REME • Rev Min Enferm. 2023;27:e-1503
DOI: 10.35699/2316-9389.2023.40468

RESEARCH

SOCIODEMOGRAPHIC AND CLINICAL FACTORS ASSOCIATED WITH HANDGRIP STRENGTH IN ELDERLY AUTOMOBILE DRIVERS

FATORES SOCIODEMOGRÁFICOS E CLÍNICOS ASSOCIADOS À FORÇA DE PREENSÃO MANUAL DE IDOSOS CONDUTORES DE VEÍCULOS

FACTORES SOCIODEMOGRÁFICOS Y CLÍNICOS ASOCIADOS A LA FUERZA DE PRENSIÓN DE LA MANO EN CONDUCTORES DE VEHÍCULOS DE ANCIANOS

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Funding: *Fundação Araucária - Apoio ao Desenvolvimento Científico e Tecnológico do Paraná.*

Submitted on: 07/14/2022
Approved on: 02/07/2023

Responsible Editors:
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ABSTRACT

Objective: to investigate the association between handgrip strength and sociodemographic and clinical characteristics of elderly automobile drivers. **Method**: cross-sectional study, carried out in traffic medicine clinics in the city of Curitiba/Paraná, with 421 elderly people (≥ 60 years old). Statistical analysis was performed using the Logistic Regression model and the Wald Test, considering a 95% confidence interval and p values <0.05 as significant. **Results**: eighty-four (20%) seniors had reduced handgrip strength. Reduced handgrip strength was associated with age group (p=0.001) and hospitalization in the last year (p=0.002). **Conclusion**: there was a significant association between the handgrip strength of elderly drivers and the variables age and hospitalization in the last year. Thus, it is essential to include specific assessments, centered on sociodemographic and clinical variables specific to the elderly person, during the aptitude test to drive automobiles.
Keywords: Hand Strength; Aged; Automobile Driving; Automobile Driver Examination; Cross-Sectional Studies.

RESUMO

***Objetivo**: investigar a associação entre força de preensão manual e características sociodemográficas e clínicas de idosos condutores de veículos automotores. **Método**: estudo transversal, realizado em clínicas de medicina de tráfego na cidade de Curitiba/Paraná, com 421 idosos (≥ 60 anos). Realizou-se análise estatística pelo modelo de Regressão Logística e Teste de Wald, considerando intervalo de confiança de 95% e valores de p <0,05 como significativos. **Resultados**: oitenta e quatro (20%) idosos apresentaram força de preensão manual reduzida. A força de preensão manual reduzida foi associada à faixa etária (p=0,001) e à hospitalização no último ano (p=0,002). **Conclusão**: houve associação significativa entre a força de preensão manual de idosos motoristas e as variáveis idade e hospitalização no último ano. Dessa forma, torna-se essencial a inclusão de avaliações específicas, centradas nas variáveis sociodemográficas e clínicas próprias da pessoa idosa, durante o exame de aptidão para dirigir veículos automotores.*

Palavras-chave: *Força da mão; Idoso; Condução de Veículo; Exame para Habilitação de Motoristas; Estudos Transversais.*

RESUMEN

***Objetivo**: investigar la asociación entre la fuerza de prensión de la mano y las características sociodemográficas y clínicas de los ancianos conductores de vehículos automotores. **Método**: estudio transversal, realizado en clínicas de medicina de tránsito de la ciudad de Curitiba/Paraná, con 421 ancianos (≥ 60 años). El análisis estadístico fue realizado por el modelo de Regresión Logística y Test de Wald, considerando intervalo de confianza de 95% y valores de p <0,05 como significativos. **Resultados**: 84 (20%) sujetos ancianos presentaron reducción de la fuerza de prensión de la mano. La reducción de la fuerza de prensión de la mano se asoció al grupo de edad (p=0,001) y a la hospitalización en el último año (p=0,002). **Conclusión**: hubo una asociación significativa entre la fuerza de prensión de la mano de los conductores ancianos y las variables edad y hospitalización en el último año. Así pues, es esencial incluir evaluaciones específicas, centradas en las variables sociodemográficas y clínicas de los ancianos, durante el examen de aptitud para conducir vehículos automotores.*

Palabras clave: *Fuerza de la Mano; Anciano; Conducción de Automóvil; Examen de Aptitud para la Conducción de Vehículos; Estudios Transversales.*

How to cite this article:
Lenardt MH, Lourenço TM, Betiolli SE, Binotto MA, Cechinel C, Barbiero MMA. Sociodemographic and clinical factors associated with handgrip strength in elderly automobile drivers. REME - Rev Min Enferm. 2023[cited _____];27:e-1503. Available from: https://doi.org/10.35699/2316-9389.2023.40468

INTRODUTION

Among the challenges imposed on society by the rapid growth of the elderly population, the increase in the number of elderly drivers who seek to continue their automobile license stands out. This is due to the complexity of driving a car, which involves different skills, such as motor, visual and cognitive skills. Even in the face of a healthy aging process, these skills undergo changes over the years and need to be monitored.[1]

The aging process affects musculoskeletal and neuromuscular function, which can lead to a decrease in muscle strength, motor control and coordination.[2,3] For this reason, it is essential to evaluate these conditions of elderly people, aiming at driving safely and avoiding risks in traffic.

In this perspective, the National Traffic Council considers the Handgrip Strength (HGS) as an important criterion for evaluating candidates for automobile licenses, establishing minimum values to be considered for approval — determined by Resolution No. 425/2012. It is necessary to reach a minimum of 20 kgf in both hands for categories A and B and 30 kgf for the other qualification categories. This condition is imposed both for the first license and for renewal, and these values are stipulated for the general population (≥ 18 years old), regardless of age group.[4]

HGS reduction is considered a marker of physical frailty in the elderly, according to the frailty phenotype, commonly called Fried's phenotype. It consists of five markers: unintentional weight loss; self-report of fatigue and exhaustion; decrease in gait speed; low level of physical activity; and HGS reduction, focus of the present study.[5] Physical frailty is defined as a "clinical state characterized by an increase in vulnerability in the individual, when exposed to internal and external stressors, in addition to being one of the main contributors to functional decline and early mortality in the elderly".[6]

Some factors related to sociodemographic characteristics,[7] such as advanced age, sex, low education, low income and clinical conditions[8] (such as the presence of chronic diseases, use of medication and need for hospitalization) interfere with the reduction of HGS. Elderly drivers who have these characteristics may have restrictions on automobile driving or even be prevented from continuing with the activity of driving an automobile.

Few studies in the scientific literature present the HGS theme in the elderly driver, and this topic is relevant for today's society, due to the increase in elderly people who maintain driving. Muscle weakness arising from the aging process, which can be identified by the reduction in HGS, poses risks to the elderly person driving an automobile for carrying out actions inherent to the act of driving. In this way, this reduction can compromise the safety of the elderly and other actors who are part of the traffic.

A cross-sectional study9 with 172 elderly people was carried out in the city of Curitiba/PR. Among those who intended to keep their driving license, 18.6% showed a reduction in HGS and, as a result, had their driving license downgraded. In a longitudinal study10 carried out in South Korea with 716 elderly people (≥ 65 years), researchers identified that advanced age, living in an urban area, having lower HGS, depression and impaired cognition are among the factors associated with the interruption of driving in the elderly. Therefore, the present study aims to investigate the association between handgrip strength (HGS) and sociodemographic and clinical characteristics of elderly car drivers.

METHOD

Cross-sectional quantitative study developed between January 2015 and December 2018 in ticket clinics registered with the Traffic Department of Curitiba, Paraná, where physical and mental aptitude tests for driving are carried out.

For sample calculation, we considered the estimate of the number of elderly people in the municipality, a confidence index (CI) of 95% (CI=95%), a significance level of five percentage points, a proportion estimate of 50% and a sampling error of 5%. From the estimated number of elderly people by the Instituto Brasileiro de Geografia e Estatística [Brazilian Institute of Geography and Statistics] - IBGE in the 2010 census for Curitiba-PR (198,089 elderly people), the sample calculation initially indicated 384 elderly people. Therefore, due to the possibility of losses and refusals, it was decided to add 10% to the final sample, which totaled 421 elderly people.

The following criteria were established for inclusion of the elderly in the study: being aged ≥ 60 years and presenting an appointment for the physical and mental aptitude tests for driving licenses in the ticket clinics chosen for the investigation. Exclusion criteria for the elderly were: to present temporary physical limitations for the application of physical examinations. Four hundred and sixty-five elderly people were recruited to participate in the study, of which 44 had the following reasons for refusing: lack of time (n=28); lack of interest in the subject (n=11); did not agree to provide personal data (n=3); and unhappiness/dissatisfaction with the final result of the automobile license exam (n=2). Therefore, the final sample consisted of 421 elderly people.

The selection of ticket clinics was carried out using the technique of simple random sampling, from a list of 54 accredited clinics made available by the Executive Traffic Agency. Each clinic was represented by a number from 1 to 54, the numbers being mixed in an urn. The draw to establish the order of clinics for data collection was performed manually. In each clinic, data were collected from 35 elderly people, up to the amount established by the sample calculation.

The Paraná Traffic Executive Agency system schedules users to take physical and mental aptitude tests, distributed among accredited ticket clinics, in an equitable, random and impartial manner. In the search for the homogeneity of the sample of the elderly in the clinics, an equal amount (n=35) of elderly per clinic was defined. The previously defined clinics were approached at random, with 14 located in different neighborhoods of the city being contacted. However, two clinics were excluded, one because of not having enough physical space to apply the tests and another because the responsible person did not accept to participate in the research.

Data were collected through semi-structured questionnaires and tests. The questionnaire contained sociodemographic and clinical questions with the variables of interest: gender, age range, marital status, education, monthly income, source of income, health problems, number of illnesses, use and number of medications, history of hospitalization in the last year, dizziness/fainting/vertigo and use of alcohol, tobacco or assistive technologies.

The Mini-Mental State Examination (MMSE)[11] was used for cognitive screening, according to the following cutoff points: no education – 17/18 points; 1 to 4 years of schooling – 20/21 points; 5 to 8 years of schooling – 23/24 points; and 9 or more years of schooling – 25/26 points.[12]

The focus of this study is the HGS component belonging to the frailty phenotype.[5] The HGS of the elderly was measured in kilograms/force (kgf) using a handheld hydraulic dynamometer (Jamar® brand), as instructed by the American Society of Hand Therapists (ASHT).13 The elderly performed the test three times, applying maximum pressure with the dominant hand. After adjustments for gender and BMI, HGS values corresponding to the lowest quintile (20%) indicated frail elderly for this marker[5] (Table 1).

Data were organized in a Microsoft Excel® 2015 spreadsheet and validated by double checking to verify the existence of possible inconsistencies. The analysis used descriptive (frequency distribution) and inferential statistics, using Chi-square and Fisher's exact tests, with the support of the statistical program IBM Statistical Package for Social Sciences (SPSS). Values of $p \leq 0.05$ indicated statistical significance.

For multivariate analysis, factors associated with the probability of having reduced HGS were jointly evaluated. A multivariate Logistic Regression model was adjusted, including as explanatory variables those that were significant in the univariate analysis. The variables age range (60-69.9; 70-79.9; ≥ 80 years old), work (no or yes), illnesses (no or yes), assistive technology (no or yes) and hospitalization in the last year (no or yes) were included. The variables that were not included were medications and number of medications (as they are associated with the disease variable) and retirement (as they are associated with the source of income variable — work).

The research project received a favorable opinion report for approval (nº 833.460) by the Ethics in Research in Human Beings Committee. The ethical principles of voluntary and consensual participation were observed from the signing of the Free and Informed Consent Term (ICF) of the participants, according to Resolution nº 466 of the National Health Council.[14]

Table 1 - HGS cutoff values, adjusted according to gender and Body Mass Index quartiles of the elderly. *Curitiba*, PR, 2018

MALE		FEMALE	
BMI (kg/m2)	Decreased HGS (kgf)	BMI (kg/m2)	Decreased HGS (kgf)
≥ 24.12	≤ 30.48	≥ 23.84	≤ 19.86
24.12┤ 26.21	≤ 32	23.84┤26.56	≤ 20.24
26.21┤ 28.70	≤ 31	26.56┤28.38	≤ 20.69
> 28.70	≤ 31.86	> 28.38	≤ 20

Note: BMI: Body Mass Index; FPM: Handgrip Strength; kgf: kilogram force.

RESULTADOS

Of the sample made up of 421 elderly applicants for the National Driver's License, 84 (20%) of them had reduced HGS, of which 44 (52.4%) were in the age range of 60-69.9 years old, 59 (70, 2%) were male, 28 (33.3%) received from 1.1 to 3 minimum wages, the majority being retired (n=70; 83.3%), of which 51 elderly (60.7%) were still working. There was a significant association between reduced HGS and age range (p=0.001), working elderly (p=0.014) and retirees (p=0.027) (Table 2).

Of the 84 (20%) elderly people who had reduced HGS, regardless of the variables included in the model, age and hospitalization in the last year were factors

significantly associated with the probability of having reduced HGS. Individuals aged ≥ 80 years are 2.80 times more likely to have reduced HGS than individuals aged between 60 and 69.9 years, as well as hospitalized individuals are 2.28 times more likely to have reduced HGS compared to non-hospitalized individuals in the last year (Table 3).

Table 2 - Association of handgrip strength to the sociodemographic characteristics of the elderly submitted to the physical and mental aptitude test for automobile registration. *Curitiba*, PR, Brazil, 2018

Variables	Categories	Handgrip Strength (HGS)				*p* Value
		HGS preserved		HGS reduced		
		n	%	n	%	
Gender	Male	235	69.7	59	70.2	1.000*
	Female	102	30.3	25	29.8	
Age range	60 – 69.9	234	69.4	44	52.4	0.001**
	70 – 79.9	88	26.1	28	33.3	
	≥ 80 years old	15	4.5	12	14.3	
Marital Status	Married	238	70.7	58	69.1	0.879**
	Divorced, separated	44	13.1	9	10.7	
	Widowed	38	11.3	12	14.3	
	Single	17	5.0	5	6.0	
Education	Read and write but had never been to school	28	8.3	9	10.7	0.772**
	Elementary School	98	29.1	21	25.0	
	High School	82	24.1	23	27.4	
	Higher Education	129	38.3	31	36.9	
Income	No income	20	5.9	3	3.6	0.180**
	0.1 a 1	25	7.4	12	14.3	
	1.1 a 3	109	32.3	28	33.3	
	3.1 a 5	66	19.6	20	23.8	
	5.1 a 10	59	17.5	13	15.5	
	> 10	58	17.2	8	9.5	
Work	Yes	184	54.6	33	39.3	0.014*
	No	153	45.4	51	60.7	
Retirement	Yes	240	71.2	70	83.3	0.027*
	No	97	28.8	14	16.7	
Pension	Yes	43	12.8	10	11.9	1.000*
	No	294	87.2	74	88.1	

Note: *Fisher's exact test; ** Chi-square test

Table 3 - Multivariate logistic regression model of handgrip strength reduced to the clinical variables of the elderly submitted to the physical and mental aptitude test for automobile registration. *Curitiba*, PR, Brazil, 2018

Variable	Classification	Total	Reduced handgrip strength n (%)	*p**	OR (95%CI)
Age Range	60 - 69.9 (ref)	278	44 (15.8%)		
	70 - 79.9	116	28 (24.1%)	0.416	1.27 (0.72 - 2.25)
	≥ 80 years old	27	12 (44.4%)	0.024	2.80 (1.15 - 6.84)
Work	Yes (ref)	217	33 (15.2%)		
	No	204	51 (25.0%)	0.134	0.67 (0.40 - 1.13)
Diseases	No (ref)	126	16 (12.7%)		
	Yes	295	68 (23.1%)	0.112	1.64 (0.89 - 3.02)
Assistive technology	No (ref)	416	80 (19.2%)		
	Yes	5	4 (80%)	0.109	6.46 (0.66 - 63.5)
Hospitalization in the last year	No (ref)	378	67 (17.7%)		
	Yes	43	17 (39.5%)	0.024	2.28 (1.12 - 4.64)

Note: *Multivariate Logistic Regression Model and Wald Test, $p<0,05$

DISCUSSION

Reduced HGS was associated with the sociodemographic characteristics of the elderly, with emphasis on age [p=0.024; OR 95%CI = 2.80 (1.15 – 6.84)] and hospitalization in the last year [p=0.024; OR 95%CI = 2.28 (1.12 – 4.64)]. Studies15-17 point to the age factor as a potential reducer of muscle strength. In Singapore, a cross-sectional study with 2,043 elderly people aged ≥ 60 years showed a mean HGS, in the 60-64 age group, of 31.1 kgf and 18.2 kgf for men and women, respectively. In the age group ≥ 85 years, the values dropped to 18.5 kgf in women and 12.4 kgf in men. Handgrip strength was significantly higher in the younger age group (60-64) when compared to other more advanced age groups, 70-74 (β = −3.29, p<0.001), 75-79 (β = − 5.28, p<0.001), 80-84 (β = −5.94, p<0.001) and 85+ (β = −9.15, p<0.001), with men presenting (β = 10.76; p<0.001) than women.[15]

In national surveys, in a cross-sectional study[16] developed in Curitiba, conducted with a sample of 243 elderly people, researchers found a significant association between handgrip strength and age (p=0.001). Another study[17] developed with a similar sample (203 elderly) was carried out with elderly users of primary health care. The results indicated a significant association between reduced HGS and the gender (p<0.001) and age (p<0.0012) variables, with repercussions on the impairment of these elderly people's activities of daily living.

The systematic review[18] that identified HGS studies and associations with sociodemographic variables selected 26 articles and, in 20 (76.9%) of them, it was observed that increasing age resulted in a decrease in the levels of muscle strength in the elderly. The probability of an association between lower strength levels and age is related to changes in the neuromuscular and endocrine system that occur with advancing age. The decrease in fast-twitch fibers is among these changes, reducing the total number of muscle fibers, decreasing the activation of agonist muscles, and increasing the demand for antagonistic muscles; consequently, the ability to revise motor units is lower.[19]

The reduced HGS marker also showed a significant association with the variable hospitalization in the last 12 months [p=0.024; OR 95%CI = 2.28 (1.12 – 4.64)]. Among the elderly who had a reduction in HGS, 17 (20.2%) of them required hospitalization in the last year. In the systematic review with meta-analysis[20] on the predictive value of HGS as a marker of vulnerability and association between HGS and mortality, of the 34 studies included, only one identified HGS associated with hospitalization. The study in question involved 3,075 elderly North Americans aged between 70 and 80 years, for whom the association between the risk of hospitalization and the variables strength, function, lean mass, and muscle density was evaluated. After a follow-up of 4.7 years, the relationship between HGS and the risk of hospitalization showed a relative risk of 1.56 (95%CI = 1.31 – 1.85).[21]

Research points to the loss of HGS after periods of hospitalization, which causes greater wear to the individual for his recovery. A cross-sectional study[22] carried out in Santiago (Chile) evaluated the predictive value of HGS during hospitalization and functional decline after 30 days of hospitalization. Of the sample consisting of

125 non-critical and hospitalized participants, functional decline was observed in 28.8% of them after 30 days, with HGS being associated with this decline (β = 0.025; OR= 0.974; 95%CI = 0.956 – 0.992; p=0.007).

The variables elderly who work (p=0.014) and who receive retirement (p=0.027) showed an association with reduced HGS. Those who still worked and had reduced HGS engaged in activities such as: taxi driver, truck, bus, visiting friends and relatives, picking up grandchildren from school and volunteering. Therefore, they are insufficient activities to acquire or maintain HGS.

The clinical variables diseases (p=0.016) and number of diseases (p<0.001) were associated with reduced HGS in the elderly. Corroborating these data, a study conducted in Girona (Italy) with 875 elderly people (≥ 75 years old) identified 217 (24.8%) drivers with comorbidities (3.7±2.9; p=0.001). Elderly people who still drove automobiles were in better health conditions, but no relationship was established between driving activity and maintaining good health. It was observed that elderly people with a greater number of comorbidities self-regulated and suspended driving automobiles, avoiding the withdrawal of their license during exams.[23]

Other clinical variables associated with HGS were "use of medications" (p=0.020) and "number of medications" (p=0.036). Most elderly people with reduced HGS, 65 (77.4%), use medication and use 1 to 3 medications (50; 59.5%), and some of these medications may interfere with safe driving. According to the Brazilian Association of Traffic Medicine,[24] 20% of traffic accidents in the country are caused by drivers whose reflexes are altered by drowsiness due to the use of antidepressants, anxiolytics, tranquilizers, and anticonvulsants. When driving an automobile, you must be in good physical and mental condition, due to the dynamic nature of traffic. Furthermore, the elderly are expected to know how to react to situations in a timely and safe manner.

A longitudinal study[25] carried out with men aged ≥ 70 years living in Sydney (Australia) investigated the relationship between medical prescription and physical frailty in 1,662 elderly people. It was observed that 31.6% of the elderly had reduced HGS and 627 (37.7%) used polypharmacy, of which 40 (56.3%) reported a decrease in HGS. It was concluded that the prescription of a high number of drugs presents a high risk of exacerbating frailty in some elderly people, and the prescription reduction is a therapeutic target for the management of care for physical frailty.

Regardless of whether the elderly person is frail or not for the HGS component, a periodic review of medications prescribed to frail elderly people and the discontinuation of those that are inappropriate is recommended.[26] Medication withdrawal is indicated by the Screening Tool of Older Person's Prescriptions/Screening guidelines (STOPP) and Tool to Alert doctors to Right Treatment (START), which bring guidelines for the deprescription of drugs and rational use of these drugs.[27,28]

The use of assistive technologies by the elderly was significantly associated with reduced HGS (p=0.020). Elderly people with greater mobility difficulties and who use technologies to move around were referred for evaluation at the traffic department, not being evaluated at the ticket clinics. A study[29] carried out in Ribeirão Preto (São Paulo), with 114 elderly people from the community, identified that 77% of them used support devices for their daily activities. The most used devices were grab bars (21.9%), cane (15.8%), walker (11.4%) and crutches (0.8%). The variables associated with frailty were cane (p=0.0026), walker (p=0.0386) and grab bars (p=0.0215). In the current literature, studies on the association between assistive technologies and HGS were found. Elderly people who use assistive technologies for walking need muscle strength and endurance for the safe use of these means, which provide them with independence in locomotion.

It should be noted that it was not possible to infer certain data due to the cross-sectional design of this study, as it makes the causality relationship of the studied variables unfeasible. The possibility of bias in the responses of the elderly to the self-report questions is considered, due to the convenience and interest in passing the automobile license. Another considerable limitation of the study was the Discussion of the Results item, due to the scarcity of studies in the scientific literature on the subject of HGS and automobile driving for the elderly.

CONCLUSION

The variables age ≥ 80 years and hospitalization in the last year were associated with reduced HGS in elderly automobile driving. Thus, in the aptitude test to drive automobiles, it is essential to include specific assessments centered on sociodemographic and clinical variables specific to the elderly person. The reduction in HGS cannot be overlooked by professionals who work in this segment, since muscle decline can compromise actions in the act of driving an automobile. For safer traffic, it is essential that, in programs related to driver education, there is the inclusion of the elderly person and their family members, in order to show the relationships between changes in

strength and muscle resistance generated by variables that are interconnected to the process of senescence and senility.

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