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Evaluation of Vitamin D and Clock Drawing Test Performance in Low Educated Elderly Patients

Düşük Eğitim Düzeyli Yaşlı Hastalarda D Vitamin ve Saat Çizme Testinin Değerlendirilmesi

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ABSTRACT

Purpose: We aimed to investigate whether CDT and 25-hydroxyvitamin D (25OHD) level are predictors for sun exposure and walking duration, and aimed to investigate whether CDT is reliable in low educated (LE) elderly.

Material and Methods: A total of 185 LE patients without dementia above the age of 65 who had applied to internal medicine clinic were included in the study. The patients' demographic data, sun exposure, walking duration, a history of coronary artery disease (CAD) and the number of falls were recorded. Clock drawing was measured using Manos scoring system.

Results: The study population included 127 (68.6%) males with a mean age of 73 ± 6 years and 58 (31.4%) females with a mean age of 70 ± 5 years. According to Manos scoring system a total of 90 (48.6%) subjects had a CDT score of 0, 70 (37.9%) subjects had a CDT score of 1-9 and 25 (13.5%) subjects had a CDT score of 10. The mean vitamin D level of the patients was 18.4 ± 7.3 ng/mL. Vitamin D levels and CDT scores were predictive for sun exposure, duration of walking, number of falls and CAD.

Conclusion: CDT scores of LE subjects were unreliable to demonstrate cognitive functions. This study has shown that vitamin D levels to be more potent predictor than CDT scores to demonstrate sun exposure, walking duration, numbers of falls and the incidence of CAD in LE subjects.

Key words: Vitamin D; clock drawing test; low education level, sun exposure; physical activity.

ÖZET

Amaç: Saat çizme testi (SÇT) kognitif fonksiyonları değerlendirmede kullanılan kısa, pratik ve güvenli bir testtir. Biz SÇT ile 25-hidroksivitamin D seviyesinin güneşe maruziyet ve yürüme süresi için prediktif olup olmadığını ve SÇT'nin düşük eğitim düzeyli (DE) yaşlılarda güvenilir olup olmadığını araştırmayı amaçladık.

Materyal ve Metod: İç hastalıkları kliniğine başvuran 65 yaş üzeri demansı olmayan 185 DE hasta bu çalışmaya dahil edildi. Hastaların demografik verileri, güneş maruziyetleri, yürüme süreleri, koroner kalp hastalığı (KKH) öyküsü ve düşme sayısı kaydedildi. SÇT, Manos skorlama sistemi kullanılarak ölçüldü.

Bulgular: Çalışma populasyonu yaş ortalaması 73 ± 6 yıl olan 127 (%68.6) erkek ve yaş ortalaması 70 ± 5 yıl olan 58 (%31.4) kadın hastayı içeriyordu. Manos skorlama sistemine göre, 90 (%48.6) kişinin CDT skoru 0, 70 (%37.9) kişinin CDT skoru 1-9 arası ve 25 (%13.5) kişinin CDT skoru 10 idi. Hastaların ortalama D vitamin düzeyi 18.4 ± 7.3 ng/mL idi. D vitamin seviyesi ve SÇT skorları güneş maruziyeti, yürüme süresi ve düşme sayısı ve KKH için tahmin edici değerdeydi.

Sonuç: DE kişilerin SÇT skorları bilinç fonksiyonlarını göstermede güvenilir değildir. Bu çalışma gösterdi ki DE bireylerde D vitamin seviyeleri güneş maruziyeti, yürüme süresi, düşme sayısı ve KKH sıklığını göstermede SÇT skorundan daha güçlüdür.

Anahtar kelimeler: D vitamin, saat çizme testi, düşük eğitim düzeyi, güneş maruziyeti, fiziksel aktivite.

INTRODUCTION

Mini mental state examination (MMSE) test is a reliable and widely used test to evaluate cognitive functions. However, misleading and biased results have been reported in low educated (LE) and illiterate subjects[1]. Clinical Dementia Rating scale (CDR) is widely used for screening cognitive functions in LE subjects[2]. The clock drawing test (CDT) is a simple and useful test for screening and evaluating cognitive, visuospatial and executive functions[3,4]. It has been translated into many languages. It is reliably used in Turkish[5] similar to many different cultures and languages. It demonstrates the cognitive functions easily even in low educated subjects, however CDT are low sensitivity and variable specificity for LE elderly[6]. There are different scoring systems used to interpret this test. As the scoring system out of 4 there is another scoring system out of 10 called Manos[7]. Fuzikawa has shown CDT that scored by the Shurman method to be a very good test for evaluating the cognitive functions of LE *elderly people unlike Manos*[8,9].

The relationship between vitamin D levels and cognitive functions has been reported in the literature. Vitamin D level has been found to be a good marker for evaluating cognitive functions[10-12]. Cognitive function is severely impaired especially with vitamin D level lower than 10[13]. Vitamin D supplements has been reported to improve cognitive functions[14,15]. Previous studies have shown higher serum vitamin D levels to be associated with better cognitive test performance in patients with Alzheimer's disease[16]. There is a strong correlation between vitamin D level and MMSE score. An interaction among sun exposure and the duration of walking with cognitive function has been reported17. A previous study has shown that Manos score to be predictor of sun exposure and the duration of walking in elderly[17].

In this study we aimed to investigate whether Manos score and vitamin D level are predictive for sun exposure and the duration of walking.

MATERIALS AND METHODS

Patients

One hundred and eighty five low educated patients above the age of 65 who had applied to the internal medical outpatient clinic of Our University Medical School Hospital between May and July 2012 and accepted the informed consent were enrolled in the study. All the patients included in the study were selected from those who could perform their daily physical activities such as eating, drinking, wearing clothes, etc. CDR tests were applied to all subjects included in the study and evaluated by neurologists. Those with CDR score of 0 were considered to be normal for age and were included in the study. Patients with CDR score of 0.5 or more, dementia, Alzheimer, delirium, hyponatremia and untreated hypothyroidism were excluded from the study. The subjects included in the study were asked to perform CDT then a blood sample was taken to measure 25-hydroxyvitamin D (25OHD) level. The study was approved by the local ethics committee of Our University School of Medicine (Approval numbers: 2012/74).

Application of CDT

CDT was performed in the outpatient clinic under the supervision of an internal medicine specialist. The patients were given a pre-drawn circle and were asked to write the numbers in the face of a clock and make it show 10 minutes after 11 o'clock. The test was scored by a neurologist using the Manos[7] scoring system from 1 to 10. The CDT was scored by drawing a line through number 12 and the center of the clock, then dividing the circle into quarters, then eighths. One point each was given for the 1, 2, 4, 5, 7, 8, 10 and 11 if at least half of its area was in the proper octant of the circle relative to number 12. One point was given for a short hand pointing to number 11 and one point for a long hand pointing to number 2. No points were given for hands if the examiner was unable to tell at a glance which hand was longer according to Manos scoring system[7].

Predictor parameters

The study was designed similar to a model of a previous pilot study[17]. The demographic data such as height, weight and body mass index (BMI) were collected from all the subjects. They were asked if they had lost more than 5 kg within the last year and the weight changes were recorded. The patients were given 3 response options; they were asked whether (1) had a weight loss more than 5 kilograms, (2) weight had not been changed and (3) if they gained more than 5 kilograms (without developing edema). The patients expressed their socioeconomic status by answering a three options question then recorded as good, fair or poor. The education level was evaluated and categorized as illiterate, literate or a primary school graduate. The Marital status was recorded as single, cohabiting, married or widowed. According to the present low the social health security covers all the citizens so it was not investigated. The patients were asked whether they lived in their own homes. The participants were asked if they had chronic diseases such as coronary artery disease (CAD), hypertension, heart failure, diabetes mellitus and thyroid diseases, arthritis and pulmonary disease. Patient's health status was recorded as very good, good or bad. Daily drug usage, the number of hospitalization and application to the doctor in the last year were recorded. The presence of visual, hearing or sleeping disorders and their severity was investigated. The subjects were asked whether they had urinary incontinence.

Similar to the previous pilot study sun exposure and walking duration were recorded as hours/week. The subjects were asked a 4 response options question as how many hours a week did they expose at least their hands and face to direct sunlight during the last summer, the answers were (1) <1 h; (2) 1–3 h; (3) 3–6 h; (4) > 6 h.

The subjects were asked a 5 response options question to determine the duration of weekly walking as how many hours a week did they walk outside the house in the last year, the answers were (1) <30 min; (2) 30–60 min; (3) 1–3 h; (4) 3–6 h; (5) > 6 h. The patients were asked whether they used alcohol in the last year and whether they used it before or not. They were asked also whether they smoked in the last year and whether they smoked before or not.

The measurement of 25OHD levels

Patients with known vitamin D deficiency, calcium metabolic disorders and users of vitamin D or calcium supplements were excluded from the study. Serum levels of 25OHD were measured by chemiluminescence microparticle immunoassay (CMIA) on the Architect-I 2000(®) (Abbott) system.

Statistical analysis

The data analysis was performed using the statistical software SPSS for Windows (version 18; SPSS, Chicago, IL, USA). CDT scores and vitamin D levels were applied for the parameters like age, gender, BMI, sun exposure, walking duration, CAD, number of falls, disorders of (vision, hearing, sleeping) , drug usage and applying to doctor. CDT scores were categorized as 0, 1-9 and 10. Vitamin D levels were categorized as <10 ng/mL, 10-20 ng/mL and >20 ng/mL. Stepwise multivariate (MVA) logistic regression analyses were performed also for them. Dichromatic correction were done for the parameters like yes-no, good, fair and bad.

Results are given as odd ratio (OR), %95 confidence interval (Cl). Mann Whitney U test was used for CDT scores of 0, between 1-9 and 10, vitamin D level, sun exposure, walking duration and BMI. Chi-square test was used for doubly group's comparison of falling number and CAD incidence. Chi-square test was used for comparison of vitamin D levels <10, between10-20 and >20 ng/mL with CDT scores, fall numbers and CAD incidence. Mann Whitney U test was used for comparison of sun exposure, walking duration and BMI.

RESULTS

The study population included 127 (68.6%) males with a mean age of 73 ± 6 years and 58 (31.4%) females with a mean age of 70 ± 5 years. According to Manos scores a total of 90 (48.6%) subjects had a CDT score of 0, 70 (37.9%) subjects had a CDT score of 1-9 and 25 (13.5%) subjects had a CDT score of 10. The mean Manos CDT score was 3.3 ± 3.0 (Figure 1). The mean vitamin D level of the patients was 18.4± 7.3 ng/mL. The patients' demographic, anthropometric and lifestyle findings are shown in Table 1. Health related features are given in Table 2.

The patients were subdivided into 3 groups according to CDT scores as 0, 1-9 and 10. The mean vitamin D level of the patients with a score of 0 was 17.7 ± 6.6 ng/mL, with a score of 1-9 was 19.7 ± 8.2 ng/mL and with a score of 10 was 17.2±6.5 ng/mL. Vitamin D levels according to CDT scores and gender distribution are shown in Figure 2.

The subjects were subdivided into 3 groups according to vitamin D levels as group 1 with the level <10 ng/mL, group 2 between 10-20 ng/mL and group 3 >20 ng/mL. In group 1 there were 25 subjects 15 (60%) of them had a CDT score of 0, 8 (32%) of them had a CDT score of 1-9 and 2 (8%) of them had a CDT score of 10. In group 1 there were 95 subjects 47 (49.4%) of them had a CDT score of 0, 34 (35.7%) of them had a CDT score of 1-9 and 14 (14.7%) of them had a CDT score of 10. In group 3 there were 65 subjects 28 (43.0%) of them had a CDT score of 0, 28 (43.0%) of them had a CDT score of 1-9 and 9 (14.0%) of them had a CDT score of 10. CDT scores according to vitamin D levels are shown in figure 3. In the patients with CDT score of 10 according to MVA, CDT was found to be non-predictive of sun exposure, walking duration and fall frequency. CDT scores of 0 and 1-9 have been found to be predictive of sun exposure, walking duration and fall frequency.

In addition, vitamin D level <10 ng/mL has been found to be a strong predictor of sun exposure, walking duration and fall frequency. Vitamin D level between 10-20 ng/mL has been found to be predictive of sun exposure, walking duration and fall frequency. Vitamin D level > 20 ng/mL has been found to be non-predictive of sun exposure, walking duration and fall frequency. MVA results are shown in Table 3.

When vitamin D levels and other parameters were compared according to CDT scores they were not statistically significant ($p > 0.05$). When CDT scores and other parameters were compared according to vitamin D levels they were statistically insignificant ($p > 0.05$). Vitamin D levels in regard to CDT scores are shown in Figure 2 and CDT scores in regard to Vitamin D levels are shown in Figure 3.

Table 1. Anthropometric, socio-demographic and lifestyle features of the research population, mean±S.D. or n (%).

Age (years)	72±6
BMI (kg/m^2)	27.8 ± 4.0
Weight change in the last year, > 5 kg weight loss	26 (14.1)
Gender, males / females	127 (68.6) / 58 (31.4)
Marital status, married / widowed/ living alone	162 (87.6) / 21 (11.4) / 2 (1.0)
Attendance to the examination, alone	180 (97.3)
Accompanied by a caregiver	5 (2.7)
Occupation, manual worker / office worker	163 (88.1) / 22 (11.8)
Presence of social security	185 (100)
Level of education, literate / primary school	26 (14.0) / 159 (86.0)
Economic status, poor / fair / good	0 / 157 (84.9) / 28 (15.1)
Owning a house	185 (100)
Current smoking	8 (4.3)
Having smoked >100 cigarettes in a lifetime	123 (66.4)
Tobacco consumption (pack-years)	0
Having ever consumed alcohol	28 (15.1)
Currently consuming alcohol	0
Exposure to sun (hours/week)	
< 1 h	23 (12.4)
1–3 h	17 (9.2)
4–6 h	48 (26.0)
> 6 h	97 (52.4)
Walking (hours/week)	
< 30 min	42 (22.7)
30–60 min	1 (0.5)
1–3 h	29 (15.7)
4–6 h	38 (20.5)
> 6 h	75 (40.6)

Table 2. Health-related features of the research population, n (%) or mean±S.D.

Chronic disease	
Diabetes mellitus	39 (21.0)
Hypertension	85 (45.9)
Coronary artery disease	46 (24.8)
Congestive heart failure	7 (3.7)
Peripheral vascular disease	5 (2.7)
Pulmonary disease	7 (3.7)
Thyroid disease	9 (4.8)
Arthritis	3 (1.6)
Number of visits to a physician in the last year	
Never	0
Once	5 (2.7)
2–3	69 (37.2)
4–6	80 (43.3)
>6	31 (16.8)
Hospitalization in the last year	
None / At least once	167 (90.2) / 18 (9.8)
Perceived health status	
Poor	2 (1.0)
Fair	134 (72.5)
Good	42 (22.8)
Very good	5 (2.7)
Excellent	2 (1.0)
Number of daily medications	2.2±2.1
Visual impairment	
None / Mild / Severe	95 (51.4) / 83 (44.9) / 7 (3.7)
Hearing impairment	
None / Mild / Severe	118 (63.8) / 62 (33.5) / 5 (2.7)
Sleep disorder	
None / Mild / Severe	136 (73.6) / 46 (24.8) / 3 (1.6)
Number of falls in the last year	
0	160 (86.5)
1–3	23 (12.5)
3–6	2 (1.0)
6–12	0
>12	0

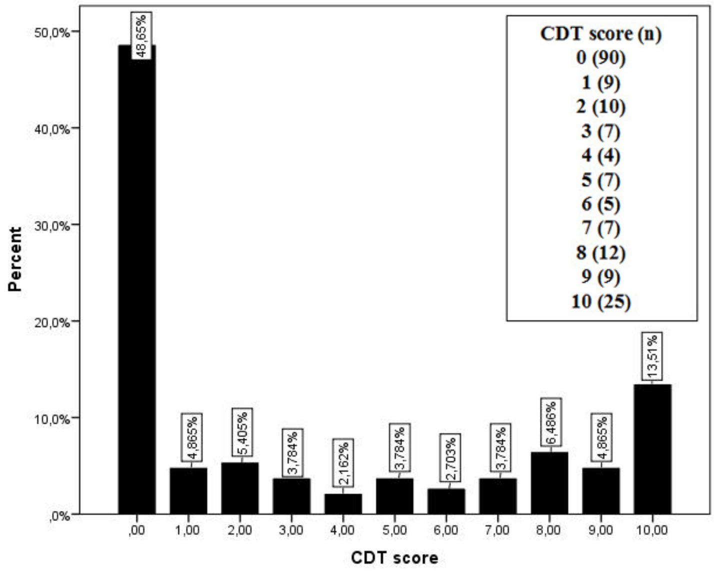

Figure 1. Distribution of Manos CDT scores in the study group

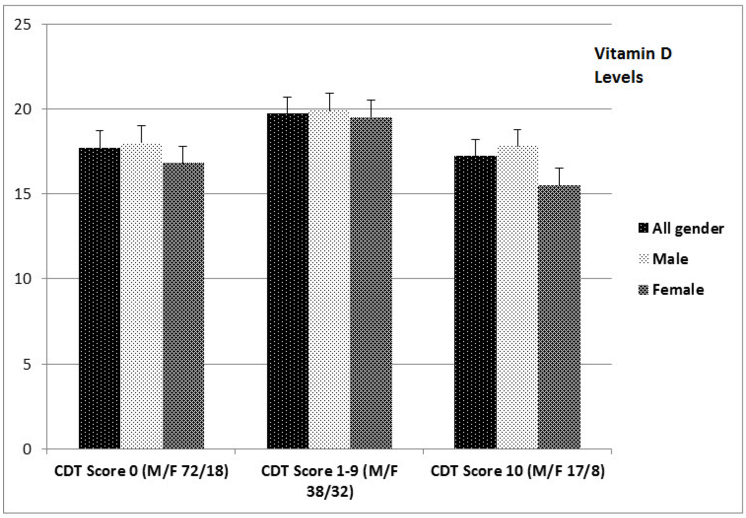

Figure 2. Subgroup analysis of vitamin D for each group stratified by manos CDT scores

Table 3. Multivariate (stepwise) logistic regression analysis of factors related to CDT performance and vitamin D levels

Dependent	Independent	OR (95 % CI)	P values
Getting score 0	Walking	0.9 (0.8-1.0)	0.003
	Sun exposure	1.0 (0.9-1.1)	0.013
	CAD	0.8 (0.7-0.8)	0.029
Getting a score between 1-9	Walking	1.2 (1.0-1.3)	0.003
	Sun exposure	1.1 (0.9-1.2)	0.001
	Number of falls	1.3 (1.1-1.4)	0.013
	CAD	1.0 (0.6-1.3)	0.018
Getting a full score	N.S.		
Vitamin D <10 ng/mL	Walking	12.4 (11.2-14.0)	0.001
	Sun exposure	11.0 (9.7-11.9	0.001
	CAD	5.6 (4.0-6.7)	0.001
	Number of falls	3.4 (2.8-5.2)	0.001
Vitamin D 10- 20 ng/ml	Walking	9.0 (8.1-11.3)	0.001
	Sun exposure	7.9 (6.3-8.5)	0.001
	Number of falls	1.4 (1.1-1.5)	0.019
	CAD	1.4 (1.2-1.5)	0.009
Vitamin D > 20 ng/ml	N.S.		

N.S. not-significant; CAD, coronary artery disease

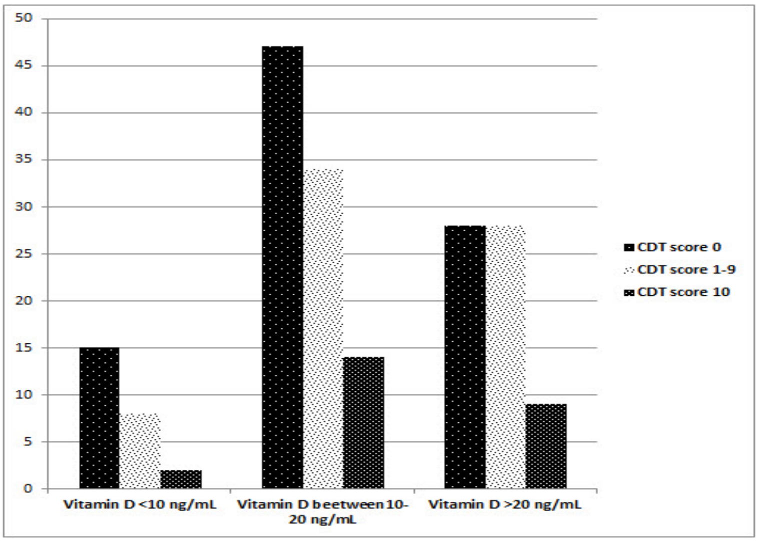

Figure 3. Subgroup analysis of CDT scores for each group stratified by vitamin D

DISCUSSION

In our study, about 50% of the subjects had a CDT score of 0. The most of the patients enrolled in our study were LE individuals. In the study conducted by Aydin et al. even though 4.8% of the patients were with dementia 38.4% of all the patients had CDT score of 0 according to Manos scoring system[17]. As there are many CDT scoring systems the experts suggest simple scoring systems to be the best of them[18]. Previous studies have shown CDT scores of illiterate and LE subjects to be lower than subjects with high education level. CDT sores have been reported to be correlated with education level[19,20]. Another study has shown CDT scores to have a comparable sensitivity but a lower specificity than the MMSE in patients with dementia[21]. Despite the absence of dementia in illiterate and LE subjects some of them had CDT of 0[9,22,23]. CDT score is unreliable test for the detection of dementia in LE subjects[24]. Although dementia was not considered in our study there were subjects with CDT score of 0. Low CDT score may be related to socio-cultural differences.

Measurement of circulating vitamin D concentration is recognized as the best functional measure of vitamin D status[25]. Previous studies have shown a positive correlation between vitamin D level and MMSE and they have reported vitamin D to be predictive for cognitive functions in elderly[26]. Low vitamin D level has been found to be associated with Alzheimer, dementia, schizophrenia and multiple sclerosis[27,28]. Vitamin D is known to decrease free oxygen radicals formation in brain tissues by decreasing nitric oxide synthesis[29]. Additionally previous studies have reported that Vitamin D enhanced calcium homeostasis also could protect against neurodegeneration and associated cognitive impairment[30].

In our study, there was no obvious difference in vitamin D levels of the patients with different CDT scores. However, 60% of the patients with vitamin D < 10 ng/mL had CDT score of 0. Vitamin D insufficiency is very common worldwide including Turkey[31]. In particular, vitamin D deficiency is common in the Eastern Black Sea region of Turkey (41.2 N)[28,32]. In many studies vitamin D level was found to be low in elderly patients[33]. We may have found vitamin D level to be low due to both regional characteristics and elderly population. Previous studies have shown vitamin D deficiency to be more frequent in women than in men[34]. Vitamin D level of women with CDT score of 0 and 10 was mildly lower than males. However, it was statistically insignificant. So in our study there was no difference in vitamin D level according to gender. Elderly patients with obvious low vitamin D level have been reported to have increased hip fracture risk due to secondary hyperparathyroidism[35]. Recent observations have demonstrated an association between vitamin D deficiency, postural instability and falls. There is a significant correlation between vitamin D concentration and the occurrence of falls in the elderly36. So osteomalacia, rickets and osteoporosis can occur due to vitamin D deficiency. Low vitamin D has also been shown to be associated with decline of muscle strength, sarcopenia, functional limitation, and disability[37]. In this study, low vitamin D levels and CDT scores have been found to be effective in demonstrating the incidence of falls. Vitamin D is required for bone mineralization and calcium homeostasis. Interestingly in our study CDT score of 0 was found to be non-predictive of fall frequency.

A previous study has reported CDT scores to be predictors of sun exposure, walking duration and CAD[17]. In this study, it was observed that both CDT score and low vitamin D levels were predictive on sun exposure and walking duration. Vitamin D formation is directly interaction to sun exposure. Short sun exposure duration is related with a lower level of vitamin D[38,39]. Walking is strongly associated with vitamin D level which is required for the stability and strength of the skeletal bone structure. Vitamin D level predicts also the subjects' walking duration. Vitamin D level less than 20 ng/mL was found to be associated with CAD[32,40]. In our study both low CDT score and vitamin D level were associated with CAD.

Limitations of study

The number of the individuals included in this study was insufficient to reflect the general population. The vast majority of the patients enrolled in the study had a vitamin D level < 20 ng/mL and very few patients had a level more than 30 ng/mL. Low sunlight may be the main reason for low vitamin D level in our region.

The number of men who were included in our study was higher than the number of women. There may be a difference between male and female gender in lifestyle, physical activity and outdoor activities. Our study population includes relatively low number of active smokers and alcohol consumers. This may be due to the religious and cultural characteristics of the population of this region. However may not reflect the general population.

CONCLUSION

Scoring systems in particular Manos CDT score of LE subjects is unreliable to demonstrate cognitive functions. Simple CDT scoring systems are suggested to be used especially in LE patients. In addition, CDT score should not be used alone in the dementia screening of LE subjects. This study has shown vitamin D level of LE subjects to be more portent predictor of sun exposure, walking duration, fall frequency and CAD incidence. There was no correlation between CDT score and vitamin D level. Further studies are needed in this regard.

Conflict of interest statement

None declared.

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