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Mini-mental state examination (MMSE) scores in elderly Jordanian population

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ABSTRACT

Background: The Mini-Mental State Examination (MMSE) is a simple informative and validated screening test of cognitive functions. No data of MMSE scores has been published about elderly Jordanian population. Objective: To study the MMSE scores in the elderly Jordanian population (defined as age of 50 years or more).

Methods: This was a cross sectional study. A 250 healthy elderly Jordanians were interviewed and tested for their MMSE score. Their scores were analyzed and the effect of age, gender, education, marital status, diabetes mellitus (DM), hypertension (HTN), smoking, dyslipidemia, heart disease (HD), and family history of dementia (FHD) on the score was studied.

Results: MMSE scores of 236 elderly subjects, aged 63±8.4 years (range 50–86 years) were analyzed. There were 111 (47%) males. There was a direct correlation between MMSE score and education level. People with a higher education (college) had the highest scores in comparison with people who are illiterates or have a high school level. The score correlated negatively with age (Pearson correlation $r = -0.23$, $p = 0.00$). Other studied variables did not correlate with score on multivariate analysis.

Conclusion: Jordanians ≥50 years old with no previous brain disease scored 26.7 ± 3.2. Education was the most important determining factor of this score. the score showed also a negative correlation with age. We suggest that in this population a cut off score of 24 for those with high education beyond high school and 21 for those with up to high school education and it is not appropriate for illiterate.

1. Introduction

The Mini-Mental State Examination (MMSE) is the most widely known brief cognitive test for the screening and detection of dementia,[1] While the MMSE has limited specificity with respect to individual clinical syndromes, it is a brief, standardized method to grade patients' cognitive mental status. It assesses orientation, attention, immediate and short-term recall, language, and the ability to follow simple verbal and written commands. It provides a total score that places the individual on a scale of cognitive function.[2] It is also a common measure of grading cognitive impairment, monitoring its evolution over time, and estimating the treatment effects on cognitive function.[3] Since its development, there has been a wealth of literature published on the MMSE, demonstrating it to be a relatively sensitive marker of overt dementia.[4–6] Its utility decreases, however, when patients with mild cognitive decline and psychiatric conditions are assessed.[7–9] This test has been validated in different cultures and societies, [10,11] including Arabic cultures.[12,13] Normal data have shown that the score is related to both age and level of education. [2] There are no normative data in Jordan covering those who are above 50 years and it is not known whether age and level of education are also important determinants of the score in Jordanians above 50. In this study, the findings of MMSE scores in healthy adult Jordanians ≥50 years are reported and their relations to age, education level, marital status, and atherosclerosis risk factors were determined.

2. Methods

Elderly (defined here as those who are 50 years of age or older) were recruited for the study, exclusion criteria included having a neurological medical illness, history of any brain disease that has left any deficit and taking any central nervous systme acting agents. Absence of these criteria were used to define healthy people. A team of 5 investigators, AH, RB, AE, TA and AQ, explained the test to the candidates. ***We screened***

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Table 1
showing main features of patients and their total MMSE score on univariate analysis

ANOVA *p* value	MMSE Score Mean± SD	Number (%)	Total (236)
Gender: M/F	111(47)/125(53)	27.5 ± 2.3/26.1 ± 3.8	0.001
Marital: S/Ma/D/W	5(2.2)/203(86)/3(1.3)/25(10.6)	27.2 ± 1.5/26.9 ± 3/28.3 ± 0.6/25.0 ± 4.8	0.037
Education: I/H/C	19(8.1)/52(22)/165/(69.9)	19.6 ± 3.1/25.9 ± 2.8/27.8 ± 2.0	0.000
DM: No/Yes	139(58.9)/97(41.1)	27.1 ± 3.0/26.2 ± 3.4	0.039
HTN: No/ Yes	113(47.9)/123(52.1)	27.2 ± 2.8/26.3 ± 3.6	0.049
Smoking: No/Yes	202(85.6)/34(14.4)	26.5 ± 3.4/27.9 ± 1.7	0.019
Dyslipidemia: No/Yes	120(50.8)/116(49.2)	27.3 ± 2.9/26.1 ± 3.4	0.005
HD: No/Yes	201(85.2)/35(14.8)	26.7 ± 3.4/27.1 ± 2.3	0.465
FHD: No/Yes	222(94.1)/14(5.9)	26.7 ± 3.3/26.9 ± 2.9	0.829

M male, F female, S single, Ma married, D divorced, W widow, I illiterate, H up to high school, C college and above, DM diabetes mellitus, HTN hypertension, HD heart disease, FHD family history of dementia.

478 possible volunteers. We excluded 228 candidates as they had one or more of the exclusion criteria or did not fit into our definition of elderly. Of these excluded 184 were younger than 50 years, 30 had history of previous brain disease, mainly cerebrovascular disease (23 persons) and 14 did not sign the consent form. After obtaining their written consent, the test was presented in its Arabic version. The test generally took between 10 and 20 min. The patients' demographic data including age, gender, level of education, and marital status, as well as history of heart diseases and family history of dementia were recorded. Atherosclerosis risk factors were also studied (DM, HTN, smoking, and dyslipidemia). *a volunteer was considered to have HTN, DM or dyslipidemia based on a definite previous diagnosis of any of these by their primary health care provider and/or current use of antihypertensive, antidiabetic or anti-lipid medications* The score was done in the field; which included patients' waiting areas in outpatient clinics, living areas of some volunteers and other areas such as mosques and churches. Data was collected on a separate sheet for each volunteer and then analyzed using the SPSS 22 package. We calculated the total score and the score for each of its components which included orientation, registration, attention, language and recall. The mean and standard deviation were calculated and the correlation with age, gender, marital status, education level, DM, HTN, smoking, dyslipidemia, heart disease, and family history of dementia using the Pearson correlation factor, was derived. *Because illiterate people are not able to read or write and this constitutes 2 points in the MMSE score, we corrected for this by multiplying the score by 30 and dividing the result by 28 so that a score of 20 will be 21.4. though this has not been validated in illiterate people before*

3. Results

We interviewed 250 volunteers, 14 were excluded due to verifying history of previous brain disease and 236 fulfilled the inclusion criteria and, their scores were analyzed. The mean age was 63±8.4 years (range 50–86 years). Table 1 summarizes the general features and findings in the population. There were 111 (47%) males and 125 (53%) females who scored 27.5 ± 2.3, and 26.1 ± 3.8 respectively ($P = 0.001$ ANOVA). The majority (203, 86%) were married, while 5 subjects were single (2.2%), 3 subjects were divorced (1.3%) and 25 subjects were widowed (10.6%). MMSE Score mean was 26.9 ± 3, 27.2 ± 1.5, 28.3 ± 0.6, and 25.0 ± 4.8 respectively ($P = 0.037$ ANOVA, the difference mainly explained by the married compared to widowed scores). There was a direct correlation between MMSE score and education level (Table 2). illiteracy was found in 19 subjects (8.1%), up to high school level in (22%), and college (beyond high school level) in (69.9%). They scored 19.6 ± 3.1, 25.9 ± 2.8 and 27.8 ± 2.0 respectively ($p = 0.000$) The distribution of the scores among subjects based on their gender, marital status and education level is shown in Fig. 1a, b, and c respectively.

The score correlated negatively with age (Pearson correlation $r=-0.23$, $p = 0.00$) (Fig. 2, Table 2). Other factors that were studied include DM, HTN, smoking, dyslipidemia, heart disease, and family history of dementia. Non-diabetics, 139 subjects (58.9%) had a score mean of 27.1 ± 3.0, while diabetics had a score mean of 26.2 ± 3.4($P = 0.039$ ANOVA). There were 113 subjects without HTN (47.9%) and 123(52.1%) with HTN, with a score mean of 27.2 ± 2.8, and 26.3 ± 3.6 respectively ($P = 0.049$ ANOVA). There were 202 non-smokers (85.6%), and 34 smokers (14.4%) with a score mean of 26.5 ± 3.4, and 27.9 ± 1.7 respectively ($P = 0.019$ ANOVA). Those without dyslipidemia 120 subjects (50.8%), compared to 116 subjects (49.2%) with dyslipidemia, had a score mean of 27.3 ± 2.9, and 26.1 ± 3.4 respectively ($P = 0.005$ ANOVA). Subjects (201, 82.5%) with no HD compared to those (35, 14.8%) with HD, had a score mean of 26.7 ± 3.4, and 27.1 ± 2.3 respectively ($P = 0.465$ ANOVA). Family history of dementia present in 14 subjects (5.9%) compared to those with no FHD, 222 subjects (94.1%) scored 26.7 ± 3.3, and 26.9 ± 2.9 respectively ($P = 0.829$ ANOVA). On multivariate analysis model (Table 2). none of these factors correlated with MMSE score. The only factors that remained significant were education level and age.

Table 2
showing multivariate analysis of different variables and MMSE score.

Variable	*P* value
Gender	.391
Marital status	.365
Education	.000
DM	.426
HTN	.267
Smoking	.355
Dyslipidemia	.534
Heart disease	.193
FHAD	.381
Age	.014

4. Discussion

In this study, it has been shown that there is a correlation between level of education and MMSE score which was like that reported from previous study of healthy educated adult Jordanian population. [14]. The data from the Jordanian department of statistics according to 2017 census results showed that only11.8% of the Jordanian population were 50 years of age or above, which makes the Jordanian population a quite young one. Most of Jordanian population is educated and the rate of illiteracy in the general population was 5.2% (males 2.9% and females 7.5%). 53.9% have had less than secondary school education (males 58.8% and females 49%), and 15.2% had secondary school education (males 14.2% and females 16.2%), while 25.7% had higher education (males 24.1% and females 27.3%).[15] *This may explain why on multivariate analysis gender was not a differentiating factor in the score in this study.* Though previous work on MMSE was on those with low level education, one study addressing the sensitivity and specificity of MMSE

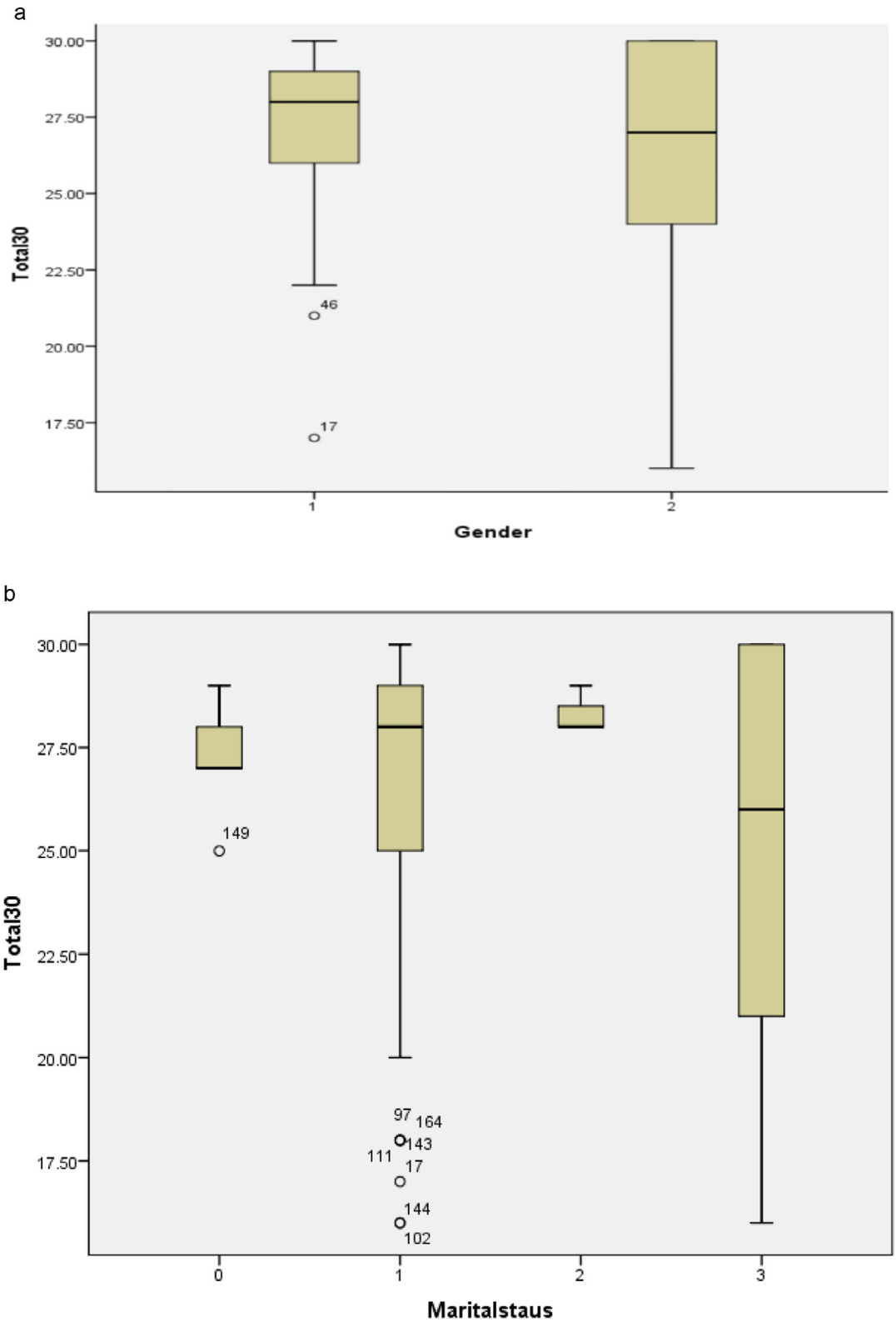

Fig. 1. (1a): Boxplot showing the distribution of MMSE score based on gender:(1 male, 2 female). Figure (1b) marital status (0 single, 1 married, 2 divorced, 3 widowed). Figure (1c) education level (0=illiterate, 1up to high school, 2 beyond high school, college).

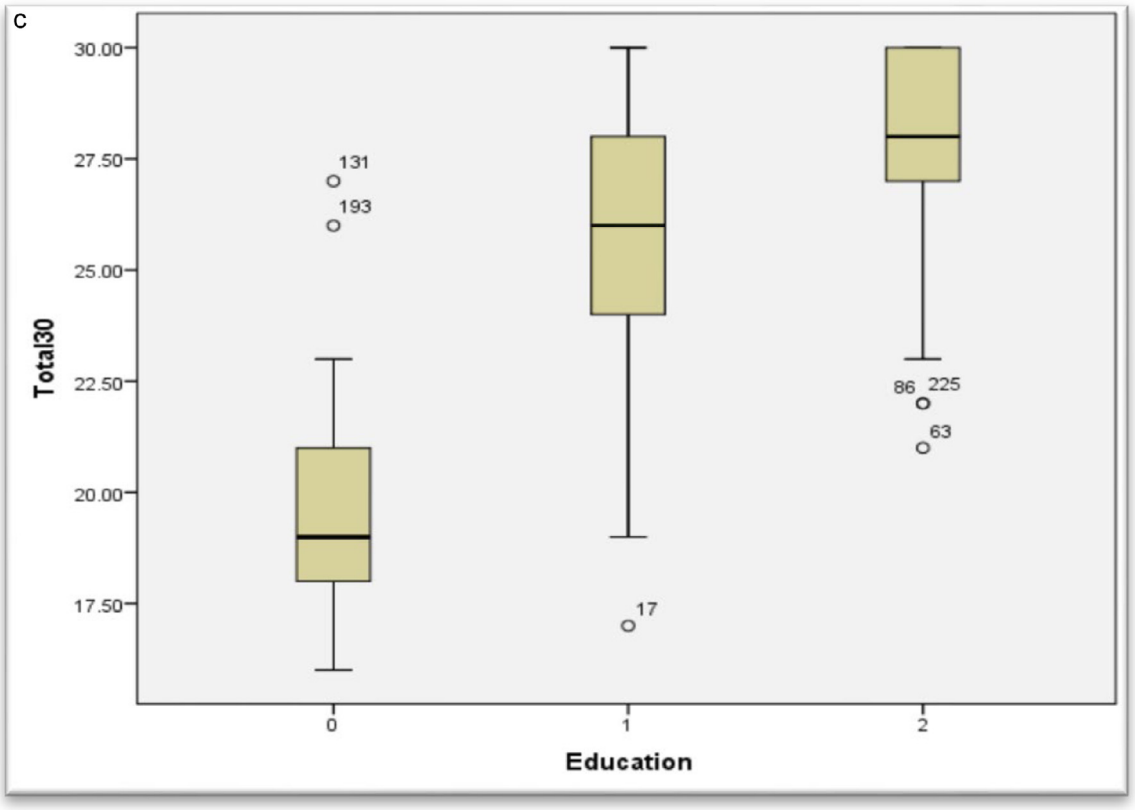

Fig. 1. Continued

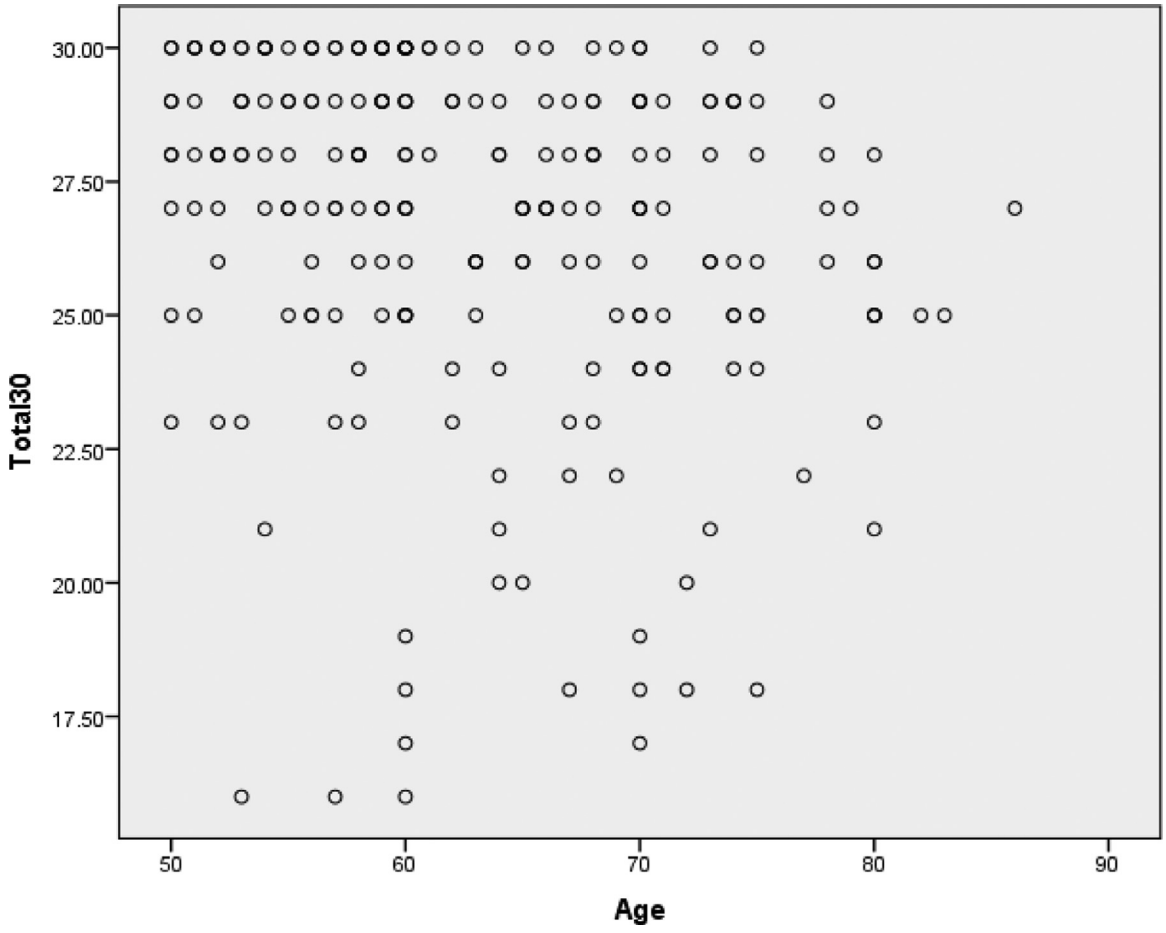

Fig. 2. Scatter diagram showing relationship of MMSE score and age.

in highly educated people (average 17 years of formal education) suggested a cutoff point of 27 below which they will become at higher risk to develop dementia [16]. In our study subjects with higher education (> 12 years of formal education) scored on average 27.8 ± 2. The possible explanation of the different results between our results and that study is that our subjects were less educated and the total number was quite small compared to that study[16] In fact, research suggests that lower cut-scores on the MMSE are appropriate when evaluating populations obtaining lower levels of education [2] and correction formulas have been published [6] If we consider a normal distribution of scores in patients with similar level of education we will suggest a cutoff point of 24 for those with higher level of education (mean −2SD) and 21 for those with education below high school. As the number of illiterate subjects was low and at least 2 points of the score are not appropriate for them, we believe that this test is not appropriate for this population and other screening tests must be explored in such population As our sample did not include patients with cognitive impairment we could not assess the specificity/sensitivity or predictive value of our suggested cutoff points for the different levels of education. Our study also succeeded to confirm the well-known negative relationship between MMSE scores and the age. The average age in our population (63yeras) was very close to the very small minority (3.7%) of the whole population who are ≥65 years old. So, this sample represent elderly Jordanians though we included those who are ≥50 years of age. Getting old is the single most important factor for degenerative dementia and we expect that our cognitive performance will get less as we get old. The limitations of this study must be acknowledged. First, the number of volunteers was not large enough to make any solid conclusions. Second, the population studied does not necessarily represent the whole population of Jordan since the subjects were drawn from the capital city of Amman. Our sample had more illiterate persons 8.1% vs 5.2% in the general population but also more highly educated people 69.9% vs 25,7%. We need to study a much larger sample and include different areas of Jordan. Our results may be more representative of the capital area rather than whole country of Jordan. Third, the mechanism that was used in confirming/excluding presence of any neurological diseases, central acting agents, and other studied features was only by taking history, but no further investigations were performed to confirm these claims. Fourth, our focus was mainly on the exclusion criteria, and the features that were tested without taking into consideration the presence of other major diseases (like depression) that might affect the results of MMSE scores. In conclusion, the MMSE scores of 236 elderly Jordanians is presented here. Their education level and age are documented as relevant to the score and cut-off score points were suggested to classify people in this age as normal vs subnormal that may predispose people to cognitive disorders. Other studied factors showed no relevant correlation to the score. We believe that the results of this study help researchers and clinicians who study or take care of Jordanian patients with suspected dementia.

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Declaration of Competing Interest

There is no conflict of interest to be disclosed by any of the authors.

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