Prevalence of Overweight Among Deaf Children

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The study examined the prevalence of overweight cases in a sample of 151 deaf children aged 6-11 years. Participants were deaf students attending six elementary schools, both regular and special, in four states. Body mass index (BMI) was calculated using height and weight, plotted on the Center for Disease Control and Prevention (CDC) U.S. BMI-for-age growth charts, then compared to national values for same age and gender (CDC, 2006a, 2006b; National Center for Health Statistics, 2005). The results indicated that the prevalence of overweight deaf children aged 6-11 years was above the national percentage for same age and gender. A larger percentage of boys was overweight (24.7%) than girls (20.4%). After age 8 years, girls showed a consistent decrease in BMI with increasing age, a trend not demonstrated by boys. As a group, deaf children demonstrate a higher prevalence of overweight than national averages.

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It has become a common perception over the past several decades that an alarming number of adults in the United States are overweight or obese. Nor is it an original perception that children, adolescents, and young adults are following a similar trend (Crespo & Arbesman, 2003). Statistics from the most recent National Health and Nutrition Examination Survey indicate that the prevalence of overweight and obesity in children between the ages of 2 and 19 years has increased considerably since the 1960s, and continues to worsen across all age groups (National Center for Health Statistics, 2005; Ogden, Flegal, & Carroll, 2002). With the obesity epidemic in full force, research has indicated that an increase in caloric intake and a decrease in physical activity are contributing factors to the rise in pediatric overweight and obesity (Crespo, Smit, & Troiano, 2001). With each additional pound there comes an increased risk of developing chronic conditions such as diabetes mellitus, dyslipidemia, heart disease, hypertension, gall bladder disease, and arthritis (NHLBI Obesity Education Initiative Expert Panel, 2000).

The 1999–2002 NHANES report indicated that approximately 16% of children aged 6 to 19 years were overweight (National Center for Health Statistics, 2005). Overweight was defined by age-specific and gender-

specific body mass index (BMI) values corresponding to the 95th percentile or above (Ogden et al., 2002). Evidence exists that individuals who were overweight as children remain so as adults (Garn & LaVelle, 1985; Guo & Chumlea, 1999; Guo, Roche, Chumlea, Gardner, & Siervogel, 1994). Being at risk for overweight (i.e., between the 85th and 95th percentiles) or being overweight (i.e., having a body weight that puts one in the 95th percentile or higher) during childhood may be where adult weight problems originates. While only 10% of children with a BMI-for-age below the 85th percentile (i.e., who are at normal weight or underweight) go on to be reported as overweight or obese as adults, 75% of children at risk for overweight and 80% of those in the overweight category go on to be reported as overweight or obese (Whitaker, Pepe, Wright, Seidel, & Dietz, 1998).

The obesity trend has affected all corners of society, some more than others. Adults with disabilities have demonstrated a higher rate of obesity than nondisabled adults. Among deaf adults, the prevalence of overweight has been reported to be 33.9% and the prevalence of obesity 23.4% (Weil et al., 2002).

With the correlation between childhood weight in the 85th percentile or higher (at risk or overweight) and adulthood overweight and obesity, there is a legitimate concern that children with disabilities will be at an even greater risk of weight-associated diseases and other weight-related problems in adulthood. Research has found that 60% of children between the ages of 5 and 10 years who demonstrate BMI-for-age in the overweight category have at least one condition related to obesity (e.g., hypertension, diabetes, osteoarthritis, asthma, heart disease, sleep apnea, high cholesterol), and 20% demonstrate two or more obesity-related conditions (Freedman, Dietz, Srinivasan, & Berenson, 1999). With the high percentage of overweight and obese deaf adults and the lack of information regarding trends in this population during childhood, information relating to prevalence of at risk and overweight cases is needed.

The present study had three purposes: (a) to determine the prevalence of overweight among deaf children aged 6 to 11 years; (b) to determine any gender differences in the prevalence of overweight; and (c) to determine if the prevalence of overweight deaf children was higher within regular schools or special schools.

Method

One purpose of the present study was to examine the prevalence of overweight among deaf children aged 6 to 11 years, with the determination of overweight based on the BMI-for-age charts of the Centers for Disease Control and Prevention (CDC, 2006a, 2006b). Study participants' height was measured with a wall chart and their weight with a calibrated floor scale. Height was recorded to the nearest quarter inch and weight to the nearest half pound. The data were then converted into the appropriate measurement scales (i.e., height converted from inches into meters), and BMI was calculated using the equation *weight (kilograms) / height*^{2} (meters) = BMI. The data were from a larger study investigating health-related components of physical fitness in deaf children (Ellis, Lieberman, Fittipaldi-Wert, & Dummer, 2005).

BMI-for-age charts were used to determine whether individuals fell into the underweight, normal weight, at risk for overweight, or overweight categories. Because BMI during the growth and development years is gender- and age-specific, the use of BMI-for-age charts was valid for this purpose (Hammer, Kraemer, Wilson, Ritter, & Dornbusch, 1991; Pietrobelli et al., 1998). Underweight was classified as having a BMI-for-age at or below the 5th percentile. Normal weight ranged from the 5th to the 85th percentile, and at risk for overweight from the 85th to the 95th percentile. Overweight began at the 95th percentile.

Participants

The sample included 151 deaf children aged 6 to 11 years and consisted of 97 boys (mean age 8.49 ± 1.64 years) and 54 girls (mean age 8.33 ± 1.66 years). Participants were students in three regular and three special elementary schools in the midwestern and northeastern United States. Regular schools were local public schools where most deaf children were educated in self-contained classrooms (n = 43). Special schools were state schools for the deaf (n = 108).

Selection Criteria

Children had to meet three criteria to participate in the present study:

1. They had to be deaf with no other disabilities. Participants with any reported diagnosis other than deafness were excluded from the study.
2. They had to be between the ages of 6 and 11 years.
3. They had to have a hearing loss of at least 55 dB in the better ear.

Informed consent was obtained from each participant and his or her parents prior to the dates of testing. Signed and verbal directions were provided to the children, and verbal assent was granted prior to participation in any individual test.

Results

Descriptive statistics were calculated for frequency, mean, and standard de-

viation for BMI, and categorical results by age and gender. Participants were categorized into underweight, normal weight, at risk for overweight, and overweight groups as identified by the CDC's BMI-for-age growth charts (2006a, 2006b). Percentages of at risk and overweight children based on age and gender were compared to CDC national percentages of children 6 to 11 years old (National Center for Health Statistics, 2005). At risk for overweight was defined as having a BMI between the 85th and 95th percentiles for age and gender, and overweight was defined as a BMI in the 95th percentile or higher.

Table 1 illustrates the descriptive statistics for BMI based on overall group, age, and gender outcomes. The average BMI for male participants was above the 85th percentile for all age groups, indicating that with increasing age this group was still at risk or already overweight rather than falling into the normal weight category. Girls also demonstrated overall BMI above the 85th percentile, but only for the 6-, 7-, and 10-year old groups.

Table 2 and Figure 1 depict the percentages of underweight, normal weight, at risk for overweight, and overweight deaf children by overall group, age, and gender. Sixteen percent of the nation's children were overweight at the conclusion of 2002 (National Center for Health Statistics, 2005). The proportion of overweight deaf children in the present study surpassed 16% in every age group except 11-year-old girls (12.5%). The overall group consistently demonstrated overweight prevalence above 20% for all ages. Higher percentages of boys were overweight than girls, except in the 8-year-old group (23.1% for boys versus 25.0% for girls). Overall, 50.0% of girls were at normal weight for age; 42.3% of boys were.

Table 1
Body Mass Index, by Age and Gender

Age (years)	*Overall*	*Male*	*Female*
6	17.82 ± 2.00 (*N* = 24)	17.61 ± 1.79 (*n* = 16)	18.24 ± 2.44 (*n* = 8)
7	17.89 ± 2.58 (*N* = 28)	17.45 ± 2.38 (*n* = 15)	18.39 ± 2.80 (*n* = 13)
8	18.33 ± 4.00 (*N* = 21)	19.24 ± 4.52 (*n* = 13)	16.85 ± 2.57 (*n* = 8)
9	18.30 ± 2.91 (*N* = 34)	18.67 ± 3.15 (*n* = 23)	17.54 ± 2.26 (*n* = 11)
10	20.69 ± 3.97 (*N* = 24)	20.31 ± 4.98 (*n* = 18)	21.81 ± 4.98 (*n* = 6)
11	20.48 ± 3.77 (*N* = 20)	21.50 ± 3.62 (*n* = 12)	20.56 ± 4.58 (*n* = 8)
Total sample	19.79 ± 3.07 (*N = 151)*	20.02 ± 3.21 (n = 97)	19.37 ± 2.80 (*n* = 54)

Note. Body mass index (BMI) is computed by dividing height in meters by kilogram weight squared: m/kg^2.

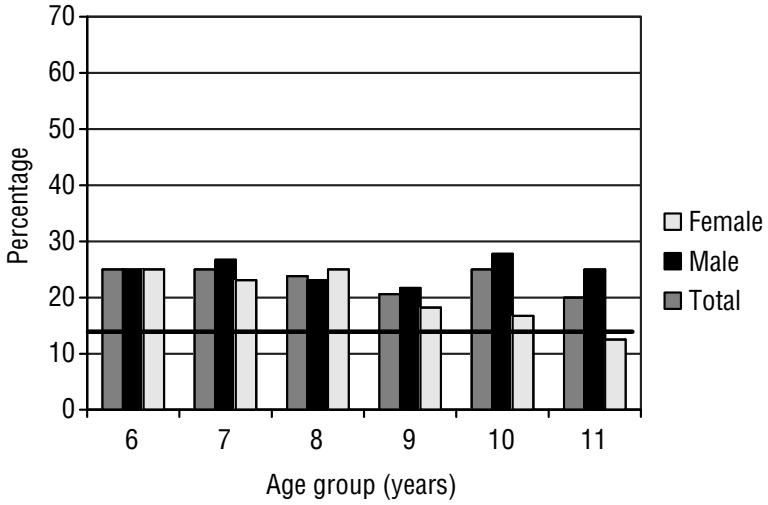
The distribution of the study participants among the four weight categories (underweight, normal weight, at risk for overweight, and overweight) by age and gender is shown in Figure 2. No consistent trend was demonstrated for these results. All percentages in the overweight category were above the

Table 2
Age, Gender, and Weight Characteristics of the Sample

Age (years)	*Gender category*	*Underweight (%)*	*Normal weight (%)*	*At risk for overweight (%)*	*Overweight (%)*
6	Overall	8.3	37.5	29.2	25.0
	Male	6.3	37.5	31.3	25.0
	Female	12.5	37.5	25.0	25.0
7	Overall	3.6	46.2	25.0	25.0
	Male	6.7	46.7	20.0	26.7
	Female	0.0	46.2	30.8	23.1
8	Overall	4.8	47.6	23.8	23.8
	Male	0.0	46.2	30.8	23.1
	Female	12.5	50.0	12.5	25.0
9	Overall	2.9	47.1	29.4	20.6
	Male	4.3	39.1	34.8	21.7
	Female	0.0	63.6	18.2	18.2
10	Overall	4.2	45.8	25.0	25.0
	Male	5.6	44.4	22.2	27.8
	Female	0.0	50.0	33.3	16.7
11	Overall	5.04	5.0	30.0	20.0
	Male	0.0	41.7	33.3	25.0
	Female	12.5	50.0	25.0	12.5
Total sample	Overall	4.6	45.0	27.2	23.2
	Male	4.1	42.3	28.9	24.7
	Female	5.6	50.0	24.1	20.4

Notes. N = 151. Some rows do not equal 100.0% because of rounding.

Figure 1
Proportions of the Sample That Were Overweight, by Age and Gender



Note. The heavy dark line indicates the level of prevalence of overweight among children ages 6 to 11 years in the general US population: 16%, in 2002 (National Center for Health Statistics, 2005).

Figure 2
Distribution of the Whole Sample Among the Weight Categories

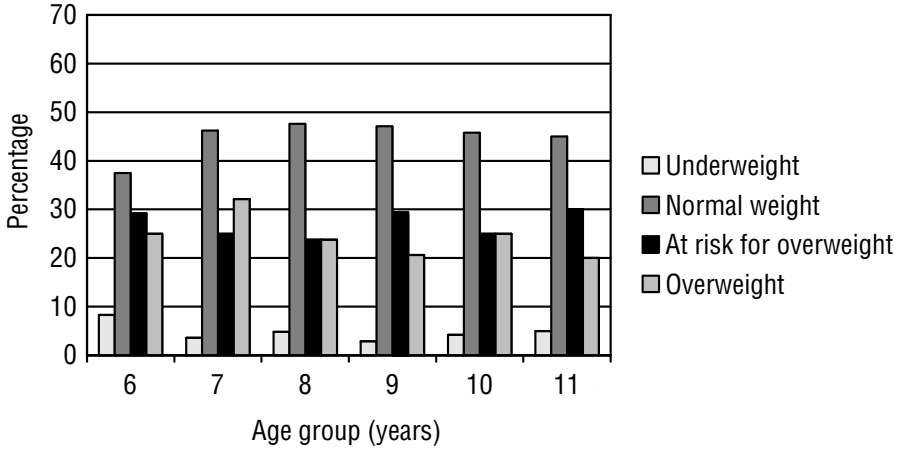
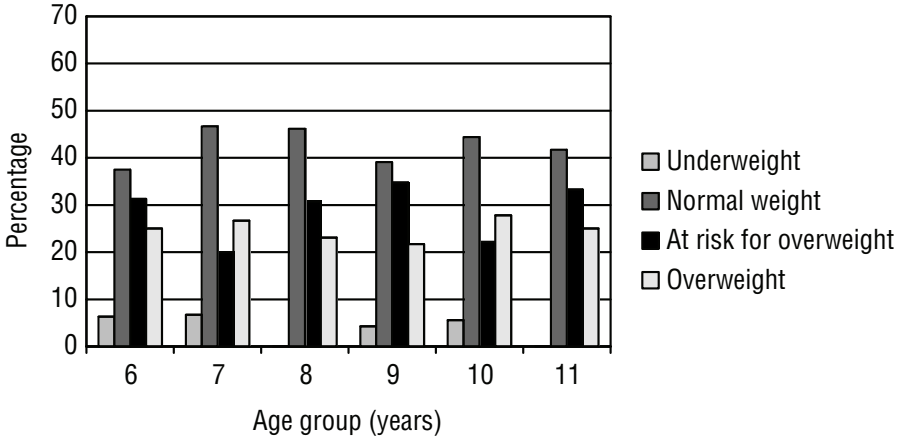


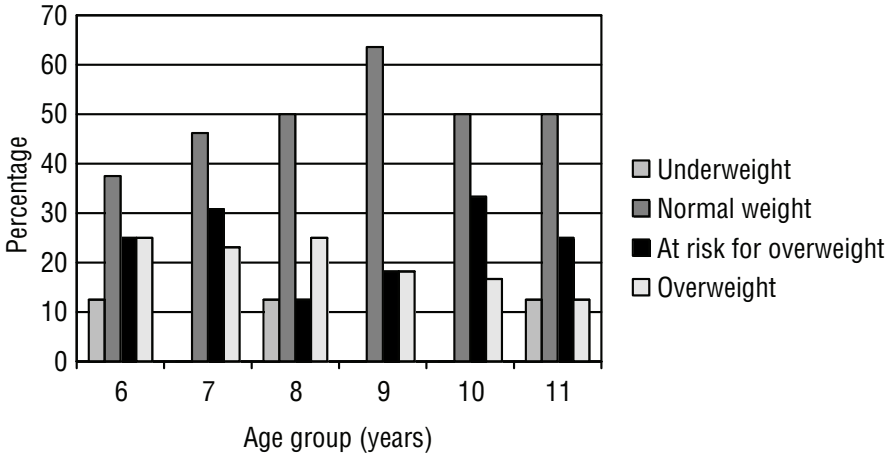
Figure 3
Distribution of Male Participants Among the Weight Categories



national average of 16% for children aged 6 to 11 years. By gender and age, Figures 3 and 4 show the percentages of children who were underweight, normal weight, at risk for overweight, and overweight. There was no consistent trend in any of the categories for the male participants, with the percentage overweight varying with each age group. The female participants, however, did reveal a trend of decreasing percentages of overweight after the age of 8 years, a finding that contrasts with past evidence of increasing body fat with age (Longmuir & Bar-Or, 1994, 2000; National Center for Health Statistics, 2005). The girls also showed higher percentages in the normal weight range, with at least 50% ages 8 to 11 years within this category. The highest percent of boys in the normal weight range was 46.7%, for the 7-year-olds.

School placement was investigated to determine if the prevalence of overweight deaf children was higher within regular schools or special schools. Descriptive statistics on age, gender, school placement, and weight category are presented in Tables 3 and 4 and Figures 4, 5, and 6. While no significant differences for BMI were found between regular and special school participants ($F = 2.54$, $p = .113$), the children attending regular schools were more likely to have BMIs within the normal range. There were consistently higher percentages of participants from regular schools within the normal weight category, with the exception of the 10-year-old group. In addition, after age 7 years, the percentage of deaf children in regular schools who were overweight was below the national average (16%). By contrast, the percentage of deaf children in special schools who were overweight exceeded the national average at all age levels. Neither group followed any other specific trend.

Figure 4
Distribution of Female Participants Among the Weight Categories



More than a quarter of study participants were in the at risk for overweight category (Table 2). A higher percentage of boys than girls were in the at risk for overweight category (28.9% versus 24.1%). With the exception of 8- and 9-year-old girls, all groups demonstrated BMI-for-age in at least 20% of the cases. The percentages of at risk for overweight cases were consistent across overall groups (Figure 2). As Figures 3 and 4 show, boys and girls demonstrated no specific trend in the at risk for overweight category, with peaks and valleys across age groups. Information on at risk for overweight cases is as important as that on overweight cases given that a high percentage of children within these categories maintain this status into adulthood. Among the study participants, an alarming 50.4% would be classified as overweight and obese as adults should they maintain their present BMI category.

Table 3
Body Mass Index, by Age and School Placement

Age (years)	*Special school*	*Regular school*
6	17.82 ± 1.97 (*n* = 18)	17.33 ± 2.24 (*n* = 6)
7	17.80 ± 2.33 (*n* = 18)	18.04 ± 3.11 (*n* = 10)
8	19.82 ± 4.37 (*n* = 13)	15.89 ± 1.40 (*n* = 8)
9	18.51 ± 3.12 (*n* = 27)	17.49 ± 1.84 (*n* = 7)
10	20.98 ± 4.28 (*n* = 15)	20.19 ± 3.59 (*n* = 9)
11	20.79 ± 3.91 (*n* = 17)	18.71 ± 2.72 (*n* = 3)
Total sample (N = 151)	19.14 ± 3.51 (*n* = 108)	17.95 ± 2.88 (*n* = 43)

Note. Body mass index (BMI) is computed by dividing height in meters by kilogram weight squared: m/kg^2.

Discussion

The present study addressed the question of whether deaf children aged 6 to 11 years were more likely to be overweight than their hearing peers. The results of the study suggest that, with the exception of 11-year-old girls, deaf children have a stronger tendency to be overweight than their hearing peers. The existing literature was limited in that there were no studies that examined the prevalence of overweight solely among deaf children. However, several studies reported deaf children to be heavier or have a higher percentage of body fat than comparable hearing peers (Ellis, 2001; Goodman & Hopper, 1992; Pender & Patterson, 1982; Wiegersma & Van der Velde, 1983).

When average BMI by age and gender was evaluated, deaf children were classified in the at risk for overweight group or higher (i.e., 85th percentile or higher) in most cases. At first glance, the average BMI for boys exceeded the baseline for the at risk for overweight category at every age, while the BMIs for the 8-, 9-, and 11-year-old girls were below the baseline, and those for the 6-, 7-, and 10-year-old girls above the baseline, for being at risk for overweight. However, the data for those groups indicated that there were higher numbers of girls who were either classified as underweight or were borderline underweight/normal weight, which naturally would bring down the overall BMI average. These data do not diminish the finding that both the boys and the girls in the present study were above the national norm of 16% overweight for all ages, with the lone exception being the 11-year-old girls.

At any given age, the BMI-for-age categories begin at slightly higher levels for girls than for boys, with the differences widening as the children get older. For example, at age 6 years, the

at risk for overweight category begins at a BMI of 17.0 for boys and 17.1 for girls, while at age 11 years the same category begins at a BMI of 20.2 for boys and 20.9 for girls. This development can be attributed to the normal trend in weight development among the genders: Females naturally gain weight more rapidly than males (National Center for Health Statistics, 2005). In addition, females begin puberty, which involves an increase in BMI, between the ages of 10 and 13 years, while male onset of puberty begins, on average, 2 years later (Rice, 1999). The difference in BMI at some ages among male and female participants in the present study could be attributed to the onset of puberty among some individuals, potentially of both genders, resulting in a variation in average BMI between the genders leading to some averages being closer to normal weight (below 85th percentile) and other averages being closer to overweight (95th percentile and above).

Deaf children attending regular schools were found to be less overweight than their deaf peers attending special schools. An interesting, and significant, finding was that after the age of 7 years, deaf children in regular schools demonstrated a prevalence of overweight below the national average. From the ages of 9 to 11 years, there was a downward trend in overweight. This finding is in contrast to past research that indicated decreases in fitness, including increases in BMI, with increasing age (Longmuir & Bar-Or, 1994, 2000; National Center for Health Statistics, 2005). The differences found between regular schools and special schools are at odds with deaf education literature indicating that special schools tend to be better geared to meeting the needs of deaf children (Moores, 2001; Stewart, 1991).

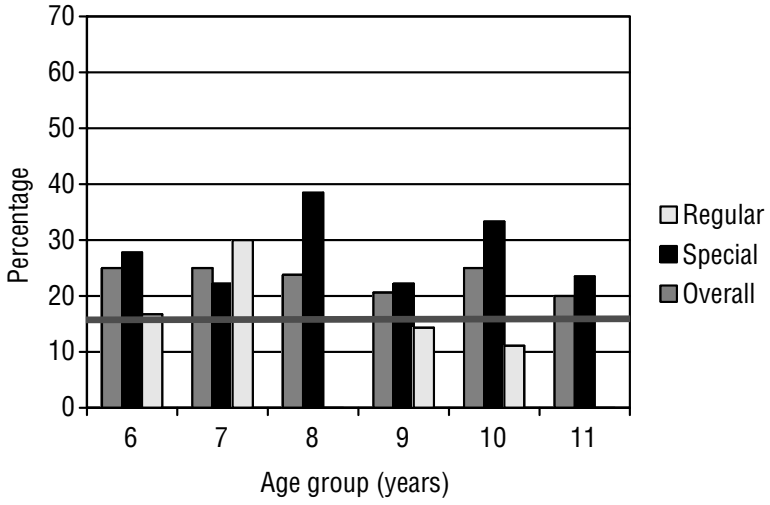
Table 4
Distribution of the Sample by Age, School Placement, and Weight Category

Age (years)	*School placement*	*Underweight (%)*	*Normal weight (%)*	*At risk for overweight (%)*	*Overweight (%)*
6	Special	5.6	33.3	33.3	27.8
	Regular	16.7	50.0	16.7	16.7
7	Special	5.6	33.3	38.9	22.2
	Regular	0.0	70.0	0.0	30.0
8	Special	0.0	30.8	30.8	38.4
	Regular	12.5	75.0	12.5	0.0
9	Special	3.7	44.4	29.6	22.2
	Regular	0.0	57.1	28.6	14.3
10	Special	6.7	46.7	13.3	33.3
	Regular	0.0	44.4	44.4	11.1
11	Special	5.9	41.2	29.4	23.5
	Regular	0.0	66.7	33.3	0.0
Total sample	Special	4.6	38.9	29.6	26.9
	Regular	4.7	60.5	20.9	14.0

Notes. N = 151. Some rows do not equal 100.0% because of rounding.

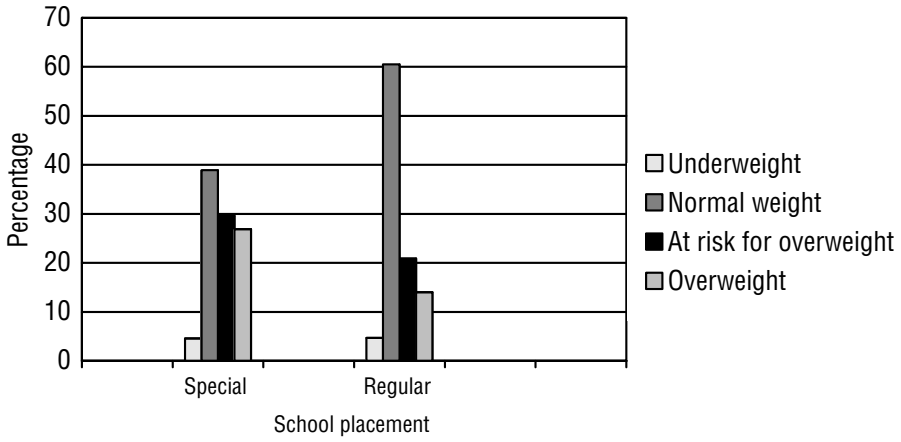
Children who are overweight or at risk for overweight have a greater likelihood of becoming overweight and obese adults (Whitaker et al., 1998). The BMI-for-age growth charts define at risk for overweight as being between the 85th and 95th percentiles; this corresponds with overweight standards for adults. Furthermore, the overweight category (95th percentile and above) for children corresponds with obesity standards for adults. An alternative view relating to the at risk for overweight and overweight BMI categories is that children who fall into these categories exhibit BMIs that are higher than that of at least 85% or 95%, respectively, of their same-age and gender peers. In other words, compared to that of their same-age and

Figure 5
Proportions of Study Participants Who Were Overweight, by School Placement



Note. The heavy dark line indicates the level of prevalence of overweight among children ages 6 to 11 years in the general U.S. population: 16%, in 2002 (National Center for Health Statistics, 2005).

Figure 6
Proportions of Study Participants in Each of the Weight Categories, by School Placement



gender peers, their BMI is among the highest 15% or 5%, respectively. Seventy-five percent of children who demonstrate a BMI-for-age in the at risk category maintain that level as adults, while 80% with BMI-for-age in the overweight category are obese as adults. The children in the present study demonstrated BMIs in the at risk category at prevalence rates of 20% or higher, with the exception of 8- and 9-year-old girls. The average percentage in the at risk for overweight category was 27.2%. The highest percentage of children considered at risk for overweight was 34.8% (9-year-old boys), a proportion very similar to the 33.9% of deaf adults found to be overweight (Weil et al., 2002). In addition, the proportion of the overall sample of deaf children who had BMIs in the overweight range was 23.2%, almost exactly the same as the proportion of deaf adults (23.4%) reported to be obese (Weil et al., 2002).

Despite the lack of studies to support these findings, a number of conclusions can be drawn that may explain the elevated prevalence of overweight among deaf children. Primarily, it is probable that deaf children are overweight for the same reasons as hearing children, namely, a reduction in physical activity, an increase in leisure activities, and an increase in caloric intake. Another explanation may be related to deaf children's physical fitness levels. Several studies have found deaf children to be less physically fit than their hearing peers, not only generally but in specific areas such as aerobic strength and endurance (Ellis, 2001; Goodman & Hopper, 1992; Pender & Patterson, 1982; Wiegersma & Van der Velde, 1983). Even though physical fitness scores may not be a valid indicator of the amount of physical activity a child participates in, these scores might suggest that deaf children may participate in less regular physical activity either in advance of or because of these lower fitness levels.

The present study has several limitations. Using BMI to assess overweight, while a popular method with children, should be done with caution. BMI maintains its usefulness as a noninvasive tracking/screening tool for physicians and other health practitioners, but it should not be used to diagnose or predict adiposis. Another limitation was the small sample size. While the overall differences among age and gender groups were clear, some cells had small samples, such as the 10-year-old females, to the point where moving one participant from one cell to another would have had drastic effects on the outcome. Additional research should investigate overweight trends with a larger sample, as well as potential causes for higher prevalence levels among deaf children.

The results of the present study provide support for early intervention to instill healthy lifestyle habits in deaf children. Some means of providing intervention or strategies for improving physical activity and fitness include peer-tutoring programs, opportunities for participation in Deaf sport, involvement in community sports and recreation programs, effective physical education programs within the schools, using pedometers to encourage increased movement, and educating parents and families about healthy lifestyles.

All four categories of health-related physical fitness can be affected by an individual's BMI. For example, carrying around excess weight can have negative effects on cardiorespiratory endurance, flexibility, muscular strength and endurance, and overall body composition (Wilmore & Costill, 1994). With increases in BMI, purposeful movements associated with health-related physical fitness becomes more laborious, increasing the possibility of sedentary lifestyle habits. One reason why deaf children may not participate in regular physical activity may be related not only to the physical aspects of participation but to the psychological and social aspects. For example, deafness poses a communication barrier that may lead to isolation and lower self-esteem among some deaf individuals (Coakley, 1990; Stewart, 2001). This is where Deaf sport becomes so valuable, in that it offers a physical and social context of commonality for the deaf individual. Increases in pride and self-concept are not uncommon in Deaf sport, given experiences based

on similar language and experiences among participants (Stewart, 1991). Therefore, involvement in Deaf sport as a forum not only for lifelong participation but for socialization is a crucial experience for deaf children.

Given that overweight and obesity are pronounced among deaf adults, and that most individuals who fall into the at risk and overweight categories during childhood maintain that status into adulthood, the results of the present study show an alarming trend. Parents, physicians, and educators should be aware of the increased risk that deaf children will fall into the overweight category, and ensure that health-related physical fitness is promoted among these children. As with any child, recommendations for lifelong healthy lifestyles involve achieving and maintaining a level of fitness that is conducive to participation in a variety of enjoyable regular physical activities. This across-the-lifespan approach focuses on lifelong physical activity that positively affects the components of health-related physical fitness. In addition, participation in regular physical activity can serve as either a breeding ground or bridge into Deaf sport. As with many cases, insufficient physical activity and unhealthy lifestyles are not due to lack of awareness that these conditions exists, but, rather, to inadequate knowledge and understanding of how to achieve and sustain healthy fitness levels.

One of the best ways to do ensure knowledge and understanding is to educate the community about BMI, risks associated with overweight and obesity, physical activity, and nutrition. Peer-tutoring programs using trained peer tutors have been shown to increase physical activity among deaf students, which may lower BMI (Lieberman, Dunn, van der Mars, & McCubbin, 2000). Community events could be offered through school systems and directed by physical education teachers or other qualified professionals. Opportunities to be involved should be family based at the activity, awareness, and knowledge levels. The key here, as with many intervention programs, is to involve as many people as possible in order to influence a greater diversity of individuals, including deaf children and their families.

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