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# Healthy behaviors and lifestyles in young adults with a history of developmental disabilities

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## Abstract

**Objective:** Measure select Healthy People 2010 Leading Health Indicators in young adults with and without a history of developmental disabilities (DD) using a population-based cohort.

**Methods:** Young adults were interviewed to assess the prevalence of seven Leading Health Indicators: physical activity, overweight and obesity, tobacco use, substance abuse, responsible sexual behavior, injury and violence, and access to healthcare.

**Results:** Young adults with a history of DD were less likely to be involved in tobacco use, substance abuse and sexual activity. Areas of concern included below normal Body Mass Index, lack of HIV/AIDS and sex education, preventive healthcare services for women, and victimization.

**Conclusions:** Despite some healthy lifestyle indicators, health gaps may place young adults with a history of DD at risk for poor health and quality of life.

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**Keywords:** Developmental disabilities; Epilepsy; Body mass index; Leading Health Indicators

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## 1. Introduction

The benefits of preventing chronic diseases through a healthy lifestyle have been well documented in the general population (Kopelman, 2000; Leslie, Fotheringham, Owen, &

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Bauman, 2001; Lowry et al., 2000; Mokdad et al., 1999, 2000; Pate et al., 1995; Resnick et al., 1997; Sutherland, Couch, & Iacono, 2002). For people with disabilities, promoting healthy lifestyle behaviors such as physical activity also facilitates efforts to prevent secondary conditions (e.g. muscle atrophy and obesity) (Lancioni & O'Reilly, 1998; Rimmer & Braddock, 2002; Rimmer, Braddock, & Pitetti, 1996; Sutherland et al., 2002). This view is reinforced by the inclusion of the goal to “promote health of people with disabilities, prevent secondary conditions, and eliminate disparities between people with and without disabilities in the U.S. population” as one of the main objectives of the *Healthy People 2010* (HP2010, 2000, II, p. 6.3). In order to achieve this objective, HP2010 recommends the use of 10 Leading Health Indicators as markers of health promoting behavior related to the current major public health concerns in the United States. The HP2010 Leading Health Indicators consist of physical activity, overweight and obesity, tobacco use, substance abuse, responsible sexual behavior, mental health, injury and violence, environmental quality, immunization and access to health care (*Healthy People 2010*, 2000, I p. 24).

Several studies have examined specific Leading Health Indicators such as substance abuse, tobacco use and/or responsible sexual behavior among individuals with and without a broad range of disabilities in age groups ranging from adolescence to adulthood (Blum, Kelly, & Ireland, 2001; Brawarsky, Brooks, Wilber, Gertz, & Klein, 2002; Gilson, Chilcoat, & Stapleton, 1996; Hogan, McLellan, & Bauman, 2000; Kokkonen, Saukkonen, Timonen, Serlo, & Kinnunen, 1991). However, none of these studies focused on young adults with developmental disabilities (defined as a diverse group of chronic physical, cognitive, psychological, sensory, or speech impairments that are manifested before 18 years of age (Yeargin-Allsopp, Murphy, Oakley, & Sikes, 1992)). Young adulthood (we defined as ages 21–25 years) is a vulnerable transitional stage between adolescence and adulthood, during which unhealthy behaviors developed during adolescence may be either changed through behavioral interventions or become ingrained as lifetime patterns (Emmons, Wechsler, Dowdall, & Abraham, 1998). These vulnerabilities may be exacerbated for young adults with developmental disabilities because as they transition out of childhood many of the resources, supervision, and support systems that may have protected them from risky behaviors or encouraged healthy lifestyles as children or adolescents are no longer available. To date there have been no population-based studies that have examined healthy behavior and lifestyle outcomes among young adults with developmental disabilities. The purpose of this study was to compare the prevalence of healthy behaviors and lifestyles using select HP2010 Leading Health Indicators in young adults with and without a history of developmental disabilities using a population-based cohort in Metropolitan Atlanta.

## **2. Methods**

### *2.1. Study population*

We used two data sources to establish our cohort: the Metropolitan Atlanta Developmental Disabilities Study (MADDS) and the MADDS Follow-Up of Young Adults (MADDS-FU). The MADDS was a population-based study of 10-year-old children with developmental disabilities whose parents or legal guardians resided in one of five

Metropolitan Atlanta counties (Clayton, Cobb, DeKalb, Fulton, or Gwinnett), between 1985 and 1987. The purpose of MADDs was to develop surveillance methods and also generate hypotheses about risk factors for the developmental disabilities through case–control studies (Yeargin-Allsopp et al., 1992). Children were identified with one or more of five developmental disabilities: mental retardation (MR), cerebral palsy (CP), epilepsy (SZ), hearing loss (HL), or vision impairment (VI). The case definitions for each of the five conditions have been previously described. Cases were identified using a multiple source ascertainment method in which existing records from various sources were reviewed. The reported prevalence rates for each of the developmental disabilities from the MADDs are comparable to other population-based estimates (Yeargin-Allsopp et al., 1992). Within the MADDs a random sample of 10-year-old children without developmental disabilities was also chosen from the regular education rosters of the public school systems in the five-county study area to serve as a comparison group in the case–control studies. A total of 2258 children were identified by MADDs of which 1608 had at least one type of developmental disability and 650 did not have a developmental disability identified in childhood.

The MADDs-FU was designed to evaluate functioning and social participation in young adults with and without a history of developmental disabilities between ages 21 and 25 years. However, it did not evaluate changes in impairment status at ages 21–25 years. A stratified two-stage probability sample based on type of developmental disability, severity of mental retardation, and number of impairments in MADDs was used to establish the MADDs-FU cohort (Kim Van Naarden Braun, Marshalyn Yeargin-Allsopp, Donald Lollar, unpublished data [Activity Limitations among Young Adults with Developmental Disabilities: A Population-based Follow-up Study], August 2004). Data for the MADDs-FU were collected using a structured questionnaire administered in-person (27%) or over the telephone (73%) to study participants and/or their parents or legal guardians (proxy).

A total of 983 (44%) MADDs participants were targeted for the MADDs-FU, 635 young adults actually participated in the study (65%), 511 of whom had at least one developmental disability and 124 had no developmental disabilities (Kim Van Naarden Braun, Marshalyn Yeargin-Allsopp, Donald Lollar, unpublished data [Activity Limitations among Young Adults with Developmental Disabilities: A Population-based Follow-up Study], August 2004). Of the final MADDs-FU cohort, 24.1% ( $N = 153$ ) of the responses were by proxy only. Among those that answered by proxy, 32 (20.9%) had mild MR (IQ 50–70) with or without the presence of a coexisting impairment; 110 (71.9%) had severe MR (IQ < 50) with or without the presence of a coexisting impairment; 11 (7.2%) had either SZ, CP, HL and/or VI but no MR. For these analyses, we excluded all responses by proxy because information relating to lifestyle and behavior from the MADDs-FU questionnaire were missing for young adults who answered by proxy. In doing so, we excluded 78% of all young adults with severe MR (IQ < 50) with or without the presence of a coexisting impairment therefore, the young adults with a history of MR with or without the presence of a coexisting impairment in our final study population consisted of 132 (81%) young adults with mild MR (IQ 50–70) and 31 (19%) young adults with severe MR (IQ < 50). Thus, our final population consisted of 482 young adults of which 358 young adults had a history of developmental disabilities and 124 had no history of developmental disabilities. Information on race, presence, type and number of childhood impairments from the MADDs dataset were linked to the MADDs-FU dataset by a unique identifier, thus creating the final data set.

## *2.2. Leading Health Indicators*

We identified one or more interview questions from the MADDS-FU that addressed the following 7 of the 10 Leading Health Indicators: physical activity, overweight and obesity, tobacco use, substance abuse, responsible sexual behavior, injury and violence, and access to health care. Appendix A consists of a detailed description of the MADDS-FU questions that we selected to address these seven Leading Health Indicators.

## *2.3. Impairment*

Since impairment status was not reassessed at ages 21–25 years, impairment was determined based on the MADDS case definitions at age 10. We defined an isolated impairment as having a history of only one DD and multiple impairments as having a history of two or more coexisting impairments. Thus, for our analyses, impairment was defined as a history of isolated mental retardation; isolated cerebral palsy; isolated epilepsy; isolated hearing loss; isolated vision impairment; multiple developmental disabilities (Mult-DD); and no developmental disabilities (no DD). Because we were lacking measures of severity for DDs except for HL, VI, and MR, we used a history of multiple DDs as a crude measure of greater severity compared to a history of an isolated DD.

Of the 482 young adults in our final population, 128 (33%) had a history of isolated mental retardation, 18 (2%) had a history of isolated cerebral palsy, 126 (19%) had a history of isolated epilepsy, 34 (4%) had a history of isolated hearing loss, 7 (1%) had a history of isolated vision impairment, 45 (6%) had a history of multiple developmental disabilities and 124 (35%) had no history of developmental disabilities. Among the 45 young adults with a history of multiple developmental disabilities, 35 had MR and at least one other coexisting impairment (e.g. cerebral palsy and or epilepsy), 9 had cerebral palsy and epilepsy or vision impairment, and 1 had epilepsy and hearing loss.

The demographic characteristics of the study subjects are presented in [Table 1](#). The mean age of the MADDS-FU population was 23 years (range = 21–25 years). In comparison with young adults without a history of developmental disabilities, young adults with a history of developmental disabilities regardless of the type of DD had significantly fewer years of education – the majority only completing high school/GED. Other demographic differences were seen among individuals with a history of isolated MR who in comparison to young adults without a history of developmental disabilities had a higher proportion of men, Black young adults, and young adults receiving income-dependent services.

## *2.4. Social and demographic correlates of healthy lifestyle and behaviors*

For our analysis, we selected the following variables as confounders: age (21–22 years; 23–25 years—referent), gender (male; female—referent), race (Black; White—referent), education level attainment (did not complete high school; completed high school/GED only; post high school education—referent), and receipt of income-dependent services such as Women, Infants and Children Program (WIC), and/or Food Stamps (yes; no—referent). General Educational Development Test (GED) is a test that measures the academic skills and knowledge expected of high school graduates in the United States or

Table 1  
Demographic characteristics of young adults by type of impairment at age 10: MADDs-FU study

	Isolated MR (N = 128) %	Isolated CP (N = 18) %	Isolated SZ (N = 126) %	Isolated HI (N = 34) %	Isolated VI (N = 7) %	Multiple DD (N = 45) %	No DD (referent) (N = 124) %
<b>Age</b>							
Mean (years) <sup>a</sup>	23.4**	23.3*	23.7	23.8	22.9*	23.2*	23.9
<b>Gender</b>							
Male	60.3*	66.7	50.8	55.9	85.7*	55.6	45.2
Female (referent)	39.7	33.3	49.2	44.1	14.3	44.4	54.8
<b>Race</b>							
Black	67.2**	27.8	33.2	36.4	42.9	42.2	35.5
White (referent)	32.8	72.2	66.8	63.6	57.1	57.8	64.5
<b>Highest level of education</b>							
Did not complete high school	36.4**	5.6	12.0	11.8	14.3	15.6*	11.3
High school/GED only	59.7**	44.4	38.6*	47.1*	71.4*	73.3**	25.0
Post high school education (referent)	3.8	50.0	49.4	41.2	14.3	11.1	63.7
<b>Use of income-dependent services</b>							
Yes	21.7*	0**	13.6	17.7	14.3	15.6	12.1
No (referent)	78.3	100	86.4	82.4	85.7	84.4	87.9

Key: All proportions were weighted in order to represent the original sampling scheme. GED: General Educational Development Test; it is a test that measures the academic skills and knowledge expected of high school graduates in the United States or Canada.

<sup>a</sup> Used Student's *t*-test to compare the mean age of young adults with DD to young adults without DD.

\* Chi-square *p*-value <0.05.

\*\* Chi-square *p*-value <0.001.

Canada. Information for race was obtained from the MADDs, whereas all the other information was obtained from the MADDs-FU.

### *2.5. Analytical approach*

For our analyses, we wanted to address whether a history of developmental disabilities was associated with a lower prevalence of healthy behaviors in young adulthood compared to no history of developmental disabilities. Our main exposure variable was the presence or absence of impairment at age 10 (since impairment at follow-up was not reassessed), and the dependent variables were responses to the MADDs-FU questions representing the seven Leading Health Indicators. Univariate statistics (chi-square) were generated for each dependent variable stratified by type of impairment. Multivariate analyses was performed using logistic regression to measure the association between the Leading Health Indicators and type of impairment adjusting for age, gender, race, level of educational attainment, and use of income-dependent services. Data were analyzed using SUDAAN 8.0 statistical software to account for the multi-stage probability-sampling scheme in the MADDs-FU. Standard errors were calculated using the Taylor series linearization method to account for the unequal sampling fractions of the study design. All proportions reported were weighted in order to represent the original sampling scheme.

## **3. Results**

[Table 2](#) presents the distribution of participation in healthy lifestyle behaviors in young adulthood by type of impairment at age 10 and [Table 3](#) presents the results after multivariate adjustment for potential confounders. There were few differences between the univariate and multivariate analyses therefore the following discussion focuses on the results presented in [Table 3](#).

### *3.1. Physical activity and body mass index*

No difference was observed among young adults with and without a history of DD with respect to exercise or sports participation in the past 7 days or the prevalence of overweight/obese body mass index (BMI). However, young adults with a history of isolated CP and young adults with a history of multiple DD had an over 8-fold significantly increased risk of having a below normal BMI compared to their counterparts with no history of DD.

### *3.2. Tobacco use and substance abuse*

Fewer young adults with a history of DD reported themselves as current smokers compared to young adults without a history of DD; this difference was statistically significant except among young adults with a history of isolated epilepsy. Also, in general, fewer young adults with a history of DD reported one or more days of alcohol consumption in the last 4 weeks compared to young adults without a history of DD, and this was statistically significant except for young adults with a history of isolated CP.

Table 2  
Chi-square analyses of HP2010 Leading Health Indicators in young adults by type of impairment at age 10: MADDs-FU study

Leading Health Indicators	Isolated MR (N = 128) %	Isolated CP (N = 18) %	Isolated SZ (N = 126) %	Isolated HL (N = 34) %	Isolated VI (N = 7) %	Multiple DD (N = 45) %	No DD (referent) (N = 124) %
<b>Physical exercise</b>							
No exercise/sports in last 7 days	46.4*	27.8	36.7	35.3	28.6	26.7	29.0
<b>Overweight and obesity BMI (kg/m<sup>2</sup>)</b>							
Normal (referent)	44.2	52.9	42.4	48.5	42.9	50.0	49.2
Below normal	4.3	11.8	2.5	0	14.3	13.9*	2.5
Overweight/obese	51.5	35.3	55.1	51.5	42.9	36.1	48.4
<b>Tobacco use</b>							
Currently smoking some days/everyday	24.0	5.6**	29.4	14.7*	14.3	15.6*	31.7
<b>Substance abuse</b>							
Drank alcohol one or more days in the last 4 weeks	25.1**	44.4	51.0*	35.3**	71.4	17.8**	63.9
<b>Responsible sexual behavior</b>							
Not taught sex education in school/parents	84.4**	100	95.2	88.2*	85.7	75.6**	97.6
Not taught HIV/AIDS in school/parents	86.1*	83.3	92.0	94.1	85.7	65.9**	93.5
One or more sex partners in last 6 months	58.0**	27.8**	71.1	48.5**	50.0	26.7**	79.3
Of those who had ≥1 sex partners, never/occasionally use protection against disease/pregnancy	27.1	20.0	28.4	73.3*	33.3	16.7	35.4
Ever made/been pregnant	41.0	11.1*	37.1	44.1	42.9	11.1**	40.2
<b>Injury and violence</b>							
Ever been arrested	30.3*	5.9	19.4	26.5	42.9	11.1	17.2
Ever been robbed in the past 12 months	18.7	5.6	13.0	11.8	42.9	8.9	18.7
Ever been attacked/beaten in the past 12 months	7.3*	0	5.6*	2.9	0	4.4	1.6

Table 2 (Continued)

Leading Health Indicators	Isolated MR (N = 128) %	Isolated CP (N = 18) %	Isolated SZ (N = 126) %	Isolated HL (N = 34) %	Isolated VI (N = 7) %	Multiple DD (N = 45) %	No DD (referent) (N = 124) %
Access to health care							
Never had a pelvic exam/pap smear	23.4*	33.3	14.4	13.3	0	40.0*	7.4
Of those that have ever had a pelvic exam/pap smear, have you had one in past 12 months (No)	21.6	50.0	11.4	7.7	0	41.7*	11.1
Any visit to a doctors in past 12 months (No)	51.7**	33.3	24.7	47.1*	71.4*	29.6	26.8
Visit dentist less than once per year	68.5**	33.3	46.9	52.9	40.0	48.8	41.0
Visit dentist only for problems	66.6**	27.8	45.1	47.1	40.0	44.4	36.6
Rate Your health in general							
Fair/poor	19.1*	16.7	18.5*	8.8	0*	20.0*	8.1

Key: All proportions were weighted in order to represent the original sampling scheme.

\* Chi-square  $p$ -value <0.05.

\*\* Chi-square  $p$ -value <0.001.



Table 3  
 Logistic regression of HP2010 Leading Health Indicators in young adults by type of impairment at age 10: MADDs-FU study

Leading Health Indicators	Isolated MR adjusted odds ratio* (95% CI)	Isolated CP adjusted odds ratio* (95% CI)	Isolated SZ adjusted odds ratio* (95% CI)	Isolated HL adjusted odds ratio* (95% CI)	Multiple DD adjusted odds ratio* (95% CI)
Physical exercise					
No exercise/sports in last 7 days	1.36 (0.77–2.41)	0.87 (0.31–2.47)	1.34 (0.84–2.14)	1.21 (0.62–2.39)	0.63 (0.30–1.34)
Overweight and obesity BMI (kg/m <sup>2</sup> )					
Below normal	4.03 (0.61–26.41)	<b>13.22 (1.49–117.54)</b>	1.83 (0.44–7.53)	–	<b>7.78 (1.18–51.27)</b>
Overweight/obese	0.97 (0.54–1.73)	0.73 (0.27–2.00)	1.37 (0.87–2.17)	1.03 (0.51–2.06)	0.62 (0.27–1.44)
Tobacco use					
Currently smoking some days/everyday	<b>0.41 (0.22–0.78)</b>	<b>0.11 (0.02–0.75)</b>	0.79 (0.47–1.32)	<b>0.22 (0.08–0.62)</b>	<b>0.28 (0.12–0.66)</b>
Substance abuse					
Drank alcohol one or more days in the last 4 weeks	<b>0.28 (0.15–0.50)</b>	0.44 (0.17–1.11)	0.65 (0.41–1.04)	<b>0.33 (0.16–0.68)</b>	<b>0.19 (0.08–0.42)</b>
Responsible sexual behavior					
Not taught sex education in school/parents	<b>5.77 (2.15–15.49)</b>	–	1.84 (0.59–5.73)	3.43 (0.87–13.51)	<b>9.85 (3.52–27.58)</b>
Not taught HIV/AIDS in school/parents	1.71 (0.71–4.10)	2.13 (0.57–7.90)	1.07 (0.46–2.51)	0.65 (0.17–2.48)	<b>4.83 (1.93–12.11)</b>
One or more sex partners in last 6 months	<b>0.27 (0.14–0.52)</b>	<b>0.12 (0.04–0.33)</b>	0.67 (0.39–1.14)	<b>0.24 (0.11–0.51)</b>	<b>0.09 (0.04–0.20)</b>
Of those who had ≥ one sex partners how often use protection for sex against disease/pregnancy	<b>0.31 (0.13–0.69)</b>	0.47 (0.07–3.04)	<b>0.52 (0.29–0.93)</b>	<b>3.70 (1.16–11.79)</b>	<b>0.18 (0.04–0.85)</b>
Never/Occasionally					
Ever made/been pregnant	<b>0.23 (0.12–0.46)</b>	<b>0.22 (0.06–0.86)</b>	0.73 (0.43–1.25)	0.89 (0.40–1.95)	<b>0.03 (0.01–0.09)</b>
Injury and violence					
Ever been arrested	0.76 (0.39–1.47)	<b>0.18 (0.04–0.90)</b>	0.90 (0.49–1.64)	1.07 (0.43–2.68)	<b>0.28 (0.09–0.82)</b>
Ever been robbed in the past 12 months	0.58 (0.29–1.17)	0.19 (0.03–1.34)	0.57 (0.31–1.05)	0.50 (0.19–1.29)	<b>0.28 (0.09–0.86)</b>
Ever been attacked/beaten in the past 12 months	<b>7.15 (1.62–31.55)</b>	–	<b>4.16 (1.06–16.28)</b>	2.19 (0.24–20.43)	4.06 (0.70–23.43)
Access to health care					
Never had a pelvic exam/pap smear	<b>8.57 (2.30–32.01)</b>	4.98 (1.00–24.81)	2.16 (0.78–5.98)	2.32 (0.46–11.75)	<b>7.41 (1.93–28.43)</b>
Of those that have ever had a pelvic exam/pap smear, have you had one in past 12 months (No)	1.86 (0.53–6.51)	<b>10.15 (1.41–73.00)</b>	1.21 (0.45–3.22)	0.76 (0.11–5.20)	<b>5.87 (1.50–22.89)</b>

Table 3 (Continued)

Leading Health Indicators	Isolated MR adjusted odds ratio* (95% CI)	Isolated CP adjusted odds ratio* (95% CI)	Isolated SZ adjusted odds ratio* (95% CI)	Isolated HL adjusted odds ratio* (95% CI)	Multiple DD adjusted odds ratio* (95% CI)
Any visit to a doctors in past 12 months (No)	1.43 (0.77–2.63)	1.06 (0.39–2.87)	0.78 (0.45–1.35)	<b>2.47 (1.15–5.30)</b>	0.73 (0.32–1.68)
Visit dentist less than once per year	1.39 (0.76–2.55)	0.69 (0.25–1.97)	1.22 (0.75–1.97)	1.52 (0.74–3.12)	0.97 (0.47–2.02)
Visit dentist only for problems	1.40 (0.77–2.53)	0.64 (0.22–1.88)	1.42 (0.87–2.30)	1.28 (0.62–2.67)	0.85 (0.43–1.69)
Rate Your health in general					
Fair/poor	2.00 (0.84–4.75)	2.69 (0.74–9.85)	<b>2.57 (1.25–5.29)</b>	0.98 (0.32–3.05)	2.24 (0.84–5.99)

Bold data indicate significant adjusted odds ratio (95% CI).

\* Adjusted for race, gender, income-dependent services, and level of education.

### *3.3. Responsible sexual behavior*

Young adults with a history of isolated MR, and young adults with a history of multiple DD had a 6-fold and a 10-fold significant increased risk, respectively, for not receiving sex education in school/by parents compared with young adults without a history of DD. Young adults with a history of multiple DD also had a significant 5-fold increased risk for not being taught about HIV/AIDS in school/by parents.

However, overall, young adults with a history of DD were less likely to be sexually active in the past 6 months compared to young adults without a history of DD; this difference was significant except among young adults with a history of isolated epilepsy. Furthermore, among those that had at least one sex partner in the past 6 months, fewer young adults with a history of DD reported never/occasionally using protection against diseases or pregnancy (with the exception of young adults with a history of isolated HL). Also, in general, fewer young adults with a history of DD had ever made or been pregnant; this was significant except among young adults with a history of isolated epilepsy or a history of isolated HL.

### *3.4. Injury and violence*

In general, few young adults with a history of DD were involved in the injury and violence Leading Health Indicator activities. The exception, however, was among young adults with a history of isolated MR and young adults with a history of isolated epilepsy who had a significant 7-fold and 4-fold increased risk, respectively, for having been attacked or beaten in the past 12 months.

### *3.5. Access to health care*

With respect to access to health care, young women with a history of isolated MR or with a history of multiple DD had a significant 9-fold and 7-fold increased risk, respectively, for never having a Pap smear/pelvic exam. Of those that ever had a Pap smear/pelvic exam, young women with a history of isolated CP or with a history of multiple DD had a significant 10-fold and 9-fold increased risk, respectively, for not having one in the past 12 months.

No differences were observed for frequency of doctor or dentist visits among young adults with a history of DD except among young adults with a history of isolated HL who had a significant 2-fold increased risk for not visiting a doctor in the past 12 months. Finally, when asked to rate their health in general, only young adults with a history of isolated epilepsy were more likely to rate their health as fair or poor.

## **4. Discussion**

Our results show that in many respects, young adults with a history of DDs were less likely to be involved in risk behaviors such as tobacco use, substance abuse and sexual activity than young adults without a history of DD. However, health areas of concern

among young adults with a history of DD included below normal BMI, lack of receipt of HIV/AIDS and sex education, victimization, and lack of preventive health care services for women with a history of DD. There was some variability in participation of healthy behaviors by type of impairment. Overall, young adults with a history of multiple DDs consistently differed from young adults without DD both in terms of being less likely to participate in risk behaviors (such as tobacco use or substance abuse or irresponsible sexual behavior), but were more likely to be at risk for lack of preventive measures (e.g. receipt of HIV/AIDS and sex education or preventive health care services for women). In contrast, young adults with a history of isolated epilepsy were consistently most similar to young adults without a history of DDs.

We found no differences between young adults with and without a history of developmental disabilities in regards to physical activity. In contrast, prior studies have reported that individuals with MR are more likely to lead sedentary lifestyles, have poor muscular fitness and muscular strength and individuals with CP have a lower work capacity, energy expenditure and are less active than their counterparts in the general population (Bandini, Schoeller, Fukagawa, Wykes, & Dietz, 1991; Bell & Bhate, 1992; Pitetti, Rimmer, & Fernahll, 1993; Rimmer, Braddock, & Fujiura, 1993; Stallings, Cronk, Zemel, & Charney, 1995; Stallings, Zemel, Davies, Cronk, & Charney, 1996; Suzuki et al., 1991; Van den Berg-Emons et al., 1995; Van den Berg-Emons, Van Baak, Speth, & Saris, 1998). In our study we were only able to evaluate physical activity from one MADDs-FU question that did not provide information on habitual physical activity and this may partly explain why we found no differences in this Leading Health Indicator between young adults with and without a history of developmental disabilities.

Although several studies have reported a high prevalence of overweight and obesity among adults with MR, our results did not support this association (Bell & Bhate, 1992; Horwitz, Kerker, Owens, & Zigler, 2000; Rimmer et al., 1993; Suzuki et al., 1991). Rimmer et al. (1993) specifically found these results among adults with severe MR. When we stratified by severity of MR, we also found a high proportion of obesity among young adults with severe MR. Since the majority of young adults with severe MR answered the MADDs-FU interview by proxy they were excluded from our analyses. Exclusion of these individuals may explain our finding. We did observe that significantly more young adults with a history of isolated CP or multiple DD had a below normal BMI. Previous work on the MADDs FU cohort has shown that there is a dose–response relationship between severity of DDs and severity of functional limitations, measured by limitations in activities of daily living (ADLs, e.g. bathing, dressing) and instrumental activities of daily living (IADLs, e.g. paying bill, shopping). The limitations in ADLs often represent problems with mobility and limitations in IADLs are representative of motor and cognitive difficulties. This dose–response relationship showed that approximately 71–98% of young adults with a history of multiple DDs and 41% of young adults with a history of CP experienced limitations in functioning (Kim Van Naarden Braun, Marshalyn Yeargin-Allsopp, Donald Lollar, unpublished data [Activity Limitations among Young Adults with Developmental Disabilities: A Population-based Follow-up Study], August 2004). Therefore, our findings that young adults with a history of CP or multiple DDs were significantly different from young adults without a history of DD in terms of having low BMI may be due, wholly or in part, to their functional limitations.

We found that young adults with a history of developmental disabilities were less likely to smoke or drink alcohol compared to their counterparts without a history of developmental disabilities. Similar findings have been reported by Britto et al. (1998) in a population-based study of chronically ill teens and by Hymowitz, Jaffe, Gupta, and Feuerman (1997) in a hospital-based study of adults with MR. These findings could partly be a result of the young adults with a history of DDs being less exposed to social situations that could potentially influence negative behaviors.

In general, young adults with DDs in our study lacked sex and HIV/AIDS education. This lack of education on responsible sexual behavior reinforces the need, expressed in qualitative studies on sexuality issues among individuals with DDs, for families and health care providers to increase sex and HIV/AIDS awareness among individuals with DDs (Brown & Jemmott, 2002; Committee on Children with Disabilities, 1996; Stinson, Christian, & Dotson, 2002; Sulpizi, 1996; Zajicek-Farber, 1998). These findings are similar to studies with teens or young adults with disabilities (e.g. cystic fibrosis and/or CP) in which few disabled individuals reported ever being sexually active, and among those that were, few reported risky sexual behaviors (e.g. having three or more life partners and no condom use) which is comparable to findings in this study (Britto et al., 1998; Kokkonen et al., 1991). Like the findings on tobacco and alcohol use, these findings could partly be a result of a lack of exposure to social situations that could potentially influence negative behaviors among these young adults.

We found that young adults with a history of isolated MR or epilepsy were more likely to have been attacked or beaten in the past 12 months (victimized) than young adults without a history of DD. No other studies have reported similar findings and future studies are needed to confirm it. This finding could partly be a result of a lack of adequate education on self-awareness in different surroundings, and/or safety precautions to prevent victimization, as these individuals became more independent within the community. If confirmed, future studies should determine why these young adults are being victimized and suggest ways to prevent further victimization.

Finally, comparable to our findings, it has been previously reported that women with mobility difficulties were significantly less likely to receive preventive services such as Pap smear and mammograms than women without impairments (Iezzoni, McCarthy, David, Harris-David, & O'Day, 2001). It has been argued that this could be due to inadequate access to these health care services, and/or the false assumption by caretakers and/or healthcare providers that these young women are less likely to be sexually active hence do not require these services (Committee on Children with Developmental Disabilities, 1996; Stinson et al., 2002; Sulpizi, 1996; Zajicek-Farber, 1998).

This study had a few limitations. While our results were based on self-reported data, the validity of the data is reflected in the fact that young adults without a history of DDs in our study reported similar proportions of overweight and obesity, tobacco use, substance abuse, and use of health care services for women as reported in other population-based studies of unimpaired adults (Behavioral Risk Factor Surveillance System Survey Data, 2003; Ford, Moriarty, Zack, Mokdad, & Chapman, 2001; Healthy People, 2010, 2000). However, the results for the young adults who were unable to self-report and were excluded from our study (most of whom had severe MR) may be different from what was described here. It is important to note that, strictly speaking, our results do not reflect a population-based cohort

of young adults with impairments since impairment was not re-evaluated at follow-up. Rather the longitudinal design of this study enabled us to assess outcomes of lifestyles and behaviors of young adults with impairment identified in childhood. In a study evaluating whether activity limitations in young adulthood are a consequence of childhood impairment using the MADDSS-FU, Van Naarden Braun et al. found that for young adults with isolated impairment (especially isolated epilepsy) activity limitations were not probable outcomes whereas young adults with severe MR and/or multiple impairments experienced activity limitations (Kim Van Naarden Braun, Marshalyn Yeargin-Allsopp, Donald Lollar, unpublished data [Activity Limitations among Young Adults with Developmental Disabilities: A Population-based Follow-up Study], August 2004). Previous studies that looked at behaviors and lifestyles among persons with disabilities had varying definitions of impairment making comparisons across type of impairment, and to our findings difficult. However, in defining impairment as we did, and using a global measure of severity, we were able to compare behaviors and lifestyles across impairment and potentially provide an impetus for further research. Finally, the MADDSS-FU study was designed to assess overall functioning and social participation in young adults with and without a history of developmental disabilities and not specifically for the HP2010 Leading Health Indicators. Thus, for some Leading Health Indicators such as physical activity we did not have enough information to fully assess the Leading Health Indicator.

This is one of the few population-based studies on the consequences of developmental disabilities in young adulthood and fills a research gap in the field that has primarily focused on identification of risk factors and etiologies. In evaluating the consequences of developmental disabilities in young adulthood we think that it is important to make the distinction between the underlying impairment and the consequent functional limitations that may result from impairment. Negative healthy behaviors in adulthood may not be due to the underlying impairment, but rather to limitations in daily functioning. Making the distinction between impairment and functioning enables us to identify groups of individuals with specific types of impairment that are at high risk of unhealthy behaviors as well as hypothesize whether functional limitations play a role in our results.

We used the HP2010 Leading Health Indicators as a public health tool to assess healthy behaviors and lifestyles in young adults with and without a history of DD by type of DD. In doing so, we were able to identify possible behavior and lifestyle risks in young adults with and without a history of DD that could be modified using targeted behavioral intervention programs (such as increasing access to preventive health care services for women, and preventing victimization). This is important because as young adults with DDs integrate into the community and become more exposed to social situations that may influence negative behaviors, adequate education and support from caretakers and/or health care providers could potentially prevent unhealthy behaviors and lifestyles.

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**Appendix A. MADDs-FU interview questions used to evaluate 7 HP2010 Leading Health Indicators**

Leading Health Indicator	Question from MADDs-FU	MADDs-FU responses	Analysis variable	Analysis response category
Physical activity	On how many of the last 7 days did you happen to participate in sports activities?	# of days	Exercise/sports in last 7 days	No = 0 days, Yes = 1 + days
Overweight and obesity	How tall are you? About how much do you weigh?	Height in feet and inches; weight in pounds	Body mass index calculated using HP2010 BMI formula: (BMI = [weight (lbs)/ height (inches) 2] *704.5)	Below normal BMI <18.5 Kg/m <sup>2</sup> ; normal BMI 18.5–24.9 Kg/m <sup>2</sup> ; overweight/obese BMI ≥ 25 Kg/m <sup>2</sup>
Tobacco use	Do you now smoke cigarettes everyday, some days, or not at all?	Everyday; some days; or not at all?	Currently smoking	No = not at all; Yes = some days/everyday
Substance abuse	On how many days of the last 4 weeks did you drink any alcoholic beverages	Everyday; # of days; not at all	No. of days drank alcohol in the last 4 weeks	0 days; 1 + days
Responsible sexual behavior	Were you ever taught sex education when you were in school?	Yes; no	Taught sex education in school or by parents	Yes; no
	Have you ever talked about sex education with your parents or other adults in your family?	Yes; no		
	Were you ever taught about HIV/AIDS when you were in school?	Yes; no	Taught HIV/AIDS in school or by parents	Yes; no
	Have you ever talked about HIV/AIDS with your parents or other adults in your family?	Yes; no		
	During the past 6 months, how many different people have you had sex with?	Number; none	No. of sex partners in last 6 months	0 partners; 1 + partners
	Of those who had ≥ one sex partners, how often did you or your partner use protection so you would not get a disease?	Never; occasionally; always	Of those who had ≥ one sex partners how often use protection for sex against disease or pregnancy?	Always; occasionally/ never

**Appendix A** (Continued)

Leading Health Indicator	Question from MADDs-FU	MADDs-FU responses	Analysis variable	Analysis response category
	How often did you or your partner use protection to keep from getting pregnant?	Never, occasionally, always		
	For males—how many times have you made someone pregnant?	Yes; no	Ever made/ been pregnant	Yes; no
	For females—how many times have you been pregnant	Yes; no		
Injury and violence	In the past how many times were you arrested or picked by the police for any reason?	Never; once; twice; three or more times	Ever been arrested	Yes = once, twice, three or more times; No = never
	In the past 12 months were any of your belongings or money stolen?	Yes; no	In the past 12 months were any of your belongings or money stolen?	Yes; no
	In the past 12 months were you ever beaten up or attacked?	Yes; no	In the past 12 months were you ever beaten up or attacked?	Yes; no
Access to health care	Have you had a pelvic exam or PAP smear?	Yes; no	Have you had a pelvic exam or PAP smear?	Yes; no
	Of those that have ever had a pelvic exam or pap smear, have you had one in past 12 months?	Yes; no	Of those that have ever had a pelvic exam or pap smear, have you had one in past 12 months?	Yes; no
	Have you had any visit to a doctor in the past 12 months?	Yes; no	Have you had any visit to a doctor in the past 12 months?	Yes; no
	How often do you visit a dentist per year?	Less than once/year, once/year, twice/year, more than 2 times/year	How often do you visit a dentist per year?	Less than once/year, Once or more/year
	Do you visit a dentist only for problems?	Yes; no	Do you visit a dentist only for problems?	Yes; no



**Appendix A** (Continued)

Leading Health Indicator	Question from MADDs-FU	MADDs-FU responses	Analysis variable	Analysis response category
Other analytical variables				
Health in general	Would you say your health in general is	Excellent; good; fair or poor	Rate health in general	Excellent/good; fair/poor

**Disclaimer**

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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