency of dinner prepared away from home.** Adolescents were asked 1 item about their source of dinner over the past week. They were asked how many days they ate a home-cooked meal for dinner (0–7 days). For example, meals prepared at home but taken to eat at afterschool activities would be counted as meals prepared at home. This value was subtracted from a total of 7 possible meals to estimate the number of dinner meals prepared away from home per week. Since only 1 item asked about dinner and there was not an explicit question about total number of dinners eaten, skipped meals may have counted as meals prepared away from home; however, skipping dinner is less common than for other meals [19].

**Snack purchases.** Adolescents were asked how many times in a usual week they ate snacks purchased from a vending machine, convenience store, snack bar, or coffee shop (never to 5+ times per week). Few adolescents reported the most frequent purchasing categories; therefore, responses were dichotomized into never purchasing snacks from vending machines and purchasing snacks ≥1 times per week.

**Eating out with friends.** Adolescents were asked how often they go out to eat a meal or purchase a snack with friends outside of school (never, rarely, some of the time, most of the time, all of the time). This continuous variable captured meals or snacks with friends over and above exposure at school, allowing for greater variation between adolescents in how often they eat socially.

**Peer modeling.** Five items adapted from a previous measure of peer modeling [20] were averaged to create a continuous scale that assessed friends’ eating behaviors. Questions included: “My friends eat vegetables when I am with them,” “My friends eat fruits when I am with them,” “My friends eat salad at a restaurant when I am with them,” “My friends eat low-fat snacks when I am with them,” and “My friends eat low-fat dressings with salads when I am with them.” Response options for each item were on a 4-point scale (never, sometimes, frequently, always) and the combined scale (1–4) had an internal consistency of 0.76.

**Covariates.** Adolescent height and weight were measured in duplicate using a stadiometer (Hohltain, U.K.) and calibrated scale (Model 597K, Health-o-meter, McCook, Illinois). BMI was calculated from the average height (nearest 0.1 cm) and weight (nearest 0.1 kg) with the formula kg/m². BMI z scores were derived from WHO growth charts for children ages 5–19 years [15]. Age and sex were adolescent-reported, whereas ethnicity and maternal education were parent-reported; demographic items were obtained from the Canadian Community Health Survey [21]. Responses for maternal education were grouped into 4 categories; parental ethnicity was collapsed into 5 categories (Table 1).

**Analysis.** Linear regression models were used to examine associations between dietary quality (HEI-C score) and the away from home eating context: (i) number of lunch meals prepared away from home, (ii) number of dinner meals prepared away from home, (iii) frequency of snack purchases, (iv) frequency of eating out occasions with peers, and (v) peer modeling of.
healthy eating. To test each of these away from home factors on HEI-C scores, unadjusted and covariate-adjusted models were run for each independent variable. Adjusted models controlled for key socio-demographic variables thought to play a role in eating behaviours and their determinants such as age, sex, parent ethnicity, and maternal education [18]. Regression estimates, standard errors, and P values were calculated. A P value < 0.05 was considered statistically significant. For the regression analyses, independent and covariate variables with missing data (<5% missing data, see Table 1) were handled using multiple imputation, which assumes variables are missing at random. Missing data on the outcome, HEI-C score, were not imputed. Ten imputation datasets were estimated using multivariate normal imputation and included all model variables and BMI z score. All analyses were conducted using STATA (v.11, StataCorp LP, College Station, Texas, 2009).

RESULTS
Characteristics of the adolescent sample are presented in Table 1. Adolescents had a mean age of 13 years, 55% were female, and the mean BMI z score was 2.7. About half of the parents self-identified as White and 42% of the mothers had a university degree. The mean HEI-C score of 64 represents an average diet that requires improvement (Table 2). Less than 5% of adolescents had either a poor (score ≤50) or high-quality diet (score ≥80). Adolescents obtained on average approximately 3 lunch or dinner meals prepared away from home per week.

In unadjusted and adjusted analyses (Table 3), the frequency of purchasing snacks was inversely associated with dietary quality. Specifically, adolescents who reported purchasing snacks from a vending machine or store 1 or more times in a typical week had HEI-C scores 3 points lower, on average, than adolescents who reported never purchasing snacks. In unadjusted models only, more dinner meals prepared away from home, purchasing snacks from a vending machine or store 1 or more times per week, and a greater number of times eating out with friends were associated with lower HEI-C scores. Peer modeling of healthful eating was not associated with adolescent HEI-C scores in either model. Socio-demographics associated with higher HEI-C scores included a younger age (b = −1.18, standard error (SE) = 0.38, P < 0.01) and a higher maternal education (university degree vs high school diploma; b = 4.82, SE = 2.15, P = 0.03).

DISCUSSION
This study sought to examine the away from home context of adolescents presenting for obesity treatment and to identify what away from home factors were associated with the dietary quality of these youths. Of the adolescents examined in this study, about 3 lunch or dinner meals were prepared away from home per week and half of adolescents purchased snacks from sources such as vending machines or food outlets in a typical week. Although more dinner meals prepared away from home and more frequent eating out with friends were associated with lower dietary quality as hypothesized, only purchasing snacks from vending machines or food outlets was associated with lower dietary quality in adjusted models. These findings may suggest that foods obtained or prepared away from home by these youths, particularly snacks, are less healthful than those prepared at home. Multiple strategies are likely needed to improve the dietary quality of these adolescents including improving the quality of foods made available in schools, recreation facilities, and restaurants and providing adolescents with the tools for making healthier selections when away from home.

The dietary quality and eating behaviours of adolescents in this sample were similar or slightly better than Canadian adolescent estimates [18, 19]. Over half of Canadian children and adolescents report consuming some food that is prepared outside the home on any given day [6], and U.S. data show that 35% of energy comes from meals or snacks prepared outside the home, including 7% from items purchased from vending machines [22]. Similarities may suggest that adolescents who present for treatment are more typical of the general population of adolescents than those who do not present for treatment. Adolescents of families who self-select into programs may be healthier, more motivated to change, or already engaging in weight-loss strategies. These results may also reflect the generally healthier diets of British Columbians in comparison with the Canadian population [23].

The most consistent finding was that purchasing snacks from vending machines, convenience stores, snack bars, or coffee shops was associated with lower dietary quality. This finding was consistent with the hypotheses and is in line with

### Table 2. Description of the Healthy Eating Index (HEI-C) components, criteria, and scores (n = 173)

<table>
<thead>
<tr>
<th>Component</th>
<th>Range of scores</th>
<th>Mean score (SD) [range]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total vegetables and fruit</td>
<td>0–10</td>
<td>5.2 (2.7) [0–10]</td>
</tr>
<tr>
<td>Whole fruit</td>
<td>0–5</td>
<td>2.6 (2.0) [0–5]</td>
</tr>
<tr>
<td>Dark green and orange vegetables</td>
<td>0–5</td>
<td>1.1 (1.6) [0–5]</td>
</tr>
<tr>
<td>Total grains</td>
<td>0–5</td>
<td>4.2 (1.0) [0.8–5]</td>
</tr>
<tr>
<td>Whole grains</td>
<td>0–5</td>
<td>2.5 (1.8) [0–5]</td>
</tr>
<tr>
<td>Milk and alternatives</td>
<td>0–10</td>
<td>6.2 (3.2) [0–10]</td>
</tr>
<tr>
<td>Meat and alternatives</td>
<td>0–10</td>
<td>8.6 (2.6) [0–10]</td>
</tr>
<tr>
<td>Unsaturated fats</td>
<td>0–10</td>
<td>8.4 (2.3) [0.9–10]</td>
</tr>
<tr>
<td>Saturated fats</td>
<td>0–10</td>
<td>5.6 (3.4) [0–10]</td>
</tr>
<tr>
<td>Sodium</td>
<td>0–10</td>
<td>6.4 (3.1) [0–10]</td>
</tr>
<tr>
<td>Other food</td>
<td>0–20</td>
<td>13.5 (4.6) [0–20]</td>
</tr>
<tr>
<td>Total</td>
<td>0–100</td>
<td>63.9 (8.9) [39.1–83.8]</td>
</tr>
</tbody>
</table>

*Based on age- and sex-specific recommendations in Canada’s Food Guide.

*Based on estimates of intake from solid fats and added sugars.*
adolescents [24]. In particular, this previous study suggested sugary drinks, and more frequent fast food intake) among (e.g., higher energy, lower in fruits and vegetables, higher in from home is associated with poorer dietary quality previous findings that show purchasing snacks while away from home is associated with poorer dietary quality (e.g., higher energy, lower in fruits and vegetables, higher in sugary drinks, and more frequent fast food intake) among adolescents [24]. In particular, this previous study suggested that the quality of snacks was important for overweight risk, as snacking on energy-dense foods, and not snacking itself, was associated with higher BMI scores [24]. Therefore, the quality of foods and beverages available to purchase as snacks in schools, stores, and community facilities may be of particular importance. Despite the recent strengthening of food access policies in British Columbia in schools and recreational facilities, our findings correspond with others and suggest adolescents continue to access energy-dense, nutrient-poor foods from venues such as vending machines [25, 26]. Nonetheless, continued strengthening of policies to improve the quality of foods in vending machines and other outlets may be helpful for teens who are overweight and trying to make dietary changes. Further studies examining the context of snack purchasing by adolescents may help to better understand this relationship.

Unexpectedly, peers were not found to influence dietary quality of adolescents with overweight. These findings are somewhat contradictory to other studies demonstrating an influence of peers on adolescents’ food choices [14, 27]. However, our study only examined peer modeling of healthy foods; peer modeling of unhealthy foods may have revealed different associations. In the current study, associations with peer modeling disappeared when socio-demographic characteristics were accounted for. Similar to what others have found [6], younger age and higher maternal education were associated with higher dietary quality. Thus, younger, more affluent adolescents with peers in the same age and social group are likely to have similar diets, and these shared socio-demographic factors seem to explain the link with higher dietary quality. This study’s sample was also comprised predominantly of adolescents with obesity who tend to have smaller social networks [12, 13], and this can explain why the home environment is still important in adolescence.

Limitations
The participants of this study were a convenience sample of adolescents presenting for obesity treatment in an urban city in British Columbia. Thus, findings may not be generalizable to wider groups of Canadian adolescents experiencing overweight (e.g., living in rural settings, not volunteering for treatment), but may reflect adolescents who typically participate in obesity interventions; therefore, they are a useful group on their own to understand. Analyses are based on cross-sectional data that limit our ability to make causal inferences. Prospective and experimental studies are needed to determine if decreasing snack purchasing and increasing food prepared at home improve dietary quality. In addition, with the exception of BMI, measures were based on self-report and may be influenced by misreporting and social desirability bias. Measures assessing away from home eating were developed or adapted for this study and included various exposure periods (e.g., some items assessed exposure in a typical week, while others assessed exposure in the past week), and so it is important to replicate findings in other studies. Questions also left some ambiguity, for example, skipped dinners or those eaten as a snack may have been captured as meals away from home. Trouble interpreting a “home-cooked” dinner might also have contributed to differential inclusion of convenience meals (e.g., frozen lasagne purchased at the grocery store but assembled at home). The 24-h dietary recalls did not collect the location or source of foods; therefore, it is unknown if these foods were healthy or unhealthy. Finally, youths who are overweight and eat out more often may also have unhealthy foods at home, and it is possible that these adolescents are more likely

### Table 3. Selected away from home factors associated with adolescent dietary quality scores (n = 173).

<table>
<thead>
<tr>
<th></th>
<th>Healthy Eating Index (HEI-C)</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Unadjusted models</td>
<td>Adjusted models*</td>
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<tr>
<td></td>
<td>b (SE)</td>
<td>P value</td>
<td>b (SE)</td>
<td>P value</td>
<td></td>
<td></td>
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<tr>
<td><strong>Away from home eating</strong></td>
<td></td>
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<tr>
<td>Lunch prepared away from home (days per week)</td>
<td>-0.68 (0.38)</td>
<td>0.07</td>
<td>-0.37 (0.40)</td>
<td>0.35</td>
<td></td>
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<tr>
<td>Dinner prepared away from home (days per week)</td>
<td>-0.96 (0.45)</td>
<td>0.03</td>
<td>-0.81 (0.46)</td>
<td>0.08</td>
<td></td>
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<tr>
<td><strong>Snack purchases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>Reference</td>
<td></td>
<td>Reference</td>
<td></td>
<td></td>
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<tr>
<td>≥ Once per week</td>
<td>-3.66 (1.36)</td>
<td>0.01</td>
<td>-3.00 (1.37)</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating out with friends, 1 (never)–5 (all the time)</td>
<td>-1.65 (0.71)</td>
<td>0.02</td>
<td>0.75 (0.86)</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peers model healthy eating, 1 (never)–4 (always)</td>
<td>1.60 (1.39)</td>
<td>0.25</td>
<td>1.56 (1.38)</td>
<td>0.26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: b, unstandardized regression coefficient; SE, standard error. Bolded values are statistically significant, P < 0.05.

*Separate linear regression models for each independent variable adjusted for age, sex, parent ethnicity, and maternal education. Unstandardized regression coefficients are interpreted as the mean change in HEI-C score for each unit change in the independent variable (e.g., adolescents who purchase snacks 1 or more times per week have a mean HEI-C score 3.18 units lower than adolescents who report never purchasing snacks controlling for covariates).
to select options that are less healthful even when healthier alternatives are available. Qualitative studies that explore the unique experiences of adolescents with overweight in preparing food at home, and in selecting foods when out to eat, will inform what interventions are needed for these youths.

**RELEVANCE TO PRACTICE**

Many of the adolescents who presented for obesity treatment in this study reported purchasing snacks and eating meals prepared away from home, and more frequent purchasing of snacks was associated with lower dietary quality. Therefore, strategies that may help to improve the dietary quality of adolescents who are overweight might include encouraging adolescents and their families to pack healthy meals and snacks to bring from home and advice for selecting healthier options when eating out. Many foods and beverages prepared and eaten at home can also be of low quality so the importance of preparing healthy foods at home should not be overlooked.

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**Conflicts of interest:** None to disclose.

**References**