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Documenting Disparities in Obesity and Disability

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This issue of* FOCUS *was developed to provide background information for a two-part webcast series: Documenting Disparities in Obesity and Disability. This* FOCUS *and the first webcast present research highlighting the disparities in obesity experienced by people with disabilities and the potential consequences of those disparities. The second webcast focuses on strategies to address these disparities and efforts to include disability as a diversity and equity factor in federal and community health-promotion programs by developing research partnerships and interdisciplinary collaborations. The NCDDR Community of Practice on Research Quality sponsored these events to highlight disparities research in disability.

The epidemic of obesity in the United States and in many other countries throughout the developing world has made it one of the most significant public health problems confronting our society today (Flegal, Carroll, Ogden, & Johnson, 2002; Ogden, Yanovski, Carroll, & Flegal, 2007; Rigby, Leach, Lobstein, Huxley, & Kumanyika, 2009; Hossain, Kawar, & El Nahas, 2007). During the past 3 decades, the prevalence of obesity among adults and adolescents across all gender, race/ethnicity, and age groups has increased from 13% in the early 1960s to 32% in 2003–2004 (Flegal et al., 2002; Ogden et al., 2006). The ambitious agenda proposed in Healthy People 2010 in the late 1990s aimed to reduce obesity to a population prevalence of 15% (U.S. Department of Health and Human Services, 2002). Disappointingly, the prevalence rate over the last 10 years in the U.S. adult population has instead increased to more than double the rate targeted by the Healthy People Initiative. Obesity prevalence in people with disabilities is even higher than in the general population (Campbell, Crews, & Sinclair, 2002; Liou, Pi-Sunyer, & Laferrère, 2005; Weil et al., 2002). These population-level data may actually underestimate the magnitude of the problem because people with intellectual, cognitive, and psychiatric disabilities; people who are unable to stand to record their height and weight; and people who live in group homes or supportive living facilities may have been excluded. Moreover, self-report data may have a higher error rate among people with disabilities because of the difficulty in

The research presented in this issue of *FOCUS* was carried out through the NIDRR-funded Disability Rehabilitation Research Project (DRRP) titled "Reducing Obesity and Obesity-Related Secondary Conditions in Adolescents with Disabilities" at the Center on Health Promotion for Persons with Disabilities, University of Illinois at Chicago. Project partners include Shriners Hospitals for Children and six national disability organizations (Easter Seals, United Cerebral Palsy, Spina Bifida Association, the Arc, Partners for Youth with Disabilities, and Blaze Sports America).

ADVANCING RESEARCH SEDL IMPROVING EDUCATION

The National Center for the Dissemination of Disability Research (NCDDR) is a project of SEDL. It is funded by the National Institute on Disability and Rehabilitation Research (NIDRR).

having weight measured in the clinic or home setting (Rimmer & Wang, 2005), and because the criterion for obesity using body mass index (BMI) is not accurate for people with paralysis, who have lowered ratios of fat to lean muscle tissue (Buchholz & Bugaresti, 2005).

The public health implications of this increasing prevalence of obesity are of tremendous concern to federal officials, public policy experts, lawmakers, and health professionals because of the associated staggering costs and the impaired quality of life. In addition to the numerous medical complications linked to obesity, including higher rates of type 2 diabetes, cardiovascular disease, osteoarthritis, gall bladder and liver disease, certain forms of cancer, and depression and other mental health disorders (Ma, Ko, & Chan, 2009), people who are obese are more susceptible to social disadvantage and psychological problems because of stereotyping, prejudice, discrimination, and stigmatization (Hill, 2009). In people with disabilities, higher BMIs also present a greater risk of secondary conditions, defined as preventable medical, emotional, or social problems resulting directly or indirectly from an initial disabling condition (Turk, 2006). Although there are no empirical data on the cumulative health effects of being disabled and obese, one qualitative study from the United Kingdom noted that obese people with disabilities need a higher level of care, pay more for assistive devices, and experience greater perceived levels of prejudice than individuals in the general population (Pain & Wiles, 2006).

"People who are obese are more susceptible to social disadvantage and psychological problems because of stereotyping, prejudice, discrimination, and stigmatization."

Although obesity affects individuals of all ages, genders, and racial/ethnic groups, people with disabilities appear to be at the highest end of the risk curve (Liou et al., 2005; Altman & Bernstein, 2008). The consequences of obesity may, in fact, cause greater harm to people with disabilities because of a lower threshold of health associated with various secondary conditions (Bauman, 2006; Campbell, Sheets, & Strong, 1999; Ravesloot, Seekins, & Walsh, 1997; Turk, 2006) and the difficulty in accessing health promotion programs in their home or community (Liou et al., 2005; Rowland, White, & Wyatt, 2006; Rimmer, Wang, & Smith, 2008). This report reviews the available prevalence data on obesity in adults and youth with disabilities, discusses issues associated with measurement error in examining body composition in people with paralysis, and provides recommendations for future research.

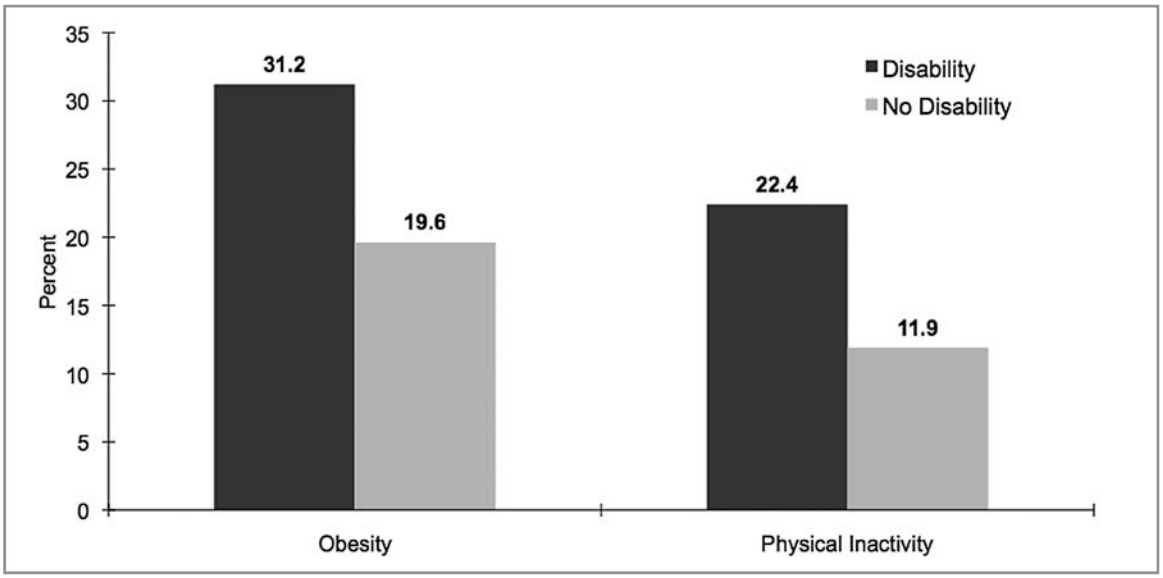

Figure 1: Obesity and Physical Inactivity by Disability Status

Obesity Prevalence Data on Adults and Youth With Disabilities

Obesity Prevalence: Adults With Disabilities

People with disabilities are particularly vulnerable to obesity, according to research showing a disproportionately higher incidence in this population (Rimmer & Wang, 2005; Weil et al., 2002; Yamaki, 2005). Results of data from the 1994–1995 National Health Interview Survey Disability Supplement (NHIS-D) and the 1995 NHIS Healthy People 2000 Supplement indicate that adults with physical disabilities had a 66% higher rate of obesity compared with people without disabilities. In a Centers for Disease Control and Prevention (CDC) analysis of obesity prevalence data from the 1998 and 1999 Behavioral Risk Factor Surveillance Survey (BRFSS), regardless of age, sex, or race/ethnicity, people with disabilities were reported to have higher rates of obesity than people without disabilities (Campbell et al., 2002). In the most recent analysis of the 2001 and 2003 BRFSS data set, shown in Figure 1, people with disabilities reported a 59% higher rate of obesity and an 88% higher rate of physical inactivity compared with people without disabilities (Centers for Disease Control and Prevention, 2006).

Data from the National Health Interview Survey (NHIS) are reported in Figures 2 and 3 (Jones & Sinclair, 2006). The prevalence of obesity (BMI > 30) and morbid obesity (BMI > 40) was significantly higher among Whites and African Americans with disabilities than among Whites and African Americans without disabilities, and the morbid obesity rate was approximately 4 times higher (Figure 2). Lower rates of physical activity in persons with disabilities also matched higher rates of obesity in both racial groups. Figure 3 provides additional data on the risk of obesity and physical inactivity in adults with and without disabilities using adjusted odds ratios (OR). The data indicate that obesity and morbid obesity were substantially higher in disabled populations and highest in African Americans with disabilities. Within each racial/ethnic group, individuals with disabilities had substantially higher rates of obesity and morbid obesity. The highest obesity rates were in African Americans with disabilities, who were at 4 times more risk for obesity and 10 times more risk for morbid obesity than White Americans without disabilities.

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Obesity Prevalence: Youth With Disabilities

Obesity is also a significant health issue among youth with disabilities. Researchers have reported

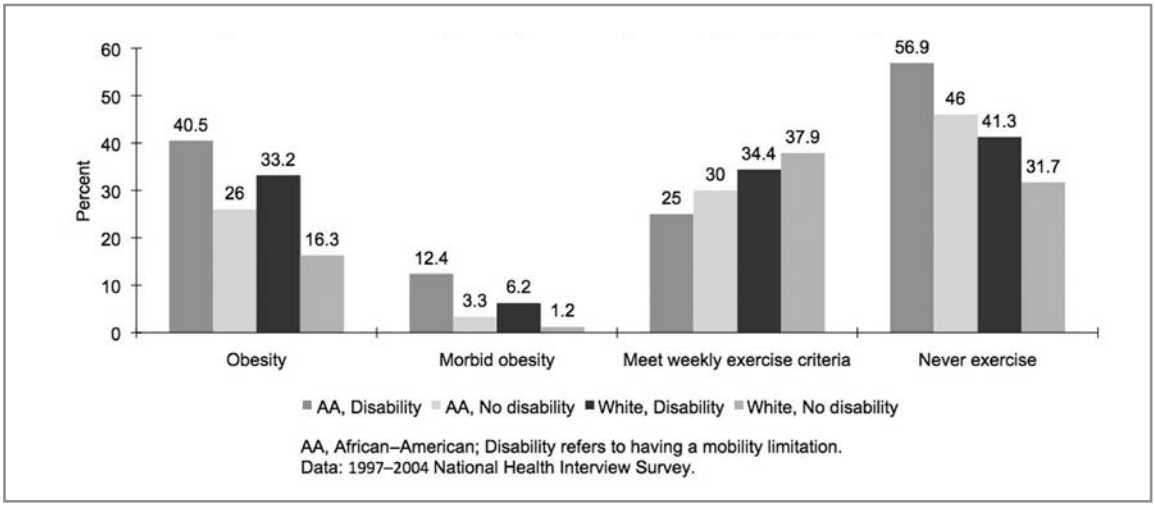

Figure 2: Prevalence of Obesity and Physical Inactivity in Adults (18–64 yrs) by Disability and Race

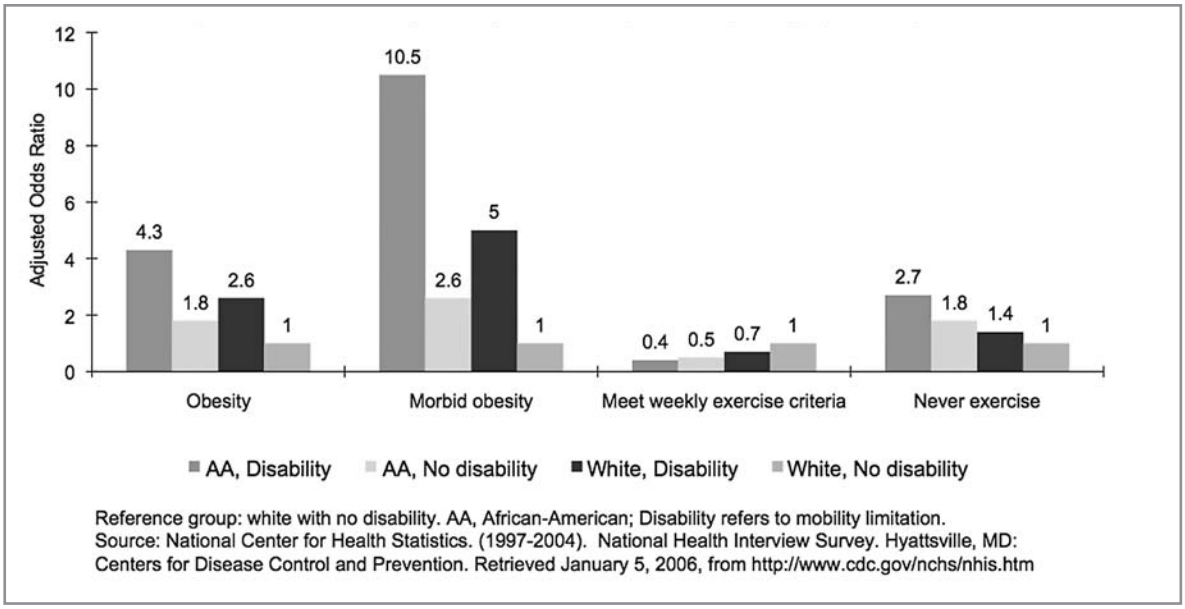

Figure 3: Risk for Obesity and Physical Inactivity in Adults (18–64 yrs) by Disability and Race

a higher prevalence of being overweight among children and adolescents with specific conditions, including spina bifida (Simeonsson, McMillen, & Huntington, 2002), cerebral palsy (Hurvitz, Green, Hornyak, Khurana, & Koch, 2008), and Down syndrome (Luke, Roizen, Sutton, & Schoeller, 1994; Cronk et al., 1988). Figure 4 illustrates data from the 1999–2002 National Health and Nutrition Examination Survey (NHANES). The rate of obesity (i.e., BMI ≥ 95th% for age and sex) was significantly higher for youth (6–17 years) with mobility limitations (29.7%) compared with youth without mobility limitations (15.7%) (Bandini, Curtin, Hamad, Tybor, & Must, 2005). The 2005 Youth Risk Behavior Survey (YRBS) also reported that across two groups of nationally representative samples of 9th–12th grade students, adolescents with disabilities had a higher rate of being overweight compared with their age-matched peers without disabilities (Rimmer, Rowland, & Yamaki, 2007).

We recently examined obesity prevalence and obesity-related secondary conditions among youth with disabilities through the use of an online survey. A convenience sample of 461 parents of youth with disabilities completed the Health and Lifestyles of Youth with Disabilities Survey (Rimmer, Yamaki, & Davis, 2009). The findings, reported in Table 1, show that youth with

Demographics	Youth w/ disability[a] (N=461)	Youth w/o disability[b] (N=12,973)	Adjusted Odds Ratio	95% CI
Total				
% Obesity (>95% tile)	16.8	13.0	1.36	1.07–1.75
% Overweight (>85% tile)	36.1	28.8	1.39	1.15–1.69
Male				
% Obesity (>95% tile)	17.9	16.3	1.13	0.80–1.59
% Overweight (>85% tile)	34.4	32.7	1.08	0.82–1.42
Female				
% Obesity (>95% tile)	15.7	9.6	1.76	1.22–2.54
% Overweight (>85% tile)	37.9	24.7	1.85	1.41–2.43
White				
% Obesity (>95% tile)	16.3	10.8	1.61	1.17–2.20
% Overweight (>85% tile)	31.8	25.0	1.40	1.09–1.79
African American				
% Obesity (>95% tile)	18.1	18.3	0.96	0.52–1.77
% Overweight (>85% tile)	41.2	37.3	1.17	0.73–1.88
Hispanic				
% Obesity (>95% tile)	17.5	16.6	1.04	0.58–1.86
% Overweight (>85% tile)	49.0	34.7	1.80	1.15–2.79

[a]DRRP data; [b]2007 YRBS data
Data were weight-adjusted by age, gender, and race using sample ranking so the proportion segments of age, gender, and race were matched between DRRP and YRBS data.

Table 1. Comparison of Obesity Between Youth (12–18 yrs) With Disabilities and Youth Without Disabilities by Gender and Race

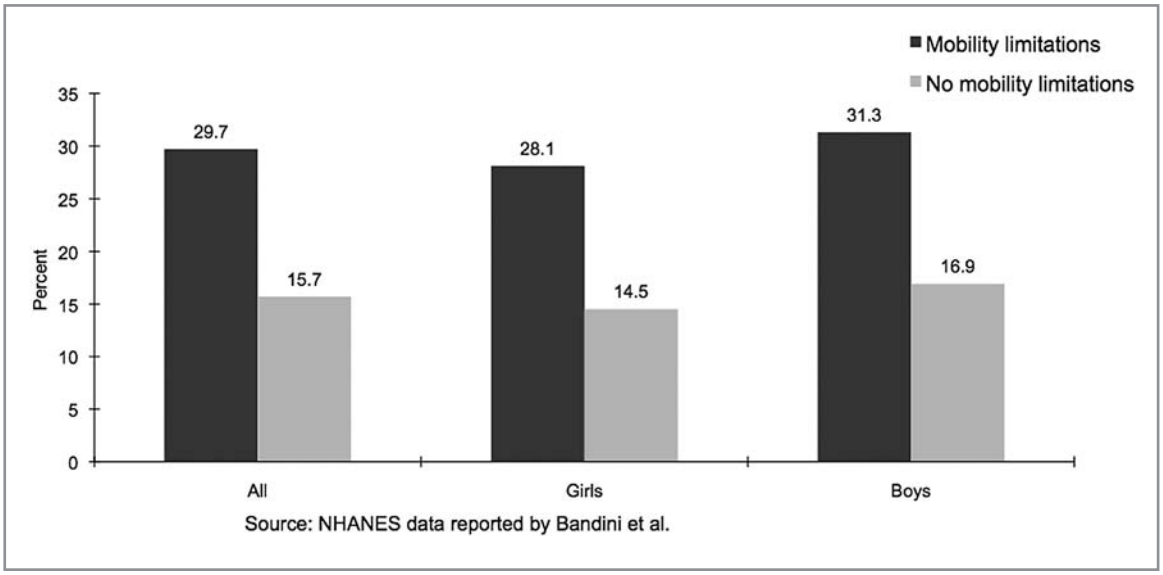

Figure 4: Prevalence of Obesity (BMI ≥ 95th%) Among Adolescents by Mobility Limitation and Sex

disabilities were 1.36 times (95% CI 1.07–1.75) and 1.39 times (95% CI 1.15–1.69) more likely to be obese and overweight than youth without disabilities. Female and White youth with disabilities had greater risk of being obese and overweight when compared with youth without disabilities. Female youth with disabilities were almost 2 times more likely to be obese and overweight than female youth without disabilities. White youth with disabilities also had a higher rate of obesity and overweight compared with White youth without disabilities.

When separating the data by disability type (Table 2), youth with autism and Down syndrome had significantly greater odds of being obese and overweight than nondisabled youth. Youth with autism were 2.2 and 1.8 times more likely to be obese and overweight, while youth with Down syndrome were 3 times more likely to be obese and overweight compared with youth without disabilities.

Disability Type	Youth w/ disability[a] (n= 461)	Youth w/o disability[b] (n=12,973)	Adjusted Odds Ratio	95% CI
Autism				
% Obese (>95% tile)	24.6	13.0	2.19	1.44–3.31
% Overweight (>85% tile)	42.5	28.8	1.84	1.28–2.64
Down syndrome				
% Obesity (>95% tile)	31.2	13.0	3.00	1.86–4.81
% Overweight (>85% tile)	55.0	28.8	3.01	1.95–4.66
Intellectual Disability				
% Obesity (>95% tile)	12.4	13.0	0.96	0.51–1.81
% Overweight (>85% tile)	27.2	28.8	0.93	0.58–1.49
Cerebral Palsy				
% Obesity (>95% tile)	4.0	13.0	0.30	0.13–0.68
% Overweight (>85% tile)	18.8	28.8	0.57	0.37–0.87
Spina Bifida				
% Obesity (>95% tile)	18.6	13.0	1.61	0.66–3.93
% Overweight (>85% tile)	64.5	28.8	4.50	2.16–9.41

[a]DRRP data; [b]2007 YRBS data
Data were weight-adjusted by age, gender, and race using sample ranking so the proportion segments of age, gender, and race were matched between DRRP and YRBS data.

Table 2. Comparison of Obesity Between Youth (12–18 yrs) With Disabilities and Without Disabilities by Disability Type

Obesity-Related Secondary Conditions

Prevalence data were obtained as well on secondary conditions associated with obesity. As shown in Figure 5, overweight and obese

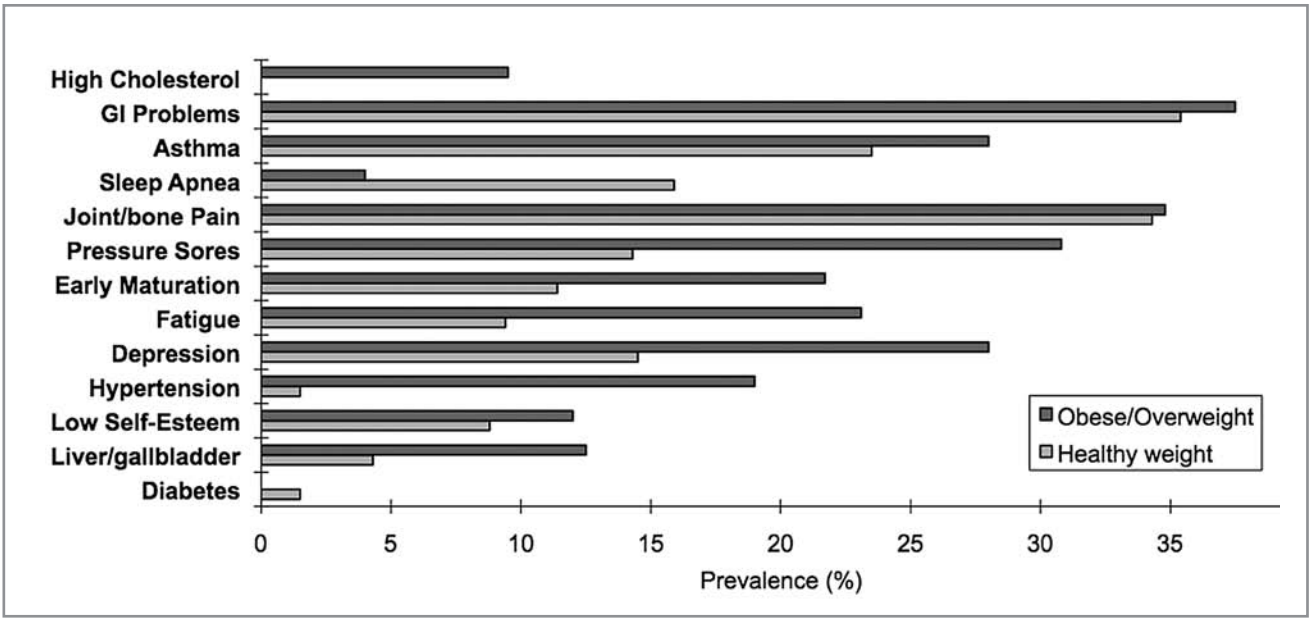

Figure 5: Prevalence of Secondary Conditions in Youth With Physical Disabilities (Cerebral Palsy, Spina Bifada)

youth with physical disabilities (cerebral palsy and spina bifida) had a significantly higher prevalence of hypertension. Though the differences did not reach statistical significance, there was also a clear trend toward higher cholesterol, pressure sores, early maturation, fatigue, depression, low self-esteem, and liver or gallbladder problems among obese and overweight youth compared with healthy weight youth. Similarly, Figure 6 shows that overweight and obese youth with cognitive disabilities (autism, Down syndrome, intellectual disability) had a significantly higher prevalence of high blood cholesterol, early maturation, and diabetes than youth with healthy weight.

Measurement Issues in Adults and Youth With Disabilities

Actual vs. Self-Report Measures of Height and Weight

While national data sets reporting the magnitude of obesity among youth and adults with disabilities provide a composite overview of the disparities observed in this population, the majority of studies used self-reported height and weight data, which often result in inaccurate estimates by the respondent. Obesity prevalence estimates based on self-report data tend to be substantially lower than those based on actual measurement of height and body weight (Flegal et al., 2002; Ogden et al., 2007). Inaccurate estimates of obesity often result from overestimates of height and underestimates of weight (Ogden et al., 2007). For example, BRFSS self-report data recorded on the general population from 1991 to 1994 showed a prevalence of obesity of 12.7% to 14.4% (Mokdad et al., 1999); whereas the corresponding NHANES data, which involved actual measurements of height and weight, reported an obesity prevalence of 23.3% from 1988 to 1994 (Flegal, 2002), nearly 2 times higher than the BRFSS estimates.

Using actual measurements of BMI, Rimmer and Wang (2005) reported substantially higher prevalence rates of obesity among individuals with disabilities than had been reported in two previously published reports using self-report data from people with disabilities (NHIS and BRFSS). In the NHIS study, 24.9% of persons with disabilities were obese (Weil et al., 2002). In the BRFSS report, 26% of Whites were obese compared with 36% of Blacks and 31% of Hispanics (Campbell et al., 2002). After adjusting for age and sex, obesity rates in the study by Rimmer and Wang (2005) were 54% for Whites, 70% for Blacks, and 44% for Hispanics.

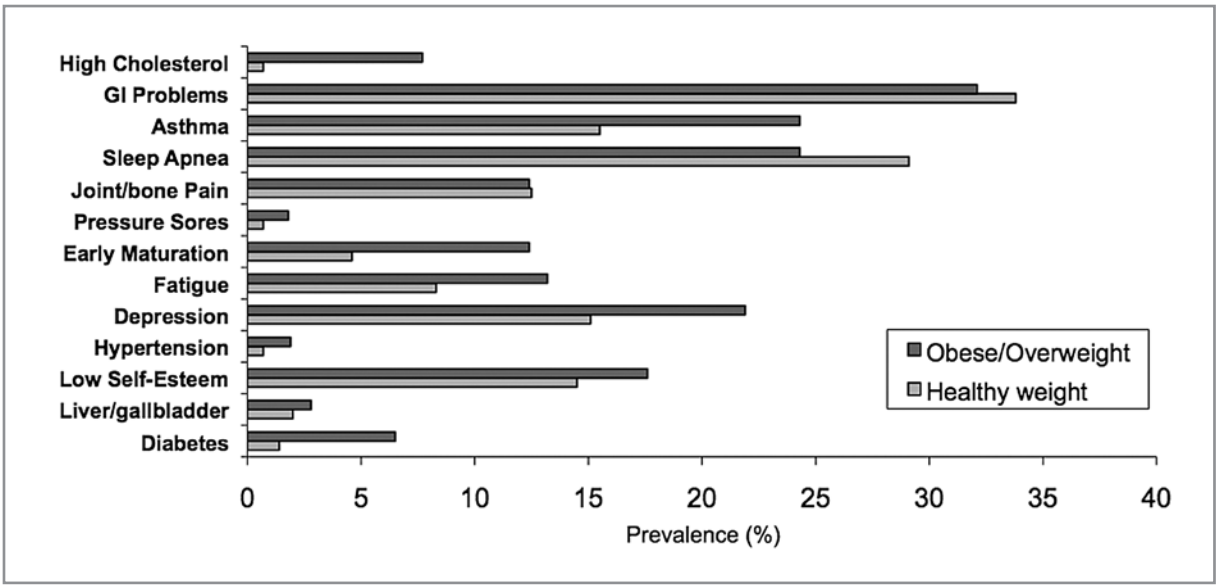

Figure 6: Prevalence of Secondary Conditions in Youth With Cognitive Disabilities (Autism, Down Syndrome, Intellectual Disability)

Although the differences in population sample size and distribution make it difficult to compare data sets, the findings from Rimmer and Wang (2005) raise an interesting question regarding the potential underreporting of obesity prevalence in disabled populations. Several investigators have noted that height-weight self-report data are not as accurate as actual data among nondisabled populations (Palta, Prineas, Berman, & Hannan, 1982), and the discrepancy may be even greater among sampling distributions involving people with disabilities.

Inaccuracy of BMI in Populations With Paralysis

Measurement of body composition to estimate risk factors for all causes of morbidity and mortality requires an accurate instrument for the target population. A major issue with assessing BMI in individuals who have some form of paralysis is the difficulty in obtaining an accurate measure of height and weight (Buchholz & Bugaresti, 2005; Spungen et al., 2003). Many health-care facilities do not have height-adjustable exam tables to measure supine length (proxy for standing height), nor do they have wheelchair scales that allow for an accurate measure of weight. Moreover, in many individuals with spasticity and contractures, it is often difficult to obtain an accurate measure of supine length because of the difficulty in fully extending the torso and limbs (Garshick, Ashba, Tun, Lieberman, & Brown, 1997).

"A major issue with assessing BMI in individuals who have some form of paralysis is the difficulty in obtaining an accurate measure of height and weight."

Adults With Spinal Cord Injury (SCI)

Although there is considerable support for the use of BMI as an index for being overweight in nondisabled populations, (Neovius, Linné, & Rossner, 2005; Taylor, Jones, Williams, & Goulding, 2002), there is mounting evidence that BMI may be an inaccurate indicator of body composition for certain subgroups of adolescents (Warner, Cowan, Dunstan, & Gregory, 1997) and adults with physical disabilities (Gater, 2007; Jones, Legge, & Goulding, 2003; Laughton, Buchholz, Martin Ginis, & Goy, 2009). Buchholz and Bugaresti (2005) and Gater (2007) conducted extensive reviews on the use of BMI as a marker for obesity in persons with chronic SCI, and recommended that SCI-specific BMI classifications be determined because the standard BMI obesity criteria developed on nondisabled

Reference	Study Population	SCI BMI Control BMI	% Fat Mass
Buchholz et al., 2005	28 paraplegic adults	24.3	**30.8**
	34 BMI-matched able-bodied controls	**26.0**	22.8
Jeon et al., 2003	7 men w/ complete tetraplegia	26.7	**34.6**
	Age-, weight-, height-, BMI-, & waist circumstance-matched able-bodied controls	**29.4**	24.4
Jones et al., 2003	20 men w/ SCI	23.1	**27.5**
	20 age-, height-, & weight-matched able-bodied controls	**24.0**	18.1
Maggioni et al., 2003	13 men w/ SCI	25.7	**31.1**
	13 age- & BMI-matched able-bodied controls	**24.5**	20.8

Table 3. BMI and Measured Percent Fat Mass in Cross-Sectional Studies of Adults With Chronic SCI

populations is an insensitive marker of obesity in persons with SCI.

Table 3 summarizes findings from four studies that examined the accuracy of BMI in adults with SCI. In all of these studies, there was substantial variance in the BMI and percent fat mass in SCI subjects compared with controls with similar BMI values (discrepancies shown in bold), resulting in significant underestimates of obesity in persons with SCI. In one of the largest clinical studies to date, Spungen et al. (2003) reported that 133 adults with SCI demonstrated significantly less lean tissue and more adipose tissue for any given age group compared with nondisabled controls, and those with BMI levels in the normal range had higher total fat mass and higher body-fat percentages than nondisabled populations.

In a recent study published by Laughton et al. (2009), BMI cutoffs recommended by the World Health Organization and other obesity panels significantly underestimated obesity in adults with SCI. The researchers found that the current BMI criteria for obesity (> 30 kg/m^2) failed to identify 73.9% of persons with SCI who were found to be obese using bioelectrical impedance, and recommended a BMI cutoff for adults with SCI of 22 kg/m^2 for identifying individuals who may need to alter their lifestyle or receive medical treatment for obesity and obesity-related chronic conditions. To date, this is the lowest recommended BMI cutoff value for any population and needs further investigation before it becomes standard practice for diagnosing obesity in individuals with SCI.

Youth With Paralysis

BMI is closely associated with measures of adiposity derived from dual energy x-ray absorptiometry (DEXA) scans in nondisabled youth (Lindsay et al., 2001). However, despite a good correlation between BMI and percent body fat in nondisabled youth, two small studies have indicated that BMI is not an accurate estimate of adiposity in youth with physical disabilities (Liusuwan, Widman, Abresch, & McDonald, 2004; Warner et al., 1997).

Preliminary data from our Center on Adiposity in Youth with Disabilities has revealed gross discrepancies between body-weight status classified by BMI and status derived from objective measures of body fat (DEXA scan and Triceps skinfold caliper measurements). These data include 20 youth with cerebral palsy (CP), spina bifida, and SCI, ages 14–17 years. Although BMI indicated that only 5.6% of the youth were obese, triceps skinfold measurements classified 38.9% as obese, and the gold-standard DEXA scan resulted in 72.2% of youth with disabilities being classified as obese (see Figure 7). Of the 20 youth measured, one was classified as a true positive (BMI and DEXA both indicated obese status), one was a true negative (BMI and DEXA both indicated healthy weight

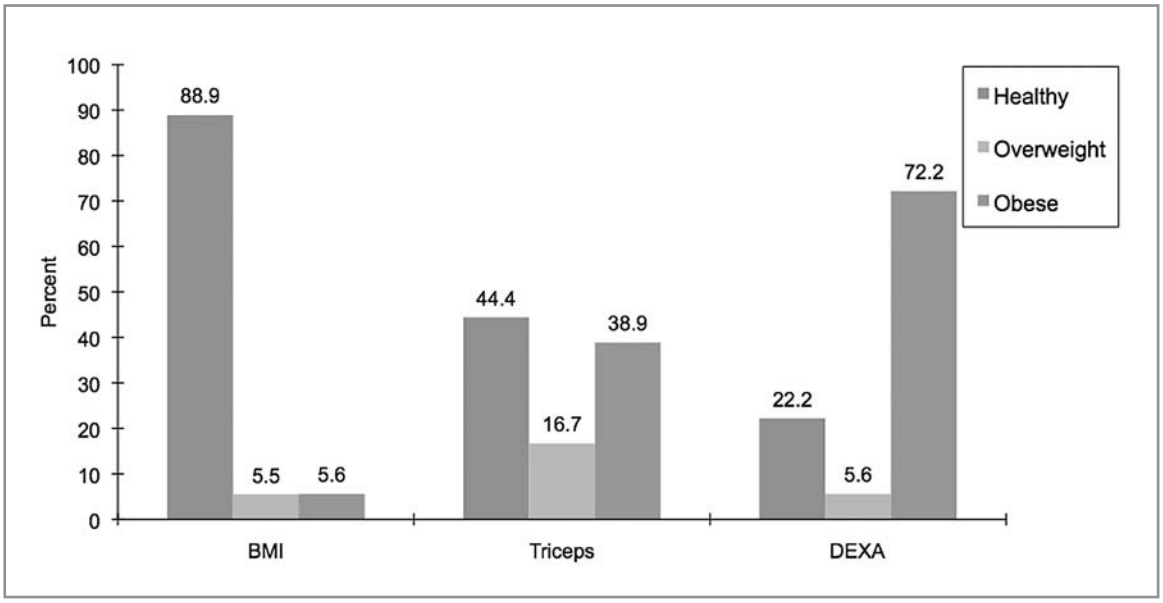

Figure 7. Body Weight Status by Measurement Type

status), and 18 were false negatives (BMI indicated underweight, healthy, or overweight status, although the true status per DEXA was overweight or obese).

Although youth with CP appear to have low BMIs and are not typically classified as overweight, data from two studies show the potential inaccuracy of using BMI with this population. In an earlier study by Bandini, Schoeller, Fukagawa, Wykes, and Dietz (1991), BMI levels for youth with CP (n = 13) ages 15–20 years were lower than what was typically reported for nondisabled youth. Only one subject had a body weight greater than the 50th percentile, yet the percent of body fat for females was extremely high (M = 33.2%). Half the subjects had a percent of body fat that exceeded the 95th percentile for age, which is a significantly high rate of obesity compared with classifying youth with CP using BMI.

Bandini et al. (1991) also reported that all subjects with spina bifida (n = 16) fell into the 95th percentile on percent of body fat and were obese (M = 46.4% females, 32.7% males). Compared with nondisabled youth, only males with CP (n = 4) had a slightly lower rate of percent body fat (13.2% vs. 14.5%). Percent of body fat for females with CP was 34.4% higher than in nondisabled controls and was almost twice as high among females with spina bifida. Males with spina bifida (n = 5) had a percent of body fat that was more than double that of nondisabled controls. Hurvitz et al. (2008) also reported that ambulatory youth with CP had a high prevalence of obesity (33%); however, obesity levels in nonambulatory youth with CP were much lower.

Future Recommendations

Our review of the literature on disparities and obesity experienced by individuals with disabilities illustrates an urgent need for future research, particularly to

- provide large-scale data on obesity prevalence in various disabled populations;
- identify effects of obesity on people with disabilities;
- establish appropriate cutoffs for BMI for subgroups with paralysis;
- establish appropriate methodology and equipment for accurate measurement of body composition in select disability groups;
- address the potentially higher risk of obesity in minorities with disabilities; and
- identify the antecedents of obesity in people with disabilities.

Provide Large-Scale Data on Obesity Prevalence in Various Disabled Populations

Population-based survey data have been used for several decades to examine obesity status, monitor changes longitudinally, and identify potential disparities across subgroups within the population. However, people with disabilities, particularly those with severe disabilities, are likely to be underrepresented in these data sets for several reasons.

First, many surveys sample noninstitutionalized residents in community households. People with disabilities who reside in congregate settings, (e.g., community-based residential programs, assisted and supportive living facilities, shelters) are excluded from this sampling frame. Second, even when people with disabilities are given the opportunity to participate in surveys, a lack of disability-specific accommodations may prohibit the participation of people with physical or cognitive disabilities. Third, people with disabilities, particularity minorities, may be more reluctant to respond to telephone-based surveys than the general population. And fourth, different definitions of *disability* and a lack of additional demographic data (e.g., use of assistive aids, severity, function) make it difficult to compare data across or within disability groups. For example, among youth with CP, there appears to be a higher rate of obesity in ambulatory vs. nonambulatory individuals. Data sets that cluster youth with CP under mobility limitation do not allow for further subanalyses by disability group or level of severity. In a subset of individuals who represent as having a disability, obesity may have been a primary driver leading to arthritis and, subsequently, disability.

One way to improve prevalence data on populations with disabilities is for national centers that fall under the auspices of the Department of Health and Human Services (e.g., CDC, NIH, HRSA) to use a consistent definition of *disability* across various data collection efforts so that comparisons can be made between different disability groups by age, gender, severity, etc. Formal collaborations between government agencies and existing centers that have expertise on obtaining accurate data on disabled populations would enhance these data collection methods.

Identify Effects of Obesity on People With Disabilities

One of the more urgent areas of study is the need to examine the rate of illness, functional limitations, and secondary conditions associated with obesity in people with disabilities. Qualitative reports have shown that being disabled and obese can lead to a greater decline in health, function, and quality of life (Pain & Wiles, 2006). Obesity may also increase the severity and progression of certain secondary conditions (e.g., pain, fatigue, depression, and social isolation) (Kinne, Patrick, & Doyle, 2004; Turk, 2006; Jensen, Chodroff, & Dworkin, 2007), resulting in significant interruptions in life, including loss of work and/or lower productivity, greater stereotypes, and lower self-efficacy (Pain & Wiles, 2006). Conversely, higher rates of secondary conditions may lead to greater rates of obesity by reducing energy expenditure (i.e., physical activity). This *cause-and-effect* relationship between secondary conditions and obesity and their directionality is not well understood.

"Future research should also examine the social and economic effects of obesity on various disabled populations and/or their families/ caregivers. Youth and adults with disabilities who are dealing with other issues related to their health and function (e.g., spasticity, poor balance, altered gait pattern, lower strength and cardiovascular fitness) may experience greater economic and social hardship associated with the additive effect of excess weight."

Future research should also examine the social and economic effects of obesity on various disabled populations and/or their families/caregivers. Youth and adults with disabilities who are dealing with other issues related to their health and function (e.g., spasticity, poor balance, altered gait pattern, lower strength and cardiovascular fitness) may experience greater economic and social hardship associated with the additive effect of excess weight.

Given the differences in lifestyle, health, and function among youth and adults with various types of physical and cognitive disabilities, there is a strong need to establish prospective cohort studies that examine changes in health and function associated with the onset and progression of obesity across the lifespan. Establishing collaborations with various disability-specific advocacy and health organizations, pediatric hospitals, rehabilitation centers, and other clinical sites is one framework that may provide access to actual (vs. self-report) measures of height, weight, and specific health conditions experienced by youth and adults with disabilities.

Establish Appropriate Cutoffs for BMI for Subgroups With Paralysis

Currently, BMI is the most common measure of body weight status. As such, there is a pressing need to determine if the BMI cutoffs used for the general population are accurate for *all* disability groups. There is growing evidence that these cutoffs are not accurate for people with SCI. Gater (2007) provides an excellent review on the issues associated with the inaccuracy of BMI as a measure of adiposity for SCI populations and notes that while more than two–thirds of people with SCI are obese, because of inappropriate cutoff points, the vast majority are not classified as obese according to the current standard (i.e., false negative). To date, almost all of the research on the inaccuracy of BMI cutoffs has been associated with adult SCI populations. It is unclear if BMI cutoffs for other disabled populations (e.g., CP, multiple sclerosis, head injury) and for youth with disabilities have similar error rates. There is a need for research to determine the sensitivity of current BMI obesity cutoff points for adults and youth with physical disabilities by utilizing appropriate algorithms for assessment of cardiovascular risk factors for these populations. Regression equations need to be developed based on criterion measures of adiposity for these disability groups.

Establishing collaborations with various disability-specific advocacy and health organizations, pediatric hospitals, rehabilitation centers, and other clinical sites is one framework that may provide access to actual (vs. self-report) measures of height, weight, and specific health conditions experienced by youth and adults with disabilities.

Establish Appropriate Methodology and Equipment for Accurate Measurement of Body Composition in Select Disability Groups

Estimates of obesity prevalence such as BMI involve accurate measurement of body weight and height. There is, however, difficulty in obtaining these measures in certain subgroups of youth and adults with paralysis, resulting in a gross underestimation of the magnitude of the problem. First, there are few homes or medical facilities that have a wheelchair accessible scale to measure weight accurately in individuals who are unable to stand. Second, obtaining an accurate measure of height in individuals with spasticity (e.g., SCI, CP) is extremely difficult because of the person's inability to maintain a fully erect position either standing or supine. This raises a significant concern that one of the most important biomarkers (i.e., body weight) for optimal health may not be accurate or available for a significant percentage of people with physical disabilities in the home or clinical setting.

Additionally, there is a need for further research to determine *alternative* methods to BMI to assess adiposity in people with SCI and other forms of paralysis, including measurements such as abdominal circumference and limb length and circumference. Waist-to-hip ratio, or waist circumference, is a strong indicator of cardiovascular disease risk; but the measurement is performed in a standing position. It is unclear if performing this measure in a supine position will achieve the same level of sensitivity for predicting disease risk.

Modified measurement protocols with appropriate training procedures need to be established for obtaining direct measures of body composition in people with physical disabilities. Use of segmental measures (heel to knee, knee to hip, hip to head) needs to be better understood in terms of establishing a more accurate estimation of height in individuals who cannot maintain an erect posture.

Technologies need to be developed that will allow body weight to be measured in a seated position without expensive medical equipment.

Address the Potentially Higher Risk of Obesity In Minorities With Disabilities

Although there is a disproportionately higher rate of obesity among non-Hispanic Blacks and Hispanics with disabilities (Jones & Sinclair, 2008), it is unclear if this higher rate is associated with racial/ethnic differences, different disability types, or lifestyle and environmental differences. Given the difficulty in obtaining population-based prevalence data on minorities with disabilities, there is a strong need to partner with various associations and federal agencies that have access to minorities with disabilities to ensure an adequate sampling frame for this subgroup.

Identify the Antecedents of Obesity in People With Disabilities

While the major antecedents of obesity among youth and adults with disabilities are still unclear, there appears to be growing support for the notion that disability-related impairments, activity limitations, and participation restrictions may each have their own additive effect on obesity in various subpopulations with disability. Liou et al. (2005) noted that risk factors for obesity could relate to type of disability, severity and duration of disease and associated impairments, gender, and age. Use of certain weight-gaining medications also has been found to cause significant increases in obesity (Sachs & Guille, 1999), particularly among people with mental illness, where these drugs are used on a regular basis (Allison et al., 2009). Weight-gaining psychotropic medications may also be an issue for certain disability groups who use them to manage or control undesired behaviors. Greater reliance on powered mobility devices may reduce energy expenditure, increasing the risk for obesity. Inaccessible environments and poor access to health clubs and exercise facilities may also create higher levels of physical inactivity, increasing the risk of obesity. There is a need for prospective cohort studies that explore the potential risk factors (i.e., antecedents) for obesity to guide effective weight-management interventions.

Conclusion

Obesity is much higher in youth and adults with disabilities compared with the general population; furthermore, it is likely to be even higher than current estimates because of the inaccuracy of BMI in populations with some form of paralysis and because of underreporting in certain disability groups. Moreover, chronic and secondary conditions associated with obesity in youth and adults with disabilities can undermine physical independence and limit opportunities for community engagement in work, leisure, and physical activity. The secondary effects of obesity can impose substantial physical and psychological burdens on the individual, families, and caregivers. However, little attention and few resources have been directed at the identification and treatment of obesity in people with disabilities. These factors highlight the need for more research to address this major health disparity in both youth and adults with disabilities.

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