

**Perception of Body Image, Physical Activity and Sedentary Behavior among African-American,
Mexican-American and Caucasian Adolescents**

Sophia D. Dzilenski

A thesis
submitted in partial fulfillment of the
requirements for the degree of

Master of Public Health

University of Washington
2018

Committee:

Daniel A. Enquobahrie (Chair)

Todd C. Edwards

Program Authorized to Offer Degree:
Department of Health Services

©Copyright 2018

Sophia D. Dzilenski

University of Washington

Abstract

Perception of Body Image, Physical Activity and Sedentary Behavior among African-American, Mexican-American and Caucasian Adolescents

Sophia D. Dzilenski

Chair of the Supervisory Committee:

Daniel A. Enquobahrie, Associate Professor

Epidemiology and Health Services

Background: There is strong evidence that overweight and obesity rates among adolescents in the U.S. have increased over the last several decades. The aim of this study was to examine how perceived body image is related to how adolescents, aged 11-18, engage in physical activity and/or sedentary behavior, important in obesity prevention and adolescent health.

Methods: This mixed-methods study used cross-sectional data collected between 2006-2008, on adolescents in Seattle, WA and Los Angeles, CA (N=486) as part of the Quality of Life of Overweight Youth: A Multicultural View study. Quantitative data was collected using a self-administered survey questionnaire. Qualitative data was collected using semi-structured interviews. Perceived body image was characterized using the Pictorial Body Image Assessment (score 1-13). Outcomes related to physical activity and sedentary behavior were collected using responses to questions about number of daily physical activity behavior in a week that cause an individual to sweat and breathe hard or not and number of hours of sedentary behavior in an

average week, such as TV watching, video games or computer use. Unadjusted and adjusted linear regression models were used to test associations of perceived body image with physical activity and sedentary behavior. Potential confounders included race/ethnicity, age, gender, site, and mother's educational attainment. Qualitative interview responses were reviewed to identify evidence of barriers and motivating factors for physical activity or sedentary behavior.

Results: The mean age of participants was 14.8 years. Over 2/3 of participants were overweight or obese, with a mean body mass index (BMI) of 27.7 kg/m² and mean perceived body image score of 4. On average, participants engaged in 3-4 days a week on any physical activity and 2-3 hours a day on TV watching, video game and computer use. Perceived body image score and standardized BMI were moderately correlated ($r=0.66$, $p\text{-value} < 0.001$). Perceived body image was inversely associated with physical activity of at least 20 minutes a day that caused an adolescent to sweat and breathe hard ($\beta -0.121$; 95% CI: -0.23, -0.02; $p\text{-value} 0.024$). Perceived body image was positively associated with TV watching for at least 30 minutes a day ($\beta 0.093$; 95%CI: 0.01, 0.18; $p\text{-value} 0.034$) after adjustment for confounders. The majority of adolescents felt they were only somewhat active in comparison to their peers, although many were aware of the importance of physical activity. They also mentioned family encouragement as a motivating factor for engaging in physical activity, and physical capability as a common barrier.

Conclusion: Adolescent's perceived body image is associated with physical activity and sedentary behavior. This may have implications in considering strategies to improve perceived body image accuracy, increase physical activity, and reduce sedentary behavior among adolescents of different sizes.

Acknowledgement

I acknowledge partial support for this work from the Center of Excellence in Maternal and Child Health at the University of Washington, funded by the U.S. Department of Health and Human Services, Health Resources and Services Administration's Maternal and Child Health Bureau (#T76MC00011). Funding for the original study upon which this thesis is based was provided by grant #R01 DK071101 from the National Institute of Diabetes, Digestive and Kidney Diseases.

Table of Contents

Introduction.....	7
Methods.....	9
Study Design and Setting.....	9
Study Population.....	10
Data Collection.....	10
Statistical Analysis.....	13
Results.....	16
Discussion.....	21
References.....	26
Tables.....	29
Appendix.....	35

Introduction

Overweight and obesity among adolescents is a major public health concern in the United States.(1,2) Approximately, 21% of adolescents aged 12-19 were obese in the United States in 2011-2014 with higher prevalence among Hispanics (22.8%) and non-Hispanic Black (22.6%), compared with non-Hispanic white adolescents (19.6%).(3) In recent years, prevalence has plateaued with no significant differences between 2013-2014.

Obesity in childhood and adolescence is a risk factor for obesity in adulthood.(5) Comorbidities and chronic conditions associated with excessive weight and obesity for adolescents, similar to adults(5), include cardiovascular risk, type 2 diabetes, prediabetes, metabolic syndrome, polycystic ovarian syndrome and non-alcoholic fatty liver disease.(6,7,8) Further, previous studies on obese adolescents have demonstrated impairments in social and emotional functioning.(9)

Obesity has also been associated with lower quality of life (QoL), as defined by adolescents themselves.(6,10-15) One part of understanding how weight is related to QoL involves understanding what role one's body image plays.(16) Body image is the self-evaluation of one's physical body appearance.(17) Previous studies that assessed body image in terms of body satisfaction, body image discrepancy and its relationship to certain behaviors have found that both normal-weight and overweight adolescents often misperceive their weight.(16) A previous study examining a national sample of youth from the Youth Risk Behavior Surveillance Survey found accurate weight perception to be important among both normal weight and overweight

adolescents, by reducing the chance of an adolescent of normal weight adopting extreme weight-loss methods and by increasing intentions to lose weight among overweight adolescents.(18) Differences in weight status perception among adolescent males and females(18,19), as well as, among different racial and ethnic groups have also been reported before.(19,20)

Research has shown that physical activity as well as sedentary behaviors (time spent watching TV and leisure time computer use) are associated with body image perception (18) regardless of one's body size.(21-23) Given the importance of physical activity to overall health and the fact that a substantial number of young people are not meeting the recommended sixty minutes of physical activity per day (24-26), it is important to have a clear understanding of the impact of perceived body image on physical activity and sedentary behavior among adolescents.

The current study used a mixed methods approach to study the relationships between weight perception and physical activity and sedentary behavior among adolescents, aged 11-18. It examined associations of perceived body image with physical activity and sedentary behavior, and, identified perceived body image related barriers and motivating factors that may explain physical activity or sedentary behavior. Since the period of adolescence is a critical formative period of developing habits that set the stage for health later in life, study findings can enhance our understanding of actionable ways to promote physical activity among adolescents, of different sizes.

Methods

Study Design and Setting

The current study is a secondary cross-sectional analyses of data collected as part of the community-based study to develop and validate a multicultural Youth Quality of Life Weight module (YQOL-W). The YQOL-W module, specific to adolescents aged 11-18, was designed to measure quality of life associated with obesity and weight loss. The parent study was conducted between 2006-2008 at three sites, Seattle, WA, Los Angeles, CA and Cuernavaca, Mexico. Information regarding the study and study procedures have previously been published.⁽²⁷⁾ Qualitative interviews (in both English and Spanish) were conducted with 60 adolescents (11-18 years of age) to develop items for the weight-specific quality of life (QoL) instrument. The items represented areas of greatest importance to the adolescents, such as body satisfaction, psychosocial impact, and coping strategies as part of the concept of weight in relation to one's self. The module, comprised of 21 items, evaluated three domains of weight specific QoL: Self (n=4), Social (n=12) and Environment (n=5), and includes a total score. The Self domain refers to an adolescent's feelings about himself or herself. The Social domain refers to adolescent's relationships with others including family and peers. The Environment domain pertains to opportunities and obstacles in adolescent's social and cultural milieu. Each item is evaluated on an 11-point rating scale (zero to 10), with a higher score representing a higher QoL, or "very much".

Following the interviews, a community sample of 634 adolescents in Seattle (n=232), Los Angeles (n=221) and Cuernavaca, Mexico (n=181) were asked to complete the questionnaire to validate the previously developed YQOL-W module. Participants were recruited to obtain approximately equal numbers of participants with respect to sex (male or female), age (11-14 or 15-18), race/ethnicity (African-American, Mexican-American, or Caucasian) and weight categories (as defined below).

Study Population

The current study is based on information collected from participants of the Seattle, WA and Los Angeles, CA sites. At these two sites, 55 participants participated in semi-structured interviews and 454 participants responded to survey questionnaires. Participants were excluded if they had been told by a doctor that they had a major comorbid condition with a stronger impact on their life other than obesity. After exclusion of participants with missing data and presence of a significant co-morbid condition, a total of N=53 participants from the interviews and N=433 participants from the surveys remained for analyses. Study protocols were approved by the Institutional Review Boards of the University of Washington and the University of California Los Angeles. All study data used in the current secondary analyses was de-identified and no IRB approval was necessary.

Data Collection

Interview Data: Semi-structured interviews were conducted with a total of 53 adolescents ages 11-18, from Seattle, WA (n=32) and Los Angeles, CA (n=21). Seven thematic questions were

posed to adolescent participants. The thematic questions probed adolescents about their QoL related to obesity and weight management. The interview questions were open-ended to allow flexibility of responses. Additional questions were used as specific probes to elicit more context regarding the adolescent's response in relation to their home, school, work or community.(28) Interviews were coded in Atlas ti 5.0. Pairs of researchers coded transcripts (inter-coder agreement of 94%). Sense of self, social relationships and environmental influences were used to categorize adolescent's perception of weight and feelings in Atlas ti 5.0. The current analyses evaluated responses to thematic questions related to physical activity and sedentary behavior among adolescents.

Survey Data: Study participants completed a 40-minute self-administered survey questionnaire. The survey included generic (YQOL) and weight-specific quality of life questions, as well as self-reported physical activity and sedentary behavior. Perceived body shape was assessed using the previously developed and updated Pictorial Body Image Assessment (PBIA), a single body silhouette selection item described below (Figure 1).(29,30) The silhouettes range from underweight (body mass index, BMI < 19 kg/m²) to severe obesity (BMI > 50 kg/m²). Weight, height and waist circumference measurement were taken and recorded by the study research team upon survey completion. Information on other covariates including age (11-18), gender and race/ethnicity (African American, Hispanic/Latino or Caucasian) were obtained from questionnaire completed by the participants' parents or guardians as part of the screening procedures.

Measures

Anthropometric Variables

Based on participants' height and weight, BMI and standardized body mass index (zBMI) were calculated. zBMI scores were calculated as $\text{weight (kg)}/[\text{height (m)}]^2$, normalized to population (z distribution) using age- and gender-specific national norms from the Centers for Disease Control and Prevention.(31) The percentile cutoffs were used to place participants into one of the three weight categories: normal (85th percentile or less), overweight (85th percentile to less than the 95th percentile), and obese (95th percentile or above).

Perceived Body Image

Self-perceived body image was assessed using the PBIA (Figure 1). The PBIA silhouettes were originally introduced by Stunkard, Sorenson & Schulsinger (29), but have since been updated to include larger body shapes.(30) The silhouettes range from underweight (BMI < 19 kg/m²) to highly severe obesity (BMI > 50 kg/m²). Study participant's perceived body image was assessed by asking participants to select a body shape image most similar to their own, on a scale of 1-13, with 1 being most slender and 13 being most overweight (Figure 1).

Self-Reported Physical Activity and Sedentary Behavior

To assess physical activity and sedentary behavior, participants' response to four survey questions related to physical activity and sedentary behavior were examined. Survey questions were derived from the Youth Risk Behavior Survey (YRBS) (32) and the Washington State 2002 Healthy Youth Survey (HYS).(33) To assess physical activity behavior, one question inquired the

number of days in the past seven days, that the participant was physically active for at least 20 minutes that made them sweat and breath hard, while another question inquired the number of days in the past seven days, that the participant was physically active for at least 30 minutes that did not make them sweat and breath hard. To assess sedentary behavior, one question inquired the number of hours spent on an average school day spent watching TV, while another question inquired the number of hours spent playing video games or using a computer for fun.

Statistical Analyses

Study participant demographics and anthropometric variables from the quantitative data were summarized using descriptive statistics (means and standard deviations or count and percentages). Pearson's correlation test was conducted to examine correlations between the perceived body image score (1-13) and zBMI, adjusted for sex, age and race/ethnicity.

Linear regression analyses were conducted to examine crude and adjusted associations between perceived body image (predictor variable) and physical activity /sedentary behavior (outcome variables based on the four survey questions described above). Perceived body image was a continuous variable based on the PBIA silhouettes (1-13). Each outcome variable (two physical activity behavior and one sedentary behavior) was evaluated separately based on the four survey questions described above. The two physical activity behavior related outcomes were number of days (0-7 days) in the past week with physical activity for at least 20 minutes that made them sweat and breath hard, and, the number of days (0-7 days) in the past week with physical activity for at least 30 minutes that did not make them sweat and breath hard.

The sedentary behavior related outcome were coded (0-6) as follows based on the number of hours spent on an average school day spent watching TV, and, the number of hours spent playing video games or using a computer for fun: no time spent watching TV or playing video games or using a computer for fun (0), watching TV, playing video games or using a computer for fun for less than 1 hour per day (1), for 1 hour (2), for 2 hours (3), for 3 hours (4), for 4 hours (5), for 5 or more hours (6). The linear regression models were then adjusted for *a priori* selected potential confounders: age (continuous), gender (male or female), site (Seattle or Los Angeles), race/ethnicity (African American, Hispanic, or Caucasian), and mother's educational attainment level (no schooling, primary school, some high school, high school graduate/GED (General Education Development), some college, college graduate and Master's/post-graduate).

Statistical significance was determined using the p-value<0.05 cut off and 95% confidence intervals. All analyses were performed using the R statistical software program, version 3.3.1, through RStudio interface (version 0.99.903).

Qualitative interview responses were reviewed to identify evidence of barriers and motivating factors for physical activity or sedentary behavior. More specifically, responses to the following semi-structured questions from the YQOL-W instrument were used for these analyses:

“Comparing yourself to others your age and thinking about exercise, do you exercise a lot, about the same amount or less than others your age? Would you consider yourself to be very active, somewhat active, or not at all active? Additional probes were used to solicit response:

“So when you think about your weight, how does it affect your ability to do the things you would like to do? How does it affect your ability to exercise? How do you feel when you are active? When you are not active? How important is it to be physically active to you because of your weight? How motivated are you to do physical exercise like walk, run, bike ride, etc.? How motivated are you to play on a sports team? How does your weight make you feel not motivated? How does your family help you to exercise or be physically active? How does being physically [active/inactive] affect the quality of your life? Descriptive statistics (count and percentages) were used to summarize themes in the responses.

Results

Quantitative Study (Survey)

The mean age of participants was 14.8 years. Of the 433 adolescents included in this study, 52% were between 11 and 14 years of age and 48% were between 15 and 18 years of age, 53% were female, 36% were Caucasian, 30% were African American and 33% were Mexican American (**Table 1**). Sixty-four percent of the adolescents' mothers had at least some college education or higher and 36% had a high school education or less.

The average BMI of participants was 27.12 kg/m². About thirty-three percent of adolescents had a normal zBMI percentile range ($\leq 84^{\text{th}}$ percentile), while 20% were overweight (85^{th} – 94^{th} percentile) and 46% were obese ($\geq 95^{\text{th}}$ percentile). The mean perceived body image score on a scale of 1-13, was 3.94 (SD: 1.92). The median score was 4 (25th percentile= 3, 75th percentile= 5). Fifty-two percent of the study participants were recruited from Seattle and 48% from Los Angeles. About 47% of adolescents from the Seattle sample were Caucasian, 28% were African American and about 25% were Mexican American. Among the Los Angeles sample, 42% of adolescents were Mexican American, 35% were of African American, and 23% were Caucasian.

Body image score was moderately correlated with zBMI ($r = 0.66$, $p\text{-value} < 0.001$). Correlations were stronger among adolescents aged 15-18 years ($r = 0.70$, $p\text{-value} < 0.001$), compared with correlations among adolescents aged 11-14 years ($r = 0.63$, $p\text{-value} < 0.001$). Similarly, correlations were stronger among female participants ($r = 0.72$, $p\text{-value} < 0.001$), compared

with correlations among male participants ($r = 0.59$, p -value < 0.001). Among participants of the various race/ethnic groups, correlations were strongest among Caucasian participants ($r = 0.75$, p -value < 0.001), compared with correlations among Mexican American participants ($r = 0.67$, p -value < 0.001) or African American participants ($r = 0.52$, p -value < 0.001).

On average, study participants engaged in physical activity that made them sweat and breathe hard for at least 20 minutes on 3.96 days within the past seven days (median=4; 25th percentile= 2, 75th percentile= 6). Study participants engaged in physical activity that did not make them sweat and breathe hard for at least 30 minutes on 3.04 days within the past seven days (median=3; 25th percentile= 1, 75th percentile= 5).

Using linear regression models, we observed an inverse association between perceived body image and days of engagement in physical activity that made participants sweat and breathe hard for 20 minutes (β : -0.171; 95%CI: -0.27, -0.07; p -value 0.001) (**Table 2**). Participants who perceived themselves as having a larger body shape tended to be less engaged in physical activity that results in sweating or breathing hard. Association remained statistically significant after adjustment for confounders, age, gender, site, race and ethnicity, and, mother's educational attainment level (β : -0.121; 95%CI: -0.23, -0.02; p -value 0.024). We did not observe a significant association between perceived body image and days of engagement in physical activity that did not make them sweat and breathe hard for 30 minutes (β : -0.036; 95%CI: -0.15, 0.08; p -value 0.530). After adjustment for potential confounders, the β estimate did not change

much and the association remained statistically insignificant (β : -0.057; 95%CI: -0.18, -0.06; p-value 0.346.)

Among participants, in unadjusted models, we did not observe associations of perceived body image with hours spent on an average school day watching TV (β : 0.044; 95%CI: -0.04, 0.13; p-value 0.311) or hours spent on an average school day playing video games or using a computer for fun (β : 0.067; 95%CI: -0.02, 0.15; p-value 0.125) (**Table 3**). However, after adjustment for potential confounders, we observed statistically significant positive associations of perceived body image with hours spent on an average school day watching TV (β : 0.093; 95%CI: 0.01, 0.18; p 0.034). After adjustment for potential confounders, we did not observe a significant association between perceived body image and hours spent on an average school day playing video games or using a computer for fun (β : 0.075; 95%CI -0.01, 0.16; p-value 0.095).

Qualitative Analyses - Interviews

Of the 53 adolescents included in the qualitative study interviews, 58% were between 11 and 14 years of age, 52% were female, 30% were Caucasian, 28% were African American, 28% were Mexican American, 9% were mixed African American/Caucasian and about 4% were mixed African American/Mexican American (**Table 4**).

About 8% of adolescents had normal zBMI, while 11% were overweight and 81% were obese. The mean BMI was 32.45 kg/m² (SD: 6.93). Sixty percent of participants were from Seattle and 40% from Los Angeles. Participants at the two sites had different race and ethnicity

composition. About 37% of participants in Seattle were Caucasian, 22% were African American, 19% were Mexican American, 16% were mixed African American/Caucasian, and 6% were mixed African American/Mexican American. In contrast, 43% of participants in Los Angeles were Mexican American, 38% were African American, and 19% were Caucasian.

Among participants who described their level of physical activity in comparison to others their age, about 70% described themselves as somewhat active or less active than their peers.

Adolescents mentioned playing video games, watching TV and using the computer as activities they do when not being physically active. Physical education (P.E.) class in school was mentioned throughout the interviews as a time to partake in physical activity. One adolescent mentioned:

“the only time I exercise is when I’m in P.E...” (17019, MA, F)

Among participants who discussed the level of importance of physical activity, 63% described it as important, with the rest of participants describing physical activity as only somewhat important for them or not at all. Four youth cited diabetes prevention specifically as a reason to be physically active, and some linked this illness to someone they know. Two adolescents specifically mentioned learning the benefits of physical activity in health class, such as health factors, risk factors, cardiovascular disease prevention and how physical activity can improve one’s mood. Eleven adolescents described how being active made them feel good, while eight participants commented on how it made them tired. One participant commented:

“That physical activity can actually make your mood better. It releases a chemical throughout your body that makes you feel good about yourself, and also because it helps me think of things a bit more clearly...” (16049, MA, F)

Study participants described motivating factors and various barriers they experience. Eleven participants (20%) mentioned family encouragement as a motivating factor to get some physical activity. Only three adolescents described motivation coming from a personal choice and having to be self-motivated. Sixteen adolescents commented on how their physical weight affected their ability to maintain an activity, one participant described being unable to afford participation on a football team and another commented on having to take two buses to get to a center where weight loss programs geared specifically towards youth are offered. One adolescent who described being unable to participate in sports was able to find engagement through after-school activities and programs. Other barriers included the weather (Seattle) and not having neighborhood friends to co-engage in activity.

Discussion

The aim of this study was to better understand how perceived body image was related to level of physical activity and sedentary behavior among adolescents. We found that perceived body image is inversely associated with physical activity that makes an individual sweat and breathe hard. On the other hand, perceived body image was positively associated with frequency of television watching. The majority of adolescents considered themselves somewhat active or less physically active, although many were aware of the importance of physical activity. They also indicated family encouragement as a motivating factor and physical capability as a barrier for physical activity.

Previous studies have examined perceived body image, body image discrepancy and weight status perception accuracy in relation to physical activity and sedentary behaviors or intention to lose weight with physical activity among adolescents.(18,34) Robbins et al. found moderate-to-vigorous and vigorous physical activity were negatively correlated with body image discrepancy among female adolescents.(34) However, the correlation was not present after adjusting for race and BMI.(34) Another study has shown that normal-weight adolescents who mistakenly perceive themselves as overweight are less likely to engage in physical activity and alternatively watch more television and play more video games.(18) On the other hand overweight adolescents who recognize their overweight body image have greater intention to lose weight although they fail to do so through behaviors.(18)

Given the complexity of this relationship, our study adds to the growing body of literature on the relationship between perceived body image and physical and sedentary behavior. Similarities and differences of findings in our study compared with others should be carefully assessed in the context of study population differences, exposure and outcome characterization, and study power. Our study used an established pictorial body image assessment (PBIA) tool with a wide range of body shape response options from underweight (BMI <19) to highly severe obesity (BMI >50), an improvement over previous literature that used a smaller 5-point Likert-type scale of weight categories.(18) The use of this tool may explain our finding of a moderate correlation between body image perception and zBMI ($r = 0.66$, $p\text{-value} < 0.001$), which has not been the case in previous reports. Adolescents often misclassify their own body weight status and experience body image discrepancy.(35-37) The moderate correlation between body image and zBMI suggest that adolescents larger in size may engage less in intense physical activity. Our findings are similar to previous reports, which suggest that among adolescents, perceived body image is a strong predictor for weight-related QoL, and body weight perception is a strong determinant of methods used to manage weight and other behavior such as dietary habits (35,38) for both normal and overweight adolescents.

To our knowledge, only one other study has looked at the relationship between perceived body image and sedentary behavior.(18) Previous studies have focused on the relationship between sedentary behaviors with body image discrepancy (34), with body image satisfaction (39,40) and with the intention to lose weight.(41) The limited research on perceived body image has shown that among normal-weight adolescents, those who inaccurately perceive themselves as

being overweight engage in more sedentary behavior such as TV watching and video game use.(18) This is in line with our current finding of positive association between perceived body image and sedentary behavior.

The qualitative interview findings provide further insight on some barriers and motivating factors adolescents may experience. Given the number of students who recognize the importance of physical activity, we can infer that adolescents would like to be engaged in physical activity but experience barriers that limit their engagement in physical activity. Similar to previous qualitative studies, participants described physical difficulty in their ability to maintain an activity (42) and participants considered themselves only somewhat active or less active than their peers. This suggests that adolescents would benefit from learning more ways to be physically active, whether that be through activities that do make one sweat and breathe hard or do not. Additionally, adolescents would benefit from greater support in believing in their physical capability to engage in a physical activity (43) and how this can make them feel good. This support could also aid in perceived body image accuracy and building self-esteem.

One strength of the current study is that it included adolescent participants from race and ethnicity groups that experience the highest prevalence of overweight and obesity in the U.S. The inclusion of a diverse group of study participants to create a validated weight-related quality of life module helps to ensure the module items can be applicable to future research on these populations. While previous studies have examined associations of body image discrepancy with physical activity or sedentary behavior among females (34), our study added

to the literature by examining associations of perceived body image with physical activity and sedentary behavior among males and females.

On the other hand, several limitations of the study deserve mention. First, self-report of responses may be biased due to social desirability related to body image, physical activity, or sedentary behavior. Additionally, different samples of adolescents were included in the interviews and questionnaires. Our findings may also be limited by the ability of measures to capture adequate amounts of sedentary and physical activity behavior due to the time frame of the questions as well as the breadth and depth of the questions. However, we attempted to address this by using previously validated questions from the Youth Risk Behavior Survey and the Washington State Healthy Youth Survey. The current study was cross-sectional and data may not provide information regarding causal relationships between perceived body image and physical activity or sedentary behavior. Finally, as these were community-based convenience samples, generalizability of findings may be limited to populations that share similar cultural, social, and economic characteristics to the study population.

Though the study findings should be taken with caution, there is a clear need for clinicians and researchers to consider perceived body image when considering weight-specific interventions and promotion of increased physical activity and less sedentary behavior. Given the high prevalence of overweight and obesity among adolescents in the United States, having a better understanding of factors that contribute to adolescent's body image perceptions and physical activity and sedentary behaviors can help healthy behavior promotion and obesity prevention.

We know from previous literature that physical activity is associated with greater body image satisfaction independent of changes in BMI.(44) Therefore, it is important to help youth achieve a positive and a more accurate body image in order to create a cycle where adolescents feel confident in their physical capabilities or body image and initiate healthy lifestyle behavior.

Future research is needed to understand the reasons behind associations of perceived body image and physical activity or sedentary behavior. This will help to promote accurate perception of body image among adolescents and affect behavior change, intention and follow-through. Since childhood and adolescence are formative time periods for laying the groundwork for healthy choices, it is important to understand these issues from an adolescent's perspective. This will also allow decision-makers to think about the factors and barriers that may contribute to an environment more conducive to making healthier choices.

References:

1. Ogden CL, Carroll MD, Kit BK, et al. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA*. 2012; 307(5): 483-490. doi:10.1001/jama.2012.40
2. Flores G, Tomany-Korman SC. Racial and ethnic disparities in medical and dental health, access to care, and use of services in U.S. children. *Pediatrics*. 2008; 121(2):e286–98.
3. Ogden CL, Carroll Margaret, Lawman Hannah, et al. Trends in obesity prevalence among children and adolescents in the United States, 1988-1994 through 2013-2014. *JAMA*. 2016;315(21): 2292-2299. doi 10.1001/jama.2016.6361
4. Iannotti RJ, Wang J. Trends in physical activity, sedentary behavior, diet and BMI among US adolescents, 2001-2009. *Pediatrics*. 132(4): 606-614.
5. Deckelbaum Richard, Williams Christine L. Childhood obesity: the health issue. *Obes Res*. 2001;9:239S–243S.
6. Ogden CL, Carroll MD, Kit BK, et al. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA*. 2014; 311(8):806–814.
7. Farhat Tilda, Iannotti Ronald J., Summersett-Ringgold Faith. Weight, Weight Perceptions and Health–Related Quality of Life Among a National Sample of US Girls. *J Dev Behavior Pediatrics*. 2015; 36(5): 313–323
8. Cruz ML, Shaibi GQ, Weigensberg MJ, et al. Pediatric obesity and insulin resistance: Chronic disease risk and implications for treatment and prevention beyond body weight modification. *Annual Review of Nutrition*. 2005; 25, 435–468.
9. Tsiros MD., Olds T, Buckley JD, et al. Health-related quality of life in obese children and adolescents. *International Journal of Obesity (London)*. 2009; 33(4), 387–400.
10. Williams J, Wake M, Hesketh K, Maher E, Waters E: Health-related quality of life of overweight and obese children. *JAMA* 2005, 293:70–76.
11. Schwimmer JB, Burwinkle TM, Varni JW: Health-related quality of life of severely obese children and adolescents. *JAMA* 2003, 289:1813–1819.
12. Friedlander SL, Larkin EK, Rosen CL, Palermo TM, Redline S: Decreased quality of life associated with obesity in school-aged children. *Arch Pediatr Adolesc Med* 2003, 157:1206–1211.
13. Modi AC, Loux TJ, Bell SK, Harmon CM, Inge TH, Zeller MH: Weight-specific health-related quality of life in adolescents with extreme obesity. *Obesity (Silver Spring)* 2008, 16:2266–2271.
14. Kolotkin RL, Zeller M, Modi AC, Samsa GP, Quinlan NP, Yanovski JA, Bell SK, Maahs DM, de Serna DG, Roehrig HR: Assessing weight-related quality of life in adolescents. *Obesity (Silver Spring)* 2006, 14:448–457.
15. Swallen KC, Reither EN, Haas SA, Meier AM: Overweight, obesity, and health-related quality of life among adolescents: the National Longitudinal Study of Adolescent Health. *Pediatrics* 2005, 115:340–347.
16. Edwards TC, Huebner CE, Connell FA, et al. Adolescent quality of life, part I: conceptual and measurement model. *Journal of Adolescence*. 2002; 25(3):275-286.
17. Thompson JK, Heinberg LJ, Altabe M, Tantleff-Dunn S. Exacting beauty: theory,

- assessment, and treatment of body image disturbance. Washington, DC: American Psychological Association; 1999.
18. Fan M, Jin Y. The effects of weight perception on adolescents' weight-loss intentions and behaviors: evidence from the youth risk behavior surveillance survey. *International Journal of Environmental Research and Public Health*. 2015. 12(11), 14640–14668.
 19. Martin M, Frisco M, May A. Sex and race/ethnic differences in accurate weight perceptions among U.S. adolescents. *Womens Health Issues* 2009; 19(5): 292-299. doi:10.1016/j.whi.2009.05.003.
 20. Yan AF, Zhang G, Wang MQ, Stoesen CA, Harris BM. Weight perception and weight control practice in a multiethnic sample of US adolescents. *South Med J*. Apr; 2009 102(4):354–360.
 21. Monteiro Gaspar MJ, Amaral TF, Oliveira BMPM, Borges N. Protective effect of physical activity on dissatisfaction with body image in children – a cross-sectional study. *Psychol Sport Exercise* 2011;12(5): 563–569
 22. Goldfield GS, Mallory R, Parker T, et al. Effects of modifying physical activity and sedentary behavior on psychosocial adjustment in over- weight/obese children. *J Pediatr Psychol*. 2007;32(7):783–793.
 23. Huang JS, Norman GJ, Zabinski MF, Calfas K, Patrick K. Body image and self-esteem among adolescents undergoing an intervention targeting dietary and physical activity behaviors. *J Adolesc Health*. 2007;40(3):245–251.
 24. Corder K, Sharp SJ, Atkin AJ, et al. Change in objectively measured physical activity during the transition to adolescence. *Br J Sports Med* 2014. doi: 10.1136/bjsports-2013-093190.
 25. Ekelund U, Tomkinson G, Armstrong N. What proportion of youth are physically active? Measurement issues, levels and recent time trends. *Br J Sports Med* 2001; 45: 859–865.
 26. Hausenblas HA, Fallon EA. Exercise and body image: A meta-analysis. *Psychol. Health* 2006, 21, 33–47
 27. Morales LS, Edwards TC, Flores Y, et al. Measurement properties of a multicultural weight- specific quality-of-life instrument for children and adolescents. *Quality of Life Research*. 2011; 20(2), 215–224.
 28. Bronfenbrenner, U. *The ecology of human development: experiments by nature and design*. Cambridge, MA: Harvard University Press. 1979.
 29. Stunkard AJ, Sorenson T, Schulsinger F. Use of Danish adoption register for the study of obesity and thinness in Kety S, Rowland LP, Sidamn RL, Mathhysse SW, (Eds). *The Genetics of Neurological and Psychiatric Disorders*. New York, Raven Press: 115-120.
 30. Song AY, Rubin JP, et al. Body Image and Quality of Life in Post Massive Weight Loss Body Contouring Patients. *Obesity* 2006; 14(9): 1626-1636.
 31. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. *Advance Data*. 2000; 314, 1–27.
 32. Grunbaum JA, Kann L, Kinchen SA, et al. Youth risk behavior surveillance-United States, 2001. *Morb Mortality Wkly Rep Surveill Summ* 2002; 51:1-62.
 33. Washington State Department of Health. Healthy Youth Survey. 2006. Web: <http://www3.doh.wa.gov/HYS/>.

34. Robbins L, Ling J, Resnicow K. Demographic differences in and correlates of perceived body image discrepancy among urban adolescent girls: a cross-sectional study. *BMC Pediatrics* 2017; 17:201.
35. Strauss RS. Self-reported weight status and dieting in a cross-sectional sample of young adolescents: National Health and Nutrition Examination Survey III. *Arch Pediatr Adolesc Med* 1999; 153(7):741-747.
36. Tienboon P, Rutishauser IH, Wahlqvist ML. Adolescents' perception of body weight and parents' weight for height status. *J Adolesc Health* 1994; 15(3):263-268.
37. Lowry R, Galuska DA, Fulton JE, et al. Weight management goals and practices among U.S. high school students: associations with physical activity, diet, and smoking. *J Adolesc Health* 2002, 31(2):133-144.
38. Brener ND, Eaton DK, Lowry R, et al. The association between weight perception and BMI among high school students. *Obes Res* 2004; 12(11):1866-1874.
39. Schneider S, Weiss M, Thiel A, et al. Body dissatisfaction in female adolescents: extent and correlates. *Eur J Pediatr* 2013; 172:373–84.
40. Añez E, Fornieles-Deu A, Fauquet-Ars J, et al. Body image dissatisfaction, physical activity and screen-time in Spanish adolescents. *J Health Psychol* 2018; Vol. 23 (1) 36-47. doi: 10.1177/ 1359105316664134.
41. Wang Youfa, Huifang Liang, Chen Xiaoli. Measured body mass Index, body weight perception, dissatisfaction and control practices in urban, low-income African-American adolescents. *BMC Public Health* 2009; 9:183.
42. Stankov I, Olds T, Cargo M. Overweight and obese adolescents: what turns them off physical activity? *Int J Behav Nutr Phys Act* 2012; 9:53–53.
43. Pate RR, Heath GW, Dowda M, Trost S. Associations between physical activity and other health behaviors in a representative sample of us adolescents. *Am. J. Public Health* 1996; 86, 1577–1581.
44. Boudreau Alexy, Kurowski Daniel, Gonzalez Wanda, et al. Latino families, primary care and childhood obesity: a randomized controlled trial. *Am J Prev Med* 2013; 44(3 Suppl 3): 247–257. doi:10.1016/j.amepre.2012.11.026.

Table 1: Survey Participant Demographics

	Seattle N = 227	Los Angeles N = 206	Total N = 433
Age (Continuous)*, years	14.78 (1.95)	14.96 (2.37)	14.77 (2.16)
Age (categories)			
11-14 years	121 (53.3%)	103 (50%)	224 (51.7%)
15-18 years	106 (46.7%)	103 (50%)	209 (48.3%)
Sex			
Female	119 (52.4%)	111 (53.9%)	230 (53.1%)
Male	108 (47.6%)	95 (46.1%)	203 (46.9%)
Race/ethnicity			
African American	63 (27.8%)	71 (34.5%)	134 (30.1%)
Caucasian	108 (47.6%)	48 (23.3%)	156 (36.0%)
Mexican American	56 (24.7%)	87 (42.2%)	143 (33.0%)
Mother's Education			
Less than HS 0-1	13 (5.8%)	18 (9%)	31 (7.3%)
Some HS	24 (10.8%)	20 (10%)	44 (10.4%)
HS/GED	39 (17.5%)	40 (20%)	79 (18.6%)
Some College	65 (29.1%)	67 (33%)	132 (31.1%)
College	55 (24.7%)	42 (21%)	97 (22.9%)
Masters or higher	27 (12.1%)	14 (7%)	41 (9.7%)
BMI (Continuous)*, kg/m²	28.34 (6.78)	25.77 (6.45)	27.12 (6.74)
zBMI weight category			
Normal (\leq 85 th percentile)	56 (24.7%)	89 (43.2%)	145 (33.5%)
Overweight (85 th – 94 th percentile)	46 (20.3%)	41 (19.9%)	87 (20.0%)
Obese (\geq 95 th percentile)	125 (55.1%)	76 (36.9%)	201 (46.4%)
Perceived Body Image	4.3 (1.86)	3.54 (1.91)	3.94 (1.92)
Number of days doing physical activity for at least 20 minutes that makes you sweat and breathe hard	3.89 (2.14)	4.04 (2.13)	3.96 (2.13)
Number of days doing physical activity for at least 30 minutes that does not make you sweat and breathe hard	3.19 (2.32)	2.89 (2.37)	3.04 (2.34)
Watching TV (Score 0-6)	2.8 (1.79)	3.34 (1.71)	3.06 (1.77)
Playing video games or using a computer (Score 0-6)	2.34 (1.74)	2.31 (1.76)	2.33 (1.74)

*Mean (SD) otherwise N (%)

Abbreviations: HS: High School; GED: General Education Development; zBMI-standardized BMI

Perceived Body Image: Score 1 (most slender) to 13 (most overweight)

Number of hours spent per day doing sedentary behaviors (TV, video games or computer use): Score 0 (none), 1 (less than 1 hour), 2 (1 hour), 3 (2 hours), 4 (4 hours), 5 (4 hours per day), 6 (5 or more)

Table 2: Level of Physical Activity Behavior in relation to Predictor Variable of Perceived Body Image

Physical Activity Behavior		Coefficient	95% CI	P-Value
Physical activity behavior within the past 7 days for at least 20 minutes that made you sweat and breathe hard	Crude	-0.171	(-0.27, -0.07)	0.001
	Adjusted*	-0.121	(-0.23, -0.02)	0.024
Physical activity behavior within the past 7 days for at least 30 minutes that did not make you sweat and breathe hard	Crude	-0.036	(-0.15, 0.08)	0.53
	Adjusted*	-0.057	(-0.18, -0.06)	0.346

*Adjusted for: race/ethnicity, age, gender, mother's educational attainment

Table 3: Level of Sedentary Behavior in relation to Predictor Variable of Perceived Body Image

Sedentary Behaviors		Coefficient	95% CI	P-Value
Hours spent watching TV on an average school day	Crude	0.044	(-0.04, 0.13)	0.311
	Adjusted*	0.093	(0.01, 0.18)	0.034
Hours spent playing video games or using a computer for fun on an average school day	Crude	0.067	(-0.02, 0.15)	0.125
	Adjusted*	0.075	(-0.01, 0.16)	0.095

*Adjusted for: race/ethnicity, age, gender, mother's educational attainment

Table 4: Selected characteristics of participants of the study interview

	Seattle N = 32	Los Angeles N = 21	Total N = 53
Age (Continuous)*, years	13.78 (1.87)	14.14 (2.06)	13.92 (1.9)
Age in years			
11-14 years	21 (65.6%)	10 (47.6%)	31 (58.5%)
15-17 years	11 (34.4%)	11 (52.4%)	22 (41.5%)
Sex			
Female	17 (53.1%)	11 (52.3%)	28 (52.8%)
Male	15 (46.9%)	10 (47.6%)	25 (47.2%)
Race/ethnicity			
African American/Black	7 (21.9%)	8 (38.1%)	15 (28.3%)
African American/Mexican American	2 (6.3%)	0	2 (3.8%)
African American /Caucasian	5 (15.6%)	0	5 (9.4%)
Caucasian/White	12 (37.5%)	4 (19.0%)	16 (30.2%)
Mexican American	6 (18.7%)	9 (42.9%)	15 (28.3%)
BMI (continuous), kg/m²*	30.93 (7.34)	34.76 (5.88)	32.45 (6.93)
zBMI weight category			
Normal (\leq 85 th percentile)	4 (12.5%)	0	4 (7.5%)
Overweight (85 th – 95 th percentile)	5 (15.6%)	1 (4.8%)	6 (11.3%)
Obese (\geq 95 th percentile)	23 (71.9)	20 (95.2%)	43 (81.1%)

*Mean (SD) otherwise N (%)

Abbreviations: BMI-body mass index; zBMI-standardized BMI

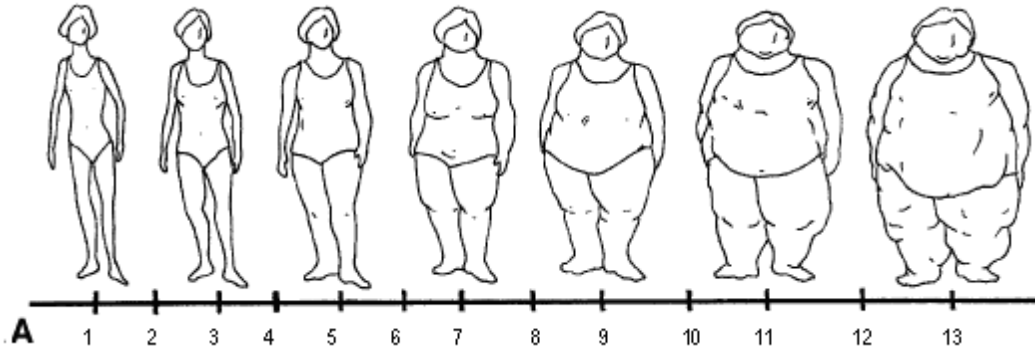
Table 5: Items of the Weight-Related Quality of Life Index

Domain	Subdomain	Item	Categorization
Self	Reno Heart Study	Which figure is closest to your usual weight? (1-13) 1 – Most slender 13 – Most overweight	Continuous
Environment	Youth Risk Behavior Survey, Healthy Youth Survey	On how many of the past 7 days did you exercise or participate in physical activity for at least 20 minutes that made you sweat, and breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or aerobic activities? <i>(please circle one number)</i> 0 0 days 1 1 days 2 2 days 3 3 days 4 4 days 5 5 days 6 6 days 7 7 days	Continuous
	Youth Risk Behavior Survey, Healthy Youth Survey	On how many of the past 7 days did you do physical activity for at least 30 minutes that did not make you sweat and breather hard, such as fast walking, slow bicycling skating, pushing a lawn mower, or mopping floors? <i>(please circle one number)</i> 0 = 0 days 1 = 1 days 2 = 2 days 3 = 3 days 4 = 4 days 5 = 5 days 6 = 6 days 7 = 7 days	Continuous
	Youth Risk Behavior Survey, Healthy Youth Survey	On an average school day, how many hours do you watch TV? 0 = I do not watch TV on an average school day 1 = Less than 1 hour per day 2 = 1 hours per day 3 = 2 hours per day 4 = 3 hours per day	Continuous

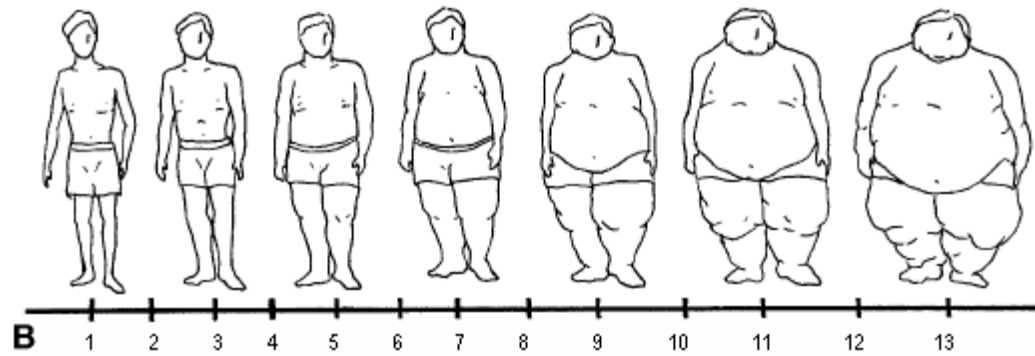
	<p>Youth Risk Behavior Survey, Healthy Youth Survey</p>	<p>5 = 4 hours per day 6 = 5 hours per day 7 = 6 hours per day</p> <p>On an average school day, how many hours do you watch TV?</p> <p>0 = I do not watch TV on an average school day 1 = Less than 1 hour per day 2 = 1 hours per day 3 = 2 hours per day 4 = 3 hours per day 5 = 4 hours per day 6 = 5 hours per day 7 = 6 hours per day</p>	<p>Continuous</p>
--	---	---	-------------------

Appendix:

Figure 1 Pictorial body image assessment (PBIA) (29,30)



A. Female Figures



B. Male Figures