Research

iMedPub Journals
http://www.imedpub.com/

Journal of Childhood Obesity
ISSN 2572-5394

2017
Vol.2 No.2:4

DOI: 10.21767/2572-5394.100026

Effect of School-based Wellness Intervention in 7th Graders on Stage of Change for Lifestyle Behaviors: The MATCH Program

Pooja Purswani[1], Suzanne Lazorick[2], Xiangming Fang[3] and George T Hardison[4]

[1]Brody School of Medicine, East Carolina University

[2]Departments of Pediatrics and Public Health, Brody School of Medicine, East Carolina University

[3]Department of Biostatistics, College of Allied Health Sciences, East Carolina University

[4]Department of Pediatrics, Brody School of Medicine, East Carolina University

Corresponding author: Suzanne Lazorick, Associate Professor of Pediatrics and of Public Health East Carolina University, Brody School of Medicine, 600 Moye Blvd, 174 Life Sciences Building Greenville, NC 27834, USA, Tel: (252) 744-2535; E-mail: lazoricks@ecu.edu

Received date: February 02, 2017; **Accepted date:** March 23, 2017; **Published date:** March 27, 2017

Citation: Purswani P, Lazorick S, Fang X, Hardison GT (2017) Effect of School-Based Wellness Intervention in 7th Graders on Stage of Change for Lifestyle Behaviors: The MATCH Program. J Child Obes 2: 4.

Abstract

Objective: For the MATCH intervention, assess concurrent validity of a single item Stage of Change (SOC) measure and association with effectiveness.

Methods: Observational pre, post intervention study in 17 schools in North and South Carolina. Subjects included 908 youth with all measures (908/1,468=62%) who participated in an interdisciplinary seventh grade wellness program called Motivating Adolescents with Technology to Choose Health (MATCH). Measures included: Pre and Post-MATCH self-reported SOC, frequency of fruit and vegetable intake (F/V) and Physical Activity (PA) and measured Body Mass Index z-score (zBMI). Concurrent validity was assessed using Wilcoxon rank tests (pre-action *vs.* action SOC category for F/V and PA at pre- and post-MATCH) and Spearman correlations (between change in SOC, F/V and PA). Change in SOC category distribution was assessed with McNemar's test; association between change in SOC and change in zBMI was investigated with multiple regression.

Results: Both PA and F/V were found to be statistically significantly higher for students in the action SOC category ($p<0.0001$). Greater increase in SOC was weakly associated with a greater increase in PA (correlation 0.1069, $p=0.0013$). Participation demonstrated a shift in SOC post-MATCH (% in "action" SOC 47% pre, 53% post; $p=0.003$). ZBMI decreased significantly from pre- to post-MATCH ($p<0.0001$). A significant association existed between baseline SOC and change in zBMI: students with higher baseline SOC tended to have more decrease/less increase in zBMI (all overweight subgroup, $b=-0.040$, $p=0.0108$). Limitations: lack of a control group, survey questions not validated for individual behavior change.

Conclusion: The SOC measure appears to be valid. Participation in MATCH may improve SOC and baseline SOC may predict increased effectiveness; however this result must be considered cautiously in this observational study.

Keywords: School; Adolescent; Measurement issues; Wellness; Stage of change; Obesity intervention

Introduction

Childhood obesity is a major public health problem in the United States. Even though the rates of obesity among youth have not changed significantly between 2003-2004 and 2011-2012, the reported prevalence rates remain considerably high at 17% [1]. Combating childhood obesity requires modifying behaviors on both sides of the energy equation, dietary intake and Physical Activity (PA) [2]. The public school system can serve as an effective medium for behavioral interventions to reach large numbers of students. There is increasing evidence to suggest school-based interventions, especially in elementary grades, targeting dietary and PA behaviors contribute to a Body Mass Index (BMI) reduction in children [3], although less is known about the effectiveness of school-based intervention in middle and high school grades [4,5].

Transtheoretical model

The transtheoretical model (TTM) provides a reasonable framework for designing school-based interventions. The TTM was described and applied originally for behavior change in adults for addictive and specifically smoking behaviors [6]. Subsequently it has been used in school-based programs in adolescents for a variety of behaviors such as nutrition change, obesity, tobacco use, and sun-protection [7-11]. The TTM model consists of five stages of change (SOC): Precontemplation, Contemplation, Preparation, Action, and Maintenance. An individual in precontemplation is not ready for change in the next 6 months, while an individual in the contemplation stage is

considering change in the next 6 months. Those in the preparation stage have a plan to change within the next month and are therefore, the ideal candidates for recruitment into a behavioral intervention [12]. Since adolescence is commonly referred to as a period of growth and change, a SOC-based intervention implemented during middle school is particularly appropriate as adolescents are likely to identify with the change process [13].

Furthermore, SOC incorporates an individual's attitude and motivation to change, important factors for behavior change [14]. Despite SOC being especially appropriate for adolescents, to date there have been few school-based interventions based on the construct. A review of 11 interventions between 1999 and 2004 yielded only one intervention based on TTM [15] and it did not study SOC associations with BMI [8]. To our knowledge, SOC in adolescents participating in a school-based, educational-behavioral intervention with BMI z-score as an outcome has not been reported previously.

Intervention

Motivating Adolescents with Technology to CHOOSE Health (MATCH) is a school-based interdisciplinary obesity intervention designed to improve nutrition and PA habits in seventh grade students. Key components of MATCH have been described previously [16]. MATCH leverages constructs from both Social Cognitive Theory (SCT) [17] and Self-Determination Theory [18,19].

Also a key component of MATCH, self-efficacy is a shared construct between SCT and TTM. In MATCH self-efficacy develops through learning behavior modification strategies, such as self-monitoring and goal setting, integrated with lessons on nutrition, PA, and technology that align with the Standard Course of Study [16,20]. After findings from a pilot study of MATCH in a single school with high rates of obesity demonstrated improved BMI measures in both short and long term results when compared to a national comparison group [16,21], the MATCH intervention expanded to include more schools. In the 2013-14 year of MATCH in 17 schools, a new question (described in detail below and in Table 1) was added to the pre/post lifestyle behavior survey completed by students that assessed SOC for nutrition and PA behaviors.

Table 1: Survey Questions and Response Choices for Stage of Change, Fruit and Vegetable Consumption, and Physical Activity.

Stage of Change Question	**Category**
Which statement best describes your intentions regarding your health?	
A. I have no interest in starting to become more physically active or eating healthier in the next 6 months.	Precontemplation
B. I am thinking about starting to become more physically active and eating healthier within the next 6 months.	Contemplation
C. I am planning to start becoming more physically active and eating healthier in the next 30 days.	Preparation
D. I have been more physically active and eating healthier in the past few months (less than 6 months).	Action
E. I have been more physically active and eating healthier for more than 6 months now.	Maintenance
Fruit and Vegetable Question	
How many servings of fruits or vegetables do you eat daily? Do not count french fries.	
A. Never, less than one per week	
B. 1 per week	
C. 2 to 4 per week	
D. 5 to 6 per week	
E. 1 per day	
F. 2 to 3 times per day	
G. 4 or more times per day	
Physical Activity Question	
How many days each week are you physically active for at least 60 minutes each day? Add up all the time you spend doing any kind of physical activity that increases your heart rate and makes your breathe harder.	
A. 0 days	
B. 1 day	
C. 2 days	

D. 3 days
E. 4 days
F. 5 days
G. 6 days
H. 7 days

Staging algorithms

An important component in an SOC-based intervention is identifying a staging measure to accurately classify participant SOC. However, a common challenge with assessing interventions based on stage theories is the lack of valid staging algorithms [22]. A variety of approaches for measuring SOC have been described and the most commonly studied are multi-item algorithms [23]. Multi-item staging based on specific behaviors related to weight loss is thought to have greater reliability and utility than staging based on single items related to global constructs [24]. However, the incorporation of lengthy, complex algorithms that measure SOC for just a few behaviors into established questionnaires is not always feasible due to time and length constraints. In adults regarding staging for PA, a few studies have demonstrated promising results that a single-item format with 5-choice responses, each choice representing a SOC, has been effective [25,26]. The lack of consensus for measuring SOC for PA and dietary behaviors in adolescents underscores the need to examine the validity of a single-item SOC measure that identifies intentions towards becoming more physically active and eating healthier.

Study objectives

According to TTM, self-reported engagement in PA and consumption of fruit and vegetable intake should be higher for those in “action” (action and maintenance) stages of change than those in “pre-action” (precontemplation, contemplation, and preparation) stages because those in the latter stages are actually modifying their behaviors in an attempt to change. This assumption has been supported by several published studies [23,26,27] and served as the rationale for this study design aimed at determining the validity of the SOC survey question in assessing readiness to change dietary and PA behaviors. Therefore, the purpose of this study in young adolescents participating in the MATCH intervention is three-fold; to determine 1) the validity of the single-item SOC survey question, 2) if MATCH participation was associated with a change in SOC, and 3) associations with baseline and changes in SOC and changes in BMI z-score.

Methods

Design: Observational cohort pre, post intervention study.

Sample: During the 2013-2014 school year, 13 North Carolina (NC) and 4 South Carolina (SC) middle schools with a high prevalence of obesity implemented the MATCH intervention. All students enrolled in regular seventh-grade classes were exposed to MATCH in regular school activities. Sample size was predetermined by the number of students in seventh grade at each school; however, only data from students with both parental consent and student assent were included in the study.

Measures: MATCH outcome measures and procedures have been described previously [20,28]. Birth date, gender, and ethnicity were obtained from school files. Age was determined from date of birth and date of measurement. Height and weight measurements were obtained privately by trained school staff following a protocol and after viewing a training tutorial on accurate measurement. For all measures students were dressed in school uniforms or standard school attire with shoes off. Weight was measured using a calibrated scale (HealthOMeter 349KLX, ScalesGalore) and height was measured to the nearest ¼ inch with a constructed, wall mounted stadiometer. Stadiometers were constructed by attaching a commercially available construction-grade measuring (1/8" increments) stick to a piece of lumber (2" x 6") that was mounted to a wall in each school flush with the floor. A groove adjacent to the stick was milled into the wood so that a carpenter's "speed square" fit into the groove, allowing the square to easily slide and rest on the head of a student being measured and maintain a right angle from the stick. BMI was calculated from height and weight measurements. Standardized Center for Disease Control (CDC) charts were used to determine BMI z-score and BMI percentile for age and gender [29]. Weight category (underweight <5%ile; healthy weight 5-<85%ile; overweight 85-<95%ile; obese ≥ 95%ile) was determined using current CDC definitions. All students were provided a 35-item Sleeping, Eating, Activity, and Technology (SEAT) online survey at baseline and post-intervention. Responses to three of the SEAT questions are the focus of this paper and are investigated in this analysis. The first question assesses PA and is a validated question that comes from the 2007 Youth Risk Behavior Survey. The other two questions were created de novo for MATCH; one queries fruit and vegetable intake, [30] and the other assesses SOC and was a new question added during the 2013-14 MATCH year. The single-item SOC question and response options can be found in Table 1 and is described in more detail below.

Stage of change: The SOC survey question and response choices are depicted in Table 1. Students were asked “Which statement best describes your plans regarding your health?” Students had the opportunity to respond with one of the five multiple choice answers (letters A-E). The following algorithm was used to evaluate responses. Responses A-E were assigned values as follows: A=0, B=1, C=2, D=3, E=4. The scoring from 0-4 corresponded to the following stages: pre-contemplation, contemplation, preparation, action, and maintenance, respectively. Responses were further categorized as “pre-action” for scores 0-2 or “action” for scores 3-4.

Fruit and vegetable intake: Fruit and vegetable intake was measured with a question created for MATCH. The question and response choices are shown in Table 1. The multiple choice responses (letters A-G) were converted to reflect average servings per week as follows: A=0, B=1, C=3, D=5.5, E=7, F=17.5 and G=20.

Physical activity: A question from the Youth Risk Behavior Survey was used to assess PA [30]. The question and response choices (letters A-H) are illustrated in Table 1.

Intervention

The MATCH intervention was initially developed and implemented by a middle school teacher in a school in rural, eastern NC with high obesity prevalence [16]. Since inception in one school in 2006, MATCH has expanded to include 17 schools in the 2013-2014 school year.

Prior to implementation of MATCH, one school teacher is identified as the school coordinator and is responsible for monitoring lessons taught, while all seventh grade teachers are trained to teach MATCH lessons in their subject areas. Current training procedures include school coordinators' training at a one-day training with remaining teachers being trained during a 45-minute group meeting time at their school. Approximately 15 or more lessons are delivered over five to six months with the highest concentration of lessons taught in health or science classes.

Students track their progress in workbooks and are provided with small incentives (e.g. water bottles, pens, drawstring bags) periodically or after accomplishing goals [20]. In the first expansion year lesson materials were provided on a CD-ROM requiring printing of materials by teachers and storage by students in notebooks. Since 2010 the lessons (slide sets, guiding materials, etc.) are all available to teachers in a central, password-protected web-based resource system and students are each provided a printed workbook with all lesson materials. The pre-printed notebook has helped with more consistent lesson sequencing and completion.

Analysis

Concurrent validation of staging algorithms utilizing constructs of the TTM model as a standard of comparison has been described [23,26]. Concurrent validity of this single-item stage algorithm was determined through two-steps: 1) Wilcoxon rank tests were used to cross-sectionally analyze data collected pre and post-MATCH to assess if those in the "action" *vs*. "pre-action" category reported higher amounts of fruit and vegetable consumption and PA; 2) Spearman correlation analyses were subsequently performed to determine if a higher increase in stage score is associated with a higher increase in reported fruit and vegetable consumption and PA participation.

Descriptive statistics (means, standard deviation) were calculated for baseline participant characteristics. BMI z-score changes from pre to post MATCH were tested for significance using t-tests. Only those participants with BMI measures and completed SEATS at both pre- and post-MATCH were included in the SOC analysis.

Wilcoxon signed-rank test was used to test for change in SOC scores from pre- to post-MATCH. Wilcoxon rank test was used to compare reported frequencies of PA and F/V intake between SOC categories. McNemar's test was used to compare the SOC categories pre- *vs.* post-MATCH, by gender, ethnicity, and weight category.

Multiple regression analyses were conducted to determine association between change in SOC and change in BMI z-score from pre to post intervention.

Additional multiple regression analyses controlled for baseline weight category to determine association of level of SOC at baseline with BMI z-score change. This study was approved by the University Medical Center Institutional Review Board (#07-0741) at East Carolina University.

Results

MATCH study participants included 1,468 of 1,601 (92%) seventh graders enrolled at the school. No significant difference in gender, ethnicity, age, baseline BMI or BMI z-score was found between the MATCH participants (N=1,468) and excluded group (N=133). Baseline characteristics of the 1,468 participants are shown in Table 2.

More than half of the students identified as non-white and were overweight or obese at baseline. Of the 1,468 participants, 1,308 had post-MATCH measurements. Of these, 908 (62%) students in 13 schools had pre and post SEATs and were included in the SOC analysis.

Students with all pre- and post- measures (pre and post BMI; pre and post SEAT; N=890) differed somewhat in racial distribution (p=0.024), with higher percentage Caucasian (51% *vs.* 48%) and other race (10% *vs.* 6%), and lower percentage African American (39% *vs.* 46%) from those with missing measures (N=356) (Table 2).

Statistically significant differences were found between the two stage categories ("pre-action" *vs.* "action") in regard to amounts of PA and fruit and vegetable consumption reported pre- and post- MATCH.

Summary results for self-reported servings of F/V consumption by SOC category (pre-action *vs.* action) and weight category (all Overweight or Healthy Weight) pre-MATCH and post-MATCH are shown in Table 3.

When comparing the pre-action *vs.* action group, self-reported median servings of fruit and vegetable consumption was significantly higher for the students in the action category at both pre-MATCH (p=0.0001) and post-MATCH (p<0.0001).

Table 2: 2013-2014 Baseline Participant Characteristics for All MATCH Participants, Stage of Change (SOC) and Participants with Incomplete Measures Groups.

	All MATCH Participants	SOC Participants	Participants with Incomplete Measures	p[b]
	N=1,468	N=890	N=356	
Age, mean ± SD, months	153.8 ± 6.7	153.3 ± 6.3	154.1 ± 7.3	0.052
Sex				0.157
Female, n (%)	720 (49)	433 (49)	189 (53)	
Male, n (%)	748 (51)	457 (51)	167 (47)	
Race				0.024
Caucasian, n (%)	712 (49)	458 (51)	170 (48)	
African American, n (%)	635 (43)	346 (39)	164 (46)	
Other, n (%)	121 (8)	86 (10)	22 (6)	
BMI, mean ± SD, kg/m^2	23.5 ± 6.1	23.2 ± 5.8	23.7 ± 6.1	0.12
BMI z-score, mean +/- SD	0.912 ± 1.0	0.903 ± 1.1	0.921 ± 1.2	0.806
BMI percentile, mean +/- SD	73.542 ± 28.2	73.556 ± 27.9	73.390 ± 28.9	0.926
Weight Category, n (%)[a]				0.865
Underweight	31 (2)	18 (2)	6 (2)	
Healthy (5%-<85%)	701 (48)	430 (48)	167 (47)	
Overweight (85%-<95%)	281 (19)	175 (20)	68 (19)	
Obese (≥ 95%)	455 (31)	267 (30)	115 (32)	

[a]Weight category based on Centers for Disease Control and Prevention Classification

[b]p-value for Included (SOC participants) *vs.* Excluded (Incomplete Measures)

Abbreviations: SOC: Stage of Change; BMI: Body Mass Index; MATCH: Motivating Adolescents with Technology to CHOOSE HealthTM

Table 3: Summary of self-reported servings of fruits and vegetables pre-MATCH and post-MATCH by stage category and baseline weight category.

	Pre-MATCH					Post-MATCH				
Stage Category and Baseline Weight Category[a]	**Median**	**Lower Quartile**	**Upper Quartile**	**N**	**pb**	**Median**	**Lower Quartile**	**Upper Quartile**	**N**	**p[b]**
Servings of Fruits and Vegetables										
Action										
All	5.5	3	17.5	427	0.0001	5.5	3	17.5	479	<0.0001
Healthy Weight	5.5	3	17.5	227	0.0085	5.5	3	17.5	241	<0.0001
All Overweight (OW+OB)	5.5	3	17.5	191	0.0112	5.5	3	7	229	0.0858
Pre-Action										
All	3	3	7	480		3	3	7	427	
Healthy Weight	4.25	3	7	212		3	3	7	194	
All Overweight (OW+OB)	3	3	7	260		3	3	7	224	

Days of Physical Activity										
Action										
All	6	4	7	428	<0.0001	6	4	7	480	<0.0001
Healthy Weight	6	5	7	227	<0.0001	6	5	7	242	<0.0001
All Overweight (OW+OB)	5	4	7	192	<0.0001	5	4	7	229	<0.0001
Pre-Action										
All	4	3	5	480		4	3	5	428	
Healthy Weight	4	3	6	212		4	3	6	195	
All Overweight (OW+OB)	4	2	5	260		4	2	5	224	

[a]Weight Category based on Centers for Disease Control and Prevention Classification

[b]p-value for "Action" *vs.* "Pre-Action", calculated based on Wilcoxon rank test

Abbreviations: SOC: Stage of Change; OW: Overweight; OB: Obese; MATCH: Motivating Adolescents with Technology to CHOOSE HealthTM

Summaries for self-reported days of PA by SOC category and weight category are reported in Table 3. When comparing the pre-action *vs.* action groups, self-reported median days of PA were significantly greater for the students in the action category pre-MATCH (p<0.0001) and post-MATCH (p<0.0001). When controlling for baseline weight category, students in both weight subgroups ("All Overweight," a combination of obese and overweight, and HW) reported significantly more median days of PA than those in the pre-action category pre-MATCH (p<0.0001 and p<0.0001 respectively) and post-MATCH (p<0.0001 and p<0.0001 respectively).

Results from Spearman correlation analyses revealed a statistically significant but weak association between changes in reported PA frequency and changes in SOC score. A greater increase in stage score was associated with a greater increase in PA days (spearman correlation=0.1069, p=0.0013). No association was found between changes in fruit and vegetable consumption and changes in SOC score.

Results for change in self-reported SOC score from pre to post intervention are depicted in Table 4. Self-reported SOC category ("pre-action" *vs.* "action") improved for participants post-MATCH, with the percentage of participants in the "action" stage increasing from 47% to 53% (p=0.0030). The median (IQR) SOC score increased from 2.0 (1.0, 3.0) to 3.0 (2.0, 3.0) for all participants post-MATCH (p=0.0029). Trends for increases were demonstrated in all subgroup analyses, but only reached statistical significance in females (2.0, (2.0, 3.0), p=0.0012), whites (3.0 (2.0, 3.0), p=0.0016), and baseline All Overweight (3.0 (2.0, 3.0), p=0.0045) subgroups (Table 4).

Table 4: Self-Reported Stage of Change (SOC) Score at Time 1 (Pre-MATCH) and Time 2 (Post-MATCH) by Sex, Ethnicity, and Pre (Baseline) Weight Category.

	Pre or Post MATCH	SOC Score, Mean ± SD	Median	Lower Quartile	Upper Quartile	N	p
All Participants							
	Pre	2.326 ± 1.221	2	1	3	908	0.0029
	Post	2.459 ± 1.196	3	2	3	908	
Sex							
Female	Pre	2.143 ± 1.150	2	1	3	446	0.0012
	Post	2.367 ± 1.123	2	2	3	444	
Male	Pre	2.502 ± 1.261	3	1	4	462	0.3107
	Post	2.547 ± 1.256	3	2	4	464	
Ethnicity							
White	Pre	2.345 ± 1.159	2	1	3	467	0.0016
	Post	2.535 ± 1.204	3	2	3	469	

Black	Pre	2.320 ± 1.271	2	1	3	353	0.6188
	Post	2.354 ± 1.178	2	2	3	353	
Other	Pre	2.250 ± 1.341	2	1	4	88	0.1413
	Post	2.477 ± 1.205	3	1	3	86	
Pre Weight Category[a]							
All Overweight[b]	Pre	2.237 ± 1.132	2	1	3	452	0.0045
	Post	2.402 ± 1.122	3	2	3	453	
Healthy	Pre	2.408 ± 1.287	3	1	4	439	0.1233
		2.526 ± 1.246	3	2	4	437	
	Post						

[a]Weight Category based on Centers for Disease Control and Prevention Classification

[b]All Overweight is Overweight (OW)+Obese (OB)

Abbreviations: SOC: Stage of Change; OW: Overweight; OB: Obese; MATCH: Motivating Adolescents with Technology to CHOOSE HealthTM

Change in BMI z-score from pre to post-MATCH is shown in Table 5. For all participants, there was an overall decrease in BMI z-score from pre to post intervention (-0.051, p<0.0001). There was a decrease in BMI z-score by state as follows: NC (-0.067, p<0.001), SC (-0.031, p=0.0042). The change in BMI z-score reached statistical significance for both sexes and for all weight categories in both states (Table 5). The decrease in BMI z-scores reached statistical significance for all ethnicities in NC schools, but was not statistically significant for the black and other ethnicity subgroups in SC.

Table 5: Change in BMI Z-score for MATCH Participants from Pre to Post Intervention, Stratified by Baseline Weight Category, Sex, Ethnicity, and State.

	Change in BMI Z-score, Mean ± SD	**N**	**p**
MATCH Participants			
All	-0.051 ± 0.283	1308	<0.0001
Baseline Weight Category[a]			
Healthy Weight	-0.039 ± 0.320	629	0.0024
Overweight	-0.103 ± 0.247	253	<0.0001
Obese	-0.067 ± 0.155	400	<0.0001
All overweight (OW+OB)	-0.081 ± 0.196	653	<0.0001
Sex			
Female	-0.056 ± 0.273	635	<0.0001
Male	-0.047 ± 0.292	673	<0.0001
Ethnicity			
White	-0.021 ± 0.284	655	0.0572
Black	-0.087 ± 0.288	545	<0.0001
Other	-0.050 ± 0.226	108	0.0242
State			
North Carolina			
All	-0.067 ± 0.299	735	<0.0001
Healthy weight	-0.063 ± 0.334	370	0.0005
Overweight	-0.112 ± 0.234	370	<0.0001

Obese	-0.095 ± 0.162	370	<0.0001
South Carolina			
All	-0.031 ± 0.260	573	0.0042
Healthy weight	-0.009 ± 0.299	283	0.6085
Overweight	-0.092 ± 0.262	115	0.0003
Obese	-0.029 ± 0.135	168	0.0058

[a]Weight Category based on Centers for Disease Control and Prevention Classification

Abbreviations: BMI: Body Mass Index; OW: Overweight; OB: Obese; MATCH: Motivating Adolescents with Technology to CHOOSE HealthTM

Although no significant association was found between change in SOC and change in BMI z-score, multiple regression analyses controlling for baseline weight category showed there were differences in the relationship of baseline SOC and change in BMI z-score by baseline weight category. In the HW subgroup, for each unit of increase in baseline SOC score, the change rate of BMI z-score increased slightly (0.025, p=0.0219), while in the All Overweight the change rate was slightly negative (-0.040, p=0.0108).

Discussion

This study of SOC in MATCH in seventh grade demonstrated that a single-item SOC question for dietary and PA behaviors was a valid measure of SOC and that it appears to have captured SOC in this population. Although a change in fruit and vegetable consumption was not associated with a change in SOC score, the results demonstrating an association between change in PA and change in SOC score provide support for the concurrent validity of the staging measure. Given the importance of assessing SOC and the paucity of published studies on single-item staging assessments, this result can have implications in future work focused on developing feasible, concise staging measures in young adolescents.

In this observational study, self-reported SOC for dietary and PA behaviors in MATCH participants increased from pre- to post-intervention. Although an increase in SOC was not associated with a decrease in BMI z-score from pre to post intervention, the results demonstrating an association between baseline SOC score and a change in BMI z-score in the all overweight subgroup are encouraging and suggest improved SOC is a plausible mechanism for the observed long term improvement in BMI measures in MATCH participants. All subgroups exhibited a general trend upward in SOC from pre to post MATCH; however, it is interesting that the effect size was greatest in the all overweight, female, and white subgroups. MATCH was designed to reach disadvantaged, overweight youth in rural areas. A possible explanation for the larger effect size (decrease in zBMI) in the All Overweight subgroup may be that an underlying mechanism of MATCH helped to improve SOC in the target population. Future studies with larger sample sizes and control groups are needed to further explore sub-group analyses.

Originally designed to measure behaviors such as smoking cessation, applying the TTM model to more complex behaviors such as weight loss requires taking into account multiple health behaviors. Therefore, assessing an individual's SOC on each target behavior may be important [24]. For example, an individual may not be willing to consume more fruits and vegetables, but may be willing to increase PA. Another consideration is that the 4-5 month duration of MATCH may not be enough time to capture a change in SOC for multiple health behaviors. One consideration in future studies would be to revise the SOC survey question to differentiate intentions regarding specific behaviors to better capture SOC for a particular change. In addition, longer term follow up with repeated SOC measures may be informative.

Limitations

There are several limitations to this study. MATCH was implemented in select schools in rural areas of NC and SC a with a predominately Caucasian and African American student population. Therefore, results may not be generalizable to more diverse groups in other areas. Of the 17 schools enrolled this school year, only 13 completed the SEAT survey which reduced the participants in the SOC study and there was no control group. Therefore, we cannot conclude definitively that MATCH participation is exclusively responsible for improvements in adolescent SOC. Finally, the questions used to measure dietary and PA behaviors, although validated, were taken from cross sectional population based surveys not designed to detect individual level behavior change, and do not specify types of PA or distinguish it from exercise. There is some emerging evidence that this distinction between PA and exercise behaviors may be important in obesity studies.

Strengths

Strengths of this study include the rural setting, young adolescent population, high participation rate and large sample size from two states. Results are from schools with a high prevalence of obesity and thus represent a high risk population. The validity testing of a single item SOC measure provides a significant contribution to the field. Finally, the MATCH intervention is a practical, feasible intervention to address obesity.

Improved SOC in MATCH participants is an important finding because SOC can be used as an indicator of intervention effectiveness [23]. Therefore, findings from this study provide support for the effectiveness of this feasible, school-based

intervention at addressing obesity. Improved SOC may serve as one of several mechanisms responsible for the improved BMI measures observed in MATCH participants. Baseline SOC seemed to predict success with BMI reduction, such that the higher the baseline SOC score, the stronger the association with reduction in BMI measures pre to post MATCH. This suggests then that the intervention is most effective at reaching those with higher SOC. However, without a control group this conclusion should be considered with caution and further studies are warranted.

Conclusions

Schools are an opportune setting for implementing wellness interventions targeting obesogenic behaviors as long as the intervention fits well into the educational priorities and mission. School-based interventions based on TTM may be particularly effective during adolescence. The results of this observational study found that participation in MATCH may improve adolescent SOC for health behaviors which could provide support for the effectiveness of the intervention while providing insight into a possible mechanism contributing to improved BMI measures in participants.

Acknowledgements

We thank all the school system faculty and staff who conducted this work. We would like to express our gratitude to Lesley Lutes, Associate Professor, Department of Psychology at the University of British Columbia, Canada for her guidance and expertise regarding measures of Stage of Change and to B. Kelsey Ross, graduate assistant at East Carolina University, for her assistance with editing and manuscript preparation.

References

1. Ogden CL, Carroll MD, Kit BK, Flegal KM (2014) Prevalence of childhood and adult obesity in the United States, 2011-2012. JAMA 311: 806-814.
2. Barlow SE, Expert Committee (2007) Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. Pediatr 120: S164-92.
3. Lavelle HV, Mackay DF, Pell JP (2012) Systematic review and meta-analysis of school-based interventions to reduce body mass index. J Public Health 34: 360-369.
4. Wang Y, Wu Y, Wilson RF, Bleich S, Cheskin L, Weston C, et al. (2013) Childhood obesity prevention programs: Comparative effectiveness review and meta-analysis. Comparative Effectiveness Reviews: 115.
5. Waters E, de Silva Sanigorski A, Burford B, Brown T, Campbell KJ, Gao Y, et al. (2011) Interventions for preventing obesity in children. Cochrane collaboration 12: 1-224.
6. Prochaska JO, DiClemente CC, Norcross JC (1992) In Search of How People Change: Applications to Addictive Behaviors. American Psychologist 47: 1102-1114.
7. Adams MA, Norman GJ, Hovell MF, Sallis JF, Patrick K (2009) Reconceptualizing Decisional Balance In an Adolescent Sun Protection Intervention: Mediating Effects and Theoretical Interpretations. Health Psychol 28: 217-225.
8. Frenn M, Malin S, Bansal N (2003) Stage-based interventions for low-fat diet with middle school students. J Pediatr Nurs 18: 36-45.
9. Mauriello LM, Driskell MM, Sherman KJ, Johnson SS, Prochaska JM, Prochaska JO, et al. (2006) Acceptability of a school-based intervention for the prevention of adolescent obesity. J Sch Nurs 22: 269-77.
10. Redding CA, Prochaska JO, Armstrong K, Rossi JS, Hoeppner BB, Sun X, et al. (2015) Randomized trial outcomes of a TTM-tailored condom use and smoking intervention in urban adolescent females. Health Educ Res 30: 162-178.
11. Robinson LM, Vail SR (2012) An Integrative Review of Adolescent Smoking Cessation Using the Transtheoretical Model of Change. J Pediatr Health Car 26: 336-345.
12. Prochaska JO, Velicer WF (1997) The transtheoretical model of health behavior change. Am J Health Promot 12: 38-48.
13. Kidd P, Reed D, Weaver L, Westneat S, Raynes MK (2003) The transtheoretical model of change in adolescents: Implications for injury prevention. J Safety Res 34: 281-288.
14. Krebs NF, Himes JH, Jacobson D, Niklas TA, Guilday P, Styne D, et al. (2007) Assessment of Child and Adolescent Overweight and Obesity. Pediatrics 120: 193-228.
15. Sharma M (2006) School-based interventions fro childhood and adolescent obesity. Obes Rev 7: 261-269.
16. Lazorick S, Hardison GT, Esserman DA, Perrin EM (2011) Sustained Body Mass Index Changes One and Two Years Post MATCH: A School-Based Wellness Intervention in Adolescents. Childhood Obesity 7: 372-378.
17. Bandura A (1986) Social foundations of thought and action: A Social Cognitive Theory. Prentice-Hall, Englewood Cliffs, NJ.
18. Deci EL, Ryan RM (2008) Self-determination theory: A macrotheory of human motivation, development, and health. Can Psychol 49: 182-185.
19. Ryan RM, Patrick H, Deci EL, Williams GC (2008) Facilitating health behaviour change and its maintenance: Interventions based on Self-Determination Theory. The European Health Psychologist 10: 2-5.
20. Lazorick S, Fang X, Hardison GT, Crawford Y (2015) Improved body mass index measures following a middle school-based obesity intervention- The MATCH program. J of School Health 85: 680-687.
21. Lazorick S, Crawford Y, Gilbird A, Fang X, Hardison GT, Burr V, et al. (2014) Long term obesity prevention and the Motivating Adolescents with Technology to CHOOSE Health™ (MATCH) program. Childhood Obesity 10: 25-33.
22. Schwarzer R, Sheng Cao D, Lippke S (2010) Stage-Matched minimal interventions to enhance physical activity in chinese adolescents. J Adolesc Health 47: 533-539.
23. Di Noia J, Mauriello L, Byrd-Bredbenner C, Thompson D (2012) Validity and reliability of a dietary stages of change measure among economically disadvantaged african-american adolescents. Am J Health Promot 26: 381-389.
24. Sutton K, Logue E, Jarjoura D, Baughman K, Smucker W, Capers C, et al. (2003) Assessing Dietary and Exercise Stage of Change to Optimize Weight Loss Interventions. Obes Res 11: 641-652.

25. Reed GR, Velicer WF, Prochaska JO, Rossi JS, Bess HM (1997) What makes a good algorithm: Examples from regular exercise. Am J Health Promot 12: 57-66.

26. Sarkin JA, Johnson SS, Prochaska JO, Prochaska JM (2001) Applying the Transtheoretical Model to Regular Moderate Exercise in an Overweight Population: Validation of a Stages of Change Measure. Preventative Medicine 33: 462-469.

27. Cullen KW, Bartholomew JB, Parcel GS, Koehly L (1998) Measuring stage of change for fruit and vegetable consumption in 9- to 12-year -old girls. J Behav Med 21: 241-254.

28. Lazorick S, Fang X, Crawford Y, Hardison GT (2016) The MATCH Program- long term obesity pervention through a middle school based intervention. Childhood Obesity 12: 103-112.

29. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, et al. (2000) CDC Growth Charts: United States. National Center for Health Statistics, Hyattsville.

30. Centers for Disease Control and Prevention (2007) Youth Risk Behavior Survey.