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ORIGINAL ARTICLES

Associated factors to surgical delay hip fracture in a Mexican hospital 33

Leonardo J. Candelario-Martínez, Francisco J. López-Esqueda, Gonzalo R. González-González, Marco V. González-Rubio, Nalleli García-Aguirre, and Juan M. Shiguetomi-Medin

Long-term cognitive impairment after liver transplantation in a third-level hospital in Mexico City 39

Gilberto A. Jiménez-Castillo, Lorena Velázquez-Álvarez, Alberto J. Mimenza-Alvarado, Sandra Juárez-Arellano, Ángel Flores-González, Ignacio García-Juárez, José A. Ávila-Funes, and Sara G. Aguilar-Navarro

Gait speed and interdisciplinary intervention in hospitalized older adults 44

Vanesa A. Carrera-Alcívar and Patricio G. Buendía-Gómez de la Torre

REVIEW ARTICLE

Religion, spirituality, and old age: A review of the literature 52

Dafne E. Durón-Reyes, Martha I. Mondragón-Cervantes, Yénesis C. Jiménez-Acosta, María S. Velázquez-Rangel, José L. Muñoz-Morales, Ana P. Navarrete-Reyes, David Leal-Mora, and Julio A. Díaz-Ramos

SHORT COMMUNICATION

Correlation between results of NEUROPSI, Mini-Mental State Examination, and Montreal Cognitive Assessment Studies in older adults with subjective memory complaint 58

César A. Moreno-Cervantes, Alejandra del R. Regalado-Villalobos, Sara Luna-Torres, José G. Rivera-Chávez, Sonia G. Saldaña-Cruz, and Jorge L. Torres-Gutiérrez





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Associated factors to surgical delay hip fracture in a Mexican hospital

Leonardo J. Candelario-Martínez¹, Francisco J. López-Esqueda^{1†}, Gonzalo R. González-González^{1*}, Marco V. González-Rubio¹, Nalleli García-Aguirre¹, and Juan M. Shiguetomi-Medina²

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Abstract

Objective: The objective of the study was to determine the factors that influence the surgical delay of hip fracture in older adults. **Materials and methods:** An observational, descriptive, and prospective study, which includes patients over 60 years with a diagnosis of hip fracture, admitted to the orthopedics service, from March 2018 to June 2019. The causes of surgical delay and the number of patients surgically operated before 48 h after admission until surgery were stratified as well as the number of days of hospital stay, complications, and costs related to surgical delay. **Results:** Seventy-eight patients were admitted to the study. The average hospital stay was 156 ± 66.5 h. The main complication was delirium and the average cost of hospitalization was $\$44,770.93 \pm 16,080.40$ Mexican pesos. Sixty-six patients suffered surgical delay and 12 (15.38%) underwent surgery in < 48 h. The causes of the delay were the non-availability of an operating room (66.66%), decompensation of comorbidities (24.24%), and use of antiplatelet agents or anticoagulants (9.09%). **Conclusions:** The causes of delay found are likely to be modified and resolved by the orthopediatric team, with the main objective of surgical care within the first 48 h of hospitalization.

Key words: Hip fracture. Surgical delay. Elderly.

Factores asociados al retraso quirúrgico de la fractura de cadera en un hospital Mexicano

Resumen

Objetivo: Determinar los factores que influyen en el retraso quirúrgico de la fractura de cadera en adultos mayores. **Material y métodos:** Estudio observacional, descriptivo y prospectivo que incluye pacientes mayores de 60 años con diagnóstico de fractura de cadera, ingresados al Servicio de Ortopediátrica de marzo del 2018 a junio del 2019. Se estratificaron las causas de demora quirúrgica y la cantidad de pacientes intervenidos quirúrgicamente antes de las 48 horas del ingreso hasta la intervención quirúrgica, así como la cantidad de días de estancia hospitalaria, complicaciones y costos relacionados con el retraso quirúrgico. **Resultados:** Setenta y ocho pacientes fueron ingresados al estudio. La estancia hospitalaria promedio fue de 156 ± 66.5 horas. La principal complicación fue el delirium y el costo promedio de hospitalización fue de $\$44,770.93 \pm 16,080.40$ pesos mexicanos. Sesenta y seis pacientes sufrieron retraso quirúrgico y 12 (15.38%) se intervinieron en menos de 48 horas. Las causas del retraso fueron: la no disponibilidad de quirófano (66.66%), descompensación de comorbilidades (24.24%) y uso de antiagregantes o anticoagulantes (9.09%). **Conclusión:** Las causas de retraso encontradas son susceptibles de modificar y resolver por parte del equipo ortopediátrico, teniendo como objetivo principal la atención quirúrgica dentro de las primeras 48 horas del ingreso hospitalario.

Palabras clave: Fractura de cadera. Retraso quirúrgico. Adulto mayor.

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INTRODUCTION

According to the World Health Organization, there are globally 125 million people 80 years of age or older. Between 2015 and 2050, the percentage of the inhabitants of the planet over 60 will almost double, from 12% to 22%. By 2050, 80% of the elderly will live in low- and middle-income countries, therefore, all countries will face significant challenges to ensure that their health and social systems are prepared to face this demographic change¹.

In Mexico, in 2018, 15.4 million people aged 60 years or older reside according to the “Encuesta Nacional de la Dinámica Demográfica” conducted by the Instituto Nacional de Estadística y Geografía².

In San Luis Potosí, the estimates of the Consejo Nacional de Población, in 2015, the group of older adults represented 7.6% (209,757 people) of the total population and by 2050, it is projected to be 16.6% (524,445 people)³.

Hip fractures are common, especially in elderly patients. As elderly population grows, the number of hip fractures continues to increase⁴. In our country, it is estimated that between 8.5% and 18% of women will have a hip fracture throughout their lives⁵.

In Mexico City, in 2005, the incidence of hip fracture was 1725 cases in women and 1297 cases in men per 100,000 inhabitants, with a projection of increase up to 7 times more by 2050⁶.

Surgical treatment of hip fracture is the standard of care for most patients⁷. Clinical practice guidelines recommend surgical intervention in the first 48 h of hospital admission as an indicator of the quality of care^{8,9}.

Surgical delay > 48 h from hospital admission to surgery is a factor that has been linked to an increased risk of medical complications, increased morbidity, mortality, and costs¹⁰⁻¹⁹. The length of hospital stay is an important factor that determines the use of resources and costs²⁰. The identification and modification of the factors associated with the delay of surgery and hospital stay have the potential to affect medical expenses and the quality of care for patients with hip fractures^{20,21}.

Given the increase in elderly people in San Luis Potosí, it is necessary to develop programs and strategies that are aimed at preventing hip fracture and, within the hospital environment, optimize the treatment, reducing the days of hospital stay, complications, and costs since this can be an important economic burden for the health system.

The objective of this study is to determine the factors that influence the surgical delay of hip fracture in older adults who enter the Central Hospital “Dr. Ignacio Morones Prieto,” in San Luis Potosí, Mexico.

MATERIALS AND METHODS

Patients over 60 years of age registered in a prospective database of proximal femur fractures who entered the orthopedic ward in the period from March 2018 to June 2019 were included in the study. Those patients who presented pathological fracture, polytrauma, simultaneous fracture of both hips, and refracture were discarded. On admission, general patient data, sex, age, and fracture date were recorded. The type of fracture was classified as intracapsular or extracapsular. The presence of comorbidities was recorded through the medical history or with the patient’s previous file. The Charlson comorbidity index, the ASA classification was calculated and the consumption of anticoagulant and/or antiplatelet drugs was recorded.

The patient was evaluated in the emergency room by the orthopedic surgeon, who requested a radiological study of the chest and pelvis, as well as electrocardiogram and laboratory studies. Subsequently, the geriatrics service is involved for comprehensive geriatric assessment, patient stabilization, pre-surgical assessment, and medical management.

In the area of hospitalization, the patient was admitted by orthopedics, with joint participation of geriatrics. Anesthesiology assessment is performed before surgery. The indicated surgical technique and the request for the osteosynthesis material depend on the trauma service. After surgery, the type of anesthesia, type of surgery, and osteosynthesis material used were recorded.

What was described in the guidelines was considered as surgical delay. This variable was categorized into two groups: no surgical delay and surgical delay. The causes of surgical delay of hip surgery were classified as follows: (1) use of anticoagulant or antiplatelet medication, (2) decompensation of comorbidities, and (3) lack of surgical time. Hospital hours, related complications, and hospitalization costs were recorded. An analysis of the continuous data summarized using averages, means and standard deviations were performed, while frequencies and percentages were used for categorical data.

RESULTS

In total, 92 patients who met the admission criteria were registered, 14 (4 polytraumatized, 1 for

Table 1. Baseline characteristics of the population

	With surgical delay	No surgical delay	Total %
Patients	66	12	78
Sex			
Female	42	10	54 (69.2)
Male	22	2	24 (30.7)
Age	80.0 ± 8.19	78.58 ± 8.77	80 ± 8.25
ASA			
I-II	54	11	65 (83.3)
III-IV	12	1	13 (16.6)
Comorbidities			
1	31	4	35 (44.87)
≥ 2	35	8	43 (55.12)
Type of fracture			
Intracapsular			
Subcapital	10	1	11 (14.1)
Extracapsular			
Petrochanteric	54	11	65 (83.3)
Subtrochanteric	2	0	2 (2.56)
Charlson index	4.5 ± 1.42	4.75 ± 1.48	4.5 ± 1.42
Anesthesia			
General	13	3	16 (20.51)
Regional	53	8	61 (78.20)
Mixed	0	1	1 (1.28)
Type of surgery			
Internal fixation	34	10	44 (56.41)
Hemiarthroplasty	20	2	22 (28.2)
Arthroplasty	12	0	12 (15.38)
Types of prosthesis			
Total prosthesis	20	2	22 (28.20)
Partial prosthesis	15	0	15 (19.23)
Endomedular nail and others	31	10	41 (52.56)

simultaneous fracture of both hips, 5 for pathological fractures, and 4 for refracture) were excluded from the study. Seventy-eight patients were included in the study. The mean age was 80 ± 8.25 years (Table 1). The average Charlson index was 4.5 ± 1.42 (58% of patients presented 2 or more comorbidities). The type of fracture that predominated was extracapsular, occurring in up to 85.6% of patients. The most frequent surgery was open reduction and internal fixation in 56.4% of patients; regional anesthesia was the most prevalent (78.2%). The type of prosthesis most used was the endomedular nail and internal fixations in 52.56% followed by total prostheses (22.2%) and partial prostheses (19.3%).

Twelve patients (15.38%) were intervened within the first 48 h after admission to the emergency department. The expected average surgical time from admission was 102.6 ± 56.8 h. The average surgical delay was 77.4 h for patients who underwent surgery 48 h after admission.

The main cause of delay was the lack of surgical time (66.6%) followed by decompensation of comorbidities (24.2%) and use of antiplatelet agents or anticoagulants (9.1%). The main causes of decompensation were infectious processes in 6 patients (37.5%), cardiovascular problems in 3 (18.75%), gastrointestinal problems in 3, anemia in 2, hyponatremia in 1, and cerebral vascular accident in 1.

The average hospital stay was 154.3 ± 66.5 h, being 8.1% higher in the group with surgical delay (166.1 ± 64.2 h) and 86.7% lower in the group without delay (82.66 ± 15.59 h).

In the group of patients who had surgical delay, there was a greater number of complications compared to the group without delay (Fig. 1); the main causes being delirium in 22 patients (68.75%) and infections in 6 (18.75%). There were no deaths.

The average cost of general hospitalization without taking into account the osteosynthesis material was \$

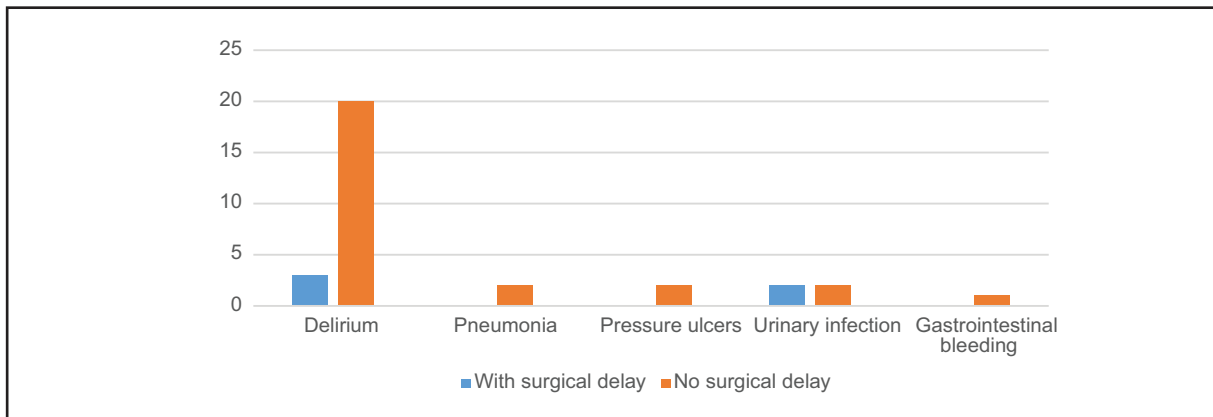


Figure 1. Hospital complications.

24,770.70 ± 8997.86 Mexican pesos; in patients without surgical delay, the hospital cost was \$ 18,136.71 ± 3299.18 Mexican pesos (36.5% lower); and for patients with surgical delay, it was \$ 25,549.49 ± 9248.67 Mexican pesos (3.0% higher), with a difference per patient between the two groups of \$ 7412.78 Mexican pesos.

Adding the cost of osteosynthesis material, the average expenditure was \$ 44,770.93 ± 16,080.40 Mexican pesos, amounting to \$ 45,951.08 ± 16,070.78 Mexican pesos (2.5% more) for patients with surgical delay and falling to \$ 36,185.98 ± 13,996.12 Mexican pesos (23.7% less) for patients without surgical delay, with a difference of \$ 9765.10 Mexican pesos.

DISCUSSION

The main finding in this study is that the main causes that delay hip surgery in our hospital are lack of surgical time (66.6%) followed by decompensation of comorbidities (24.2%) and use of antiplatelet or anticoagulants (9.1%).

Ojeda-Thies et al. published an analysis of the National Registry of Hip Fracture (RNHF) Spanish, where an annual report of 2018 was made, mentioning that the lack of available operating rooms was the reason for surgical delay in approximately half of the cases studied²².

Our results show that the main cause of decompensation was infections followed by cardiovascular and gastrointestinal problems, while in the United States, a study of three hospitals in Phoenix, Arizona, related surgical delays with instability of medical conditions, such as coagulopathy and cardiac comorbidities as the main causes²³.

Another measure of comparison is the percentage of patients who intervene in the first 24 h. In Spain,

in 2018, it was 18.1% in the population of 75 years or more; and at 48 h, it was 40.3%²².

In the United States, up to 95.2% of people over 65 years old are surgically operated in < 48 h²⁴. In comparison with our environment, we found that only 1.5% (1 patient) was intervened in the first 24 h and 15.3% within 48 h in a population aged 60 or over, with rates below the countries listed (Table 2).

Regarding the type of populations studied, the Spanish RNHF has an average of 86.7 ± 5.5 years, with a range of 75-108, with a prevalence of women of 75.4%²².

In our sample, the average age was 80 ± 8.2 years, range 60-101, with a prevalence of 69.2% of women. An average of 71.2 ± 16.5 years has been described in China²⁵, unable to obtain a range and percentage of women, while in the US two studies, one in Phoenix had an average age of 82.3 years with 70.7% of women²³ and another in Miami found 84 years on average with 75.5% of women²⁴.

The mean hospital stay in our study was 6.4 days, while in the Spanish RNHF, 11 ± 6.7 days are reported²², this difference between the two populations is probably explained by the time of rehabilitation since, in Spain, it is slightly greater so the hospitalization time increases; Jackson et al. reported a stay of 4.7 ± 2.7 days for a multidisciplinary team²³; and in China, 14.8 ± 11.8 days were reported²⁵.

There is evidence that the delay in surgery longer than 48 h has been associated with an increased risk of mortality and perioperative complications^{26,27}. This relationship was also presented in our results, mainly due to the increase in delirium in the surgical delay group, although it should be noted that mortality was zero in both groups.

In a multicenter study of several provinces of China published in 2018, an average hospitalization cost

Table 2. Comparison with other studies

	Spain ²² (RNHF)	United States		China ²⁵	Mexico	
		Phoenix ²⁸	Miami ²⁴		San Luis Potosi	Mexico ³⁰
Published year	2019	2019	2018	2018	2020	2018
Duration of follow-up (moths)	12	72	36	24	15	8
Years of completion of the study	2018	2011-2016	2015-2017	2014-2015	2018-2019	2017-2018
Cases included	7208	2895	485	27,205	78	70
Hospitals included	54	3	1	73	1	1
% of women	75	70.7	75.5	-	69.2	68.6
Age (average)	86.6	82.3	84	71.2 ± 16.5	80 ± 8.25	83 ± 7
ASA 3-4 (%)	61	-	-	-	16.6	-
Pertrochanteric fracture (%)	52	53.5	-	-	82.05	-
Spinal anesthesia (%)	93	-	-	-	78.2	-
Type of surgery						
Internal fixation	60	63.6	-	42.4	52.5	-
Hemiarthroplasty or other	34	36.4	-	57.6	47.5	-
Hospital stay (average in days)	11 ± (6.7)	4.7	-	14.8 (± 11.8)	6.5 (± 2.75)	7
Total cost (average Mexican pesos)	-	67,233 ± 40,274	-	128,256 ± 84,571.2	44,770.93 ± 16,080.40	-
Surgery in < 48 h (%)	40.3	-	95.25	-	25.6	-

of \$ 53,440 ± 35,238 yuan was found²⁵ equivalent to 128,256 ± 84,571.2 Mexican pesos²⁸. In another multicenter study in Phoenix, Arizona, USA, published in 2019, the cost was the US \$ 5171 ± 3098²⁸ equivalent to \$ 67,233 ± 40,274 Mexican pesos²⁸. The average hospitalization costs per patient in our environment were \$ 44,770.93 ± 16,080.40 Mexican pesos, observing that the average hospitalization cost is higher in the two studies cited. These results are probably due to variables such as population characteristics, rehabilitation services, type of prosthesis, hospital stay, and complications.

In Mexico, an average hospital stay of 6 days, with a range of 1 and 81 days²⁹, was reported at the Instituto Mexicano del Seguro Social (IMSS) in 2015, and other in 2018, in an orthogeriatric unit of the IMSS, 7 days of hospital stay were reported³⁰, while in our orthopedics team, 6.4 days on average and a range between 1 and 12 days are reported.

In 2007, Carlos et al. reported the cost of an estimated hip fracture of \$ 37,363.67 Mexican pesos in the scenario of the Régimen de Protección Social en Salud known as Seguro Popular³¹, which becomes less than the average cost of hospitalization in our hospital, which depends on the same health agency,

without taking inflation into account.

Due to the large difference in the distribution and the number of patients included in the study, it was not possible to obtain a significant statistic between the cohort < 48 h and the cohort > 48 h, therefore, we consider a pilot study to determine the sample size in future research.

CONCLUSIONS

The main causes of surgical delay in our setting were lack of surgical time, use of antiplatelet or anticoagulant, and decompensated pathology, the first two factors can be modified. It is necessary to implement measures to strengthen the institutional protocols and actions of the orthopediatric team, through continuous improvement processes that allow reducing surgical delay in older adults with hip fractures.

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CONFLICTS OF INTEREST

None.

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ETHICAL DISCLOSURES

Protection of people and animals. The authors declare that the procedures followed conformed to the ethical standards of the responsible human experimentation committee and in accordance with the World Medical Association and the Declaration of Helsinki.

Confidentiality of the data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is held by the correspondence author.

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Long-term cognitive impairment after liver transplantation in a third-level hospital in Mexico City

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Abstract

Objective: This study aims to study the frequency of cognitive impairment and neurocognitive pattern of post-transplanted liver patients after 1 year of intervention. **Materials and methods:** This was a descriptive, cross-sectional study. It included transplant consult patients between October 2018 and May 2019. The cognitive evaluation included Montreal cognitive assessment (MoCA), 5-word test, and frontal assessment battery. ANOVA and Student's t-test were performed. **Results:** Seventy-six patients were included in the study. The mean age was 53.53 years (± 11.3). Forty-three (56.6%) of the patients had subjective memory loss, while only 33 (43.4%) had objective decline by cognitive tests. A frontal-subcortical pattern was shown. The affected domains were visuospatial abilities (-1.3 ± 0.95 , $p = 0.00$), attention (-0.75 ± 1.2 , $p = 0.00$), language ($-0.99 \pm 0.1.0$, $p = 0.00$), abstraction (-0.61 ± 1.6 , $p = 0.015$), and retrieval (-0.80 ± 1.1 , $p = 0.00$). **Conclusions:** Cognitive evaluation measured by MoCA is useful to detect cognitive impairment and a frontal-subcortical pattern in post-transplanted liver patients.

Key words: Liver transplant. Cognition. Cognitive impairment.

Deterioro cognitivo a largo plazo después de un trasplante de hígado en un hospital de tercer nivel en la Ciudad de México

Resumen

Objetivo: Conocer la frecuencia de presentación de deterioro cognitivo, así como el perfil neurocognitivo en pacientes postrasplantados de hígado después de un año de intervención. **Material y métodos:** Estudio descriptivo, transversal. Incluyó pacientes de consulta externa de trasplantes, entre octubre del 2018 y mayo del 2019. La evaluación neurocognitiva consistió en el Examen Cognitivo de Montreal (MoCA), la Prueba de 5 palabras y la Batería de Evaluación del Lóbulo Frontal. Se realizó ANOVA y de Student. **Resultados:** Se reclutaron 76 pacientes. La media de edad fue 53.53 años (± 11.3). Cuarenta y tres (56.6%) pacientes refirieron queja subjetiva de memoria, aunque solo 33 (43.4%) presentaron alteración objetiva mediante pruebas. Se confirmó la presencia de un perfil frontosubcortical. Los dominios afectados fueron: habilidades visuoespaciales (-1.3 ± 0.95 ; $p = 0.00$), atención (-0.75 ± 1.2 ; $p = 0.00$), lenguaje (-0.99 ± 1.0 ; $p = 0.00$), abstracción (-0.61 ± 1.6 ; $p = 0.015$) y evocación (-0.80 ± 1.1 ; $p = 0.00$). **Conclusiones:** La evaluación cognitiva mediante el MoCA resulta útil para detectar un perfil subcortical en pacientes postrasplantados.

Palabras clave: Trasplante hepático. Cognición. Deterioro cognitivo.

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INTRODUCTION

As a result of epidemiologic transition, chronic degenerative diseases have increased, among them, liver failure. Due to its high prevalence, INEGI and WHO rank liver failure among the top 10 causes of morbimortality nation and worldwide^{1,2}.

At this time, according to the 2017 CENATRA, liver transplant (LT) represents the third most frequent cause for organ replacement in Mexico, only after cornea and kidney³. It is also considered the treatment of choice for end-stage liver disease. Some additional indications for the procedure are evidence of fulminant hepatic failure, a systemic life-threatening complication associated with liver failure, metabolic liver diseases, or commonly known cirrhosis complications such as hepatic encephalopathy (HE), ascites, hepatocellular carcinoma, hepatorenal syndrome, or hemorrhage due to portal hypertension⁴.

After LT, some patients have a higher prevalence of cognitive impairment, some of the risk factors associated are number of HE episodes, perioperative complications such as hypoperfusion, use of immunosuppression, and the presence of comorbidity⁵. For example, HE causes neurotransmission modifications⁶, while immunosuppressors have been associated with microvascular or white matter lesions^{7,8}. These cognitive disorders have been considered mostly as reversible, due to a healthy liver replacing and disrupting the physiopathological mechanisms.

Although cognitive impairment is considered as reversible, literature reports a post-LT variable percentage where cognition disorders are sustained, this ranges from 8% to 70%⁹. This manifestation or complication has been named post-transplant encephalopathy (PTE)¹⁰. The cognitive domains reported also vary between studies^{11,12}.

At present, PTE prevalence data are unknown in Mexico. Therefore, the objective of our study is to acknowledge cognitive impairment frequency after liver transplantation and its cognitive performance profile measured through Montreal cognitive assessment (MoCA).

MATERIALS AND METHODS

This was a descriptive, cross-sectional study. Participants were recruited from the LT outpatient clinic located at "Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán," a third-level hospital in Mexico City. The recruitment period was

established between October 1, 2018, and June 30, 2019. Those included in this study had the following characteristics: cirrhosis of any origin, age of 18 years or older, and cognitive evaluation at least 1 year after the LT procedure. Participants with visual or hearing issues and neurologic or psychiatric diseases that may interfere with the evaluation, decompensated clinical or metabolic conditions such as uncontrolled hypothyroidism, any degree HE, use of toxic substances, or acute cellular rejection were excluded from the study.

The specialist in LT verified the inclusion and exclusion criteria and evaluated the laboratory results for every patient; further, patients were invited to participate in this study. With the previous approval of the Institutional Committee and after obtaining and informed consent, sociodemographic and clinical data were obtained for each participant. Cognitive evaluation was performed by a specialist in geriatric neurology and consisted in the following tests: MoCA¹³, 5-word test¹⁴, and the frontal assessment battery¹⁵.

Statistical analysis

Descriptive analysis was performed by measures of central tendency and dispersion. ANOVA and Student's t-test were used to compare means. Participants were categorized or grouped according to their MoCAs global score in ≥ 27 points, 24-26 points, and < 24 points. Cognitive domains evaluated through neuropsychological tests were transformed to z-scores to simplify comparisons among the sample. $p < 0.05$ was considered as statistically significant. Statistical analysis was performed using the SPSS software for Windows® (SPSS Inc., Chicago, IL version 23.0).

RESULTS

Seventy-six participants were included in the study. The mean age was 53.53 (± 11.3) years, 46 (60.5%) of them were female, and mean education was 13.89 (± 4.8) years. All participants were independent of their basic and instrumental activities of the daily living. Of them, 56.6%, 43 subjects had a subjective cognitive decline; thus, only 33 (43.4%) participants had objective cognitive decline shown in neuropsychological tests (Table 1).

Our sample had the following clinical characteristics: 19 (25%) had diabetes mellitus type 2 (DM2), 14 (18.4%) hypertension, and 13 (17.1%) hypothyroidism. Similarly, 38 (50%) had at least one HE episode

Table 1. Demographic and clinical characteristics of post-live transplant patients

Variable Mean \pm SD/n (%)	Total (n = 76)	MoCA > 27 (n = 43)	MoCA 24-26 (n = 19)	MoCA < 24 (n = 14)	p*
Age	53.53 \pm 11.61	51.74 \pm 12.48	55.00 \pm 9.97	57.07 \pm 10.48	0.273
Female (%)	46 (60.5)	27 (62.8)	13 (68.4)	6 (42.86)	0.299
Education	13.89 \pm 4.84	14.33 \pm 4.07	14.68 \pm 5.1	11.50 \pm 6.10	0.117
Charlson index	1.76 \pm 1.62	1.58 \pm 1.61	2.05 \pm 1.81	1.93 \pm 1.439	0.531
Hypertension (%)	14 (18.4)	8 (18.6)	4 (21.05)	2 (14.3)	0.883
Diabetes mellitus (%)	19 (25)	9 (20.9)	5 (26.3)	5 (35.7)	0.534
Dyslipidemia (%)	2 (2.6)	1 (2.3)	0 (0)	1 (7.1)	0.440
Hypothyroidism (%)	13 (17.1)	6 (13.9)	2 (10.5)	5 (35.7)	0.116
Hepatic encephalopathy (%)	38 (50)	23 (53)	7 (36)	8 (57)	0.404
Liver failure – years	5.76 \pm 8.49	5.30 \pm 5.25	5.63 \pm 5.17	7.36 \pm 8.49	0.532
Memory complaint (%)	43 (56.6)	24 (55.8)	13 (68.4)	6 (42.9)	0.338

p-value represents differences among groups.
SD: standard deviation, MoCA: montreal cognitive assessment.

Table 2. Cognitive domains evaluated by the Montreal cognitive assessment – z scores

Variable Mean \pm SD	Total (n = 76)	MoCA > 27 (n = 43)	MoCA 24-26 (n = 19)	MoCA < 24 (n = 14)	p*
Visuospatial/executive function	0.00 \pm 0.99	0.59 \pm 0.53	-0.34 \pm 0.70	-1.3 \pm 0.95	< 0.001*
Denomination	-0.27 \pm 0.99	0.08 \pm 0.00	0.08 \pm 0.00	-0.53 \pm 2.3	0.108
Attention	-0.01 \pm 1.0	0.38 \pm 0.66	-0.36 \pm 1.2	-0.75 \pm 1.2	< 0.001*
Language	0.00 \pm 0.99	0.47 \pm 0.64	-0.33 \pm 0.99	-0.99 \pm 1.0	< 0.001*
Abstraction	-0.00 \pm 0.99	0.24 \pm 0.62	-0.11 \pm 0.96	-0.61 \pm 1.6	0.015*
Orientation	-0.08 \pm 1.3	0.21 \pm 0.00	1.9 \pm 0.43	-0.56 \pm 2.1	< 0.074
Free recall	0.00 \pm 1.0	0.39 \pm 0.82	-0.28 \pm 0.80	-0.80 \pm 1.1	< 0.001*
Cued recall	0.00 \pm 0.99	-0.12 \pm 0.96	0.20 \pm 1.1	0.13 \pm 0.88	0.426
Recognition recall	-0.0 \pm 0.99	-0.35 \pm 0.62	0.12 \pm 0.92	0.91 \pm 1.4	< 0.001*
5-Word test	18.0 \pm 1.8	18.7 \pm 1.3	17.3 \pm 1.7	16.9 \pm 2.2	< 0.001*
FAB	0.01 \pm 0.99	0.29 \pm 0.90	-0.26 \pm 1.0	-0.47 \pm 0.91	0.013*

p-value represents difference between groups.
SD: standard deviation, MoCA: montreal cognitive assessment, FAB: frontal assessment battery.

Graded III or IV by the West Haven scale; besides, they had a mean of 5.76 (\pm 8.5) years of liver failure previous to the transplant procedure.

Based on the MoCA groupings, 43 (56.6%) participants had a global score \geq 27 points, 19 (25%) participants were included in the 24-26 points group, and 14 (18.4%) in the < 24 points group. After analyzing the different cognitive domains, the participants clustered in the < 24 points or cognitively worse group, showed a greater change in visuospatial abilities (-1.3 ± 0.95 , $p < 0.001$), attention (-0.75 ± 1.2 , $p < 0.001$), language (-0.99 ± 1.0 , $p < 0.001$), abstraction (-0.61 ± 1.6 , $p = 0.015$), and free recall

(-0.80 ± 1.1 , $p = 0.00$) when compared to the best score group. Besides, it was shown that, although, spontaneous free recall was affected, there was a tendency to recover words by cued recall and recognition tasks (0.91 ± 1.4 , $p < 0.001$). The rest of the cognitive battery found significant differences in the 5-word test (16.9 ± 2.2 , $p < 0.001$) and FAB (-0.47 ± 0.91 , $p = 0.013$) (Table 2).

Therefore, the neuropsychological battery distinguished the presence of a frontal-subcortical profile in the post-LT participants, where attention and executive functions are affected, as free recall facilitated by cue recall and recognition.

DISCUSSION

Our study shows low cognitive performance in 43.4% of post-LT procedure. Specifically, a frontal-subcortical dysfunction was seen in these patients. The neuropsychological battery used to evaluate participants in this study, has not been utilized in other trials. Our results agree with the previous published literature in the frontal-subcortical circuit dysfunction, and, although worldwide known, the MoCA test has not previously been used for evaluation. Other studies denote the presence of major cognitive deficits in inhibitory control, attention, and motor function; some of them include orientation and free recall impairment. Although most patients are evaluated before the LT, post-LT assessments show frontal-subcortical domain dysfunction^{10,16-20}.

Other published trials have used different tests to evaluate global cognition and specific cognitive domain evaluations in post-LT patients. The most widely utilized is the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), which evaluates five cognitive domains: immediate recall, delayed recall, visuospatial abilities, attention, and language²¹. The Trail Making Test-B, which measures executive functions and attention, has also been applied¹⁶⁻¹⁸.

Usual cognitive tests for the evaluation of dementia such as the Mini-Mental State Examination (MMSE)²² and MoCA have also been applied but in a limited way. Meyer et al. evaluated 148 patients previous to LT with MMSE, TMT-A, TMT-B, and RBANS. Mean global cognition by MMSE was 28 points, and TMT-B was the most affected test¹⁸. However, as previously mentioned, these participants were assessed previous to the procedure. The MoCA test has only been used in one study. Ko et al. found a mean global cognition by MoCA of 24.42 ± 3.1 puntos²³. Specific cognitive domains were not defined. Comparatively, our study shows a mean MoCA test score of 26.26 ± 2.5 points.

As previously mentioned, post-LT patients could suffer cognitive impairment for multiple reasons, including HE previous to the procedure, immunosuppressant medication, and comorbidity presence. Approximately 30-45% of the patients have a HE episode during the course of their disease²⁴. In our study, 50% of our sample had at least one HE episode; however, there were no significant differences between MoCA groups. However, many of patients with liver failure are hard to classify cognitively. In the 1970s, the term minimal HE began to be used to describe cirrhosis or post-LT patients without clinical symptoms,

but with affection in the neuropsychological tests or electroencephalogram. Therefore, it is classified as a subclinical or silent HE²⁵. The percentage of patients with HE episodes could rise up to 50% or more if minimal HE is taken into account¹⁰.

HE has been described as the most important clinical risk factor for cognitive impairment. Its physiopathology is founded by the presence of ammonium (NH₃), inflammatory cytokines, and manganese deposits in basal ganglia. NH₃ crosses the blood-brain barrier and its metabolized by astrocytes; under glutamine synthetase action, it catalyzes into glutamine. Osmotic gradient and further astrocytic edema due to NH₃ presence lead to reactive oxygen species production and cognitive dysfunction²⁴.

Different trials have validated that a previous HE episode brings a worse cognitive prognosis. Although, after the acute event of HE, there is evidence of cognitive improvement, global scores do not reach values as non-HE patients¹⁶. Therefore, the question arises, is encephalopathy reversible after LT?²⁶

After LT procedure, cerebral hemodynamic changes have been shown by a decrease in the pulsatility index and resistance, as possible biomarkers that reflect an improved vasoconstriction and so cognition²⁷. Furthermore, after HE, LT reestablishes neuronal deficits in the default, dorsal attention, and central executive networks, been similar to healthy patients²⁸.

HE is not the only risk factor. Heits et al. emphasized the impact of LT pharmacologic treatment in cognition. By TMT-B test, processing speed was measured; patients medicated with cyclosporine and tacrolimus showed differences dose based. Tacrolimus once daily had the fastest TMT-B score, followed by tacrolimus twice a day and at last cyclosporin¹⁹. Our study had only five patients under cyclosporine regimen; therefore, a similar analysis was not completed.

Comorbidities are also a risk factor for cognitive impairment²⁹. Besides, HE, DM2, and cardiovascular risk factors bring a worse cognitive prognosis³⁰. Thus, the current management should also focus on prevention of risk factors such as cardiovascular and metabolic diseases. This emphasis has been the cornerstone for all-cause dementia or cognitive impairment and should transcend into the so-called PTE.

Our study has several limitations. The cross-sectional analysis is the most significant, as does not let to determine cause-effect relationships. Furthermore, patients were not evaluated previous to LT, their cognitive status pre-surgery is unknown. However, our study has several advantages, sample size brings

statistical power and internal validity. Likewise, this is the first study in post-LT Mexican population evaluated with practical and widely available cognitive tests, such as MoCA with particular cognitive domain analysis.

CONCLUSIONS

This study demonstrates a residual cognitive effect on cognition in post-LT participants. The full understanding of cognitive impairment in this context is still lacking and insufficient. Cognitive deficits are often undiagnosed in post-LT patients, yet risk factors such as HE are mostly present. The cognitive evaluation showed frontal-subcortical dysfunction established by poor performance in executive function/visuospatial abilities, attention, language, abstraction, and free recall with improvement in cue recall and recognition tasks. MoCA could be a useful and brief tool for the assessment of LT patients. Additional prospective studies are needed to establish long-term relationships to identify clinical factors susceptible to preventive actions.

CONFLICTS OF INTEREST

The authors have no conflicts to declare.

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ETHICAL DISCLOSURES

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

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Gait speed and interdisciplinary intervention in hospitalized older adults

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Abstract

Objective: The objective of the study was to determine the role of gait velocity as a predictor of functional recovery and the importance of the multidisciplinary team in hospitalized older adults. **Materials and methods:** A historical, fixed, correlation cohort of 152 patients was evaluated. It was developed in the geriatrics service of the National Police Hospital in Quito, during the period from May 2014 to September 2014. Demographic data were obtained from the unique medical records, and patients were evaluated using the comprehensive geriatric evaluation scales: Barthel Index, Mini-Mental test, Tinetti scale, Charlson Comorbidity Index, and gait speed measurement in 6 m in two moments; on admission and hospital discharge. **Results:** A statistically significant association ($p < 0.05$) was found with all the study variables. **Conclusions:** The improvement in gait after multidisciplinary intervention during hospitalization was relevant, gait speed was a predictor of reliable hospital stay, those patients with low rates of gait on admission remained hospitalized for a longer period of time.

Key words: Walking speed. March. Adult. Hospitalization. Observational Study. Geriatrics.

Velocidad de marcha e intervención interdisciplinaria en adultos mayores hospitalizados

Resumen

Objetivo: Determinar el papel de la velocidad de la marcha como predictor de recuperación funcional y la importancia del equipo multidisciplinario en adultos mayores hospitalizados. **Materiales y métodos:** Se evaluó una cohorte de correlación histórica, fija, de 152 pacientes. El estudio se desarrolló en el Servicio de Geriátrica del Hospital de la Policía Nacional en Quito, durante el periodo de mayo a septiembre del 2014. Los datos demográficos se obtuvieron de los registros médicos únicos y los pacientes fueron evaluados utilizando las escalas de evaluación geriátrica integral: Índice de Barthel, Mini-mental Test, Escala de Tinetti, índice de comorbilidad de Charlson y la medición de la velocidad de la marcha en 6 metros en dos momentos, al ingreso y al alta hospitalaria. **Resultados:** Se encontró una asociación estadísticamente significativa ($p < 0.05$) al correlacionar las escalas de valoración geriátrica integral y la velocidad de la marcha. Se resalta además la importancia de la intervención interdisciplinaria desde el ingreso del paciente. **Conclusiones:** La mejora en la marcha después de la intervención multidisciplinaria durante la hospitalización fue relevante, la velocidad de la marcha es un predictor de estancia hospitalaria fiable, aquellos pacientes con bajas tasas de velocidad de marcha al ingreso permanecieron hospitalizados durante un periodo de tiempo más largo.

Palabras clave: Velocidad de marcha. Adulto mayor. Hospitalización. Estudio observacional. Geriátrica.

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INTRODUCTION

Aging well is everyone's ideal, but a positive old age can be the result of a life framed in the parameters that social welfare contains. According to the National Institute of Statistics and Censuses (INEC) (2012)¹, life expectancy in Ecuador reached 76.19 years for both sexes, which places older adults as a priority group in health policies that would have to be focused on guaranteeing an adequate quality of life^{2,3} and optimization of resources.

Elderly patient must be evaluated holistically, for this, the best tool in our daily medical practice is the comprehensive geriatric assessment (VGI), whose main objective is the development of an individualized plan with a preventive, therapeutic, and rehabilitative approach, which guarantee adequate, effective medical care, with quality and warmth.

The geriatric patient presents particular characteristics, different from the general adult population so that attention is measured in terms of functionality, which involves physical, mental, affective, economic, and sociofamilial aspects². As components of the functionality, the basic activities of daily life (ABVD) such as bathing and dressing, the instrumental activities of daily life (AIVD) such as answering the telephone or shopping, cognitive status, balance, and mobility are described^{4,5}.

Globally and nationally, acute health problems constitute conditions of functional impairment in older adults and can lead to situations of severe disability such as immobility, instability, intellectual impairment, putting the individual at risk of disability, institutionalization, and death⁶.

It is essential to find a reliable parameter that allows predicting patients at risk of staying longer in hospital, greater possibility of hospital complications, and increased risk of functional loss after hospitalization^{6,7}. Therefore, the objective of this study was to determine the role of gait velocity as a predictor of functional recovery in hospitalized older adults.

During hospitalization, interdisciplinary intervention becomes a fundamental pillar in the treatment of an older adult. It has been shown that mortality decreases, improves functionality, decreases hospital readmissions, and contributes to the proper care of caregivers since the hospital stay is used to educate them about patient management when they are discharged from home. We emphasize the creation of a work team with spaces for dialogue, keeping the uniqueness of each member and contributing from it

with the common objective of the patient's integral well-being.

Globally, multiple tests have been studied to estimate the functionality, both biochemical and mechanical, dismissed for their high cost or low sensitivity and specificity⁷. Since 1995, physical tests have been driven by their easy application, low cost, and promising results. In 2000, Guralnik et al.⁸ proposed the speed of gait as a single measure to define the prognosis of disability. This validation of the test would be one of the most important impulses to recommend the speed of the march as a gold standard in the evaluation of the movement and therefore of the functionality^{9,10}.

Varela, Montero-Odasso et al., and other researchers^{4,11,12} recommend setting specific cutoff points for each population; in Europe, the most accepted consensus and from which the majority of studies take reference are the European Consensus of Sarcopenia¹³, which establishes a cutoff point of 0.8 m/s, differentiating them as slow and fast. Due to the constitutional and clinical characteristics of European patients, these values are not applicable in Latin American populations. In the absence of locally conducted studies, we take as a reference the ranges of walking speed used in research with Colombian older adults¹⁴, a population similar to ours. These values were as follows: 0.1-0.39 m/s: very slow, 0.4-0.59 m/s: slow, 0.6-0.79 m/s: intermediate, and greater than or equal to 0.80 m/s: fast.

MATERIALS AND METHODS

A fixed historical correlation cohort was evaluated, a total of 167 patients were analyzed. The final sample was 152 patients. All older adults who required hospitalization in the geriatric unit of acute were included and their basic pathology did not prevent them from walking. Thirteen patients due to the inability to perform the gait speed test, 1 due to death during hospitalization, and 1 due to loss of data were excluded from the study. The study was carried out in the geriatrics service of the Quito Hospital No. 1 of the National Police, during the period from May 25, 2014, to September 25, 2014.

Demographic data and clinical-geriatric characteristics were taken from the single clinical history during hospitalization, and patients were evaluated using the comprehensive geriatric assessment scales: Barthel Index (ABVD), Mini-Mental test (cognitive state), scale of Tinetti (balance mobility), Charlson

Comorbidity Index (accumulation of diseases), and the measurement of the speed of walking in 6 m (m/s), in two moments, at admission and hospital discharge, making a correlation by groups before/after between these two moments. For gait velocity, patients were classified in the following ranges: 0.1-0.39 m/s = Very slow, 0.4-0.59 m/s = Slow, 0.6-0.79 m/s = Intermediate, and ≥ 0.80 m/s = Quick.

To avoid deterioration of the speed of gait, from the patient's admission, an integral intervention was carried out with the interdisciplinary team of the hospital headed by the Geriatra, conducting weekly meetings and joint visiting passes with the nutrition and dietetics services, physiotherapy, respiratory therapy, and psychology, to approach patients multidimensionally. Early mobilization was also promoted as soon as its acute pathology allowed it. In the first 24-48 h of hospitalization, the patient, under the supervision and direction of the physical rehabilitation, was already trying the standing.

In the daily visiting passes, a climate of cooperation was created, with a predominance of good communication, fostering dialogue both with the rest of the health professionals and with the patient's relatives.

The following programs were used to analyze the data: Microsoft Excel 2010 (spreadsheet) for database creation. For the bivariate correlation between gait velocity as the independent variable and geriatric assessment scales, the Statistical Package for the Social Sciences (SPSS) Inc., Chicago, version 18.0 for Windows XP, was used at the Pontifical Catholic University of Ecuador.

The descriptive statistics included the means, standard deviations (SD), and proportions to characterize the study population, according to the type of variable, and contingency tables were drawn up. Subsequently, the differences of the means and proportions were analyzed by means of the "t"-tests of Student's and analysis of variance (ANOVA).

Pearson's correlation coefficient was used for the correlation of the scales with quantitative random variables, then determining whether said that coefficient is statistically different from zero; a test was applied based on the distribution of Student's t-test for mixed elements with two categories and ANOVA, for mixed variables with more than two categories. The statistical significance of each of the variables of the study was identified. Any value of $p < 0.05$ was considered statistically significant. For the calculation of these variables, 95% confidence intervals were used and the Chi-square test was used for qualitative variables.

Table 1. Diagnosis of admission of elderly patients admitted

n = 152	Number	%
Pneumonia	64	42.1
Acute coronary syndrome	1	0.7
Coxartrosis	1	0.7
Urinary tract infection	7	4.6
Abdominal pain in study	2	1.3
Congestive cardiac insufficiency	4	2.6
Mild crane-encephalic trauma	1	0.7
Hepatic cirrhosis	1	0.7
Gastric cancer	2	1.3
Acute gastroenteritis	1	0.7
Lumbosciatic pain	1	0.7
Hypertensive crisis	4	2.6
Soft parts infection	1	0.7
Acute crisis by herpes zoster	2	1.3
Convulsive crisis	1	0.7
Colangitis	1	0.7
COPD over infected	1	0.7
Exacerbated COPD	19	12.5
Anemia	2	1.3
Pulmonary embolism	1	0.7
Mellitus diabetes decompensated	15	9.9
Sepsis	4	2.6
Bronchospasm	2	1.3
Hydroelectrolytic unbalance	14	9.2
Total	152	100.0

COPD: chronic obstructive pulmonary disease.

RESULTS

The average age in the study population was 78.4 years with an SD of 12.4 years, a minimum of 65 years and a maximum of 98 years, with a slight predominance of the female sex with 53% (80:152) and 47% (71:152) for the male sex.

About 51.3% of our older adults did not present any chronic disease diagnosed before admission. Only 29 (19.1%) presented more than 3 points in the Charlson Comorbidity Index, which gives them a high risk of mortality in 1 year.

When it comes to physical, respiratory, and cardiac rehabilitation, the older adults participating in the study received it for the most part. Only 25.7% had no need or no interconsultation was indicated to these services.

The most prevalent admission diagnosis was community-acquired pneumonia (N-acetyl cysteine) with

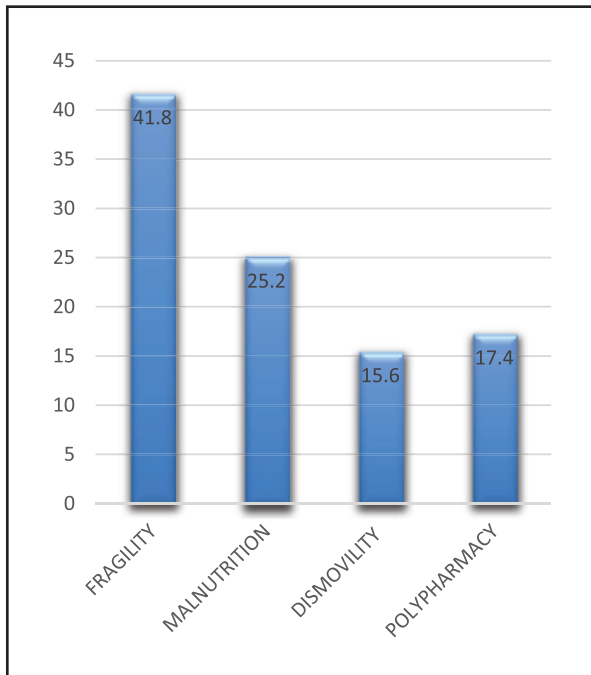


Figure 1. Geriatric syndromes.

42% followed by chronic obstructive pulmonary disease exacerbated with 12.5% and decompensated type 2 diabetes mellitus and hydroelectrolytic imbalance, with 9.9 and 9.2%, respectively (Table 1).

Among the geriatric syndromes, it was determined that 42.8% (65 patients) do not present any geriatric syndrome, 26.3% (40 patients) have only one geriatric syndrome, 20.4% have two syndromes, and 10.5% corresponding to 16 patients, have 3 or more.

The most frequent was fragility with 41.8% (64 patients) followed by malnutrition with 25.2% (38 patients) and dysmobility syndrome in 15.6% (24 patients).

Regarding polypharmacy, 17.4% of patients reported using more than 4 drugs a day; the rest was below this number (Fig. 1).

The walking speed at entry had an average of 0.5 m/s with an ED \pm 0.24 m/s, a minimum of 0.1 m/s and a maximum of 1.1 m/s.

Table 2 reflects the distribution of patients in the intervals used at admission and hospital discharge, highlights the decrease in patients classified as very slow and the increase of up to 3.0% in patients with intermediate and rapid speed levels at the time of hospital discharge.

At hospital discharge, the walking speed averaged 0.7 m/s with SD \pm 0.42, with a minimum of 0.1 m/s and a maximum of 1.1 m/s obtaining a net gain of 0.2 m/s after interdisciplinary intervention during hospitalization.

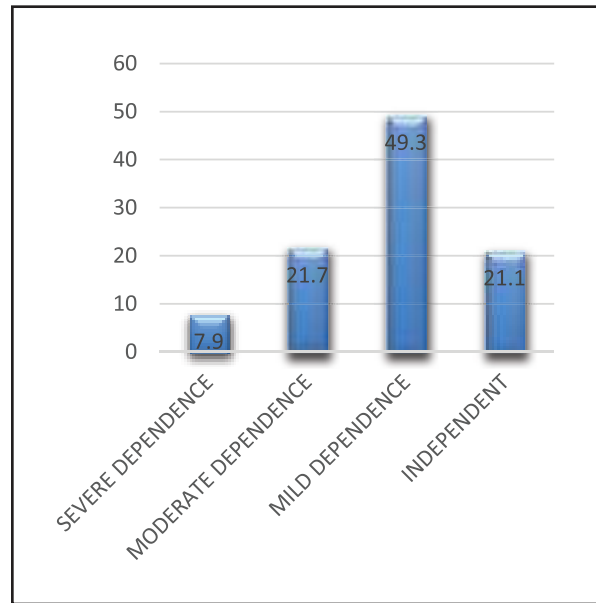


Figure 2. Barthel Index at the time of admission.

Table 2. Distribution of patients according to the speed of gait at hospital admission and discharge

Interval	G. S. admission	G. S. discharge
0.1-0.39 m/s	15.80% (24:152)	10.60% (16:152)
0.4-0.59 m/s	26.30% (40:152)	25.70% (39:152)
0.6-0.79 m/s	34.90% (53:152)	37.40% (56:152)
> 0.80 m/s	23.0% (35:152)	26.30% (40:152)

Regarding the speed of gait and functionality, the results of the Barthel Index at admission were as follows: 49.3% (75:152) of patients were found in mild dependence, 21.7% (33:152) in moderate dependence, 21.1% (32:152) were independent patients, and 7.9% (12:152) had severe dependence (Fig. 2).

At the time of hospital discharge, the results were as follows: 44.7% (68:152) were in mild dependence, 28.3% (43:152) in independence, 17.1% (26:152) in moderate dependence, and 9.9% (15:152) in severe dependence (Fig. 3).

A minimum increase of 2.0% (3:152) is evident in the group of patients with severe dependence, and the group of independent patients increased from 21.0% (32:152) to 28.0% (43:152), respectively. A considerable increase in the values obtained at hospital discharge is demonstrated, indicating a clear improvement in the basic activities of daily living. When correlating the speed of the march with the components of the functionality, including the Barthel Index, through the ANOVA test, the value of the test statistic,

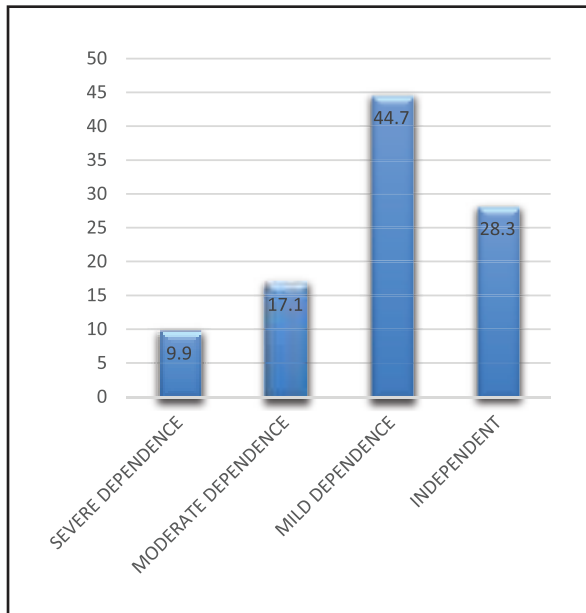


Figure 3. Distribution of patients Barthel Index at discharge.

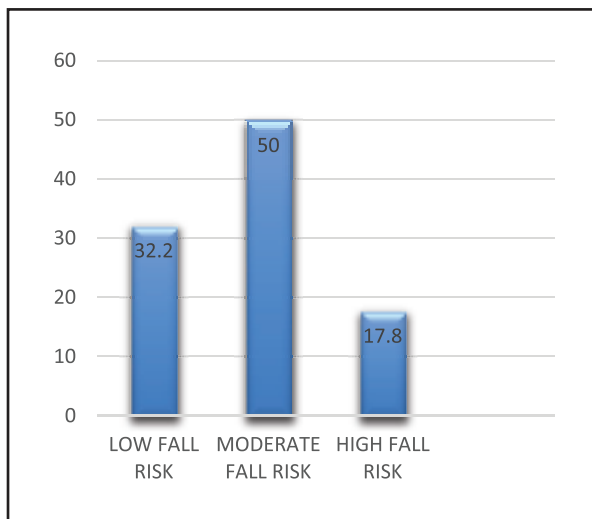


Figure 4. Tinetti scale at patient admission.

F is 8.66 at admission and 8.43 at discharge, both significantly different from 1 and, therefore, a statistically significant association is exposed ($p < 0.05$).

Those patients with low gait velocities presented a greater degree of dependence; on the contrary, those who found themselves in high-speed ranges were placed in mild dependence or independence.

The analysis of the Tinetti scale at hospital admission showed 50.0% (76:152) of older adults with moderate risk of falls, 32.2% (49:152) at low risk, and 17.8% (27:152) with high risk of falls (Fig. 4).

At discharge, 48.0% were found at moderate risk (73:152), 35.5% (54:152) with low risk of falls, and only 16.4% (25:152) with high risk of falls (Fig. 5).

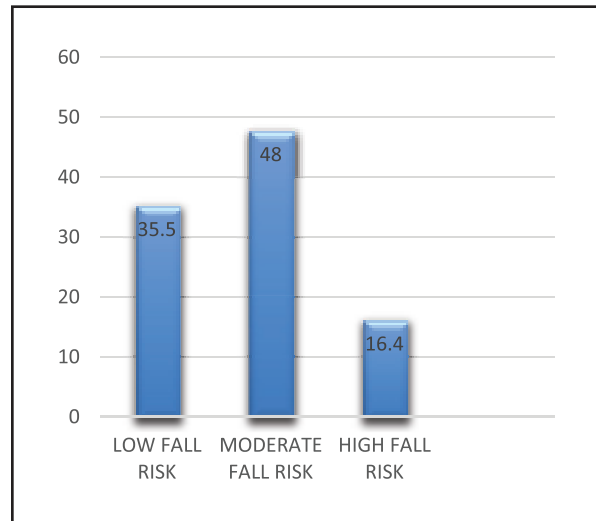


Figure 5. Tinetti scale at patient discharge.

The evaluation with the Tinetti test shows that 3.0% (5:152) revealed an improvement in gait and balance, and there were no significant changes in patients at high risk. Therefore, an improvement in gait and balance after hospitalization was defined, which was reflected in a lower risk of patient falls. When correlating the Tinetti test with the speed of gait at admission and hospital discharge, the value of the ANOVA F test at admission is 8.43 and at discharge 6.42, both different from zero, finding an association statistically significant ($p < 0.05$). Those patients who had a low gait speed had a higher risk of falls, while those who were in high ranges had a low risk.

The results of the Mini-Mental test on hospital admission show a distribution of 39.5% (60:152) with mild cognitive impairment, 27.0% (41:152) without cognitive impairment, 24.3% (37:152) with moderate cognitive impairment, and 9.2% (14:152) with severe cognitive impairment. At hospital discharge, there was an increase of 5.2% (8:152) of patients without impairment and a reduction of 6.6% (10:152) of patients with severe cognitive impairment (Figs. 6 and 7).

The bivariate analysis of the Mini-Mental test with walking speed at hospital admission showed a significant association ($p < 0.05$) with an ANOVA F = 12.65; those patients with low gait velocity had a higher degree of cognitive impairment; on the contrary, those that were located in higher ranks exhibited lower grade. At hospital discharge, the same trend was maintained with an F ANOVA value of 4.89.

On geriatric syndromes, a statistically significant association ($p < 0.05$) was found with a Pearson's correlation index of 1, interpreted as a positive and direct correlation. Those patients who do not have any

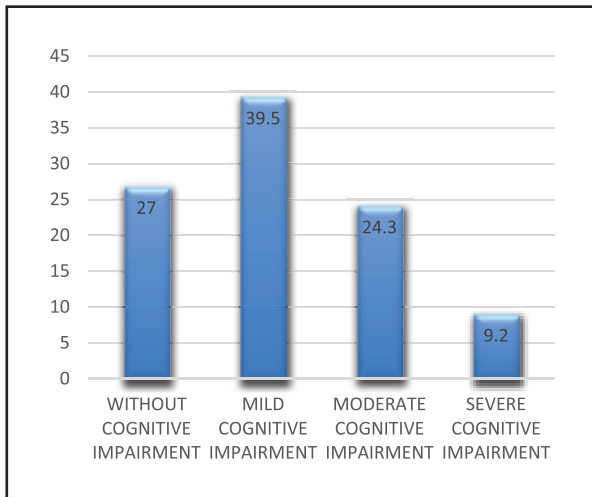


Figure 6. Mini-Mental test at patient admission.

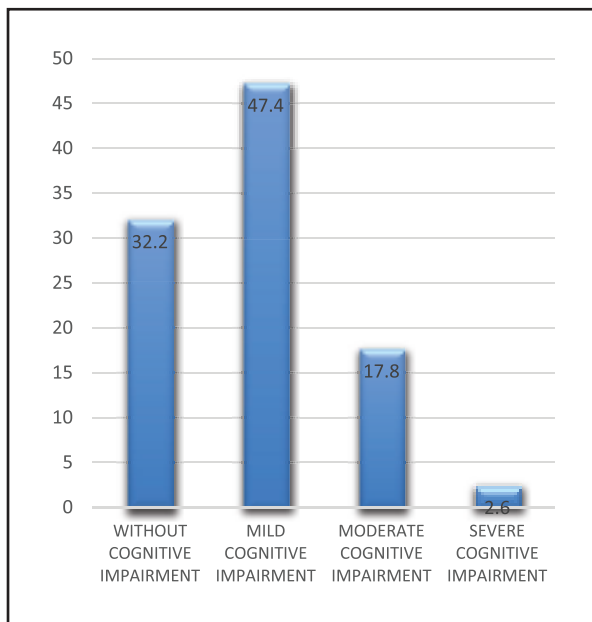


Figure 7. Mini-Mental test at patient discharge.

geriatric syndrome are in the walking velocity groups of 0.6-0.79 or > 0.8 m/s.

When correlating the Charlson Index, valued at admission together with the walking speed, we see a statistically significant relationship ($p < 0.05$) with a Pearson's value of 1, also an association between the speed of walking with the days of hospital stay ($p < 0.05$) that is to say that those patients with greater number of comorbidities had a slower walking speed (between 0.4 and 0.5 m/s), and stayed more days in the hospital (10-14 days).

DISCUSSION

In the sample studied, the average speed of walking at admission was 0.5 m/s, at hospital discharge, it was

0.7 m/s, data similar to those found by Fredy Barragán and Jorge Hernán López in the geriatrics service of the San Carlos Hospital Foundation, Colombia (2013)¹⁴.

The statistically significant relationship between the Barthel Index and gait velocity showed that a decreased gait velocity at hospital admission had an important correlation with the functional loss of the ABVD, in contrast to speed within normal or high ranges that are associated with maintaining and even improving the ABVD. The study carried out by Maider Yerobi in Spain¹⁵, when comparing the self-employed and the dependent, showed that the more dependent the person is, the speed of gait is decreasing, becoming practically nil in those with severe dependence. The speed of gait at hospital admission can be used as a predictor of adverse events and, therefore, of loss or functional recovery at hospital discharge^{16,17}.

When the speed of walking was related to the Mini-Mental test, greater cognitive impairment was observed in slow older adults both at admission and hospital discharge. Therefore, a high gait velocity on hospital admission predicted maintenance or recovery of cognitive status after hospitalization. Abellan van Kan et al.¹⁸⁻²⁰ showed that patients with a lower degree of cognitive impairment were faster.

According to the results obtained, the relationship between the Tinetti scale and the walking speed oriented toward a recovery or stability of balance and coordination in hospitalized patients with high gait velocity values results consistent with Verghese et al.²¹, which showed that people with a walking speed of less than 0.7 m/s suffer more falls. Each 0.1 m/s decrease was associated with 7.0% (11:152) increase in risk of falls²².

During the hospitalization process, older people lose functionality, even reaching critical levels of disability²³. This has been a predictor of institutionalization at discharge and difficulties in the continuity of care. Different studies^{24,25} reported that 35% of hospitalized older adults lose their baseline functional level after discharge.

An older adult in an acute unit receives interdisciplinary and specialized attention, mainly to fragile people and focuses both on the recovery of his acute condition and also on the prevention of dependence and functional recovery. In this study, the most prevalent geriatric syndrome was fragility with 41.8%, and these patients were the most benefited by recovering the speed of walking to hospital discharge.

Baztán et al.²⁶ indicated that "Interdisciplinary teams are highly efficient in working with older people at risk

of functional loss." This type of approach is intended to reduce the incidence of geriatric syndromes such as pressure ulcers, falls, infections associated with health care, delirium, urinary and fecal incontinence, and adverse drug reactions, among others.

A multi- and interdisciplinary approach to care for the elderly gives us a clear vision of the objectives of the management plan to provide quality of life. The management that was given to our patients was multidisciplinary and integrated, which was reflected in the remarkable improvement of its functionality.

CONCLUSIONS

The geriatric units of acute, under a model of comprehensive geriatric care, propose the approach of the elderly and their environment from a multidimensional perspective, making the hospitalization process and opportunity for functional rehabilitation and intervention in other areas of the person more related to their well-being, through coordination with other levels of care.

It is exposed to the speed of gait as a predictor of reliable functional recovery, finding a close relationship with all the elements that value the functionality in the hospitalized elderly patient.

The intervention of the multidisciplinary team throughout the hospitalization is the main complement of the functional recovery of an older adult.

RECOMMENDATIONS

Research is required with a greater number of patients that involve gait velocity measurement in older adults. These studies should be carried out in the third-level centers with high flow of elderly patients with acute pathologies and that have a committed multidisciplinary team, headed by the geriatrics and gerontology service, to obtain proper cutoff points for our population and that in the end, the measurement of the speed of the march is systematically adopted in any geriatric evaluation carried out in hospitals in the country.

CONFLICTS OF INTEREST

The authors report not having any personal, financial, intellectual, economic, and corporate interest conflicts.

FUNDING

The present investigation has not received any specific scholarship from public, commercial, or non-profit agencies.

ETHICAL DISCLOSURES

The study was carried out under the ethical standards of the Institutional Human Experimentation Committee and in accordance with the World Medical Association and the Declaration of Helsinki.

Protection of people and animals. The authors declare that the procedures followed conformed to the ethical standards of the responsible human experimentation committee and in accordance with the World Medical Association and the Declaration of Helsinki.

Confidentiality of the data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to the article. This document is held by the correspondence author.

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Religion, spirituality, and old age: A review of the literature

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Abstract

Background: Religion, spirituality, health, and medicine have common roots in the conceptual framework of relationship among human beings, nature, and God. Old age is a stage of life associated with spirituality. During this time, religious, spiritual, and cultural beliefs may be particularly important. **Objective:** The aim of this article is to present a review and to contrast the scientific evidence on the role that religion and spirituality take on health and illness. **Methods:** A research was conducted using the PUBMED database with different search terms and covering articles from 2002 to 2018. Eligibility of each article was decided by at least two independent authors. **Results and conclusion:** Religious practices seem to help individuals to cope with various aging-related illnesses and losses, help them build up an important resource for resilience, and encourage social interaction and support. Health-care providers should consider asking patients about their spiritual practices and well-being.

Key words: Religious. Spirituality. Aging. Mental health.

Religión y espiritualidad en la vejez: revisión de la literatura

Resumen

Antecedentes: La religión, la espiritualidad, la salud y la medicina tienen orígenes comunes en el marco de referencia de las relaciones entre seres humanos, naturaleza y dios. La vejez es la etapa de la vida comúnmente asociada a la espiritualidad y es cuando creencias religiosas, espirituales y culturales adquieren mayor importancia. **Objetivo:** Revisar y contrastar la evidencia científica sobre religión y espiritualidad, así como el rol que puedan tener en los procesos de salud y enfermedad. **Métodos:** Se realizó una búsqueda en la base de datos PubMed con diferentes términos, abarcando artículos desde el 2002 hasta el 2018. La elegibilidad de cada artículo fue decidida de manera independiente por dos autores. **Resultados y conclusión:** Las prácticas religiosas parecen ayudar a las personas a ser más resilientes y a lidiar de mejor manera con pérdidas relacionadas con la edad, así como a alentar mejores interacciones sociales.

Palabras clave: Religión. Espiritualidad. Envejecimiento. Salud mental.

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INTRODUCTION

Globally, the number of old adults is increasing rapidly. It is projected that by 2050, 1 in 4 people living in developed countries and 1 in 7 living in developing countries will be older than 65¹. It has been described that contemplation of life's meaning and purpose increases during old age and toward the end of life². Religiosity and spirituality are frequently referenced as predictors of population health, thus, it is not surprising that during the past decade, a surge in the volume of scientific studies exploring the association between religion, spirituality, and health among older adults has taken place³.

Religion, spirituality, health, and medicine have common roots in the conceptual framework of relationship among human beings, nature, and God. Religion is referred to be a personal or institutional system of organized beliefs, practices, rituals, or ways of worship; in contrast, spirituality generally describes the feeling of connectedness with a higher power or consciousness and the search for answers to questions about the meaning of life, of illness and other sufferings, of death, and of the purpose of life itself. These adopted beliefs influence the way that individuals, families, and community groups respond to significant life events such as disability and aging. It is possible to assess spirituality and other existential issues related to health⁴. The Spiritual Distress Assessment Tool (SDAT) is a 5-item instrument developed to assess unmet spiritual needs in hospitalized elderly patients and to determine the presence of spiritual distress. SDAT has acceptable psychometric properties and appears to be a valid and reliable instrument⁵.

Religion and medicine have been tightly intertwined since records are available. Across history, priests have frequently acted as physicians, and religious institutions have established hospitals to care for the sick. Moreover, in some religious contexts, knowledge of medicine was sacred. However, the above-described relationship between religion and medicine was interrupted in the late 17th century with the increasing use of the scientific method for the understanding of nature and disease, and the subsequent emphasis on material reality being governed by physical laws. More recently, the epidemiological transition characterized by the increase of chronic diseases resulting in slower dying processes, has opened the door to a more holistic way of caring for the sick and subsequently to the development of the biopsychosocial model of health

care that reprises the role of religion and spirituality on health status⁶. Old age might be viewed as a period of physical decline and perceived as a burden for societies.

However, other authors suggest that the aging process should be viewed as a spiritual journey, a journey searching for meaning in one's life that could rend us hopeful and willing to live fully even in the presence of disability and of possibility of death⁷. Spirituality in old age is determined by the individual's upbringing, life events and experiences, current circumstances, the presence of illness, the level of religiousness and its knowledge, and spiritual awareness. Mehta believes that religion has an impact in old age only if it has been learned in childhood and reinforced in adulthood⁸.

Therefore, the aim of this article is to review the impact of spiritual and religious beliefs and practices on health-related outcomes, in elderly populations.

From this perspective, this work aims to contrast the information of scientific evidence on the role of spirituality and religious practices as modulators of the disease and its impact on health in old age.

MATERIALS AND METHODS

Search strategy and selection criteria

For this review, we searched the PubMed database (<http://www.ncbi.nlm.nih.gov/pubmed/>) to find all published studies describing health impacts of spirituality and religious practices in older adults. We used various combinations of search terms such as "spirituality," "religious practices," "aging," "age-related disease," "geriatrics syndromes," "spirituality struggle," "cancer," "neurodegenerative disease," "frailty," "disability," and "longevity." The literature search covered articles published from 2002 to 2018 in English. At least two authors of the present article reviewed each paper and independently decided whether potentially eligible papers met inclusion criteria, assessed them for methodological quality, and extracted data. Data from experimental studies, evaluating molecular mechanisms behind protective properties of spirituality and religious practices, were also included in this review.

RESULTS

Spirituality and aging

Religious/spiritual beliefs and practices are widespread among older adults worldwide. Gallup

polls indicate that 67% of Americans aged 65-74 years and 75% of those 75 or older report that religion is "very important" to them 70% between 65 and 74 years and 80% of those over age 75 indicate that they are members of a religious organization⁹. Diaz-Ramos et al. found that 98% of the elders who assisted to a geriatric's clinic had regular religious practices in the west of Mexico. In an elderly Brazilian population, it was found that 57% attended churches or religious temples at least once a week and 66% considered religion to have an important role in their lives¹⁰. Older people often need support and spiritual health when life itself seems threatened, achieving it through reminiscence⁷. Spirituality can be used as a tool to promote and maintain resilience in later life, which can be considered as a process of successful adaption to adversity¹¹.

Cross-sectional data show that religious belief and activity are more common among older than in young adults, and this association was stronger in women⁹. For example, women pray more frequently than men and they are more likely to use religion as a form of consolation. In fact, in women, there is a strong positive relationship between religious attendance and social issues (visiting friends and entertaining guests). People who attend religious services may have better lifestyle habits such as refraining from drinking or smoking. On the other hand, people who had lower levels of religious attendance were more likely to be illiterate and have physical health problems, higher levels of depressive symptoms, less social support, and poorer cognitive functioning¹².

When the elders have health problems, those who are religious can positively cope with their diseases through hope and an optimistic attitude, as well they are more likely to manage the treatment process and disability caused by the diseases¹³.

Religious practices and mental health in the elderly

Empirical studies have identified significant links between religion, spirituality, and health. Spiritual life seems to play a role in coping with stress and maintaining health in late life¹⁴⁻¹⁶. In a systematic review of 850 articles, it was shown that the levels of religious involvement have a positive correlation with aspects related to psychological well-being¹⁷. A study showed that prayer strengthens frontal circuits, trains episodic memory, and improves introspection and attention. Prayer repetition may reduce progression

of disease because they facilitate concentration and act as a cognitive stimulus. Community prayer sessions keep people in touch with their social sphere, and this support holds back sadness, anxiety, depression, and hostility¹⁸. Researchers at the University of Pennsylvania have used single-photon emission computed tomography to image the brains of meditating Buddhists and Franciscan nuns and have observed localized neural activity during this practice¹⁹. Religious or spirituality feelings were associated with thicker cortices in the parietal and occipital lobes, right mesial frontal lobe, and cuneus and precuneus in the left hemisphere. In individuals with familiar risk to major depression, a thicker cortex may confer resilience to the development of the illness by expanding a cortical reserve²⁰. Religious practices and activities are positively associated to life satisfaction, decreased depressive symptoms, better emotional adjustment and quality of life (QOL), less cognitive impairment, and less perceived pain²¹.

Depression

It was found in a meta-analysis of 147 independent studies a consistent association between religiosity and fewer depressive symptoms^{22,23}. Religiosity may help through psychosocial mechanisms including social support, activity engagement, and coping improvement²⁴⁻²⁶.

On the other hand, religious struggle may lead to depressive symptoms and social alienation²⁶⁻²⁸. A systematic review identified 141 studies that examined the relationship between spirituality and suicide. Of those, 75% found inverse associations between suicide attempts, completed suicide, positive attitudes toward suicide, and spirituality involvement²⁹.

Some studies have shown an inverse association between church attendance and depressive symptoms²⁸⁻³⁰. Koenig et al. also found that intrinsic religiosity predicted shorter remission time of depression in an 87 medically ill older patient sample³⁰. However, almost 56% of American psychiatrists never, rarely, or only sometimes inquire about religious/spiritual issues in patients with depression or anxiety³¹.

Substance abuse

Regarding alcohol use, abuse, and dependence, at least 278 studies have examined the relationship of it with religious practices and spirituality. Of those, 86% reported inverse relationship and only 1% indicated

a positive relationship. Of 145 studies with the best methodology, 90% reported inverse relationships and only one study found a positive relationship. Findings are similar regarding other drugs use or abuse³¹.

Cognitive impairment

Many studies suggest that people living with dementia experience a deep understanding of spirituality, often enhanced by their remembrance of early life experiences². Personal faith, prayer, connection to church, and family support enhanced the ability of people in an early stage of Alzheimer's disease to keep a positive attitude as they faced living with their disease. For example, Coin et al. found that a higher level of religion (according to the Behavioral Religiosity Scale) in Alzheimer's disease correlates with a slower cognitive and behavioral decline. However, Beeri showed that the prevalence rates of dementia were higher (27%) for men participants with an exclusive religious education compared to those with mixed education (13%) and secular education (16%)³².

Religious attendance may increase sensory stimulation through prayer, scripture reading, singing, sermons, philosophical discussions, and socializing. Some studies suggest that this social engagement has a unique influence on cognitive functioning, so Alzheimer's disease seems to benefit from religion and spirituality¹². When people have a degenerative disease, as dementia, it could be expected that they may use religion to help adapt to the situation. Religious involvement is related to a greater sense of coherence, meaning, and hope, which may help individuals cope effectively with increasing stress, anxiety, and depression associated with cognitive impairment¹⁸.

Disability and QOL

Multiple researches have demonstrated a positive association between religiosity/spirituality and QOL³³. In this way, a study that was carried out in Mexican elderly patients found that spiritual life is related to greater longevity, low anxiety, increased self-esteem, and increased marriage satisfaction⁵. Church attendance is in many ways related to physical health and functional status^{25,34}. In a study, religious struggle was predictive of poorer physical recovery²⁹. A 12-year prospective study, which included nearly 3000 older adults, showed that attendance to religious activities might forestall disability²³. Religiosity and spirituality enhance life satisfaction possibly through positive psychosocial and

physiological mechanisms²⁴. Spirituality turns to be an important component, responsible for improving QOL, and a resource in ill patients; thus, it was associated with better mental and physical health⁵.

Chronic and terminal diseases

Older adults with chronic diseases have more mood disorders and often find themselves in a process where depression worsens disability and vice versa. In addition, excessive preoccupation often triggers anxiety symptoms¹⁰. Several clinically useful constructs of spirituality in patients with heart failure suggest that psychological and spiritual well-being remain distinct phenomena³⁵. In a multivariate model, spirituality, but not religiosity, was an important predictor of self-appraisal good health in patients with heart failure after adjusting for QOL, physical functioning, age, race, and depression³⁵. A 5-year follow-up study documented an increase in the use of self-prayer and a prevalence of spiritual healing as a common therapy for lung problems¹⁹. In a sample of seriously ill patients, the current spiritual well-being and past negative religious experiences were related to anxiety symptoms³⁶. Religious involvement and spirituality have been observed to help those with HIV cope with their disease³⁷.

It has been demonstrated that patients receiving high levels of spiritual support from religious communities are less likely to receive hospice care, but they are more likely to end up with aggressive medical interventions and finally die in an intensive care unit setting. One possible explanation is that these communities may emphasize that perseverance and hope may be found within suffering³⁸.

A study of 160 terminal illness patients found that spiritual wellness protects against hopelessness at this stage of life³⁹. Prayer appears to be an effective strategy that reduces anxiety in patients who undergo chemotherapy⁴⁰⁻⁴³. Thus, spiritual care has been incorporated into national care quality guidelines, including those of the National Consensus Project for Quality Palliative Care and the Joint Commission³⁸.

The elders often rely on spirituality to manage the stress accompanying bereavement, loneliness, economic decline, and illness⁴⁴⁻⁴⁹. Spirituality is a complex, multifaceted construct related to health outcomes that remain poorly defined and difficult to measure. It may be broadly defined as "the way in which people understand their ultimate life meaning and value." Religion on the other hand, can be defined as "a set

Table 1. Popular beliefs against facts based on evidence

Beliefs	Evidence
Elderly are more religious than younger people	Yes, religious belief and activity are more common among older adults, and this association was stronger in women.
Religious involvement promotes healing	No, however, it is related with better health outcomes and less dependence on the elderly.
Spirituality is a protective factor	Spirituality can be used as a tool to promote and maintain resilience in later life, which can be considered as a process of successful adaption to adversity. It was shown that the levels of religious involvement have a positive correlation with aspects related to psychological well-being.
Religion/spirituality promotes mental health and improves quality of life (QOL)	Religious practices and activities are positively associated to life satisfaction, decreased depressive symptoms, higher perceived health, better emotional adjustment and quality of life, less cognitive impairment, and less perceived pain. Multiple researches have demonstrated a positive association between religiosity/spirituality and QOL.
Depression is less common among religious old people.	Not at all: 1. Religiosity may help through psychosocial mechanisms including social support, activity engagement, and improves coping. 2. On the other hand, religious struggle may lead to depressive symptoms and social alienation.
Prayers delay cognitive impairment	Some studies suggest that this social engagement has a unique influence on cognitive functioning, however, there is not enough evidence.

of beliefs, practices and own language that seeks the meaning of the human experience of a particular community, based on the transcendence and faith of a divine figure¹³⁵.

Does spirituality really matter? In one study of 330 consecutively hospitalized patients to general medicine, cardiology, and neurology services of Duke Hospital when asked an open-ended question about what enabled them to cope with the stress of their illness, 42% spontaneously reported that it was some aspect of religious faith or activity²⁹. The concept of spirituality and its relation to health and wellness needs to be better understood. Involvement in religious and spiritual practices has been found to correspond to better health-related outcomes regardless of age. Spirituality and religiousness can serve as buffers to life stressors, by allowing individuals to interpret their experiences within the context of their beliefs, which may provide them purpose, meaning, as well as promote transcendence. In the elderly assessment, health-care providers should consider asking about current spiritual well-being and past negative religious experiences because religion and spirituality could help patients to combat the feeling of helplessness as well as promote health recovery with hope, confidence, and optimism. These elements could also encourage social interaction and adequate social support that helps patients

relieve stress, adapt to diseases, and live a healthy life, table 1.

CONCLUSION

Successful aging refers to dealing successfully with the negative changes in life rather than just facing losses that accompany this age. Old age is seen as the period of life that is associated with wisdom, philanthropic attitude, and spirituality. Religious practices seem to help individuals to cope with aging-related diseases and help them build up in themselves as a resource for resilience.

CONFLICTS OF INTEREST

The authors have declared no conflicts of interest for this article.

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ETHICAL DISCLOSURES

Protection of people and animals. The authors declare that no experiments have been performed on humans or animals for this research.

Confidentiality of the data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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Correlation between results of NEUROPSI, Mini-Mental State Examination, and Montreal Cognitive Assessment Studies in older adults with subjective memory complaint

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Abstract

Background: The prevalence of dementia worldwide is rising. Many screening tests are available, the Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) are commonly use. To establish diagnosis, a neuropsychological battery sometimes is essential. **Objective:** The objective of the study was to identify if an appropriate correlation exists between the results of neurocognitive test MMSE, MoCA, and NEUROPSI, in patients with a cognitive complaint from the geriatric clinic in a third-level hospital. **Materials and methods:** A cross-sectional study was performed, in 65-year-old patients or older. Pearson's correlation test was used. Cognitive tests MMSE, MoCA, and NEUROPSI were applied and the results were analyzed by SPSS statistical program 25 version. **Results:** Thirty-five patients were included; we obtained a correlation index $r = 0.716$ ($p < 0.01$) for the correlation between MMSE and MoCA tests. For the correlation between MMSE and NEUROPSI, the correlation index was $r = 0.734$ ($p < 0.01$) and between MoCA and NEUROPSI, $r = 0.809$ ($p < 0.01$). The results of the correlation when we divided the population for academic years were statistically significant only in those who had more years of schooling. **Conclusions:** The tests' results of NEUROPSI, MMSE, and MoCA have an acceptable correlation between them, but we must consider schooling years when we decide to apply these tests.

Key words: Dementia. Mini-Mental State Examination. Cognition. Montreal Cognitive Assessment. NEUROPSI.

Correlación entre resultados de estudios de NEUROPSI, Minimental State Examination y Montreal Cognitive Assesment en adultos mayores con queja subjetiva de memoria

Resumen

Antecedentes: La prevalencia de demencia a nivel mundial se encuentra en aumento, por lo que la identificación oportuna de trastorno cognitivo en la población es prioritaria. **Objetivo:** Identificar si existe correlación adecuada entre los resultados de pruebas cognitivas, MMSE, MoCA y NEUROPSI, en pacientes con queja subjetiva de memoria en la consulta de geriatría. **Material y métodos:** Estudio transversal, en mayores de 65 años, de agosto del 2018 a septiembre del 2019. Se aplicaron las pruebas de screening cognitivo MMSE, MoCA y NEUROPSI y se utilizó un programa estadístico SPSS versión 25 para el análisis de datos. **Resultados:** Se incluyeron en el estudio 35 pacientes, se utilizó prueba de correlación de Pearson. Se obtuvo un r de 0.716 ($p < 0.01$) al correlacionar prueba MMSE con MoCA Para la correlación entre MMSE y NEUROPSI se obtuvo un r de 0.734 ($p < 0.01$), mientras que en la correlación entre MoCA y NEUROPSI se obtuvo una r de 0.809 ($p < 0.01$). Cuando se dividió a la población

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por escolaridad, la correlación fue significativa solo para escolaridades altas. **Conclusiones:** Los resultados de las pruebas NEUROPSI, MMSE y MoCA tienen adecuada correlación en pacientes con queja subjetiva de trastorno de memoria, sin embargo, debemos considerar la escolaridad al momento de aplicar las pruebas de tamizaje cognitivo.

Palabras clave: Demencia. MMSE. Cognición. MoCA NEUROPSI.

INTRODUCTION

With the aging of the population, memory disorders are more frequently diagnosed, and this problem is becoming a challenge for physicians now at days. In 2010, the prevalence of major neurocognitive disorder was 35.6 million people around the world, and it is speculated that approximately 115.4 million people will suffer the diagnose for 2050¹. The incidence of major neurocognitive disorder varies from 0.1% at the age of 65 to 8.6% at the age of 95². The main risk factors in our population are illiteracy, depression, chronic diseases such as diabetes, arterial hypertension, and cardiovascular disorders, among others³.

The first challenge for health-care providers is to identify cognitive alterations in a timely and accurate manner. Subjective memory complaints are very common in the elderly, its presence is important data to suspect neurocognitive disorder. It may be present in 10%-88% of older adults. These complaints can be secondary to other pathological processes, however, once secondary causes are ruled out, subjective memory complaint is considered as an independent predictor for major cognitive disorder⁴.

In 2018, a study was performed to evaluate the accuracy of the presence of subjective memory complaints to detect a cognitive disorder, they evaluated patients considered as cognitively normal, with mild cognitive impairment or with Alzheimer's disease (AD) living in the community, the authors reported that these complaints can be an early manifestation of the pathological process of AD⁵.

Therefore, the presence of subjective memory complaint is a major reason to start a diagnostic protocol regarding cognitive disorder. There are a large number of cognitive screening tests to initiate the study protocol, however, many of these tests have disadvantages, such as lack of validation in different populations, low accuracy to detect mild stages of cognitive impairment, or that some of these tests do not consider cultural variables¹.

So, which of these tests is ideal? And, are they correlated properly? Two of the screening tests most used by clinicians are the Mini-Mental State Examination (MMSE), and the Montreal Cognitive Assessment (MoCA), these tests have been validated for Mexican

population and have the advantage of been applied in a short period of time, they evaluate different cognitive domains, but MoCA is more accurate in the evaluation of executive functions⁶⁻⁸.

Many clinical trials have tried to demonstrate an adequate correlation between these screening tools, especially because important differences have been reported between them. There are studies that demonstrate that MoCA is a better tool to identify mild cognitive impairment, another concern regarding the use of MoCA is related to years of schooling, and how they can influence the results⁹.

In 2015, a cross-sectional trial was done to evaluate the relationship between MMSE tool and MoCA test, the authors reported that they correlated properly in the group of patients with the diagnosis of dementia ($r = 0.86$), but this was not the case for mild cognitive impairment and healthy subjects¹⁰. This correlation was performed in Japanese population, with diagnosis of vascular dementia by imaging studies, they included elderly patients with an average age of 76 years (± 8.7), they reported a very strong correlation between the test ($r = 0.9$, $p < 0.001$), this probably told us that the presence of a cognitive disorder will increase this correlation¹¹.

Another clinical trial tried to prove the utility and diagnostic accuracy of the MoCA and MMSE compared to a more detailed neuropsychological performance, The Consortium to Establish a Registry for AD Neuropsychological Battery in the diagnosis of AD and mild clinical impairment. They reported that a more detailed neuropsychological test is more accurate at distinguishing mild cognitive impairment and AD from healthy controls, but not better than MoCA or MMSE to distinguish AD from mild cognitive impairment, this seems ideal, given the fact that, neuropsychological batteries require more time and resources to be applied and sometimes this is a challenge in the daily clinical practice¹².

In Mexico, Ostrosky et al. developed the brief neuropsychological batteries NEUROPSI, this test was adapted to sociocultural features of Mexican population and provides quantitative and qualitative results, this instrument can be applied in different age groups and scholarship, with different cut points, the

importance of this test is that takes into a count the low grade of academic training, and it can be applied in illiterate people^{13,14}.

To the best of our knowledge, few clinical trials have tried to compare this neuropsychological test with other cognitive tests, in 2007, validation of NEUROPSI was carried out in Portuguese population for AD, in their analysis, the authors reported that the correlation with MMSE was strong ($r^2 = 0.89$, $p < 0.001$) and proved that this test is efficient diagnosing AD and mainly identifying mild stages of AD¹⁵.

The main objective of this study is to identify the correlation between the results of the MMSE, MoCA and brief neuropsychological battery, NEUROPSI, among older adults who refer subjective memory complaint. As a secondary objective, we analyzed the correlation of these tests after we divided the population into groups by years of schooling to determine if this variable impacts the correlation.

METHODS

We developed a cross-sectional study from March 2018 to September 2019. We invited those patients who met inclusion criteria and accepted to participate in our study through the application of the three cognitive tests, MMSE, MoCA and NEUROPSI.

The MMSE and MoCA were applied in approximately 10-15 min, these two screening tests were applied in one medical appointment; meanwhile, the NEUROPSI, being a more extensive test, took approximately 45 min to be finished, for this reason, it was applied in a single clinical appointment no more further than 3 weeks from the application of MMSE and MoCA.

We used the Reyes's version of the MMSE⁷ and the Spanish version of MoCA⁸. We make sure to avoid distractors at the time of the application of the tests, such as environmental factors, to perform the tests in a quiet place, and to prevent alteration of the results.

The inclusion criteria were the following ones: patients with 65 years of age or older, patients who were attended at the geriatric service in Regional Hospital ISSSTE from the city of Leon, the presence of subjective memory complaint, and patients who accepted to finish or who already had finish the three cognitive tests in their medical record. The exclusion criteria were as follows: patients with the previous diagnosis of major neurocognitive disorder or mild cognitive impairment, patients with basic or instrumental daily living activities lost secondary to cognitive disturbances, and the

presence of a chronic pathology previously established that were out of clinical control at the moment of the study, such as diabetes mellitus, systemic arterial hypertension, hypothyroidism, chronic obstructive pulmonary disease, obstructive sleep apnea, uncorrected sensory deprivations, and depression.

The patients were eliminated if they did not finish the resolution of the three cognitive tests or if we identified a secondary cause of subjective memory complaint during the evaluation.

We considered a value of $\alpha = 0.05$ and $\beta = 0.2$ for the estimation of the sample. We established a correlation coefficient of 0.5 as the minimum value accepted for our study, for a bilateral analysis, a total of 29 patients were necessary to obtain a power of 80% and a confidence level of 95%.

This study protocol was approved by the Ethics and Research Committee of ISSSTE, with registry number 715.2018. We considered the regulations from general health law on health research and the Helsinki Declaration, and its amendments, as well as codes and international standards that are in force for good clinical practice.

Statistical analysis

For the statistical analysis, we applied the Shapiro-Wilk test to determine the distribution of the MMSE, MoCA, and NEUROPSI final results, the test demonstrated a normal distribution; therefore, we used the Pearson's correlation test for the final analysis. The information was processed through the Statistical Package for the Social Sciences 25 version (SPSS).

RESULTS

We included in our study 35 patients, aged 65-96 years old, that met the inclusion criteria, and completed the cognitive tests. The average age was 79.4 ± 6.6 years, 66.7% were female. The average years of schooling were 6 ± 5.14 years, 30.6% had 10 years or more of schooling, 27.8% had 5-9 years, 16.7% between 1 and 4 years, and 22.2% had 0 years of schooling. The characteristics of the population are shown in table 1.

The final average score of the MMSE was 24 ± 4.25 , the MoCA final average score was 16.76 ± 5.9 , and the NEUROPSI was 68.7 ± 20.3 .

It should be noted that we classified the population by years of schooling, to evaluate the final scores

Table 1. Population characteristics

Characteristics	n = 35
Age (years)	79.4
Sex, n (%)	
Female	24 (66.7)
Male	11 (30.6)
Years of education, n (%)	
0	8 (22.2)
1 a 4	6 (16.7)
5 a 9	10 (27.8)
> 10	11 (30.6)
Comorbidity	
Hypertension	25 (69.4)
Diabetes	11 (30.6)
Ischemic heart disease	6 (16.7)
Ischemic cerebrovascular disease	5 (13.9)
Hypothyroidism	5 (13.9)
Atrial fibrillation	3 (8.3)
Hemorrhagic cerebrovascular disease	1 (2.8)
Chronic kidney disease	1 (2.8)
Síndromes geriátricos, n (%)	
Polypharmacy	31 (86.1)
Urinary incontinence	22 (61.1)
Sleep disorder	20 (55.6)
Falls	17 (47.2)
Frailty	13 (36.1)
Functional assessment	
KATZ	B
Lawton y Brody n	5/8
Cognitive tests scores	
MMSE, n	24 (\pm 4.25)
MoCA, n	16.76 (\pm 5.9)
NEUROPSI, n	68.7 (\pm 20.3)

MMSE: Mini-Mental State Examination; MoCA: Montreal Cognitive Assessment. NEUROPSI: Brief neuropsychological batteries.

Table 2. Scores of the NEUROPSI, MMSE, and MoCA by years of schooling

Years of schooling (years)	NEUROPSI	MMSE	MoCA
0	48 (\pm 18.4)	21.37 (\pm 3.9)	10.75 (\pm 7.8)
1-4	62.5 (\pm 4.5)	21 (\pm 3.3)	15 (\pm 4.5)
5-9	72 (\pm 15.7)	25 (\pm 3.1)	18.9 (\pm 5.5)
\geq 10	84 (\pm 17.4)	25.2 (\pm 4.8)	20.1 (\pm 5.31)

MMSE: Mini-Mental State Examination; MoCA: Montreal Cognitive Assessment; NEUROPSI: Brief neuropsychological batteries.

Table 3. Cognitive tests correlation coefficients (total population)

Tests	MoCA (r)	MMSE (r)	p
Participants (n = 35)			
NEUROPSI	0.809	0.739	< 0.0001
MMSE	0.716	1	<0.0001

n: number of participants; R: Pearson's correlation coefficient; MoCA: Montreal Cognitive Assessment; MMSE: Mini-Mental State Examination.

Table 4. Cognitive test correlation, 10 years or more of schooling

Schooling 10 years or more	MoCA (r)	MMSE (r)	p
Participants (n = 11)			
NEUROPSI	0.881	0.874	< 0.0001
MMSE	0.845	1	0.001

N: number of participants; R: Pearson's correlation coefficient; MoCA: Montreal Cognitive Assessment; MMSE: Mini-Mental State Examination.

of each test, in the group of 0 year of schooling, the average NEUROPSI score was 48 ± 18.4 , the MMSE was 21.37 ± 3.9 , and the MoCA was 10.75 ± 2.8 . In the group of 1-4 years of schooling, the NEUROPSI score was 62.5 ± 4.5 , the MMSE was 21 ± 3.3 , and the MoCA was 15 ± 4.5 . In the group of 5-9 years of schooling, the NEUROPSI final score was 72 ± 15.7 , the MMSE was 25 ± 3.1 , and the MoCA was 18.9 ± 5.5 . Finally, for the group of 10 or more years of schooling, the NEUROPSI average score was 84 ± 17.4 , the MMSE was 25.2 ± 4.8 , and MoCA was 20.1 ± 5.31 (Table 2).

For the correlation of the final scores of the three tests, we used the Pearson's correlation test. For the correlation between MMSE and MoCA, we obtained $r = 0.716$ ($p < 0.01$), between MMSE and NEUROPSI, we got $r = 0.734$ ($p < 0.01$), and between MoCA and

NEUROPSI, $r = 0.809$ ($p < 0.01$). The correlation coefficients for the total population are shown in table 3.

When we classified the population by years of schooling, we appreciated that the stronger correlation was between MoCA and NEUROPSI in the group of 10 or more of schooling, but the correlation became weaker as the academic degree was lower. The correlation coefficients by years of schooling are shown in tables 4-6.

DISCUSSION

In our study, we found a strong correlation between MMSE, MoCA, and NEUROPSI, among people with

Table 5. Cognitive test correlation, 5-9 years of schooling

Schooling 5-9 years	MoCA (r)	MMSE (r)	p
Participants (n = 10)			
NEUROPSI	0.681	0.588	(< 0.05)
MMSE	0.623	1	(< 0.05)

n: number of participants; R: Pearson's correlation coefficient; MoCA: Montreal Cognitive Assessment, MMSE: Mini-Mental State Examination.

Table 6. Cognitive correlation, ≤ 4 years of schooling

Schooling 4 years or less	MoCA (r)	MMSE (r)	p
Participants (n = 14)			
NEUROPSI	0.582	0.506	(0.02) , (0.065)
MMSE	0.327	1	(0.254)

n: number of participants; R: Pearson's correlation coefficient; MoCA: Montreal Cognitive Assessment; MMSE: Mini-Mental State Examination.

subjective memory complaint. Some studies have reported a strong correlation between screening tests, such as the one published in 2017, in this trial, the authors had as primary objective to validate the Spanish version of the MoCA test, in their analysis, they found a strong correlation between MoCA and MMSE ($r = 0.83$, $p < 0.001$), as our population, they performed the study in Mexican elderly people and had very similar results¹⁶. It is important to demonstrate the correlation between this screening tool is adequate, especially because there are some limitations in the MMSE that could make us hesitate whether to use MMSE or MoCA in people with subjective memory complaint.

The previous research has shown, the MMSE may overlook mild stages of cognitive disorders, and even though in our study, the correlation coefficient was strong when we analyzed the final average scores of the tests, in the population with higher academic degree, the Mini-Mental seems to be over the cut points for a cognitive disorder, unlike MoCA test, this may be related to the ceiling and floor effects of the MMSE test¹⁷.

We tried to correlate the MMSE and the MoCA screening tests with a neuropsychological battery, the NEUROPSI, there are few studies that have compared this test with other cognitive tools, in 2012, a

correlation study was performed, the authors tried to compared three cognitive tests, among them, the MMSE and the NEUROPSI, they found a weak correlation between them ($r = 0.182$), although statistically significant. However, their population was different to ours, they included young and cognitively healthy people and this could influence in their results¹⁸.

Even though, the NEUROPSI test is a neuropsychological battery and is considered not just as a screening test, as a tool to establish the diagnosis of mild cognitive impairment or major neurocognitive disorder, and it is a more profound cognitive test, compared to MoCA or MMSE¹⁹. We consider that good correlation between these tests could be, maybe, because memory complaint is usually the first manifestation of an early cognitive impairment without functional loss²⁰. When we analyzed the average scores of the tests, we observed that the scores were lower when the years of schooling were less. Moreover, when we correlated the results of the tests, after we divided the population into groups of schooling, we reported that the correlation was weaker in person with less education (< 4 years of schooling).

This demonstrates that the academic degree is an important factor to consider once a screening or diagnostic cognitive test is applied. This has been observed in other clinical research, in 2015, a study was developed in Brazilian population, the authors tried to demonstrate how age, sex, and education could influence on cognitive test performance, they reported that at a lower education and older age, the response rates were lower despite the population they included was cognitively normal²¹.

As we mentioned earlier, we consider a strength of this work that there are very few publications that compare neuropsychological batteries with other cognitive tests (NEUROPSI). This test is considered as diagnostic tool, and unlike MoCA and MMSE, it takes more time and training to be applied, in many clinical scenarios, like public health services, these resources are lacking, so the use of screening tools such as MMSE or MoCA can help the clinicians to take decisions, while they can prepare the patients to a more extend neuropsychological evaluation.

On the other hand, a limitation in our work was taken into a count when we analyzed the population into groups by years of schooling, the size of the sample for each group was smaller, and this could influence in the statistical analysis and the results, so we suggest that more studies are needed considering the

academic training in patients with subjective memory complaint.

CONCLUSIONS

The cognitive screening tests MMSE, MoCA, and the brief neuropsychological battery NEUROPSI have a strong correlation between them in the population with subjective memory complaint; however, in older adults with low years of schooling, it is necessary to do more research to prove an appropriate correlation between these tests.

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CONFLICTS OF INTEREST

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ETHICAL DISCLOSURES

Protection of people and animals. The authors declare that no experiments have been performed on humans or animals for this research.

Confidentiality of the data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is held by the correspondence author.

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