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ORIGINAL

Intellectual Performance and Serum Vitamin D Levels in Elderly: A Systematic Investigation

Rendimiento intelectual y niveles séricos de vitamina D en ancianos: Una investigación sistemática

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ABSTRACT

Consideration should be given to the possibility that a lower intake of the vitamin D subtype 25(OH) D could increase the hazard of intellectual decline and the emergence of cognitive disorders. This investigation used the Trail Building Test, Part B (Trails B), and the enhanced Mini Mental State Examination (MMSE) to assess cognitive function in 25(OH) D, a sample of 550 males. They also monitored changes in cognitive ability over an average of 4,6 decades. In an approach that took into account factors such as age, place of residence, period, and 25(OH) D levels, males with lower levels seemed to be more probable to have cognitive destruction. Still, the test for tendency failed to achieve numerical implication 1,84 with a 95 percent confidence interval 0,81-4,19 for the first quartile, 1,41, 0,61-3,28 for the second, and 1,18, 0,50-2,81 for the third. Age and education were taken into consideration, the relationships were even lessening. However, there appeared to be an increase for a separate link among more negligible levels and odds of intellectual send regrets by 3MS concert. There was no correlation between cognitive refusal by Trails B. Lower levels of 25-hydroxyvitamin D didn't appear to be able to predict inclusive and supervisory cognitive function at baseline.

Keywords: Serum Vitamin D; Trail; Confidence Interval; Mini Mental State Examination.

RESUMEN

Debe considerarse la posibilidad de que una menor ingesta del subtipo de vitamina D 25(OH) D pueda aumentar el riesgo de declive intelectual y la aparición de trastornos cognitivos. En esta investigación se utilizaron el Trail Building Test, Parte B (Trails B), y el Mini Mental State Examination (MMSE) mejorado para evaluar la función cognitiva en 25(OH) D, una muestra de 550 varones. También controlaron los cambios en la capacidad cognitiva a lo largo de una media de 4,6 décadas. En una aproximación que tuvo en cuenta factores como la edad, el lugar de residencia, el periodo y los niveles de 25(OH) D, los varones con niveles más bajos parecían tener más probabilidades de sufrir destrucción cognitiva. Aun así, la prueba de tendencia

no logró una implicación numérica de 1,84 con un intervalo de confianza del 95 por ciento de 0,81-4,19 para el primer cuartil, 1,41, 0,61-3,28 para el segundo, y 1,18, 0,50-2,81 para el tercero. Si se tenían en cuenta la edad y la educación, las relaciones eran aún menores. Sin embargo, parecía haber un aumento para un vínculo separado entre los niveles más insignificantes y las probabilidades de intelectual enviar arrepentimientos por 3MS concierto. No hubo correlación entre el rechazo cognitivo por Trails B. Los niveles más bajos de 25-hidroxivitamina D no parecían capaces de predecir la función cognitiva inclusiva y supervisora al inicio del estudio.

Palabras clave: Vitamina D Sérica; Rastro; Intervalo de Confianza; Mini Examen del Estado Mental.

INTRODUCTION

The capacity to receive and comprehend detailed information and apply it to solve problems, make choices, and do other cognitive activities is called intellectual performance. It includes a variety of cognitive skills, such as executive function, language, logic, memory, and attention. Cognitive declines could be linked to several neurological and psychiatric disorders, such as dementia, traumatic brain injury, and depression, as well as to natural aging.[1] It's crucial to understand that, despite the possibility of a connection between vitamin D and intellectual performance, taking vitamin D supplements does not always result in an improvement in cognitive function. Age, genetics, lifestyle, and underlying medical disorders are just a few of the variables that could have an impact on the connection, which itself could be complicated.[2] Age, skin pigmentation, nutritional consumption, and sun exposure are some of the variables that could affect the serum vitamin D level in older people. Inferior blood vitamin D levels could result from people's declining capacity to synthesis vitamin D from sunshine as they become older. Additionally, older persons could have insufficient vitamin D dietetic consumption and reduced vitamin D food absorption.[3] Mature people with low blood vitamin D levels are connected to several illnesses, such as osteoporosis, fractures, falls, and muscular weakness. Additionally, several studies have revealed a possible connection between low vitamin D levels furthermore an elevated threat of dementia and cognitive refuse in older persons.[4] Gait variability is the term used to describe the regular variations in these variables over time and from step to step. Both enhanced nutritious meals and supplements include vitamin D. It has been added to several foods during the production process to improve their vitamin content, which is known as fortification. Dairy goods, including milk, cheese, and yogurt, as well as various cereals and drinks could be among them. Aside from that, vitamin D supplements are generally accessible in a range of dosages, including liquid drops, pills, and capsules.[5] For those with dietary limitations that prevent those from consuming enough vitamin D-rich foods or were could not get enough sun exposure, taking supplements could be a helpful strategy to guarantee enough vitamin D consumption.[6] Depressive symptoms could include chronic feelings of melancholy, despair, or worthlessness. However, they can also manifest differently, such as with bodily problems like exhaustion, discomfort, or lack of appetite. In addition to the harmful effects are described, depression in older persons could also result in social exclusion, worse cognitive function, a higher chance of accidents like falls, and a lower quality of life overall. Additionally, diabetes and heart disease could be made worse by depression, which could raise the mortality rate.[7] Vitamin D deficiencies and insufficiencies are common around the globe, especially in specific populations. Sunlight exposure produces vitamin D in the skin. However, due to their geographic location, lifestyle choices, or cultural customs like skin-covering, many individuals do not receive enough sun exposure. Additionally, there are a few accepted sources of vitamin D and few foods that have been fortified with it, making dietary supplies of the vitamin scarce consequently, and many individuals cannot get enough vitamin D from foodstuffs.[8] Diminutive vitamin D levels contain been connected to several adverse fitness effects, together with an amplified risk of osteoporosis, fractures, falls, and muscular weakness, in addition to cognitive loss.[9] The cortical and hippocampal regions of the brain, which are crucial for cognitive function, memory, and learning, contain vitamin D receptors. These receptors participate in several cellular and molecular procedures vital for maintaining brain health, including controlling calcium homeostasis, producing and releasing neurotransmitters, and defending the body against oxidative stress and inflammation.[10]

Three more in-person visits, yearly phone calls, and hospitalization monitoring were given to participants. At visit five, a broad range of neuropsychological outcomes were evaluated using established procedures. A rigorous approach that includes information starting in-person cognitive tests, phone interview, infirmary liberation code, and decease permit codes was used to determine the incidence of dementia. An experienced physician group decided on dementia diagnoses.[11] The research group had daily fortified yogurt for three months.[12]

Similar amounts of proteins, carbs, and fats could be found in the non-fortified yogurts, but they also had less calcium (300 mg) and no vitamin D3 addition. Using a computerized walkway, spatial and temporal gait

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metrics were evaluated. Hydraulic dynamometers were used to measure handgrip strength. Recorded cognitive performances included overall cognitive execution calculated by the diminutive balanced Status Examination. Both at the beginning and the conclusion of the follow-up, all outcomes were evaluated. In research clinical experiment, it was examined how vitamin D supplements affected the treatment of despair in elder personnel. [13]

The consequences of the numerous regression analyses indicated to facilitate the vitamin D faction and the pre-research dejection achieve were the factors that could account for 81,8 % of the post-intervention depression score. The research conducts a cross-sectional examination, data from the population-based EpiFloripa age Cohort analyses second transcribe wave were gathered in 2013 and 2014.[14] The MMSE was used to evaluate cognitive mutilation. The present investigation was a six month, randomized, twofold sightless, placebo prohibited research including 60 sarcopenic older adult volunteers. Before and after the 6-month intervention, measurements of muscle mass, handgrip potency, material function (6-m gait speed), and excellence of existence and blood biochemical indexes were made.[15] Evidence shows that low vitamin D levels increase the harmful contact of air effluence on mental health issues. The purpose of the research was to find links between exposure to Blood vitamin D levels, mental health, and ambient air pollution.[16]

Only in the group who felt stressed and had depressive symptoms did the pollutants NO_2 and CO have an impact. Exposure to PM10 and NO2 was substantially linked to a higher risk of individuals with poor mental health due to vitamin D insufficiency. The research was two times visor, randomized, and placebo-controlled. 210 AD patients were randomized into control and therapeutic groups at random.[17] Vitamin D 800 IU/day was given to participants for 12 months, or starch granules served as a placebo. At baseline, six months later, and a year later, tests of cognitive function and A-related biomarkers were taken. The participation collection outperformed the management group. During the follow-up period, the vitamin D group's full-scale IQ significantly increased (p=0,001, mixed-model analysis). In addition to patients on hemodialysis, peritoneal dialysis, and placement kidney transplantation, included CKD patients. The Montreal Cognitive Assessment, MMSE, and Geriatric Depression level were used to analyze the patients' psychological and cognitive status, as well as scientific, laboratory, and detailed assessment, such as bioimpedance analysis, hand-grip strength, intima-media thinness, flow-mediated dilation, and epicedial adipose cloth.[18]

The purpose of the research is to examine at the connection between senior citizens' cognitive function and their serum vitamin D levels. The Trails B test is used to assess cognitive decline across various vitamin D quartiles. Additionally, the research assesses lifestyle, comorbidity, and demographic factors that affect cognitive health.

METHOD

Data collection

To ensure a representative and diverse sample, the Osteoporotic Fractures in Men (MrOS) research, a large-scale, multinational research project aimed at determining the factors that contribute to bone fractures in older men, recruited elderly male participants from different locations. To ensure consistency and reliability, the research design, recruitment procedures, and data collection processes were meticulously documented (table 1).

Table 1. Demographic data

Variables	No. of participants (n=550)	Percentage value (%)
Age group (years)		
65 - 70	200	34,5
71 - 75	240	41,4
76 - 80	140	24,1
Education level		
Less than high school	41	7,5
High school	85	15,5
Some college or beyond	424	77,0
BMI (kg/m^2)		
Underweight (<18,5)	20	3,4
Normal (18,5 – 24,9)	220	37,9
Overweight (25 – 29,9)	240	41,4
Obese (≥30)	100	17,3

Lifestyle Factors		
Current smokers	190	34,5
Former smokers	250	45,4
Never smoked	110	20
Physical Activity (PASE Score Category)		
Low (<100)	190	32,8
Moderate (100 - 200)	260	44,8
High (>200)	130	22,4
Comorbid Conditions		
Diabetes	110	18,9
Hypertension	250	43,1
Cardiovascular Disease	150	25,9
Vitamin D Levels (ng/mL) by Quartile		
Q1 (≤15 ng/mL)	150	27,2
Q2 (16 - 25 ng/mL)	110	20
Q3 (26 - 35 ng/mL)	145	26,3
Q4 (>35 ng/mL)	145	26,3

Analysis of Serum Vitamin D and Seasonal adjustments

Serum levels were tested in this research to evaluate individuals' vitamin D status. To guarantee accuracy, duplicate pooled serum controls were used in each assay. Seasonal fluctuations were taken into consideration in the investigation since exposure to sunshine has a substantial impact on vitamin D production.

Evaluation of Cognitive Function and Its Association to Vitamin D Levels

With scores ranging from 0 to 100, the 3MS evaluates global cognitive capacity; higher scores denote superior intellectual function. The Trails B test measures the amount of time needed to finish a series of verbal and visual activities to assess executive function, which includes attention, processing speed, cognitive flexibility, and task-switching ability. Better cognitive performance is reflected in shorter completion times. Cognitive impairment levels were evaluated longitudinally in this investigation.

Statistical analysis

The quartile of levels was used to compare baseline differences using tests for unconditional variables, the investigation of difference for unbroken variables with ordinary distributions, and the Kruskal-Wallis test for twisted distributions. This research utilized a logistic deterioration model to investigate the association between the baseline altitude and the probabilities of cognitive decline and impairment. These findings were then further accounted for in terms of education and race. The ultimate multivariable predicts comprised variables that were known hazard features for cognitive mutilation in the MrOS group to facilitate were considerably connected between levels.

RESULTS

Trail B had an average completion time of 136,1 seconds (SD = 60,3), while the SD baseline 3MS attain. Of the 550 participants, individuals in the lesser quartiles were more likely to be elder, have a higher BMI, report being in bad health, be less physically active, and have impairments. In comparison to those who took the Trails B test, participants who did not (n=15) reported more medical issues, were substantially older, had lower educational attainment, and drank less alcohol. The distribution of educational attainment across serum 25(OH)D quartiles is depicted in table 2.

Table 2. Distribution of education level by Serum 25 (OH)D

Education level	**Q1**	**Q2**	**Q3**	**Q4**
Less than high school	14	10	9	8
High school	22	20	24	19
Some college or beyond	64	70	67	73

To ascertain the percentage of current, former, and never smokers in each serum 25(OH)D quartile, researchers evaluated the smoking status of 550 participants. According to their self-reported smoking

behaviors, participants were divided into three groups: current smokers, who actively use tobacco products, former smokers, who have smoked in the past but no longer do so, and never smokers, who have never used tobacco products. Table 3 shows the distribution of smoking status by vitamin D quartile.

Table 3. Serum 25(OH) D quartiles of research participants

Smoking status (%)	Q1	Q2	Q3	Q4
Current smokers	9	7	6	5
Former smokers	58	60	62	64
Never smoked	33	33	32	31

The Trails B test and the 3MS were used to evaluate cognitive impairment in this research, which included 550 participants. Individuals who took more than 226,5 seconds to finish Trails B were also categorized as disabled, as were those who scored less than 80 on the 3MS were presented in table 4. At least one of these factors was used to classify 62 participants (11,3 %) as handicapped (table 3). Of these, 42 individuals were deemed impaired only on the basis of the Trails B criterion, 10 on the basis of the 3MS criterion, 8 on the basis of both impairment criteria, and 2 on the basis of 3MS but without Trails B data.

Table 4. Numerical outcome of 3MS score

Defined by 3MS score	Q1	Q2	Q3	Q4
Model 1	1,92	1,50	1,28	1,10
Model 2	1,00	1,20	1,05	1,02
Model 3	0,78	0,94	0,97	1,02

According to Trails B performance, participants in this research, 550-person trial who had lower levels were more possible to have baseline cognitive impairment than those in the highest vitamin D quartile (table 5). With an OR of 1,66, persons in Q1 had a higher likelihood of intellectual impairment after controlling for age, season, and location. However, no clear statistical pattern was observed (p = 0,12) in the ORs for Quartiles 2 (16–25 ng/mL) and 3 (26–35 ng/mL), which were 0,96 and 1,30, respectively. Additionally, no independent correlation between baseline Trails B performance and blood 25(OH)D levels was discovered when the research was limited to subjects with comparable demographic backgrounds.

Table 5. Numerical outcome of B score

Defined by Trails B score	Q1	Q2	Q3	Q4
Model 1	1,72	1,00	1,28	1,02
Model 2	1,38	0,94	1,22	1,02
Model 3	1,20	0,85	1,10	1,02

DISCUSSION

With a focus on the results of the Trails B and 3MS, this research investigation aims to determine that serum vitamin D intake and cognitive ability relate to one another in older adults. The results imply that those with lower baseline vitamin D levels were more likely to have cognitive impairment. Smoking status and educational attainment were similarly distributed differently among vitamin D levels categorized into quartiles, with individuals in the lower ranges exhibiting a higher likelihood of smoking and having less education. After adjusting for other variables, there was no discernible relationship between serum vitamin D levels and cognitive impairment, suggesting that factors other than vitamin D status may also play a role in cognitive decline. However, early research indicated that there might be a connection between low vitamin D levels and cognitive decline. This association weakened when demographic and lifestyle factors were taken into account.

CONCLUSION

Using the 3MS and Trails B tests, this research intended to evaluate the suggestion among serum vitamin D levels and cognitive function in aged individuals. According to the results, individuals in the lowest vitamin D quartile (≤15 ng/mL) were substantially more likely to experience cognitive impairment than those in the highest quartile, with an OR of 1,66 in the Trails B test. In the same way, Model 1's OR of 1,92 for the 3MS test indicated that the odds of impairment were higher in the lowest quartile. Cognitive impairment was exacerbated by the fact that participants in the lower vitamin D quartiles were often older, had higher BMIs, reported worse health, and had less schooling. However, the association diminished and no significant

trend (p = 0,12) was seen across quartiles when controlling for confounders like education and demographic characteristics. These findings imply that although there could be a connection between decreased vitamin D levels and cognitive impairment, other sociodemographic and health-related factors also play a role. The cross-sectional methodology, possible unmeasured confounders, and absence of longitudinal data to demonstrate a causal relationship between vitamin D levels and cognitive deterioration are the research's limitations. To investigate causal mechanisms and the possible advantages of vitamin D supplementation for mental health, future research should concentrate on longitudinal studies involving a variety of populations.

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CONFLICT OF INTEREST

None.

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