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Prevalence of epilepsy and health status of adults with epilepsy in Georgia and Tennessee: Behavioral Risk Factor Surveillance System, 2002

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Abstract

Behavioral risk factors associated with comorbidity in people with epilepsy are largely unknown. We studied a population-based sample of 8057 adults through the 2002 Behavioral Risk Factor Surveillance System, in Georgia and Tennessee, ascertaining a lifetime epilepsy prevalence of 2.1% in this population. This structured interview revealed that those with epilepsy had significantly worse self-reported fair or poor health status (39% vs 17% in adults without epilepsy), significantly greater cigarette smoking (38.8% vs 24.9% in other adults), and high rates of obesity (34.1% vs 23.7% in adults without epilepsy). Large percentages of adults with epilepsy reported currently symptomatic asthma and recent joint pain. Adults with epilepsy had lower educational attainment and lower household incomes, but a higher rate of medical insurance coverage, than did other adults. This type of population-based survey can serve to identify health disparities, behavioral risk factors for other chronic diseases, and unmet health care needs in individuals with epilepsy, and to track changes in these measures over time.
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Keywords: Epilepsy; Seizure; Comorbidity; Health outcomes; Obesity; Smoking

1. Introduction

A broad array of health promotion activities are relevant to all people experiencing a disabling condition, such as major depression, cerebral palsy, diabetes, or epilepsy. Yet there are few health promotion and disease prevention activities designed for individuals with such conditions [1,2]. Nonetheless, people with chronic disorders such as epilepsy can benefit from the gains associated with a healthful lifestyle, as do individuals with other chronic disorders [2]. No state-based population studies have assessed behavioral risk factors associated with secondary conditions in a representative sample of U.S. adults with epilepsy. The purpose of this study was to assess the prevalence of epilepsy in a population-based sample and to examine behavioral risk factors and comorbidities in adults with epilepsy, to assess their health status and need for preventive behaviors that might improve health outcomes and reduce their risk for secondary chronic conditions.

2. Methods

In 2002, Georgia and Tennessee included one or more questions about epilepsy on their Behavioral Risk

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Factor Surveillance System (BRFSS). The BRFSS is an ongoing, state-based, random-digit-dialed telephone survey of the noninstitutionalized population in the United States aged 18 years and older designed to assess chronic disease burden and monitor health risks of the U.S. population [3]. BRFSS data are weighted to reflect the age, sex, and racial and ethnic distribution of the estimated population of each state during the survey year. The standard survey used in all states includes questions on key health and safety-related behaviors and demographic characteristics [3]. States can add questions on their BRFSS to cover topics not addressed by the standard core questions or optional modules. Four epilepsy items similar in style to existing BRFSS questions were developed by content experts at CDC for inclusion as state-added BRFSS questions (Table 1). Prior to inclusion on the BRFSS, the wording of all questions was reviewed by people with epilepsy to identify any epilepsy items that were unclear. Three of four available epilepsy questions were included on the 2002 Georgia BRFSS and one item was included on the 2002 Tennessee BRFSS (Table 1).

Table 1
Epilepsy questions included on the Georgia and Tennessee Behavioral Risk Factor Surveillance System Survey (BRFSS), 2002

1. Have you ever been told by a doctor that you have a seizure disorder or epilepsy?[a,b]
   1. Yes
   2. No
   7. Don't know/Not sure
   9. Refused

2. How many seizures of any type have you had in the last 3 months?[a]
   1. None
   2. One
   3. More than one
   4. No longer have epilepsy or seizure disorder
   7. Don't know/not sure
   9. Refused

3. During the past month, to what extent has epilepsy or its treatment interfered with your normal activities like working, school, or socializing with family or friends?[a]
   1. Not at all
   2. Slightly
   3. Moderately
   4. Quite a bit
   5. Extremely
   7. Don't know/not sure
   9. Refused

4. Are you currently taking any medicine to control your seizure disorder or epilepsy?[c]
   1. Yes
   2. No
   7. Don't know/not sure
   9. Refused

[a] Question included in the 2002 Georgia BRFSS.
[b] Question included in the 2002 Tennessee BRFSS.
[c] Question developed for use in BRFSS by CDC Epilepsy Program, but not used in Georgia or Tennessee due to local funding constraints.

Adults with epilepsy were defined as those who responded "yes" to the question, "Have you ever been told by a doctor that you have a seizure disorder or epilepsy?" All analyses were performed with SUDAAN statistical software to account for the complex survey design (Research Triangle Institute, 2001). Significant differences were noted by comparing overlap in 95% confidence intervals. We analyzed prevalence estimates for each state and examined the demographic distribution of respondents with epilepsy in each state. The sample with epilepsy from Georgia and Tennessee did not differ with respect to demographic characteristics or self-rated health status. Thus, to increase the sample size and reliability of our estimates, subsequent analyses on behavioral and demographic risk variables focused on the combined sample.

All BRFSS items used in this study are available on the CDC BRFSS web site: http://www.cdc.gov/brfss [3]. Several definitions, however, follow: BRFSS examines access to health care with the following questions, "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?" "Was there a time in the past 12 months when you needed medical care, but could not get it?" Persons were considered physically active if they answered "yes" to the question, "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" Respondents were considered to be current smokers if they reported smoking at least 100 cigarettes in their lifetime and were currently smoking. Body mass index (BMI), a measure of weight in proportion to height, was calculated from self-reported weight and height using the formula weight in kilograms divided by height in meters squared (kg/m^2). BMI was defined using the following standardized categories: neither overweight nor obese ($BMI < 25$); overweight ($25 \leqslant BMI < 30$); obese ($BMI \geqslant 30$) [4]. Women with gestational diabetes were excluded from analysis of diabetes prevalence; women who had a hysterectomy were excluded from the analysis of the question assessing recent Pap test. Questions on arthritis, joint pain and cholesterol were included only in the Tennessee BRFSS.

3. Results

3.1. Epilepsy prevalence

In Georgia, 88 (1.7%, 95% CI = 1.3–2.2) of 4914 respondents reported having epilepsy (weighted estimate = 105,157 adults) (Table 2). In Tennessee, 73 (2.6%, 95% CI = 1.8–3.4) of 3143 respondents reported having epilepsy (weighted estimate = 112,395 adults). The combined lifetime prevalence estimate of 161 adults

Table 2
Prevalence of epilepsy by sex, age, and race\ethnicity: Georgia and Tennessee Behavioral Risk Factor Surveillance System, 2002

Variable	n	% (95% CI)
Lifetime prevalence		
Georgia	88	1.7 (1.3–2.2)
Tennessee	73	2.6 (1.8–3.4)
Georgia and Tennessee	161	2.1 (1.7–2.5)
Sex		
Male	61	1.8 (1.3–2.3)
Female	100	2.3 (1.7–3.0)
Age		
18–34	41	1.8 (1.0–2.5)
35–44	38	2.5 (1.6–3.4)
45–64	67	2.7 (1.9–3.4)
65+	13	1.0 (0.4–1.6)
Race/ethnicity		
Non-Hispanic white	119	2.1 (1.7–2.6)
Nonwhite or Hispanic	41	2.0 (1.3–2.8)

with epilepsy out of 8057 respondents in Georgia and Tennessee was 2.1% (95% CI = 1.7–2.5). The prevalence of epilepsy differed significantly by age, with those 45–64 years old being more likely to report having epilepsy than those aged ⩾65 years. We found no significant differences in prevalence by sex and race or ethnicity (Table 2). In the follow-up question designed to measure seizure frequency, 10 respondents (14%) in Georgia stated that they no longer had epilepsy or seizure disorder. Removing these 10 individuals from the lifetime prevalence estimate provided us with a point prevalence estimate of epilepsy among adults in Georgia of 1.6% (95% CI = 1.1–2.0).

3.2. Seizure frequency

The majority of adults with epilepsy (62.8%, 95% CI = 49.6–76.0) in Georgia reported having had no seizures in the past 3 months. However, 18.1% (95% CI = 7.5–28.5) reported having had at least one or more seizures in the past 3 months. About 6% (95% CI = 0.6–10.5) of adults with epilepsy reported that they did not know how many seizures they had in the past 3 months.

3.3. Demographic characteristics

As shown in Table 3, significantly fewer (41%) adults with epilepsy completed some college or were college graduates, compared with about 53% of those without epilepsy. About half of adults with epilepsy were currently employed, but significantly more (31%) of those with epilepsy were unemployed or unable to work, compared with almost 11% of people without epilepsy who were unemployed or unable to work. Significantly more (44%) adults with epilepsy had household annual incomes ⩽$24,999, than those without epilepsy. However, at least 21% of those with epilepsy reported incomes ⩾$50,000/year. Adults with epilepsy did not differ from those without epilepsy with respect to marital status.

Adults with epilepsy were significantly more likely to have health care coverage than people without epilepsy, but at least 1 in 10 (13%) had been unable to obtain health care during the last 12 months.

3.4. Behavioral risk factors

Thirty-nine percent of adults with epilepsy reported fair or poor health, compared with 17% of the general population. A significantly larger percentage of adults with epilepsy smoked cigarettes (38.8%) than those without epilepsy (24.9%) (Table 3). Adults with epilepsy were less likely to report exercising during the past month. While fewer adults with epilepsy were likely to report drinking any alcoholic beverages in the past 30 days than those without epilepsy, about one-third of adults with epilepsy did report drinking alcoholic beverages in the past 30 days.

A larger percentage of adults with epilepsy were obese (34.1%) compared with those without epilepsy (23.7%), but this difference was of borderline significance. Adults with epilepsy did not differ from people without epilepsy in their intake of daily servings of fruit and vegetables—both groups consumed less than the recommended level of five or more servings of fruit and vegetables. About half of adults with epilepsy reported taking vitamin pills or supplements. More than one-third of adults with epilepsy had not seen a dentist in the past year. More than half of adults with epilepsy aged ⩾50 years reported having received a flu shot in the last 12 months, similar to those without the disorder. More than half of adults with epilepsy (66%) reported having been tested for HIV other than for blood donation, whereas only half of those without epilepsy had ever been tested. About 1 in 10 adults with epilepsy reported living in a home with a loaded and unlocked firearm.

3.5. Comorbid conditions and screening tests

Adults with epilepsy were as likely as adults without epilepsy to report having diabetes or having arthritis, and joint pain or swelling in the last 30 days. Significantly more adults with epilepsy, however, reported having current asthma. About one-third of adults with epilepsy and those without reported having had high blood cholesterol.

More than half of respondents with and without epilepsy aged 50 and older have never had a sigmoidoscopy or colonoscopy. More than one-third of women with epilepsy aged 40 years and older had not had a mammogram within the past 2 years. The majority of women with epilepsy reported having had a Pap test within the past 3 years.

Table 3
Characteristics of persons with and without epilepsy by demographic and behavioral risk categories: Georgia and Tennessee Behavioral Risk Factor Surveillance System, 2002

Variable	Epilepsy	
	Yes % (*n*) [95% CI]	No % (*n*) [95% CI]
Education		
Less than high school	21.5 (34) [13.5–29.4]	13.8 (1149) [12.8–14.8]
High school graduate	37.4 (60) [28.1–46.7]	32.9 (2541) [31.6–34.2]
Some college or college graduate	41.1 (67) [31.1–51.1]	53.2 (4188) [51.8–54.6]
Employment		
Currently employed	49.5 (76) [39.6–59.4]	63.1 (4759) [61.7–64.5]
Unemployed or unable to work	31.0 (52) [22.0–40.0]	10.8 (828) [9.9–11.7]
Other (student/retired/hmkr)	19.5 (31) [10.0–29.1]	26.0 (2296) [24.8–27.3]
Income		
⩽$24,999	44.5 (64) [34.7–54.3]	30.0 (2186) [28.5–31.5]
$25,000–$49,999	34.4 (47) [25.3–43.6]	34.7 (2298) [33.2–36.1]
⩾$50,000	21.1 (26) [12.9–29.3]	35.3 (2173) [33.9–36.8]
Marital status		
Married or member of unmarried couple	52.6 (77) [42.7–62.6]	61.4 (4311) [60.0–62.8]
Not married	47.4 (84) [37.4–57.3]	38.6 (3574) [37.2–40.0]
Have health care coverage		
Yes	92.0 (143) [88.1–96.0]	85.5 (6880) [84.4–86.6]
No	7.9 (18) [4.0–11.9]	14.5 (1000) [13.4–15.6]
Unable to get health care during last 12 months		
Yes	12.7 (22) [6.8–18.5]	6.5 (491) [5.8–7.2]
No	87.3 (139) [81.5–93.1]	93.5 (7389) [92.8–94.2]
Self-rated health status		
Good, very good, or excellent	61.0 (89) [51.6–70.3]	83.0 (6374) [82.0–83.9]
Fair or poor	39.0 (72) [29.7–48.4]	17.0 (1497) [16.0–17.9]
Cigarette smoking status		
Current smoker	38.8 (58) [29.2–48.3]	24.9 (1794) [23.7–26.2]
Former smoker	16.6 (30) [10.0–23.2]	21.0 (1755) [19.9–22.1]
Never smoked	44.6 (72) [34.6–54.6]	54.1 (4309) [52.6–55.8]
Any exercise during past month		
Yes	60.0 (85) [50.8–69.3]	71.4 (5534) [70.1–72.7]
No	39.9 (76) [30.7–49.2]	28.6 (2352) [27.3–29.8]
Drink any alcoholic beverages in past 30 days		
Yes	30.3 (45) [20.3–40.3]	42.0 (3060) [40.6–43.4]
No	69.6 (114) [59.6–79.6]	58.0 (4768) [56.6–59.4]
Body mass index[a]		
Neither overweight nor obese	34.2 (51) [24.0–44.3]	40.0 (3037) [38.7–41.4]
Overweight	31.7 (50) [22.9–40.5]	36.2 (2702) [34.9–37.6]
Obese	34.1 (57) [24.9–43.3]	23.7 (1831) [22.5–24.9]
Daily servings of fruit and vegetables		
Less than 5 per day	77.4 (124) [69.8–85.1]	75.1 (5855) [73.9–76.3]
5 or more per day	22.5 (37) [14.9–30.2]	24.9 (2037) [23.7–26.1]
Currently take vitamin pills or supplements		
Yes	49.9 (78) [40.0–59.8]	51.1 (4272) [49.6–52.5]
No	50.1 (83) [40.2–59.9]	48.9 (3598) [47.5–50.4]
Last dentist visit		
Within past year	64.5 (93) [55.5–73.5]	67.9 (5247) [66.6–69.2]
2 or more years ago	35.5 (62) [26.5–44.5]	32.1 (2508) [30.8–33.4]
Had flu shot in last 12 months, ⩾50 years?		
Yes	53.6 (30) [37.7–69.5]	48.7 (1695) [46.7–50.7]
No	46.4 (31) [30.5–62.3]	51.2 (1674) [49.2–53.2]
Ever tested for HIV?		
Yes	66.0 (90) [56.7–75.2]	50.0 (3041) [48.4–51.6]
No	34.0 (55) [24.8–43.3]	50.0 (3123) [48.4–51.6]
Living in home with loaded and unlocked firearm		
Yes	9.8 (15) [4.1–15.6]	7.1 (589) [6.4–7.7]
No	90.2 (144) [84.4–95.9]	92.9 (6937) [92.2–93.6]
Ever told have arthritis[b]		
Yes	38.4 (31) [24.8–52.0]	29.2 (976) [27.4–31.0]
No	61.6 (42) [50.3–72.9]	71.0 (2083) [69.0–72.6]

Table 3 (*continued*)

Variable	Epilepsy	
	Yes % (*n*) [95% CI]	No % (*n*) [95% CI]
Had joint pain, swelling in last 30 days[b]		
Yes	50.8 (41) [36.0–65.6]	43.8 (1363) [41.7–45.8]
No	49.2 (32) [34.4–64.0]	56.2 (1696) [54.2–58.3]
Ever told had diabetes[c]		
Yes	13.6 (24) [7.1–20.2]	7.5 (659) [6.8–8.2]
No	86.3 (137) [79.8–92.9]	92.5 (7219) [91.8–93.1]
Have asthma now		
Yes	18.7 (31) [10.9–26.5]	7.3 (622) [6.7–8.0]
No	81.3 (130) [73.5–89.0]	92.6 (7250) [92.0–93.3]
Ever told blood cholesterol high[b]		
Yes	30.9 (22) [17.1–44.7]	30.8 (745) [28.7–32.9]
No	69.0 (35) [55.2–82.8]	69.2 (1612) [67.1–71.3]
Ever had sigmoidoscopy or colonoscopy, ⩾50 years		
Yes	44.9 (27) [28.5–61.3]	48.2 (1630) [46.2–50.3]
No	55.1 (32) [38.7–71.5]	51.8 (1691) [49.7–53.8]
Mammogram within past 2 years, women aged ⩾40 years		
Yes	68.3 (42) [53.8–82.8]	75.6 (2346) [73.8–77.5]
No	31.7 (21) [17.2–46.2]	24.4 (72) [22.5–26.2]
Pap test within past 3 years, women ⩾18 years[d]		
Yes	88.2 (75) [81.2–95.1]	91.2 (4090) [90.3–92.1]
No	11.8 (11) [4.9–18.6]	8.8 (465) [7.9–9.7]

[a] BMI (kg/m^2) categories: neither overweight nor obese (BMI < 25); overweight (25 ⩽ BMI < 30); obese (BMI ⩾ 30).
[b] Question asked only on Tennessee BRFSS.
[c] Excludes women with gestational diabetes.
[d] Excludes women who have had a hysterectomy.

4. Discussion

The lifetime self-reported prevalence of epilepsy of 2.1% from Georgia and Tennessee is consistent with results from a previous population-based study that found a self-reported lifetime prevalence of epilepsy among adults of 1.8% [5]. While the question assessing seizure frequency was not asked in Tennessee, in Georgia, only 14.4% ($n = 10$, 95% CI = 2.7–26.1) reported no longer having epilepsy or seizure disorder. Using these confidence limits we can conclude based on our measures of self-reported epilepsy and seizure frequency that between 73.9 and 97.3% of persons in Georgia who reported having epilepsy still carry this diagnosis. Furthermore, because both state samples are population-based and because the demographic distribution of those with epilepsy in Georgia and in Tennessee did not differ substantially on any factor, it is likely that a similar proportion of people in Tennessee with self-reported epilepsy currently carry this diagnosis as well. The mixing of a small proportion of people with inactive epilepsy in these samples appears unlikely to substantially bias our results.

Because the incidence of epilepsy is high among older adults (e.g., ⩾60 years of age) [6,7], it was surprising that in our study, adults aged 45–64 years were more likely to report having epilepsy than those aged 65 years or older. Older adults with epilepsy may have been more reluctant than younger adults to disclose their disorder during the survey. Alternately, the exclusion of institutionalized adults aged ⩾65 years from the BRFSS survey design may have resulted in an underestimate of self-reported epilepsy prevalence.

The fact that a majority of adults with epilepsy in Georgia reported having had no seizures in the past 3 months suggests that they had adequate seizure control, and this level of seizure control was similar to that of the general epilepsy population [8]. A substantial minority, however, did report having at least one or more seizures in the past 3 months or not knowing how many seizures they had during that period. Perhaps providing additional cognitive aids to assist respondents in their recall of the number of seizures would be helpful in future studies. Others, however, may have felt uncomfortable reporting seizure activity, leading to an underestimate of seizure frequency in the sample. Individuals with recurrent seizures are at increased risk for impaired health related quality of life [9] and sudden unexplained death in epilepsy [10–12], and these individuals should be evaluated to optimize treatment outcomes [13].

A significantly larger percentage of adults reporting epilepsy in Georgia and Tennessee reported fair or poor self-rated health than those without the disorder. This is consistent with a previous study that found that 45.9% of adults with epilepsy reported fair or poor health compared with 18.5% of respondents without epilepsy [5]. The higher proportion of fair or poor health among adults with epilepsy is also consistent with rates of

persons with other chronic disorders such as coronary artery disease, diabetes, arthritis, depression, and asthma [2]. Self-rated health is sensitive to comorbidities, and is correlated with health risk behaviors, demographic and social factors, and lack of access to health care [14]. We found in our sample, however, that adults with epilepsy were just as likely as persons without epilepsy to have health care coverage, suggesting, perhaps, that other factors, such as poor health outcomes associated with epilepsy, comorbidities, employment status, and low income may have influenced health status. Indeed, these findings indicate that adults with epilepsy continue to face challenges associated with employment, as more than one-third of adults with epilepsy were unemployed or unable to work, and significantly more lived in households with the lowest income levels than those without the disorder. We further examined the health status of the five men and five women in Georgia who reported no longer having epilepsy to examine if this group differed substantially from those reporting seizure activity in Georgia. One-half reported having fair or poor health. This finding must be interpreted with caution given the small sample size, but it suggests that people in our sample who reported no longer having epilepsy have similarly low levels of health status as those reporting seizure activity.

Significantly more adults with epilepsy reported smoking cigarettes than those without epilepsy. While we could find no other studies that documented increased smoking rates in adults with epilepsy, we did confirm similarly high smoking rates in adults with epilepsy from BRFSS data collected in Texas in 1998 (CDC, unpublished data). Sociodemographic risk factors for smoking include unemployment and low socioeconomic status [15,16]. Personal risk factors include poor self-image and low self-esteem [15] and maladaptive coping strategies when faced with stress and anxiety [17–19]. The high rates of unemployment and low income found among adults with epilepsy in this study might help explain the high rates of smoking in our sample. Similarly, mood disorders (anxiety, depression) often found in those with epilepsy [13,20,21] might be among such personal risk factors associated with smoking in our study population. We were not able to assess any personal psychosocial risk factors in our sample. Nonetheless, adults with epilepsy who smoke are not only susceptible to all the adverse effects of smoking on their health [1,22], but, like members of the general public, are at increased risk of injury or death from housefires caused by cigarettes that are dropped or forgotten by a smoker whose alertness is impaired [23,24].

Increased rates of obesity have been reported among patients referred for care of epilepsy [25,26] as observed in our population-based survey. BRFSS data on self-reported weight and BMI are reliable and valid [27]. Epilepsy-related factors that might increase obesity rates include persistent reductions in exercise, increases in feeding, and increases in efficiency of lipogenesis independent of exercise and eating. While the majority of persons with epilepsy reported some exercise during the past month, about 40% did not engage in any exercise, and more than one-third of the sample was obese. Obesity, among people treated for epilepsy, may be related to the sedating effects of several older antiepileptic drugs (e.g., phenobarbital), as an indirect cause of reduced activity levels, to medication effects that increase appetite and thereby increase eating (e.g., valproic acid, gabapentin), and perhaps to decreased insulin sensitivity or other causes of increased lipogenesis (as suggested for valproate) [28–30].

The health-related consequences of obesity, such as increased rates of hypertension and diabetes mellitus, are the subject of considerable study, but the possibility that obesity causes additional comorbidities in epilepsy has not been fully explored. In particular, increased rates of sleep apnea are suspected in epilepsy [31,32], and might be explained by decreased central ventilatory drive related to interictal epileptic dysfunction or medication effects, interacting with increased airway resistance in obesity. Obesity, furthermore, might also exacerbate perceptions of stigmatization, discrimination, and low self-esteem already potentially present in epilepsy [33–35]. In the past, adults with epilepsy were discouraged from participating in physical activity because it was believed that for some physical activity could provoke seizures. Regular physical activity aids in weight control and can reduce symptoms of depression and anxiety and improve mood [33]. Nakken et al. [36] argued that while more study was necessary to determine the beneficial effects of physical activity in people with epilepsy, individuals with epilepsy should be encouraged to participate in regular physical training. Arida et al. [37] found that most people with epilepsy believed that exercise would improve their medical treatment. Recent studies have demonstrated that despite absence of significant reductions in seizure control, individuals with epilepsy who adopted a routine exercise program reported significant improvement in mood and quality of life [38]. The U.S. Department of Health and Human Services recommends that 30 minutes of moderate physical activity (e.g., walking, housework, yard work) 5 days per week can have beneficial effects on health and reduce comorbidities associated with conditions such as diabetes, arthritis, and obesity [1]. Even such moderate physical activity as that obtained by activities of daily living might have beneficial effects on adults with epilepsy in relation to weight loss. Our findings support the need for additional studies that examine the physiological and psychosocial interactions between obesity and epilepsy.

About one-third of our sample reported having drunk some alcoholic beverages within the past 30 days.

Health care providers may want to inquire into the extent of alcohol use to determine if providing patient information about the effects of alcohol use is warranted.

One in 10 adults with epilepsy reported having a loaded and unlocked firearm around the house. Having a firearm in the house substantially increases the risk for firearm-related injury and fatality [39,40]. This risk has not been assessed in adults with epilepsy, but given the high suicide rate among this population [41], additional studies are warranted to prevent the possibility of firearm-associated suicide.

Epilepsy and its treatment can often cause nutritional deficiencies in certain vitamins and minerals such as vitamins B-6 and D, calcium, folate, manganese, and magnesium. Furthermore, people often try to treat seizures with various vitamins, herbs, and amino acids, but there is no formal evidence beyond anecdotal accounts that any of these nutritional supplements improve seizure control [19,42]. Additionally, some dietary supplements can cause drug interactions [42]. In our study we found that half of adults with epilepsy reported taking vitamin pills or supplements. Peebles et al. [43] found that only about one-third of people with epilepsy who reported using alternative medicines including vitamin and herbal supplements reported doing so to their physicians. While some dietary supplements are beneficial to persons with epilepsy, health care providers need to improve their patients' awareness of the safe and effective use of dietary supplements and other forms of alternative treatments [42].

While information regarding the oral health status of adults with epilepsy is limited, one study found that individuals with epilepsy had worse oral health and dental status than individuals without epilepsy [44]. We found that almost half of those with epilepsy in Georgia and Tennessee reported not having visited a dentist within the past year. This suggests that some with epilepsy are at risk for adverse oral health outcomes.

In addition to their epilepsy, substantial numbers of adults with epilepsy reported having been told by a physician that they had arthritis, diabetes, asthma, or high blood cholesterol. Given the cross-sectional design of the survey, we are unable to determine when or if epilepsy and these conditions were present simultaneously. Nonetheless, these findings indicate that adults with epilepsy are often faced with additional health challenges posed by other chronic disorders. BRFSS does not, however, address a number of comorbid neurological conditions frequently associated with epilepsy. Conversely, a diagnosis of epilepsy in addition to an existing chronic disorder may further impair epilepsy-specific health outcomes. General self-management strategies designed to improve knowledge and understanding of chronic disease, medication adherence, and coping skills such as those used in the chronic disease self-management program [45] might be useful interventions for adults with epilepsy as they manage their epilepsy and other chronic disorders [46].

Finally, our findings indicate that many women and men with epilepsy may be at risk for breast, cervical, and colon cancer because they do not have important screening tests such as mammograms, Pap tests, sigmoidoscopy, and colonoscopy. Health care providers should be vigilant about providing sex- and age-appropriate screening tests to adults with epilepsy to prevent the onset of other serious life-threatening diseases. It is, however, noted that providers for persons with epilepsy may be more likely to be specialists and less likely to provide general preventive care.

The findings in this report are subject to several limitations. Households without telephones and those with only cellular phones were excluded from the sampling frame. BRFSS also excludes adults in institutions (e.g., prison, nursing homes) and the homeless. Third, this study might have excluded adults whose epilepsy causes severe impairment because time and functional capacity are required to participate in the BRFSS. Fourth, given the cross-sectional nature of the survey, we were unable to assess any causal relationships between epilepsy and behavior and other health conditions. Fifth, the small sample sizes in some subgroup comparisons limited our ability to comment on the results. The self-reporting of epilepsy is subject to potential biases. On the one hand, there is a possible conflation of "seizure" with "seizure disorder" or clinically diagnosed epilepsy which could lead to overreporting of epilepsy in the population. For example, alcohol-associated seizures might have been misreported as seizure disorder. While on the other hand, stigma could lead to underreporting of the disorder. Individuals with febrile seizures who no longer remember having had seizures may not report having epilepsy, leading to an underestimate of true lifetime prevalence.

5. Conclusion

This is the second report of a state-based population assessment of self-reported epilepsy prevalence and health status of adults with epilepsy in a representative sample of adults. Consistent with our previous study, we found a self-reported lifetime prevalence of epilepsy in the general population of about 2%. These findings confirmed previous results indicating substantially worse self-perceived health among adults with epilepsy than those without the disorder [5]. This suggests the need for interventions that improve the health status of adults with epilepsy. We also found that adults with epilepsy were at risk from complications associated with other chronic disorders such as arthritis, asthma, and diabetes, and from behavioral risks such as alcohol use, smoking cigarettes, and obesity.

Our findings suggest a need for increased sensitivity to general health status in adults with epilepsy, including awareness of gender-specific health issues and of any nonepilepsy-related health concerns of both men and women with epilepsy. Furthermore, the use of population-based survey data such as the BRFSS can help monitor the health status of people with epilepsy in the general population to identify health disparities, behavioral risk factors for other chronic diseases, and unmet health care needs in individuals with epilepsy, and to track changes in these measures over time.

References

[1] U.S. Department of Health and Human Services. Healthy People 2010. 2nd ed. With understanding and improving health and objectives for improving health. 2 vols. Washington, DC: U.S. Govt. Printing Office; November 2000.

[2] Robert Wood Johnson Foundation. A portrait of the chronically ill in America, 2001. Princeton, NJ: Foundation for Accountability; 2001.

[3] Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System [cited 2003 Oct 1] [5 screens]. Available from: http://www.cdc.gov/brfss.

[4] National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. Bethesda, MD: National Heart, Lung, and Blood Institute; 1998.

[5] Centers for Disease Control and Prevention. Health-related quality of life among persons with epilepsy—Texas 1998. MMWR 2001;50:24–6.

[6] Shorvon SD. The epidemiology and treatment of chronic and refractory epilepsy. Epilepsia 1996;37:S1–3.

[7] Kotsopoulos IAW, van Merode T, Kessels FGH, de Krom MCTFM, Knottnerus JA. Systematic review and meta-analysis of incidence studies of epilepsy and unprovoked seizures. Epilepsia 2002;43:1402–9.

[8] Kwan P, Brodie MJ. Early identification of refractory epilepsy. N Engl J Med 2000;342:314–9.

[9] Leidy NK, Elixhasuer A, Vickrey B, Means E, Willian MK. Seizure frequency and the health-related quality of life of adults with epilepsy. Neurology 1999;53:162–6.

[10] Opeskin K, Berkovic SF. Risk factors for sudden unexpected death in epilepsy: a controlled prospective study based on coroners cases. Seizure 2003;12:456–64.

[11] Langan Y, Nashef L, Sander JW. Certification of deaths attributable to epilepsy. J Neurol Neurosurg Pscyhiatry 2002;73:751–2.

[12] Walczak TS, Leppik IE, D'Ameilio M, et al. Incidence and risk factors in sudden unexpected death in epilepsy: a prospective cohort study. Neurology 2001;56:519–25.

[13] Gilliam F. Optimizing health outcomes in active epilepsy. Neurology 2002;58(S5):S9–19.

[14] Hennessy CH, Moriarty DG, Zack MM, Scherr PA, Brackbill R. Measuring health-related quality of life for public health surveillance. Public Health Rep 1994;109:665–72.

[15] Institute of Medicine. Health and Behavior: The interplay of biological, behavioral, and societal influences. Washington, DC: National Academy Press; 2001.

[16] Wilson SH, Walker GM. Unemployment and health: a review. Public Health 1993;107:153–62.

[17] Long D. Smoking as a coping strategy. Nurs Times 2003;99:50–3.

[18] Leventhal H, Avis N. Pleasure, addiction, and habit: factors in verbal report or factors in smoking behavior? J Abnorm Psychol 1976;85:478–88.

[19] Stroebe W. Behavior and health: excessive appetites. In: Social Psychology and Health. 4th ed. Philadelphia: Open Univ. Press; p. 88–98.

[20] Piazzini A, Canevini M, Maggiori G, Canger R. Depression and anxiety in patients with epilepsy. Epilepsy Behav 2001;2:481–9.

[21] Attarian H, Vahle V, Carter J, Hykes E, Gilliam F. Relationship between depression and intractability of seizures. Epilepsy Behav 2003;4:298–301.

[22] Devinsky O. Epilepsy: patient and family guide. 2nd ed. Philadelphia: F.A. Davis; 2002.

[23] Istre GR, McCoy MA, Osborn L, Barnard JJ, Bolton A. Deaths and injuries from house fires. N Engl J Med 2001;344:1911–6.

[24] Barillo DJ, Brigham PA, Kayden DA, Heck RT, McManus AT. The fire-safe cigarette: a burn prevention tool. J Burn Care Rehabil 2000;21:162–4.

[25] Jalava M, Sillanpaa M. Physical activity, health-related fitness, and health experience in adults with childhood-onset epilepsy: a controlled study. Epilepsia 1997;38:424–9.

[26] Steinhoff BJ, Neususs K, Thegeder H, Reimers CD. Leisure time activity and physical fitness in patients with epilepsy. Epilepsia 1996;37:1221–7.

[27] Nelson DE, Holtzman D, Bolen J, Stanwyck CA, Mack KA. Reliability and validity of measures from the Behavioral Risk Factor Surveillance System (BRFSS). Soz Praventivmed 2001;46(S1):S3–42.

[28] Jallon P, Picard F. Bodyweight and anticonvulsants: a comparative review. Drug Saf 2001;24:969–78.

[29] Isojarvi JI, Laatikainen TJ, Knip M, Pakarinen A, Juntunen KTS, Myllyla VV. Obesity and endocrine disorders in women taking valproate for epilepsy. Ann Neurol 1996;39:579–84.

[30] Luef GJ, Lechleitner M, Tennesseeer M, Bauer G, Trinka E, Hengster P. Valproic acid modulates islet cell insulin secretion: a possible mechanism of weight gain in epilepsy patients. Epilepsy Res 2001;55:53–8.

[31] Malow BA, Levy K, Maturen K, Bowes R. Obstructive sleep apnea is common in medically refractory epilepsy patients. Neurology 2000;55:1002–7.

[32] Manni R, Terzaghi M, Arbasino C, Sartori I, Galimberti CA, Tartara A. Obstructive sleep apnea in a clinical series of adult epilepsy patients: frequency and features of the comorbidity. Epilepsia 2003;44:836–40.

[33] U.S. Department of Health and Human Services. Physical activity and health: a report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 1996.

[34] Morrell MJ. Stigma and epilepsy. Epilepsy Behav 2002;3:S21–25.

[35] Jacoby A. Stigma, epilepsy, and quality of life. Epilepsy Behav 2002;3:S10–20.

[36] Nakken KO, Bjorholt PG, Johannessen SI, Loyning T, Lind E. Effect of physical training on aerobic capacity, seizure occurrence, and serum level of antiepileptic drugs in adults with epilepsy. Epilepsia 1990;31:88–94.

[37] Arida RM, Scorza FA, de Albuquerque M, Cysneiros RM, de Oliveira RJ, Caballero EA. Evaluation of physical exercise habits in Brazilian patients with epilepsy. Epilepsy Behav 2003;4:507–10.

[38] McAuley JW, Long L, Heise J, et al. A prospective evaluation of the effects of a 12-week outpatient exercise program on clinical and behavioral outcomes in patients with epilepsy. Epilepsy Behav 2001;2:592–600.

[39] Wiebe DJ. Homicide and suicide risks associated with firearms in the home: a national case–control study. Ann Emerg Med 2003;41:771–82.

[40] Shenassa ED, Catlin SN, Buka SL. Lethality of firearms relative to other suicide methods: a population-based study. Epidemiol Community Health 2003;57:120–4.

[41] Blumer D, Montouris G, Davies K, Wyler A, Phillips B, Hermann B. Suicide in epilepsy: psychopathology, pathogenesis, and prevention. Epilepsy Behav 2002;3:232–41.

[42] Tyagi A, Delanty N. Herbal remedies, dietary supplements and seizures. Epilepsia 2003;44:228–35.

[43] Peebles CT, McAuley JW, Roach J, Moore JL, Reeves AL. Alternative medicine use by patients with epilepsy. Epilepsy Behav 2000;1:74–7.

[44] Karolyhazy K, Kovacs E, Kivovics P, Fejerdy P, Aranyi Z. Dental status and oral health of patients with epilepsy: an epidemiologic study. Epilepsia 2003;44:1103–8.

[45] Lorig KR, Ritter P, Stewart A, et al. Chronic disease self-management program: 2-year health status and health care utilization outcomes. Med Care 001;39:1217–23.

[46] Center for the Advancement of Health. Patients as effective collaborators in managing chronic conditions. Washington, DC: Fox DM, Gruman J. [cited 6/1/02] [1 screen]. Available from: http: //www.milbank.org/reports/990811chronic.html.