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PROPIEDADES PSICOMÉTRICAS DEL TEST DE CRIBADO DE DEMENCIAS PESOTEST EN MUESTRAS CLÍNICA Y NO CLÍNICA DE ADULTOS MAYORES

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Resumen

El objetivo de este estudio instrumental fue determinar las propiedades psicométricas del test de cribado de demencias Pesotest en muestras clínica y no clínica de adultos mayores de Bogotá. Los participantes fueron 213 adultos mayores de 65 años. Los instrumentos utilizados fueron el Pesotest, el Mini Mental State Examination (MMSE), la Encuesta Sociodemográfica y la Escala de Depresión Geriátrica de Yesavage (GDS). La consistencia interna del Pesotest obtenida con el Alpha de Cronbach fue de 0.86. Se usó el MMSE para establecer la validez convergente y se encontró una correlación significativa de 0.596. Se hallaron diferencias estadísticamente significativas entre las muestras clínica y no clínica. El análisis factorial arrojó cuatro factores: mediante la curva ROC se encontró que la sensibilidad o proporción de personas diagnosticadas con demencia que dieron positivo fue de 0.83; la especificidad o proporción de personas sanas que según la prueba puntúan sin demencia fue de 0.78, y el punto de corte fue 18. El análisis con el modelo de Rasch evidenció que solo un ítem no se ajustó al modelo, y que el ítem con mayor dificultad era el que evaluaba memoria y cálculo, cuya alteración indica evolución a demencia. Con base en los resultados favorables del análisis psicométrico, adecuada consistencia interna, validez convergente, validez de criterio y validez de constructo, se recomienda utilizar el Pesotest en servicios de atención primaria.
Palabras Clave: Demencia, *test,* validez, confiabilidad.

PSYCHOMETRIC PROPERTIES OF A SCREENING TEST FOR DEMENTIA PESOTEST IN CLINICAL AND NON-CLINICAL SAMPLES OF ELDERLY PEOPLE

Abstract

The aim of this instrumental study was to establish the psychometric properties of the screening test for dementia Pesotest in clinical and non-clinical samples of elderly people. The participants of this study were 213 elderly people over 65 years old. The instruments used were the Pesotest, the Mini Mental State Examination (MMSE), the Sociodemographic Survey and the Geriatric Depression Scale Yesavage (GDS). A Cronbach's alpha of 0.86 for internal consistency of the Pesotest was found. The MMSE was used to establish convergent validity, finding a significant correlation of 0.596. Statistically significant differences were also found between the clinical and nonclinical samples. The factor analysis yielded four factors and using the ROC curve it was found that the sensitivity, or the proportion of people diagnosed with dementia, was 0.83; and the specificity, or the proportion of healthy people that were diagnosed with dementia by the test, was 0.78, with a cut-off point of 18. The analysis with the Rasch Model showed that only one item was not fit and that the most difficult item was the one which assessed calculation and memory, whose alteration indicates an evolution towards dementia. Based on the favorable results of the psychometric analysis, suitable internal consistency, convergent and construct validity and reliability, the use of the Pesotest in primary care services is recommended.
Key words: Dementia, test validity, statistical validity, test reliability.

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PROPRIEDADES PSICOMÉTRICAS DO TESTE DE RASTREIO DE DEMÊNCIAS PESOTESTE EM AMOSTRAS CLÍNICA E NÃO CLÍNICA DE IDOSOS

Resumo

O objetivo deste estudo instrumental foi determinar as propriedades psicométricas do Teste de Rastreio de Demências Pesoteste em amostras clínica e não clínica de idosos de Bogotá (Colômbia). Participaram do estudo 213 adultos maiores de 65 anos. Os instrumentos utilizados foram o Pesoteste, o Mini Mental State Examination (MMSE), a Pesquisa Sociodemográfica e a Escala de Depressão Geriátrica de Yesavage (GDS). A consistência interna do Pesoteste obtida com o Alpha de Cronbach foi de 0,86. Foi usado o MMSE para estabelecer a validade convergente e constatou-se uma correlação significativa de 0,596. Acharam-se diferenças estatisticamente significativas entre as amostras clínicas e as não clínicas. A análise fatorial demonstrou quatro fatores: mediante a curva ROC, constatou-se que a sensibilidade ou a proporção de pessoas diagnosticadas com demência que deram positivo foi de 0,83; a especificidade ou a proporção de pessoas saudáveis que, segundo o teste pontuam sem demência, foi de 0,78, e o ponto de corte foi 18. A análise com o modelo de Rasch evidenciou que somente um item não se ajustava ao modelo, e que o item com maior dificuldade era o que avaliava memória e cálculo, cuja alteração indica evolução a demência. Com base nos resultados favoráveis da análise psicométrica, na adequada consistência interna, na validade convergente, na validade de critério e na validade de construto, recomenda-se utilizar o Pesoteste em serviços de atenção primária.
Palavras-chave: demência, teste, validade, confiabilidade.

According to the projections of the National Administrative Department of Statistics (DANE), in Colombia there are currently 4.628.394 people over 60 years old, equivalent to 10% of the total population; by 2020, there will be around 6.500.000 elderly, representing an increase of 39.2% compared to 2011 (Rincon, 2013). This stage of development is associated with the presence of various problems, among them cognitive impairment and some form of dementia. In Colombia, some studies on the prevalence of dementia in people over 50 years old recorded figures between 1.3% and 5.4% (Diaz, Ruano, Chacon & Vera, 2006; Pradilla & Vesga, 2002; Pradilla, Vesga & Bautista 2000; Pradilla, Rosselli & Bautista, 1998), while a study in elderly population over 65 years old in the city of Neiva (Huila) established a prevalence of 23% (Gooding, Amaya, Parra & Rios, 2006).

The above figures show that clinical psychologists and other professionals in the area of primary health care should perform the screening process, i.e. apply instruments to detect and identify on a quick way all cases of patients who are more likely to present dementia, in order to refer them for a complete diagnostic study (Arango, Fernandez, & Ardila, 2003; Carnero, 2005). The screening test must meet the requirements of both, applicability: brevity, ease, simplicity, economy, acceptability, equity, adaptability and flexibility (Carnero, 2005), as well as psychometric requirements for reliability and validity, to which psychological tests are subjected (Kerlinger & Lee, 2002; McIntire & Miller, 2000; Nunnally & Bernstein, 1995).

Screening tests in Spanish language have limitations related to application time (Meulen et al., 2004), educational level (Ostroskyj- Solis, Lopez-Arango & Ardila, 1999) and illiterate populations (Rosselli et al, 2000; Peña-Casanova, Gramunt & Gich, 2004). In Colombia, the Mini Mental State Examination (MMSE) is the test that best allows disciplinary and interdisciplinary dialogue due to its widespread use. It is the only instrument that has normative values stratified by age for the Colombian population, which is why it will continue to be used due to lack of validation of a screening test that also presents cut-off scores established empirically (Arango et al., 2003). Among senior people in the country, about 20% have no education, 58% have completed only primary education, 17% have secondary and 5% have higher education (Profamilia, 2010). Therefore, it is important to have a screening test for dementia that can be applied to illiterate people and not be influenced by educational level, as the Eurotest screening test (Carnero, & Montoro, 2004).

Avendaño and Avendaño (2009) adapted this test to the Colombian context with the name of Pesotest. They applied it to 73 adults over 40 years of age, 26% of those diagnosed with dementia and the remaining 74% without clinical diagnosis. The analysis of the psychometric characteristics showed internal consistency, content validity, convergent validity and construct validity. Differences between clinical and non-clinical samples were found; factor analysis yielded three factors; sensitivity was 0.92 and specificity was 0.84, for a cut-off point of 18. All of these are psychometric indicators consistent with the studies carried out by the author of the Eurotest.

Bearing in mind the aforementioned factors of an increasing elderly population, a greater prevalence of dementias, benefits of screening tests, time constraints for implementing tests in health services, illiteracy in Colombia, and the results obtained by Avendaño and Avendaño (2009), it was considered appropriate to conduct the study with a larger sample of adults over 65 years of age since the prevalence of this age range is greater.

Consequently, the overall objective of the research was to determine the psychometric properties (internal consistency and validity) of the Pesotest screening test for dementia in clinical and non-clinical samples of elderly people.

METHOD

Type of research

This is an instrumental study aimed at analyzing the psychometric properties of a test (Montero & León, 2007) to establish the presence / absence of dementia.

Participants

The sample consisted of 213 adults over 65 years of age, 116 women (54.5%) and 97 men (45.5%), from 14 departments of Colombia. Cundinamarca and Boyacá had the highest representation with 96 (45.1%) and 54 (25.4%) people respectively. The total sample, 179 people (84%) were literate and the remaining 34 (16%) were illiterate; in the first group, 112 persons (52.6%) had elementary/ primary studies, 30 (14%) secondary studies, 9 (4%) technical studies, 9 (4%) undergraduate studies and 6 (3%) graduate; 47 (22%) had no formal education.

The study was done with participants from all socioeconomic strata, with the highest concentration in stratum 1 (53.52%), followed by stratum 2 (18.7%) and 3 (15.96%). As for work activity, 193 (90.6%) did not work, and 20 (9.4%) did some kind of labor activity.

The clinical sample was composed of 75 people treated in healthcare institutions or nursing homes, who had a diagnosis of dementia supported by medical history, and had been selected through a non-probabilistic sampling of subject type, with the support of psychology and psychiatry professionals. The nonclinical sample consisted of 138 participants without clinical diagnosis, who knew the purpose of the study and voluntarily chose to participate. Participants with visual or hearing impairments, or those lacking advanced devices for correction (glasses and hearing aids) were excluded. Those with a history of psychiatric illness, chronic substance abuse, neurological disorders or depression at the time of the evaluation, according to the results of GDS (equal to or higher than 10 score) were also excluded. Since diagnosis of neurology or neuropsychology was not available over a GDS or CDR scale, dichotomous data were used: 1. Has dementia; 2. Does not have dementia.

Instruments

Sociodemographic data survey. Designed by Avendaño and Avendaño (2009).

Screening test for evaluating dementia in elderly people (Eurotest/Pesotest). The original test developed by Carnero and Montoro (2004), called Eurotest, was adapted by Avendaño and Avendaño (2009) with the name of Pesotest. Its aim is to determine whether the evaluated subject presents a cognitive compromise, through a sequence of tasks that involve following directions, handling national currency (pesos) common denomination (50, 100, 200 and 500), math operations with money and short and long term evocation of specific information (Appendix A). These authors, using a Colombian sample of 75 participants, found a cut-off point of 18, internal consistency with Cronbach's Alpha of 0.85 and a factor analysis with a three factor structure. All of these elements explain 62.45% of the variance corroborated by the results found by the author of the original test.

Mini Mental State Examination (MMSE). Screening tool for the diagnosis of cognitive impairment and dementia. Its original version was proposed by Folstein, Folstein and McHugh (1975). Rosselli et al. (2000) adapted it to the Colombian context as a screening tool to classify the group of adults evaluated and compare the results obtained with each of the tests. It consists of 19 items that evaluate temporal and spatial orientation, immediate recall, calculus, evocation, object naming, repetition, comprehension and following verbal and written commands, as well as the writing and copying of a diagram. The results showed that the MMSE had a sensitivity of 92.3% and a specificity of 53.7%; scores are highly correlated with educational level.

Yesavage´s Geriatric Depression Scale (GDS). It was designed by Brink et al. (1982) to evaluate the affective state in the elderly. The questionnaire used by Gomez-Angulo, & Campo-Arias (2011) was taken up with Colombian population; it has 15 items with dichotomous response (yes or no); the questionnaire presented internal consistency of 0.78, construct reliability of 0.87, and a two-dimensional structure (hopelessness and depressed mood).

Procedure

The investigation follows the ethical guidelines of the Ministry of Health (1993) and the Congress of Colombia (2006). It was developed in four phases:

Phase I. Permission to apply and carry out psychometric analysis of the original test called Eurotes was requested to its author, Dr. Cristobal Carnero. Authorization for the application of instruments was demanded to previously identified health institutions and nursing homes that treat older adults with and without a dementia diagnosis. Signatures for the informed consent were requested from participants of the non-clinical sample, and from relatives/representatives of participants of the clinical sample.

Phase II: Application of instruments was done with the help of psychologists, senior psychology students, a physiotherapist and a nurse's aide. All were previously instructed on the application of the test.

Phase III: Data were registered in Excel and then were exported to SPSS (version 20). Database was purged; the descriptive analysis of each of the sociodemographic variables was performed. Scores for the two samples in each test were obtained; normal distribution was established, as well as the difference between the mean scores of the subtests and totals for each test sample.

Phase IV: The psychometric properties of Pesotest were analyzed. Under the classical test theory (CTT), with SPSS software, the internal consistency of each part and of the total Pesotest test with Cronbach's Alpha was established. Convergent validity was determined by Pearson´s product-moment correlation coefficient between scores on the MMSE and the Pesotest, and construct validity of the Pesotest was obtained by exploratory factor analysis. Under the Item Response Theory (IRT), verification of items adjustment to Rasch model with empirical data was performed with Winsteps software, a procedure that cannot be performed with CTT. IRT does not contradict the assumptions of the CTT, so the use of the two models was considered relevant.

RESULTS

To begin with, the normality of the distributions was established through the Kolmogorov–Smirnov statistic, and it was found that both distributions of Pesotest and MMSE for the clinical and non-clinical samples were normal. Mean differences in scores on the MMSE and the Pesotest are presented. Next, the psychometric properties of Pesotest are related: the internal consistency of each of the three parts and the total test, convergent validity and construct validity. Finally, scores of sensitivity and specificity and the cut-off point for Pesotest are presented.

Mean differences in scores obtained in Pesotest and MMSE

In subtests that evaluate calculation and memory in the Pesotest and the MMSE, as well as in the totals of each of these tests, statistically significant differences between clinical and non-clinical samples (tables 1 and 2) were found. In the evaluated components, the standard deviation of the clinical sample was always higher than that of the non-clinical sample. To set the size of the effect with the scores of Pesotest and MMSE, Cohen's *d* was used, which led to scores of 1.61 and 1.68, respectively. These scores, according to Ledesma, Macbeth, & Cortada de Kohan (2008), represent high effects.

Table 1.
Mean differences by sample type (clinical and non-clinical) in each part of the test and in the totals of the Pesotest

Subtest	M Clinical Sample	M Non-Clinical Sample	s Clinical Sample	s Non-Clinical Sample	t	P	Cohen´s d
P1 Total (coins)	1,8	2,64	1,42	1,22	-5,88	0,00	1,61
P2 Total (bills)	1,88	4,36	2,12	1,84	-8,43	0,00	
Total Calculation	3,8	6,75	2,48	2,45	-8,34	0,00	
Total Memory	4,27	6,83	2,59	2,13	-7,34	0,00	
Pesotest Total	11,67	20,84	5,69	5,7	-11,22	0,00	

Table 2.
Mean differences by sample type (clinical and non-clinical) in each part of the test and in the totals of the MMSE

Subtest	M Clinical Sample	M Non-Clinical Sample	s Clinical Sample	s Non-Clinical Sample	t	P	Cohen´s d
Total calculation	1,01	2,06	1,33	1,94	-4,55	0,00	1,68
Total Memory	1,17	2,07	1,18	1,13	-5,28	0,00	
Total Nomination	1,91	1,97	0,33	0,24	-1,27	0,20	
MMSE Total	18,2	26,13	4,82	3,52	-3,18	0,02	

When comparing the averages obtained in the Pesotest by people who can and cannot read and write, a Student *t* value of 1.74 and a *p* of 0.086 was found, which means that there are no differences (table 3). With the scores on the MMSE, this comparison was also established and a Student *t* value of 4.21 and $p = 0.00$ was found. According to this score, the differences are statistically significant (table 3).

Internal Consistency

With the Cronbach´s Alpha values of each of the applied tests, Pesotest 0.86, MMSE 0.87 and GDS 0.76, it was found that there was internal consistency in all three tests. The Cronbach´s Alpha values of each of the Pesotest parts were: knowledge / denomination 0.82, calculation 0.73, memory 0.72, and total test 0.89. These values indicate homogeneity and internal consistency of the test.

Convergent Validity

Convergent validity was established by the Pearson´s product-moment correlation coefficient (*r*) between subtests and total scores of Pesotest and subtests and total scores of MMSE. Table 4 shows that all correlations were statistically significant except for totals denomination.

Construct Validity

Construct validity was obtained through factor analysis. The feasibility of such an analysis was determined by the Bartlett test of sphericity and the Kaiser-Meyer-Olkin (KMO) test. The first gave a value of 751.23 with a significance level of $p = 0.00$, and the second gave a value of 0.845. Both indicators allow performing the analysis.

Factor analysis yielded four factors explaining 61.65% of the total variance. This procedure was estimated from the method of main factors. The factor loadings of the components were established with Varimax rotation and the analysis took into account values higher than 0.30.

Table 5 shows the factors and the way the items in each part of the Pesotest version were pooled. Items 1, 2, 10.1, 10.2, 10.3 and 10.4 form the first factor, which has been called Knowledge / Denomination – Memory, although these items are also loaded in the fourth factor, Knowledge / Denomination, Calculation. Item 3 ("How many coins are there?") shares its load between factor 2, called Calculation, and 4, called Knowledge / Denomination and Calculus. Items 3, 4, 5, 6 and 7 form the second factor, Calculus. Items 8 and 9 constitute the third factor, Memory and Calculation.

Table 6 presents the scores for the cut-off point, sensitivity, specificity and Cronbach´s Alpha of the four Eurotest / Pesotest versions.

Table 3.
Mean differences on scores obtained by participants on Pesotest and MMSE

Pesotest	Has reading and writing skills	n	M	s	t	p
Punctuations	YES	179	17,94	7,349		
Totals					1,74	0,086
Pesotest	NO	34	15,88	6,064		
MMSE						
Punctuations	YES	179	22,53	6,43		
Totals					4,21	0,000
MMSE	NO	34	18,79	4,34		

Table 4.
Correlations between obtained scores in each part of the tests and in the total tests: Total sample

Components	r	p
Total Pesotest denomination Vs Total MMSE denomination	0.073	0.29
Total Pesotest calculation Vs Total MMSE calculation	0.584**	0.00
Total Pesotest memory Vs Total MMSE memory	0.483**	0.00
Total Pesotest Vs Total MMSE	0.596**	0.00

Table 5.
Factor load of components with rotation values higher than 0,30

Item	Rotated Principal Component Matrix			
	1	2	3	4
	Knowledge/Denomination, Memory	Calculation	Memory And calculation	Knowledge/Denomination, Calculation
subp1	,396			,661
subp2	,582			,449
p3		,304		,701
p4		,430		
p5		,516		
p6		,866		
p7		,821		
p8			,795	
p9			,637	
p101	,743			
p102	,730			
p103	,666			
p104	,742			

Table 6.
Scores obtained in the different versions of Eurotest/ Pesotest

	EUROTEST (Carnero, & Montoro, 2004)	EUROTEST (Carnero, 2005)	EUROTEST / PESOTEST (Avendaño & Avendaño, 2009)	PESOTEST (Cantor & Avendaño, 2015)
Cut-off point	23 or less	20/21	18	17/18
Sensitivity	0,93	0,91	0,92	0,83
Specificity	0,87	0,82	0,84	0,78
Cronbach's Alpha Total test			0.85	0.86

Results with Rasch Analysis

Given that the model requires being one-dimensional, Rasch analysis by factor and with the total test was performed. Two adjustment measures were used: Outfit, or sensitive measure to unexpected behavior away from the mean, and Infit, or sensitive measure to unexpected behavior close to average (Burga, 2005). These measures have an expected value of 1.0 and range between zero and infinite. Values below 0.8 indicate that data do not show much randomness, and values above 1.3, that data present too much randomness (Gonzalez, 2008). According to the results, 20 of the 21 items fit the Rasch model. Item p3 was the only item that did not conform to the model in both factor analysis and the analysis of all the evidence. Measurement error had values between 0.12 and 0.27, and the average error in the total test was 0.15. The items that best identify cognitive impairment are the item called *coin 3* (Knowledge / Denomination of the $ 200) coin, and items p8 ("How many coins did I show you before?") and p9 ("How much money was there in total?"). Overall, these results show a high degree of adjustment of items estimates (Table 7). Of the total test, only the mean and the standard deviation of each of the parameters analyzed are presented.

Table 7.
Statistical adjustment to Rasch´s model, item measurement in logits and measurement error

Factors	Item Name	Item´s order	Total n	Measurement Parameter	SE	INFIT		OUTFIT	
						MNSQ	ZSTD	MNSQ	ZSTD
Factor 1	mo1	1	213	-0.09	0.18	1.23	2.5	1.33	2.0
	mo2	2	213	-0.77	0.19	1.22	2.0	1.32	1.4
	mo3	3	213	-0.28	0.18	1.01	0.2	1.04	0.3
	mo4	4	213	-0.06	0.18	1.12	1.4	1.17	1.2
	bille1	5	213	-0.18	0.18	0.94	-0.7	0.76	-1.6
	bille2	6	213	0.30	0.17	0.86	-1.9	0.80	-1.6
	bille3	7	213	0.56	0.17	0.87	-1.8	0.76	-2.1
	bille4	8	213	0.67	0.17	0.86	-2.0	0.83	-1.5
	bille5	9	213	0.18	0.17	0.79	-2.8	0.75	-2.0
	bille6	10	213	-0.06	0.18	0.87	-1.6	0.85	-1.0
	p101	18	213	-1.03	0.14	0.83	-1.4	0.83	-0.7
	p102	19	213	0.24	0.13	1.04	0.4	1.05	0.5
	p103	20	213	0.66	0.13	1.20	2.2	1.18	1.9
	p104	21	213	0.16	0.12	1.13	1.1	1.31	1.4
Factor 2	p3	11	213	-2.19	0.16	1.43	2.7	3.95	4.5
	p4	12	213	-1.42	0.13	0.81	-1.5	1.60	1.4
	p5	13	213	0.13	0.12	1.06	0.6	1.11	0.6
	p6	14	213	1.62	0.13	0.80	-1.6	0.46	-1.6
	p7	15	213	1.86	0.14	0.67	-3.0	0.46	-3.0
Factor 3	p8	16	213	1.04	0.27	1.00	0.0	1,00	0.0
	p9	17	213	-1.04	0.27	1.00	0.0	1,00	0.0
Factor 4	mo1	1	213	0.00	0.18	1.14	1.6	1.17	1.3
	mo2	2	213	-0.69	0.19	1.11	1.1	1.45	2.3
	mo3	3	213	-0.20	.0.18	0.95	-0.6	0.95	-0.3
	mo4	4	213	0.03	0.18	1.10	1.2	1.12	1.0
	bille1	5	213	1.10	0.18	0.90	-1.2	0.76	-1.9
	bille2	6	213	0.41	0.17	0.79	-2.9	0.71	-2.8
	bille3	7	213	0.68	0.17	0.89	-1.5	0.86	-1.2
	bille4	8	213	0.80	0.17	0.88	-1.7	0.83	-1.5
	bille5	9	213	0.28	0.18	0.79	-2.8	0.73	-2.5
	bille6	10	213	0.03	0.18	0.90	-1.3	0.91	-0.7
	p3	11	213	-1.25	0.15	1.72	4.1	2.98	4.4
Test total	M		213	0.00	0.15	1.00	-0.2	1.11	0.0
	s		0.1	0.93	0.03	0.18	1.6	0.55	1.8

The parameter measurement is presented in logits and indicates the difficulty of each item. The values ranged from -2.19 for item p3, the easiest one, and 1.86 for item p7, the most difficult one. 11 items were found with scores above the average of 0 logits and 10 were below the average difficulty.

The cut-off point, the sensitivity and specificity of the test were calculated contrasting responses of the nonclini-

cal sample (n = 138) with the clinical sample (n = 75) by Receiver Operating Characteristic Curves (ROC Curves, for their acronym, Receiver Operating Characteristics). The results indicated a cut-off point of 18, sensitivity (83%) and specificity (78%).

Regarding DIF, it is known that "an item operates differently or presents DIF, when two comparable groups of subjects, that is, with an identical level in respect to the attribute measured by the test is performed in a different manner" (Hidalgo Galindo, Ingles, Campoy & Ortiz, 1999; p.331). Given this definition, it was not considered relevant to apply DIF, since the groups are not comparable, so better performance in the nonclinical sample is expected. In fact, an earlier study with Pesotest, carried out by Avendaño, Avendaño and Cruz (2014) with another sample, whose objectives included analyzing differences by item between samples, used DIF and showed that indeed the results of the two samples per item were different.

DISCUSSION

This research determined the psychometric properties of the Pesotest screening test for dementia in clinical and nonclinical samples on an elderly population. Statistically significant differences found in scores on the Pesotest between clinical and non-clinical samples, with higher averages for the nonclinical sample in each of the subtests and higher variance for the clinical sample, indicate greater homogeneity in scores of the nonclinical sample.

The scores obtained by literate and illiterate participants showed no significant differences in Pesotest, which indicates that education is free of bias, whereas significant differences in MMSE show a schooling bias for this test. This confirms the findings of Carnero (2005), Avendaño and Avendaño (2009) and Martinez (2012) as to the usefulness of Pesotest for screening, especially in populations with low education and high illiteracy rates. Given that 16% of this sample and about 20% of older Colombian adults lack schooling (Profamilia, 2010), the need for an educational bias-free evaluation, fast, reliable and applicable to illiterate populations is emphasized. These were aspects taken into account by Gonzalez (2012) to describe the neuropsychological performance with the Pesotest in the process of naming, calculation, working memory and episodic memory. These are essential cognitive functions required by a group of illiterate unschooled and institutionalized elderly for managing money.

Regarding internal consistency, the Cronbach's Alpha values for each of the components proposed in the original version indicate homogeneity of the test in each of the parts of the Pesotest, an aspect that corroborates the findings of Avendaño and Avendaño (2009). It was found that the test has convergent validity, therefore Pesotest can be used instead of the MMSE because it also allows screening.

Regarding construct validity, Carnero (2005) indicated that this screening test groups its items on three factors: 1. Knowledge/denomination, 2.Calculation, and 3. Memory. The findings of Avendaño and Avendaño (2009) agree with this number of factors. Although the results of this study showed that Pesotest was distributed in four factors, it is important to clarify that an additional domain to those reported by the authors of the Eurotest is not proposed, but a combination of the ones initially proposed by them.

At this point it is pertinent to note that in establishing the diagnosis of dementia the commitment of several cognitive domains (memory and at least one other) is required. The analysis of the components of Pesotest shows that it includes memory and calculation assessment. In this research, two of the four factors in the Pesotest assessment domain include memory (Factor 1. Knowledge / Denomination-Memory; Factor 3. Memory and calculation) and the other two (Factor 2. Calculation and Factor 4. Knowledge / Denomination -Calculation) to assess the calculation domain, something that favors the Pesotest since it has been found that the latter domain is one of the best predictors of cognitive performance in both normal subjects and patients with Alzheimer's disease (Rosselli et al., 2000). According to Heun et al. (1998, as cited in Carnero, 2005), it has been empirically proven that the instruments that assess several cognitive domains also have more validity in the early detection of cognitive impairment and dementia.

The analysis with the Rasch model showed that 20 of the 21 items fit the model and the more difficult item was p7, which evaluates calculation. It corroborates what was established by Ferreira, Campagna, Colmenares and Suarez (2008), who point out that the main indicators of progression to dementia are impairments in executive functions, an aspect to take into account to assess dementia. The p3 item did not adjust to the model, neither in Rasch analysis by factor nor in the analysis of the total test. This aspect corroborates the results found with TCT, since according to the factorial analysis this item shared load in two factors, 2 and 4; in factor 2 it had a 3.95 Outfit and in factor 4 it had an Infit of 1.72 and an Outfit 2.98, scores that reveal model mismatch.

The cut-off point suggested by Carnero (2005) for detecting dementia with Eurotest is 20 points, with a sensitivity of 0.91 and specificity of 0.82. The cut-off point suggested by Avendaño and Avendaño (2009) for detecting dementia with Pesotest is 18 points, with a sensitivity of 0.92 and

specificity of 0.84. Based on the results of this study, the cutoff suggested for Pesotest was also 18 points with a sensitivity of 0.83 and specificity of 0.78. To ensure greater confidence in the results obtained in the previous study by Avendaño and Avendaño (2009), the sample size was expanded, all participants were people over 65 years old (age from which a higher prevalence of dementia is found) and controlled that no participant had depression at the time of application of the test. Although the specificity found in this study was lower than that reported in previous studies, it is likely that several of the participants in the non-clinical sample, whose ages ranged between 65 and 94 years were starting an undiagnosed period of dementia. The results confirm the predictive ability of Pesotest as a screening test for early diagnosis of dementia and cognitive impairment.

One of the constraints to the development of the research was the difficulty to make a more specific conformation of the clinical sample. This limitation is associated with the following facts: 1) the diagnosis of dementia in most nursing homes is carried out by professionals of psychiatry and psychology. Therefore, medical records do not register data corresponding to the degree of the condition in the GDS or CDR scale as established by neurology or neuropsychology. 2) There is no concept based on the evaluation of specialized professionals in neurology or neuropsychology about the absence of dementia or mild cognitive impairment in the non-clinical sample. 3) Potential participants were excluded due to the advanced state of their sensory and motor impairments. 4) Some entities specialized in dementias that offer neurology and neuropsychology services had previously provided access to several researchers for the assessment of this population or were involved at that time in other research processes they required. 5) There is a restriction on the part of institutions to allow access to investigative processes due to institutional policies or to the refusal of relatives to participate in them.

To correct the above limitation, the suggestion made by Avendaño and Avendaño (2009) on the importance of continuing research related to psychometric analysis of Pesotest, especially in institutions with the support of specialized professionals (neurology and neuropsychology) is ratified. This support will allow to classify and group together participants based on the degree of dementia established by the GDS or CDR scores. It will also allow the inclusion of mild cognitive impairment and provide greater depth to the considerations of the diagnostic utility of the test, so that both the area of psychometrics and the academic and health fields (medicine, neurology, neuropsychology and psychology) can benefit from the research findings when using the test.

For future research, it is suggested to ensure that older adults with moderate auditory and visual deficits use corrective devices (glasses and hearing aids) at the time of the application and to exclude those with advanced sensory and motor impairments.

In addition to the favorable results of the psychometric Pesotest analysis, this test meets the characteristics of applicability listed by Carnero (2005): 1) ease of application, supported by professionals who collaborated in this study. 2) Simplicity and economy since it uses only the Pesotest format and 11 coins readily available. 3) Acceptability, since it avoids bias by educational level or illiteracy. 4) Equity, as it does not discriminate among participants. 5) Adaptability to cultural and ethnic conditions of the participants, and 6) flexibility, which involves the ability of the instrument to suit the exact objective pursued (detect vs. confirm) and the difficulty of each case.

Based on the results of the psychometric properties and characteristics of applicability of Pesotest, their use is recommended in primary care as a screening tool with predictive utility in the diagnosis of dementias. Any professional suspecting the existence of a cognitive impairment or dementia, by applying Pesotest, will have the possibility of referring clients to specialized professionals in order to complete the study.

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APPENDIX A

PESOTEST
((Made by Carnero, & Montoro, 2004; adapted by Avendaño, & Avendaño, 2009).

1. First Part (Knowledge/Denomination)

1. "Please tell the de denominations or values of all coins there are currently circulating; Please take into account that I am asking you about coins and not bills" (1 minute maximum time) Coins: □ 50 □ 100 □ 200 □ 500 □ Ohers (specify): Total correct: Intrusions: * Please remember that even though they no longer circulate, coins of 10, 20 and 1.000 pesos existed.		
2. "Please tell me the denominations or values of all bills there are currently circulating?" (1 minute maximum) Bills: □ 1000 □ 2000 □ 5000 □ 10.000 □ 20.000 □ 50.000 □ Others (s'ec9f7): Total correct: Intrusions:		

1

2. Second Part (Calculation)

Place the coins in front of the subject **(3 of 500 pesos, 2 of 200 pesos, 4 of 100 pesos, and 2 of 50 pesos**) and consecutively ask the following tasks. If the answer is wrong, let them know and give a unique new attempt. Some items have several solutions, all of which are valid. Allow up to one minute per item and proceed to the next if he/she has not answered correctly at the time or has exhausted two attempts.

3. "¿How many coins are there?" **(11)** □ Correct □ Second try correct □ Incorrect		
4. "Please change this coin (500) for a combination of others that add up to the same amount of money" (take two coins of 500 pesos and only leave one) □ Correct □ Second try correct □ Incorrect		
5. "¿How much money is there?" ($2.400 pesos) (all coins presented again) □ Correct □ Second try correct □ Incorrecto		
6. "Please sort out these coins into two piles so that each has the same amount of money" ($1200) □ Correct □ Second try correct □ Incorrect		
7. "Please sort out these coins into three piles, so that each has the same amount of money" ($800 pesos) □ Correct □ Second try correct □ Incorrect		

2

3. Distraction Tasks: Semantic Verbal Fluency

"I want for you to tell me all the names of animals you can think of, they can be from land, sea, or air, from the farm, or from home, all the names you can think of!

4. Third Part (Memory)

"To finish up, I would like you to do a last effort and try to remember":

8. "¿How many coins did I show you before?" (11) □ Correcto □ Incorrecto		
9. "¿How much money was there in total?" ($2.400 pesos) □ Correcto □ Incorrecto		
10. "¿Do you remember how many coins of each denomination or value you saw exactly?" Quantity Currency (Coins) Intrusions □____3 of 500 pesos ____ □ Total 10 pesos ____ □ Total □____2 of 200 pesos ____ □ Successes 20 pesos ____ □ Intrusions □____4 of 100 pesos ____ □ _____ 1000 pesos ____ □ _____ □____2 of 50 pesos ____ □ Bills ____ □		
Total (1 + 2 + 3)		

3

Maximum of 30 points