VOL IV

Ciências da Saúde:

Investigação e Prática

Dr. Guillermo Julián González-Pérez
Dra. María Guadalupe Vega-López
(organizadores)

EDITORA ARTEMIS
2025

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Imagem da Capa	peopleimages12/123RF
Bibliotecário	Maurício Amormino Júnior – CRB6/2422

Editora Artemis
Curitiba-PR Brasil
www.editoraartemis.com.br
e-mail:publicar@editoraartemis.com.br

Editora Artemis
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Dados Internacionais de Catalogação na Publicação (CIP)
(eDOC BRASIL, Belo Horizonte/MG)

C569 Ciências da Saúde [livro eletrônico] : investigação e prática IV / Organizadores Guillermo Julián González-Pérez, María Guadalupe Vega-López. – Curitiba, PR: Artemis, 2025.

Formato: PDF
Requisitos de sistema: Adobe Acrobat Reader
Modo de acesso: World Wide Web
Inclui bibliografia
Edição bilíngue
ISBN 978-65-81701-74-1
DOI 10.37572/EdArt_091225741

1. Ciências da Saúde – Pesquisa. 2. Cuidado comunitário. 3. Saúde familiar. I. González-Pérez, Guillermo Julián. II. Vega-López, María Guadalupe.

CDD 610.7

Elaborado por Maurício Amormino Júnior – CRB6/2422

EDITORA ARTEMIS
2025

Editora Artemis
Curitiba-PR Brasil
www.editoraartemis.com.br
e-mail:publicar@editoraartemis.com.br

PRÓLOGO

La obra *Ciências da Saúde: Investigação e Prática IV* reúne un conjunto plural y profundamente significativo de 17 estudios que reflejan la complejidad, la urgencia y la diversidad de los desafíos contemporáneos en salud.

Elaborado por autoras y autores de distintos países iberoamericanos - Argentina, Colombia, Chile Ecuador, México y Portugal-, con trayectorias académicas y profesionales igualmente diversas, este volumen se consolida como un espacio de diálogo interdisciplinario, en el que confluyen perspectivas de la salud pública, la clínica, la salud mental, la enfermería, la fisioterapia, la farmacéutica, las tecnologías en salud y la epidemiología.

Estructurado en cuatro grandes ejes, el libro recorre escenarios que abarcan desde los determinantes sociales y ambientales de la salud hasta la aplicación de tecnologías emergentes para el diagnóstico, el monitoreo y el cuidado.

En el eje **Salud pública, ambiente y sistemas de salud**, se presentan reflexiones y evidencias sobre problemáticas colectivas que afectan a poblaciones enteras: el control de vectores, la exposición a contaminantes tóxicos, las características de los accidentes en el hogar, las desigualdades persistentes tanto en la sociedad como en los sistemas de salud y su impacto en el comportamiento de indicadores como la mortalidad materna. Los estudios aquí reunidos iluminan cómo factores sociales, ambientales y políticos moldean las condiciones de vida, riesgo y bienestar, reforzando la necesidad de políticas integradas de prevención y equidad.

El eje **Salud mental, bienestar y psicología de la salud** incluye investigaciones sobre los aspectos emocionales, conductuales y psicosociales que influyen en la vida académica, profesional y social. Se destacan análisis sobre satisfacción con la vida, estilos de vida saludables, intervenciones terapéuticas innovadoras, estilos educativos y de afrontamiento así como sobre las adicciones de nuevo tipo. Sus contribuciones revelan una comprensión ampliada y actualizada del cuidado en salud mental, siempre guiada por la evidencia y la sensibilidad humana.

En el eje **Clínica, diagnóstico y tecnologías en salud**, se presenta un conjunto de trabajos que exploran herramientas clínicas, protocolos diagnósticos, procesos de esterilización, estudios neurobiológicos de los trastornos alimentarios y modelos basados en inteligencia artificial para el apoyo a la toma de decisiones en entornos críticos. Estos capítulos dan cuenta del avance continuo de la innovación tecnológica y de su capacidad para transformar las prácticas asistenciales, promover la seguridad y ampliar la eficiencia de los servicios de salud.

Finalmente, el eje **Enfermería, familia y comunidades de cuidado** aborda la intervención clínica y relacional de profesionales que trabajan directamente con las familias, personas mayores y grupos comunitarios. Son aportes que evidencian el papel estratégico de la enfermería en la promoción de la autonomía, la funcionalidad, la salud emocional y la construcción de redes de apoyo – elementos esenciales para el cuidado integral.

Este libro, por lo tanto, no solo reúne resultados de investigación: materializa una visión contemporánea de la salud como un campo interdisciplinario, integrado y profundamente humano. Celebra la producción científica latinoamericana e ibérica, fomenta nuevas discusiones e invita a profesionales, estudiantes e investigadores a reflexionar sobre prácticas, desafíos y posibilidades emergentes.

Que estas páginas inspiren nuevas miradas, nuevas preguntas y formas de cuidar.

Buena lectura.

Guillermo Julián González-Pérez

María Guadalupe Vega-López

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SAÚDE PÚBLICA, AMBIENTE E SISTEMAS DE SAÚDE

CAPÍTULO 12

RELIABILITY OF THE TIMED UP AND GO TEST IN DETERMINING FALL RISK IN PATIENTS AND ADULTS OF THE HOSPITAL MILITAR CENTRAL

Data de submissão: 11/11/2025
Data de aceite: 28/11/2025

Pt Laura Suárez S.
Faculty of Medicine
Universidad Nacional de Colombia

PT Edgar Debray Hernández Álvarez, MsC., PhD
Titular Professor
Chair, Kinesitherapy Group
School of Medicine
Faculty of Medicine
Universidad Nacional de Colombia
https://orcid.org/0000-0002-9678-8538

PT Karim Martina Alvis Gómez, MsC., PhD
Titular Professor
Chair Mechanical and Neuromechanical Movement Analysis Group
Faculty of Medicine
Universidad Nacional de Colombia
https://orcid.org/0000-0002-4772-0852

PT Claudia Patricia Galeano Navarro, SP
Phisical Terapy
Hospital Militar Central

PT Sandra Milena Forero Espinosa
Phisical Terapy
Hospital Militar Central

PT Nubia Esperanza Barbosa Meneses
Phisical Terapy, SP
Hospital Militar Central

PT Tania Martínez V.
Faculty of Medicine
Universidad Nacional de Colombia

ABSTRACT: Demographic changes have shown that the older adult population has been growing nationally and globally, increasing the odds of falling in this vulnerable population, particularly for in-hospital patients. The Timed Up and Go (TUG) test assesses functional performance and risk of falling in adults and older adults with a high level of sensitivity and specificity. However, no evidence of this reliability has been reported in the Colombian population. **GOAL:** Determine the inter- and intra-rater reliability of the TUG test in adult and older adult hospitalized populations in a Colombian institution. **Method:** The study involved 132 hospitalized adult patients with ages averaging between 40–80 years. All participants were interviewed for the registration of their sociodemographic and health conditions and the fulfillment of the inclusion criteria and were asked to sign an informed consent. A test-retest was conducted for the administration of the TUG two different times for each participant, with an hour difference between the two assessment moments, and the test results were recorded independently. None of the physiotherapist researchers who had access to the patients had knowledge of the test results as registered by the peer. The data were

systematized in a database, and an analysis of Lin's concordance correlation coefficient was performed between measures. **Results:** Inter- and intra-rater reliability for the TUG test for the 132 hospitalized patients was determined by three trained physiotherapists who had 15–25 years of experience. It was performed at two different times, in which the physiotherapists took on the roles of leader and observer of the records for each of the patients. Spearman's Rho coefficients were 0.67 for intra-rater tests and 0.97-0.98 for inter-rater tests. Lin rho Pearson coefficients oscillated between 0.978–0.987 (Bland & Altman, 1986). **Conclusions:** High inter- and intra-rater reliability was found for the TUG test in adult hospitalized Colombian patients.
KEYWORDS: Timed Up and Go Test; intra-rater reliability; inter-rater reliability; older adult.

CONFIABILIDAD DE LA PRUEBA TIMED UP AND GO EN LA DETERMINACIÓN DEL RIESGO DE CAÍDAS EN PACIENTES ADULTOS DEL HOSPITAL MILITAR CENTRAL

RESUMEN: Los cambios demográficos han evidenciado que la población adulta mayor ha venido creciendo tanto a nivel nacional como global, aumentando la probabilidad de caídas en esta población vulnerable, particularmente en pacientes hospitalizados. La prueba *Timed Up and Go* (TUG) evalúa el desempeño funcional y el riesgo de caídas en adultos y adultos mayores con un alto nivel de sensibilidad y especificidad. Sin embargo, no se ha reportado evidencia de esta confiabilidad en la población colombiana. **Objetivo:** Determinar la fiabilidad interevaluador e intraevaluador de la prueba TUG en poblaciones adultas y adultas mayores hospitalizadas en una institución colombiana. **Método:** El estudio incluyó 132 pacientes adultos hospitalizados con edades promedio entre 40 y 80 años. Todos los participantes fueron entrevistados para registrar sus condiciones sociodemográficas y de salud, así como para verificar el cumplimiento de los criterios de inclusión, y firmaron un consentimiento informado. Se realizó un test-retest para la aplicación del TUG en dos momentos diferentes para cada participante, con una hora de diferencia entre las evaluaciones, y los resultados se registraron de manera independiente. Ninguno de los fisioterapeutas investigadores tuvo acceso a los resultados registrados por su par. Los datos fueron sistematizados en una base de datos y se realizó un análisis del coeficiente de correlación de concordancia de Lin entre las mediciones. **Resultados:** La fiabilidad interevaluador e intraevaluador de la prueba TUG para los 132 pacientes hospitalizados fue determinada por tres fisioterapeutas entrenados con 15–25 años de experiencia. La prueba se aplicó en dos momentos diferentes, en los cuales los fisioterapeutas asumieron los roles de evaluador principal y observador de los registros para cada paciente. Los coeficientes Rho de Spearman fueron 0.67 para las pruebas intraevaluador y entre 0.97–0.98 para las pruebas interevaluador. Los coeficientes rho de Pearson de Lin oscilaron entre 0.978–0.987 (Bland & Altman, 1986). **Conclusiones:** Se encontró una alta fiabilidad interevaluador e intraevaluador para la prueba TUG en pacientes adultos hospitalizados en Colombia.
PALABRAS CLAVE: Prueba Timed Up and Go; fiabilidad intraevaluador; fiabilidad interevaluador; adulto mayor.

1. INTRODUCTION

Mobility or the ability to move about independently and safely is fundamental in ensuring a good quality of life (Gorgon, Said, & Galea.M., 2007). According to the World Health Organization (WHO), falls are the second-leading cause of accidental or unintentional injury deaths worldwide, and their scale may be related to physical, sensory, and cognitive disorders. Falls may be associated with aging in combination with environments that are not adapted for an aging population (Organización Mundial de la Salud, 2018). Early identification of people at risk of falling is crucial for the timely initiation of prevention strategies that thwart the occurrence of complications that affect people's quality of life (Tobón C., 2016). To attempt to minimize this risk, tools have been developed to timely detect changes in balance, equilibrium, and gait (Cerda, 2014).

The Timed Up and Go (TUG) test is a basic test for functional mobility (Mancilla S, Valenzuela H., & Escobar C., 2015) that measures speed during several functional maneuvers, including standing, walking, turning, and sitting, and the test can easily be used in a clinical setting. The TUG test has proven to be reliable in subjects with different conditions, presenting intraclass correlation coefficient (ICC) values ranging from 0.69–0.99, indicating moderate to good acceptance (Mesquita, *et al*, 2016). It has also been shown that TUG is valid by virtue of its correlation using measures such as the Berg Balance scale, walking speed/time, climbing, and functional indices (Bohannon, 2006) and for its ability to discriminate between hospitalized patients, risk of fall, and mortality. Reliability between raters was 0.99, which measured high sensitivity (87%) and high specificity (87%) when used with a cut-off value of 14 s to identify older people who are prone to falls (Shumway-Cook & B.M, 2000). It has been found that TUG's sensitivity and specificity for the cut-off point ≥ 13.5 seconds was 44% and 71%, respectively, with a 95% confidence interval (Barry, Galvin, Keogh, F., & Fahey, 2014). This was reaffirmed in another study, where the following was found: sensitivity, specificity, positive, and negative predictive values were 30.5%, 89.5%, 46.2%, and 81.4%, respectively (Kojima, y otros, 2015), which correlates with previously agreed-upon results.

Considering the excellent psychometric properties, clinical relevance, and easy administration of the test, it is important to determine the intra- and inter-rater reliability of the test so that it can be used as a valuable tool to predict falls, which will generate important information for decision making and in the creation of fall prevention programs for the Colombian population.

2. OBJECTIVE

To determine the inter- and intra-rater reliability of the (TUG) test in an adult and older adult hospitalized population in a Colombian institution.

3. MATERIALS AND METHODS

A total of 123 adult hospitalized patients were recruited for the administration of the TUG test. All participants were initially interviewed for their sociodemographic and health conditions, which were taken from their medical records, to determine compliance with the inclusion criteria established, such as hemodynamic stability, cognitive ability to follow instructions, and self-sufficiency in walking. Subsequently, an informed consent was signed by the participant or the companion when required.

3.1. DETERMINATION OF COGNITIVE STATUS AND RISK OF FALLING

The Mini-Mental State Exam and Downton Scale were administered to determine cognitive status and the risk of falling in the subjects. In the case of a participant presenting considerable neurological deterioration or very high risk of falling, the test was immediately excluded.

3.2. ADMINISTRATION OF TUG TEST-RETEST

The researchers who conducted the assessments had professional experience ranging between 15–25 years. The test was administered by two physiotherapists, one assuming the role of leader and the other as observer, who recorded the test results simultaneously and independently. The TUG tests were administered inside the room of each of the participants at two different moments, with an hour difference between them. Test results were kept by each physiotherapist in sealed envelopes, without them having knowledge of the information of the other rater.

Participants who presented saturation rates lower than 89% were given low-flow oxygen support by nasal cannula when necessary to ensure adequate oxygenation for the effort required to perform the test. Test results were systematized by researchers who did not carry out the tests.

3.3. STATISTICAL ANALYSIS

For the statistical analysis, measures of central tendency were determined for each of the variables; Spearman's Rho correlation analysis was performed for measures between the raters; and the inter-rater reliability of measurements was determined using

Lin's concordance correlation coefficient between measurements. The scores were analyzed in order to determine a possible ceiling or floor effect within the assessments performed using the statistical package STATA 2016.

4. RESULTS

In the study, 123 subjects who met the eligibility criteria were accepted from June 2017 to June 2018. Of the participants, 52% were male, with a mean age of 68.3 years (range: 40–87; SD: 12.29); marital status: 52% married, followed by 18.78%, who were widowers; and all hospitalized with a median hospitalization of 5 days (Range: 1–32 days) at the Hospital Militar Central in the city of Bogotá. On the other hand, the average weight was 69.27 kg SD 14.19; average heart rate 76.4 beats/min (SD=14.19 beats/min); and average blood pressure was 124/74.3 (± 23.21/± 13.36), respectively. With respect to the Mini-Mental State Exam, 73.17% of the study population was above 26 points. All these findings are described in Table 1.

Table 1. General Characteristics of the Sample.

Variable	n (%) [a]
SOCIODEMOGRAPHIC VARIABLES	
Age in years [b]	68.03±12.29
Gender	
Male	52
Marital status	
Married	58.5
Widower	18.78
Education level	
Some degree of schooling	93.49
Days in hospital [c]	5 (1-42)
CLINICAL VARIABLES	
Weight in kg [b]	69.27±14.19
Heart rate [b]	76.4±15.16
SBP and DBP [b]	124/74.3 (±23.21/±13.36)
Saturation 02 [b]	92.72 ± 2.65
Mini-Mental State Exam [c]	28 (19-32)
Mini-Mental State Exam	
% Normal	73.17
Downton Scale	
% with Risk	22.77

(a) Variables expressed in absolute and relative frequencies
(b) Variables described in terms of average and SD
(c) Variables described in terms of means and ranges

The TUG test averages varied in the 123 adults assessed, with values ranging from 3.88–35.6 seconds, with a mean and standard deviation s for each of the raters and the times as observed in Table 2. It can be seen that the mean times in rater 1 and 2 at time 1 varied in 0.23 thousandths of a second, and at time 2, the mean varied in 0.12 thousandths of a second. It should be noted that the differences between the raters ranged between 0.94 thousandths of a second for rater 1 and 0.59 thousandths of a second for rater 2 (see Table 2).

Table 2. Description of Timed Up and Go (TUG) Scores by Time and Rater.

Variable (measured in sec)	N	Average	SD	Min	p25	Mean	p75	Max
TUG score rater 1 time 1	122	14.21	5.479	6.89	10.41	12.38	16.28	31.63
TUG score rater 2 time 1	123	13.98	5.474	3.88	10.28	12.09	15.87	31.75
TUG score rater 1 time 2	123	13.27	5.152	6.37	9.96	11.96	14.59	35.06
TUG score rater 2 time 2	123	13.39	5.226	6.00	10.00	12.00	15.00	35.00

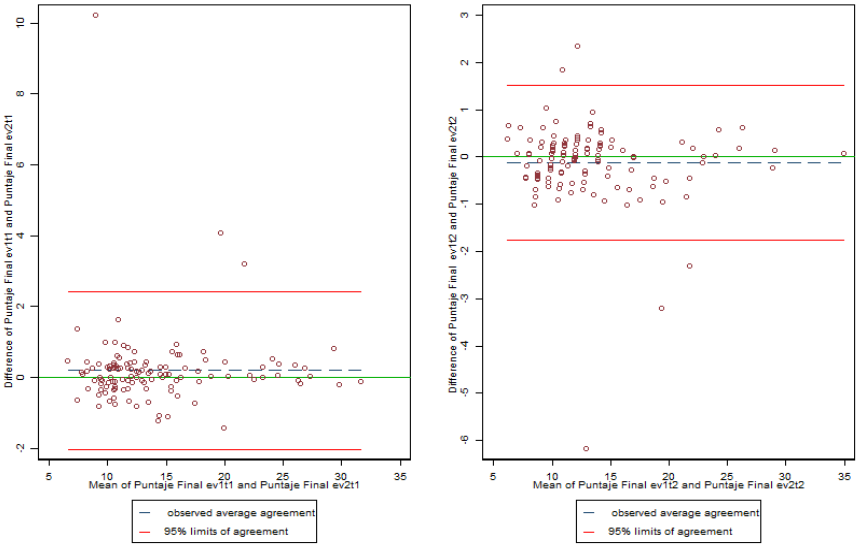
4.1. INTRA- AND INTER-RATER RELIABILITY

The inter- and intra-rater reliability for the TUG test for the 123 hospitalized patients was assessed by three trained physical therapists with 15–25 years of experience. Each of the physiotherapists conducted the assessment at two moments (one as the leader of the assessment process and the other as an observer of the measurement) for each of the patients participating in the study. The finding, as a result of these tests, was that the correlation between assessment times for all raters, measured using Spearman's Rho coefficient, ranged between 0.67–0.97. With respect to inter-rater reliability, Lin's coefficient values ranged from 0.978–0.987 (Bland & Altman, 1986) (see Graph 1 and Table 3).

Table 3: Lin's Coefficient for the Assessments Performed.

	Reliability level 95%			
Ev1 vs Ev2	**Lin's Coefficient**	**Standard Error**	**Lower Limit**	**Upper Limit**
Time 1	0.978	0.004	0.97	0.986
Time 2	0.987	0.002	0.98	0.99

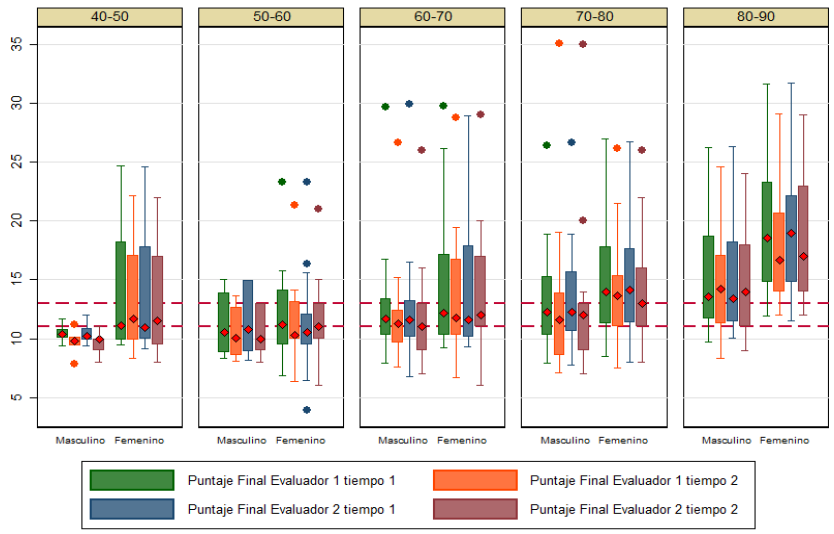
Graph 1: Levels of Agreement for Raters and Times.



Base: 123 sujetos
y=0 is line of perfect average agreement

As can be observed in Graph 1 and Table 3, there was a high degree of agreement for both assessment moment 1 and moment 2 by the therapists. Graph 2 compares the results between times 1 and 2 segregated by sex and age group. There were no significant differences between the raters or the times. However, there were considerable differences between the various age groups assessed and, in the groups, according to the gender of the subjects.

Graph 2. Description of TUG Scores Segregated by Age Group and Sex.



Base: 123 sujetos evaluados

Scores were analyzed to determine a possible ceiling or floor effect in the assessments. Of the observations, 2.44% were oriented to the highest/lowest scores of the corresponding measurements, indicating that neither of these two effects was present.

5. DISCUSSION AND CONCLUSIONS

The results in this document in relation to 123 older adult patients serve to establish the high inter- and intra-rater reliability at a TUG item level for the hospitalized older adult population. The Lin Spearman's Rho coefficients of 0.99 (95%; CI: 0.989–0.996) in the intra-rater tests and 0.98 (95%; 0.976–0.99) in the inter-rater test and the Lin rho Pearson coefficient of 0.99 demonstrate the high reliability of the test. The differences between the scores and the disagreements in the scores are minimal, thus reaching high reliability values. They indicate the excellent reliability and reproducibility of the test, which allows for establishing the use of this test to determine the risk of falling in older adults as a fundamental element in diagnosis and prognosis (Van Lummel, Hobert, Maetzler, & Garres, 2016), (Mesquita R. W., 2016). The TUG test has been widely used worldwide and in different languages to determine the risk of falling in older adults (Barry, Galvin, Keogh, F., & Fahey, 2014) (Hofheinz & Schusterschitz, 2010) (Kojima, y otros, 2015) (Modica & cols., 2017) (Shumway-Cook & B.M, 2000). However, in the case of this study, it is the first to perform cross-cultural validation in Spanish and to determine the inter- and intra-rater reliability in Colombian hospitalized people.

The evidence reported in the population in community settings to determine the risk of falling has been controversial (McGrath, Doheny, McKeown, De Vito, & Caulfield, 2011). Barry *et al.*, in their systematic review, suggest that the test measures the risk of falling, but the predictive cut-off points raised in the evidence are not specific enough to determine which adult is more likely to fall than others. They do, however, suggest that it is a sensitive enough test to determine the risk of falling, in addition to the evidence in our study that relates age and gender to the probability of falling in older adults (Barry, Galvin, Keogh, F., & Fahey, 2014).

The values found in this study are consistent with several studies conducted in clinical and community contexts, where the TUG test has been used in different settings to determine the risk of falling in older adults. This is the case of the study conducted by Martín Hofheinz in 2010 (Hofheinz & Schusterschitz, 2010), which determined the intra-rater reliability of the TUG test. Test results were compared by administering a test-retest. An intraclass correlation (ICC) for the TUG test of 0.94 was obtained, indicating a very high retest reliability. Additionally, in a prospective study conducted in 2009, the reliability of the TUG test-retest in an adult population diagnosed with Alzheimer's disease had an

ICC of 0.98, where the retest test reliability of the TUG scores showed excellent reliability (Ries, Echternach, Nof & Gagnon).

Similarly, Kojima and Cols (2015), in a prospective study in the older adult population, established, as in our study, the values of the TUG test for the older adult population but at the community level. They also established the predictive values for fall risk in a British population (Kojima, *et al*, 2015). The results of these studies allow us to establish that the TUG test has been used worldwide, and it can be a predictor of the risk of falling. The same occurred in a study carried out by Modica (2017) – an observational, prospective, and longitudinal study – in which coefficients very similar to those found in this study were established for the intra- and inter-observer and TUG test-retest reliability with the ICC in subjects with rheumatoid arthritis (Modica & cols., 2017). This is in contrast to what was found by Kojima, Kang, *et al.* (2017) in their prospective study with 541 participants, which stated that TUG is not predictive of fall risk, but rather it is a basis for measurement in older adults for general risk (Kojima T. *et al*, 2017).

6. ACKNOWLEDGEMENTS

All authors contributed substantially to the conception and design of this research. The military central hospital founded this project. Additionally, we must acknowledge the Medicine Faculty Universidad National de Colombia for the edition of this paper, which improved the quality of the final manuscript, and for the support given in the framework of the permanent call for editing texts in English for scientific publications submitted to high-impact international magazines 2020.

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SOBRE OS ORGANIZADORES

Guillermo Julián González-Pérez

Sociólogo, Demógrafo y Doctor en Ciencias de la Salud. Orientación socio-médica. Profesor-Investigador Titular "C" y responsable del Cuerpo Académico Consolidado “Salud, Población y Desarrollo Humano” en el Centro Universitario de Ciencias de la Salud de la Universidad de Guadalajara, México. Miembro desde 1993 del Sistema Nacional de Investigadores de México auspiciado por CONAHCYT (actualmente Nivel III) y miembro de la Academia Mexicana de Ciencias desde 2002. Ha publicado más de 100 artículos científicos en revistas indizadas del campo de las Ciencias Sociales aplicadas a la salud y la Salud Pública, diversos libros como autor, editor o coordinador y dirigido más de 50 tesis de posgrado.

María Guadalupe Vega-López

Licenciada en Trabajo Social; Maestra en Salud Pública; Maestra en Sociología y Doctora en Ciencias de la Salud, Orientación Socio-médica. Profesora-Investigadora Titular "C" y directora del Centro de Estudios en Salud, Población y Desarrollo Humano, en el Centro Universitario de Ciencias de la Salud de la Universidad de Guadalajara, México. Miembro desde 1999 del Sistema Nacional de Investigadores de México (actualmente Nivel II); integrante del Cuerpo Académico Consolidado “Salud, Población y Desarrollo Humano”. Ha publicado más de 60 artículos científicos en revistas indizadas del área de las Ciencias Sociales aplicadas a la salud y la Salud Pública, así como diversos libros como autora y coordinadora, de carácter internacional. Es revisora en varias revistas científicas de carácter internacional.

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EDITORA ARTEMIS
2025