

ORIGINAL ARTICLE

Driving Behaviors Among Community-Dwelling Persons With Multiple Sclerosis

Maria T. Schultheis, PhD, Valerie Weisser, MA, Kevin Manning, MS, Allison Blasco, BS, Jocelyn Ang, BA

ABSTRACT. Schultheis MT, Weisser V, Manning K, Blasco A, Ang J. Driving behaviors among community-dwelling persons with multiple sclerosis. *Arch Phys Med Rehabil* 2009;90:975-81.

Objective: The current study examined driver behaviors and patterns among drivers with multiple sclerosis (MS) as a function of disease severity and in comparison to drivers without MS.

Design: Between-group comparisons of participants with and without MS and cohorts of MS groups at varying levels of severity.

Setting: All data were collected in an outpatient research setting.

Participants: Community-dwelling persons (n=66) with clinically definite MS who were active drivers and healthy controls (n=30) were included.

Interventions: Not applicable.

Main Outcome Measures: Driving characteristics' measures included (1) driving frequency defined in days and miles driven per week, (2) self-reports of voluntarily limited driving behaviors, (3) changes in driving since MS diagnosis, and (4) self-rating as a driver. Driving performance was also assessed by using pass/borderline performance on a clinical behind-the-wheel evaluation.

Results: Mann-Whitney *U* tests showed a significant difference in driving frequency ($P=.021$) with MS participants reporting they drove fewer days per week than healthy control group. This was also seen between cohorts of MS drivers ($P=.014$), with high Expanded Disability Status Scale (EDSS) participants driving less frequently than the low EDSS group. Descriptive observations suggested that participants with moderate EDSS scores drove less and engaged in more self-limiting behaviors. Chi-square tests showed that participants with high EDSS scores were more likely to report changing their driving behavior after diagnosis ($P=.01$) and were more likely to not pass the behind-the-wheel evaluation ($P<.001$).

Conclusions: The current findings suggest that as disease severity progresses, differences in frequency of driving (days per week) and the use of self-limiting driving behaviors may vary. Furthermore, the findings also raise questions regarding the overall sensitivity of the most commonly used clinical driving assessment method (the behind-the-wheel evaluation) to accurately capture driving capacity in the milder stages of

the disease process. The results indicate the need to consider issues related to driving as MS severity progresses, and, given the progressive nature of MS and the concerns of the validity of the most common clinical driving assessment measures (the behind-the-wheel evaluation), repeated assessment of driving ability may be the most effective approach for identifying driving difficulties among persons with MS.

Key Words: Automobile driving; Multiple sclerosis; Rehabilitation.

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MULTIPLE SCLEROSIS IS A chronic inflammatory and neurodegenerative disorder of the central nervous system that is associated with physical, cognitive, and psychologic impairments that can negatively affect various aspects of independent functioning.¹ One essential aspect of functional independence is the ability to drive a motor vehicle.

Research on MS and driving ability has suggested that the presence of cognitive and physical impairments can impact driving-related skills. For example, studies have shown that the presence of cognitive impairment alone can negatively affect performance on computerized measures of driving skills² and results in a higher frequency of documented accidents among drivers with MS when compared with healthy controls and MS drivers without cognitive impairment.³ Other work has examined the contribution of lower-limb spasticity to performance in a driving simulator and reported that spasticity was associated with specific driving components, including maintaining speed and following another vehicle.⁴ This study and a handful of others have also expanded on defining the contribution of cognitive functioning on driving performance among drivers with MS. Specifically, areas of attention, information processing speed, executive functioning, and visuospatial skills are relevant to driving performance in this clinical population.⁴⁻⁶ In sum, in addition to the overall importance of driving for maintaining an independent lifestyle, the findings from these studies underscore that determining driving capacity is an important consideration for persons with MS.

By contrast, research examining factors related to driving status and driving behaviors is sparse. It can be argued that without an understanding of typical driving behaviors, which can include driving cessation and/or driving modifications, accurate prediction and measurement of driving are limited. Although not comprehensive, preliminary findings indicate some differences in driving patterns among this clinical population.

From the Department of Psychology (Schultheis, Weisser, Manning, Blasco, Ang) and the School of Biomedical Engineering, Science and Health Systems (Schultheis), Drexel University, Philadelphia, PA.

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Reprint requests to Maria T. Schultheis, PhD, Drexel University, Dept of Psychology, 3141 Chestnut St, PSA Building 218, Philadelphia, PA 19104, e-mail: sg94g745@drexel.edu.

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List of Abbreviations

ANOVA	analysis of variance
DBQ	Driver Behavior Questionnaire
DMV	Department of Motor Vehicles
EDSS	Expanded Disability Status Scale
HC	healthy control
MS	multiple sclerosis

lation. For example, a study using self-reported driving measures found that drivers with MS reported a decrease in frequency of days per week driving.⁷ Another study examining awareness deficits and driving found that 23% of their sample had discontinued driving and that persons who continued to drive were physically and cognitively healthier, showed greater awareness of their deficits, and reported fewer barriers to driving than nondrivers with MS.⁸ Yet, little remains known about potential self-regulatory strategies, such as avoiding difficult driving conditions and general driving habits of this population.

Numerous studies have examined changes in driving behaviors or patterns among patients after an acute event, such as traumatic brain injury⁹ or stroke.¹⁰ By contrast, the course of MS is typically progressive rather than acutely acquired, and, therefore, findings from these studies cannot be generalized to the MS population. As such, it would be important to understand changes in driving behavior in relation to MS, and in particular, severity of MS. Finally, little is known about the use of current clinical driving assessment methods in MS. Anecdotal information from rehabilitation professionals suggests that many persons with MS are not evaluated for driving competency. In addition, the validity of the most common clinical measure of driving performance, the behind-the-wheel evaluation, has not been thoroughly assessed for persons with MS. Answers to these questions would assist in the identification of the risks for drivers with MS.

The current study was conducted to learn more about the driving behaviors of persons with MS. By using self-reported measures and a clinical driving assessment, the study examined driving exposure and driving habits, self-regulatory behaviors, and changes in driving as a function of MS diagnosis. These factors were examined and compared with non-MS drivers and at different stages of MS severity.

METHODS

Participants

Participants with relapse-remitting and secondary progressive MS were recruited from a neurology clinic in an urban, tertiary-care teaching hospital and through advertisements posted in conjunction with local chapters of the National Multiple Sclerosis Society. The current study did not use a convenience sample but rather recruited over 110 potential participants from the community who, prior to enrollment, underwent a comprehensive telephone screening. A total of 66 individuals with a diagnosis of clinically definite MS verified through medical records submitted by a treating physician were included in the study. An additional 30 education- and sex-matched HCs were also included.

All participants were adults aged 18 years or older and were at least 1 month after their last clinical exacerbation. Participants with a history of other neurologic disease, psychiatric illness, or substance abuse were ineligible based on self-report and medical records from the treating neurologist. In addition, participants were excluded from the study if they were currently taking medications that have been shown to adversely affect cognition such as steroids, benzodiazepines, neuroleptics, opioids, or narcotic analgesics. MS participants were allowed to continue to take Avonex, Beta-Seron, and Copaxone because that reflected standard care for people with MS. Table 1 shows participant demographic variables and disease characteristics.

At the time of testing, all participants held a valid driver's license in the states of New Jersey or Pennsylvania and were classified as "active" drivers, which was operationally defined

Table 1: Demographics: MS Versus Healthy Controls

Characteristics	MS (n=66)	HCs (n=30)
Age	43.2±8.07	37.3±10.33*
Sex (% men/women)	21.2/78.8	36.7/63.3
Education (y)	15.3±2.07	15.8±2.08
Ethnicity (%)		
White	84.8	70.0
Black	9.1	13.3
Asian/Asian American	1.5	10.0
Hispanic	4.5	6.7
Driving experience (y)	24.8±7.56	17.8±9.29*
EDSS mean (range)	3.42 (1.5–6.5)	NA
Years since diagnosis	8.88±6.43	NA
Type of MS (%)	8.1 (1.68)	8.7 (0.9)
Relapsing remitting	86.4	NA
Secondary progressive	7.6	NA
Progressive relapsing	3.0	NA
Unknown	3.0	NA

NOTE. Data are presented as mean ± SD unless otherwise noted. Abbreviations: NA, not applicable.

* $P < .05$, HC < MS group.

as a minimum of 1 driving occasion during a 1-month period in the past year. New drivers (<1 year driving experience) were not included in the study. Only participants who had not received driving rehabilitation or retraining were included, and all were required to meet the minimum visual requirements as established by the DMV in their respective states. Participants with a history of reckless driving and/or loss of driving privileges were not included in the study.

The current study further divided the MS sample into varying levels of MS severity. The level of MS severity was determined based on the EDSS,¹¹ the most common clinical measure to assess disease severity and progression in MS patients. The EDSS has good test-retest reliability ($r = .93$), but data on the interrater reliability are more varied, and estimates range from .32 to .98 depending on how the investigators operationalized reliability.¹² In general, the reliability of the EDSS tends to decrease when participants in the moderate range compared with the extremes are assessed, which has been a common criticism of the scale. However, the validity of the scale is less disputed. The EDSS has shown high convergent validity with the Scripps Neurological Rating Scale ($r = .78$), the Ambulation Index, and the physical function domain of a quality of life scale ($r = -.79$).¹² All participants' EDSS evaluations were conducted by a physician with experience administering and scoring the exam. The EDSS assesses predominantly physical and, to a lesser extent, visual and cerebral function. Total EDSS scores range from 0 (normal neurologic examination) to 10 (death from MS).

Measures

Driving behaviors. Self-reported driving behaviors were assessed by using the DBQ. The DBQ is a questionnaire designed to obtain driving information not available from the DMV and assesses self-reported information regarding driving frequency, patterns, and habits in a standardized manner. It was developed by the principle investigator in conjunction with 2 certified driving specialists, each with a minimum of 10 years of professional experience as a rehabilitation driver evaluator, and has been used in a previous study¹³ documenting driving behaviors in individuals with traumatic brain injury.

Specifically, for this study, participants were asked to complete the DBQ during the testing sessions. The DBQ included

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