

Effects of summer school participation and psychosocial outcomes on changes in body composition and physical fitness during summer break

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Kyung-Shin Park and Man-Gyoon Lee. Effects of summer school participation and psychosocial outcomes on changes in body composition and physical fitness during summer break. *JENB.*, Vol. 19, No. 2, pp.81-90, 2015 **[Purpose]** Evidence suggests that adolescents gain more weight during the summer break than they do during the school year, and that participation in the summer school program is beneficial in maintaining their healthy lifestyle. It is known that obesity and physical fitness in adolescents can be affected by their socio-economic and psychological status, especially during a long school break. The purpose of this study was to examine the effects of summer school participation and psychosocial outcomes on changes in body composition and physical fitness in underprivileged adolescents during the summer break. **[Methods]** Body composition and physical fitness in 138 underprivileged adolescents were measured at the beginning and end of the summer break. A survey on socio-economic and psychological status was conducted at the beginning of the summer break. Two-way repeated measures ANOVA and Tukey *post hoc* tests were used for data analysis. Pearson correlation analysis was performed to establish a relation between psychological outcomes and changes in body composition and physical fitness during the summer break. **[Results]** Significant increases in body weight ($p = .003$) and % body fat ($p = .014$) as well as a decrease in VO_{2max} ($p = .018$) were found in summer school non-attendants during the summer whereas no significant changes were found in summer school attendants. Summer school non-attendants with lower psychosocial outcomes had a greater decline in physical fitness and weight gain; however, summer school attendants were not affected by psychosocial outcomes. The summer school program effectively prevented summer weight gain among underprivileged adolescents due to the structured environment, restricted food access, and scheduled time for exercise in addition to minimizing the effects of their psychosocial outcomes. **[Conclusion]** Results indicated that summer school non-attendants may require comprehensive intervention for psychosocial outcomes and nutritional education to maintain body weight and physical fitness levels during the summer break. **[Key words]** adolescent obesity, summer break, weight gain, underprivileged adolescents.

INTRODUCTION

Obesity is recognized as a major cause of morbidity and mortality and obesity rates have shown dramatic increases in both adults and school-aged populations over the last 30 years [1]. The prevalence of obesity has especially increased markedly in adolescents in recent decades. The rate of obese adolescents aged 12-19 in the United States increased from 5% in 1980 to nearly 18% in 2010 [2]. Adolescence is a critical stage for psychological and physical development since any excessive weight gained in this stage may be easily transferred to adulthood and may affect the quality of life.

80% of obese adolescents become obese adults with various health problems and long-term risk of diseases related to their obese state [3].

Summer break represents about 23% of a typical American school year and is the largest consecutive period of out-of-school time [4]. During the summer break, the decline in physical fitness and weight gain in adolescents are results of physical inactivity as well as increased food intake [5]. Previous research shows that the increase in Body Mass Index (BMI) of children during the summer is roughly twice as fast as that in the school year [6]. During the summer break, children tend to live a sedentary lifestyle while having an

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unhealthy calorie intake with larger portion sizes, fewer nutrients, and more energy dense foods than the foods they eat at school [7,8]. It has been suggested that schools employ an effective approach in improving the level of physical activity and the diet of their students during the school year, therefore, out-of-school time, especially long summer breaks, may be more problematic for weight management. Compared to the school year when children are influenced by both academic and non-academic environments, students spend their breaks solely in a non-academic environment. Consequently, their physical activity and diet may be affected by the socio-economic status of their family during the summer break [9,10].

In underprivileged groups such as racial and/or ethnic minorities, those living in poverty and those with low levels of education, there is a high prevalence of obesity in adolescents in comparison to others [11]. Compared to non-Hispanic whites, African-American and Hispanic children showed a higher prevalence of obesity due to more obesity promoting behaviors such as skipping breakfast, low intake of fruits and vegetables, and physical inactivity [12]. Family income had a larger effect for Hispanic children than for non-Hispanic whites and African-Americans [13]. In underprivileged communities, children exhibit poor dietary and physical behaviors that affect obesity [14].

Obesity and physical levels of fitness are believed to affect adolescents' psychological outcomes, resulting in low self-esteem and depression [15-17]. Higher self-esteem can provide adolescents with a buffer against the impact of negative influences and help them choose better physical health and health-related behaviors such as regular exercise and healthy diet patterns [18,19]. Self-body image satisfaction is also known to be central to emotional well-being, which has a strong influence on eating habits and regular physical activity [20,21].

Several groups have reported success in the loss or prevention of weight gain during the summer break by conducting summer camp studies that incorporate physical activity and diet interventions; however, no summer intervention studies have been conducted in underprivileged communities. Most summer intervention studies targeted children who were socio-economically able to attend camps. Children from unprivileged community may have less access to out-of-school activities such as sports and summer camps [4,8,10,13]. To our knowledge, none of the studies investigated the relationship between psychosocial outcomes and changes in body composition or physical fitness over the summer break depending on whether the students attended a structured and extended summer school program. Therefore, we hypothesized that a structured and extended school program during the

summer may reduce weight gain and loss of physical fitness in underprivileged adolescents by dampening the effects of the out-of-school environment and psychosocial outcomes, thus, reducing the prevalence of obesity in this population. The primary purpose of this study was to determine the effects of psychosocial outcomes and a five week summer school participation, designed to increase physical activity and reduce dietary intake, on changes in body composition and physical fitness in underprivileged high school students.

METHODS

Participants

Participants were recruited from the freshman and sophomore student populations (ages 15-17 yrs) in a high school located in an underprivileged Hispanic area in Southern Texas. In this high school, all freshman students participate in a compulsory 5 week summer school program in their first summer break. Therefore, freshman participants were considered summer school attendants while sophomore participants were summer school non-attendants. The number of students in each grade was about 100 students. Excluding students who had known chronic diseases, were taking medication that could alter metabolic, cardiovascular or immune function, had musculoskeletal limitations, or were not willing to volunteer for this study, a total of 145 high school students performed the PRE test, but only 138 students (70 summer school attendants vs. 68 non-attendants; 71 males vs. 67 females) completed both PRE and POST data collection. Seven students that could not participate in the POST test due to sickness (three students), missing school (three students), and changing schools (one student) were excluded from data analyses. The experimental protocol [TAMIU IRB 2011-04-05] was approved by the Institutional Review Board of Texas A&M International University, and participants provided written informed consent.

Procedure

The summer school program was held five days a week during regular school hours (08:00-16:00) for 5 weeks. This was exactly the same schedule as the regular school days, with an hour of physical activity every day. During the physical activity period, students conducted aerobic exercises, resistive exercises with body weight (push-up, sit-up, etc) and a variety of games. Since the high school was located in an underprivileged community, all summer school attendants

were provided with breakfast (250-400 kcal) and lunch (700-900 kcal). For both the summer school attendants and non-attendants, all variables were measured and assessed before (Pre: last two weeks of school year in May) and after (Post: first two weeks of new school year in August) the summer break.

Anthropometric measurements were initially acquired from all participants. All measurements were completed twice by a trained technician. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively, with the participants wearing indoor clothes without shoes.

Percent Body Fat (% Fat) was estimated using the data obtained with a skin fold caliper (Beta Technology Incorporated, Cambridge, MD). The thickness of the skin was measured and used to calculate percent body fat based on previous research [16,22]. For this study, the males were assessed in the following three areas: chest, abdominals, and front thigh. For the females, the following areas were assessed for percent body fat: the triceps, supra-spinal, and the front thigh.

The skin fold measurements and equations used for this study were as follows:

Male:

$$BD = 1.10938 - 0.0008267 \times (\sum 3SKF) + 0.0000016 \times (\sum 3SKF)^2 - 0.0002574 \times (\text{age}) \quad [17]$$

Female:

$$BD = 1.0994921 - 0.0009929 \times (\sum 3SKF) + 0.0000023 \times (\sum 3SKF)^2 - 0.0001392 \times (\text{age}) \quad [22]$$

Percent Fat = $((4.95/BD) - 4.5) \times 100$ BD: Body Density

Several other fitness tests such as the Queens College step test, push-ups, and the sit-and-reach test were used to assess cardiovascular function, muscular strength and endurance, and flexibility, respectively. The Queens College step test was used to estimate cardiovascular function (VO_{2max}) and is known as a valid and reliable measure for adolescents [23-25]. Chatterjee and colleagues [24,25] reported that estimated VO_{2max} from the Queens college step test using a standardized procedure was highly correlated with actual VO_{2max} in male and female participants whose mean height were 166 cm and 157 cm, respectively ($r = .95$). Mean heights for male and female students in this study were 172 and 156cm, respectively, therefore, the Queens college step test was conducted without height and speed adjustment. Each participant stepped up and down on the 41.3 cm height platform, at a rate of 22 steps per minute for females and 24 steps per minute for males, for a total of 3 minutes. The speed of the step exercise was set up using a metronome at 96 and 88 beats per minute for male and female students, respectively. The participants immediately stopped upon completion of the test, and their

heart rates were counted for 15 seconds from 5-20 seconds of recovery. A prediction of VO_{2max} was calculated using the following formula [23];

$$\text{Male: } VO_{2max} \text{ (ml/kg/min)} = 111.33 - 0.42 \times \text{heart rate (bpm)}$$

$$\text{Female: } VO_{2max} \text{ (ml/kg/min)}$$

$$= 65.81 - 0.1847 \times \text{heart rate (bpm)}$$

The push-up test was performed according to the procedures outlined in the Fitnessgram Reference Guide [26]. The sit-and-reach test was performed using a commercially available metal sit-and-reach box. Participants sat on the floor in the long-sitting position with knees straight and with the soles of their feet against the box and performed the test according to ACSM guidelines [27].

A survey with an approximate time of 20 minutes was completed by participants and their legal guardians before the summer break. The survey captured socio-economic data including sex, level of parents' education, living status, caregiver status, annual house hold income, and frequency of fast food consumption. A self-esteem scale by Rosenberg [16] and the Self-body shape Questionnaire developed by Copper, Taylor, Cooper, & Fairburn [28] were used in this study to estimate psychological data such as self-esteem and self-body shape image.

Data analysis

Sample size was estimated using the operating characteristic curve [29]. Power calculations were conducted to assess the overall change in body composition within the group using results from Smith *et al.* [7]. The results indicated that 54 participants in each group were needed to detect a significant increase in body composition during the summer break with 90% power at $\alpha = .05$. All statistical analyses were conducted using SPSS 22 (SPSS inc., Chicago, USA). Two-way analysis of variance (ANOVA) with repeated measures were used to analyze changes in body composition and levels of physical fitness during the summer break as well as the effects of socio-economic status on changes in body composition and levels of physical fitness. Post hoc tests using Tukey post hoc test were performed when appropriate. Pearson correlation analysis was performed to establish a relation between psychosocial outcomes and changes in physical fitness during the summer break. Statistical significance was accepted for all tests at $P < .05$.

RESULTS

Table 1. shows changes in body composition and levels

of physical fitness in summer school attendants and non-attendants over the summer break. Summer school attendants showed no significant changes in any of the variables during the summer break. In contrast, summer school non-attendants gained body weight ($63.6 \pm 1.9 \text{ kg} \rightarrow 65.6 \pm 1.9$, $P = .003$) and % body fat ($24.4 \pm 0.7 \% \rightarrow 26.17 \pm 1.2$, $P = .014$) without significant changes in height during the summer break. Estimated cardiovascular fitness ($\text{VO}_{2\text{max}}$) via the step test also decreased significantly ($44.3 \pm 1.3 \text{ ml/kg/min} \rightarrow 42.7 \pm 1.5$, $P = .018$). The push-up and sit-and-reach results did not change significantly in both groups over the summer break.

Effects of socio-economic status on changes in body composition and levels of physical fitness over the summer break are provided in Table 2, 3 and 4. The numbers for body composition and physical fitness variables reflect the changes during the summer obtained by subtracting values before the summer from those after the summer. Each group was further divided into two or three sub-groups depending on socio-economic status and changes in body composition. Physical fitness levels were then compared among these sub-groups. For summer school attendants, body composition and physical fitness were not affected by socio-economic

Table 1. Body composition, and physical fitness before (PRE) and after (POST) summer break.

	Summer school attendants			Non-attendants		
	PRE	POST	<i>P</i>	PRE	POST	<i>P</i>
Height (cm)	163.8 ± 1.1	164.3 ± 1.2	0.856	163.5 ± 0.9	163.9 ± 1.1	0.704
Body weight (kg)	64.1 ± 2.0	64.3 ± 1.9	0.914	63.6 ± 1.9	65.2 ± 1.9**	0.003
% body fat (%)	24.9 ± 0.9	25.1 ± 0.9	0.988	24.4 ± 0.7	25.9 ± 1.2*	0.014
$\text{VO}_{2\text{max}}$ (ml/kg/min)	44.6 ± 1.2	46.2 ± 1.3*	0.022	44.3 ± 1.3	42.7 ± 1.5*	0.018
Push-up (times)	20.6 ± 1.4	22.6 ± 1.6	0.092	20.7 ± 1.3	18.4 ± 1.7	0.066
Sit-and-reach (cm)	29.4 ± 0.8	31.5 ± 0.8	0.255	30.7 ± 1.3	27.7 ± 1.5	0.091

Values are means ± SD; There were no significant differences between groups at baseline. * significantly different from PRE, within group, $P < 0.05$. ** significantly different from PRE, within group $P < 0.01$.

Table 2. Effects of parents' education level on changes in body composition and physical fitness in summer school attendants and non-attendants.

Factors	Changes in physical fitness	Attendants			Non-attendants		
		A	B	<i>P</i>	A	B	<i>P</i>
Father's Education	% body fat (%)	0.14 ± 0.6	0.05 ± 0.5	.375	2.24 ± 0.5	0.74 ± 0.5	.004**
	$\text{VO}_{2\text{max}}$ (ml/kg/min)	1.42 ± 2.9	1.73 ± 2.4	.807	-1.72 ± 2.8	-1.27 ± 3.0	.541
	Push-up (times)	2.36 ± 3.8	1.81 ± 3.8	.316	-2.09 ± 3.8	-2.63 ± 4.1	.644
	Sit-and-reach (cm)	2.41 ± 3.8	1.65 ± 4.6	.658	-3.40 ± 4.8	-2.97 ± 4.3	.211
Mother's Education	% body fat	0.10 ± 0.6	0.11 ± 0.5	.551	1.87 ± 0.5	1.17 ± 0.5	.013*
	$\text{VO}_{2\text{max}}$	1.37 ± 2.9	1.65 ± 2.7	.285	-1.89 ± 2.9	-1.13 ± 2.8	.199
	Push-up	2.54 ± 3.7	1.46 ± 3.9	.304	-2.36 ± 3.9	-2.20 ± 3.9	.895
	Sit-and-reach	2.11 ± 4.3	2.13 ± 3.6	.364	-3.48 ± 4.8	-2.59 ± 4.3	.368

Parents' education (A: up to high school, B: university and above). * significantly different within group, $P < 0.05$. ** significantly different within group $P < 0.01$.

Table 3. Effects of living status and existence of day time adult caregiver on changes in body composition and physical fitness in summer school attendants and non-attendants.

Factors	Changes in physical fitness	Attendants			Non-attendants		
		A	B	<i>P</i>	A	B	<i>P</i>
Living Status	% body fat (%)	0.07 ± 0.5	0.33 ± 0.6	.101	0.62 ± 0.6	2.41 ± 0.5	.0001**
	$\text{VO}_{2\text{max}}$ (ml/kg/min)	1.48 ± 2.6	1.69 ± 3.3	.174	-1.27 ± 2.2	-1.94 ± 1.7	.172
	Push-up (times)	2.49 ± 3.9	1.52 ± 3.6	.474	-1.51 ± 3.6	-3.13 ± 3.8	.012*
	Sit-and-reach (cm)	1.65 ± 3.8	2.31 ± 4.8	.515	-0.76 ± 3.8	-5.46 ± 3.3	.000**
Caregiver Status	% body fat	0.09 ± 0.5	0.29 ± 0.6	.172	0.73 ± 0.5	2.25 ± 0.5	.015*
	$\text{VO}_{2\text{max}}$	1.85 ± 2.3	1.36 ± 2.4	.387	-1.42 ± 2.2	-1.76 ± 2.3	.587
	Push-up	1.48 ± 3.9	2.51 ± 3.7	.407	-2.23 ± 3.9	-2.35 ± 3.9	.919
	Sit-and-reach	2.11 ± 4.1	1.93 ± 4.1	.503	-1.91 ± 4.8	-4.14 ± 4.3	.151

Living Status (A: living with both parent, B: living with one parent or none), Caregiver Status (A: adult caregiver available during the day, B: caregiver not available during the day). * significantly different within group, $P < 0.05$. ** significantly different within group $P < 0.01$.

Table 4. Effects of annual house hold income and fast-food consumption per week on changes in body composition and physical fitness in summer school attendants and non-attendants.

Factors	Changes in physical fitness	Summer school Attendants				Summer school Non-attendants			
		A	B	C	P	A	B	C	P
House hold Income	Body fat (%)	0.22 ± 0.6	0.16 ± 0.6	1.22 ± 0.5	.917	3.18 ± 0.6**	0.67 ± 0.6	0.61 ± 0.6	.002
	VO _{2max} (ml/kg/min)	1.61 ± 2.1	1.91 ± 2.5	1.29 ± 2.6	.692	-1.96 ± 2.1	-2.10 ± 2.5	-0.75 ± 2.7	.097
	Push-up (times)	1.93 ± 3.0	1.67 ± 4.4	2.42 ± 4.6	.785	-3.11 ± 3.9	-1.82 ± 3.2	-1.97 ± 3.7	.612
	Sit-and-reach (cm)	1.70 ± 4.6	1.88 ± 3.3	2.36 ± 4.6	.694	-5.79 ± 4.1*	-1.96 ± 4.3	-1.40 ± 4.6	.014
Fast-food consumption	Body fat	0.17 ± 0.6	0.30 ± 0.6	0.13 ± 0.4	.504	0.36 ± 0.7**	1.65 ± 0.5	2.49 ± 0.6	.000
	VO _{2max}	1.25 ± 2.4	2.12 ± 2.6	1.44 ± 2.2	.541	-0.91 ± 2.2	-1.75 ± 2.4	-2.15 ± 2.9	.302
	Push-up	3.07 ± 3.4	2.38 ± 3.7	0.56 ± 2.9	.540	-1.48 ± 3.8	-1.64 ± 3.8	-3.79 ± 3.2*	.024
	Sit-and-reach	3.32 ± 3.6	1.98 ± 4.1	0.81 ± 4.1	.067	-0.43 ± 4.3**	-3.86 ± 4.3	-4.90 ± 3.8	.0001

House hold Income (A: 0-\$10K, B: 10K-35K, C: more than 35K), Fast-food consumption (A: 0-1 times/week, B: 2-3 times/week, C: more than 4 times). * significantly different from other groups, P < 0.05. ** significantly different from other groups P < 0.01.

Table 5. Correlation between psychological status and changes in BMI and physical fitness during summer break.

		Summer school Attendants		Summer school Non-attendants	
		Self-esteem	Self-Body Image	Self-esteem	Self-Body Image
% body fat	Correlation	-.045	.033	-.542**	.370**
	Sig.	.0721	.794	.0001	.002
VO _{2max}	Correlation	-.067	-.057	.195	-.044
	Sig.	.594	.649	.106	.718
Push-up	Correlation	.074	-.251	-.104	-.024
	Sig.	.557	.064	.391	.841
Sit-and-reach	Correlation	.129	-.076	.399**	-.337**
	Sig.	.302	.543	.001	.004

* significantly different within group, P < 0.05. ** significantly different within group P < 0.01.

status during the summer break. In contrast, body composition and physical fitness in summer school non-attendants were influenced by their socio-economic status. Summer school non-attendants who had parents that were educated beyond the university level (P < .05), lived with both parents (P = .0001), had day time adult caregivers during the summer break (P = .015), had higher house hold income (P = .002), or consumed fast-food less than once a week (P = .0001) gained less body fat. A lesser decrease in push-up ability was found in summer school non-attendants who lived with both parents (P = .012) and had fast-food less than once a week (P = .024). Non-attendants who lived with both parents (P = .0001), had higher house hold income (P = .014) and fast-food consumption less than once a week (P = .0001) showed a smaller decrease in sit-and-reach score compared to their counterparts.

The correlations between psychological factors and changes in body composition as well as the levels of physical fitness are demonstrated in Table 5. No psychological factors were correlated with changes in body composition and levels of physical fitness in summer school attendants. In summer school non-attendants, self-esteem was significantly correlated

with changes in body composition (r = -0.542, P = 0.0001), and sit-and-reach score (r = 0.399, P = 0.001). Self-body image (level of dissatisfaction) was negatively correlated with changes in body composition (r = 0.370, P = 0.002), and sit-and-reach score (r = -0.337, P = 0.004), indicating that relatively high self-esteem and self-body satisfaction were closely associated with less weight gain.

DISCUSSION

To our knowledge, this is the first study to investigate the combined effects of a structured summer school program and psychosocial outcomes on changes in body composition and physical fitness in Hispanic adolescents during the summer break. The primary purpose of this study was to examine whether a student's participation in a summer school program can prevent an increase in their body composition and a decrease in their physical fitness levels. Furthermore, the secondary purpose of this study was to investigate whether such changes are associated with socio-economic and psychological status in underprivileged Hispanic high school

students. To achieve these purposes, we examined changes in body composition and physical fitness during the students' summer break and also conducted a survey with the students and their parents to determine their psychosocial outcomes.

The summer break represents approximately one quarter of a typical school year and is the largest consecutive out-of-school time [4]. There are many habits and lifestyle changes that may develop during this time, all of which can affect the student's body weight and physical fitness. Moreno *et al.* [5] investigated changes in weight over the school year and the summer break for 5 years and found that the most weight gain occurred during the summer break. An increase in % body fat during this period was more than double the rate during the school year [30]. The results of these two investigations indicate the importance of the summer break for weight management.

The results of this study show that students that did not attend summer school experienced significant increases in body weight and % body fat in addition to a decrease in estimated VO_{2max} . For these students, 3 months of summer break seemed to have negative effects on body composition and physical fitness. However, summer school attendants effectively maintained their body composition and levels of physical fitness during the summer break. None of the variables changed significantly for these students during the summer break, with the exception of estimated VO_{2max} , which increased significantly. Our findings correspond with results from previous studies despite differences in the environmental setting. Studies that employed either community based [4, 8] or school based intervention [22] found that participants improved or maintained their body composition and physical fitness. In contrast, studies that observed changes in body composition and physical fitness without any intervention reported accelerated weight gain during the summer break [5-7,17].

The reasons for the more rapid increases in body weight and % body fat and the decrease in physical fitness levels in adolescents during the summer break are not clear. Potential mechanisms for the accelerated summer weight gain observed and the loss in physical fitness are suggested to be at least partially due to physical inactivity [22], easy access to unhealthy food [2,5], unstructured schedules [30], and increased sedentary behaviors [5]. Even though none of the studies including our investigation directly investigated any of the potential mechanisms above, the combined results from studies with and without summer intervention revealed that the school environment has a protective effect against accelerated weight gain and a decline in physical fitness. The national school lunch program provides students with most

of their daily intake of nutrient-dense fruits and vegetables, and a school meal includes less sugar and soda than an out of school meal [31,32]. Schools also offer students the opportunity for physical education, sports, and extracurricular activities [5,33]. In the present study, summer school attendants participated in regular school programs for five weeks between 8:00am-4:00pm from Monday to Friday, with an hour of physical activities every day. The high school provided all summer school attendants with breakfast and lunch. Other meals and soda were prohibited inside the school. Taken together, it appears that a structured summer school program provides healthy food and the opportunity for physical activity just as provided in the school year and may promote healthy lifestyle habits in students year-round.

Adolescents who attend summer school have more opportunities to be physically active, which could be the reason for the increase in physical fitness during the summer break. Meanwhile, summer school non-attendants are often limited to inactivity at home. In this respect, the results of this study correspond with previous findings that adolescent weight gain during the summer break may be due to physical inactivity. It is known that VO_{2max} decreases by 4 - 20% with physical inactivity of two weeks or more [34]. Therefore, physical inactivity might be one of the causes for the VO_{2max} decrease in summer school non-attendants in this study. Summer school attendants effectively maintained their body composition and level of physical fitness during the summer break, which indicates the possibility of cancelling out disadvantages of the summer break.

Previous research investigated the association of the prevalence rate of obesity in adolescents with socio-economic status such as annual house hold income, sex, race and ethnicity. The studies reported that the rates of obesity were greater in African American and Hispanic adolescents than in their white counterparts [35,36]. The higher rate of obesity in minority adolescents is known to be related to socio-economic status in complex ways [11,13]. We found in this study that socio-economic status did not have an influence on changes in body composition and levels of physical fitness in summer school attendants. We believe this was partly due to the 5 week summer school program, which extended the regular program offered during the school year and included physical education as well as a breakfast and lunch program. Another finding in this study was that the influence of socio-economic status was observed in changes in body composition and levels of physical fitness in summer school non-attendants. Summer school non-attendants that had higher levels of parental education, daytime caregivers, and were living with both parents showed less of an increase in % body

fat. Also, adolescents who regularly experienced parental care and participated in summer school had a significantly lower risk of gaining weight and reducing the level of physical fitness during the summer break. Similar results were reported by Mahoney and Parente [37], who suggested that parental supervision can protect against poor developmental outcomes in lifestyle behavior especially during out-of-school periods.

This study found that adolescents with lower house hold income were more likely to gain a greater amount of body fat during the summer break if they did not attend summer school. These results are similar to previous research performed during the school year [36-38]. Mutunga *et al.* [38] reported significantly higher levels of physical activity and lower levels of energy intake in adolescents with higher socio-economic status compared to their counterparts. Children from low socio-economic backgrounds may have less access to out-of-school activities such as sports, extracurricular activities, and summer camps during the summer break [4, 39], which can prevent weight gain during the out-of-school season. The frequency of fast-food consumption is one of the most important factors affecting weight gain during the summer break. Summer school non-attendants who had 0-1 fast-food meals per week showed significantly lower increase in % body fat as well as lower decreases in muscular strength and flexibility compared to the summer school non-attendants who had fast food more than 2-3 times per week or more than 4 times per week. Overall, socio-economic status did not have any effects on changes in body composition and physical fitness for the adolescents who were actively engaged in a summer program such as sports, summer camp or a structured summer school program. However, it did have a faster and negative effect on adolescents with a sedentary lifestyle during the summer break.

To our knowledge, several studies have reported a relationship between obesity and psychological outcomes, but no study has investigated the relationship between psychological outcome and changes in body composition or physical fitness over the summer break. We observed changes in body composition and physical fitness through the summer break and found that they were significantly associated with psychological outcomes such as self-esteem and body satisfaction when the adolescent did not attend a summer school program.

Psychological status such as self-esteem and body satisfaction can be key factors that may motivate students to maintain physical fitness and control their diets [40]. In a review of the literature on self-esteem and obesity based on cross-sectional studies, French *et al.* [41] consistently found that obese adolescents had relatively lower levels of self-esteem in comparison with healthy-weighted counterparts. Strauss

[15] reported that the relationship between obesity and self-esteem in white and Hispanic students was significantly greater than in African-American students and suggested significant social consequences of reduced self-esteem such as elevated loneliness, sadness and nervousness that may contribute to the increased prevalence rate of obesity in the Hispanic population. Participating in summer camps had health benefits and significantly increased self-esteem [42].

Body satisfaction is central to the emotional well-being associated with self-esteem [20] and is known to affect eating habits such as binge eating or overeating [21, 43]. Neumark-Sztainer *et al.* [21] conducted a five year longitudinal study to investigate associations between body satisfaction and health behavior and found that adolescents with lower body satisfaction employed more unhealthy weight control behaviors and binge eating and were physically less active. Quick *et al.* [44] suggested that adolescents with body dissatisfaction attempt dieting to lose weight. However, they are more likely to gain weight due to their use of restrictive and unhealthy weight control behaviors. Carraça *et al.* [43] carried out a study using a 12 month behavioral weight management program and found that eating behavior was positively predicted by investment in body image change, indicating that a high level of body satisfaction may be related to healthy eating behaviors and may prevent weight gain. The results of this study correspond with previous studies in which body dissatisfaction was highly correlated with an increase in % body fat for summer school non-attendants but had no influence on changes in body composition in summer school attendants.

One major limitation of this study is that the participants were not selected randomly. Participants were recruited from a high school located in an underprivileged Hispanic society because the school was an exemplary school that required participation in a 5 week summer school program at the end of the freshman year. Therefore, volunteers from freshman and sophomore classes were automatically considered summer school attendants and non-attendants, respectively. Although the results of this study demonstrate an association between psychosocial outcomes and changes in body composition as well as levels of physical fitness, the causal relationship remains speculative. Occupation was one of the variables in socio-economic status that was not investigated in this study. In reference to house hold income, even the highest category of house hold income in this study was in the average house hold income range in the overall United States. Lastly, this study was conducted over the summer break without any observations during the school year. Since changes in body composition and levels of physical fitness during the school year were not examined, it is not clear whether the changes

we recorded in this study were due to the summer break. Longitudinal studies would be needed to achieve fully prospective results.

CONCLUSIONS

In the United States, the typical length of the summer break is about 23% of the calendar year and it is the largest consecutive period of non-school time [4]. How adolescents spend their summer break has important implications for their well-being. Results of this study revealed that a long summer break may increase summer weight gain and decrease physical fitness in underprivileged adolescents, indicating that a structured summer school program may minimize the negative effects of non-school environments with regard to psychosocial aspects. During the summer break, adolescents experience tremendous variations in non-school environments. On the other hand, during the school year, all students are in relatively similar environments, all of which tend to dampen variability [45]. In our findings, summer school attendance dampens the effects of psychosocial outcomes on changes in body composition and levels of physical fitness similar to the regular school year. Only for summer school non-attendants did a significant increase in body composition and decrease in physical fitness levels occur and these were affected by psychosocial outcomes. This observation indicates the importance of summer school programs on the management of weight and physical fitness during the summer break in school aged adolescents, especially in underprivileged students who are more susceptible to psychosocial outcomes. These findings support the idea that schools provide healthier environments, whereas the environments are downgraded during the summer break for underprivileged adolescents. Additionally, the home environment including the parents' level of education, living and caregiver status, and fast-food consumption may influence the health habits of these adolescents during the summer break. Psychological status, such as self-esteem, and concerns regarding body shapes may be determinant factors for the management of body composition during the summer break.

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