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DOI: 10.2174/1874944501710010126

RESEARCH ARTICLE

Exercise Program-Related Psychosocial Changes Promote Healthy Weight in Youth

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Received: April 21, 2017 Revised: May 25, 2017 Accepted: June 16, 2017

Abstract:

Background:

An inappropriately high weight in children is a predictor of health risks. Reliable interventions that are easily disseminated are needed.

Objective:

Based on findings with adults, exercise-support methods might be leveraged to change behavioral predictors of a healthy body composition in youth. Analyses of changes in theory-based psychological variables' association with changes in body composition within the context of youth-tailored treatment are required.

Method:

A 45 minute/day, 4 day/week, social cognitive/self-efficacy theory-based after-school care protocol, Youth Fit 4 Life, was tested in children of a normal (n=54) and overweight/obese (n=32) body composition over a school year. The treatment's emphasis was on improvements in mood, self-efficacy, and self-regulation related to physical activity. Validated self-report measures of negative mood, self-regulation, and self-efficacy, and BMI, were administered at baseline, and months 3 and 9. The prediction of BMI change from changes in the psychosocial variables was assessed using multiple regression analyses.

Results:

Change in BMI and improvements in the aforementioned psychosocial factors were significant over both 3 and 9 months, and did not differ between body composition groups. Analyses indicated that over 3 months, self-regulation change was a significant predictor of BMI change (β=-0.26, SE=0.05, P=0.03), while over 9 months, self-efficacy change significantly predicted BMI change (β=-0.21, SE=0.02, P=0.05).

Conclusion:

After replications and extensions focused also on eating behaviors, it was suggested that the inexpensive and efficient Youth Fit 4 Life protocol might be scalable across community venues to address childhood overweight and obesity.

Keywords: Physical activity, Exercise, Self-regulation, Self-efficacy, BMI, Children.

1. INTRODUCTION

An inappropriately high body mass index (BMI; kg/m^2) is now present in over one-third of elementary school-age children in the United States [1]. Increased childhood overweight and obesity across industrialized nations are a predictor of health risks and future health care expenditures [2, 3]. It was suggested that theory-based treatments could

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be leveraged to address this problem through a focus on psychosocial correlates of physical activity, and a proposed carry-over to healthy eating and weight [4]. Social cognitive theory [5] and self-efficacy theory [6] are related paradigms that focus on individuals' ability to negotiate their environments and develop such behavioral changes.

In an effort to best utilize the time in after-school care settings allocated to physical activity using health behavior change theory, an earlier version of the treatment assessed within the present investigation was initially developed [7], and researched over a considerable period [8]. In addition to the treatment's primary focus on delivering moderate-to-vigorous physical activity, it aimed to increase out-of-program (voluntary) physical activity and improve eating behaviors through instruction in self-regulatory skills (*e.g.,* positive self-talk, thought restructuring, goal setting/progress feedback, recruiting social supports), fostering feelings of mastery (*i.e.,* self-efficacy) through the purposeful use of those self-regulatory skills to solve problems and overcome barriers, and improving psychological states through relaxation and other self-control techniques. Although, the treatment demonstrated significant improvements in physical activity levels, attaining/maintaining a healthy body composition, and targeted psychosocial factors [8], revisions were recently made through adjusting and extending its curriculum separately for the age ranges of 5–8 and 9–12 years. The 9–12 year-old version of that protocol, Youth Fit 4 Life (YF4L), was preliminarily tested here.

It was expected that YF4L would be associated with overall significant improvements in BMI, and demonstrate greater improvements in the overweight/obese participants. Also, it was hypothesized that program-related improvements in self-efficacy, self-regulation, and mood would predict changes in body composition. Hopefully, findings could eventually be translated into large-scale, efficient applications to increase physical activity and reduce overweight/obesity in youth.

2. MATERIAL AND METHODS

2.1. Participants

Participants enrolled in pilot research on the YF4L after-school care program [9] were classified as either overweight/obese (≥85th BMI percentile, based on age- and sex-adjusted normative data [10]) (n=32) or normal weight (5th–84.9th BMI percentile) (n=54) for purposes of this research. No participant was classified as underweight (<5th percentile). Ages ranged from 9–12 years. Appropriate consent, assent, and institutional review board approval were obtained.

2.2. Measures

Based on established surveys intended for older age groups, corresponding scales for the present age range were used to measure negative mood (*e.g.*, "sad," "nervous"; 6 items with responses ranging from 0=not at all to 4=extremely), self-regulation (*e.g.*, "I say positive things to myself about being physically active"; 5 items with responses ranging from 1=never to 4=often), and self-efficacy (*e.g.*, "I am sure I can exercise most days of the week even if the weather was bad"; 5 items with responses ranging from 1=not at all confident to 5=definitely) in a physical activity context. Both internal consistencies (Cronbach's α) and test-retest reliabilities over 1 week were acceptable at ≥0.70, for each measure [9].

BMI, a measure of body composition, was assessed using a recently calibrated digital scale for weight (Seca 876, Seca, Hanover, Maryland, USA), and a stadiometer for height (Seca 213, Seca, Hanover, Maryland, USA). The mean of 2 consecutive measurements was recorded. BMI was calculated as weight in kg/height in m^2.

2.3. Procedure

The elementary after-school care physical activity/healthy eating program based on tenets of social cognitive theory [5] and self-efficacy theory [6], YF4L, was tested in children of both a normal (5th–84.9th percentile BMI) and overweight/obese (≥85th percentile BMI) body composition. Specifically, the protocol's 9–12 year old version was administered 4 days/week, 45 minute/day, for 24 sessions over 9 months. YF4L's bases in social cognitive theory and self-efficacy theory emphasized development of feelings of mastery, self-regulation, and positive psychological states to promote behavioral changes [5, 6]. Its present application was also driven by 1) a desire to administer structured, theory-based methods through existing after-school care staff, and 2) reviews of earlier after-school intervention results with similar health-promotion goals [11 - 14]. Existing after-school care counselors in the southeast United States directly administered the YF4L protocol after completing its 5-hour training. They had no other credentialing in health-promotion or physical education methods. The treatment protocol was supported by a 311-page manual.

Daily program components were: 1) a warm-up and a featured "isolated movement" (5 minutes); 2) a "high-intensity activity" (10 minutes) intended to have cardiovascular benefit and foster feelings of individual progress; 3) a "behavioral topic" or "health topic" (10 minutes on alternating days) intended to facilitate self-regulatory skills (*e.g.*, goal setting/progress feedback, cognitive restructuring, recruiting social supports), an adjustment of psychological states (*e.g.*, deep breathing/progressive relaxation), and facilitate a focus on healthy eating (*e.g.*, maximizing fruits, vegetables, whole grains); 4) a "content reinforcement" activity (10 minutes) intended to support the above topics through a specially designed game/physical activity; and 5) a "go-to game" (10 minutes) which allowed choice of an activity that exemplified control over health behaviors.

Although expressed in lay terms for those directly administering the program, the protocol maintained a consistent emphasis on self-regulatory skills to deal with health-related behavioral barriers, fostering feelings of mastery through documenting one's short-term healthy eating and physical activity goal progress, and purposefully controlling negative affect through newly learned skills.

Survey and height/weight (*i.e.,* BMI) measurements were privately administered at baseline, month 3 (just prior to the mid-school year break), and month 9 (end of the school year). Regular protocol fidelity checks using a 24-item survey indicated consistent delivery of the treatment protocol.

3. RESULTS

Analyses were conducted using SPSS version 22.0 (IBM, Armonk, NY). Statistical significance was set at $\alpha \leq 0.05$ (2-tailed). The 12% of missing-at-random data were imputed using the expectation-maximization algorithm.

There was no significant difference in age (overall mean±SD=9.9±0.9 years), sex (overall 42% female), or race/ethnicity (overall 23% White, 57% African-American, 14% Hispanic, 6% other) based on body composition groupings.

Mixed-model repeated measures ANOVAs indicated significant overall change in BMI ($F_{1,84}$=12.60, P=0.001), and improvements in self-efficacy ($F_{1,84}$=9.28, P=0.003), self-regulation ($F_{1,84}$=10.21, P=0.002), and mood ($F_{1,84}$=31.18, P<0.001), that did not significantly differ by group (P-values>0.70). BMI change was adjusted for expected increases associated with participants' maturation. Specifically, the difference between each participant's identified change, and projected change based on his/her initial BMI (to the nearest one-tenth point), age (to the nearest one-fourth year), and sex (extracted from previously published normative values for United States youths [10]), was used as data. Because of previously established directionality [9], Bonferroni-adjusted within-group t-tests that followed-up ANOVAs were 1 tailed (Table **1**).

Table 1. Scores of Youth Fit 4 Life participants over 9 months, by body composition classification.

	Baseline Mean±SD	Month 3 Mean±SD	Change: Baseline-Month 3 Mean±SD *t* (*d*)	Month 9 Mean±SD	Change: Baseline-Month 9 Mean±SD *t* (*d*)
Overweight/obese group (n=32)					
Self-efficacy	17.44±4.83	18.69±4.46	1.25±4.75 1.49 (0.26)	19.25±4.27	1.81±4.74 2.16* (0.37)
Self-regulation	17.25±1.98	18.34±2.29	1.09±1.94 3.19** (0.55)	18.13±2.32	0.88±2.08 2.08* (0.44)
Negative Mood	6.38±3.49	4.56±3.78	-1.81±3.72 2.76** (0.52)	4.03±4.55	-2.34±4.34 3.06** (0.67)
BMI (kg/m^2)	23.02±2.60	23.03±2.62	-0.15±0.71 1.17 (0.06)	23.13±2.60	-0.36±0.78 2.57* (0.14)
Normal Weight group (n=54)					
Self-efficacy	16.04±5.41	17.09±4.81	1.06±5.28 1.47 (0.20)	17.48±4.75	1.44±4.82 2.20* (0.27)
Self-regulation	16.89±2.74	17.52±2.63	0.63±1.72 2.69** (0.23)	17.76±2.76	0.87±2.49 2.57* (0.32)
Negative Mood	6.98±3.58	6.02±3.66	-0.96±3.52 2.01* (0.27)	4.30±4.02	-2.69±3.85 5.13***(0.75)
BMI (kg/m)	16.55±1.50	16.59±1.65	-0.12±0.64 1.39 (0.08)	16.69±1.77	-0.33±0.91 2.65** (0.22)

Note: Possible score ranges: self-efficacy (5–25), self-regulation (5–20), negative mood (-4–20). For overweight/obese df=31. For normal weight df=53. Effect sizes for within-group changes (dependent t-tests) are expressed as Cohen's d ($mean_{baseline}$-$mean_{time2}$/$SD_{baseline}$), and considered small (0.20) to large (0.80). Within-group changes in BMI, t-values and d-values reflect changes adjusted for participants' maturation (accounting for age, sex, and baseline BMI). *$P \leq 0.05$. **$P \leq 0.01$. ***$P \leq 0.001$.

In multiple regression analyses using score changes from baseline–month 3, the prediction of BMI change by self-efficacy change did not reach statistical significance (R^2=0.03, β=-0.17, SE=0.01, P=0.11). In step 2 of that equation, change in self-regulation (β=-0.26, SE=0.05, P=0.03), but not mood (β=-0.04, SE=0.02, P=0.73), significantly added to the explained variance in BMI change and rendered the overall model significant (ΔR^2=0.06, R^2=0.09, SE=0.65,

P=0.05). In step 3, the addition of group (overweight/obese vs. normal) was not a significant contributor (*P*=0.99). By repeating the above regression analyses testing changes through month 9, self-efficacy change now significantly predicted BMI change (R^2=0.05, β=-0.21, SE=0.02, *P*=0.05). Although each in the expected direction, neither self-regulation (β=-0.17, SE=0.04 *P*=0.16) nor mood (β=0.08, SE=0.02, *P*=0.51) significantly added to the explained variance in BMI change. The impact of body composition classification was again non-significant (*P*=0.90).

4. DISCUSSION

The present findings support tenets of social cognitive theory and self-efficacy theory as applied within the YF4L after-school care curriculum for 9–12 year olds. Specifically, the treatment's focus on advancing self-efficacy and participants' use of self-regulation skills was substantiated through its association with significant improvements in targeted psychosocial variables, and their linkage to BMI change. Consistent with related research with adults with obesity [4], improved self-regulation appeared to be more relevant over the initial months, while self-efficacy was the better predictor of BMI change over the longer term. Further research should carefully examine this apparent temporal pattern. It should be noted, however, that the referenced adult physical activity-prominent treatment [4] was over 24 months, rather than the 9 months within the present study. The field nature of this investigation was an advantage [15], along with its decomposition of treatment effects which has often been suggested but rarely implemented [16]. Findings were consistent with explanatory models based on social cognitive theory and self-efficacy theory that predicted physical activity and eating behavior changes, and subsequent weight losses in adults with obesity [17]. Effect sizes for BMI change were favorable when contrasted with related treatments with youths [11 - 14].

Based on the present findings, research is now planned to test extended theoretical paths (*e.g.*, YF4L→improved exercise-related self-efficacy→improved eating-related self-efficacy→improved exercise and eating behaviors→healthy weight) to better-assess the effects on eating behaviors in children. Of importance will be evaluation of the proposed generalization, carry-over, and/or co-action [18] between psychosocial changes induced through physical activity, to corresponding effects around improved eating behaviors such as those that were found in adults [17]. Curriculum improvements will emerge from both the present findings and future related investigations.

Limitations of this research include the lack of a control group, and a relatively small sample size with a greater proportion of African-American participants than in the United States population, as a whole. Additionally, (yet unknown) characteristics of children participating in after-school care might further limit generalizability of finding to other settings (*e.g.,* summer camp). Also, although missing data were minimal and shown to be missing-at-random, it is still possible that scores were partially biased by participants who were adverse to the program's curriculum. For example, participants with extreme obesity (*i.e.,* >99th percentile on BMI) might have perceived the treatment demands as extreme, and either withdrew or did not fully participate. Further research will be required to better account for such concerns in the future. Replication is also required for the 5–8 year old age group.

Although pediatricians, other medical professionals, and public health workers seek evidence-based methods to manage the weight of children, most available programs are atheoretical and/or difficult to access.

Although further testing and replications are required, findings suggested that the YF4L protocol is a promising program for the promotion of physical activity, healthy eating, and a healthy weight in youth. While possessing a clear theoretical foundation, it is both scalable and cost-effective; requiring neither advanced-degree specialists nor expensive equipment. It is also delivered in a common venue for children, with no additional registration costs associated with the program. Although further study and refinements should address areas such as 1) the efficacy of specific aspects of the program on their target area (*e.g.,* use of goal setting affecting overall physical activity outputs), 2) generalization of self-regulatory skills to other areas (*e.g.,* health eating, academic tasks), and 3) carry-over of effects throughout childhood, based on the present results, YF4L should soon be considered adequate for large-scale community-based applications.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Institutional review board approval and consent to participate was obtained.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the *Helsinki*

Declaration of 1975, as revised in 2008 (http://www.wma.net/en/20activities/10ethics/10helsinki/).

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

The author acknowledges the participants, staff, and curriculum developers who made this research possible, and Ms. Chandler A. Annesi for her management of the data. No specific source of funding was used for this research.

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