HHS Public Access

Author manuscript

Disabil Health J. Author manuscript; available in PMC 2017 July 01.

Published in final edited form as:

Disabil Health J. 2016 July ; 9(3): 392–398. doi:10.1016/j.dhjo.2015.12.003.

Intellectual disability is associated with increased risk for obesity in a nationally representative sample of U.S. children

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Disclosures

The authors do not have any relevant conflicts of interest to disclose. A similar analysis was presented in poster format at the 2014 annual meeting of The Obesity Society (TOS). The Secondary Data Analysis Core of the Healthy Weight Research Network for Children with Autism Spectrum Disorder and Developmental Disabilities (HWRN) (1 UA3MC25735-01-00) conducted this research as part of our larger research agenda on obesity and its correlates in this population. We thank the other members of the HWRN for their participation in the Network's efforts. Funding was also provided to the last author from NIHDK046200 and to the first author from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, grant R03HD076588.

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Abstract

Background—Data on obesity prevalence in children with intellectual disability (ID) are scarce.

Objective—We estimated rates of obesity among children aged 10–17 years with and without ID in a nationally representative dataset that included measures of child weight and ID status, as well as family meal frequency, physical activity, and sedentary behavior.

Methods—Chi-square tests compared prevalence of obesity, demographic and behavioral characteristics between children with and without ID as reported in the 2011 National Survey of Children's Health. Tests for interaction in logistic regression models determined whether associations between obesity and behavioral characteristics were different between children with/without ID.

Results—Obesity prevalence for children with ID was 28.9% and 15.5% for children without ID. After adjusting for age, sex, race/ethnicity and poverty level, the odds ratio was significantly 1.89 times greater among children with ID than among those without ID (95% CI: 1.14 to 3.12). Among children with ID, 49.8% ate at least one meal with family members every day compared to 35.0% without ID ($p < 0.002$), and 49.5% with ID participated in frequent physical activity compared to 62.9% ($p<0.005$). Prevalence of obesity was higher among all children who ate family meals every day compared to fewer days per week, and the effect was significantly more pronounced among those with ID ($p=0.05$).

Conclusions—Prevalence of obesity among youth with ID was almost double that of the general population. Prospective studies are needed in this population to examine the impact of consistent family mealtimes and infrequent physical activity.

Keywords

intellectual disability; children; obesity prevalence

Introduction

The epidemic of childhood obesity appears to affect all U.S. population subgroups, whether defined by race, ethnicity, income level or developmental disability status [1–3]. Studies of obesity rates in children with intellectual disabilities (ID) have often been based on small convenience samples and have used varying definitions of weight status and disability, yielding inconsistent results. Despite the methodological concerns, these studies in general have suggested that overweight and obesity may be even more prevalent among children and adolescents with ID than in those who develop typically.

Substantial research evidence suggests that childhood obesity is associated with serious health consequences [1], including high blood pressure, Type 2 diabetes [4], and possible musculoskeletal problems [5]. Of great concern, childhood obesity is a predictor of obesity in adult life [6], which has been implicated in Type 2 diabetes, hypertension, coronary artery disease, stroke, respiratory complications, arthritis, and some cancers [7]. For individuals with ID, these medical conditions may increase functional limitations that threaten further their opportunity to live in the least restrictive, most independent setting.

According to the American Association of Intellectual and Developmental Disabilities, ID originates before the age of 18 and is characterized by significant limitations in both intellectual functioning and in adaptive behavior. Intellectual functioning, which includes learning, reasoning, and problem solving, is often measured by IQ test scores which average 100 in the general population. A score of around 70 – 75 is considered to indicate a limitation in intellectual functioning. Adaptive behavior includes conceptual, social and practical domains [8]. ID is found in approximately 1% of the US population [9], and affected persons often have other associated conditions such as autism, attention deficit disorder, sensory and motor impairments, and depression [10].

Data on weight status in children with ID are scarce. Internationally, a study in France of 87 adolescents with ID found that 25.3% were overweight or obese [11]. Another study of 410 French adolescents with ID found a lower prevalence of 19% combined overweight and obesity, which was nevertheless higher than 13.6%, the cited rate in typically developing adolescents in France [12]. Obesity prevalence was 36% in a study of 206 Scottish children with mild to moderate ID, significantly greater than the general population [13].

In the U.S. 2003 National Survey of Children's Health (NSCH), 19.3% of 5,945 children identified as having learning disabilities (a category that includes academic learning problems but at least average intelligence) were obese after adjusting for covariates, compared to 12.2% of 40,762 children without a chronic condition such as learning disability [2]. However, the 2003 NSCH did not include ID as a separate category. In another study that collected data from a convenience sample of parents reporting weight status of 82 adolescents with ID, 12.4% of the youth were obese after adjusting for covariates. This was a non-significant difference when the authors compared this obesity rate to the rate of 13.0% that was reported in the concurrent national 2007 Youth Risk Behavior Survey of high school students without disability. However, diagnoses such as autism and Down syndrome that are often associated with ID were considered separately, and 159 youths with autism and 81 youths with Down Syndrome had significantly higher obesity prevalence than the reference group: 24.6% and 31.2% respectively [14].

Given the general data scarcity and the variability in children's obesity rates and methodology in previous studies, we sought a reliable estimate of ID as a primary condition by analyzing results of a large representative data set. The NSCH, a nationally representative survey conducted by the Center for Disease Control's (CDC) National Center for Health

Statistics, has included estimates of overweight and obesity prevalence based on parent report since 2003. The most recent wave of surveys conducted in 2011–2012 was the first to include items characterizing children as with/without ID along with the information on weight status. Information in the NSCH also allowed users to assess how weight status is affected by associated medical conditions as well as behavioral risk factors associated with obesity, such as mealtimes and physical activity. We hypothesized that disparities in the prevalence of obesity between children with and without ID would correlate with patterns of mealtimes, physical activity, and sedentary behaviors such as television viewing and electronic device use.

Methods

The 2011–2012 NSCH is a nationally representative survey conducted by the CDC's National Center for Health Statistics, administered as a module of the State and Local Area Integrated Telephone Survey. Households were sampled via random digit dialing of land-lines, supplemented with an independent sample of cell phone numbers. The survey screened households for the presence of children aged 0–17 years, and one child was randomly selected to be the survey subject. The questions were answered by a parent or guardian in the household with knowledge of the child's health. The overall response rate for 2011–2012 was 23.0%, resulting in a total of 95,677 parent interviews completed from February 2011 through June 2012. For more information about NSCH, including its sample design, data collection procedures, and questionnaire content, visit http://www.cdc.gov/nchs/slaits/nsch.htm. This public use data set is available through the Data Resources Center for Child and Adolescent Health (www.childhealthdata.org) [15].

After reviewing the NCHS codebook, we decided a priori to use ID status, weight, and available items that were most closely related to caloric intake and energy expenditure. The Tufts University Institutional Review Board deemed that the study, a collaborative effort of members of the Healthy Weight Research Network led by Tufts University researchers, was exempt, given that the data were publicly available and de-identified.

Assessment of ID status

Parent report of current ID was based on responses to two questions. Parents were first asked if they had ever been told by a doctor or other health care provider that their child had "an intellectual disability or mental retardation?" Parents who answered "yes" to this question were given a follow-up question: "Does [child] currently have an intellectual disability or mental retardation?" In this analysis, only children whose parents answered "yes" to both questions were included in the "current ID category." Parents who answered "yes" to the first question but indicated that their child does not currently have ID were combined with parents who answered "no" to the first question.

Parents were also asked about the presence of 17 other health conditions using a similar pair of questions: first, whether a health care professional had ever indicated the condition and, if yes, second, if they currently had the condition. These health conditions included problems in cognitive, psychological and sensorimotor functioning. We analyzed information on the top 7 conditions the parents concurrently endorsed for their children.

Assessment of weight status

In the NSCH 2011–2012 data file, a Body Mass Index (BMI) classification variable identifies children as underweight (<5th percentile BMI-for-age), healthy weight (5th to <85th percentile BMI-for-age), overweight (85th to <95th percentile BMI-for-age), or obese (≥95th percentile BMI-for-age) using the CDC 2000 growth reference [16]. BMI-for-age is calculated using parent-reported height, weight, sex and age (calculated from date of birth and interview date). The child's age in months is used to calculate BMI-for-age. However, because the NSCH reports age in years only, all children were assumed (by NCHS) to be at the midpoint of their age-year for this calculation. The key binary outcome used in this analysis is obesity, which was created by comparing those children identified as obese using BMI-for-age (≥95th percentile), to all other children, the non-obese (underweight, normal weight, overweight). BMI classifications for children under 10 years of age are not provided by NSCH in the public use data set due to evidence that parent-reported data on children's weight status for these ages are not sufficiently accurate to estimate overweight prevalence [17]. Thus our analysis is restricted to children aged 10–17.

Assessment of behavioral covariates

The NSCH includes a limited number of items that address behaviors that would be expected to be related to obesity. We selected for consideration all variables related to eating- or activity-related behaviors. The following behavioral variables were included in our analysis: *physical activity*, assessed by parental response to the question 'During the past week, on how many days did [child] exercise, play a sport, or participate in physical activity for at least 20 minutes that made [him/her] sweat and breathe hard?' (values range from 0–7); *family meals*, assessed by parental response to the question 'During the past week, on how many days did all the family members who live in the household eat a meal together?' (values range from 0–7); *television viewin*g, assessed by parental response to the question 'On an average weekday, about how much time (coded in hours) does [child] usually spend in front of a TV watching TV programs, videos, or playing video games?'; and *use of electronic devices*, assessed by parental response to the question 'On an average weekday, about how much time does [child] usually spend with computers, cell phones, handheld video games, and other electronic devices, doing things other than schoolwork?'

Statistical analyses

All statistical analyses were carried out using the survey procedures in SAS 9.3 (SAS Institute Inc., Cary, NC) software, which are capable of handling complex sample design structures. Sampling weights that adjusted for survey non-response, non-coverage, and non-telephone households were provided in the NSCH public-use data set. Chi-square tests were used to compare the prevalence of demographic characteristics, other current diagnoses, and behavioral characteristics between children with and without ID. Tests for interaction in multivariable logistic regression models were used to determine whether associations between obesity and behavioral characteristics were different between children with and without ID, and included age, sex, race/ethnicity, and poverty level as covariates. Results are reported as adjusted prevalence and adjusted odds ratios with corresponding 95% confidence intervals.

Results

The number of children aged 10–17 years for whom both parent-reported ID and weight status were available was 43,818; of these, 672 children had ID and 43,146 did not. The prevalence of ID was 1.37% (95% CI: 1.11 to 1.63) or 1 in 73. A greater proportion of children with ID were male (68.4% of children with ID vs. 51.1% non-ID, p <0.01, Table 1). A greater percentage were also poor: 27.6% of children with ID lived in households with incomes below the federal poverty level, compared to 18.3% of those without ID, yielding a significant difference across the four income levels (p=0.04, Table 1). Age and race/ethnicity did not differ significantly between children with and without ID.

The prevalence of obesity among children aged 10 to 17 years with ID was 28.9% compared to 15.5% among children without ID (Table 1). Children with ID were 2.22 times more likely to be obese compared to children without ID (95% CI: 1.39 to 3.53). In a logistic regression model that adjusted for age, sex, race/ethnicity, and poverty level, the odds ratio was 1.89 (95% CI: 1.14 to 3.12). Among boys, the prevalence of obesity was 28.3% and 18.2% for those with and without ID respectively. Among girls, the prevalence was 30.4% and 12.7% for those with ID and without ID respectively. We conducted a sensitivity analysis combining the 92 parents who said their children had been diagnosed with ID in the past, but not currently, with the group of children with current ID. The odds ratio of 2.1 was similar.

As shown in Table 2, children with ID often have other chronic health conditions. Of the seven most prevalent conditions among children with ID, all were more prevalent among children with ID compared to the children without ID. For example, 38.2% of children with ID also had behavior problems compared to 3.4% of children without ID (p<0.001), and anxiety was more frequently reported in children with ID than in children without ID (26.3 vs. 4.6%, respectively, p<0.001).

Given the higher prevalence of these conditions among children with ID, we assessed whether certain conditions believed to be associated with obesity (ASD, ADHD, asthma, depression, anxiety) confounded the association between obesity and ID. The only condition that was weakly confounding was autism; when autism was included as a covariate in the logistic regression model, the OR decreased from 2.22 (95% CI: 1.39 to 3.53) to 1.92 (95% CI: 1.14 to 3.21).

As shown in Table 3, a higher percentage of children with ID ate at least one meal with all family members every day (49.8% compared to 35.0%, p< 0.002). Children with ID participated less frequently in physical activity: 49.5% of children with ID participated 4 or more days a week compared to 62.9% of children without ID, p<0.005. Time spent watching television and using electronic devices did not differ significantly between the two groups.

The prevalence of obesity was higher among all children, with and without ID, who ate meals with all family members every day compared to six or fewer days per week, and the effect was more pronounced in those with ID [test for interaction p-value=0.05, Table 4]. While less frequent participation in physical activity and more frequent television viewing and use of electronic devices were associated with higher rates of obesity in children without

ID, these associations were not statistically significant in children with ID, perhaps because the relatively low number of subjects with ID resulted in insufficient statistical power. As noted earlier, children with ID were more likely to be obese than children without ID, as evident for each level of each correlate in Table 4.

Discussion

In this large nationally representative data set, 10–17 year old children with ID were almost twice as likely to be obese as their typically-developing peers, which is consistent with earlier non-representative studies [11, 13]. Although children with ID were significantly more likely to live in poverty, a risk factor for obesity [18] and severe obesity (>99th percentile), [19] the elevated likelihood of obesity by ID status clearly persisted after adjusting for poverty as well as age, sex, and race/ethnicity.

Various reasons for the higher prevalence of obesity observed in children with ID have been proposed. In this study, there were high rates of other conditions associated with obesity, including attention deficit/hyperactivity disorder [20–26], behavior problems [27], anxiety [28], and depression [29]. However, none of them affected the relationship between obesity and ID with the exception of autism, confirming earlier work on autism by our group [30] and others [31, 32].

The association between eating family meals every day and higher prevalence of obesity in both groups of children was surprising, given that a meta-analysis has concluded that frequent family meals are protective against pediatric obesity [33]. However, the association in adolescents is more nuanced and not clear-cut, perhaps because family meals are normative in younger children but decrease in frequency during adolescence [34]. Further exploration of these associations in older children, perhaps using qualitative approaches, is warranted.

Reasons for the greatly increased prevalence of obesity among children with ID who ate family meals every day are unclear. One possibility is that the children who ate family meals every day differed on one or more attributes from those who did not. For example, they may have had greater anxiety resulting in social impairment and decreased opportunities for interactions at mealtimes with peers, as well as in disordered eating, e.g. binge eating and over-eating. Another possibility is that dynamics and/or foods served during family meals may have promoted obesogenic behavior in ways that are not well understood. As in all observational research, the direction of causality cannot be determined and may not operate in the same way for all families with children with ID. Future research that explores the structure and contextual variables of family meals in children with ID as well as foods offered and accepted will be crucial to our understanding of this thought-provoking interaction between family meals and ID status in children's obesity.

A smaller percentage of 10–17 year old children with ID participated in regular physical activity than those without ID. Review of previous research on levels of physical activity in U.S. children with ID have shown mixed results, with inconsistent methods and very small samples [35, 36]; however, it appears that youth with disabilities have fewer opportunities to participate in physical activity than typically developing youth (Bandini et al, unpublished observations). Reasons for limited participation by children with ID are varied, and may include poor gross motor control [37] in some children with ID. Another factor in some children may be low impulse control [38, 39] with attending low tolerance for frustration, for example, through unwillingness to push physical limits if even slightly uncomfortable, difficulty in waiting for turn taking, and resistance to following directions that seem unclear. Reports of barriers to physical activity programs for children with ID are scarce. In a recent survey of 59 parents of children (ages 10–18) with ID, 86% reported difficulty in finding any appropriate programs as a barrier to their children's participation in after school physical activity, higher than difficulties attributed to cost (59%), transportation (46%), family time constraints (68%), and children's motivation (54%; Segal et al, unpublished observations).

Greater participation in physical activity has been associated with lower risk of obesity in studies of typically developing children [40] and in a recent study, higher levels of cardiorespiratory fitness were associated with lower rates of obesity in adolescents with ID [11]. In our analysis, as expected, less frequent physical activity was associated with higher obesity rates for children with and without ID, although this difference was only significant for children without ID.

There have been few studies of screen time comparing children with and without ID; a small convenience sample of 18 children also found no difference, similar to our study [41]. The NSCH data are parent-reported, and parents may be poor monitors of screen activity, given its pervasive use among today's youth. More hours of television viewing have been associated with higher risk of obesity in typically developing children [40, 42], and night time use of electronic entertainment and communication devices has also been associated with obesity in children [43]. In children with ID, the lack of association between screen time and obesity may have been an issue of decreased power due to the smaller sample size of children with ID, as the absolute difference was the same for children with and without ID.

Our study results should be considered in light of several notable limitations. A potential source of bias in our analysis was the NSCH reliance on parent-reported height and weight, which are subject to error. We restricted our analysis to children age 10 and greater, given a National Center for Health Statistics report that indicated parent-report at these ages was accurate [44]. In their comparison of parent-report to measured values, parent-report for youth aged 10–11 was overestimated whereas for youth aged 12–17 years, parent report underestimated obesity prevalence, with an overall tendency to underestimate prevalence. However, it is possible that because they are in more frequent contact with their health care providers compared to parents of typically developing children, parents of children with ID are more accurate in their reports of their child's height and weight; this would bias our comparisons. Also, there were a limited number of items included in the NSCH to address behavioral characteristics related to obesity: mealtimes, physical activity, television viewing and electronic device use were each assessed with a single question.

A further limitation is the relatively few variables we were able to assess that are associated with childhood obesity. While these were first steps that yielded some interesting findings, the NSCH does not include information on children's actual caloric intake or food consumption. It includes a few questions about existing sidewalks, playgrounds, and recreation centers in the community that might affect a child's participation in physical activity, but lacks items on their accessibility. Furthermore, variables affecting food buying patterns such as shopping in corner stores and eating in fast food chains are not included in the NSCH. We hope future work will systematically use other data sources to examine these environmental variables that have been shown to have a clear impact on children's diet and weight status.

Strengths of our analysis include a nationally representative data set with a larger sample size than available in other US data sources. Our estimates of prevalence and related characteristics are expected to be representative of children in the US nationally.

Conclusions

This study, an analysis of the first U.S. dataset that includes measures of both ID and weight status in children, shows that prevalence of obesity in youth with ID aged 10–17 years is almost double that of the general population of the same age. The disparity persists after controlling for age, sex, race/ethnicity and poverty level. Psychological and behavioral characteristics as well as medical conditions associated with the diagnosis may contribute to the elevated prevalence of obesity, and thus prospective studies are urgently needed to examine the impact on this population of infrequent physical activity, sedentary lifestyles, and most particularly consistent family mealtimes. The association of the latter with higher levels of obesity is much more robust in youth of this age with ID than in typically developing children and merits further study. A recent review of intervention effects for youths with ID on healthy lifestyles, including those related to obesity, found that existing information is scarce and inconclusive [44]. Therefore, prospective studies will be important in identifying risk factors to enable health care providers and public health officials to develop successful strategies for the prevention and treatment of obesity in this at risk population.

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Table 1

Participant Characteristics by Group

	With ID (%) N = 672	Without ID (%) N = 43,146	Difference (%) (95% CI)	p-value
Age (mean, SEM)	13.3 (0.19)	13.6 (0.03)	−0.23 (−0.60 to 0.14)	0.23
Obese weight status	28.9	15.5	13.4 (4.0 to 22.9)	<0.001
Male sex	68.4	51.1	17.3 (8.9 to 25.6)	<0.001
Racial/ethnic group				
White	57.4	55.4	2.0 (−8.0 to 12.0)	0.52
Black	17.0	14.2	2.8 (−3.8 to 9.4)	
Hispanic	18.5	18.9	−0.4 (−11.2 to 10.5)	
Other/missing	7.1	11.5	−4.4 (−7.3 to −1.6)	
Household income				
<100% FPL[1]	27.6	18.3	9.3 (1.4 to 17.2)	0.04
100–199% FPL	21.8	21.0	0.8 (−6.6 to 8.1)	
200–399% FPL	28.8	29.6	−0.8 (−11.3 to 9.8)	
400% or more FPL	21.8	31.1	−9.3 (−15.6 to −3.0)	

[1]FPL=Federal Poverty Level

Table 2

Prevalence of Other Current Diagnoses Among Children with and without ID

	With ID (%) N = 672[a]	Without ID (%) N = 43,146[a]	Difference (%) (95% CI)	p-value
Speech problems	65.8	2.3	63.5 (54.9 to 72.1)	<0.001
ADHD	45.0	10.8	34.2 (24.8 to 43.6)	<0.001
ASD	41.8	1.6	40.2 (30.3 to 50.2)	<0.001
Anxiety	26.3	4.6	21.7 (13.9 to 29.6)	<0.001
Behavior problems	38.2	3.4	34.8 (24.5 to 45.0)	<0.001
Depression	13.6	3.6	10.0 (3.2 to 16.8)	<0.001
Asthma	17.9	10.5	7.4 (1.6 to 13.2)	0.002

[a]Sample sizes vary slightly due to missing data.

Table 3

Prevalence of Behavioral Characteristics by Group

	With ID (%) N = 672*	Without ID (%) N = 43,146*	Difference (%) (95% CI)	p-value
Family meals Everyday	49.8	35.0	14.8 (5.1 to 24.4)	0.002
Physical activity 4–7 days/wk	49.5	62.9	−13.4 (−23.1 to −3.8)	0.005
Television viewing > 2 hrs/day	31.9	26.0	5.9 (−2.4 to 14.2)	0.14
Electronic devices use > 2 hrs/day	22.0	25.3	−3.3 (−10.4 to 3.7)	0.38

*Sample sizes vary slightly due to missing data

Table 4

Adjusted Prevalence of Obesity and Odds Ratios by Group and Behavioral Characteristic

	With ID		Without ID		
	Prevalence of Obesity (%)	Odds Ratio (95% CI)	Prevalence of Obesity (%)	Odds Ratio (95% CI)	P-value for interaction[2]
Family meals					
Not everyday	16.1	3.00	14.6	1.28	0.05
Everyday	36.5	(1.27 to 7.08)	17.9	(1.12 to 1.46)	
Physical activity					
0–3 days/wk	28.4	0.77	18.8	0.69	0.84
4–7 days/wk	23.3	(0.28 to 2.12)	13.8	(0.60 to 0.79)	
Television viewing					
≤ 2 hrs/day	26.8	0.92	14.5	1.38	0.40
> 2 hrs/day	25.2	(0.36 to 2.36)	19.0	(1.20 to 1.59)	
Electronic devices use					
≤ 2 hrs/day	25.0	1.31	14.5	1.38	0.91
> 2 hrs/day	30.3	(0.51 to 3.21)	19.0	(1.18 to 1.62)	

All analyses were adjusted for age, sex, race/ethnicity, and poverty level.

[2]Test for interaction from multiple logistic regression models assessing heterogeneity of odds ratios between children with and without ID.