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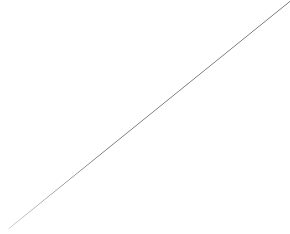
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REVIEW

Is the Montreal Cognitive Assessment (MoCA) screening superior to the Mini-Mental State Examination (MMSE) in the detection of mild cognitive impairment (MCI) and Alzheimer's Disease (AD) in the elderly?

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ABSTRACT

Objective: To compare the accuracy of Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) for the detection of mild cognitive impairment (MCI) and Alzheimer's Disease (AD).

Method: A Systematic Review of PubMed, Embase, Science Direct, Cochrane Library, and PsycInfo databases was conducted. Using criteria based on the meta-analysis of 1,629 articles, 34 articles were selected. The meta-analysis was conducted using the QUADAS-2 and QUADAS-2 Accuracy Score (QUADAS-2).

Result: More than 80% of the studies used MoCA to be compared with MMSE. The diagnostic accuracy of MoCA was significantly higher than MMSE for the detection of MCI and AD. The AUC was significantly higher for MoCA than for MMSE for the detection of MCI (0.883 (CI 95% 0.855-0.912) vs. MMSE 0.780 (CI 95% 0.740-0.820) $p < 0.001$).

Conclusion: The results of MoCA are superior to MMSE in the detection of MCI, and both tests are effective for the detection of AD.

Keywords: Alzheimer's Disease, Mild Cognitive Impairment, Diagnostic Accuracy, Systematic Review, Meta-Analysis, Montreal Cognitive Assessment, Mini-Mental State Examination.

Introduction

Demographic data indicate that the world population is aging. According to the World Health Organization (WHO), in 2012, 36% of the world population was aged 65 years or older, and this percentage is expected to reach 4.7% by the year 2050. For the elderly population aged 65, the prevalence of MCI is estimated to be 10.3% (Fennell et al., 2012). In addition to the prevalence of MCI, the prevalence of AD is also expected to increase significantly in the elderly population (Alzheimer's Association, 2011; Hild et al., 2013; Prince et al., 2013; Wilson et al., 2013a;

2013b; Zúñiga et al., 2015). As a result, there has been a growing interest in the development of screening tests for MCI and AD. The MoCA is a screening test for MCI and AD that has been shown to be more accurate than the MMSE (Burgmans et al., 2010; Prince et al., 2011). AD is a complex disease that is characterized by a progressive decline in cognitive function, particularly in memory, and is a leading cause of disability and death (Dubois et al., 2015). AD is a complex disease that is characterized by a progressive decline in cognitive function, particularly in memory, and is a leading cause of disability and death (Dubois et al., 2015). AD is a complex disease that is characterized by a progressive decline in cognitive function, particularly in memory, and is a leading cause of disability and death (Dubois et al., 2015). AD is a complex disease that is characterized by a progressive decline in cognitive function, particularly in memory, and is a leading cause of disability and death (Dubois et al., 2015).

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Table 1.

Table 1.

STUDY; COUNTRY	POPULATION (N SAMPLING)	AGE (YEARS) AVERAGE SD	FEMALE GENDER (%)	EDUCATION (YEARS) – AVERAGE SD	CUT OFF MoCA – CONTROL VS MCI VS AD	ACCURACY OF MoCA (AUC) – CONTROL VS MCI	ACCURACY OF MoCA (AUC) – CONTROL VS AD	ACCURACY OF MMSE (AUC) – CONTROL VS MCI	ACCURACY OF MMSE (AUC) – CONTROL VS AD	MoCA CONTROL VS MCI SENSITIVITY/ SPECIFICITY	MoCA CONTROL VS DEMENTIA SENSITIVITY/ SPECIFICITY	MMSE CONTROL VS MCI SENSITIVITY/ SPECIFICITY	MMSE CONTROL VS DEMENTIA SENSITIVITY/ SPECIFICITY	TEST WHICH PRESENTED A HIGHER ACCURACY
Ta et al. (2016); Ta et al.	C (26) MCI (59) AD (57)	76.2 8.5	49.6	E e e a y c . . : 35.9% f . . c . . : 16.2% S e . . r c . . : 19.0% U . . y : 28.9%	23/24 19/20	0.91	0.87	0.88	0.89	88/73	79/80	88/70	84/86	M CA . MCI –
C et al. (2015); H et al. K et al.	C (115) MCI (87) AD (64)	72.2 6.1 77.2 6.3 78.5 5.8	75.7 63.2 60.9	6.97 4.69 4.62 5.19 4.56 5.00	22/23 19/20	0.85	0.99	0.78	0.99	78/73	94/92	67/83	94/98	M CA . MCI
H et al. (2015); USA	C (124) MCI (126) AD (67)	69.6 7.9 69.4 7.7 74.4 8.1	67 52 37	15.3 2.6 14.5 2.8 15.2 2.7	25/26 19/20	0.88	0.93	0.79	0.95	–	–	–	–	M CA . MCI
H et al. (2015); Ta et al.	C (260) AD (16)	67.93 6.06	50.7	11.4 4.0	– 23/24	–	0.89	–	0.7	–	78/94	–	38/92	M CA
Ta et al. (2015); C et al.	C (4150) MCI (2311) De e a (984)	80.9 4.6 82.1 4.5 83.9 4.9	4.9 3.6 3.9	8.5 5.5 7.5 5.7 6.0 6.0	60–79y ea . : 25/26 24/25 21/22 ≥90y ea . : 23/24 19/20	0.94	0.91	0.85	0.89	>85/>85	>80/>74	–	–	M CA
Ceca et al. (2014); B et al.	C (39) MCI (45) AD (52)	71.8 6.9 76.6 7.1 77.9 7.0	74.4 60.0 63.5	>9y ea . : 58.8	24/25 22/23	0.94	0.99	0.83	0.95	82.2/92.3	98.1/100.0	80.0/82.1	92.3/82.1	M CA
K et al. (2014); T et al.	C (246) MCI (114) AD (114)	68.0 10.3 74.2 8.8 77.2 9.1	60.1 43.0 57.0	–	E e e a y : 17/18 15/16 H . . r . . c . . : 20/21 18/19 H . . r e e q . . ca . . : 22/23 19/20	0.85	0.99	0.84	0.98	E e e a y : 67/83 H . . r . . c . . : 73/85 H . . r e e q . . ca . . : 81/86	89/90 98/97 99/99	– – –	– – –	M CA . MCI
Ma e - A ad et al. (2014); USA	C (73) MCI (39) AD (34)	82.59 7.67 80.54 8.43 84.74 6.74	45.2 46.2 38.2	14.55 2.41 14.77 2.53 14.56 3.15	– –	0.71	0.94	0.76	0.97	–	–	–	–	–
Y et al. (2014); H et al. K et al.	C (49) MCI (93) De e a (130)	73.6 7.6 76.4 7.5 79.5 6.8	59.0 53.0 65.0	5.61 4.27 4.80 4.78 3.26 4.03	21/22 18/19	0.85	0.97	0.86	0.99	82.8/73.5	92.3/91.8	78.5/81.6	95.4/89.8	–

Table 1. , ➔

STUDY; COUNTRY	POPULATION (N SAMPLING)	AGE (YEARS) AVERAGE SD	FEMALE GENDER (%)	EDUCATION (YEARS) – AVERAGE SD	CUT OFF MoCA – CONTROL VS MCI CONTROL VS AD	ACCURACY OF MoCA (AUC) – CONTROL VS MCI	ACCURACY OF MoCA (AUC) – CONTROL VS AD	ACCURAAV
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STUDY; COUNTRY	POPULATION (N SAMPLING)	AGE (YEARS) AVERAGE SD	FEMALE GENDER (%)	EDUCATION (YEARS) – AVERAGE SD	CUT OFF MoCA – CONTROL VS MCI CONTROL VS AD	ACCURACY OF MoCA (AUC) – CONTROL VS MCI	ACCURACY OF MoCA (AUC) – CONTROL VS AD	ACCURACY OF MoCA (AUC) – CONTROL VS AD
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AD, the National Institute of Neurological and Communicative Disorders and Stroke—Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) criteria (McKhann *et al.*, 1984) and the revised criteria (Petersen *et al.*, 2004) are used for the diagnosis of MCI. The Area under the curve (AUC) calculation of the ROC curve, adjusted for age and education, is used for MCA and MMSE. Of the 34 subjects, 31 were diagnosed with MCI based on the criteria of MCA and MMSE and 3 were diagnosed with MCI. The specificity (80.6%) was used for MCA, MMSE diagnosis. The diagnosis of MCI was based on the criteria of MCA and MMSE (Cecchi *et al.*, 2014; Cella *et al.*, 2016; Cella *et al.*, 2015; DeGrada *et al.*, 2017; D'Esposito *et al.*, 2012; Fea *et al.*, 2013; Filippini *et al.*, 2010; Gifford *et al.*, 2010; Hwang *et al.*, 2015; Hwang *et al.*, 2015; Hwang *et al.*, 2013; Jang *et al.*, 2017; Kwon *et al.*, 2014; Lee *et al.*, 2008; Lichtenberg *et al.*, 2012; Liu *et al.*, 2011; Liu *et al.*, 2009; Marcella *et al.*, 2012; Meisler *et al.*, 2016; Meisler *et al.*, 2013).

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Discussion

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