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Cross cultural dementia screening in illiterates with the RUDAS

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Contents

Abstract

Objective: The prevalence of dementia in the ageing Non-Western migrant population in the Netherlands is increasing. The largest groups of the first generation Non-Western migrants consist of many low educated and illiterate elderly. In order to meet the needs of this population we need to provide them with optimal cognitive assessment and treatment. In this study, we assessed the effect of educational level and illiteracy on the RUDAS, a new cognitive screening instrument in the Netherlands. Furthermore, we examined the performance of illiterates in the migrant population on the visuoconstructional item of the RUDAS and the Stick Design Test as alternative test.

Method: One hundred and twenty-eight patients were recruited in a memory clinic, among them patients diagnosed with MCI (*n*= 35; 57% illiterates) and patients diagnosed with dementia (*n*= 59; 47% illiterates). The control group consisted of cognitively healthy participants (*n*= 50; 22% illiterates) recruited from community centers. All participants were aged 55 years or older and completed the RUDAS and the Stick Design Test, which measured visuoconstructional abilities without using a pencil. Participants with incomplete test results or other missing values were excluded.

Results: No effect was found of educational level on the RUDAS score. However, literates in general scored higher on the RUDAS than illiterates among the total group of participants, especially on the visuoconstructional item. When assessing the results on the Stick Design Test no performance difference was found between cognitively healthy literates and illiterates, which supports our hypothesis that the Stick Design Test is a good alternative to measure visuoconstructional abilities in illiterates.

Discussion: The RUDAS score is not affected by educational level, while it is by illiteracy. Further research is needed, for example a replication study. Regarding the visuoconstructional abilities, the RUDAS showed inadequacy in measuring these abilities in cognitively healthy illiterate migrants. The Stick Design Test could be used as a good alternative.

1. Introduction

A few generations ago, being uneducated or being low educated was not unfamiliar. Nowadays, this has changed immensely. In 2015, 15% of the worldwide population reported to be illiterate, with a higher occurrence among elderly, especially in non-Western countries (Ardila et al., 2010). Despite illiteracy occurrence among elderly native inhabitants, in Europe it is also common among the immigrants (Schellingerhout, 2004). The two largest groups of first –and second-generation non-Western migrants in the Netherlands are from Moroccan and Turkish descent (CBS, 2017) (Alzheimer Nederland, 2014). According to data on ethnic minorities from the Dutch Central Bureau for statistics (CBS) (2017) in January 2017, the Netherlands consisted of 391.088 habitants of first and second generation Moroccans and 400.367 from Turkish origin. In total, there were 2.173.723 first and second-generation migrants of non Western origin. Accordingly, illiteracy is more common in the Netherlands among the elderly population from Non-Western origin such as Morocco (36%) and Turkey (17%) (Schellingerhout, 2004). Illiteracy can be due to "social reasons, such as poverty, not enough accessible schools or child labor" (Ardila et al., 2010, p. 690). Illiteracy can also be due to "personal reasons such as learning difficulties, mental retardation and other conditions that may cause difficulty in learning to read and write despite accessible education" (Ardila et al., 2010, p. 690). In case of the first generation migrants in the Netherlands, illiteracy is often due to social reasons (Uysal-Bozkir, Parlevliet, & de Rooij, 2013). Furthermore, 55% of the Turkish migrants and 35% of the Moroccan migrants lack Dutch language proficiency (Schellingerhout, 2004). Because of illiteracy and the inability to speak Dutch fluently, the first generation migrants are often underrepresented in the development of assessment methods, which might have caused suboptimal healthcare and even suboptimal treatments (Uysal-Bozkir et al., 2013).

1.1 Dementia

Studies have shown a high risk of chronic diseases among minorities in the UK population and in the Dutch population, for example cardiovascular diseases (Schellingerhout, 2004) and dementia (Adelman, Blanchard, Rait, Leavey, & Livingston, 2011). In this study, we focus on the latter. The dementia syndrome involves notable decline in one or more cognitive domains, which is not due to delirium or other mental disorders (American Psychiatric Association [APA], 2013). Approximately 10% of the population with dementia in the Netherlands are migrants. The percentage might seem low, which is due to the group of migrants consisting of mostly young people (Alzheimer Nederland, 2014). However, the group consists also of ageing first-generation migrants who settled in the country around 1960/1970 (Van Wezel et al., 2016). The prevalence of dementia among the population of migrants is expected to increase twice as much as in the native (Dutch) inhabitants (Alzheimer Nederland, 2014). In order to accommodate these ageing populations of low educated or illiterate elderly from different cultures, we need to provide them with adjusted healthcare. Therefore proper assessment is necessary.

Dementia can have many causes: Alzheimer dementia, Lewy body dementia, frontotemporal dementia and vascular dementia (McKeel, 2007). Distinction between the dementia subtypes can be accomplishes through observing differences in psychosocial regression, attention deficits, apathy, memory disorders, changes in the brain, the cause, the progress, and in some occasions even genes in the DNA. Alzheimer dementia (AD) is the most common form of dementia (Lezak, Howieson, Bigler, & Tranel, 2012).

The stage that may possibly occur before dementia, with the earliest changes in cognitive decline is called Mild Cognitive Impairment, MCI (McKeel, 2007). MCI may progress, stay the same or even recover. By definition, it does not always evolve into a dementia. MCI as a stage before dementia is being referred to as "MCI due to Alzheimer's Disease" and can be recognized by its progressiveness, according to Albert and colleagues (2011, p. 271). The cognitive deficits of MCI are above average for the concerned age, but not as grave as the symptoms of dementia. Possible cognitive deficits that appear in the stadium before dementia are impairments in episodic memory, processing speed, executive functioning, verbal capacity and attention. The deficits are not that serious to cause social and professional dysfunctions as it does in dementia (American Psychiatric Association [APA], 2000; Albert et al., 2011).

1.2 Dementia prevalence and cognitive performances according to educational level

Individuals with higher levels of education are less likely to develop dementia, according to a variety of population-based studies (Ardila et al., 2010; Livingston et al., 2017). This finding can be explained by the cognitive reserve hypothesis, which states that individuals with higher educational levels own more neurocognitive reserve to compensate for neuropathological changes that occur with age-related changes or with some diseases, such as dementia (Lezak et al., 2012). The neurocognitive reserve leads to different manners to handle and complete tasks, through different pathways or stronger pathways. Hence, individuals with a higher educational level may develop and use more efficient strategies to deal with the neuropathological changes (Ardila et al., 2010). As a result, using these efficient strategies could cause differences in performance scores on cognitive screening tests between highly educated and low educated patients. However, significant performance differences on cognitive tasks are more common between literates and illiterates than between people from different educational levels (Contador et al., 2017; Ardila et al., 2010; Petersson, Silva, Castro-Caldas, Ingvar, & Reis, 2007), since illiterates in general did not develop the specific strategies at all. Thereby, the educational levels are in a gradual order, which causes less performance differences between the educational levels subsequent to each other (Contador et al., 2017). Moreover, studies have shown neurological differences between literates and illiterates, that arise when acquiring academic skills such as reading, math, writing or drawing (Petersson et al., 2007). These academic skills are often testes in cognitive assessment methods (Goudsmit, Parlevliet, Van Campen, & Schmand, 2011), for example with visuoconstruction tasks.

1.3 Visuoconstructional abilities and illiterates

For good visuoconstructional performances different abilities are needed, for instance fine motoric finger movements (praxis) and visuospatial insight (Ardila et al., 2010). Drawing or writing something starts by holding the pencil the right way and being able to manage the right movements at the right moment with fine finger motor skills. Individuals who are experienced and used to these movements find it much easier to write, draw or copy a figure than individuals who are not used to holding a pencil. In the latter case it is difficult to distinguish between constructional apraxia and visual insight (Dansilio & Charamelo, 2005). Illiterates are not used to holding a pencil, which might be one of the reasons significantly lower performances by illiterates were found on a variety of visuoconstructional tests (Ardila et al., 2010). A study showed significant difficulties in illiterates on normal visuoconstructional tests using a pencil, especially in the areas of reproducing perspective, differentiating figures and disarray in the subsequent steps (Dansilio & Charamelo, 2005). An alternative task was tested by the study of Matute and colleagues (2000) in which the visuoconstructional abilities of illiterates were measured by copying figures with matchsticks instead of a pencil. Despite the higher range of mistakes made by the illiterates, no significant difference was found in the performance on this alternative test between literates and illiterates.

1.4 Cognitive assessment methods

Some of the cross cultural cognitive assessment methods currently being used in the Netherlands to assess dementia among migrants are the Cross-Cultural Dementia Screening (CCD) (Goudsmit et al., 2016) and the Mini Mental Status Examination (MMSE). However, the MSSE is not specifically designed to be used cross-culturally (Pang, Yu, Pearson, Lynch, & Fong, 2009) and is not suitable for illiterates (Ardila et al., 2010). The RUDAS, originally invented in Australia, is especially designed for cross-cultural use and use across different educational levels and is much shorter than the CCD (Storey, Rowland, Conforti, & Dickson, 2004). Results of translations of the RUDAS in different countries are promising (Navqi, Haider, Tomlinson, & Alibhai, 2015). Yet, it has not been incorporated as a cognitive screening tool in daily clinical practice in the Netherlands. Before the RUDAS can be incorporated in daily clinical practice, research is needed to study its validity in the elderly Dutch multicultural population.

1.5 Research objectives and hypotheses

The purpose of this study was to examine the validity and the functioning of the RUDAS dementia screening assessment in the Dutch elderly migrant population. Thereby our aim was to compare literate and illiterate or high-educated and low-educated people and their results on the RUDAS dementia screening assessment in patients with and without a diagnosis of dementia. In addition, we preferred to assess the relationship between educational level and the RUDAS score, since in a previous study no effect has been found of educational level on the RUDAS (Storey et al., 2004). Furthermore, we aimed to assess results on the visuoconstruction item of the RUDAS between literate and illiterate migrants, since visuospatial drawing tasks tend to be difficult for illiterates (Ardila, Rosselli & Rosas, 1989; Ardila et al., 2010). The objective was to find an alternative method to assess visuoconstruction abilities in illiterate potential dementia patients across cultures without using a pencil. Therefore, we used the Stick Design Test (Matute, Leal, Zarabozo, Robles, & Cedillo, 2000) in this study to examine the performances of healthy illiterates in comparison with literates.

In Summary, our hypotheses are: 1) The effect of educational level on the RUDAS is minimal. This expectation stems from the fact that the RUDAS is designed to be used across cultures and among different languages and educational levels (Storey et al., 2004). 2) Illiterates in the healthy and in the diagnosed group score lower than literates do on the RUDAS because of, among other things, the visuoconstructional drawing item. It might be difficult for someone without any experience in writing or drawing to have insight in visuoconstructional tasks (Ardila et al., 2010). 3) The Stick Design Test is a good alternative for the visuoconstructional drawing item of the RUDAS. Hence, we expected that illiterate migrants would score the same as the literate migrants on the Stick Design Test (Matute et al., 2000) in the cognitively healthy group.

1.6 Implications

Determining the usefulness of the RUDAS in a mostly illiterate population of elderly is highly needed in clinical practice. Since the first generation group of migrants in the Netherlands is ageing (Van Wezel et al., 2016), we need to provide them with proper assessment, which is necessary for appropriate health care. The RUDAS might be a good alternative for the MMSE.

2. Methods

2.1 Design

This study was designed as a diagnostic accuracy study. Two groups were compared: cognitively healthy non-Western migrants (of Moroccan and Turkish origin) aged 55 years and older and patients diagnosed with dementia at the memory clinic of three hospitals. The RUDAS, the MMSE and the Stick Design Test were administered in one session. We compared the scores between the literates and the illiterates. We also compared scores between different educational levels and between healthy participants and participants diagnosed with dementia. All procedures were approved of by the Medical Ethical Committee of MC Slotervaart and other participating centers.

2.2 Participants

In this study 128 participants visiting a memory clinic were recruited from three hospitals in the Netherlands; a large part of them (n =94) has a dementia (n =59) or mild cognitive impairment (n =35). The patients without a diagnosis of dementia or MCI (i.e. depression or unclear diagnosis) were excluded. The second (control) group consists of cognitively healthy participants who were randomly recruited from different cities in the Netherlands, for example through community centers or through the snowball method (via via) (n =50). Patients who did not complete the RUDAS or had for some reason invalid values were excluded from our study, this caused 3 missing values in the MCI group and 12 missing values in the dementia group. Inclusion criteria for all participants were a minimum age of 55 years and a non-western cultural background. In particular migrants of Moroccan and Turkish origin were being selected, since they form the biggest non-western group of migrants in the Dutch population (Alzheimer Nederland, 2014). The exclusion criteria for cognitively healthy participants were (self reported):-history of a brain tumor, epilepsy, CVA, brain damage with loss of consciousness for more than 1 hour and hospitalization, more memory complaints than are considered normal for the age of the participant, psychosis at the time of testing, a past history of psychosis or a bipolar disorder and lastly, mental retardation. The participants were being selected on their willingness to participate. All participants were tested in their native language (with the help of an interpreter if needed) and an informed consent was obtained beforehand.

2.3 Procedure

Patients visiting the memory clinic all underwent the same diagnostic workup, consisting of an extensive interview with patient and informant, physical examination, laboratory testing and cognitive testing. After diagnostic workup, medical specialists blinded for MSSE and RUDAS scores were asked to decide if the participant had MCI or dementia, or other conditions (research diagnosis). All participants were tested in a quiet setting. Patients as well as cognitively healthy participants were all administered the MMSE and the RUDAS. The complete healthy control group and a subgroup of the patients diagnosed with dementia (n = 6) took also the Stick Design Test.

Healthy participants were tested in community centers. First, the healthy participants were asked if they were willing to participate. A short information letter was read to them and the informed consent was signed. Second, the participants were being asked a few questions concerning demographic features, such as their age, gender, cultural background, literacy, health status and their educational level. Illiteracy was defined as not being able to read and/or write (self reported). Educational level was scored in years and level. They were also asked about the exclusion criteria. Third, the Mini Mental State Examination (MMSE) (Folstein, Folstein & McHugh, 1975), the Rowland Universal Dementia Assessment Scale (RUDAS) (Storey et al., 2004) and the Stick Design Test (SDT) (Bayewu et al., 2005) were administered. Meanwhile, or after testing the participant, a family member was asked to fill in the Informant Questionnaire for Cognitive Decline in the Elderly (IQCODE) (Jorm, 2004). The whole test procedure involved approximately 30 minutes per participant.

2.4 Measures

The following tests were administered: RUDAS, MMSE, Stick Design Test and IQCODE. The RUDAS (Storey et al., 2004) is a six-item cognitive screening test for dementia. It consists of items assessing memory (8-point scale), visuo-spatial orientation (5-point scale), praxis (2-point scale), judgment (4-point scale), language (8-point scale) and visuoconstructional abilities (3-point scale). The test is specifically designed to be suitable for low-educated elderly from different cultures. The maximum score is 30. A score of 22 or lower indicates a possible cognitive impairment. Subsequently, further investigation should be considered.

The MMSE (Folstein et al., 1975) is the world's most widespread short cognitive screening test and consists of 11 items assessing orientation to time and place, memory, attention, language, visuoconstructional abilities, writing skills, reading skills, praxis and judgment. The maximum score is 30 and a score below 24 indicates possible cognitive impairment.

The Stick Design Test (SDT) (Matute et al., 2000) is a test to measure visuoconstructional abilities, specifically designed for illiterates. Four geometric designs have to be copied with matchsticks. Skills like writing and drawing are not needed. The four different geometric designs are being scored by examining the completeness of the figures and the positions of the matchsticks. The match head should point out in the same direction as shown in the designs. For each design the maximum score is 3, the total maximum score of the SDT is 12.

The IQCODE-sf (Informant Questionnaire for Cognitive Decline in the Elderly-short form) (Jorm, 2004) is a 16-item informant-based questionnaire for cognitive decline. For example: the informant is asked if the patient is still able to remember his or her telephone number, compared to 10 years ago. Each item can be answered on a scale from 1 to 5, with 1 meaning 'much better' and 5 meaning 'much worse'. The total score is being calculated by summing all the scores and dividing by the total number of items. Therefore, the maximum score is 5.

The gathered data of the cognitive screening tests, the Stick Design Test and the questionnaires were compiled in SPSS. The variables obtained after testing were the MMSE total score, the RUDAS total score, the IQCODE total score and the Stick Design Test score. Covariates were obtained information of the participants such as literacy, educational level, age, gender, cultural background, social-economic status (obtained through first four numbers of the participant's zip code) and literacy in own native language. Educational level was scored based on a total of eight levels: a category of 'no school attended' and the seven levels of United Nations Educational, Scientific and Cultural Organization (ISCED; UNESCO, 2011). Diagnosis of dementia in this study included all forms of dementia. Additionally, patients diagnosed with mild cognitive impairment (MCI) were included separately.

2.5 Statistical analysis

To analyze hypothesis 1, which states that the effect of educational level is minimalized with the RUDAS, we used a univariate ANOVA. The educational levels were a) no education b) elementary education or lower c) secondary or tertiary education. Hypothesis 2, illiterates score lower on the RUDAS than literates because of, among other things, the visuoconstructional drawing item, was analyzed with a Mann Whitney U test. The effect of illiteracy on the visuoconstructional item of the RUDAS was examined and the effect was compared among the different groups (diagnosed with dementia vs. healthy). An independent samples t-test was conducted to test the effect of illiteracy on the total RUDAS score. Finally hypothesis 3, the Stick Design Test is a good alternative for the visuoconstructional drawing item of the RUDAS was analyzed in two steps. First, we analyzed if illiterates score the same as literates on the Stick Design test among the cognitively healthy participants with a one-way ANOVA. In addition, the total SDT scores of the healthy participants were compared to the total SDT scores of the MCI/Dementia diagnosed patients to examine the difference in performance along with cognitive decline and to assure the effectiveness of using the SDT. The latter was analyzed with a Kruskal-Wallis H test, since the variances of the two groups were not equal. The analyses were conducted with IBM SPSS Statistics version 23.

3. Results

3.1 The effect of educational level on the RUDAS score

The performance on the RUDAS cognitive screening test was analyzed while considering the effect of educational level of the participants from the memory clinic as well as from the community. For the first hypothesis, the participants were not divided by clinical diagnosis. All participants were analyzed together, in order to avoid a low number of participants in the higher educational levels. To gain more insight, table 1 gives an overview of the population distribution and variables used in this study.

Table 1.

Demographic and clinical characteristics of patients and participants

	Total sample (*n* =129)		
	Group		
	Intact cognition (*n* =50)	MCI (*n* =32)	Dementia (*n* =47)
Age (median, Q1-Q3)	58 (56-66)	75 (69-79)	76 (72-79)
Gender			
Male (%)	50	31	57
Country of origin (%)			
Turkey	50	63	47
Morocco	50	37	53
Illiteracy (%)			
Illiterate	22	57	47
Educational level (%)			
No education	26	59	51
<6 classes elementary school	34	22	21
Elementary school	8	10	11
More than elementary school without specialisation	0	6	2
Secondary education, skills level	0	3	7
Tertiary education (bachelor)	2	0	0
Tertiary education (master >)	4	0	0
RUDAS score (median, Q1-Q3)	25 (24-27)	20.5 (17-24)	16 (12-21)
SDT (*n* =)			
Valid	50	1	5
SDT score (median, Q1-Q3)	12 (12-12)	2 (2-2)	10 (7-10.5)

Note. RUDAS= Rowland Universal Dementia Assessment, SDT= Stick Design Test

A one-way analysis of variance (ANOVA) was conducted, with the RUDAS total score as dependent variable and the educational level as fixed factor, to test our first hypothesis: the effect of educational level on the RUDAS is minimal. The educational levels were divided over 3 groups: 1. not educated, 2. elementary education or lower, 3. secondary or tertiary education. Before using the one-way ANOVA, we tested the assumptions. Since the assumptions were met and the variances were equal, an ANOVA could be conducted to test our hypothesis.

The one-way ANOVA yielded no significant effect of educational level on the RUDAS total score: $F(2, 126) = 2.82$, $p = .064$; $\eta^2 = .04$. In accordance with our hypothesis, the results have showed no significant difference between educational level and the total score on the RUDAS, stating that there is no effect of educational level on the RUDAS score.

In addition, the covariate SES (socioeconomic status) was added in the analysis and an ANCOVA was administered. The covariate, SES, was not significantly related to the participant's total RUDAS score, $F(1, 125) = 3.51$, $p = .063$, partial $\eta^2 = .03$. Despite the addition of the covariate, still no significant effect of educational level on the RUDAS total score was found after controlling for the effect of SES, $F(2, 125) = 2.34$, $p = .101$, partial $\eta^2 = .04$.

3.2 Literates vs. illiterates and the visuoconstructional drawing item

Our second hypothesis assumed that illiterates score lower than literates do on the RUDAS because of, among other things, the visuoconstructional drawing item.

We assumed a significant effect of illiteracy on the total RUDAS score and a possible significant effect of illiteracy on the visuoconstructional item. First, an independent-samples t-test was conducted to compare the total RUDAS score among literates and illiterates in the total group of participants. On average, illiterate participants ($M = 19$, $SE = .78$) scored lower on the RUDAS than literate participants ($M = 22$, $SE = .72$). This difference, -2.55, BCa 95% CI [.357, 4.616], was significant $t(127) = 2.34$, $p = .021$. Nevertheless, when conducting the independent-samples t-test for each group of clinical diagnosis separate, no effect of illiteracy was found on the total score of the RUDAS. In the cognitively healthy group, no significant difference was found $t(48) = .97$, $p = .337$, neither in the MCI group, $t(30) = 1.61$, $p = .118$ nor in the dementia group, $t(45) = .50$, $p = .620$. Remarkably, these results differ from the finding when analyzed over the total group of participants, without considering their clinical diagnosis. The difference of the effect of illiteracy on the total RUDAS score between the total group of participants and the separate groups based on clinical diagnosis can possibly be explained by smaller groups, and therefore less statistical power, when classifying participants by their clinical diagnosis.

Secondly, to test the effect of illiteracy on the visuoconstructional item of the RUDAS, a Mann-Whitney U test was conducted. Among all participants, the total score on the visuoconstructional drawing item of the RUDAS in the illiterate group (Mdn = 0) was significantly different from the literate group (Mdn = 1), U = 1068.0, $p < .001$.

When classifying the participants into groups, using their health status and clinical diagnosis, i.e. cognitively healthy participants, patients with MCI and patients with dementia, the following results appeared from the Mann-Whitney U test; see Table 2, 3 and 4. In the cognitively healthy group, illiterate participants (Mdn = 0) performed significantly different (lower) on the RUDAS visuoconstructional drawing item from the literate participants (Mdn = 1), U = 112.5, p = .013.

In the MCI group there was also a significant difference in performance on the specific item between illiterates (Mdn = 0) and literates (Mdn = 1), U = 47.0, p = .001.

However, in the dementia group there was no significant difference in performance on the visuoconstructional drawing item between the illiterates (Mdn = 0) and literates (Mdn = 1), U = 209.0, p = .114. The finding of the non-significant effect among the patients diagnosed with dementia can possibly be explained by the fact that the dementia disorder caused all the patients, literate and illiterate, to score lower than average on the visuoconstructional item.

Table 2.

Mann Whitney U test results of effect of illiteracy on the visuoconstructional RUDAS item

	Item	Group	N	Mean Rank	Sum of Ranks	U	p
Cognitively healthy participants	RUDAS visuoconstructional drawing item total score (0-3)	Illiterates	11	16.23	178.50	112.5	.013
		Literates	39	28.12	1096.50		

Table 3.

Mann Whitney U test results of effect of illiteracy on the visuoconstructional RUDAS item

Clinical diagnosis	Item	Group	N	Mean Rank	Sum of	U	p
MCI	RUDAS visuoconstructional drawing item total score (0-3)	Illiterates	18	12.11	218.00	47.0	.001
		Literates	14	22.14	310.00		

Table 4.

Mann Whitney U test results of effect of illiteracy on the visoconstructional RUDAS item

Clinical diagnosis	Item	Group	N	Mean Rank	Sum of	U	p
Dementia	RUDAS visuoconstructional drawing item total score (0-3)	Illiterates	22	21.00	462.00	209.0	.114
		Literates	25	26.64	666.00		

In summary, an effect was found of illiteracy on the visuoconstructional item, particularly in the cognitively healthy and the MCI group. The different mean scores on the visuoconstructional item between literates and illiterates is demonstrated in Figure 1.

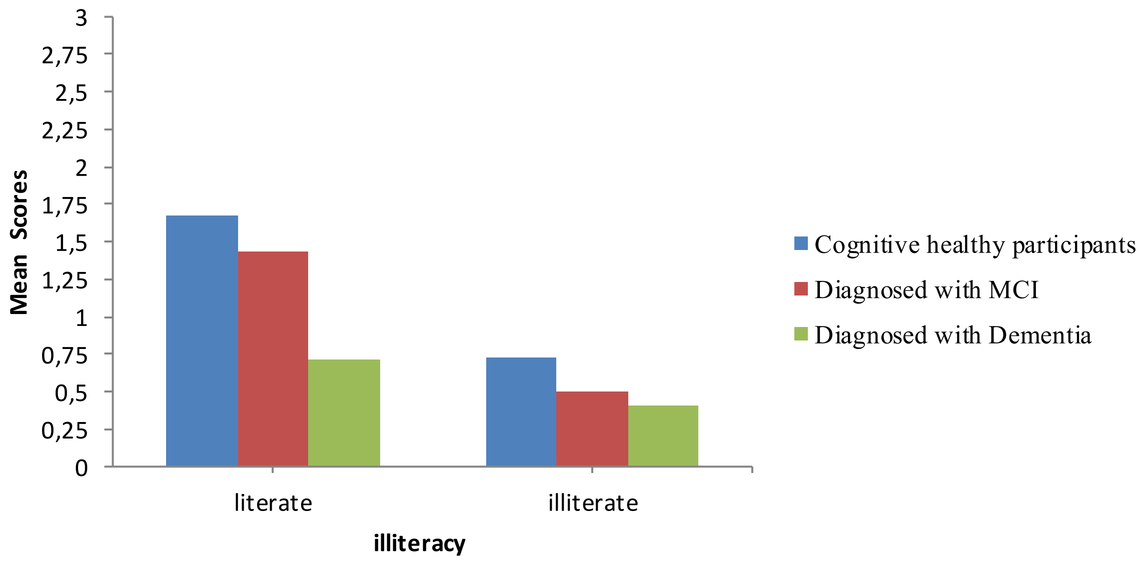

Figure 1. Estimated Marginal Means of RUDAS Visuoconstructional item total score Performance differences on the visuoconstructional drawing item between literates and illiterates.

3.3 The Stick Design Test a good alternative?

To test our third hypothesis, that there is no difference of performance on the Stick Design Test between literates and illiterates, a one-way ANOVA has been conducted with the total score on the Stick Design Test as the dependent variable and illiteracy as the fixed factor. Because there were too few patients who took the SDT (N< 10), we only used the total scores of the cognitively healthy participants (n = 50), F(1,48)= 0.11, p = .687. In line with our hypothesis, no significant effect was found of illiteracy on the SDT among the cognitively healthy participants.

Furthermore, to examine if patients diagnosed with MCI or Dementia ($n = 6$) do score lower on the SDT than cognitively healthy participants, we used a Kruskal-Wallis H test. As shown by the significant Levene's test ($p= < .05$), the variances of each group were not equal and the one-way ANOVA could not be conducted. For this reason, we conducted a Kruskal-Wallis H test to compare the mean ranks between the cognitively healthy community participants and the patients diagnosed with MCI and Dementia in the memory clinic. Since the scores did not have the same distribution between the groups, we could only compare the mean scores and not the median scores. The Kruskal-Wallis H showed that there was a statistically significant difference in the SDT total score between the two different groups (cognitively healthy participants vs. patients diagnosed with a cognitive disorder), $\chi2(1) = 19.883$, $p < .001$, with a mean rank SDT total score of 31.18 for the healthy community and 6.17 for the patients in the memory clinic. According to the above results, we can conclude that the SDT might be a good alternative for the visuoconstructional item of the RUDAS, since demented people do score significantly lower on the SDT than cognitively healthy people. In addition, there is no effect of illiteracy on the SDT, whereas there is an effect of illiteracy on the visuoconstructional item in the RUDAS among cognitively healthy people.

4. Discussion

In this study, we aimed to assess the sensitivity for educational levels and illiteracy of the RUDAS, a potentially new cognitive screening instrument in the Netherlands, in a group of 129 adults aged 55 years and older. Among them 47 diagnosed with dementia and 32 diagnosed with MCI. In addition, we focused on the visuoconstructional item of the RUDAS and the effect of illiteracy on that item. Furthermore, we assessed the performance differences of illiterates and literates on a potential alternative test for the visuoconstructional item, the Stick Design Test, in a group of 50 cognitively healthy participants.

No difference was found between lower educated and higher educated people and their performance on the RUDAS in total. People with a higher educational level do not necessarily score higher on the RUDAS than people with a lower educational level or vice versa. However when it comes down to illiteracy versus literacy, there is a difference in performance on the RUDAS. Literates scored higher on the RUDAS than illiterates among the total group of participants. The visuoconstructional item seemed to have a major role in the above finding. Likewise, literates scored higher on the visuoconstructional item than illiterates among the total group of participants, the cognitively healthy people and the MCI patients. Lastly, no difference was found between cognitively healthy literates and illiterates and their performance on the Stick Design Test.

While in our study educational level had no significant effect on the RUDAS score, Nielsen, Vogel, Gade and Waldemar (2012) reported other findings. According to their study, 16% of the variance in test scores on the RUDAS could be explained by educational career, while 44% of the variance in the test scores on the MMSE could be explained by educational career. These findings showed a higher effect of educational level on the MMSE than on the RUDAS. In that sense, the RUDAS is less sensitive for the educational level of the participants (Navqi et al., 2015). However, contradictory to our results, they did find a significant effect of education both on the RUDAS score and on the MMSE score. Hypothetically, the difference between our results could be explained by the different educational stages used in both studies. In the study of Nielsen and colleagues (2012), there were only two stages: less than primary school (which was 0 to 4 years of schooling back in the day in the home country of the Turkish migrants in Denmark) and primary school or more. While in our study, we divided the groups more accurately using three educational stages: no education, elementary education, and secondary or tertiary education. We found it particularly important to point out elderly who have never had education at all, and are illiterate in most cases. This brings us to our second finding of a significant effect of illiteracy on the RUDAS score, which is in line with findings of lower performances of illiterates in different cognitive domains (Ardila et al., 2010). For example the visuoconstructional domain. Literates scored higher on the RUDAS visuoconstructional item than illiterates did. As stated in the study by Nielsen and Jørgensen (2013), illiterates have more difficulty with visuoconstructional items. The RUDAS visuoconstructional item consists of a Necker cube (Storey et al., 2004). In case of the Necker cube, illiterates find it hard to produce three-dimensionality and to form the figure accurately by drawing straight lines (Nielsen & Jørgensen, 2013). However, among patients diagnosed with dementia, there was no performance difference on the RUDAS visuoconstructional item between literates and illiterates. An explanation could be the demented state of the patients causing both literates and illiterates to score lower on the visuoconstructional item (Lezak, 2012).

On the alternative test to measure visuoconstruction abilities, the Stick Design Test, no effect of illiteracy was found among cognitively healthy people. In line with Matute and colleagues (2000), illiterates are able to perform on the stick design tasks as well as literates are. Therefore, the Stick Design Test might be a good alternative to measure visuoconstruction. Since patients do not need to use a pencil, it is less of a challenge for illiterates to produce the figures with matchsticks.

Despite the important findings in this study, some limitations need to be mentioned. In particular, the small amount of people in the higher educated levels. This limitation could be countered with recruiting more patients in our database. However, it is difficult to get a sample with many high-educated elderly migrants of Moroccan and Turkish origin in the Netherlands, since most of them have not had the opportunity to get higher education (or even primary education) back in the days in their home country (Goudsmit et al., 2011). Therefore, we divided the educational ISCED levels (UNESCO, 2011) in to three groups, instead of exploring the differences between each educational ISCED level specifically. This might have caused a less accurate analysis of the effect of educational level on the total RUDAS score. Because of the small sample size, we could also not distinguish and assess the effect of educational level on the RUDAS between cognitively healthy participants and participants with a clinical diagnosis. Furthermore, the cognitively healthy participants were overall younger than the patients diagnosed with MCI and dementia. Hence, the cognitively healthy group consisted of a smaller percentage of illiterates than in the MCI and dementia groups. Another limitation appeared when examining the difference in performance on the Stick Design Test between cognitively healthy participants and the patients diagnosed with MCI or dementia. We only administered the Stick Design Test to a few patients in the memory clinic, since the idea of administering this alternative test emerged later in the study. However, earlier studies showed, in line with our results, a clear lack of visuoconstructional abilities in many demented patients (Lezak, 2011). Thereby, our main aim was to assess the effect of illiteracy on the Stick Design Test among cognitively healthy people.

Recommendations for further research include repeating the study with a larger sample size and especially focusing on recruiting enough participants with higher educational levels. Furthermore, we recommend additional research on the Stick Design Test as alternative to measure visuoconstructional disabilities in elderly by investigating its validity (i.e. its sensitivity to cognitive decline). Adding a task or two of the Stick Design Test in the RUDAS as an option for illiterate patients or as a second option when they lack in sufficient skills for drawing the normal RUDAS visuoconstruction item (the Necker cube) could be a possible solution in the future. For example, like the fourth item of the MMSE (Folstein et al., 1975) where two options are given, either to calculate or to spell a word backwards. This would be a practical contribution of our study in optimizing the RUDAS as a cognitive assessment method for illiterate elderly migrants and hypothetically also for illiterate native inhabitants.

In conclusion, the effect of educational level and illiteracy was examined in an elderly migrant population in the Netherlands. Despite no significant difference between educational levels on the RUDAS score, there was a significant difference between literates and illiterates. Illiterates score especially lower on the visuoconstructional item. To substitute for this item, we examined the Stick Design Test as an alternative visuoconstructional test and found illiterates being able to perform as well as literates do on this alternative test. We hope these findings will be considered in further research and improvements of existing or potentially new cognitive screening instruments, so that cognitive instruments become as optimal as possible for all participants of our society.

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