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Qualification en Gériatrie

Efficacy of the Vitamin D Status Diagnosticator amongst geriatric patients with Covid-19

Efficacité du Vitamin D Status Diagnosticator chez les patients gériatriques atteints de Covid-19

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Liste des abréviations

25(OH)D	25-hydroxyvitamin D
AUC	Area Under Curve
BMI	Body Mass Index
OR	Odds Ratio
ROC	Receiver Operating Characteristic
SD	Standard Deviation
VDSD	Vitamin D Status Diagnosticator

Plan

Efficacy of the Vitamin D Status Diagnosticator amongst geriatric patients with Covid-19

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RESUME

The 16-item Vitamin D Status Diagnosticator (VDSD) tool identifies healthy older adults with hypovitaminosis D and may guide the use of blood tests in this population. Measuring vitamin D status is especially important in the Covid-19 area. The objective of the present study was to test the efficacy of the VDSD to identify hypovitaminosis D amongst older adults with Covid-19. The study included 102 nonsupplemented geriatric inpatients consecutively admitted to the acute geriatric division of Angers University Hospital, France (mean±SD, 85.0±5.9years; 47.1% female). Serum 25-hydroxyvitaminD (25(OH)D) was measured at the time of the physician-administered VDSD. Hypovitaminosis D was defined as serum 25(OH)D concentration≤75nmol/L for vitamin D insufficiency and 25(OH)D≤50nmol/L for vitamin D deficiency. We found that 87 participants (85.3%) had vitamin D insufficiency, 63 (61.8%) had vitamin D deficiency. The VDSD identified severe vitamin D deficiency with area under curve (AUC)=0.81 and Odds Ratio (OR)=40. The VDSD was able to identify vitamin D insufficiency with less accuracy (AUC=0.57). In conclusion, the 16-item VDSD is a short questionnaire that accurately identifies hypovitaminosis D amongst geriatric patients with Covid-19. This tool may guide the use of vitamin D supplementation in the early hours of Covid-19.

INTRODUCTION

Hypovitaminosis D is common among seniors and results in multiple adverse health events [1,2]. In particular, due to its immuno-modulatory and anti-inflammatory properties [3], hypovitaminosis D has been associated in recent years with an increased risk of Covid-19 [4], especially a risk of severe forms of Covid-19 [5]. Studies have reported in people with COVID-19 that, while taking into account potential confounders, those with lower 25-hydroxyvitamin D (25(OH)D) concentrations were more likely to resort to non-invasive ventilation [6], to experience a prolonged hospital stay [7], and to die from COVID-19 [8], including in intensive care units [9]. In contrast, correction of hypovitaminosis D following supplementation limits the severity [10,11] and prevents mortality in this population [12]. Therefore it appears crucial to identify hypovitaminosis D amongst older adults in the first hours of Covid-19 to resort to supplementation and specify the dose of supplement required. The whole issue is the time necessary to perform the blood test and wait for the results of the circulating concentration of 25(OH)D, which can take several days, with the risk of supplementing too late during the course of the infection. We recently proposed a questionnaire, the Vitamin D Status Diagnosticator (VDSD), capable of accurately identifying without any blood test those with hypovitaminosis D who should be administered vitamin D supplements. The efficacy of this 16-item questionnaire coupled with a combinatorial non-linear algorithm was reported in healthy [13] and hospitalized [14] older adults, but its efficacy in identifying hypovitaminosis D and guiding the use of blood tests and supplementation in older adults with Covid-19 has not yet been examined. The objective of the present analysis was to test the diagnostic efficacy of the VDSD tool for the identification of hypovitaminosis D amongst geriatric patients with Covid-19.

METHODS

Participants

We studied inpatients aged 75 years and over consecutively recruited in the GERIA-COVID study. The GERIA-COVID study is a longitudinal observational study conducted in the geriatric acute care unit dedicated to COVID-19 patients in the University Hospital of Angers, France, during the first and second waves of the COVID-19 pandemic in France (ClinicalTrials.gov NCT04560608). Data of the GERIA-COVID study were retrospectively collected from patients' records. The detailed procedure has been previously described elsewhere [15]. The inclusion criteria in the GERIA-COVID study and present analysis were the following: i) patients aged 75 years and over admitted into the geriatric acute care unit of the University Hospital of Angers, France, during the second wave of the pandemic (between November 2020 and March 2021); ii) no objection from the patients and/or their relatives for using anonymized clinical and biological data for research purpose; iii) diagnosis of COVID-19 with RT-PCR and/or chest CT-scan; iv) data available on the circulating 25(OH)D concentration at hospital admission; v) data available on the VDSD results. The study was conducted in accordance with the ethical standards set forth in the Helsinki Declaration (1983). All data were fully anonymized in this retrospective study of medical records. The Ethics Board of the University Hospital of Angers, France, approved the study and waived the requirement for informed consent (2020/100). No participant or relatives objected to the use of anonymized clinical and biological data for research purposes. The study protocol was also declared to the National Commission for Information Technology and civil Liberties (CNIL; ar20-0087v0).

Vitamin D Status Diagnosticator

The development of the VDSD tool was described in detail previously [13]. In summary, the VDSD is based on a non-linear model of feed forward artificial neural network (multilayer perceptron), which was built among community-dwelling older adults. All available variables in the database were introduced into the model without any a priori hypothesis on their possible relationship to the vitamin D status as it was their combination, but not their direct link to vitamin D, that was tested. The unnecessary variables were then deleted one by one according to their relative importance in the algorithm until the effective minimum number of variables was obtained. The final model is based on 16 clinical items [13].

Here, participants underwent a full clinical examination by a physician to standardizedly collect the following 16 items of the VDSD: sex, age (in years), number of therapeutic classes used per day, body mass index (BMI, in kg/m2), use walking aids, use psychoactive drugs (i.e., benzodiazepines, anti-depressants or neuroleptics), wearing glasses, sad mood, fear of falling, history of falls in the preceding year, cognitive disorders, undernutrition, polymorbidity, history of vertebral fractures, living alone, use anti-osteoporotic drugs (i.e., bisphosphonates, strontium or calcium). The BMI was calculated based on anthropometric measurements. Undernutrition was defined as BMI below 22 kg/m2 [16]. Polymorbidity was defined as having more than three chronic diseases (i.e., diseases of indefinite duration or running a course with minimal change). A fall was defined as an event resulting in a person coming to rest unintentionally on the ground or at other lower level, not as the result of a major intrinsic event or an overwhelming hazard, according to the French Society of Geriatrics and Gerontology (SFGG) and French National Authority for Health [17]. The history of vertebral fractures was sought from patients' and relatives' interview and from the medical records. The fear of falling was sought using the following standardized question "Are you afraid of falling?", as previously published [18]. The presence of cognitive disorders was noted based on clinical

expertise and/or history of dementia from medical records. Sad mood was sought using the following question from the 4-item Geriatric Depression Scale: "Do you feel discouraged and sad?" [19]. Finally, and without knowledge of the blood test, we applied the algorithm previously published [13] to the items of the VDSD in order to identify among patients with Covid-19 those with hypovitaminosis D, by distinguishing the 50 and 75 nmol/L thresholds [20,21].

Serum 25(OH)D measure

Venous blood was collected from resting participants with Covid-19 at the time of the VDSD assessment for the measure of serum 25(OH)D concentration. All serum 25(OH)D measures were performed by chemiluminescent immunoassay (LIAISON XL, DiaSorin, Saluggia, It) in a single laboratory at the University Hospital of Angers, France, according to DEQAS scheme. Based on previous literature, two different threshold values were used consecutively to define hypovitaminosis D: vitamin D insufficiency was defined as serum 25(OH)D concentration ≤75nmol/L [20] and vitamin D deficiency as 25(OH)D ≤50nmol/L [21] (to convert to ng/mL, divide by 2.496).

Statistical analysis

The participants' characteristics were summarized using effectives and percentages or means ± standard deviation, as appropriate. Firstly, comparisons between participants separated into two groups based on serum 25(OH)D concentration (i.e., either ≤50nmol/L versus >50nmol/L, or ≤75nmol/L versus >75nmol/L) were performed using Student's t-test or Mann Whitney Wilcoxon test for quantitative variables, according to the normal distribution assumption, or using Chi-square test or Fisher exact test, as appropriate, for qualitative variables. Secondly, univariate logistic regressions were used to examine the associations between participants'

clinical characteristics (independent variables: every single item from the VDSD tool) and hypovitaminosis D (dependent variable). Separate models were performed for each definition of hypovitaminosis D. Thirdly, the metrological properties of the complete VDSD tool (i.e., combination algorithm) were evaluated for the identification of hypovitaminosis D in this cohort of geriatric patients with Covid-19. P-values<0.05 were considered significant. All statistics were performed using SAS®, version 9.4 (SAS Institute Inc.).

RESULTS

Among 133 eligible participants, 102 (76.7%) participants had full data available, used no vitamin D supplements and met the selection criteria (mean±SD, 85.0 ± 5.9years; 47.1% women; 100% Caucasian), and were finally included in the present analysis.

The mean 25(OH)D concentration was 44.0±23.4nmol/L, and 87 participants (85.3%) had vitamin D insufficiency, 63 (61.8%) had vitamin D deficiency. As illustrated in Table I, significant differences were found between groups, especially regarding the numbers of drugs daily taken, the fear of falling, the history of falls and the undernutrition (Table I).

Table II shows that only few clinical variables were associated to hypovitaminosis D while considered separately (Table II).

Finally, Table III reports the metrological properties of the VDSD combinatorial algorithm for the identification of hypovitaminosis D on the whole sample of older adults with Covid-19. Overall, the model was able to correctly classify patients with hypovitaminosis D regardless of the definition used, but the Kappa coefficient showed that the tool better classified individuals with or without vitamin D deficiency ≤50nmol/L. The best performance was found for the identification of vitamin D deficiency, with area under curve (AUC) of 0.81 on the receiver operating characteristic (ROC) curve. The Odds Ratio (OR) for vitamin D deficiency was 40.0 [95% confidence interval: 10.5-152.3] while using 'not combining variables' as a reference. Cohen's Kappa coefficient for the VDSD result was 0.65 [95CI: 0.50-0.80] compared to the result of the blood test. The VDSD was also able to identify vitamin D insufficiency with moderate efficiency (AUC=0.57; Cohen's Kappa=0.18 [95CI: -0.07;0.45]).

DISCUSSION AND CONCLUSION

Our results showed that the 16-item VDSD combinatorial algorithm was able to identify vitamin D deficiency ≤50nmol/L amongst older adults with Covid-19. The identification of vitamin D insufficiency ≤75nmol/L was also possible with the VDSD, but less efficient.

These results are consistent with previous studies in hospitalized geriatric patients in whom the VDSD was effective in identifying vitamin D deficiency above all [14]. Specifically, we found here that, although each separate clinical variable exhibited only modest or no association with hypovitaminosis D (Table II), the combination of the 16 items using the VDSD algorithm effectively identified vitamin D deficiency in older inpatients with Covid-19. Thus, the results of the present study provide additional information by showing that the VDSD is also effective during Covid-19. The sensitivity was particularly high (Table III), which could make the VDSD an interesting screening tool for hypovitaminosis D in the first hours of Covid-19, useful in guiding the use of blood collection. In this perspective, an on-line software incorporating the VDSD algorithm is under development. The clinicians will be able to inform the 16 items of the VDSD, and the software will instantly communicate the probability of hypovitaminosis D and the opportunity to use a blood test and/or vitamin D supplements in patients with Covid-19.

The identification of vitamin D deficiency is particularly important in older adults with Covid-19 since recent literature has shown survival benefits following correction of hypovitaminosis D with supplements. Specifically, regular vitamin D supplementation has been reported to be associated with better survival in older adults [15], especially when taking the supplement recently [22] or when supplementation was given in the first hours of Covid-19 [12], which suggests that obtaining a high 25(OH)D concentration during Covid-19 is desirable to improve the prognosis. This was recently confirmed by the COVIT-TRIAL study, a randomized clinical trial that showed improved 14-day survival in older participants randomized to a high dose of

vitamin D3 compared to those who received a standard dose of vitamin D3 [12]. Although the reflex may then be to supplement "on sight" from the diagnosis of Covid-19 as an adjuvant to standard treatments for Covid-19, it should be remembered that high-dose vitamin D supplementation, aimed at increasing 25(OH)D concentration to supraphysiological levels, is probably not useful and even toxic among people without hypovitaminosis D, compared to lower doses aiming at preventing hypovitaminosis D and maintaining 25(OH)D concentration to physiological levels [23]. Based on the hypothesis of a possible U-shaped or reverse J-shaped effect of vitamin D, with both low and high 25(OH)D concentrations being associated with adverse health events [24], it appears crucial to determine older individuals' vitamin D status before any vitamin D supplementation during Covid-19.

Besides the originality of the research question on an important issue met in clinical routine, the strengths of our study include the standardized collection of data from a single research centre, the testing of geriatric patients of both sexes, the use of the different definitions of hypovitaminosis D used in clinical practice, and the use of a complex non-linear model of artificial intelligence. Inspired by the human brain, artificial neural networks are usually presented as interconnected systems organized in several layers, which are made up of a number of interconnected nodes containing activation function. These computational models, capable of machine learning and pattern recognition, have been developed to overcome limitations of the classical linear models [13]. Because artificial neural networks apply non-linear statistic to pattern recognition, they prove particularly adapted to multifactorial mechanisms of hypovitaminosis D. This explains why, although only few isolated variables were associated to vitamin D status in the present study (Table II), their combination using the VDSD combinatorial algorithm was able to identify hypovitaminosis D (Table III). Of note, removing variables from the 16-item VDSD caused dramatic loss of the diagnostic efficiency for severe vitamin D deficiency (data not shown). Since artificial neural networks are able to

learn and improve as they are fed with additional data, it is yet plausible that future versions of the VDSD may allow reducing the number of items required.

Some limitations should also be acknowledged. First, the study cohort was restricted to inpatients with Covid-19 admitted to a geriatric ward who were probably with a particularly severe form of Covid-19 or more serious comorbidities, and with lower 25(OH)D concentrations than the population of all older patients. Second, our sample size was relatively small and could not be calculated a priori. Third, all tests were carried out over a relatively short period of time (from November to March), which prevented examining any seasonality effect. Fourth, our findings should consider the limitation of the 25(OH)D chemiluminescent immunoassay. Indeed, the gold standard is the liquid chromatography-tandem mass spectrometry (LC-MS/MS) [25]. However, the radioimmunoassay also offers reasonable cost, correct intra- and inter-rater reliability, and measures of 25(OH)D2 and 25(OH)D3 at once.

In conclusion, the 16-item VDSD was able to identify hypovitaminosis D amongst nonsupplemented geriatric patients with Covid-19, specifically those with vitamin D deficiency ≤50nmol/L. Such a fast and inexpensive screening tool may help clinicians in decisions to supplement their geriatric patients with Covid-19. In the future, the efficacy of the VDSD to monitor changes in vitamin D status after the initiation of vitamin D supplements should be questioned.

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Table I. Comparison of patients' characteristics according to vitamin D status (n=102)

Clinical characteristics	Cohort of older adults with Covid-19						
		Serum 25(OH)D concentration, nmol/L					
	Whole sample (n=102)	Vitamin D deficiency ≤ 50nmol/L (n=63)	> 50nmol/L (n=39)	P-value*	Vitamin D insufficiency ≤ 75nmol/L (n=87)	> 75nmol/L (n=15)	P-value*
Item 1- Female sex	48 (47.1)	28 (44.4)	20 (51.3)	0.501	42 (48.3)	6 (40.0)	0.553
Item 2- Age, years (mean±SD)	85.0 ± 5.9	85.2 ± 6.0	84.6 ± 6.0	0.662	85.3 ± 5.7	83.1 ± 7.1	0.196
Item 3- Number of drugs daily taken (mean±SD)	6.9 ± 3.7	6.9 ± 3.7	6.9 ± 3.6	0.860	7.3 ± 3.7	5.1 ± 3.1	**0.016**
Item 4- Body mass index, kg/m^2 (mean±SD)	26.9 ± 4.6	27.5 ± 4.7	26.0 ± 4.3	0.121	27.2 ± 4.7	25.2 ± 3.8	0.109
Item 5- Use walking aids	60 (58.8)	37 (58.7)	23 (59.0)	0.981	52 (59.8)	8 (53.3)	0.640
Item 6- Use psychoactive drugs	43 (42.2)	23 (36.5)	20 (51.3)	0.142	40 (46.0)	3 (20.0)	0.060
Item 7- Wearing glasses	98 (96.1)	60 (95.2)	38 (97.5)	1.000	84 (96.6)	14 (93.3)	0.472
Item 8- Sad mood	25 (24.5)	13 (20.6)	12 (30.8)	0.248	21 (24.1)	4 (26.7)	1.000
Item 9- Fear of falling	48 (47.1)	36 (57.1)	12 (30.8)	**0.010**	44 (50.6)	4 (26.7)	0.087
Item 10- History of falls	39 (38.2)	30 (47.6)	9 (23.1)	**0.013**	35 (40.2)	4 (26.7)	0.318
Item 11- Cognitive disorders	50 (49.0)	30 (47.6)	20 (51.3)	0.719	44 (50.6)	6 (40.0)	0.449
Item 12- Undernutrition	13 (12.8)	6 (9.5)	7 (18.0)	0.236	8 (9.2)	5 (33.3)	**0.022**
Item 13- Polymorbidity	51 (50.0)	33 (52.4)	18 (46.2)	0.541	43 (49.4)	8 (53.3)	0.780
Item 14- History of vertebral fractures	7 (6.9)	4 (6.4)	3 (7.7)	1.000	6 (6.9)	1 (6.7)	1.000
Item 15- Living alone	31 (30.4)	18 (28.6)	13 (33.3)	0.611	26 (29.9)	5 (33.3)	0.769
Item 16- Use anti-osteoporotic drugs	12 (11.8)	10 (15.9)	2 (5.1)	0.124	12 (13.8)	0 (0.0)	0.205
25-hydroxyvitamin D, nmol/L (mean±SD)	44.0 ± 23.4	28.0 ± 11.3	69.8 ± 11.4	**<0.001**	37.4 ± 18.4	82.1 ± 4.4	**<0.001**

Data presented as n (%) where applicable; SD: standard deviation; *: Based on t-test or Chi-square test, as appropriate; P-value significant (i.e., <0.05) indicated in bold.

Table II. Univariate logistic regression models examining the cross-sectional associations between patients' clinical characteristics and hypovitaminosis D (n=102)

	Hypovitaminosis D					
	Vitamin D deficiency 25(OH)D ≤ 50nmol/L			Vitamin D insufficiency 25(OH)D ≤ 75nmol/L		
	OR	**[95%CI]**	**P-value**	**OR**	**[95%CI]**	**P-value**
Item 1- Female sex	0.76	0.34-1.69	0.502	1.40	0.46-4.27	0.554
Item 2- Age, years	1.02	0.95-1.09	0.658	1.07	0.97-1.18	0.197
Item 3- Number of drugs daily taken	1.00	0.90-1.12	0.986	1.21	1.01-1.43	**0.035**
Item 4- Body mass index, kg/m^2	1.08	0.98-1.18	0.124	1.11	0.97-1.27	0.120
Item 5- Use walking aids	0.99	0.44-2.23	0.981	1.30	0.43-3.91	0.641
Item 6- Use psychoactive drugs	0.55	0.24-1.23	0.144	3.40	0.90-12.92	0.072
Item 7- Wearing glasses	0.53	0.05-5.25	0.585	2.00	0.19-20.61	0.560
Item 8- Sad mood	0.59	0.24-1.46	0.250	0.88	0.25-3.04	0.833
Item 9- Fear of falling	3.00	1.29-6.97	**0.011**	2.81	0.83-9.52	0.096
Item 10- History of falls	3.03	1.24-7.41	**0.015**	1.85	0.55-6.28	0.323
Item 11- Cognitive disorders	0.86	0.39-1.92	0.719	1.54	0.50-4.68	0.452
Item 12- Undernutrition	0.48	0.15-1.55	0.222	0.20	0.06-0.74	**0.016**
Item 13- Polymorbidity	1.28	0.58-2.86	0.541	0.86	0.29-2.56	0.780
Item 14- History of vertebral fractures	0.81	0.17-3.85	0.795	1.04	0.12-9.28	0.974
Item 15- Living alone	0.80	0.34-1.89	0.612	0.85	0.27-2.74	0.789
Item 16- Use anti-osteoporotic drugs	3.49	0.72-16.86	0.120	na	na	na
Prediction of vitamin D deficiency according to VDSD tool	40.00	10.51–152.31	**<0.001**	-	-	-
Prediction of vitamin D insufficiency according to VDSD tool	-	-	-	4.10	0.87-19.4	0.075

CI: confidence interval; 25(OH)D: 25-hydroxyvitamin D; OR: odds ratio; na: not applicable due to almost complete separation of data; P-value significant (i.e., <0.05) indicated in bold.

Table III. Metrological properties of the VDSD tool for the identification of hypovitaminosis D according to the different definitions of hypovitaminosis D (n=102)

Hypovitaminosis D	True positive	False positive	True negative	False negative	Sensitivity %	Specificity %	Positive predictive value	Negative predictive value	Accuracy %	Cohen's Kappa (95 %CI)
Vitamin D insufficiency ≤ 75 nmol/L	82	12	3	5	94.3	20.0	87.2	37.5	83.3	0.18 (-0.07;0.45)
Vitamin D deficiency ≤ 50 nmol/L	60	13	26	3	95.2	66.7	82.2	89.7	84.3	0.65 (0.50;0.80)

TABLES' SUMMARY

SUMMARY

CHARONNAT Caroline

Efficacité du Vitamin D Status Diagnosticator chez les patients gériatriques atteints de Covid-19

RÉSUMÉ

Introduction : l'outil à 16 éléments Vitamin D Status Diagnosticator (VDSV) identifie les personnes âgées ayant une hypovitaminose D et pourrait guider l'utilisation des dosages sanguins dans cette population. Doser le statut en vitamine D est spécialement important dans le cadre de la Covid-19. L'objectif de cette étude était de tester l'efficacité du VDSD pour identifier l'hypovitaminose D chez les patients âgés ayant la Covid-19.
Méthodes : l'étude incluait 102 patients gériatriques non supplémentés admis de façon consécutive dans le service de gériatrie aiguë de l'Hospital Universitaire d'Angers, France (moyenne±SD, 85.0±5.9ans ; 47.1% féminin). La 25-hydroxyvitamine D (25(OH)D) sérique était dosée au moment de la réalisation du VDSD par un médecin. L'hypovitaminose D était définie comme une concentration sérique en 25(OH)D≤75nmol/L pour l'insuffisance en vitamine D et 25(OH)D≤50nmol/L pour la carence en vitamine D.
Résultats : nous avons trouvé que 87 participants (85.3%) avaient une insuffisance en vitamine D, 63 (61.8%) avaient une carence en vitamine D. Le VDSD identifiait les carences sévères en vitamine D avec une aire sous la courbe (AUC)=0.81 et un Odds Ratio (OR)=40. Le VDSD était capable d'identifier l'insuffisance en vitamine D avec moins de précision (AUC=0.57).
Conclusion : l'outil à 16 éléments VDSD est un court questionnaire qui identifie avec précision l'hypovitaminose D chez les patients gériatriques ayant la Covid-19. Cet outil pourrait guider l'utilisation de la supplémentation en vitamine D dans les premières heures de la Covid-19.

Mots-clés : dépistage, vitamine D, carence en vitamine D, personnes âgées, hospitalier

Efficacy of the Vitamin D Status Diagnosticator amongst geriatric patients with Covid-19

ABSTRACT

Introduction: the 16-item Vitamin D Status Diagnosticator (VDSD) tool identifies healthy older adults with hypovitaminosis D and may guide the use of blood tests in this population. Measuring vitamin D status is especially important in the Covid-19 area. The objective of the present study was to test the efficacy of the VDSD to identify hypovitaminosis D amongst older adults with Covid-19.
Methods: the study included 102 nonsupplemented geriatric inpatients consecutively admitted to the acute geriatric division of Angers University Hospital, France (mean±SD, 85.0±5.9years; 47.1% female). Serum 25-hydroxyvitamin D (25(OH)D) was measured at the time of the physician-administered VDSD. Hypovitaminosis D was defined as serum 25(OH)D concentration≤75nmol/L for vitamin D insufficiency and 25(OH)D≤50nmol/L for vitamin D deficiency.
Results: we found that 87 participants (85.3%) had vitamin D insufficiency, 63 (61.8%) had vitamin D deficiency. The VDSD identified severe vitamin D deficiency with area under curve (AUC)=0.81 and Odds ratio (OR)=40. The VDSD was able to identify vitamin D insufficiency with less accuracy (AUC=0.57).
Conclusion: the 16-item VDSD is a short questionnaire that accurately identifies hypovitaminosis D amongst geriatric patients with Covid-19. This tool may guide the use of vitamin D supplementation in the early hours of Covid-19.

Keywords: screening, vitamin D, vitamin D deficiency, older adults, hospital related

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