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Short Communication

Meeting fruit and vegetable consumption and physical activity recommendations among adolescents intending to lose weight

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ABSTRACT

Two-thirds of adolescents who are overweight or have obesity report weight loss intentions. Most report using weight loss strategies consistent with expert recommendations for obesity prevention; however whether they meet recommended fruit and vegetable (F&V) intake and physical activity (PA) recommendations is unknown. We investigated whether weight loss attempts, and weight loss strategies were associated with meeting F&V and PA recommendations. Data were from the 2010 National Youth Physical Activity and Nutrition Study, which surveyed a cross-sectional, nationally representative sample of U.S. high school students. Analyses were restricted to overweight/obese students ($n = 2841$). Adjusted logistic regression models assessed the odds of meeting daily F&V and weekly PA recommendations after adjusting for grade, sex, race/ethnicity and perceived weight status. Compared to students who were overweight and were not currently intending to lose weight, students who were overweight and intending to lose weight were not more likely to meet F&V or PA. Among students with obesity, those who intended to lose weight were more likely than students who were not currently intending to lose weight to meet F&V recommendations (OR: 3.62, 95% CI: 1.70–7.73). Students who were overweight/obese and used F&V or PA for weight loss were significantly more likely to meet the corresponding recommendation than students intending to lose weight without specific strategies. Weight loss attempts alone do not affect the likelihood of meeting most expert recommendations. Public health efforts emphasizing recommended strategies for healthy eating and active living still need to be encouraged for overweight/obese youth.

1. Background

Obesity is associated with chronic diseases (Moriarty-Kelsey & Daniels, 2010), and reducing obesity is a public health priority (World Health Organization, 2012). Almost one-third of adolescents have overweight or obesity (Ogden et al., 2014). A majority intend to lose weight (Demissie et al., 2015) and use a variety of strategies including

dietary changes and physical activity (PA). Although evidence suggests dietary changes play a larger role on weight loss than PA (Johns et al., 2014), both are recommended for weight control or maintaining a healthy lifestyle (Barlow, 2007; U.S. Department of Health and Human Services, 2008).

Whether youth intending to lose weight have greater fruit and vegetable (F&V) intake and PA is unclear (Lowry et al., 2002; Lowry et al.,

Abbreviations: BMI, body mass index; CDC, centers for disease control and prevention; F&V, fruit and vegetable; NYPANS, National Youth Physical Activity and Nutrition Study; PA, physical activity

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2008). Inconsistent findings may be due to methodological differences: oftentimes youth who are normal-weight are grouped together with youth who have overweight/obesity, despite their significant differences in weight intentions, dietary and PA behaviors (Demissie et al., 2015). Youth who have overweight/obesity are disproportionately less likely to meet F&V or PA expert recommendations (Song et al., 2013; Kimmons et al., 2009). Adolescents who perceive themselves to have overweight/obesity are more likely to reduce fat intake and use PA as weight loss strategies (Bhurtun & Jeewon, 2013). Weight loss in youth is modest, with limited evidence for long-term weight loss maintenance (Whitlock et al., 2010). Adolescents may not achieve weight loss for a variety of reasons. One reason may be that they use recommended strategies, but not to the degree that would result in weight loss. Whether weight loss attempts are associated with meeting these recommendations is unclear.

Utilizing a large, nationally representative cross-sectional sample of adolescents who have overweight/obesity from the National Youth Physical Activity and Nutrition Study (NYPANS), we investigated whether (1) intending to lose weight, and (2) weight loss strategies among those trying to lose weight were associated with meeting F&V/PA expert recommendations.

2. Methods

Data were from NYPANS, a cross-sectional, nationally representative sample of U.S. high school students (majority 14–18 year olds) in 2010. Survey methodology has been previously published (Brener et al., 2013). Ethics approval was obtained by the Centers for Disease Control and Prevention (CDC) and the study contractor (ICF Macro). Data are publicly accessible (<http://www.cdc.gov/healthyyouth/yrbs/nyfans.htm>).

3. Measures

3.1. Current weight loss attempts and weight control strategies

Current weight loss attempts were assessed with, “Which of the following are you trying to do about your weight?” The response options were “lose weight,” “gain weight,” “stay the same weight,” and “I am not trying to do anything about my weight.” The last response option is referred to as “no intentions” throughout the rest of this manuscript. Additional questions assessed whether students (1) exercised or (2) ate more F&V during the past 30 days to lose weight or keep from gaining weight (yes/no).

3.2. F&V consumption

Six questions assessed the number of times per day that fruit (or 100% fruit juice) or vegetables (green salad, carrots, potatoes, other vegetables) were consumed during the past 7 days (ranging from “none” to “4 or more times” per day).

3.3. PA behaviors

PA was assessed with, “During the past 7 days, on how many days were you physically active for a total of ≥ 60 minutes per day? (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time).” Response options ranged from 1 day to 7 days. Strength training was assessed with, “On how many of the past 7 days did you do exercises to strengthen or tone your muscles, such as push-ups, sit-ups, or weight lifting?” Response options ranged from 0 days to 7 days.

3.4. Meeting recommendations

For the purposes of this research, F&V recommendations were from Barlow (2007) expert committee report, and PA recommendations were

from the US Department of Health and Human Services (2008). Whether the participants consumed F&V in any combination ≥ 5 times a day in accordance with Barlow (2007) recommendations was chosen as it is specific to the prevention and treatment of overweight and obesity. Whether students met recommendations for a combination of PA (≥ 60 min every day) and strength training (≥ 3 days) during the past 7 days were calculated (U.S. Department of Health and Human Services, 2008). The components of this recommendation (PA, strength training) were also examined separately.

3.5. Weight status

Participants' height and weight (measured by study staff following standardized protocols) were used to calculate body mass index (BMI), which was compared to the CDC growth curves adjusted for age and sex to identify participants who have overweight (≥ 85 th percentile and < 95 th percentile) or obesity (≥ 95 th percentile) (Kuczmarski et al., 2000).

3.6. Covariates

Covariates included grade (11 or 12 vs 9 or 10), sex, and race/ethnicity (non-Hispanic white, Hispanic, non-Hispanic black, and multiple or other race/ethnicity). The number of students in the multiple/other race/ethnicity category was too small for meaningful analysis and is not presented. Students were also asked to describe their weight: “slightly overweight” or “very overweight” were recoded as “self-perception as overweight.” The other response options (“very underweight,” “slightly underweight,” and “about the right weight”) were recoded as “self-perception as non-overweight.”

3.7. Statistical analysis

Respondents were excluded if they had missing data on grade ($n = 136$), sex ($n = 10$), race/ethnicity ($n = 164$), weight loss attempts or strategies ($n = 772$), weight status (based on measured height and weight [$n = 1192$]), perceived weight status ($n = 25$), or F&V consumption and PA ($n = 195$). As this study assessed differences in meeting recommendations based on weight intentions and weight control strategies among adolescents who have overweight/obesity, the analyses excluded those who did not have overweight/obesity based on their measured BMI ($n = 5592$) and those who had either a weight maintenance or gain intention ($n = 531$), resulting in a final analytic sample of 2841 students. The number of respondents with missing data was too large for multiple imputation to be practical.

All analyses were conducted with SAS 9.4 (SAS Institute, Cary, NC) and accounted for the complex sampling design. Sampling weights accounted for the non-response. Each F&V item was top-coded at 4 times per day and may underestimate the true frequency of consumption. However, as $< 5\%$ and 1% (for fruits and vegetables, respectively, data not shown) reported the maximum number of 4 times per day, the results are unlikely to be largely affected. Bivariate analyses were conducted with chi-square statistics. Due to a significant interaction between weight status with weight intention ($p < 0.05$) and weight loss strategies ($p < 0.05$) in this study, all subsequent analyses were stratified by weight status. Logistic regression assessed the following: (1) associations between attempting to lose weight and meeting recommendations, and (2) among those trying to lose weight, whether weight loss strategies were associated with meeting recommendations. The analytic sample for the secondary objective was restricted to those who had reported a current intention to lose weight. Odds ratios (ORs) and 95% confidence intervals (CIs) are reported. The logistic regression models were adjusted for grade, sex, race/ethnicity, and perceived weight status.

Table 1
Weighted frequencies of demographic, fruit and vegetable consumption and physical activity characteristics of students classified as overweight or obese (National Youth Physical Activity and Nutrition Study, 2010; $n = 2841$).

| | Overweight ($n = 1292$) ¹ | Obese ($n = 1549$) ¹ | p^2 |
|---|---|--------------------------------------|---------|
| Demographic characteristic | | | |
| Male | 43.9% | 43.7% | 0.93 |
| Grade 11 or 12 | 45.0% | 44.8% | 0.94 |
| Race | | | |
| Non-Hispanic, white | 58.2% | 53.6% | 0.01 |
| Hispanic | 21.8% | 23.8% | |
| Non-Hispanic, black | 10.6% | 16.0% | |
| Weight intention | | | |
| Lose weight | 86.9% | 91.9% | 0.007 |
| No intention ³ | 13.1% | 8.1% | |
| Self-perception as overweight | 60.8% | 85.6% | < 0.001 |
| Fruits/vegetables ≥ 5 times/day ⁴ | 22.7% | 27.7% | 0.04 |
| Physical activity (PA) ⁴ | | | |
| PA ≥ 60 min/day on all 7 days | 13.2% | 8.8% | 0.01 |
| Strength training ≥ 3 days | 47.5% | 43.4% | 0.12 |
| Meets both PA recommendations ⁵ | 10.1% | 6.1% | 0.003 |
| Weight loss strategy ($n = 2562$) ⁶ | | | |
| Eat more fruits & vegetables | 52.4% | 57.1% | 0.07 |
| Exercise | 83.6% | 82.2% | 0.53 |

¹Based on body mass index (BMI) from measured height and weight. Overweight defined as BMI ≥ 85 th and < 95th percentile, and obesity defined as BMI ≥ 95 th percentile in accordance with the Centers for Disease Control and Prevention growth curves; ²From weighted chi-squares; ³Response option of: "I am not trying to do anything about my weight"; ⁴During the past 7 days ⁵Aerobic PA ≥ 60 min/day on all 7 days and strength training ≥ 3 days during the past 7 days; ⁶Restricted to the participants who reported a current attempt to lose weight; Students indicated whether they used exercise, and/or consumed fruits and vegetables as a strategy in the past 30 days in order to lose weight or to keep from gaining weight and were not mutually exclusive. Thus participants could report the use of none, one, or both strategies and percentages will not add up to 100%.

4. Results

4.1. Descriptive statistics

The analytic sample did not differ from the excluded participants who had overweight/obesity (but excluded for any of the reasons previously described) in grade distribution, but differed in sex (male: 43.8% vs 52.8%, $p < 0.001$) and race/ethnicity (Hispanic: 22.9% vs 17.4%, non-Hispanic black: 13.5% vs 15.4%, non-Hispanic white: 55.7% vs 55.8%, $p = 0.002$). In the analytic sample, compared to students who had an overweight BMI percentile, students who had obesity were significantly less likely to meet PA recommendations but were more likely to meet F&V recommendations (Table 1).

4.2. Weight loss attempts

Among students who had an overweight BMI percentile, attempting to lose weight was not associated with meeting F&V recommendations or any of the PA (aerobic, strength training, or both) recommendations (Table 2). Among students with obesity, attempting to lose weight was not significantly associated with meeting PA recommendations but was associated with higher odds of F&V consumption ≥ 5 times/day (OR: 3.62, CI: 1.70–7.73).

4.3. Weight loss strategies among those attempting to lose weight

Prevalence of meeting recommendations among those eating F&V and exercising as weight loss strategies remained low (approximately 35–40% and 10%, respectively). Nevertheless, eating more F&V as a weight loss strategy was associated with higher odds of meeting the

expert recommendations for F&V consumption among students who had overweight/obesity compared with students who did not report more F&V for weight loss (OR: 4.82, CI: 3.12–7.45; OR: 3.36, CI: 2.41–4.70, respectively, Table 2). Participating in PA as a weight loss strategy was associated with higher odds of meeting the expert recommendations for strength training among students who had overweight/obesity compared with students who did not report exercising for weight loss (OR: 6.41, CI: 3.64–11.31; OR: 6.96, CI: 3.61–13.43, respectively). Among the students with obesity, those who reported exercising for weight loss had 4.42 (CI: 1.74–11.25) times the odds of meeting the combined PA recommendations than students with obesity but did not use PA as a weight loss strategy. There were no significant associations between weight loss strategies and aerobic PA ≥ 60 min/day.

5. Discussion

Our findings suggest that weight loss attempts alone are not associated with the likelihood of meeting most F&V and PA recommendations among youth who had overweight/obesity. In contrast, eating F&V or exercising as weight loss strategies among those trying to lose weight were more consistently associated with meeting F&V/PA recommendations, highlighting an important distinction between weight loss attempts and use of weight loss strategies.

Study results are consistent with the Health Action Process Approach model (Schwarzer, 2008) in which the specificity of planned actions enhances the likelihood of consistent behaviors. Thus successful health behavior changes are more likely to occur with specific, volitional intentions and planned actions to make the change (e.g., choosing specific weight loss strategies). However, according to the socio-ecologic model (McLeroy et al., 1988), weight influences are multidimensional. These behaviors can also be influenced as part of, for example, the home, school, community, and through larger policy and systems changes – such as through changes to the built environment allowing safe and easy access to PA (McLeroy et al., 1988). Nevertheless, prevalence of meeting recommendations remained low. Results highlight the necessity of modifying weight-related behaviors of youth by utilizing strategies at many levels of the socio-ecologic model to be successful.

This study is not without limitations. Participants were recruited in schools and results may not be representative of the ~3% of persons aged 16–17 years who are not in high school (Chapman et al., 2010). Although there was no "0 days" response to the PA question, this likely did not affect the proportion of students who reported the opposite of 0 days (i.e., daily PA). F&V/PA items were not completely aligned with expert recommendations. Thus we elected to be conservative in our estimates. For instance, each F&V item was top-coded at 4 times per day, and PA recommendation included both aerobic and strength training. As NYPANS is cross-sectional, temporality cannot be determined. One-third of youth who use these weight control strategies abandon their use as young adults, and longitudinal research assessing changes in F&V consumption/PA behaviors based on weight intentions would help address the question of temporality (Larson et al., 2009). These data were self-reported and over-reporting of socially desirable behaviors is possible. However, F&V reported as times per day has been shown to be closer approximations to 24-h dietary recalls than servings per day (Eaton et al., 2013). Lastly, the expert recommendations used in this study were not all designed to promote weight loss. Nevertheless, as a majority of adolescents are attempting weight loss, it's important to assess whether weight intentions and weight control strategies are associated with meeting general recommendations for a healthier lifestyle.

This study has several strengths. It is the first study of a representative sample of U.S. high school students to assess the likelihood of meeting expert recommendations based on weight loss attempts and weight loss strategies separately stratified by weight status. Previous

Table 2

Adjusted odds ratios and 95% confidence intervals of meeting fruit and vegetable consumption and physical activity expert recommendations in the past 7 days by current weight loss attempts and weight loss strategies, among students classified as overweight or obese (National Youth Physical Activity and Nutrition Study, 2010).

| | Fruits/vegetables ≥ 5 times/day ¹ | | Aerobic PA ≥ 60 min/day ¹ | | Strength training ≥ 3 days ¹ | | Meets PA both recommendation ^{1,2} | |
|---|---|------------------|---|------------------|--|-------------------|---|-------------------|
| | % | OR (95% CI) | % | OR (95% CI) | % | OR (95% CI) | % | OR (95% CI) |
| Weight loss intentions | | | | | | | | |
| Overweight (n = 1292) ³ | | | | | | | | |
| No intentions ⁴ | 17.4 | 1.00 (Reference) | 11.2 | 1.00 (Reference) | 41.0 | 1.00 (Reference) | 8.1 | 1.00 (Reference) |
| Weight loss | 23.5 | 1.40 (0.68–2.86) | 13.5 | 1.54 (0.87–2.71) | 48.5 | 1.66 (0.93–2.98) | 10.5 | 1.64 (0.87–3.10) |
| Obese (n = 1549) ³ | | | | | | | | |
| No intentions ⁴ | 10.2 | 1.00 (Reference) | 9.8 | 1.00 (Reference) | 44.2 | 1.00 (Reference) | 3.1 | 1.00 (Reference) |
| Weight loss | 29.2 | 3.62 (1.70–7.73) | 8.8 | 0.93 (0.41–2.11) | 43.3 | 1.23 (0.57–2.66) | 6.4 | 2.36 (0.46–12.08) |
| Weight loss strategies among those trying to lose weight ⁵ | | | | | | | | |
| Overweight (n = 1127) ³ | | | | | | | | |
| Did not use related weight loss strategy | 10.6 | 1.00 (Reference) | 12.7 | 1.00 (Reference) | 17.7 | 1.00 (Reference) | 6.6 | 1.00 (Reference) |
| Used related weight loss strategy ⁶ | 35.3 | 4.82 (3.12–7.45) | 13.6 | 0.97 (0.52–1.81) | 54.5 | 6.41 (3.64–11.31) | 11.2 | 1.62 (0.70–3.75) |
| Obese (n = 1435) ³ | | | | | | | | |
| Did not use related weight loss strategy | 16.2 | 1.00 (Reference) | 4.4 | 1.00 (Reference) | 14.1 | 1.00 (Reference) | 1.7 | 1.00 (Reference) |
| Used related weight loss strategy ⁶ | 39.1 | 3.36 (2.41–4.70) | 9.7 | 2.42 (0.97–6.06) | 49.6 | 6.96 (3.61–13.43) | 7.4 | 4.42 (1.74–11.25) |

PA: Physical activity; ¹Adjusted for grade, sex, race/ethnicity and self-perceived weight status; ²Aerobic PA ≥ 60 min/day on all 7 days and strength training ≥ 3 days during the past 7 days; ³Based on body mass index from measured height and weight; ⁴Response option of: “I am not trying to do anything about my weight”; ⁵Among those currently trying to lose weight; ⁶Related weight loss strategy was specific to each outcome. For instance, ‘Used related weight loss strategy’ for the outcome ‘Fruits/vegetables ≥ 5 times/day’ was defined as reporting the consumption of more fruits and vegetables as a weight-loss strategy, and ‘Did not use related weight loss strategy’ was defined as the participants who did not report the consumption of more fruits and vegetables as a weight loss strategy.

surveillance studies have found that the proportions meeting these recommendations is generally low (Lowry et al., 2008). This study extends this previous work (Lowry et al., 2002; Lowry et al., 2008) by determining whether weight loss strategies map onto meeting F&V and PA recommendations, while accounting for differences in measured and perceived weight status.

6. Conclusions

Although meeting expert recommendations was low, it was higher among respondents with specific weight loss strategies, rather than just weight loss attempts. Consistent with the Health Action Process Approach model (Schwarzer, 2008), education efforts encouraging recommended strategies and implementation plans are needed. Nevertheless, as behaviors are a confluence of different environments, policies, and systems, this message should be cohesive and consistent across other weight-related areas of influence in order to enact long-lasting changes.

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Conflict of interests

The authors have no conflicts of interest relevant to this article to disclose.

Contributors' statement

Dr. Kakinami conceptualized and designed the study, carried out the initial analyses, drafted and revised the manuscript, and approved the final manuscript as submitted. Drs. Demissie, Fulton, and Santosa, and Mrs. Houle-Johnson conceptualized and designed the study, reviewed and revised the manuscript, and approved the final manuscript as submitted.

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