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Original Article

Sensitivity and specificity of the safe driving behavior measure and the driving habits questionnaire for older self-drivers

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Abstract. [Purpose] To evaluate the sensitivity and specificity of the Safe Driving Behavior Measure and the Driving Habits Questionnaire in community-dwelling older self-drivers. [Subjects and Methods] Forty-five older participated in this study, to measure the Safe Driving Behavior Measure and the Driving Habits Questionnaire. Sensitivity and specificity were calculated along with cut-off values and overall accuracy of each measure as determined by the participants operating characteristic curve and the area under the curve. Multivariate logistic regression analysis was employed to identify predictors of driving abilities. [Results] The sensitivities were 0.538 for Safe Driving Behavior Measure, and 0.577, 0.423, and 0.615 for the difficulty, crash and citations, and driving space on domains of the Driving Habits Questionnaire, respectively. The specificities of the person-vehicle domain, person-environment domain, and person-vehicle-environment domain of the Safe Driving Behavior Measure were 0.474, 0.526, and 0.421, respectively, while the Driving Habits Questionnaire domains, the specificities of difficulty, crash and citations, and driving space were 0.526, 0.211, and 0.421, respectively. [Conclusion] The results of this study suggest that factors related to the accident history of older self-drivers were not well-explained, although the Safe Driving Behavior Measure and Driving Habits Questionnaire domains have the potential to determine driving-related accident history.

Key words: Automobile driving, Community-dwelling, Older adults

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INTRODUCTION

As the older adult population grows, the number of older drivers also increases. These drivers tend to drastically reduce the amount that they drive, since many are retired and have a limited range of everyday and economic activities. Additionally, drivers' abilities are affected by their normal aging as well as geriatric diseases, such as declines in visual function, attention and processing speed, physical movement, and visual perception, along with cognitive disabilities, diabetes mellitus and cardiovascular diseases[1)]. Therefore, it is necessary to be able to accurately assess driving abilities and to retrain older individuals in order to reduce the risk of motor vehicle collisions. Previous studies have introduced various measures for examining and predicting driving performance declines and the accident risk aging adults for use in research and clinical settings[2)]. In gerontology, some researchers have recognized the diversity of older adults and classified them into three sub-groups: young-old (65–74), middle-old (75–84), and oldest-old (85 and above)[3)]. This study evaluated two self-report questionnaires assessing the driving performance of young-old self-driving adults: the Safe Driving Behavior Measure (SDBM) and the Driving Habits Questionnaire (DHQ)[4, 5)]. The purpose of this study was to investigate the accuracy of the SDBM and DHQ

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Table 1. Demographic profile and driving history of the participants (N=45)

Variables	Participants
Gender (male/female)	34 (75.6%)/11 (24.4%)
Age (years)	68.36 ± 3.18*
Height (cm)	166.76 ± 6.95
Weight (kg)	66.33 ± 7.58
Accident history (Yes/No)	26 (57.8%)/19 (42.2%)
Driving exposure (months)	269.80 ± 102.01
Mini-mental State Examination (scores)	28.80 ± 1.29

*Mean ± standard deviation

in identifying the history of collisions in community-dwelling young-old self-driving adults.

SUBJECTS AND METHODS

A total of 45 community-dwelling young old self-driving adults, recruited from three senior community centers, participated in this study. Participation was solicited via a leaflet containing information on the study. This study was carried out in accordance with the International Ethical Guidelines and the Declaration of Helsinki and was approved by the local institutional review board of Chosun University. All participants voluntarily signed consent forms. The inclusion criteria were as follows: age between 65 to 74 years, valid driver's license, driving at the time of recruitment, cognitive ability to complete the SDBM and the DHQ, no missing limbs or major psychiatric diagnosis, and absence of neurological deficits or severe orthopeadic diseases that might have impaired driving skills. Participants with serious visual impairment were excluded. Table 1 displays the clinical and demographic characteristics of the participants, including gender, age, height, weight, and driving exposure.

All the participants completed the SDBM and the DHQ. The SDBM is a self-report questionnaire of safe driving behaviors that assesses the physical and cognitive aspects of driving such as car controls or features, responses to physical and social factors, and responses to environmental factors. The 68 items are divided into three domains: person-vehicle (11 items), person-environment (42 items), and person-vehicle-environment (15 items). Responses are made using a 5-point Likert scale ranging from 1 (cannot do) to 5 (not difficult), resulting in a total possible score of 340 points. Previous studies have demonstrated the good validity and reliability of this instrument[4, 6]. Its counterpart, the DHQ is interviewer-administered, and consists of 34 items grouped into six domains, of: current driving status and miscellaneous issues (10 items), driving exposure (4 items), dependence on other drivers (2 items), driving difficulty (8 items), self-reported crashes and citations (4 items), and driving space (5 items). Options for rating each item range from 1 (I drive) to 3 (this person drives), or from 1 (so difficult I no longer drive in that situation) to 5 (no difficulty) so that the domain is scored on a 100-point scale. Like the SDBM, it has good validity and reliability[5]. This study focused on only three domains of the DHQ: driving difficulty, self-reported crashes and citations, and driving space in order to obtain data on the three domains in relation to traffic accidents.

Descriptive statistics were used to analyze the demographic characteristics and driving habits, such as current driving status and miscellaneous issues, and driving exposure of the participants. To determine the cut-off values for the SDBM and the DHQ, this study used the Receiver Operating Characteristic (ROC) curve, and the Area under the Curve (AUC). The AUC indicates the probability that young-old self-driving adults who have had collisions experience will be correctly identified. Multivariate logistic regression analysis was employed to identify the predictors of the history of accident in community-dwelling young-old self-drivers. Analysis was performed with the aid of PASW version 18.0 for Windows (SPSS Inc., Chicago, IL, USA) with a statistical significance level of 0.05.

RESULTS

This study examined 45 licensed drivers (34 males and 11 females) with a mean age of 68.36 years, a mean height of 166.76 cm, and a mean body weight of 66.33 kg. Twenty-six participants reported a history of accident while 19 had none. The mean duration of driving experience was 269.80 months, and the mean MMSE score was 28.8 (Table 1). The cut-off value, AUC, sensitivity, and specificity of the SDBM and DHQ of community-dwelling young-old self-drivers were examined. The SDBM, cut-off values were found for the person-vehicle domain (53.5), person-environment domain (186.5), person-vehicle-environment domain (52.5). The cut-off values the DHQ were 84.3 for difficulty, 0.5 for accidents and citations, and 3.5 for driving space. The AUC values for the person-vehicle domain, person-environment domain, and person-vehicle-environment domain of the SDBM were 0.501, 0.517, and 0.549 respectively, and 0.593, 0.616, and 0.669 respectively. The sensitivity was 0.538 for all three domains of the SDBM, while for the DHQ, the values for difficulty, crash and citations, and driving space were 0.577, 0.423, and 0.615, respectively, for the DHQ. The specificities of in the person-

Table 2. Sensitivity and specificity of the SDBM and DHQ of community-dwelling young-old self-drivers (N=45)

Variable		Cut-off value	Area under the curve	Sensitivity (%)	Specificity (%)
SDBM	PV	53.500	0.501	0.538	0.474
	PE	186.500	0.517	0.538	0.526
	PVE	52.500	0.549	0.538	0.421
DHQ	Difficulty	84.325	0.593	0.577	0.526
	Crash and citations	0.500	0.616	0.423	0.211
	Driving space	3.500	0.669	0.615	0.421

DHQ: driving habits questionnaire; PV: person-vehicle domain; PE: person-environment domain, PVE: person-vehicle-environment domain; SDBM: Safe Driving Behavior Measure

Table 3. Multiple regression analysis of history of collisions and various driving elements (N=45)

Variable		B	SE	Beta	t	p
SDBM	PV	−0.039	0.045	−0.233	−0.864	0.393
	PE	−0.001	0.010	−0.032	−0.070	0.945
	PVE	0.005	0.014	0.116	0.385	0.703
DHQ	Difficulty	0.006	0.012	0.104	0.497	0.622
	Crash and citations	0.135	0.080	0.248	1.696	0.098
	Driving space	0.111	0.058	0.331	1.914	0.063
Constant		1.474	1.678		0.878	0.385
			R*2=0.098			

DHQ: driving habits questionnaire; PV: person-vehicle domain; PE: person-environment domain, PVE: person-vehicle-environment domain; SDBM: Safe Driving Behavior Measure

vehicle domain, person-environment domain, and person-vehicle-environment domain of the SDBM were 0.474, 0.526, and 0.421, respectively. For the DHQ, difficulty, crash and citations, and driving space had values of 0.526, 0.211, and 0.421, respectively (Table 2). According to multivariate regression analysis, the SDBM and DHQ were not significant predictors of collision history of community-dwelling young-old self-drivers. None of the three domains of the SDBM (person-vehicle, person-environment, and person-vehicle-environment) significantly predicted collision history, and the three domains of the DHQ (difficulty, crash and citations, and driving space) were also not significant predictors of collision history (Table 3).

DISCUSSION

This study investigated the accuracy of the SDBM and DHQ in identifying the automobile accident history of community-dwelling young-old self-driving adults. The main findings of this study were as follows. First, the AUC was the greatest for the driving space of the DHQ, and the lowest for the person-vehicle domain of the SDBM. Second, overall the AUC was higher for the DHQ than for the SDBM. Finally, neither the SDBM or DHQ were well-explained predictors of collision history.

Traffic accident-related injuries of the elderly are steadily increasing, and are becoming a major social problem in post-industrial societies as the older population grows. Therefore, screening for problematic driving behaviours of risk of older self-driving adults is vital. Previous researchers have studied screening tests for risk of traffic collisions in older drivers[2, 7]. However, it is insufficient to base screening of driving abilities or the risk of traffic collisions on sub-groups of age, as older adults vary in terms of their physical and cognitive abilities. Therefore, this study evaluated two major measurement tools, the SDBM and the DHQ. Previous studies have identified relationships between aging-related conditions (visual impairment, cognitive impairment, or motor impairment) and problematic traffic collisions[5, 8, 9]. Owsley et al. examined the role of cataract in driving using the DHQ. They reported that older drivers with cataract experience a restriction in their driving mobility and a decrease in their safety on the road[5]. Woolnough et al. reported that the prospective follow-up of cohort of older drivers, including both prospective collision records and identification of at-fault status, would help to clarify the relationship between vision, cognition and motor or somatosensory skills and fitness to drive[8]. However, this study only included normal aging young-old self-driving adults. Classen et al. studied item development and validity testing of older adults SDBM. They reported the SDBM has relevance as a self-report instrument for assessing older drivers[6]. The results of the current study suggest that the SDBM and DHQ can predict driving-related collision history based on the AUC values. However, the SDBM and DHQ were not accurate screening tests for the traffic collision history of young-old self-driving adults. This may be due to the limitation created by the relatively small sample size of the young-old self-driving adults.

This study also had a cross-sectional design and only young-old adults were studied. Future studies will be needed using larger samples of young-old self-driving adults, as well as investigations of other sub-groups of older adult drivers such as middle-old and the oldest adults.

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