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CONCISE REPORT

Juvenile onset systemic lupus erythematosus: a possible role for vitamin D in disease status and bone health

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Purpose: In juvenile onset systemic lupus erythematosus (JoSLE), evidence for the association between vitamin D status, lupus activity, and bone health is very limited and not conclusive. The aim of this study was, therefore, to assess in JoSLE patients the possible relevance of vitamin D deficiency in disease and bone parameters. **Methods:** Fifty-seven JoSLE patients were initially compared to 37 age, race and body mass index (BMI) -matched healthy controls. The serum concentration of 25 hydroxyvitamin D (25OHD) was determined by radioimmunoassay. Patients with 25OHD deficiency (≤ 20 ng/mL) were compared to those with levels >20 ng/mL. Disease activity was evaluated by SLE Disease Activity Index (SLEDAI). Bone mineral density (BMD) and body composition (BC) were measured using dual-energy X-ray absorptiometry (DXA). **Results:** 25OHD levels were similar in patients and controls (21.44 ± 7.91 vs 22.54 ± 8.25 ng/mL, $p=0.519$), regardless of supplementation (65% of patients and none in controls). Thirty-one patients with 25OHD deficiency (≤ 20 ng/mL) were further compared to the 26 JoSLE patients with levels >20 ng/mL. These two groups were well-balanced regarding vitamin D confounding variables: age ($p=0.100$), ethnicity ($p=1.000$), BMI ($p=0.911$), season ($p=0.502$), frequency of vitamin D supplementation ($p=0.587$), creatinine ($p=0.751$), renal involvement ($p=0.597$), fat mass ($p=0.764$), lean mass ($p=0.549$), previous/current use of glucocorticoids (GC) ($p=1.0$), immunosuppressors ($p=0.765$), and mean current daily dose of GC ($p=0.345$). Patients with vitamin D deficiency had higher SLEDAI (3.35 ± 4.35 vs 1.00 ± 2.48 , $p=0.018$), lower C4 levels (12.79 ± 6.78 vs 18.38 ± 12.24 mg/dL, $p=0.038$), lower spine BMD (0.798 ± 0.148 vs 0.880 ± 0.127 g/cm², $p=0.037$) and whole body BMD (0.962 ± 0.109 vs 1.027 ± 0.098 g/cm², $p=0.024$). **Conclusion:** JoSLE vitamin D deficiency, in spite of conventional vitamin D supplementation, affects bone and disease activity status independent of therapy and fat mass reinforcing the recommendation to achieve adequate levels. *Lupus* (2012) 21, 1335–1342.

Key words: Vitamin D; juvenile onset systemic lupus erythematosus; disease activity; bone mineral density; body composition

Introduction

Vitamin D plays an essential role in bone health and seems to be associated with a number of illnesses, including cardiovascular, cancer, infectious and particularly autoimmune diseases^{1–6} such as multiple sclerosis, type 1 diabetes mellitus, autoimmune thyroid disease, inflammatory bowel

disease, rheumatoid arthritis, systemic sclerosis and systemic lupus erythematosus (SLE).^{4,7–12}

Previous studies have shown a high prevalence of vitamin D deficiency in adult lupus with approximately one-fifth of patients having severe deficiency.^{13–16} Nevertheless, the association of hypovitaminosis D and SLE activity remains controversial with some studies demonstrating an inverse relationship between SLE activity and serum vitamin D concentration,^{17–22} while others did not find this association.^{23–26} The role of vitamin D in bone health is known to be important in the general population²⁷ however this association was not observed in adult SLE patients.^{23,28} Regarding body composition, fat mass was a

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relevant factor for hypovitaminosis D in autoimmune diseases.²⁹

In Juvenile onset SLE (JoSLE) there is no data regarding the influence of vitamin D status in bone health and the risk of deficiency was recently demonstrated to be higher in autoimmune conditions.³⁰ Moreover, glucocorticoid (GC) may have a regulatory effect on vitamin D metabolism³¹ aggravating this deficit. The recommendation to avoid sun exposure due to the high frequency of photosensitivity and renal impairment in these patients³² may also contribute to the decreased concentration of this hormone. Concerning disease factors the only available study suggested a possible association with disease activity, but the groups were not matched for hypovitaminosis D confounding parameters, precluding a definitive conclusion about their finding.³³ The aim of this study was, therefore, to assess in JoSLE patients the possible relevance of vitamin D deficiency in disease parameters and bone mineral density (BMD).

Patients and methods

Fifty-seven patients with JoSLE who fulfilled the American College of Rheumatology criteria³⁴ were consecutively selected at the Juvenile Rheumatology Outpatient Clinic, University of São Paulo. Only patients with disease onset prior to 16 years of age were included. Exclusion criteria were renal dysfunction (creatinine clearance <60 mL/min), use of drugs that affect vitamin D metabolism such as anticoagulants and anticonvulsants, use of bisphosphonates and growth hormone. Vitamin D supplementation is routinely prescribed for patients under GC treatment, prednisone ≥ 5 mg/day or equivalent doses and patients are uniformly advised to use sunscreen and avoid sun exposure.

Thirty-seven healthy individuals, matched for age, gender, BMI, and with no previous history of diseases or drugs that affect bone mass and vitamin D metabolism, comprised the control group.

Race was defined based on the self-reported race of ascendants until the second generation by each participant, as previously validated for the Brazilian population.³⁵ Those whose four grandparents were self-reported Caucasian were classified as white. The presence of mixed African and Caucasian ancestors, commonly referred to as mixed race, was classified as non-Caucasian. In the absence of racial information about grandparents, the participant's race was similarly determined by the race of parents.

Disease activity and cumulative organ damage were evaluated by the SLE Disease Activity Index (SLEDAI)³⁶ and the Systemic Lupus International Collaborating Clinics/American College of Rheumatology (SLICC/ACR) damage index³⁷ respectively. Information regarding disease duration, current dose of GC and use of GC and immunosuppressors were obtained by extensive chart review and patient interview.

25-hydroxyvitamin D (25OHD) levels

The serum concentration of 25OHD was used to measure the vitamin D reserves, in all patients and controls, using a radioimmunoassay technique (DiaSorin, Stillwater, Minnesota, USA). The intra and inter-assay variation coefficients in our laboratory were 10.5% and 17.8%, respectively.³⁸ Vitamin D deficiency was defined as 25OHD ≤ 20 ng/mL (50 nmol/L), vitamin D insufficiency as 21–29 ng/mL (52.5–72.5 nmol/L) and sufficiency/adequate levels as 30–100 ng/mL (75–250 nmol/L) according to Endocrine Society Clinical Practice Guidelines.³⁹

Bone mineral density and body composition measurements

BMD was measured by dual-energy X-ray absorptiometry (DXA) using Hologic QDR-4500 Discovery equipment. BMD expressed as g/cm² was obtained in the lumbar spine (L1–L4), total femur and whole body of patients and controls. Z-score less than -2.0 SD in lumbar spine were defined as low bone mass for chronological age.⁴⁰ Measurements were performed by the same trained technician who was certified by the International Society of Clinical Densitometry (ISCD).

The body composition comprised lean mass, fat mass and fat mass percentage and were also analyzed by DXA.^{41,42}

Vertebral deformities assessment (VFA)

Thoracic and lumbar spine (T5–L4) lateral radiographs were performed in the same Radiology Division by trained operator and according to a standardized protocol. Spine radiographs were evaluated morphometrically by an experienced radiologist and scored using the method described by Genant et al. A vertebral fracture was defined as a reduction of at least 20% of the vertebral body height.⁴³

Statistical analysis

Data were expressed as mean \pm SD or percentage. Patients and controls were compared using the Student-*t* test, non parametric test or Fisher's exact test. Further, JoSLE patients were divided in two groups regarding level of 25OHD (≤ 20 ng/mL vs >20 ng/mL) and the same analysis was performed. Statistical significance was defined as $p < 0.05$.

Results

The demographic, anthropometric and clinical characteristics of patients and controls are shown in Table 1. Patients and controls had similar age ($p = 0.982$), frequency of female gender ($p = 0.450$), weight ($p = 0.217$), and BMI ($p = 1.000$).

The majority of JoSLE patients were under vitamin D supplementation (64.91%) and the mean daily dose was 428.57 ± 409.75 UI. None of the controls was supplemented with vitamin D. Blood samples for vitamin D measurement were collected during summer in the majority of JoSLE patients (73.7%) and controls (73.0%) (Table 1). Serum vitamin D levels and the frequency of subjects with vitamin D deficiency (≤ 20 ng/mL) were similar in patients and controls (21.44 ± 7.91 vs 22.54 ± 8.25 ng/mL, $p = 0.519$ and 54.4% vs 48.6%, $p = 0.674$). There was no significant difference in 25OHD levels between JoSLE patients with and without vitamin D supplementation (19.5 ± 6.8 vs 22.4 ± 8.35 ng/mL, $p = 0.183$).

The mean disease duration was 7.42 ± 5.46 years with a mean SLEDAI score of 2.28 ± 3.78 and six (10.5%) patients had SLEDAI ≥ 8 . The mean SLICC/ACR damage index was 0.28 ± 0.43 . The majority of patients (79%) were under GC therapy, with a mean daily GC (prednisone) dose of 12.50 ± 14.63 mg and 74% were taking immunosuppressors (Table 1).

Comparing patients and controls, BMD was significantly reduced in the lumbar spine (0.834 ± 0.144 vs 0.962 ± 0.167 g/cm², $p < 0.001$), in the total femur (0.850 ± 0.134 vs 0.947 ± 0.132 g/cm², $p = 0.001$) and in the whole body (0.991 ± 0.109 vs 1.062 ± 0.104 g/cm², $p = 0.002$). In addition, low BMD for chronological age in the lumbar spine (*Z*-score ≤ -2) was found in 21 (36.84%) JoSLE patients compared to 3 (8.1%) healthy controls, $p = 0.002$. Analysis of body composition revealed lower lean mass in JoSLE patients than in controls (37.63 ± 8.28 vs 41.95 ± 9.60 kg, $p = 0.024$), and a higher fat percentage

Table 1 Demographic, anthropometric, and clinical data of juvenile onset systemic lupus erythematosus (JoSLE) patients and controls

	JoSLE n = 57	Controls n = 37	p
Age (years)	19.45 \pm 5.19	19.43 \pm 4.75	0.982
Gender, female (%)	80.70	72.97	0.450
Weight (kg)	57.25 \pm 12.13	60.69 \pm 14.20	0.217
BMI (kg/m ²)	23.10 \pm 3.81	23.03 \pm 3.75	1.000
Vitamin D use (%)	64.91	0	<0.001
Daily dose of vitamin D (U)	428.57 \pm 409.75	N/A	
Serum level of vitamin D (ng/mL)	21.44 \pm 7.91	22.54 \pm 8.25	0.519
Season			
Spring (%)	8.8	18.9	
Summer (%)	73.7	73.0	0.353
Fall (%)	12.3	5.4	
Winter (%)	5.3	2.7	
Disease duration (years)	7.42 \pm 5.46	N/A	
Disease activity (SLEDAI)	2.28 \pm 3.78	N/A	
SLICC/ACR damage index	0.28 \pm 0.43	N/A	
Current use of GC (%)	78.95	N/A	
Current dose of GC (mg/day)	12.50 \pm 14.63	N/A	
Current use of IS (%)	73.68	N/A	

BMI: body mass index; GC: glucocorticoid; IS: immunosuppressor; JoSLE: juvenile onset systemic lupus; N/A: not applicable; SLEDAI: SLE Disease Activity Index; SLICC/ACR damage index (Systemic Lupus International Collaborating Clinics/American College of Rheumatology).

Data expressed as mean \pm standard deviation or percentage.

($30.95 \pm 7.46\%$ vs $26.76 \pm 6.51\%$, $p = 0.007$). Vertebral fractures were found in 8 (14%) patients, none of the controls ($p = 0.021$) (Table 2).

Thirty-one patients with vitamin D deficiency (≤ 20 ng/mL) were further compared to the 26 JoSLE with 25OHD levels >20 ng/mL. These two groups were well balanced regarding vitamin D confounding variables: age ($p = 0.100$), gender ($p = 1.000$), ethnicity ($p = 1.000$), BMI ($p = 0.911$), season ($p = 0.502$), frequency and dose of vitamin D supplementation ($p = 0.586$ and $p = 0.481$), mean creatinine levels ($p = 0.751$), renal involvement ($p = 0.597$), fat mass ($p = 0.764$), lean mass ($p = 0.549$), previous/current use of GC ($p = 1.000$), current use of immunosuppressors ($p = 0.765$) and mean current daily dose of GC ($p = 0.345$). Menarche age (12.77 ± 2.13 vs 13.11 ± 1.69 years, $p = 0.692$) and disease duration (7.31 ± 4.66 vs 7.56 ± 6.38 years, $p = 0.863$) were alike in both groups of patients. In addition, calcium supplementation ($p = 0.684$) and serum levels of total calcium ($p = 0.572$), ionic calcium ($p = 0.921$) and intact parathyroid hormone ($p = 0.306$) were comparable in patients with vitamin D deficiency (≤ 20 ng/mL) and patients with 25OHD levels >20 ng/mL

Table 2 Bone mineral density and body composition in juvenile onset systemic lupus erythematosus (JoSLE) patients and controls

	JoSLE n = 57	Controls n = 37	p
Bone mineral density			
Lumbar spine (g/cm ²)	0.834 ± 0.144	0.962 ± 0.167	<0.001
Z-score	-1.655 ± 1.312	-0.243 ± 1.056	<0.001
Z-score < -2 (%)	36.84	8.10	0.002
Total femur (g/cm ²)	0.850 ± 0.134	0.947 ± 0.132	0.001
Whole body (g/cm ²)	0.991 ± 0.109	1.062 ± 0.104	0.002
Body composition			
Lean mass (kg)	37.63 ± 8.28	41.95 ± 9.60	0.024
Fat mass (kg)	17.90 ± 7.27	16.50 ± 6.56	0.346
Fat percentage (%)	30.95 ± 7.46	26.76 ± 6.51	0.007
VFA			
Vertebral fracture (%)	14	0	0.021

VFA: vertebral fracture assessment.

Data expressed as mean ± standard deviation and percentage.

(Table 3). None of the patients had a history of malabsorption. Regarding organ involvement, only a history of serositis ($p=0.013$) and current hematological activity ($p=0.003$) were significantly different in the two groups of patients.

JoSLE patients with vitamin D deficiency presented higher SLEDAI activity index values (3.35 ± 4.35 vs 1.00 ± 2.48 , $p=0.018$), lower complement C4 levels (12.79 ± 6.78 vs 18.38 ± 12.24 , $p=0.038$) and a tendency to lower C3 levels (86.50 ± 28.91 vs 109.00 ± 52.42 , $p=0.054$) compared to patients with $25\text{OHD} > 20$ ng/mL. The analysis of mean SLEDAI by organ group showed a higher score for renal (0.9 ± 1.7 vs 0 ± 0 , $p=0.009$) and hematological activity (0.35 ± 0.49 vs 0 ± 0 , $p=0.0005$) in JoSLE group with vitamin D deficiency compared to those with vitamin D > 20 ng/mL. No difference was observed in the mean levels of ESR (12.3 ± 10.4 vs 14.6 ± 13.9 mm/hour, $p=0.485$) and the percentage of patients with anti-DNA positive (16.1 vs 3.8%, $p=0.205$) between the two groups of JoSLE. SLICC/ACR damage index was comparable in both groups (0.39 ± 0.72 vs 0.15 ± 0.37 , $p=0.139$) (Table 4).

Lumbar spine BMD (0.798 ± 0.148 vs 0.880 ± 0.127 g/cm², $p=0.037$) and whole body BMD (0.962 ± 0.109 vs 1.027 ± 0.098 g/cm², $p=0.024$) were lower in patients with vitamin D deficiency (≤ 20 ng/mL) compared to those with $25\text{OHD} > 20$ ng/mL. Also, there was a tendency to reduced total femur BMD in vitamin D lower group (0.820 ± 0.116 vs 0.893 ± 0.154 g/cm², $p=0.062$) (Table 4).

Table 3 Comparison of factors that may influence vitamin D levels in juvenile onset systemic lupus erythematosus (JoSLE) patients with serum vitamin D levels ≤ 20 ng/mL and those with > 20 ng/mL

	Vitamin D ≤ 20 n = 31	Vitamin D > 20 n = 26	p
Age (years)	18.42 ± 4.12	20.69 ± 6.10	0.100
Gender, female (%)	80.6	80.8	1.000
Race, Caucasian (%)	67.7	65.4	1.000
BMI (kg/m ²)	23.15 ± 4.02	23.03 ± 3.605	0.911
Menarche age (years)	12.77 ± 2.13	13.11 ± 1.69	0.692
Disease duration (years)	7.31 ± 4.66	7.56 ± 6.38	0.863
Season			
Spring (%)	12.9	3.8	0.502
Summer (%)	74.2	73.1	
Fall (%)	9.7	15.4	
Winter (%)	3.2	7.7	
Vitamin D use (%)	61.3	69.2	0.586
Daily dose of vitamin D (U)	393 ± 404.9	472 ± 419.8	0.481
Calcium supplementation (mg/day)	758.1 ± 405.6	711.5 ± 451.1	0.684
Total calcium (mg/dL)	9.2 ± 0.4	9.1 ± 0.7	0.572
Ionic calcium (mg/dL)	5.2 ± 0.1	5.2 ± 0.2	0.921
Intact parathyroid hormone (pg/mL)	29.4 ± 15.4	35.1 ± 16.3	0.306
Current use of GC (%)	77	80	1.000
Current dose of GC (mg)	14.19 ± 13.62	10.48 ± 15.78	0.345
Current use of IS (%)	71	77	0.765
Lean mass (kg)	37.03 ± 7.79	38.40 ± 8.98	0.549
Fat mass (kg)	18.17 ± 7.80	17.57 ± 6.67	0.764
Fat percentage	31.22 ± 8.26	30.59 ± 6.45	0.758

BMI: body mass index; GC: glucocorticoid; IS: immunosuppressor.

Data expressed as mean ± standard deviation.

No difference was observed in the frequency of vertebral fractures in JoSLE patients with and without low vitamin D levels (16.1 vs. 11.5 %, $p=0.715$) (Table 4). Only one patient presented symptomatic and severe vertebral fracture while the other patients had grade 1 fractures.

Discussion

This is the first study that demonstrated that vitamin deficiency in JoSLE is associated with inferior bone health and disease activity parameters. The advantage of our study was that we excluded patients with factors that may interfere with vitamin D and bone metabolism such as renal dysfunction and bisphosphonates, anticoagulants, anticonvulsants and growth hormone use.² In addition, matching of age, gender, race, and BMI was essential to accurately determine if the prevalence

Table 4 Comparison of disease duration and current clinical, laboratory, and bone parameters in juvenile onset systemic lupus erythematosus (JoSLE) patients with serum vitamin D levels ≤ 20 ng/mL and those with >20 ng/mL

	Vitamin <i>D</i> ≤ 20 n = 31	Vitamin <i>D</i> > 20 n = 26	P
SLEDAI	3.35 \pm 4.35	1.00 \pm 2.48	0.018
SLICC/ACR	0.39 \pm 0.72	0.15 \pm 0.37	0.139
C3	86.50 \pm 28.91	109.00 \pm 52.42	0.054
C4	12.79 \pm 6.78	18.38 \pm 12.24	0.038
dsDNA (%)	16.1	3.8	0.205
Rash (%)	6.5	7.7	1.000
Photosensitivity (%)	9.7	7.7	1.000
Arthritis (%)	3.2	3.8	1.000
Serositis (%)	0	0	1.000
Hematological involvement (%)	29	0	0.003
CNS involvement (%)	3.2	0	1.000
Renal involvement (%)	9.7	0	0.243
BMD, lumbar spine (g/cm ²)	0.798 \pm 0.148	0.880 \pm 0.127	0.037
BMD, total femur (g/cm ²)	0.820 \pm 0.116	0.893 \pm 0.154	0.062
BMD, whole body (g/cm ²)	0.962 \pm 0.109	1.027 \pm 0.098	0.024
Vertebral fracture (%)	16.1	11.5	0.715

BMD: bone mineral density; SLEDAI: SLE Disease Activity Index; SLICC/ACR: Systemic Lupus International Collaborating Clinics/American College of Rheumatology; CNS: Central Nervous System. Data expressed as mean \pm standard deviation.

of vitamin D deficiency was distinct from controls. In this regard, the non-balanced representation of blacks and obese individuals in children with SLE and other rheumatologic autoimmune diseases in the only two available studies hampers the interpretation of their findings.^{30,33} In fact, higher concentration of melanin reduces vitamin D skin production⁴⁴ and bioavailability of this hormone is decreased in overweight/obese subjects.⁴⁵ Also, most of patients collected vitamin D serum samples during the summer, since circannual rhythms of 25 hydroxyvitamin D levels has been shown to regulate autoimmune system and cytokine responses.^{46,47}

We have confirmed, with adequate matching, previous observation that serum levels and the frequency of vitamin D deficiency were similar in JoSLE patients and controls. However, our data suggest that concentrations of this hormone are actually lower in JoSLE since more than half of patients were being supplemented. Our sample represents a real-life situation concerning vitamin D supplementation since it is recommended in GC treated patients^{48–50} and our group routinely prescribes this vitamin to patients taking prednisone in doses equal or more than 5 mg per day, or equivalent.

Of note, vitamin D deficiency was associated with higher SLE activity scores and lower

complement levels, a finding also reported in previous studies evaluating adult SLE.^{17–22} A study of vitamin D in new cases of SLE showed an inverse correlation of 25OHD concentration and the British Isles Lupus Assessment Group (BILAG) index score and the titers of antibodies to double-stranded DNA at the time of diagnosis.²² A recent study showed that seasonal declines in vitamin D levels may trigger flares in non-African American SLE patients.⁵¹

Contrarily, four studies in adult lupus showed no association between vitamin D levels and lupus activity.^{23–26} These controversial findings may be explained by the limited number of patients analyzed and differences in the severity of disease activity.

Curiously, vitamin D supplementation in SLE murine models seems to have distinct beneficial or deleterious effect on lupus disease activity according to calcium serum levels in the animals, with some evidence that high calcium background is required for the beneficial effects of vitamin D.^{52,53} This might be a possible explanation for discrepant results in the literature regarding vitamin D and lupus activity. In our study, both groups of patients had similar serum calcium levels. Moreover, no history of malabsorption was found and calcium supplementation was similar in JoSLE patients with lower and higher vitamin D levels (≤ 20 ng/mL vs >20 ng/mL). In fact, serum levels of total calcium, ionic calcium and intact parathyroid hormone were comparable in both groups of JoSLE patients suggesting that the difference in vitamin D levels was not caused by malabsorption or poor compliance.

Vitamin D modulates T cell, B cell and antigen-presenting cell function, switches immune profile from Th1/Th17 to Th2/Treg and thus affects innate and adaptive immune responses.^{54,55} In vitro and in vivo studies of vitamin D suggest a special role for vitamin D in B cell related disorders like SLE and provide an immunologic basis for the association of vitamin D and our finding of greater disease activity in vitamin D deficient JoSLE.^{56–59} Activation of vitamin D receptor (VDR) present in immune cells, affects mRNA expression, T cell and B cell proliferation, and antibody production.⁶⁰ Also, naive B cells seem to be more susceptible to vitamin D than memory B cells and its activation by NF- κ B is modulated by vitamin D.⁶¹ Furthermore, in vitro exposure to vitamin D inhibits proliferation and induces apoptosis of activated B cells of SLE patients and also decreases plasma cell generation and differentiation. Additionally, 1 α -hydroxylase was detected in

B cells, indicating a possible role for B cells in auto-crine and paracrine production and response to vitamin D.⁶² In a classic experiment with murine lupus model mice supplemented with vitamin D for 22 weeks did not develop dermatologic lesions like alopecia, necrosis of the ear, and scab formation and had less proteinuria than non-supplemented mice.⁶³ Interestingly, vitamin D deficiency was associated with antinuclear antibodies (ANA) positivity in healthy controls and with higher levels of Interferon- α and higher B cell activation in SLE patients.⁶⁴ Also, vitamin D deficient SLE patients have higher levels of anti-dsDNA antibodies.²² All these laboratory and clinical findings suggest a role for vitamin D in SLE pathogenesis and autoantibody production. Accordingly, we have observed herein a higher frequency of history of serositis and current hematological activity. Likewise, a recent study reported that the vitamin D receptor gene polymorphism was also associated with serositis and hematological involvement in Chinese SLE patients⁶⁵ reinforcing the relevance of vitamin D levels in SLE clinical manifestations.

Regarding the deleterious skeletal effects of hypovitaminosis D, little is known about the real effect of vitamin D status on bone mass and the deficiency of this hormone is expected to be more harmful for bone during BMD acquisition in adolescence. Accordingly, our study demonstrated for the first time in JoSLE patients that this deficiency was associated with poorer bone health despite comparable current GC dose, fat body mass and conventional vitamin D supplementation. In fact, vitamin D status has been demonstrated to be important for optimal BMD. Of note, this effect was particularly evident in lumbar spine suggesting that trabecular bone susceptibility to vitamin D deficiency is related to a more metabolically active bone at this site as also observed in a three years prospective study in Finnish girls.⁶⁶

JoSLE vitamin D deficiency, in spite of conventional vitamin D supplementation, affects bone and disease activity status independent of therapy and fat mass reinforcing the recommendation to achieve adequate levels to improve both conditions. Vitamin D deficient JoSLE patients may therefore need higher doses of supplementation.

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Conflicts of interest statement

None declared.

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