

Is Body Mass Index or Percent Body Fat a Stronger Predictor of Health-Related Quality of Life in Rural Hispanic Youth?

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Received: 8 September 2012 / Accepted: 6 December 2012 /

Published online: 16 January 2013

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Abstract The objective of the present study was to assess whether Body Mass Index or percent body fat was a stronger predictor of health-related quality of life in a community sample of rural Hispanic youth. The sample consisted of 219 Hispanic children and adolescents ages 8–19 years (54.8 % female). Multiple linear regression analysis was conducted with demographics and obesity indicators (BMI, percent body fat) entered as independent variables. Each subscale and summary score of the PedsQL 4.0 Generic Core Scales was a separate dependent variable. Greater percent body fat was associated with lower social functioning in our sample of rural Hispanic youth. BMI percentile was not significantly associated with any of the PedsQL domains. These findings indicate that percent body fat may be more strongly associated with psychosocial functioning than BMI percentile in rural Hispanic youth.

Keywords Obesity · Hispanic · Health-related quality of life · Adiposity · Youth

Obesity is a serious public health concern associated with physical, psychological, and economic costs (Boutelle et al. 2010; Flegal et al. 2005; Freedman et al. 1999; Pi-Sunyer 2002; Young-Hyman et al. 2006). While the obesity epidemic has impacted persons of all ethnic groups nationwide, the prevalence of overweight and obesity is considerably higher for ethnic minority populations in the United States (U.S.), including Hispanic children and adolescents (Cossrow and Falkner 2004; Haas et al. 2003). The National Health and Nutrition Examination Survey (NHANES) reported between 1988–1994

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and 2007–2008, the prevalence of obesity increased from 14.1 % to 26.8 % among Mexican-American boys and 13.4 % to 17.4 % among Mexican-American girls (Ogden and Carroll 2010).

Hispanics represent the largest minority group in the U.S. (Bernstein 2008). According to the 2010 U.S. Census, the Hispanic population expanded by 43 % in the last decade (United States Census Bureau 2010). It is predicted by 2050, roughly 30 % of the total U.S. population will be Hispanic (United States Census Bureau 2010). Disparities in the prevalence of obesity among this rapidly expanding population indicate a need to evaluate the impact of obesity on quality of life in Hispanics.

Obesity and Health-Related Quality of Life

Health-related quality of life (HRQOL) is a multidimensional construct that assesses an individual's subjective perception of the impact of disease and/or treatment on health and well-being (Varni et al. 2007; World Health Organization 1948). Assessment of HRQOL can aid in the identification of subgroups of a population at-risk for impaired health, assist with the development of targeted interventions for a population, and guide health policies and legislation (Centers for Disease Control and Prevention 2011). A number of studies have assessed HRQOL in overweight and obese youth (Arif and Rohrer 2006; Modi et al. 2008; Schwimmer et al. 2003; Wallander et al. 2009). Schwimmer et al. (2003) was one of the first studies to document deficits in HRQOL among obese children and adolescents. These authors found that in comparison to non-overweight peers, obese children and adolescents had lower health-related quality of life across physical health, emotional functioning, social functioning, and school functioning domains. In fact, the HRQOL of obese children and adolescents was similar to that of children and adolescents with cancer undergoing chemotherapy (Schwimmer et al. 2003).

Since Schwimmer et al. (2003), other studies have reported HRQOL deficits in overweight and obese youth, mainly in psychosocial domains (Arif and Rohrer 2006; Modi et al. 2008; Wallander et al. 2009). While these studies represent an important step in understanding the impact of obesity on health-related quality of life in children and adolescents, only one of the studies (Arif and Rohrer 2006) specifically assessed the association between overweight and HRQOL in *rural Hispanic* youth. Rural Hispanic populations in the U.S. are critical to study as they tend to be among the poorest, least educated, and most underserved by health care systems (Baxter et al. 2001; Eichner et al. 2008).

In addition, the existing studies all solely used Body Mass Index (BMI) as their indicator of overweight or obesity. Age and sex-specific BMI percentiles are widely utilized as estimates of obesity in children and adolescents due to the ease and low-cost of computation (Krebs et al. 2007). However, because BMI is also correlated with muscle and lean mass, BMI is not always a precise measure of body density (Flegal and Ogden 2011). Body density, also referred to as body fat composition, is the proportion of body fat that exists in the human body (Gibson 2005). The only true measure of body composition is the laboratory separation of fat from the lean mass, bone, water, and mineral content of the body, which is feasible only in a cadaver analysis. Therefore, the assessment of body composition in living human beings is

limited to estimation by various methodologies including underwater weighing, dual energy x-ray absorptiometry (DXA), and anthropometric skinfold measures. Some investigators have suggested that estimation of body density utilizing these methods is more accurate for classifying obesity in children and adolescents than BMI (Poirier 2007). This may be particularly true in ethnic minority populations for which current uniform BMI obesity cut-off score may be less accurate (Fernandez et al. 2003).

Given the limited research on HRQOL in rural Hispanic children using obesity indicators other than BMI and data that suggest current BMI cut-off scores may be less precise for ethnic minority populations, there is a need to evaluate the impact of multiple indicators of obesity on HRQOL in rural Hispanic youth. Consequently, the objective of the present study was to assess whether BMI percentile or percent body fat is a stronger predictor of HRQOL in a community sample of Hispanic children and adolescents. To the best of our knowledge, no previous studies have investigated this topic. Such research has the potential to inform empirically validated assessment of obesity in rural Hispanic youth and aid in the development of tailored, culturally sensitive interventions for this population. We hypothesized that percent body fat would be a stronger predictor of HRQOL in our sample, particularly in the psychosocial domains. We also predicted that gender would be a significant predictor of HRQOL, with girls demonstrating lower overall psychosocial functioning.

Methods

Participants

Participants were 219 Hispanic children and adolescents ages 8–19 years from two independent school districts in South Texas. These districts were specifically chosen because of the high percentage of Hispanic students (i.e., approximately 80 % of each district was Hispanic) and rural setting. These school districts were classified as rural based on their location in agricultural communities with a distance greater than 35 miles from a major metropolitan area. Measurement of height and weight was part of the Fitnessgram® assessment conducted by the state of Texas. Thus, regardless of ethnicity students ages 8 to 19 years were sampled. The initial sample was comprised of 351 children and adolescents. For the purposes of studying body mass index (BMI) and percent body fat as predictors of health-related quality of life in *rural Hispanic youth*, 80 participants were excluded from the analysis because they were not Hispanic, and 52 additional participants were excluded due to missing gender, age, health-related quality of life, or body composition/BMI data. Besides race/ethnicity, there were no systematic differences in demographic variables between the 80 non-Hispanic children and the 219 Hispanic children and adolescents included in this study. The average age of the 124 females (56.4 %) and 96 males (43.6 %) was 13.52 years (SD=2.67). With regard to BMI, 48.6 % of the sample was within the healthy range (BMI between the 5th and 84.99th percentile), 17.7 % of the sample fell within the overweight range (BMI between the 85th percentile and 94.99th percentile), and 33.6 % of the sample was obese (BMI at 95th percentile or greater). Mean percent body fat for the sample was 25.84 % (SD=11.14; range=8.35 % to 68.87 %). Sixty-eight point five percent of the sample fell within the normal percent body fat

range (<25 % body fat in boys, <32 % body fat in girls) and 31.5 % of the sample fell within the excess percent body fat range (>25 % body fat in boys, >32 % body fat in girls; Lohman 1993).

Measures

Health-Related Quality of Life The 23-item PedsQL 4.0 Generic Core Scales is made up of the following scales: 1) Physical Functioning (8 items); 2) Emotional Functioning (5 items); 3) Social Functioning (5 items); and 4) School Functioning (5 items) (Varni et al. 2001). Only the child-self-report version of the PedsQL was utilized in this study. Child self-report includes ages 5–7, 8–12, and 13–18 years. The items for each of the age forms are essentially identical, differing in developmentally appropriate language. The instructions ask how much of a problem each item has been during the past 1 month. A 5-point categorical response scale is utilized across child self-report for ages 8–18 (0 = never a problem; 1 = almost never a problem; 2 = sometimes a problem; 3 = often a problem; 4 = almost always a problem). Items are reverse-scored and linearly transformed to a 0–100 scale (0=100, 1=75, 2=50, 3=25, 4=0), so that higher scores reflect better HRQOL (Varni et al. 2001).

Demographics Demographic information regarding the participants' age, gender, and race/ethnicity was provided by the school.

Percent Body Fat Percent body fat was determined by anthropometric skinfold methods. To ensure reliability, all skinfold measures were done by one examiner experienced in skinfold methodology. Percent body fat is typically calculated utilizing an empirical equation that takes into account the association between fat content and whole body density (Gibson 2005). Equations from Slaughter and colleagues were used in the present study to determine percent body fat (Slaughter et al. 1988):

$$\begin{aligned} \text{Males Percent Body Fat} &= 0.735(\text{triceps} + \text{calf}) + 1.0 \\ \text{Females Percent Body Fat} &= 0.610(\text{triceps} + \text{calf}) + 5.1 \end{aligned}$$

Levels of body fat percentage have been designated as excess in children at >25 % body fat in boys and >32 % body fat in girls (Lohman 1993).

Body Mass Index (BMI) Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Since BMI is age- and sex-specific for children and adolescents, BMI percentiles based on the Centers for Disease Control and Prevention (CDC) age and gender norms were computed (Centers for Disease Control and Prevention 2011).

Procedures

Data collection took place during the 2010 to 2011 academic year. Measurement of height and weight was conducted in physical education classes as part of the Fitnessgram® assessment performed by the State of Texas. Weight was measured in

kilograms to the nearest 0.1 kg utilizing a Tanita BWB-800 medical digital scale. Height was measured by a standard portable medical grade stadiometer to the nearest 0.1 cm and then converted to meters. Anthropometric skinfold measures were also performed in physical education classes by one examiner experienced in skinfold methodology. Skinfolds were measured using Lange skinfold calipers. Measurements were taken from the calf and triceps skinfold sites. All measures were taken on the right side of the body following procedure explained by Slaughter and colleagues (Slaughter et al. 1988). The mean of all three measurements for the triceps and for calf were taken as a reference value to calculate body fat percentage. Height/weight and anthropometric skinfold measures were obtained on the same day. The PedsQL questionnaire was administered by physical education teachers in a classroom setting 14 days after skinfold and height/weight measures were obtained. PedsQL surveys and pencils were passed out to students and the protocol established by the survey instructions was utilized. The instructions were read aloud by physical education teachers who were available to assist students with any questions they had. Written child assent was obtained and the procedures followed were in accordance with prevailing ethical standards. This study was approved by all appropriate Institutional Review Boards (IRBs).

Statistical Analyses

Descriptive statistics (means and standard deviations) of the PedsQL 4.0 Generic Core Scales were computed. Multiple linear regression analysis was conducted. Each subscale of the PedsQL (physical functioning, emotional functioning, social functioning, school functioning) and the PedsQL Total and Psychosocial Summary Scores were separate dependent variables. A forward stepwise method was utilized with demographics and obesity indicators entered as independent variables. Demographic variables (e.g., age, sex) were entered in the first block as control variables. BMI percentile and percent body fat were added in the subsequent block to determine if they incremented the prediction of health-related quality of life. The increment in variance accounted for by the set of variables added at each step was tested for significance (Boeka and Lokken 2008; Gunstad et al. 2007).

Results

Table 1 provides descriptive statistics for the PedsQL 4.0 Generic Core Scales for the total sample and broken down by BMI and percent body fat groups. Table 2 presents both significant and non significant standardized beta coefficients (e.g., the value of the beta when all predictors were included) for the full model for which the primary outcomes were physical functioning, emotional functioning, social functioning, school functioning, Total Summary, and Psychosocial Summary. Age was significantly associated with physical functioning in that older children/adolescents self-reported better physical functioning. Neither percent body fat nor BMI percentile significantly increased the total variance accounted for in the physical functioning model.

Age was significantly associated with emotional functioning in that older children/adolescents self-reported better emotional functioning. The association between

Table 1 PedsQL 4.0 Generic Core Scales descriptive statistics

PedsQL	Total Sample (N=219)		BMI Groups				Percent Body Fat Groups			
			Normal (N=106)		Overweight/ Obese (N=113)		Normal (N=161)		Excess (N=58)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Summary	80.74	12.68	81.13	12.86	80.37	12.56	81.29	12.31	79.22	13.642
Physical Health	85.76	12.59	86.40	12.41	85.17	12.78	86.32	12.43	84.22	13.01
Psychosocial Health	78.06	14.74	78.31	15.01	77.82	14.55	78.59	14.41	76.58	15.67
Emotional Functioning	77.68	19.85	77.64	19.66	77.72	20.11	77.93	18.88	76.98	22.49
Social Functioning	83.23	17.42	83.65	17.74	82.84	17.18	84.21	16.74	80.51	19.09
School Functioning	73.21	18.36	73.56	17.92	72.88	18.84	73.56	18.37	72.24	18.45

SD equals standard deviation

Using independent samples t-tests none of the BMI group and Percent Body Fat group comparisons were statistically significant

percent body fat and emotional functioning approached significance ($p=0.06$) indicating that children and adolescents with a higher percent body fat showed a trend of self-reporting lower emotional functioning.

Age was significantly associated with social functioning in that older children/adolescents self-reported better social functioning. Children and adolescents with a higher percent body fat self-reported lower social functioning ($p<0.05$).

None of the demographic variables (e.g., age, gender) or obesity indicators (BMI percentile and percent body fat) were significantly associated with school functioning.

Table 2 Multiple linear regression analyses of factors associated with HRQOL in rural Hispanic youth

Variables	Physical Functioning	Emotional Functioning	Social Functioning	School Functioning	Total Summary	Psychosocial Summary
Block 1						
R ²	0.03	0.03	0.04	0.01	0.02	0.01
Gender	0.04	0.09	-0.06	0.04	0.04	0.03
Age	0.15*	0.13*	0.20**	-0.09	0.13□	0.10
Block 2						
R ² Change	0.01	0.02	0.03□	0.00	0.02	0.02
% Body Fat	-0.13	-0.15□	-0.19*	0.03	-0.14	-0.13
BMI Percentile	0.10	0.08	0.08	-0.07	0.06	0.04
Cumulative R ²	0.04	0.05	0.07	0.01	0.04	0.03

Betas presented are standardized betas for the full model

Both significant and non significant betas are presented

* $p<.05$, ** $p<.01$

□ equals approaching significance at $p=0.06$

Percent body fat and BMI percentile did not increase the total variance accounted for in the school functioning model.

Discussion

The objective of the present study was to assess whether BMI percentile or percent body fat (as assessed by anthropometric skinfold measures) was a stronger predictor of HRQOL in a community sample of rural Hispanic youth. We found that greater percent body fat was associated with lower social functioning in our sample. The association between percent body fat and emotional functioning also approached significance in that children with greater percent body fat showed a trend of reporting lower emotional functioning. BMI percentile was not significantly associated with any of the HRQOL domains in the present study. Although BMI percentile is often used as the primary indicator of obesity in clinical practice and research with children, our data suggest that percent body fat measured by anthropometric skinfold measures may be more strongly associated with psychosocial functioning in rural Hispanic youth. As such, health care providers assessing psychosocial outcomes and obesity in rural Hispanic youth may find it beneficial to also incorporate additional measures of body composition into their work, including percent body fat as measured by anthropometric skinfold measures.

There are some data that suggest the relationship between BMI and percent body fat may be different for ethnic minority populations compared to European Americans (Deurenberg et al. 1998). A study by Fernandez and colleagues highlights the differential relationship between percent body fat and BMI across Hispanic American, African American, and European American adult females (Fernandez et al. 2003). The authors found significant differences in percent body fat as predicted by BMI between Hispanic Americans and European Americans and African Americans and Hispanic Americans (Fernandez et al. 2003). When estimating percent body fat, the trend of the predicted percent body fat value in women differed by ethnic group and BMI category. Specifically, at a BMI <30, Hispanic American women were more likely to have greater body fat than European American women and African American women (Fernandez et al. 2003). Consequently, some investigators have indicated the need to redefine BMI obesity cutoff scores for ethnic minority populations as it is unlikely that the current uniform cut-off points for BMI are accurate across ethnic minority groups (Cole et al. 2000). These findings underscore the importance of utilizing other estimates of body composition (e.g., percent body fat as measured by anthropometric skinfold measures) with ethnic minority populations as these may be more precise indicators of obesity in these populations.

The notion of culturally sensitive interventions for Mexican-American families has been advocated by Rosas and Colleagues (Rosas et al. 2011). Based on their study, they suggested that implementing culturally sensitive interventions that incorporate the belief that obesity is not always viewed as unhealthy by Mexican-Americans may ultimately improve treatment outcomes (Rosas et al. 2011). Gallagher (2010) also emphasized the need for culturally sensitive educational interventions for Hispanic mothers to learn about transforming nutrition and physical activity beliefs into action, limiting their child's television viewing, and increasing physical activity indoors

(Gallagher 2010). Overall, our data suggest that the greatest deficits associated with excess percent body fat were in the psychosocial domains. These findings emphasize the need for childhood obesity interventions for rural Hispanic youth to not only aim to improve the physical health of individuals through weight loss, but to also incorporate techniques that promote healthy psychosocial functioning. As physicians screen for the physiological consequences of obesity, our findings suggest they should also include routine screening for social and emotional impairments in rural Hispanic youth. If a child or adolescent is identified as having psychosocial problems, they should be immediately referred to an appropriate mental health care provider. It may be beneficial for future interventions for rural Hispanic youth to be directed at teaching overweight and obese children and adolescents problem-solving tools and coping skills to address the topics of depression, bullying, and peer acceptance.

It is possible that the social stigma and negative peer perceptions associated with being obese contribute to impairments in psychosocial functioning in obese children and adolescents. Zeller and colleagues found that obese youth rated lower peer acceptance and were viewed by their teachers and peers as being more socially withdrawn, holding less leadership positions, and displaying increased aggressive/disruptive behaviors (Zeller et al. 2008). Peers also rated their obese classmates as being less physically attractive, less athletic, more sick, more tired, and more absent from school (Zeller et al. 2008). These results parallel a study by Strauss and Pollack (2003) that found overweight adolescents were more likely to be socially isolated and less likely to be selected as friends compared to normal weight peers (Strauss and Pollack 2003).

We found that neither BMI percentile nor percent body fat were significantly associated with physical functioning in our sample of rural Hispanic youth. The only significant predictor of physical functioning in our sample was age in that older children and adolescents reported better physical functioning. There are several potential explanations for this finding. First, it is possible that older children and adolescents perceived their ability to perform physical tasks (i.e., walk more than one block, run, do sports activities/exercise, lift something heavy, do chores around the house) better due to more developed coordination and strength. It is also plausible that older children and adolescents have greater opportunity to engage in behaviors such as sports activities/exercise and doing chores around the house. An alternative explanation is that greater social desirability effects among older children and adolescents (Brown et al. 1986) accounted for their better self-reported physical functioning in this group administration setting. This hypothesis may also explain our findings that older children and adolescents self-reported better emotional and social functioning.

Gender was not a significant predictor of HRQOL in the current study. This finding contrasts other studies that have been comprised predominantly of Caucasian children and adolescents (Anderson et al. 2011; Modi et al. 2008). It is possible that gender plays a different role in a rural Hispanic population. Nonetheless, our data suggest that addressing the psychosocial needs of both boys and girls is important when working with rural Hispanic youth as psychosocial functioning may be impacted by obesity across boys and girls in this ethnic minority population.

This study had a number of limitations. First, no formal measures of socioeconomic status (SES), acculturation, language usage, and pubertal status were obtained for the sample. Schaefer and colleagues (2009) found that in an ethnically diverse sample lower SES households exhibited a narrower understanding of nutrition

requirements and healthy behaviors like dieting, buying fresh fruits and vegetables, assessing nutrition and food label, and knowledge of the food guide pyramid (Schaefer et al. 2009). These investigators also noted that the environmental traits of ethnic group dense neighborhoods contribute to a higher incidence of obesity in that low-fat healthy foods are not readily available and accessible (Schaefer et al. 2009). Future studies examining the relationship between obesity and HRQOL should include measures of SES, acculturation, language usage, and pubertal status to account for these variables in the analysis. It should be noted that the two independent school districts in South Texas that participated in this study were mainly representative of a lower income, rural population.

The sampling method was another limitation of our study in that only self-reported HRQOL was obtained. Social desirability may influence an individual's likelihood of self-reporting undesirable physical or psychosocial functioning. Future studies should include reports from parents, friends, and teachers in order to more fully assess how HRQOL may be impacted by obesity. In addition, the PedsQL was administered in a classroom setting by physical education teachers. Although children and adolescents were assured anonymity, some children may have felt pressured to report favorably and consequently may have underreported negative functioning on the PedsQL. In the future, children should be individually administered the HRQOL questionnaire, to determine whether our findings hold true using a different sampling methodology. The utilization of stepwise linear regression analysis was also a limitation of the current study as there is potential this method will over fit the data if strict enough criteria are not used for selecting variables in the regression model. The broad age range of our sample is another potential limitation; however, it should be noted that we controlled for the effects of age in our analyses. Finally, although we found that percent body fat was a stronger predictor of psychosocial outcomes and advocate for the incorporation of measures of body composition in clinical practice and research with rural Hispanic youth, the authors acknowledge that these measures can be expensive, time consuming, and requires well-trained personnel to administer.

This study has numerous strengths. First, this was a community-based sample which may allow for greater generalizability of findings. Our study included multiple indicators of obesity (BMI and percent body fat) and utilized trained professionals to measure and compute percent body fat. Finally, our sample consisted of rural Hispanic youth, a population that tends to be understudied and underserved by health care systems.

Authors' Disclosure Statement No competing financial interests exist.

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