Evidence-Based Referral: Effects of the Revised "Youth Fit 4 Life" Protocol on Physical Activity Outputs

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ABSTRACT

Background: Lack of physical activity is prevalent in youths. Pediatricians seek referrals to reliably increase outputs, especially in their overweight and underactive patients.

Objective: Within a randomized controlled trial, we contrasted 2 physical activity/nutrition treatments on the basis of social cognitive and self-efficacy theory, and a comparison condition, on time in moderate-to-vigorous physical activity (MVPA) during the 45-min/day physical activity segment of elementary afterschool care.

Methods: In youths ranging in age from 9 to 12 years (9.7 ± 0.8 years, overall), the Original Youth Fit For Life treatment (Original YFFL; n = 49), the Revised Youth Fit 4 Life treatment (Revised YF4L, n = 43), and a comparison condition of typical care (Comparison, n = 46) were contrasted using a 3 (groups) × 2 (sexes) analysis of variance incorporating means of 3 accelerometer measurements over 12 weeks.

Results: There was a significantly greater amount of time in MVPA in the Revised YF4L group than either the Original YFFL or Comparison groups ($F_{2, 132}$ = 281.20, p < 0.001). Boys completed significantly more time in MVPA than girls ($F_{2, 132}$ = 16.43, p < 0.001); however, there was not a significant group × sex interaction. Supplementary analyses indicated sedentary time was significantly less by 29% in the Revised YF4L when contrasted with the Comparison group.

Conclusion: The Revised YF4L protocol that sought to maximize participants' cardiovascular physical activity appeared to improve upon the Original YFFL treatment on time in MVPA. Thus, pediatricians might have confidence in referring their patients to such evidence-based approaches. Future research should also evaluate the effects of YF4L on psychosocial predictors of physical activity and change in body mass index.

INTRODUCTION

In the US, more than one-third of youths are presently overweight or obese.[1] Comorbidities include increased risk for type 2 diabetes, heart disease, orthopedic injuries, cardiorespiratory problems, and self-esteem issues.[2,3] Physical activity among children of all ages has decreased,[4] and this decrease is associated with an inappropriately high weight.[5] The Centers for Disease Control and Prevention's recommendation for physical activity in children is at least 60 minutes per day of moderate-to-vigorous physical activity (MVPA).[6] However, a recent population-based study using accelerometry found that only 42% of US children ages 9-11 years attained this volume.[7] Consistent with other research,[8] the percentage of boys attaining the recommended amount of physical activity (49%) was considerably greater than that of girls (35%). Notably, the percentages fall to an even more dismal 8% completing the recommended minimum starting at age 12 (3% for girls).[7] Because physical activity is the strongest predictor of controlling weight as one ages,[9] these patterns of low activity suggest a continuation of the obesity epidemic unless substantial changes occur.

Pediatricians take seriously the need for children to obtain enough physical activity to prevent or improve inappropriately high weight, as well as for promoting cardiovascular fitness. Because pediatricians are not likely to be in a position to directly provide physical activity to patients, they often seek community-based resources as referrals. However, the effectiveness of these resources may vary greatly. For example, although local sports and recreation programs are widely available, overweight, deconditioned, and nonathletic children might feel threatened around more fit and athletic peers. This might lead to even less desire for physical activity for them in the future. Also, many popular sports (eg, baseball, softball, bowling) might not provide much MVPA.

Although physical education (PE) class during the school day provides an obvious venue for physical activity in elementary school students, recent research found that only 27% of a typical class period of 45 minutes (~12 min) is spent in MVPA.[10] This is consistent with earlier findings,[11-13] and falls significantly short of the Centers for Disease Control and Prevention's recommendations of at least 50% of the PE class period being in MVPA.[14] Fewer than 4% of elementary schools provide daily PE, and walking or bicycling to school and recess time have decreased.[4] Although physical activity is associated with favorable academic performance,[15] school administrators have been unwilling to increase or improve PE. Thus, the highly utilized after-school care setting has been suggested as important for facilitating physical activity.[16]

Although the provision of dedicated time and space for physical activity during after-school care is common,

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treatments or protocols have varied widely in terms of their supervision, structure, and physical outputs.[16,17] They have ranged from supervised "free play" (participation optional), to highly structured protocols based on accepted theoretical models of health behavior change. Youth Fit For Life (YFFL), first evaluated in 2005,[18] was one such structured program; it is based on tenets of social cognitive theory[19] and self-efficacy theory[20] such as building self-regulatory skills and feelings of ability and mastery, and utilizing social supports. It included components of cardiovascular exercise, resistance exercise, self-regulation skills building (eg, goal setting, controlled self-talk), and nutrition education. Although elementary after-school care treatments have often been atheoretical and lacking in significant health outcomes, numerous studies suggested the positive impact of YFFL on physical activity (both within and outside of structured settings),[21-23] body mass index (BMI),[24] psychological well-being,[25-27] and psychosocial predictors of health behaviors.[18,22,23,28] After its validation, YFFL was made available nationally as a program certified by the Research-Tested Intervention Program of the National Institutes of Health and the National Cancer Institute (http://rtips.cancer.gov/rtips/programDetails.do?programId = 293932), usable within a number of community-based venues serving elementary school-age youths. In an effort to better tailor the treatment processes of the Original YFFL to specific age ranges, enhance self-regulatory skills training, improve participants' nutrition behaviors, better address overweight/obesity, and further increase time in MVPA, a revision of the YFFL protocol (entitled Youth Fit 4 Life [YF4L]) was recently developed.

The present preliminary study aimed to contrast the Revised YF4L with typical care and the Original YFFL on time in MVPA during elementary after-school care, while also considering the sex of participants. This is the first investigation on the effects of YF4L, which sought to extend and improve upon YFFL by maximizing participants' time in cardiovascular exercise, making self-regulation skills more palatable, and better supporting consistent nutrition themes. Ages 9-12 were selected for this investigation because there was a somewhat different YF4L curriculum for ages 5-8 and 9-12 (suggesting the need for separate study). It was expected that the Revised YF4L treatment would be associated with a significantly greater duration of time in MVPA, and significantly less time in sedentary and light physical activities, than both the Original YFFL treatment and typical after-school care processes. Boys were expected to demonstrate greater time in MVPA, regardless of group. It was hoped that this initial validation study would inform revisions of the YF4L treatment in regard to its effects on physical activity outputs. Also, results might provide data for pediatricians to assess the usefulness of YF4L for referral of their patients.

METHODS

Participants

Participants included youths, ages 9-12 years, enrolled in randomly selected elementary after-school care programs operated by YMCA facilities in the greater Atlanta, GA, area. Parents/legal guardians signed written consent forms, and participants provided verbal assent to study staff. Institutional review board approval was received, and processes conformed to the provisions of the Declaration of Helsinki. An inclusion requirement was attendance in at least 2 of the 3 monthly measurement sessions. Data were excluded if a youth arrived late or left early, demonstrated inappropriate behavior, or reported an injury. Thus, the final sample sizes for the 1) typical after-school care processes (Comparison, n = 46), 2) Original YFFL protocol (n = 49), and 3) Revised YF4L protocol (n = 43) reflected those adjustments.

The sample size adjustments did not significantly differ by group ($\chi^2(df = 2) = 1.09$, p = 0.579), with a mean removal of 26.9% of youths, overall, caused by the above conditions. There was also no significant group difference in age ($F_{2, 135} = 0.90$, p = 0.410; overall mean ± SD = 9.7 ± 0.8 years), sex ($\chi^2(df = 2) = 2.37$, p = 0.305; 51.4% girls, overall), or ethnic grouping ($\chi^2(df = 8) = 14.10$, p = 0.079; 31.9% white, 43.5% African American, 14.5% Hispanic, 6.5% Asian, and 3.6% of other ethnicities, overall). On the basis of postal zip codes of participants' residences, almost all were in the middle class.

Measures

Physical activity intensity category and time were quantified using the Actigraph GT3X accelerometer (ActiGraph, Pensacola, FL). Consistent with previous research,[29] the monitor was attached at the left side of the waist with a belt, over participants' clothing. A 30-s sampling interval (epoch) was used to best capture activity patterns found in youths of ages 9 to 12 years.[30] The accelerometer recorded 45 minutes (± 1 min) of physical activity during each of the 3 monthly measurements. No measurements were made in the initial week of after-school care because the learning of new physical activity tasks associated with the present protocols might have affected outputs most during this time. The ActiGraph ActiLife data analysis software, version 5.10.0 (ActiGraph, Pensacola, FL), converted accelerometer counts into time in sedentary, light, moderate, and vigorous physical activity on the basis of cut points established by Evenson,[30] which were subsequently determined to be the most accurate estimations available for ages 5 to 15 years.[31] MVPA was derived by summing the times in moderate and vigorous physical activity.

Several previous studies reported strong interinstrument reliability of the ActiGraph accelerometer (r = 0.84-0.92).[32-34] There were also significant correspondences between scores derived from the ActiGraph accelerometer and VO_2 treadmill testing (r = 0.82-0.87)[34] and doubly labeled water measurements (r = 0.39-0.54)[35] in children within the age range of this research. It was suggested that the ActiGraph accelerometer had the largest body of research supporting its use.[36]

Procedure

YMCA-based after-school care was administered in the same elementary school that participants attended during

the school day by the existing after-school care counselors. Regardless of group, the school gymnasium was used for the standard session of 45 min/day reserved for physical activity. Study staff secured the accelerometers to each participant's waist. Although it was obvious that the accelerometer assessed physical activity, there was no coaching given to participants or counselors by study staff to either maximize or minimize intensities. As far as possible, all were kept blind to the purposes of the study. After-school care counselors were generally unfamiliar with PE instruction methods before the training provided on the present protocols. No counselor was involved with more than 1 group. The number of participants per group ranged from 10 to 18, although not all youths present were included in this research (owing mostly to an inability of study staff to secure written consent from parents/guardians).

Competition with oneself, rather than with other participants, was emphasized.

For the Comparison group, there was no training provided to after-school care counselors beyond information needed for supervision of physical activity in a safe environment. This was provided during the job orientation. For this study, counselors were asked to administer the physical activity component of after-school care in the manner that was typical for them. Some participants ran, some played skill-games in small groupings, and some engaged in primarily sedentary pursuits. It was also an option for participants to use the sport or physical activity equipment (eg, balls and jump ropes) that were stored in the gymnasium.

For the Original YFFL group, after-school care counselors were provided 5 hours of training in the protocol's 4 components: cardiovascular exercise, strength exercise (via rubber resistance bands), behavioral skills, and nutrition. This was supported by an instructor manual and participant workbook that guided program processes[37] and the required apparatus (eg, balls, bean bags, resistance bands). In addition to the behavioral skills (eg, short- and long-term goal setting, obtaining progress feedback, thought stopping and use of productive self-talk, recruiting social supports) and nutrition-education components, 30 to 35 minutes was to be dedicated to physical activity via noncompetitive games or tasks that were designated as either high or moderate intensity. Every attempt was to be made to keep participants 1) active, 2) challenging themselves, and 3) fostering feelings of mastery and self-efficacy regarding their fitness and physical abilities. The treatment was intended for ages 5 to 12 years.

For the Revised YF4L group, after-school care counselors were provided a newly designed training of approximately 5 hours, a supporting manual, and apparatus similar to the Original YFFL.[38] There was a separate training manual for ages 5 to 8 years; however, only the 9- to 12-year-old version applied here.[38] Although application of behavioral skills training and nutrition education remained in the Revised YF4L (in an enhanced form), the separate strength training component was omitted. Rather, participants' own body weight now replaced use of the resistance bands in an effort to minimize time being nearly stationary. Also, both behavior and nutrition topics were reinforced through the use of a new array of cardiovascular activities (ie, "content reinforcement activities"), and new moderate- and high-intensity tasks were incorporated. Competition with oneself, rather than with other participants, was emphasized. On the basis of earlier research on the Original YFFL,[21,23] behavioral skills and their associated graphics (eg, posters, hand-outs) were intended to better improve participants' physical self-concept, fitness goal progress, and self-efficacy. As with the Original YFFL, 30 to 35 min/session was to be dedicated to physical activities, and a goal of attaining a mean of 25 to 30 minutes in MVPA was set.

Although the physical activity component of after-school care was five days/week, and the Original YFFL and Revised YF4L protocols met three days/week and four days/week, respectively, analyses were based on single sessions to facilitate statistical contrasts. All personal identifiers were removed before data analyses. Fidelity checks for physical activity programming were completed once every two weeks by YMCA wellness staff using a structured observation form. Any problems were quickly resolved in association with the after-school counselor's supervisor.

Data Analyses

To detect the moderate effect size found in related analyses and pilot research[39] at the statistical power of 0.80, an overall minimum sample size of 117 was required.[40] The significance level was set at $\alpha = 0.05$ (2-tailed). It was previously suggested that 3 accelerometer measurements foster accuracy in assessing physical activity outputs in youth.[41] Thus, after using the expectation-maximization algorithm for imputation of missing data of no more than 1 of the 3 monthly measurements,[42] the mean number of minutes in each physical activity category (ie, sedentary, light, moderate, and vigorous) was calculated. There was no significant difference in scores based on date of measurement for any of the physical activity categories.

For the primary analysis, a 2-way between-subjects analysis of variance of 3 (groups) × 2 (sexes) was used to contrast the Comparison, Original YFFL, and Revised YF4L groups; boys and girls; and their interaction on mean number of minutes in MVPA. Post hoc follow-up tests using the Least Significant Difference method were incorporated for pairwise contrasts. Supplementary analyses were also completed on each of the 4 separately measured physical activity intensity categories (ie, sedentary, light, moderate, and vigorous) in the same manner. Effect sizes were expressed as partial eta-square (η^2_p) where 0.01, 0.06, and 0.14 denote small, moderate, and large effects, respectively.

RESULTS

Primary Analysis

For MVPA, the main effect for treatment group was significant ($F_{2, 132} = 281.20$, $p < 0.001$, $\eta^2_p = 0.17$). The main effect for sex was also significant ($F_{2, 132} = 16.43$, $p < 0.001$, $\eta^2_p = 0.11$). There was not a significant group × sex interaction ($F_{2, 132} = 0.54$, $p = 0.582$, $\eta^2_p = 0.01$). Descriptive statistics and

results of all pairwise post hoc analyses are given in Table 1.

Supplementary Analyses

For sedentary time, the main effect for treatment group was significant ($F_{2, 132}$ = 5.57, p = 0.005, η^2_p = 0.08). The main effect for sex was not significant ($F_{2, 132}$ = 1.91, p = 0.169, η^2_p = 0.01). There was not a significant group × sex interaction ($F_{2, 132}$ = 0.21, p = 0.813, η^2_p = 0.003).

For light physical activity, the main effect for treatment group was not significant ($F_{2, 132}$ = 2.08, p = 0.130, η^2_p = 0.03). The main effect for sex was significant ($F_{2, 132}$ = 4.81, p = 0.030, η^2_p = 0.04). There was not a significant group × sex interaction ($F_{2, 132}$ = 0.29, p = 0.748, η^2_p = 0.004).

For moderate physical activity, the main effect for treatment group was not significant ($F_{2, 132}$ = 2.52, p = 0.085, η^2_p = 0.04). The main effect for sex was significant ($F_{2, 132}$ = 12.01, p = 0.001, η^2_p = 0.08). There was not a significant group × sex interaction ($F_{2, 132}$ = 1.05, p = 0.354, η^2_p = 0.02).

For vigorous physical activity, the main effect for treatment group was significant ($F_{2, 132}$ = 24.13, p < 0.001, η^2_p = 0.27). The main effect for sex was also significant ($F_{2, 132}$ = 10.04, p = 0.002, η^2_p = 0.07). There was not a significant group × sex interaction ($F_{2, 132}$ = 0.37, p = 0.692, η^2_p = 0.01).

Table 1. Minutes in physical activity intensity categories, by group and participants' sex

	Boys	Girls	Overall
Group	Mean ± SD (n)	Mean ± SD (n)	Mean ± SD (n)
Moderate-to-vigorous physical activity			
Comparison	13.51 ± 5.57 (21)	9.25 ± 6.32 (25)	11.19[a] ± 6.30 (46)
Original YFFL	14.70 ± 3.46 (28)	11.43 ± 3.69 (21)	13.30[a] ± 3.88 (49)
Revised YF4L	17.48 ± 4.76 (18)	15.29 ± 3.43 (25)	16.20[b] ± 4.14 (43)
Overall	15.07* ± 4.75 (67)	12.02 ± 5.32 (71)	13.50 ± 5.26 (138)
Sedentary time			
Comparison	11.23 ± 6.69 (21)	12.99 ± 6.69 (25)	12.19[a] ± 6.68 (46)
Original YFFL	10.12 ± 5.19 (28)	10.60 ± 4.23 (21)	10.32 ± 4.76 (49)
Revised YF4L	7.80 ± 3.05 (18)	9.19 ± 2.69 (25)	8.61[b] ± 2.90 (43)
Overall	9.84 ± 5.36 (67)	10.94 ± 5.06 (71)	10.41 ± 5.22 (138)
Light physical activity			
Comparison	20.26 ± 6.66 (21)	22.49 ± 3.42 (25)	21.47 ± 5.22 (46)
Original YFFL	21.01 ± 2.84 (28)	22.93 ± 4.50 (21)	21.83[a] ± 3.73 (49)
Revised YF4L	19.67 ± 4.95 (18)	20.52 ± 3.91 (25)	20.16[b] ± 4.34 (43)
Overall	20.42 ± 4.83 (67)	21.93*± 4.02 (71)	21.19 ± 4.48 (138)
Moderate physical activity			
Comparison	9.54 ± 4.23 (21)	6.54 ± 4.54 (25)	7.91[a] ± 4.61 (46)
Original YFFL	8.76 ± 2.00 (28)	7.33 ± 2.69 (21)	8.15[a] ± 2.40 (49)
Revised YF4L	9.98 ± 2.68 (18)	8.75 ± 2.03 (25)	9.26[b] ± 2.38 (43)
Overall	9.33* ± 3.03 (67)	7.55 ± 3.38 (71)	8.42 ± 3.33 (138)
Vigorous physical activity			
Comparison	3.97 ± 2.33 (21)	2.71 ± 1.99 (25)	3.28[a] ± 2.22 (46)
Original YFFL	5.94 ± 2.42 (28)	4.10 ± 1.88 (21)	5.15[b] ± 2.37 (49)
Revised YF4L	7.50* ± 3.17 (18)	6.54 ± 2.93 (25)	6.94[c] ± 3.03 (43)
Overall	5.74 ± 2.91 (67)	4.47 ± 2.83 (71)	5.09 ± 2.93 (138)

A different letter superscript adjacent to the mean score (a, b, or c) within the same measure denotes a statistically significant difference within the post hoc test among the 3 groups (Comparison, Original Youth Fit For Life [YFFL], Revised Youth Fit 4 Life [YF4L]). For example, in the moderate-to-vigorous physical activity measure, the Comparison and Original YFFL groups did *not* significantly differ from each other, but the Revised YF4L group *did* significantly differ from both.

An asterisk (*) within the same measure denotes a significantly greater score, by sex.

DISCUSSION

The Revised YF4L treatment was associated with a significantly greater duration of time in accelerometer-measured MVPA when contrasted with typical after-school care and the Original YFFL protocol. This is an important finding because numerous studies suggested the positive effects of the original theory-based protocol on various health behaviors and their psychosocial predictors.[18,22-28] For the Revised YF4L, sedentary time was also significantly less than with typical after-school care processes. Consistent with other research,[7] boys were more active than girls. Although there was no treatment × sex interaction found, future research should integrate and evaluate intervention components that might increase MVPA specifically for girls (possibly by incorporating modes of activity that might be especially appealing to them).

Although it was above the typical proportion of MVPA/overall time in PE class previously reported for elementary school ages,[10-13] the goal of 25 to 30 minutes/day in MVPA was not attained. Approximately one-third of the treatment time presently spent in light physical activity and sedentary time (~9 min/day) would need to be converted to moderate and/or vigorous activity to attain that goal. Although an attempt was made to reinforce the learning of behavioral skills and nutrition information through physical activities, such activities might also be extended to the time *during* the learning process itself to increase total time in MVPA in the future.

Limitations

Although various ethnicities were represented, future research should evaluate the benefit of YF4L specifically in underrepresented and minority groups, who also tend to have the greatest health risks.[1] Replication should also be completed on the YF4L version for ages 5 to 8 years. Although limitations included a lack of data on 1) psychosocial mediators of MVPA; 2) effects on BMI, nutrition, and changes in MVPA outside of the programs, and 3) expectation effects (eg, Hawthorne effect;

Rosenthal effect),[43] these initial findings on the Revised YF4L protocol in elementary after-school care were informative. Additional validation research is now required to evaluate effects of YF4L on BMI and psychosocial factors. Also, because resistance training was omitted in the new YF4L curriculum (except for some body weight resistance incorporated within the increased cardiovascular exercise time), favorable benefits related to muscle mass and muscular strength gains might have been reduced.

CONCLUSION

It is hoped that, ultimately, widespread dissemination of evidence- and theory-based protocols such as YF4L will allow pediatricians to have confidence in referring patients in need of programs for increasing their MVPA and, possibly, normalizing their BMI. Involvement from physicians in matters of health behavior change is increasingly warranted and could have immense pay-offs for the future health of the nation. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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Exercise

Nothing is to be found that can substitute for exercise in any way … . Exercise will expel the harm done by most of the bad regimens that most men follow. Not all motion is exercise. Exercise is powerful or rapid motion or a combination of both, vigorous motion which alters breathing and increases its rate.

— Moses Maimonides, 1138-1204, medieval Sephardic Jewish philosopher, astronomer, Torah scholar, and physician