Epilepsy & Behavior 13 (2008) 381–386

Contents lists available at ScienceDirect

Epilepsy & Behavior

journal homepage: www.elsevier.com/locate/yebeh

Perceived risk, resources, and perceptions concerning driving and epilepsy: A patient perspective

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ARTICLE INFO

Article history:
Received 13 February 2008
Revised 10 April 2008
Accepted 25 April 2008
Available online 6 June 2008

Keywords:
Epilepsy
Driving
Health behavior
Perceived risk
Resources

ABSTRACT

Previous research on driving and epilepsy has focused primarily on determining predictors of who will continue to drive when told not to. An analysis of health behavior attitudes and beliefs in persons with epilepsy may provide insight into effective patient counseling. A three-page, 46-item questionnaire was adapted and completed by 213 respondents with epilepsy. Nineteen percent indicated that in order to drive, they were not completely honest about their seizure frequency. Twenty-six percent reported having had a car accident because of a seizure. On Safety Concern, Attitudes toward Driving, Perceived Severity/Susceptibility, Perceived Barriers, Helping Relationships, and Self-Efficacy, there were no significant differences with respect to gender or place of residence. Respondents indicated that being in good health and taking precautions were important to them. Predictors of driving behavior included race/ethnicity, employment status, dishonesty about seizure frequency with the doctor, Attitudes toward Driving, Perceived Severity/Susceptibility, Perceived Barriers to changing driving behavior, and Self-Efficacy. Recommendations for communication strategies are discussed.

1. Introduction

In the United States, driving is considered an important privilege. Patients with uncontrolled seizures are legally restricted from driving. The inability to drive creates a challenge for employment, medical access, activities of daily living, as well as social opportunities [1]. Prior studies suggest that a third of patients with uncontrolled seizures continue to drive despite medical restrictions [2–4]. The decision to drive with uncontrolled seizures can create challenges in patients and individuals exposed to this unsafe practice. Motor vehicle-related injuries and mortality have occurred secondary to accidents caused by patients with epilepsy [5].

An abundance of evidence exists evaluating individual factors correlated with driving in patients with refractory epilepsy. Younger age, employment status, and other demographics may assist in identifying those at risk secondary to driving with uncontrolled seizures [2–4]. Although identification of risk factors is helpful, there are presently no studies evaluating health behaviors associated with driving in patients with epilepsy. Data summarizing patient access to alternative transportation resources are also limited. Such research may help reveal areas where health care practitioners could provide more tailored education to patients at risk for driving while having uncontrolled seizures. The purpose of this study was to assess health behavior concepts related to driving in persons with epilepsy.

2. Methods

This research was based on a cross-sectional survey design. The survey was estimated to take approximately 10 minutes to complete. A readability analysis of the questionnaire revealed a 7.6 grade level based on the Flesch–Kincaid assessment [6]. No identifying personal information was collected from participants, and because the survey was anonymous, a standardized script describing the research was included in place of a consent form. A waiver of consent was obtained from the Ohio State University institutional review board.

Three methods of identifying and recruiting participants were used. First, the Epilepsy Foundation of Central Ohio included the survey as part of a previously planned mailing to their membership. A self-addressed stamped envelope was included so that participants could mail back the survey anonymously. Second, the clinic staff at our institution recruited patients on the lead author's epilepsy clinic days. In order to maintain confidentiality, the clinic staff was instructed not to place the complete survey in the patient's chart. Completed surveys were gathered at the end of the clinic day so that no individual patients could be identified. Third, an electronic version of the survey was created through Zoomerang (http://info.zoomerang.com). Representatives from local Epilepsy Foundation (EF) affiliates in the United States were contacted via email about the survey. The investigators described the purpose of the research along with a request for support. The local EF sites were sent a copy of the Ohio State University's institutional review board approval letter, the consent script, an electronic form of the survey in Microsoft Word, and a Web link for the survey that they could email to their electronic membership list. The electronic survey method preserves anonymity as no identifying information such as email and Internet provider (IP) addresses was collected.

2.1. Questionnaire

A 46-item questionnaire was used. Questions on 11 demographic factors (age, gender, race, ethnicity, marital status, education, working status, disability status, state of residence, and numbers of adults and children in the home) were asked. Eight questions were used to assess driving behaviors related to seizures and epilepsy (preference for getting around, currently having a driver's license, doctor talking about the risks of driving with uncontrolled seizures, decision making about

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doi:10.1016/j.yebeh.2008.04.019

driving based on the doctor's recommendations, being honest about seizure control with the doctor, ever having a accident because of a seizure, understanding the risk of having a seizure while driving could lead to injury or death of yourself and/or others, and having knowledge of state driving regulations). There were also questions on epilepsy and seizures (have you been told by a doctor that you have a seizure disorder or epilepsy, age at diagnosis, how often do you have seizures, do you have seizures while awake, and during a typical seizure are you aware of what is going on around you).

As no previous research has assessed health behavior factors related to driving in epilepsy, this involved a questionnaire format adapted, with permission, from a previous study of driving attitudes and behavior in older persons with visual impairment using an instrument called the Driver Perceptions and Practices Questionnaire (DPPQ), developed by Stalvey and Owsley and published in the *Journal of Health Psychology* [7]. Twenty questions from the DPPQ were used to assess: Safety Concern, Attitudes toward Driving, Perceived Severity of an accident, Perceived Susceptibility to an accident, Perceived Barriers, Self-Efficacy, and Helping Relationships related to driving. No specific validity and reliability data are currently available from these studies; however, the questionnaire is based on three well-established health behavior theories: the Health Belief Model, self-efficacy, and the Stages of Change [8]. These models have recently been used to assess other areas of epilepsy care [9,10].

2.2. Data analysis

Descriptive statistics and frequency of responses were calculated first. Subscales for the health behavior questions were calculated and used as continuous variables for the next step of the analysis. The range of scores for each subscale was established by determining the lowest and highest scores that could be obtained. For Safety Concern, responses were coded as very important = 2, somewhat important = 1, and not important = 0, except for the question "I think about ways to improve my safety," for which responses were coded as never = 0, rarely = 1, sometimes = 2, often = 3 and always = 4. For Attitudes toward Driving, responses were coded as strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1. For Perceived Susceptibility/Severity, questions were coded as not likely = 0, somewhat likely = 1, and extremely likely = 2, except for the question "How serious is having a car accident to you?" for which responses were coded as not serious at all = 0, somewhat serious = 1, and very serious = 2. Questions about Perceived Barriers and Helping Relationships were coded as strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1. Self-Efficacy questions were coded as not applicable = 0, not at all confident = 1, not very confident = 2, reasonably confident = 3, very confident = 4, and completely confident = 5.

Statistical comparisons of the health behavior subscales were then made through one-way ANOVA based on selected demographics. As age is divided into four categories, a Bonferroni post hoc test was conducted to determine which categories were statistically different. A logistic regression analysis of persons with epilepsy not driving versus those who are driving was conducted using the demographic and health behavior variables presented in the univariate analysis. Demographics used in the univariate and multivariate analyses were collapsed into dichotomous variables (as shown later in Table 4), except for age and the health behavior subscales, which were kept as continuous variables. All analyses were conducted with SPSS Version 15.0.

3. Results

3.1. Demographics

Two-hundred and thirteen participants completed the questionnaire. Based on the Epilepsy Foundation of Central Ohio figures, 237 surveys were mailed out to their membership, and 43 were returned, yielding an 18% response rate. To keep respondents in our clinic setting anonymous, no records were kept of who responded; therefore, no figures for response rate can be determined. For the Zoomerang online survey, there were 425 visits to the site and 143 completed surveys, yielding a 34% response rate. Participants were recruited from 17 states. Ohio (77), Massachusetts (39), Connecticut (27), and Arizona (16) contributed the majority of participants. Smaller numbers ($\leqslant$7) were recruited from 16 other states.

Sixty-nine percent were female (see Table 1). Eighty-seven percent were Caucasian. The mean (SD) age of participants was 39.1 (12.1). Mean age at epilepsy diagnosis was 18.8 (13.8). Sixty-nine percent of respondents indicated they currently have a driver's license. Twenty-six percent of respondents reported they currently held a driver's license when, based on their state's regulations and their reported seizure frequency, they should not be eligible to drive ($\chi^2 = 25.34$, $P = 0.000$). Nineteen percent of patients reported that in order to drive, they were not honest with their doctor about the frequency of their seizures. Twenty-six percent reported having had a car accident because of a seizure. Only 44% of participants knew their state's driving regulations.

Table 1
Demographics of participants

Factor	% (*n*)
Gender	
Female	69 (144)
Male	31 (66)
Ethnicity	
Caucasian	87 (182)
African-American	7 (14)
Hispanic/Other	6 (13)
Marital status	
Single	38 (81)
Married	48 (102)
Separated/divorced	13 (27)
Widowed	1 (2)
Yearly income	
<$10,000	29 (56)
$10,000–$20,000	15 (29)
$20,001–$30,000	11 (22)
$30,001–$40,000	10 (19)
$40,001–$50,000	8 (16)
>$50,001	27 (53)
Employment status	
Works for >35 hours a week	37 (75)
Works for <35 hours a week	19 (39)
Unemployed, actively looking	10 (20)
Unemployed, not actively looking	28 (56)
Retired	6 (13)
Location of residence	
City	40 (83)
Suburbs	45 (94)
Rural	15 (32)
Reports being seizure-free[a]	51 (107)
Reports presently having a driver's license	69 (147)
Reports not being honest about seizures in order to drive	19 (40)
Reports ever having an accident due to a seizure	27 (56)
Knows state's driving regulations	44 (90)
Reports practitioner has spoken about driving risks	81 (171)

[a] Seizure freedom was recoded from the open-ended question "How often do you have seizures?" Seizure freedom was coded as "yes" if what was reported met the respondent's state driving regulation.

3.2. Responses to health behavior questions

Eighty-eight percent of respondents indicated that good health was important to them, and 99% indicated they felt it was important to take precautions that would improve their safety (see Table 2). A large percentage indicated that having a car accident was very serious to them. Seventy-five percent agreed they would expect their family to support changes in their driving behavior, and 71% indicated they would expect their friends to support changes in their driving behavior. The responses to the individual health behavior questions are summarized in Table 2.

3.3. Univariate analysis

Analysis by one-way ANOVA revealed no significant differences with respect to gender or place of residence (city, suburbs or rural) in the six health behaviors (see Table 3). Younger participants (aged 16–25) reported lower levels of Safety Concern compared with those older than 35 ($F = 3.36$, $P = 0.02$). Respondents aged 35–50 reported higher levels of poor Attitudes toward Driving than

Table 2
Individual health behavior questions about driving

Question	Results (% of sample)		
Safety Concern	Very important	Somewhat important	
All things considered, good health is important to me.	88	12	
	Very/somewhat important	Not important	
I feel it is important to take precautions that would improve my safety.	99	1	
	Always	Not always[a]	
I think about ways to improve my safety.	31	69	
Attitudes toward Driving	Agree[a]	Disagree[a]	
The drivers of automobiles are best qualified to judge their own fitness to drive cars.	48	52	
Because "things just happen" one should not be concerned with the prevention of accidents.	13	87	
The occurrence of accidents is a matter of chance and should be regarded as unavoidable.	18	82	
Possession of a driver's license is evidence of the ability of the individual to drive safely.	26	74	
Changing the way I drive would take too much thought; I don't want to have to think about my driving.	43	57	
Susceptibility/Severity	Very	Somewhat/not	
How serious is having a car accident to you?	88	12	
	Likely	Not Likely	
How likely is it for you to have a car accident while driving because you have epilepsy?	53	47	
How likely are you to be injured if you are involved in a traffic accident?	89	11	
Perceived Barriers	Agree[a]	Disagree[a]	
Changing when/where I drive is not possible because other people count on me to drive them.	27	73	
Changing when/where I drive is not possible because public transportation is not available to me.	47	53	
Changing when/where I drive is not possible because my friends/family members are unavailable.	40	60	
Changing when/where I drive is not possible because I don't want to ask family/friends.	40	60	
Helping Relationships	Agree[a]	Disagree[a]	
I would expect my family to support any changes I made regarding when and where I drive.	75	25	
I would expect my friends to support any changes I made regarding when and where I drive.	71	29	
Self-Efficacy	Confident[b]	Not confident[b]	Does not apply
If you are not able to drive, rate your confidence in organizing your life so that you could use public transportation.	43	35	22
If you are not able to drive, rate your confidence in asking a family member to drive you.	56	26	18
If you are not able to drive, rate your confidence in asking a friend to drive you.	38	43	19

[a] Responses were collapsed into smaller groups (strongly agree/agree = agree, strongly disagree/disagree = disagree). "Not always" was collapsed from often, sometimes, rarely, and never.
[b] Responses were collapsed into smaller groups (completely/very/reasonably confident = confident, not at all/not very confident = not confident).

respondents over the age of 50 ($F = 3.33$, $P = 0.03$). Non-Caucasians reported higher levels of Safety Concern ($F = 10.75$, $P = 0.001$) and Perceived Susceptibility/Severity ($F = 7.87$, $P = 0.006$) compared with Caucasians.

Respondents who reported ever having a car accident because of a seizure (27% of respondents) had higher Perceived Susceptibility/Severity for a car accident ($F = 6.39$, $P = 0.012$) and lower Perceived Barriers to changing their driving behavior ($F = 4.46$, $P = 0.036$). Respondents who responded that in order to drive they were not honest with their doctor about their seizures (19% of respondents) had worse Attitudes toward Driving ($F = 5.44$, $P = 0.021$) and higher Perceived Barriers to changing their driving behavior ($F = 4.84$, $P = 0.029$).

3.4. Logistic regression analysis

Of the sixteen variables entered into the logistic regression displayed in Table 4, seven were significant predictors of driving behavior. Non-Caucasians were more likely to report they were driving than Caucasians (OR = 6.9). Not surprisingly, those employed were more likely to be driving than those unemployed (OR = 4.6). Persons who reported they were not honest with the doctor about their seizures were more likely to be driving (OR = 5.7). Negative driving attitudes were less likely in those who reported driving (OR = 0.7). Persons with higher levels of Perceived Severity/Susceptibility to car accidents and injuries from an accident were less likely to report they were driving (OR = 0.4). Higher Perceived Barriers to changing driving behavior were more likely in those who reported they were driving (OR = 1.8). Self-efficacy for changing driving behavior was higher in those who reported they were driving (OR = 1.3).

4. Discussion

4.1. Demographics

Almost one in five respondents (19%) indicated they were not honest about their seizure frequency with the doctor. This is supported by previous patient disclosure research indicating that 16% would not inform their physician about their seizures in a state that requires physician reporting [11]. In another study, 20% of patients who had at least one seizure a year and 24% of those with daily seizures continued to drive [2].

4.2. Driving-related health behaviors

Answers to the individual questions (adapted from Stalvey and Owsley's Driver Perceptions and Practices Questionnaire) in this study follow a pattern similar to that in a previous study in high-risk older drivers with vision impairment [7]. People with epilepsy in this survey reported "Good health is important to me" less than did high-risk older drivers with vision impairment (88% vs 99%). Ninety-nine percent of both groups reported "I feel it is important to take safety precautions." Fewer persons with epilepsy answered "always" to the statement "I think of ways to improve safety" (33% vs 53%).

Attitudes toward Driving were similar for the question "Because things just happen one should not be concerned with preventing crashes," to which 88% of respondents in both studies answered false. Eight-seven percent of persons with epilepsy answered false to the statement "Crashes should be regarded as unavoidable," compared with 76% of older drivers with vision impairment in the previous study.

Table 3
Health behavior scales by select demographics: Mean (SD) scores

Demographic factor	*n*	Safety Concern (0–8)[b]	Attitudes toward Driving[a] (5–20)	Perceived Susceptibility/ Severity (0–6)	Perceived Barriers (4–16)	Helping Relationships (2–8)	Self-Efficacy (0–15)
Age							
16–25	34	5.8 (1.4)[c]	10.5 (2.5)	4.0(1.1)	9.0(2.4)	6.0 (1.3)	8.3 (4.8)
26–34	43	6.4 (1.3)	10.2 (3.0)	3.9(1.2)	9.2(2.9)	5.6 (1.8)	6.9 (4.8)
35–50	87	6.6 (1.3)[c]	10.6 (3.0)[c]	3.8(1.3)	9.3(3.1)	5.9 (1.7)	7.0 (4.7)
>50	42	6.6 (1.3)[c]	8.9 (2.1)[c]	3.5(1.3)	9.4(2.5)	5.8 (1.6)	7.0 (4.3)
Gender							
Female	143	6.5 (1.3)	10.0 (2.7)	3.8 (1.3)	9.1 (2.8)	5.8 (1.7)	7.0 (4.8)
Male	65	6.3 (1.5)	10.3 (3.1)	3.7 (1.3)	9.5 (3.0)	5.8 (1.6)	7.5 (4.2)
Race/ethnicity							
Caucasian	180	6.3 (1.3)[e]	10.0 (2.8)	3.7 (1.2)[c]	9.3 (2.8)	5.9 (1.6)	7.3 (4.7)
Non-Caucasian	27	7.2 (1.3)[e]	11.0 (3.2)	4.4 (1.4)[c]	9.0 (3.6)	5.4 (1.7)	6.8 (3.9)
Annual income							
<$30,000	107	6.3 (1.4)	10.5 (2.9)	3.9 (1.3)[c]	9.1 (2.9)	5.6 (1.5)	8.5 (3.9)
>$30,000	86	6.6 (1.2)	9.9 (2.9)	3.6(1.2)[c]	9.6 (2.9)	6.0 (1.7)	8.4 (3.7)
Employment status							
Not employed	89	6.6 (1.4)	9.9 (2.7)	4.0 (1.4)[c]	8.7 (2.9)[c]	5.6 (1.8)[c]	8.8 (3.5)
Employed	111	6.3 (1.3)	10.3 (3.0)	3.6 (1.1)[c]	9.8 (2.7)[c]	6.1 (1.4)[c]	8.3(3.9)
Location of residence							
In a city	82	6.6 (1.3)	9.9 (2.6)	3.9 (1.2)	9.3 (2.9)	6.0 (1.7)	6.7 (4.7)
Not in a city	125	6.4 (1.4)	10.2 (2.9)	3.7 (1.3)	9.1 (2.8)	5.8 (1.6)	8.8 (3.5)
Seizure freedom by state driving guidelines							
No	102	6.4 (1.4)	10.0 (2.9)	4.2 (1.3)[e]	8.9 (3.1)	5.5 (1.8)[d]	8.3 (3.3)
Yes	104	6.5 (1.4)	10.2 (2.8)	3.4 (1.1)[e]	9.5 (2.6)	6.1 (1.4)[d]	8.8 (4.2)
Ever had a car accident because of a seizure							
No	150	6.5 (1.3)	10.1 (3.0)	3.6 (1.2)[c]	9.5 (2.8)[c]	5.9 (1.6)	6.8 (4.8)
Yes	56	6.4 (1.5)	10.1 (2.5)	4.1 (1.3)[c]	8.5 (2.8)[c]	5.6 (1.6)	8.0 (4.0)
Not honest with doctor about seizures in order to drive							
No	165	6.5 (1.3)	9.9 (2.6)[c]	3.8 (1.3)	9.0 (2.7)[c]	5.8 (1.6)	7.1 (4.7)
Yes	39	6.3 (1.5)	11.1 (3.5)[c]	3.7 (1.1)	10.1 (3.1)[c]	6.0 (1.8)	6.9 (4.3)

[a] A higher score indicates less desirable beliefs.
[b] Scale range is given below scale name.
[c] $P \leqslant 0.05$.
[d] $P \leqslant .01$.
[e] $P \leqslant .001$.

Table 4
Logistic regression of persons with epilepsy: Driving versus not driving

Variable	Measure	OR (95% CI)	*P* value
Age	Scale	1.0 (1.0–1.1)	0.732
Gender	Female vs male	0.8 (0.3–2.6)	0.725
Race/ethnicity	Caucasian vs non-Caucasian	6.9 (1.2–39.3)	**0.030**
Annual income	<$30,000 vs > $30,000	1.7 (0.5–6.4)	0.409
Employment status	Not employed vs employed	4.6 (1.3–16.2)	**0.017**
Marital status	Not married vs married	0.5 (0.2–1.8)	0.298
Location of residence	City vs not a city	2.7 (0.8–9.2)	0.121
Not honest about seizure frequency with doctor	No vs yes	5.7 (1.1–30.1)	**0.041**
Ever had a car accident because of a seizure	No vs yes	1.3 (0.4–4.3)	0.649
Doctor talked about risk	No vs yes	2.2 (0.5–10.0)	0.305
Safety Concern	Scale	1.1 (0.7–1.7)	0.721
Attitudes toward Driving	Scale	0.7 (0.6–0.9)	**0.014**
Perceived Severity/Susceptibility	Scale	0.4 (0.3–0.7)	**0.002**
Perceived Barriers	Scale	1.8 (1.3–2.4)	**<0.000**
Helping Relationships	Scale	0.9 (0.6–1.3)	0.690
Self-Efficacy	Scale	1.3 (1.0–1.5)	**0.013**

Eighty-eight percent of persons with epilepsy answered "serious" to the question "How serious is having a car accident to you," compared with 99% of high-risk older drivers. For Perceived Susceptibility to crashes, 53% of persons with epilepsy answered "likely" to the question "How likely are you to have a crash due to a seizure"; in comparison, 49% of high-risk older drivers answered "likely" to the question "How likely are you to have a crash due to vision". Eighty-nine percent of respondents with epilepsy and 87% of high-risk older drivers answered "likely" to the question "How likely are you to be injured if you are involved in a traffic accident".

For Perceived Barriers, 47% of persons with epilepsy, compared with 75% of older high-risk drivers, agreed that changing when/where they drive is not possible because public transportation is not available. Forty percent of persons with epilepsy and 57% of high-risk older drivers agreed that changing when/where they

drive is not possible because friends and family are unavailable. Twenty-seven percent of persons with epilepsy, compared with 36% of high-risk older drivers, agreed that "changing when/where I drive is not possible because others need me to drive".

4.3. Logistic regression results

Results of the logistic regression support previous investigations in which persons who are driving are much more likely driving for occupational purposes [4]. That Attitudes toward Driving, Perceived Severity/Susceptibility, Perceived Barriers, and Self-Efficacy were predictors of driving behavior suggests that communication strategies with patients about driving should cover these topics.

4.4. Recommendations for counseling

In the clinic setting, informing patients that they are restricted from driving is always challenging. The results of this study suggest that engaging patients on certain points may be helpful in improving compliance with driving regulations. For drivers over age 25, the perception of safety is very similar. This corresponds to the recognized increased risk for accidents and risk taking in younger drivers. Engaging younger patients in a discussion about safety concerns and driving attitudes, although important, may not yield the desired result (cessation of driving). Future research is clearly needed to more fully address these issues. Driving behavior may be influenced by highlighting the fact that a large majority of persons with epilepsy value safety and good health and also believe they would be injured in a crash. This could segue into points for counseling on how driving with uncontrolled seizures in not consistent with being a responsible citizen. As safety concerns were not a predictor of driving behavior in this study it suggests the conversation with patients should not end here.

Patients reporting a previous accident due to a seizure have less perceived barriers to changing their driving behavior as well as significantly higher perceived susceptibility/severity for an accident. But this was not a predictor in the multivariate analysis, suggesting that engaging patients about previous accidents is less likely to inspire behavioral change. Overcoming barriers to transportation is likely most important for persons with epilepsy. Enhancing patients' self-efficacy (self-confidence) to adapt their lifestyle may be one way to overcome transportation barriers.

Previous studies indicate that patients do not comply with driving restrictions primarily for occupational reasons [4]. Some have suggested home-based employment opportunities as one way to overcome this issue [2]. Unfortunately, this is not an employment option for many individuals. The need for additional resources for patients with uncontrolled seizures is evident. Thirty-five percent of patients reported that they were not confident to use public transportation, and 47% perceived a lack of transportation resources. Having a seizure while walking to public bus stations increases the risk for injury and adds to the already prevalent social stigma associated with epilepsy. Although some patients are fortunate to have family members and friends assist with driving needs, 40% felt that changing driving behavior was not possible because family/friends were unavailable. Interestingly, where people live (rural versus urban) had little impact on their driving-related health behavior. A conversation about overcoming barriers to transportation would certainly involve the availability or unavailability of family/friends, public transportation, car pools, or other disability services patients could access to get around. Although sometimes available, disability services are often costly and inconvenient with respect to scheduling. The implementation of local and statewide funds and efforts to improve driving resources would be beneficial.

The evidence supporting the severity of accidents in persons with seizures has been mixed [5,12]. In terms of road safety, there are 6.6 times more crashes associated with alcohol than those associated with medical conditions, and 156 times more alcohol-related crashes than seizure-related crashes [13]. Additionally, in one study from The Netherlands, accidents caused by epilepsy differed from "average traffic accidents" in that many involved slight injury and 80% involved only the driver's car. Over the 10-year period of the study, accidents caused by epilepsy were rare: only 1 per 10,000 [14]. A U.S. study reported a slightly elevated risk for traffic accidents for both those with diabetes (1.32) and those with epilepsy (1.33). The authors suggested that the increased risk does not warrant further restriction of driving privileges [15]. According to a recent article, seizure-related accidents did not significantly increase when the state of Arizona reduced the required seizure-free interval from 12 to 3 months [16], suggesting that states requiring extended seizure-free periods may be imposing excessive restrictions.

4.5. Limitations

The adapted survey used for this research has no established reliability estimates. As no one has assessed these concepts related to driving in patients with epilepsy, we decided to modify the Driver Perceptions and Practices Questionnaire as opposed to creating a questionnaire de novo. Although the study populations (epilepsy vs older drivers with visual problems) and methodology (online vs in-person testing) as presented in the discussion differed, both populations face similar decisions about their driving behavior. Therefore, we believe a comparison with the previously published data is worthwhile. The consistency of responses to the individual questions is also supportive of the discussion presented.

The demographic breakdown of our questionnaire is also limited by the few minority respondents. In addition, women, who tend to have safer driving behaviors or may have different employment status, were overrepresented. As respondents were identified either through our clinic (a tertiary academic medical center) or the various states' Epilepsy Foundation organizations, this survey is not a representative sample of persons with epilepsy from the general population. In addition, because a Web link to the survey was sent to individuals on the Epilepsy Foundation e-mail lists, it is possible that persons may have completed the online survey more than once. There is no way to guard against this without obtaining confidential email lists from each site. This would compromise anonymity and reduce the likelihood of candid responses.

The response rate to our Internet survey was low. Internet-based research, although providing access to a larger audience, is also limited by "the digital divide" [17]. Rates of Internet access rise dramatically with increase in educational attainment and family income [18], but are significantly lower (16% in persons aged 15–64 and 5% in persons $\geqslant$65) in households reporting a health problem or disability [19]. To overcome the limitations of the Internet-based survey, we improved our sample by recruiting patients from our clinic setting and our local Epilepsy Foundation affiliate.

5. Conclusions

Patients who are not honest about their seizure frequency have more negative attitudes toward driving and higher perceived barriers to changing their behavior. Concern for safety varies by age and race/ethnicity. Predictors of driving behavior included race/ethnicity, employment status, dishonesty about seizure frequency with the doctor, driving attitudes, perceived severity and susceptibility, perceived barriers to changing driving behavior, and self-efficacy. This study supports the need to ad-

dress health behavior constructs when counseling persons with epilepsy. Enhancing perceived susceptibility and severity may help patients change their driving behavior. Improving awareness of available resources and transportation services is vital. Overcoming barriers to change is likely the most difficult. Inspiring change in driving behavior in persons with epilepsy will continue to be a challenge.

Acknowledgments

We graciously thank Epilepsy Foundation sites in Ohio, Massachusetts, Connecticut, Arizona, and 17 other states that helped tremendously in getting this survey out to their membership. Individuals we especially thank include: Carol Johnson, Les Brody, Linda Wallace, Mary Macleish, Susan Welby, and Sara Richardson. We also thank Mohammed Rahman, Ph.D., for his advice and assistance with data analysis and interpretation.

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