

Designing and Testing the Feasibility of a Multi-level Intervention to Treat Adolescent Obesity in the Pediatric Primary Care Setting

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Abstract

Objective: To describe the development steps and feasibility test of a multi-level adolescent obesity intervention for delivery in pediatric primary care settings.

Method: To understand the target setting and population (i.e., perceptions of and receptivity to various intervention components), focus groups were conducted with clinicians, adolescents, and parents (N=58). Findings informed the development of a multi-level intervention (i.e., office support systems, brief clinician-delivered counseling, and nutritionist-led adolescent group sessions) targeting overweight and obese adolescents (N=22). The intervention was pilot-tested for feasibility using a single group pre- and post-test comparison.

Results: Families and clinicians agreed on the importance of developing approaches to address adolescent obesity in the pediatric primary care setting, and favored family involvement. The pilot-study showed that it was feasible to implement office system changes to support obesity treatment. All but one component of the clinician-delivered counseling algorithm were feasible. Adolescents participating in the intervention reported dietary improvements and movement toward the action stage for decreasing sedentary behavior.

Conclusion: Multi-level interventions for adolescent obesity in the pediatric primary care setting are feasible. Research to test the effectiveness of such interventions is warranted.

Keywords: Adolescents; Obesity; Pediatric primary care; Treatment; Clinician counseling; Diet; Physical activity

Introduction

The prevalence of obesity among adolescents has tripled over the past three decades, and currently one third of adolescents (33.6%) are either overweight or obese [1]. Excess weight is associated with adverse physiological and psychological problems in adolescence and adult life [2-4] and with increased health care costs [5]. Identification and treatment of obesity during childhood and adolescence is critical to reduce associated risks during adulthood.

Despite a plethora of research on childhood and adolescent obesity, few effective behavioral interventions for overweight and obese adolescents exist, [6] and all have limited applicability to pediatric practice settings [7]. In 2009, the majority (69.0-71.6%) of 10-17 year old children were seen by their pediatrician through well-child visits in the past year [8]. Pediatricians have resources to provide counseling on weight loss behaviors [9] and can make referrals for more intensive weight loss support for adolescents when needed. Thus, pediatric primary care settings represent a tremendous opportunity to intervene in obesity treatment in a large segment of the adolescent population. Furthermore, adolescent obesity interventions that can be easily disseminated to pediatric primary care settings leverage existing resources and have the potential to address obesity on a larger scale.

Clinical practice guidelines for obesity treatment in pediatric primary care settings have been in existence over the past decade, [10,11] yet the majority of pediatric providers (77%) report frustration and barriers to treatment, [12] including lack of patient motivation, poor parental involvement, limited clinician time, and lack of support services. Additionally, there is a paucity of research on how best to implement guidelines in pediatric primary care practice [13].

Lessons learned from efforts to intervene for diet and physical activity behaviors and weight change in adult primary care settings [14-17] have potential to inform the treatment of adolescent obesity. Multi-level approaches that are systems-based and include physician-delivered patient-centered counseling have shown to effectively promote change in diet, cardiovascular disease risk factors and weight loss among adults, with the systems component of the interventions enhancing clinician adherence to clinical practice guidelines and behavioral counseling [18,19]. Additional system linkages to ancillary staff (i.e., dietitian) at the patient level further support patient health behavior change and weight loss [14,15,20].

Relatively little has been researched about how to best adapt evidence-based interventions to new settings and populations, and how to do so in a manner that maximizes the potential for their dissemination in real world settings. The intervention translation model proposes that the process of adapting evidence-based

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Received February 14, 2014; **Accepted** March 18, 2015; **Published** March 23, 2015

Citation: Pbert L, Wang ML, Druker S, Jackson EA, Rosal MC (2015) Designing and Testing the Feasibility of a Multi-level Intervention to Treat Adolescent Obesity in the Pediatric Primary Care Setting. J Child Adolesc Behav 3: 196. doi:10.4172/2375-4494.1000196

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interventions requires understanding of the new target setting and the target population, tailoring of the evidence-based protocols to the new setting and population, pilot-testing the feasibility of the adapted intervention, and evaluating its effectiveness [21]. The purpose of this study is to describe the initial steps of this process for adapting a multi-level intervention to treat adolescent obesity in the pediatric primary care setting: intervention adaptation and pilot testing of feasibility.

Methods

Consistent with the intervention translation framework [21], the study involved several phases and a mixed methods approach. The intervention development (formative) phase used qualitative methods, and the feasibility-testing phase used quantitative methods. Informed by Social Cognitive Theory [22,23] and the Social Ecological framework, [24,25] the intervention translation framework emphasizes the understanding of factors and challenges specific to real world settings and populations, and the adaptation of evidence-based interventions to their characteristics. For example, examining population characteristics such as weight-related knowledge, attitudes, and behaviors can inform the tone, content, and format of interventions. Understanding of setting characteristics, such as organizational structure, capacity, and resources, can help leverage available resources and facilitate integration of the intervention, maximizing feasibility of implementation [21]. We also drew from the Transtheoretical Model [26] which proposes that health behavior change is a process involving progress through a series of stages of change from pre-contemplation (not intending to take action) through contemplation (intending to change in the next 6 months), preparation (have a plan of action and intending to take action in the immediate future), action (have made specific overt modifications in their lifestyle), and maintenance (working to prevent relapse and continue the behavior change). All study procedures received approval from the University of Massachusetts Medical School Institutional Review Board.

Intervention adaptation (formative) phase

Qualitative input: The study site was a pediatric practice serving a multi-ethnic population in central Massachusetts. In accordance with the intervention translation model, we made efforts to gain insights on the target setting by conducting focus groups with pediatric providers and office staff (n=13). Similarly, to gain insights on adolescents that the intervention would target, we conducted focus groups with adolescents (n=29) age 10-17 years and body mass index (BMI) at or above the 85th percentile who were seeking care at the study site, and separate focus groups with their parents (n=14).

Focus group discussions consisted of semi-structured, open-ended questions designed to collect data from staff, adolescents, and parents on: (1) receptivity to addressing obesity within the pediatric primary care setting; (2) perceptions of current office systems for screening for obesity and risks factors; (3) knowledge of and reactions to current obesity interventions being delivered in the pediatric practice; (4) recommendations for implementing American Academy of Pediatrics (AAP) guidelines for preventing and treating obesity in the pediatric practice; and (5) recommendations for additional resources. Focus groups were moderated by an experienced focus group facilitator, audio-taped and transcribed. Informed consent was obtained from participants prior to focus group participation, and cash incentives ranging from \$25-50 were provided upon completion. Participant responses were coded and categorized (e.g., by question, theme, sub-theme) in accordance with standard qualitative methods [27,28]. Theme and sub-theme instances that occurred across members within

focus groups and across focus groups were considered significant findings.

Using qualitative input to adapt the evidence-based intervention:

The adaptation of an evidence-based multi-level intervention [14,19] to target adolescent overweight and obesity was informed by focus group findings and a review of the cognitive behavioral obesity intervention literature [15,29]. Main intervention components included: (1) office systems devoted to obesity intervention; (2) a clinician-delivered intervention algorithm to guide obesity counseling during clinical visits with overweight or obese adolescent patients; and (3) a group-based three-session program targeting diet, physical activity, and sedentary behaviors for overweight or obese adolescents. A description of each intervention component is presented below. Based on feedback from focus group participants, the program was entitled Healthy Living.

Office systems: Consistent with providers' recommendations in focus groups, an office system was designed to identify and document adolescents' BMI, collect written assessments of adolescents' diet, physical activity and sedentary behavior, and support intervention delivery. Activities conducted by nursing staff included providing each overweight or obese adolescent with the survey assessment to complete and placing the Healthy Living Clinician Intervention algorithm (Figure 1) on the adolescent's medical chart.

Clinician intervention: To address adolescents' and parents'

Can we take a few minutes to talk about your eating habits, level of physical activity and weight?

- Share BMI/weight and obesity-related risk factors**
 - Your current weight is _____ and your height is _____. If we plot these two numbers on this chart (show BMI chart), your Body Mass Index, or BMI, is at the _____ percentile. It is best to be at or less than the 85th percentile. For your current height, this would mean your weight needs to be _____ or lower.
- Assess adolescent's perception of weight and concern (motivation)**
 - How do you feel about your weight? (reinforce feelings expressed). What might be your reasons for losing weight or keeping your weight from increasing? (acknowledge their reasons).
- Provide advice**
 - I am concerned because your current BMI and other risk factors such as (relevant risk factors: family history, BP, total cholesterol, large change in BMI) put you at greater risk for developing diseases like diabetes and heart disease.
 - For your BMI the recommendation for weight management is: weight loss of 1-2lbs/month (BMI ≥ 95th %tile OR 85th-94th %tile with complication)/weight maintenance (BMI 85th-94th %tile without complication), with a long-term goal of a BMI below the 85th percentile.
- Review teen's in-clinic survey and set initial goals**
 - Refer to the teen's Healthy Living In-Clinic Survey. There are 4 key things you can do to help yourself be healthy and work toward a healthy weight. Let's see how you are doing on each:
 - 5 Eat at least 5 servings of fruits and vegetables a day (survey items #1 & 2)
 - 2 Limit screen time – TV, videos, and computer time – to 2 hours or less a day (survey items #3 & 4)
 - 1 Take part in at least 1 hour of physical activity a day (survey item #5)
 - 0 Avoid soda and sugar-sweetened drinks; limit fruit juice to ½ cup or less per day; instead drink water and other low-caloric drinks like fat-free milk (survey items #6, 7, 8 & 9)
 - Congratulate those areas where the teen is already doing well
 - For areas that can be improved: Which of these would you like to work on first? (check off goals on bottom of survey and problem-solve potential barriers)
 - Instruct teen in monitoring diet, physical activity and screen time on monitoring log
- Refer teen to Healthy Living class for more specific information and assistance**
 - Have teen see Project Director in waiting room
 - Remind teen to bring their monitoring logs to class
- Schedule f/u visit in 4-6 weeks to monitor progress**
 - Remind teen to bring their monitoring logs to the visit

Figure 1: Clinician Healthy Living Intervention Algorithm.

stated need for concrete recommendations on achieving a healthy weight, the intervention messages were adapted from two existing childhood obesity campaigns: Blue Cross Blue Shield of Massachusetts' "Jump Up and Go!" 5-2-1 program [30] and the Anthem Blue Cross and Blue Shield "Keep ME Healthy 5-2-1-0 Power Up" in Maine [31]. The intervention included the following recommendations around daily behaviors: consumption of 5 servings of fruits and vegetables; limiting screen time to 2 hours or less; engaging in at least 1 hour of physical activity; limiting or drinking 0 sugar-sweetened beverages.

Building from the focus group findings and the 5-2-1-0 framework, the clinician intervention included: a brief behavioral survey adolescents completed while waiting to see their clinician; an intervention algorithm to guide the clinician in discussing BMI and obesity-related risk factors, assessing adolescents' concerns, delivering advice, reviewing the adolescent's survey, and setting goals (Figure 1); a diet and physical activity monitoring log; and a follow-up intervention algorithm to review adolescents' BMI and goals related to BMI, establish new goals, and schedule follow-up visits to monitor progress (Figure 2). Pediatric clinicians received a one-hour training session delivered by research staff during a lunch break.

Group sessions: Three one-hour group sessions with adolescents (gender-stratified) were designed and delivered by a pediatric nutritionist. 5-2-1-0 messages were integrated throughout all sessions. Each session included a review of prior goals set and self-monitoring logs; problem solving regarding unmet goals; presentation of the session topic; preparation and consumption of a healthy snack; and setting of new goals. A two-hour parent group session offered by the pediatric

nutritionist on two Saturdays provided parents with a summary of topics and skills covered in the adolescent group sessions and included additional topics such as meal planning, food shopping and budgeting, healthy recipes, parental modeling, limit-setting, and challenges with readiness to change.

Pilot testing phase

The multi-level intervention was pilot tested in the same pediatric practice that participated in the formative research phase using a single group pre- and post-test design with assessments conducted at baseline and follow-up (1 month for adolescent measures and 3 months for clinician measures). Participant eligibility criteria included: ages 13-17 years; BMI at or above the 85th percentile; current patients at the pediatric clinic; English-speaking; and parental consent to participate. Adolescents who participated in the formative focus groups were excluded. Nursing staff provided information about the study to all eligible adolescent patients at the time of their appointment. Interested adolescents were provided additional study information by research staff. Parental written consent and child written assent were obtained from interested individuals. All pediatric clinicians were eligible to participate.

Measures

Feasibility of intervention implementation and fidelity to intervention protocols were assessed through validated Patient Exit Interview (PEI) [32] surveys completed by the adolescent immediately following their visit with the pediatric clinician at baseline and at 1-month follow-up. These surveys assessed the degree to which clinicians delivered each of the intervention steps in the algorithm.

Share current BMI/weight

- Note changes in BMI/weight
 - If stable or decreased: Congratulate!
 - If gained weight: Be supportive. Acknowledge difficulty in losing or maintaining weight and that you will continue to work with the teen to help him/her.

Review status of goals set, set new goals

- *What changes have you made in your diet and level of physical activity since we last spoke?*
 - Congratulate and reinforce any healthy changes made
- Refer to the Healthy Living In-Clinic Survey completed at last visit and nutritionist's notes from the Healthy Living classes, review goal(s) set and ask about status.
 - For those goals met: Congratulate. *What helped you make these changes?*
 - For those goals not met: *What got in the way of your making this (these) change(s)? What might you try differently to deal with these barriers and help you make this (these) change(s)?*
- Set new goals: *What would you like to work on next? What are some things you will do that will help you meet this/these goal(s)?*
- Instruct teen to continue monitoring diet, physical activity and sedentary behavior in monitoring log (at least 2 week days and 1 weekend day) and bring to next visit.

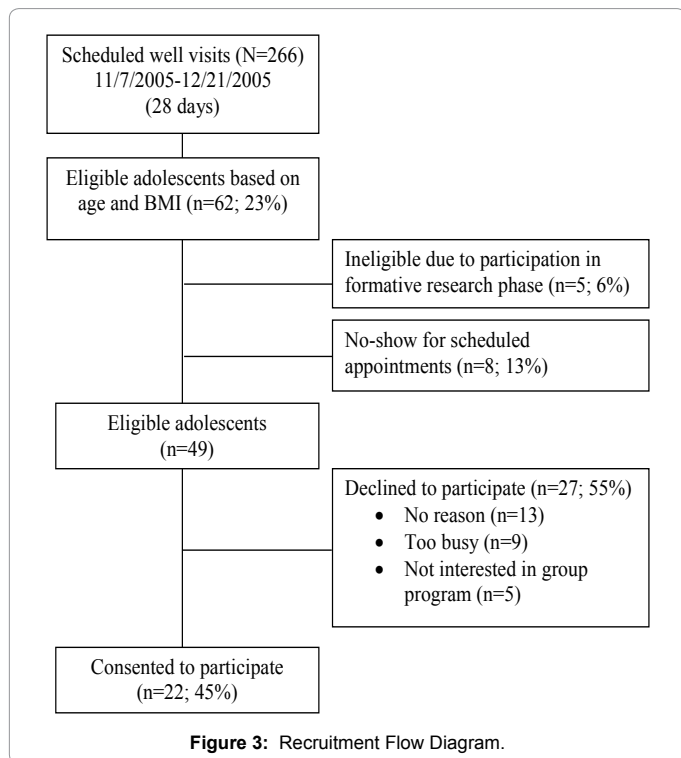
Schedule follow-up visit to monitor progress

- For overweight or obese teens with risk factors: monthly
- For overweight teens with no additional risk factors: 3 months

Figure 2: Clinician Intervention Follow-up Algorithm.

Responses were summarized in a PEI index score. Clinicians completed a survey pre- and 3 months post-training assessing their attitudes, self-efficacy, and practices in intervening among adolescents across a range of weight statuses.

Adolescents completed a self-administered survey assessing the following: stage of change for diet, physical activity behaviors, and sedentary behaviors, [33] diet, physical activity and sedentary behaviors [34] and perceived support from the clinician, assessed via



self-administered, self-report survey. A healthy diet score [33] was computed to summarize self-report regarding fruit and vegetable consumption, French fries or chips, soda and other sugar-sweetened drinks, and the number of times adolescents ate at a fast food restaurant per week, with lower scores indicating a better quality diet.

Statistical analysis

Comparisons of means at baseline, follow-up, and difference of means between times were conducted using t-tests. Differences in categorical variables were conducted using Fisher’s exact tests, and paired dichotomous outcomes were compared using McNemar’s test. Analyses were carried out using Stata 9.2.

Results

Participant characteristics

The pilot test sample consisted of 22 adolescents (Figure 3 for recruitment flow diagram). Clinicians consisted of 7 physicians and 3 nurse practitioners (70% female; mean age of 38 years (SD = 6.3)).

Intervention fidelity and feasibility

The nurse placed the intervention algorithm on 100% of the adolescent participants’ medical charts. Adolescents received the Healthy Living In-Clinic Survey with 100% completion. The completed In-Clinic Survey was placed in the patient medical record by the clinician 65% of the time. One hundred percent of adolescent baseline and follow-up surveys, post visit PEIs, and baseline and 3-month follow-up clinician surveys were completed.

PEIs indicated that clinicians completed on average 9 out of the 14 recommended intervention steps (57%) at the initial visit and 7 out of the 10 recommended steps (70%) at the follow-up visit (Table 1). Clinicians and adolescents reported similar average amount of time to go through the initial visit intervention (8.57 vs. 8.42 minutes, respectively). At least 60% of adolescents reported that the following intervention steps were delivered by their clinicians at the initial visit: discussed weight

Intervention Steps and Duration	Initial Visit	Follow-up Visit
Number of steps completed (Mean (SD))/total Summary Score; percent of total	8.6 (3.6)/14; 57%	7.3 (1.9)/10; 70%
Time (minutes) spent on intervention: Mean (SD)	8.4 (5.98)	5.2 (3.76)
Completion of Individual PEI Steps*		
1. Discussed weight/BMI	91%	76%
2. Provided recommended BMI	41%	76%
3. Asked how teen felt about weight	60%	N/A
4. Stated they were concerned about the teen’s weight	41%	N/A
5. Discussed eating at least 5 servings of fruits and vegetables	73%	N/A
6. Discussed limiting screen time to 2 hours a day	73%	N/A
7. Discussed taking part in 1 hour of physical activity a day	86%	N/A
8. Discussed avoiding soda and sugar-sweetened drinks	63%	N/A
9. Congratulated teen on positive healthy behaviors	59%	94%
10. Set goals	50%	58%
11. Provided monitoring log	27%	35%
12. Told teen to schedule follow-up appointment	91%	71%
13. Told teen about Healthy Living Classes	91%	N/A
14. Asked what changes in diet, physical activity and sedentary behavior were made	N/A	88%
15. Reviewed prior goals	N/A	82%
16. Asked what were barriers to making changes	N/A	82%

*N/A denotes that the step was only relevant for either the initial or follow-up visit.

Table 1: Dose of Clinician-Delivered Counseling Intervention Received Based on Adolescent Patient Exit Interview (PEI) Surveys.

Frequency** of Intervention Steps Taken	Baseline	Follow-up	Difference		
	Mean (SD)	Mean (SD)	Mean (SD)	95% Conf. (Interval)	p-value†
<i>With Obese Adolescent Patients</i>					
Shared BMI with adolescent	3.1 (0.93)	3.7 (0.50)	0.6 (0.73)	1.11 (0.00)	0.05
Explained recommended BMI	2.2 (1.14)	2.9 (1.10)	0.7 (0.95)	1.38 (0.02)	0.04
Scheduled a follow-up visit	2.4 (0.70)	3.0 (1.05)	0.6 (0.84)	1.20 (0.00)	0.05
Referred adolescent to other resources	2.3 (0.67)	2.7 (0.82)	0.4 (0.52)	0.77 (0.03)	0.04
<i>With Overweight Adolescent Patients</i>					
Discussed healthy diet and physical activity	3.4 (0.52)	4.0 (0.00)	0.6 (0.52)	0.97 (0.23)	0.01

*Only significant changes shown.

**Scale of 1 (lowest) to 4 (highest) frequency.

†Mean comparisons conducted using paired t-tests. P-values ≤ 0.05 were considered to be statistically significant.

Table 2: Change* in Counseling Intervention Steps Completed from Baseline to 3-Month Follow-up among Clinicians (N=10) Stratified by Patient Weight Status.

or BMI (91%); asked how the adolescent feels about his/her weight (60%); advised on the 5-2-1-0 goals (63%-86% depending on the goal); referred adolescent to the Healthy Living Classes (91%); and scheduled a follow-up appointment to assess weight and weight-related changes (91%). Intervention steps delivered less frequently included: provided recommended BMI (41%); stated concern regarding their weight (41%); congratulated adolescent on positive healthy behaviors (59%); set goals (50%); and provided monitoring log (27%). Similar patterns in intervention steps delivered were found at the follow-up visit (Table 1 for further details).

Table 2 presents significant changes in frequency of intervention steps implemented by clinicians from baseline (prior to intervention training) to follow-up, stratified by adolescent weight status (non-significant changes not shown). Frequency was noted on a scale of 1 to 4, the latter indicating the highest frequency. Among obese adolescents, significant increases in the frequency of the following clinician intervention steps were observed from baseline to follow-up: sharing BMI information with the adolescent (3.1 to 3.7); discussing recommended BMI (2.2 to 2.9); scheduling a follow-up visit (2.4 to 3.0); and referring the adolescent to additional resources for weight-related behavior change (2.3 to 2.7) (p-values ≤ 0.05). Among overweight adolescents, the only observed difference was an increase in the frequency of clinician discussion of healthy diet and physical activity levels (3.4 to 4.0, p = 0.03). Over half (62%) of clinicians perceived the intervention algorithm to be moderately helpful, and half perceived adolescents to be moderately receptive to the intervention.

Over half (55%) of adolescents attended all three group-based sessions; five (23%) attended no sessions. Sessions were favorably received by the teens who attended, with the majority (88%) reporting being comfortable with discussing their weight, diet and level of physical activity with the pediatric nutritionist running the sessions. Girls reported higher level of engagement in intervention sessions than boys (4.7 vs. 3.8 out of 5, respectively; p = 0.03). No other gender differences

Variable	Baseline	Follow-up	Difference	
	Mean (SD)	Mean (SD)	Mean (SD)	p-value*
Healthy diet score**	0.77 (0.29)	0.51 (0.28)	-0.25 (0.22)	0.0001
Physical activity	3.34 (2.04)	4.03 (1.98)	0.69 (2.04)	0.17
Sedentary behavior (TV)	2.20 (1.01)	1.92 (1.10)	-0.28 (0.83)	0.17
Sedentary behavior (computer)	1.39 (1.86)	1.11 (1.52)	-0.19 (1.20)	0.50

* Comparisons of means between baseline and follow-up were made using paired t-tests

** Lower scores indicate a healthier diet

Table 3: Dietary, Physical Activity, and Sedentary Behaviors among Adolescents (N=22) from Baseline to 1-Month Follow-up.

were observed. Only two parents attended one of the two optional group classes offered for parents (a resource strongly recommended by parent participants during focus group discussions).

Clinician outcomes

No significant changes in clinicians' perceptions of the following were observed from baseline to follow-up: extent of their role to help adolescents reduce their BMI; effectiveness of weight counseling (moderate at both time points); confidence in their counseling skills (moderate at both time points); perceived commitment of other physicians to address adolescent overweight; stage of change in addressing weight with adolescent patients; and barriers to pediatric obesity intervention. Main barriers cited included: patients having other acute medical problems, perceived lack of adolescent motivation to make changes, parents being overweight, perceived lack of effectiveness of counseling, and time-consuming nature of counseling.

Adolescent outcomes

Table 3 presents adolescents' diet, physical activity, and sedentary behaviors at baseline and 1-month follow-up. Adolescents had improvements in healthy diet scores over time, whereas change in physical activity and sedentary behaviors were not significant. The percentage of adolescents who reported being in the action stage of change for reducing their sedentary behavior (i.e., screen time) more than doubled from baseline (33%) to 1-month follow-up (72%; p = 0.04) (results not shown). Similar trends were noted with increases in percentage of adolescents in the action stage for improving their diet (44% to 67%) and level of physical activity (44% to 72%), though these improvements were not statistically significant. The majority of adolescents (81% or higher) reported being comfortable in discussing their weight, diet, physical activity, and sedentary behavior with their clinician, and 90% felt the clinician understood how they felt about their weight and about changing these behaviors. A slightly higher percentage of adolescents reported feeling more committed to making behavior changes to reduce weight at follow-up compared to baseline (90% vs. 82%).

Discussion

Pilot study results demonstrated feasibility in recruiting overweight and obese adolescents from a large pediatric practice, with nearly half of eligible participants enrolled and high adherence to data collection procedures. However, recruitment required intensive on-site research staff resources and cooperation from clinic staff. Frequent prompting by research staff was required to ensure routine implementation of office systems to support intervention delivery. Systems barriers have been found to be related to a decreased sense of competence by clinicians

in treating obesity [12]. This finding indicates the need to understand methods to maximize intervention implementation as part of routine clinical practice, consistent with research showing that systems-based interventions improve adherence to clinical practice guidelines for other behavioral interventions in primary care settings [18,19,35]. Integration into existing systems that do not require several new actions on the part of staff, including the use of electronic medical records with prompts built in may facilitate this process, as well as consideration of appropriate staff incentives and process for accountability.

Despite a clear message from adolescents and parents during focus groups that they desired group sessions to learn specifics on how to improve their diet and level of physical activity, attendance to groups by adolescents was variable and parental engagement was minimal. This is consistent with the high rate of attrition found in weight management clinics and programs [36-39]. However, girls were more likely to attend the classes than boys, suggesting that the group format may have potential for girls but needs to be revisited for assisting boys.

Discrepant views between clinicians and adolescents were observed, with adolescents reporting being very comfortable and receptive to the clinician-delivered intervention and even perceiving the intervention as part of the clinician's job. Other research has similarly shown that adolescents perceive pediatric providers to have the credibility and the knowledge necessary to provide counseling [40] and most commonly identifying their physician or nurse practitioner as the most knowledgeable about behaviors such as how to eat a healthy diet [41]. In contrast, clinicians reported the intervention algorithm was only moderately helpful in their discussions re: weight and weight-related behaviors with adolescent patients, and perceived only moderate patient receptivity to the intervention. Although the intervention algorithm was developed based on input from clinicians, and clinicians were engaged in the process of refining and finalizing it, additional refinement through beta testing and iterative modifications may be needed to ensure the algorithm is maximally helpful to clinicians. Also, greater understanding of barriers to clinicians utilizing the intervention algorithm and strategies to overcome such barriers would be valuable.

Fidelity data from PEIs indicated that less than half of the clinicians delivered key intervention steps, such as instructing the adolescent on monitoring their diet and level of physical activity. As lack of time was cited as a major barrier for completing counseling steps, one recommendation is to incorporate established referral sources, such as nutritionists or group programs, within the clinician protocol. Previous programs, such as Maine's Let's Go 5-2-1-0 program, [42] have integrated a referral approach to address childhood obesity. However, the efficacy of these programs has not yet been rigorously evaluated.

Adolescents reported higher healthy diet scores at follow-up after completing the group program with the nutritionist. This may be partially mediated by adolescents' report of being more comfortable talking with the nutritionist running the groups and feeling that the nutritionist understood how they felt about their weight to a greater extent than the clinician. As adolescents reported positive interactions with the nutritionist and increases in healthy eating, referrals to nutritionists may be routinely incorporated into pediatric obesity interventions. Further exploration is needed on how best to connect clinicians with adjunct treatment staff to facilitate referral and continuity of communication about the adolescent's progress.

The significant increase in the percentage of adolescents reporting moving to the action stage for decreasing sedentary behavior from baseline to follow-up suggests that sedentary behavior may be perceived

as the easiest weight-related behavior for adolescents to tackle first over a short period of time. However, no decreases in self-reported sedentary behaviors were observed. One possible explanation for this finding is that the intervention was primarily designed for individuals who are ready to make a change (action stage). Less than half of the adolescents at baseline reported being in the action stage of change for improving their diet and physical activity, and only a third reported being in the action stage for reducing their sedentary behavior. This may be partially attributed to the lack of improvements observed for sedentary behaviors and physical activity. Another possible explanation is that the Transtheoretical Model, originally developed to decrease smoking among adults, may not be the most appropriate theoretical framework for addressing adolescent overweight and weight-related behavior change through the primary care setting.

One implication of these findings regarding stages of change is that tailoring the intervention to each adolescent's stage of change for specific behaviors may enhance clinicians' perceptions regarding adolescent receptivity and maximize intervention effect on stage change, behavior change, and ultimately reducing BMI among overweight and obese adolescents. For example, adolescents who report readiness to make changes in physical activity but not diet or sedentary behaviors may signal to clinicians their receptivity to physical activity as the main focus of counseling, rather than allocating an equal amount of time or emphasis on discussing change for several behaviors.

Study strengths include the systematic use of a framework for adapting and pilot-testing the multi-level intervention, the high participant retention rate, and the promising intervention acceptability as perceived by adolescents. Findings should be considered in light of a number of study limitations. Due to the short amount of time in the clinic, adolescent baseline surveys were completed immediately after the initial clinician appointment. This could constitute a potential bias and may explain why additional changes between pre- and post- attitudes were not observed. Diet, physical activity, and sedentary behaviors were self-reported using the previous week as the time framework for responses, however responses to self-reports are subject to recall and social desirability biases. As with many pilot studies, the current study's sample size was small and collected from only one pediatric practice, thus limiting generalizability of study findings. Additionally, the single-group pre- and post-test study design with a short follow-up period also limits the establishment of causality. Despite these limitations, pilot study results indicate that this intervention approach is overall feasible for pediatric primary care providers and warrants further exploration.

Conclusion

Pediatric primary care settings hold strong potential for obesity intervention among adolescents. Office systems can support systematic screening for overweight and obesity of adolescents and support clinicians in delivering clinical practice guidelines, with a strong referral component to provide ongoing assistance to adolescents and their families. Further research is needed on how to effectively integrate obesity screening and treatment efforts and provide adjuncts to support adolescents in making and sustaining obesity-related behavior changes.

Acknowledgements

We would like to thank the pediatric practice and their staff who graciously took part in this study. To the adolescents and their families who agreed to participate, we extend our deepest appreciation. This study was supported by the Boston Nutrition Obesity Research Center (Lori Pbert, PhD, Principal Investigator). During preparation of this manuscript Drs. Rosal, Wang and Pbert received support from the CDC Prevention Research Center grant # U48 DP001933; Dr. Rosal also received support from the NIH/NIMHD grant #1 P60 MD006912.

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