The Effectiveness of a Local Public Health Program to Influence Fitness and Nutrition Goals in Children[1]

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Abstract. **A local public health department conducted a program to improve childhood fitness and nutrition known as "A Healthier Me" (AHM). AHM is a one-hour multidisciplinary outreach program conducted for children ages 5 to 12 (n = 129). The program included a survey of 'risk behaviors' and 'fitness and nutrition goals.' AHM was effective at improving nutrition goals (7 versus 5 days per week, p <0.05) in children not exposed to excessive television watching. Children who ate fast food were 5 times more likely to excessively watch TV (95% CI 3.5, 7.5) and 3.9 times more likely to not eat 5 servings of fruits or vegetables per day (95% CI 2.9, 5.3). Children who did not eat 5 or more servings of fruits or vegetables per day were 3.2 times more likely to watch TV excessively (95% CI 1.9, 5.6). The odds of obesity was 101.5 times greater for children who do not eat 5 or more servings of fruits and vegetables per day (95% CI 2.06 to 4993.7). In children who attended AHM twice (n = 20), exercise sessions increased from 4.9 to 6.9 per week, (p = not significant); watching TV hours decreased from 4.4 to 3.2 hours per day (p <0.01), and eating fruits and vegetables increased from 5.2 to 5.6 days of the week (p = 0.06). AHM improves fitness and nutrition goals. Improving uptake of fruits and vegetables per day is extremely important in reducing obesity in children ages 5 to 12.**

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INTRODUCTION

Childhood obesity increases the risk of cardiovascular disease (Laskarzewski and others 1980; Must and others 1992). While obesity in pre-adolescents is usually not associated with mortality or overt physical morbidity, it does represent a risk factor for several diseases later in life (Pi-Sunyer 1991). Obesity tracks from childhood to adulthood (Clarke and Lauer 1993). Indeed the genesis of adult obesity may begin in childhood (Guo and others 1994). It is important to intervene to prevent adult disease (Endo and others 1992; Williams 1994).

There is a positive relationship between TV viewing and obesity (Grund and others 2001). TV viewing causes obesity by (a) reducing resting energy expenditure (Klesges and others 1993), (b) replacing physical activities (Deheeger and others 1997), and (c) increasing consumption of unhealthy foods in subjects with increased TV watching (Jeffery and French 1998). In addition, obesity has been shown to increase TV viewing (Robinson 1998). Obese adolescents are less active than their non-obese counterparts (Bar-Or and Baranowski 1994). Structured combined interventions in children have resulted in decreased body weight, decreased body mass index, and improved fitness (Eliakim and others 2002).

The "A Healthier Me" (AHM) program is a physical fitness and nutrition promotion program conducted by the health department dietitian and social worker and Greene County Parks and Recreation's "Summer Caravan" for children in the Greene County, OH, area. The Ohio State University, Department of Human and Community Resource Development ranked Greene County as 7th in median income in 2002, with a population of 147,886 persons (over 90% who are white). The Caravan meets in two locations for a week and then goes to another location the next week. The children involved in this "Summer Caravan" often go to more than one location. While physical activity was a regular part of the "Summer Caravan" program, nutrition was not. The children who attend the "Summer Caravan" may be more physically active for the week they attend the camp, but fruit and vegetable consumption and TV watching would not be related to physical activity. The objectives of this analysis are to (a) describe the relationship between the behaviors (amount of TV watched, amount of exercise, how many fruits and vegetables are eaten, and how often fast food was eaten) and obesity among surveyed children, (b) determine the effectiveness of AHM to influence healthy goal setting among subgroups of children, and (c) determine the internal consistency and the internal validity of the program to estimate the cause and effect relationship between obesity and exposure to unhealthy behaviors.

MATERIALS AND METHODS

The AHM team surveyed groups of children at eight locations throughout Greene County, OH, in collaboration with the Greene County Parks and Recreation Department's Summer Caravan program. In all, 154 children were educated on nutrition, fitness, and also on being smoke-free. The Tobacco coalition collected data not included in this article. The children were asked, as a group, baseline questions, then participated in the 'Healthier Me' program. The Program educated children on the food guide pyramid using lectures and games. The importance of physical activity was discussed. The children's height and weight was measured. Body mass index (BMI) was calculated and a letter sent to each child's parents showing height and weight, letting them know what percentage the BMI was and if their child was overweight, underweight, or normal weight. The baseline questions were mutually exclusive. After the program the children were surveyed on their goals (post survey). (See Table 1 notes for the survey questions.) The original intent was for completing a 'one-time survey' per child, however 20 children out of 146 total surveys were repeat attendees. We took advantage of these repeats to conduct an internal test of one-way reliability for 20 repeats. If the results decreased (a one way direction) during the second exposure to AHM, the test-retest reliability would be flawed (Roberts and Priest 2006). The reason this was considered a test of one-way reliability was the hypothesis that the AHM would be beneficial on nutrition and fitness: Repeated exposures could be expected to augment the effects. Repeated surveys were not used in calculations of baseline rates or determination of odds ratios. Also,

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TABLE 1

Fitness and nutrition goals set by Greene County, OH, children ages 5 to 12, by obesity level and risk factor. Was the nutrition and fitness program effective at influencing goal setting for these children?

		Exposed to TV Watching[c]		Exposed to Fast Food[c]		Exposed to Low Fruit[c]		Exposed to Low Exercise[c]	
Goals[a]	Stats	No	Yes	No	Yes	No	Yes	No	Yes
BMI[b]	Median	63	62	63	69	55	76	63	46
Percentile	N	85	38	107	16	82	41	104	19
Exercise	Mean	5.5	6.8	5.9	6.4	5.8	6.3	5.9	7.0
Per	Median	5.5	5.5	6.0	3.5	5.0	6.0	5.0	7.0
Week	SD	3.06	6.06	4.1	3.1	4.26	4.7	4.46	3.67
	N	66	38	88	16	66	38	99	5
Watch	Mean	3.3	4.1	3.7	2.9	3.6	3.6	3.6	3.5
TV Not	Median	2.0	2.8[d]	2.0	2.0	2.0	2.5[d]	2.0	3.0
More	SD	4.31	4.75	4.8	2.04	5.27	2.64	4.54	3.08
Than	N	68	38	90	16	67	39	100	6
Eat	Mean	5.4	5.2	5.3	5.2	5.4	5.1	5.2	7.0
Nutritious	Median	7.0	5.0[e]	7.0	5.0	7.0	5.0	7.0	7.0[d]
Days per	SD	2.33	1.92	2.30	1.75	2.35	1.86	2.2	0.00
Week	N	67	38	89	16	67	38	100	5

[a]Goals: Exercise = I will participate in vigorous activity for 30 minutes per Week. I will watch TV not more than ___ hours per day. I commit to eat 5 fruits and vegetables ___ days of the week.

[b]Abbreviations: BMI = Body Mass Index Age for Gender Table; N = number of children; SD = standard deviation.

[c]Dependent variable dichotomous for Obesity at the BMI Percentile. Predictor variables are dichotomous. Exposure status defined by amount of behavior reported. How many had eaten fast food yesterday? Exposed >70%, Unexposed <40%. How many had 5 fruits and vegetables yesterday? Exposed <40%, Unexposed >50%. How much time was spent watching TV? Exposed >2.4 hours, Unexposed <1.6 hours. How many spent at least 30 minutes doing activities that made you sweat and breathe hard? Exposed >95%, Unexposed <56%.

[d]Groups have different locations using Mann-Whitney Test using two-tailed significance level $p < 0.05$.

[e]Groups have different locations using Mann-Whitney Test using two-tailed significance level $p < 0.10$.

partially completed surveys were not used, reducing the number of baseline participants from 126 to 112.

The BMI percentile was not normally distributed. Nonparametric techniques were used due to the skewed distribution of the BMI percentile and the heterogeneity of the exposure factor's variances. Natural breakpoints of the histograms for each AHM session were used to develop categories for length of TV viewing, fast food consumption, fruits and vegetables consumed, and exercise.

Odds ratios with 95% confidence intervals were calculated for exposure behaviors. Backwards logistic regression was conducted using a BMI equal to or greater than the 75th percentile as dichotomous dependent variable. The independent variables were coded for exposure dichotomously. Male and female were coded as separate variables (0 for no, 1 for yes). This allowed for proper modeling of the selected variables. The individual BMI score was interpolated from charts obtained from the Centers for Disease Control (Hammer and others 1991; Pietrobelli and others 1998). Mann-Whiney U-Tests were used to test for the effectiveness of the program in reaching across exposure groups. The locations of the distributions were considered significantly different if the p value was less than 0.05. Post analysis proportional sample size estimates were conducted. Wilcoxon Signed Rank Tests were used to evaluate the internal validity of the analysis with the assumption that children who participated in the 'Healthier Me' program twice would have improved nutrition and fitness goals. This assumption could be used to determine if there was a cause-and-effect relationship between independent and dependent variables.

Exposure was defined as exhibiting the reported behavior at a critical level by natural break points in the data. Exposure to fast food was defined as at least a 70% probability of having eaten fast food yesterday. Unexposed to fast food was defined as having <40% probability of having eaten fast food yesterday. Exposure to low fruits and vegetables was defined as having <40% probability of having eaten >5 servings of fruits or vegetables yesterday. Unexposed to low fruits and vegetables was defined has having >50% probability of having eaten >5 servings of fruits or vegetables yesterday. Exposed to excessive TV watching was defined as having watched >2.4 hours of TV per day. Unexposed to excessive TV watching was defined as watching TV <1.6 hours. Exposed to sedentary life style (low exercise) was defined as >95% probability of not having done any activities within the past week that made them sweat or breathe hard for at least 30 minutes. Unexposed to a sedentary life style (exercise) was defined as a <56% probability of not having done at least 30 minutes of activities that made them sweat and breathe hard. Limits for obesity were set at the 75th, 85th, and 95th percentiles from the CDC Age and Gender tables.

RESULTS

For ages 7 to 12, there was a significant increase in exposure

for the number of dichotomously coded exposures (0 = not exposed, 1 = exposed) to fast food, low fruits and vegetables, excessive TV watching, and low exercise to increase with age (Fig. 1). For every increase in age by one year, average exposure per person was increased by 14% ($p = 0.005$, $R^2 = 0.883$). Table 1 shows the effect of the 'Healthier Me' program to influence the goals between subgroups of children. There was no difference in nutrition and fitness promotion goal setting between children at the 75th, 85th, and 95th body mass index percentile after participating in the 'Healthier Me' program. The odds of relationships between risk behaviors are shown in Table 2. Rate of behaviors in children ages 5 to 12 in Greene County, OH, are shown in Table 3. Table 4 shows the resulting models of three backwards-logistic regressions using the 75th BMI percentile as the critical limit for obesity as the dependent variables.

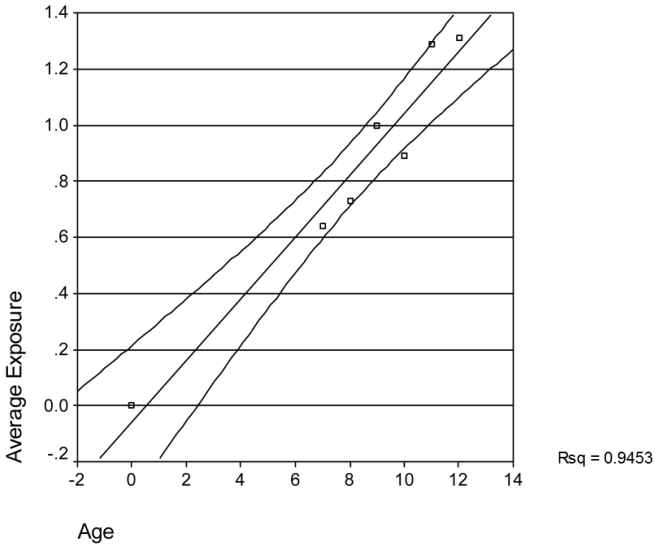

FIGURE 1. Aggregate exposures per year of age to fast food, low fruits and vegetables, excessive TV watching, and low exercise. ($y = 0.11x$, ($p = 0.005$, $R^2 = 0.945$). (Note: Number of children per year from 7 to 12 olds were: 22, 30, 20, 18, 17, and 13).

TABLE 2

Relationship of behaviors in Greene County, OH, among children ages 5 to 12 for watching TV, eating fast food, lack of exercise, and low intake of fruit and vegetables with 95% confidence intervals, N = *129.*

Children who...	Estimate	Relationship
Eat fast food are ___ times more likely to...	5.14 (3.53, 7.47)	Watch TV >2.4 hours
Eat fast food are ___ times more likely to...	3.90 (2.85, 5.33)	Eat less than 5 servings of fruits or vegetables
Eat <5 servings of fruits or vegetables are ___ times more likely to...	3.20 (1.85, 5.55)	Watch TV >2.4 hours

CONCLUSIONS

Childhood interventions related to low exercise, TV watching, eating less than 5 servings of fruits or vegetables per day, and excessive amounts of fast food consumption should include consideration that the rate of these harmful behaviors significantly increase in intensity, at least, through age 12. However, low exercise does not contribute directly to higher rates of exposure.

The "A Healthier Me" program appears to be effective at improving fitness and nutrition goals with an intervention: for exercise sessions per week (4.9 to 6.9 per week, p = not significant), watching TV (not more than 4.4 to 3.2 hours per day, $p < 0.01$), and eating fruits and vegetables (5.2 to 5.6 days per week, $p = 0.06$).

While males had twice the error rate than females when completing the post-survey (5.3% versus 1.8%), the "A Healthier Me" program results do not provide statistically inconsistent answers by sex or age.

The "A Healthier Me" program was effective in promoting goals regardless of obesity level, and was effective at improving weekly 'eating nutritious' goals (7 versus 5 days per week, $p < 0.05$) in children exposed to television watching less than 1.6 hours per day versus 2.4 hours per day.

Children who eat fast food are 5.14 times more likely to watch a lot of TV (95% CI 3.5, 7.5) and 3.9 times more likely to not eat 5 servings of fruits or vegetables per day (95% CI 2.9, 5.3). Children who eat less than 5 servings of fruits or vegetables per day are 3.2 times (95% CI 1.9, 5.6) more likely to watch a lot of TV.

The odds of obesity (as defined as being at or greater than the 95th BMI percentile) associated with: TV watching was 1.57 (95% CI 0.7, 3.8); eating fast food, 1.43 (95% CI 0.5, 4.4); low intake of fruits and vegetables, 1.78 (95% CI 0.7, 4.3). The odds of obesity may increase with excessive television watching, eating fast food, or low intake of servings of fruits or vegetables.

The odds of obesity in Greene County children ages 5 to 12 if exposed to low intake of fruits and vegetables is 100 times that of children who eat at least 5 or more servings of fruits and vegetables per day (odds ratio 101.5 with a 95% confidence interval of 2.06 to 4993.7).

DISCUSSION

Even if the attempt to prove the internal validity of the results were positive, the methods as presented herein could not prove that the intervention decreased exposure to risky behavior in the children. Behavior after the intervention was not measured. Only intended behavior in the form of goal setting was measured, which at best would loosely relate to actual behavior. In addition, the same analytical limitations such as low numbers, non-normality of the data, repeated sampling of some children and not other children, disparate sampling techniques pre- and post-intervention, and variability within the intervention itself limits the conclusions that can be reached in regards to the effectiveness of the intervention. The use of logistic regression as the primary analytical method was an attempt to offset some of these limitations.

One may ask therefore what have we gained? The results are logically efficient with the effect following the cause very closely (Rosenberg 2000). The results lend themselves not only to proven theoretical explanation, but to a practical one as well. Both the timeliness and remarkably large effect size would add to the body of science specifically aiding meta analysis of odds ratios in the current obesity epidemic the United States is currently experiencing.

Table 3

Odds of obesity from unhealthy behavior in children (with 95% confidence intervals for age and gender specific Body Mass Index at the 75th, 85th, and 95th percentile in Greene County, OH, children ages 5 to 12 from watching TV, eating fast food, lack of exercise, and low intake of fruit and vegetables).

Behavior	Exposure Status[a]	Total	75th Percentile		85th Percentile		95th Percentile	
		Rate (n/N)	Rate	Ratio	Rate	Ratio	Rate	Ratio
Watching TV	Exposed	30.9% (38/123)	39.5% (15/38)	0.96 (0.60, 1,53)	23.7% (9/38)	0.72 (0.37, 1.37)	18.4% (7/38)	1.57 (0.65, 3.80)
	Unexposed	69.1% (85/123)	41.2% (35/85)		32.9% (28/85)		11.8% (10/85)	
Eating Fast Food	Exposed	13.0% (16/123)	50.0% (8/16)	1.27 (0.74, 2.19)	25.0% (4/16)	0.81 (0.33, 1.98)	18.8% (3/16)	1.43 (0.46, 4.44)
	Unexposed	87.0% (107/123)	39.3% (42/107)		30.8% (33/107)		13.1% (14/107)	
Lack of Exercise	Exposed	15.4% (19/123)	36.8% (7/19)	0.89 (0.47, 1.68)	36.8% (7/19)	1.28 (0.66, 2.48)	15.8% (3/19)	1.17 (0.37, 3.69)
	Unexposed	84.6% (104/123)	41.3% (43/104)		28.8% (30/104)		13.5% (14/104)	
Low Fruit/Vegetables	Exposed	33.3% (41/123)	51.2% (21/41)	1.45 (0.95, 2.20	34.1% (14/41)	1.22 (0.70, 2.11)	19.5% (8/41)	1.78 (0.74, 4.27)
	Unexposed	66.7% (32/123)	35.4% (29/82)		28.0% (23/82)		11.0% (9/82)	

[a]Exposure status defined by amount of behavior reported. How many had eaten fast food yesterday? Exposed >70%, Unexposed <40%. How many had 5 fruits and vegetables yesterday? Exposed <40%, Unexposed >50%. How much time was spent watching TV? Exposed >2.4 hours, Unexposed <1.6 hours. How many spent at least 30 minutes doing activities that made you sweat and breathe hard? Exposed >95%, Unexposed <56%.

Table 4

Odds of obesity and 95% confidence intervals if exposed to risky behaviors (eating fast food, low intake of fruits and vegetables) among Greene County, OH, children ages 5 to 12.

Predictor[a]	Odds of Obesity[b]	Lower	Upper	Units
Eating Fast Food by Male	4.95	0.68	35.902	Unexposed = 0, Exposed = 1; Not Male = 0, Male = 1
Low Intake Fruits and Vegetables	101.5	2.06	4993.7	Unexposed = 0, Exposed = 1
Low Intake of Fruits and Vegetables by Age	0.63	0.42	0.94	Unexposed = 0, Exposed = 1; Years
Low Intake of Fruits and Vegetables by Female	1.51	0.32	7.07	Unexposed = 0, Exposed = 1; Female = 1, Male = 2

[a]Proportion of variation explained by final model: BMI percentile 75th: 17.4%. Significance levels of omnibus test of final model's coefficients: BMI percentile 75th: $p = 0.002$.

[b]Backwards logistic regression used to determine odds ratios. Step 1 covariates included site, age, gender, exposure variables, and primary interactions. Levels for entry and removal were 0.05 and 0.15, respectively. Obesity defined as $\geq$ the Body Mass Index Age per Gender percentile level. Dependent variable dichotomous for Obesity at the BMI Percentile. Predictor variables are dichotomous. Exposure status defined by amount of behavior reported. How many had eaten fast food yesterday? Exposed >70%, Unexposed <40%. How many had 5 fruits and vegetables yesterday? Exposed <40%, Unexposed >50%. How much time was spent watching TV? Exposed >2.4 hours, Unexposed <1.6 hours. How many spent at least 30 minutes doing activities that made you sweat and breathe hard? Exposed >95%, Unexposed <56%. Grayed cell indicates variables not in the equation.

Although data was obtained in a cross sectional manner, we feel we have validated the study by analyzing the data for an effect in those children with a second AHM visit. While we did not find a statistically significant difference in gender, probably because of low numbers of observations, gender differences have been previously noted in the body fat of low and high body mass children (Komiya and others 2000).

Recommendations have been made elsewhere that the BMI cutoff be at the 95th percentile (Ebbeling and others 1999). The BMI cutoffs used in this analysis for estimating obesity were calculated from actual measures of height and weight and the CDC charts for age for gender were used to interpolate the BMI percentile. Not only was the 95th percentile used as an outcome, the 75th and 85th percentiles were also used because of the possibility of the asymptotic effect of exercise and obesity (Beunen and others 1996).

The assumption for the generation of Table 1 that internal validity could be tested because repeated exposure to the Summer Caravan Program would increase goals may be in error. An alternative assumption could be that the repeated measurement of goals could yield more realistic goal setting, not necessarily an improvement. Despite this, the use of Table 1 in regards to these results provides a conservative suggestion to not weight the TV watching results too heavily.

Ideally the program should be equally effective regardless of disparities in prevalence of disease, demographic characteristics of subpopulations, or history of exposure. This appears to be the case, except in two incidents where children who had low amounts of exercise (7 days nutritious eating versus 5 days for persons who exercised) and girls (6 days for girls versus 5 days of nutritious eating for boys) set nutrition goals higher than their respective counterparts. Natural break points are the most defensible statistically in stratifying data, although this leads to small numbers in the unexposed. Most children have some activity, hence the strata with low activity was very small.

In examining the relationships between independent variables, only statistically significant odds ratios greater than 2.0 were shown. With obesity as the disease when controlling for the other exposures, TV watching, not eating fruit and vegetables, eating fast food, or not exercising were not statistically significant risks for disease, but this is probably due to a lower number of observations per substrata, suggesting that the multivariate method as presented in Table 4 is a more appropriate statistical method. The tendency is to look at the information in Table 4 and suggest causation. The information is from a baseline survey and does not infer causation. The higher estimates of likelihood may be related to the number of subjects observed, although presumably they are conservative since they would underestimate the existence of a relationship between the variables. It should be noted that the information in Table 4 suggests a relationship, but no statistical significance was found when the data were stratified by the exposure variables before calculating odds of disease if exposed versus unexposed to the behavior. This suggests that greater observations are required to make up for sparse cells and/or that multivariate methods are used.

In order to be conservative we deleted the estimates where the cells were zero. We felt justified in doing this when we had a reciprocal explanation of the relationship. In addition, the resulting relationships would underestimate the strength of the relationship. Exercise terms were deleted because of small number problems. Protective effects were excluded because they were not the focus of the paper and we felt it would be problematic in the detail required to fully explain the convolutions: for instance, children who ate less fruits and vegetables were less likely to not eat fast food, OR 0.l6 (95% CI 0.5, 0.8).

Although all the confidence intervals in Table 3 include one, the odds for being at these limits are increased relative to the higher percentile, suggesting there is a dose response relationship and that a post hoc sample size estimate should be conducted. While not achieving statistical significance when the odds for lack of exercise (Table 3) at the 75th BMI percentile are examined, the odds ratio was less than one suggesting a protective effect. This is not inconsistent with previous findings. Obese children spend more energy in physical activity per task than normal weight children, though not differing in daily volume of physical activity (Gazzaniga and Burns 1993). Obese adolescents are less active, although their total energy expenditure is equal or greater (Bar-Or and Baranowski 1994). Adiposity has more negative effects on fitness at the extreme ranges of fatness: A moderate increase of subcutaneous fat has only a marginal effect on physical performance (Beunen and others 1996). The risk of being at the critical BMI level for exposure to lack of exercise (Table 3) reflects these previous findings with the 75th BMI percentile outcome having odds less than one and the 85th and 95th percentile having odds greater than one.

The use of interactions with logistic regression is problematic. To avoid some of the pitfalls, gender was recoded (after the model was selected) for male (0,1) and female (0,1). The interaction terms that were selected were recoded for male or female depending on the protective or harmful association of gender. The justification for this is that we reserved freedom of degrees in the selection process and tried not to introduce bias into the process by keeping the selected model.

Previously there has been noted a significant black/white but not male/female difference in whole body bone mass and bone density before puberty (Nelson and others 1997). Additional covariate information, such as race, should be accounted for. Without some experimental controls built into the program, the intervention's effectiveness and efficacy cannot be properly monitored. In future efforts to influence healthy behaviors among children, pre-test and post-test surveys should be identical. Survey methods should be standardized so that every session can be compared. If children are going to be surveyed more than once, physiological measures and surveys should be collected in the same fashion. If possible, children who did not undergo the program should be surveyed for their goals to allow for comparisons between control and treatment groups.

Earlier intervention might be warranted as exposures to harmful behaviors increase from zero to 3 exposures between the ages of 9 to 10 years. Improving uptake of fruits and vegetables per day is extremely important in reducing obesity in children ages 5 to 12. The results suggest that AHM improves fitness and nutrition goals, but more children should be sampled for more precisely determining the validity of the measures of effectiveness of the "A Healthier Me" program on promoting exercise.

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