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Original Research Article

ASSOCIATION BETWEEN VITAMIN D STATUS, METABOLIC PARAMETERS AND DISEASE ACTIVITY IN AXIAL SPONDYLOARTHRITIS

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ABSTRACT

Background: The association between serum vitamin D concentration and axial spondyloarthritis (axSpA) activity is not uniform across published cohorts. Body composition, seasonal variation and treatment may influence circulating 25-hydroxyvitamin D [25(OH)D]. **Aim:** To examine vitamin D status, metabolic parameters and clinical disease activity in men with axSpA.

Materials and Methods: A retrospective observational assessment included 40 men aged 25–60 years from District Damoh, Madhya Pradesh, over 2022–2026. Vitamin D categories, metabolic measurements, inflammatory markers, and BASDAI or ASDAS-CRP scores were evaluated. Pearson correlations were calculated for available paired observations.

Results: Mean serum 25(OH)D was 24.0 ± 9.7 ng/mL; 14 (35.0%) men had concentrations <20 ng/mL. Mean BASDAI was 5.5 ± 1.2. Serum 25(OH)D correlated inversely with BASDAI ($r = -0.59$, $p < 0.001$) and ASDAS-CRP ($r = -0.56$, $p < 0.001$).

Conclusion: Lower vitamin D concentrations were associated with higher disease-activity scores and selected metabolic and inflammatory measures. The retrospective findings do not show whether lower vitamin D preceded or followed higher disease activity.

Keywords: axial spondyloarthritis; vitamin D; metabolic parameters; BASDAI; ASDAS-CRP; retrospective study.

INTRODUCTION

Axial spondyloarthritis (axSpA) mainly affects the sacroiliac joints and spine, causing pain, stiffness and, in many patients, fatigue and functional limitation. Symptoms alone do not fully reflect inflammatory activity. The ASAS–EULAR recommendations therefore emphasise clinical assessment, objective evidence of inflammation and response to treatment.[1] The Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) records patient-reported symptoms, whereas the Ankylosing Spondylitis Disease Activity Score (ASDAS) combines clinical information with an inflammatory marker to classify disease activity.[2]

Vitamin D is important for bone health and also has a role in immune regulation. Serum 25-hydroxyvitamin D [25(OH)D] is affected by adiposity, sunlight exposure, diet, supplementation and the season in which blood is collected. In patients whose spinal symptoms restrict outdoor activity, low vitamin D may partly reflect reduced sun exposure rather than inflammatory activity alone. In the DESIR early spondyloarthritis cohort, lower vitamin D was associated with greater disease activity, abdominal obesity, low high-density lipoprotein (HDL) cholesterol and metabolic syndrome.[3]

Findings from other cohorts have been mixed. Zhao and colleagues reported higher disease activity in vitamin D-deficient patients after accounting for age, supplementation and season.[4] In the international ASAS-COMOSPA study, vitamin D levels varied with season and radiographic characteristics, without a consistent pattern across the comorbidities assessed.[5] Deng and colleagues found no independent association with pain or disease activity in newly diagnosed axSpA.[6] Kolahi and colleagues also found no significant correlation with BASDAI

or functional indices, despite lower vitamin D concentrations in patients than in controls.[7]

A meta-analysis found inverse associations between vitamin D and BASDAI, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), although differences among the included studies limit interpretation.[8] A later routine-care cohort of patients with axial or peripheral spondyloarthritis found that low vitamin D was common, but differences in disease activity between vitamin D groups were modest.[9] In patients with radiographic axSpA receiving biologic therapy, higher 25(OH)D showed a small inverse association with disease activity; several estimates became weaker after sensitivity analyses.[10]

Thresholds for vitamin D deficiency vary between studies. The 2024 Endocrine Society guideline did not identify a universal concentration threshold for disease prevention in otherwise healthy people.[11] Assessing continuous concentrations together with clinically descriptive categories may help clarify their relationship with disease activity in axSpA.

Aim

To assess the association between serum vitamin D status, metabolic characteristics and disease activity among men with axial spondyloarthritis in District Damoh, Madhya Pradesh.

Objectives

Primary objective: To examine the relationship between serum 25(OH)D concentration and BASDAI or ASDAS-CRP scores.

Secondary objectives: To describe vitamin D categories and metabolic parameters, assess their correlations with inflammatory indices, and examine treatment and clinical characteristics relevant to interpretation.

MATERIALS AND METHODS

Study design and setting

This retrospective observational study covered clinical records from 2022 to 2026 in District Damoh, Madhya Pradesh, India. The analysis involved 40 men aged 25–60 years with a clinician-recorded diagnosis of axial spondyloarthritis. Each patient contributed one set of index measurements.

Participant selection

Eligible records contained patient age, sex, a diagnosis of axSpA, a serum 25(OH)D result and a recorded BASDAI score. Duplicate encounters were handled at patient level. Additional laboratory variables were assessed using the available measurements for each individual, so denominators could differ across analyses.

Vitamin D and metabolic assessment

Serum 25(OH)D was expressed in ng/mL and categorised as <20.0 ng/mL, 20.0–29.9 ng/mL and ≥30.0 ng/mL for descriptive analysis. The categories were not used as axSpA-specific treatment thresholds. Available metabolic measurements included BMI, fasting plasma glucose, HbA1c, total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides.

Disease activity and inflammatory markers

Disease activity was measured using the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI, scale 0–10) and the Ankylosing Spondylitis Disease Activity Score incorporating C-reactive protein (ASDAS-CRP). C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) were examined as separate inflammatory indices. Available clinical information included disease duration, smoking, vitamin D supplementation, non-steroidal anti-inflammatory drug use and biologic treatment.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation and categorical variables as number and percentage. Pearson correlations assessed serum 25(OH)D against continuous clinical or laboratory measurements using available paired observations. Two-sided p values were obtained from tests of Pearson's r; 95% confidence intervals were estimated using Fisher's z transformation. Analyses were exploratory and unadjusted, without correction for multiple comparisons; correlations were not interpreted as causal effects.

RESULTS

Baseline characteristics and vitamin D distribution

The analysis included 40 men with a mean age of 42.3 ± 9.6 years and mean disease duration of 6.8 ± 3.5 years. Mean serum 25(OH)D was 24.0 ± 9.7 ng/mL. Fourteen patients (35.0%) had values below 20 ng/mL, fourteen (35.0%) had values of 20.0–29.9 ng/mL and twelve (30.0%) had concentrations ≥30.0 ng/mL. Mean BASDAI was 5.5 ± 1.2; mean ASDAS-CRP among the 37 patients with available scores was 3.1 ± 0.7. Baseline clinical and laboratory characteristics are presented in Table 1, and vitamin D categories are shown in Figure 1.

Disease activity across vitamin D categories

Mean BASDAI was 6.3 ± 1.3 in the <20 ng/mL category, 5.3 ± 0.8 in the 20.0–29.9 ng/mL category, and 4.8 ± 1.0 in the ≥30 ng/mL category. ASDAS-CRP and CRP also tended to be higher in the group with lower vitamin D concentrations. The group summaries are given in Table 2.

Correlations with disease activity and metabolic variables

Serum 25(OH)D was inversely correlated with BASDAI ($r = -0.59$; $p < 0.001$) and ASDAS-CRP ($r = -0.56$; $p < 0.001$). Inverse associations were also observed with BMI ($r = -0.53$; $p < 0.001$), CRP ($r = -0.55$; $p < 0.001$) and ESR ($r = -0.42$; $p = 0.010$). Associations with fasting glucose, HbA1c and individual lipid components were not statistically significant. Complete correlation results, including analysis-specific denominators, are provided in Table

3. The scatter plot of serum 25(OH)D and BASDAI is shown in Figure 2.

Selected clinical covariates

Current NSAID use was recorded for 30 of 40 patients (75.0%), biologic treatment for 12 (30.0%), vitamin D supplementation for 9 (22.5%), and current smoking for 10 (25.0%). Their distribution by vitamin D group is described in Table 4. The modest sample size precluded reliable multivariable subgroup modelling.

Table 1: Baseline demographic, clinical and biochemical characteristics

Characteristic	Value
Participants, n	40
Age, years	42.3 ± 9.6
Male, n (%)	40 (100.0%)
Disease duration, years	6.8 ± 3.5
Serum 25(OH)D, ng/mL	24.0 ± 9.7
25(OH)D <20 ng/mL, n (%)	14 (35.0%)
25(OH)D 20.0–29.9 ng/mL, n (%)	14 (35.0%)
25(OH)D ≥30 ng/mL, n (%)	12 (30.0%)
BASDAI (n=40)	5.5 ± 1.2
ASDAS-CRP (n=37)	3.1 ± 0.7
BMI, kg/m² (n=39)	26.5 ± 3.0
Fasting glucose, mg/dL (n=38)	97 ± 12
HbA1c, % (n=35)	5.7 ± 0.6
LDL cholesterol, mg/dL (n=37)	114 ± 27
HDL cholesterol, mg/dL (n=37)	44 ± 7
Triglycerides, mg/dL (n=37)	158 ± 34
CRP, mg/L (n=38)	10.1 ± 5.5
ESR, mm/hour (n=37)	28 ± 13
Current smoker, n (%)	10 (25.0%)
Current NSAID use, n (%)	30 (75.0%)
Biologic therapy, n (%)	12 (30.0%)
Vitamin D supplementation, n (%)	9 (22.5%)

Continuous data are mean ± SD. Denominators are shown where measurements were incomplete.

Table 2: Disease activity and metabolic measurements by vitamin D category

Measure	<20 ng/mL (n=14)	20.0–29.9 ng/mL (n=14)	≥30 ng/mL (n=12)
BASDAI score	6.3 ± 1.3 (n=14)	5.3 ± 0.8 (n=14)	4.8 ± 1.0 (n=12)
ASDAS-CRP score	3.5 ± 0.7 (n=14)	2.9 ± 0.6 (n=14)	2.6 ± 0.6 (n=9)
BMI, kg/m²	28.8 ± 2.4 (n=13)	25.6 ± 2.7 (n=14)	24.9 ± 2.3 (n=12)
CRP, mg/L	13.3 ± 4.9 (n=13)	10.0 ± 4.9 (n=13)	6.6 ± 4.8 (n=12)
ESR, mm/hour	33.6 ± 15.1 (n=13)	28.9 ± 10.8 (n=12)	22.4 ± 9.7 (n=12)
HbA1c, %	5.8 ± 0.5 (n=13)	5.3 ± 0.5 (n=11)	6.0 ± 0.6 (n=11)

Values are mean ± SD. Analysis-specific sample sizes are presented in parentheses.

Table 3: Pearson correlations between serum 25(OH)D and clinical measures

Comparison with 25(OH)D	n	r (95% CI)	p value
BASDAI	40	-0.59 (-0.76 to -0.33)	<0.001
ASDAS-CRP	37	-0.56 (-0.75 to -0.29)	<0.001
BMI	39	-0.53 (-0.73 to -0.26)	<0.001
Fasting glucose	38	-0.09 (-0.40 to 0.24)	0.594
HbA1c	35	0.03 (-0.31 to 0.36)	0.875
LDL cholesterol	37	-0.13 (-0.43 to 0.21)	0.458
HDL cholesterol	37	0.25 (-0.08 to 0.53)	0.131
Triglycerides	37	-0.16 (-0.46 to 0.18)	0.351
CRP	38	-0.55 (-0.74 to -0.28)	<0.001
ESR	37	-0.42 (-0.66 to -0.11)	0.010

Correlations are unadjusted and exploratory; no multiplicity correction was applied.

Table 4: Selected clinical characteristics by vitamin D category (counts)

Characteristic	<20 ng/mL	20.0–29.9 ng/mL	≥30 ng/mL	Total
Current smoking	4/14	3/14	3/12	10/40
Vitamin D supplementation	5/14	3/14	1/12	9/40
Current NSAID use	9/14	11/14	10/12	30/40
Biologic therapy	5/14	4/14	3/12	12/40

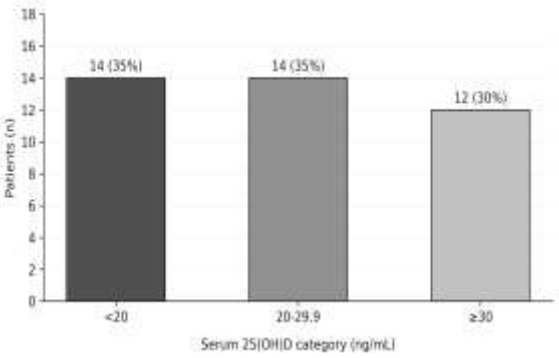


Figure 1: Distribution of serum vitamin D categories in men with axial spondyloarthritis.

Bars indicate the number and percentage of participants in each 25(OH)D category.

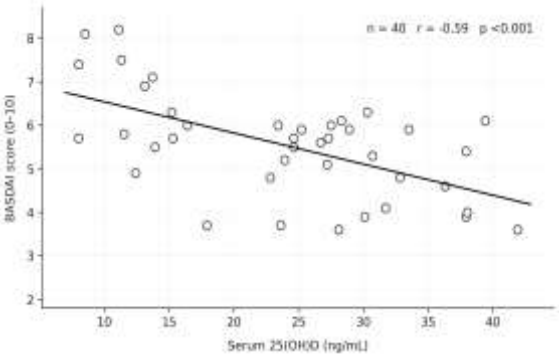


Figure 2: Relationship between serum vitamin D and BASDAI.

Each circle represents one participant; the line indicates the fitted linear trend.

DISCUSSION

Among the 40 patients included in this study, lower serum vitamin D concentrations were associated with higher BASDAI and ASDAS-CRP scores. The inverse relationship was also apparent for BMI and inflammatory indices, whereas the glycaemic and lipid measures did not demonstrate consistent associations. In this group of 40 patients, differences in treatment, supplement use and patient selection may have influenced the observed associations.

The DESIR study linked lower serum vitamin D with disease activity and metabolic abnormalities in early spondyloarthritis.[3] Zhao and colleagues also described higher disease activity among vitamin D-deficient patients after considering supplementation and seasonal variation.[4] Neither observation determines whether lower vitamin D contributes to inflammation or is a consequence of reduced activity during more symptomatic disease.

In contrast, data from ASAS-COMOSPA highlighted seasonal and radiographic differences without a consistent relationship across comorbidities.[5]

Deng and colleagues reported no independent association between vitamin D status and pain or disease activity in newly diagnosed axSpA.[6] Kolahi and colleagues similarly found no significant correlation with BASDAI despite lower vitamin D levels among patients than controls.[7]

A systematic review and meta-analysis identified inverse correlations between vitamin D and BASDAI, ESR and CRP.[8] A later routine-care cohort documented frequent low vitamin D levels but only modest between-group differences in disease activity.[9] In the longitudinal GESPIC analysis, higher vitamin D was associated with small reductions in disease-activity indices during biologic treatment, although some results were attenuated by sensitivity analyses.[10]

BMI is particularly relevant because circulating 25(OH)D may be lower in patients with greater adiposity. A concurrent association with BMI therefore complicates interpretation of the relationship between vitamin D and axSpA activity. Glycaemic and lipid measures showed no significant associations with vitamin D, although missing laboratory results limited these comparisons. Findings should not be taken to support routine vitamin D supplementation as a treatment for axSpA disease activity.

CONCLUSION

Lower serum 25(OH)D concentration was associated with higher disease-activity scores among the 40 men with axial spondyloarthritis. Relationships with BMI and inflammatory indices further suggest that vitamin D status should be interpreted alongside metabolic and clinical characteristics. Studies involving more patients and accounting for season, body composition, supplement use and treatment could help establish whether the same pattern persists.

Declarations

Ethics statement: Ethics Committee approval was obtained for the retrospective study.

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Conflict of interest: None declared.

Author contributions: Each listed author contributed equally to the work.

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