

# Assessment of the Level of Serum Beta Carotene in Chronic Low Back Pain Patients and its Association with Lumbar Osteophyte Formation

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## ABSTRACT

**Aim:** To assess the relationship between beta carotene levels, smoking, and alcohol consumption as a risk factor for developing spinal osteoarthritis.

**Materials and methods:** This is a cross-sectional study on 153 patients above 50 years of age with at least 3 months of continuous low back pain. The study period was from August 2015 to March 2017. The demographic data, the amount of alcohol intake, and smoking history were noted. The X-ray of lumbosacral spine (ap and lateral) was taken and Nathan's criteria for osteophyte positivity were applied. Blood samples were sent to biochemistry department for assessing beta carotene levels. Patients with any preexisting pathology of the spine were excluded. Statistical correlation studies were used to assess the significance.

**Results:** Spinal osteoarthritis was more in females and among them 22% had low serum beta carotene. Among the men with osteoarthritis, 32% had low serum beta carotene levels. There was a moderate correlation between beta carotene levels and osteophyte formation. There was strong association between smoking, alcohol intake, and osteophyte formation. The beta carotene levels were found to be low in persons consuming alcohol and persons who smoke.

**Conclusion:** Low serum beta carotene is a risk factor for spinal osteoarthritis, but it can be prevented by adequate dietary supplementation. Smoking and alcohol are independent but avoidable risk factors for developing spinal osteoarthritis.

**Keywords:** Beta carotene, Osteophytes, Spinal osteoarthritis.

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## INTRODUCTION

Spinal osteoarthritis is one of the common causes of chronic low back pain in people over 50 years of age.<sup>1-3</sup> The causes of degeneration are multifactorial with only a few reported associations.<sup>4,5</sup> Beta carotene has been found to lower the risk of knee osteoarthritis,<sup>6-8</sup> but the same has not been proven in spinal osteoarthritis.<sup>9,10</sup> We have assessed the association between serum beta carotene levels<sup>11</sup> and the effect of smoking and alcohol intake in causing spinal osteoarthritis.

## MATERIALS AND METHODS

This is a cross-sectional study on 153 patients above 50 years of age with at least 3 months of continuous low back pain. The study period was from August 2015 to March 2017.

### Inclusion Criteria

- Patients of more than 50 years of age.
- Low back pain patients of more than three consecutive months.

### Exclusion Criteria

- History of lumbar spine surgery.
- Trauma and malignancy.
- Osteoporosis.
- Chronic infection.
- Spondylolisthesis.
- Deformity in spine.

Along with routine demographic data, the patient's history of tobacco usage (10 cigarettes per day per year for at least five

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years) and alcohol consumption (for men 3-4 drinks per day for five years and for women 1-2 drinks per day for five years) was noted. Radiographs of lumbar spine lateral and anteroposterior view were taken and assessed.<sup>12</sup> After applying the exclusion criteria, 2 mL blood sample was taken and sent for centrifugation and the serum was sent to biochemistry department for analysis of beta carotene levels using two Human enzyme linked immunosorbent assay (ELISA) 96-strip well kit (Bioassay Company) (Fig. 1).

X-rays were reviewed by a single radiologist. Nathan's criteria of osteophyte positive (more than six osteophytes between L1 and S1) and osteophyte negative (less than six osteophytes) were used to evaluate the X-ray findings.<sup>3</sup>

### Statistical Methods

The sample (153) size was estimated using the statistical formula for estimating the population mean with relative precision. The

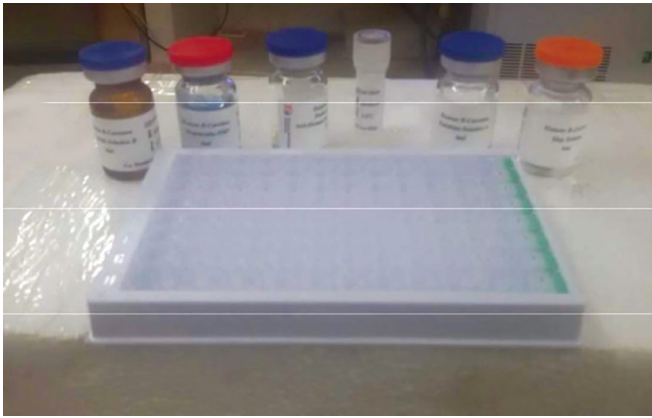


Fig. 1: Human ELISA 96-strip well kit (Bioassay Company)

Table 1: Gender distribution of patients studied

Gender	Number of patients (N)	Percentage
Female	104	68
Male	49	32
Total (N)	153	100

expected mean and standard deviation (SD) of the level of beta carotene in chronic low back pain patients is 0.55 with a SD of 0.38<sup>10</sup> and the sample size was estimated at a 5% level of significance and 11% relative precision (Table 1).

An inferential and descriptive statistical analysis was carried out in the present study. The results on continuous measurements were shown in mean SD (min–max), and the results of categorical measurements were presented in number (%). The significance was assessed at a 5% level of significance. The following assumptions on data were made.

- Dependent variables should normally be distributed.
- Samples taken from the population were random; cases of the samples independent of Student’s *t* test (two-tailed, independent) has been used to find the significance of study parameters on the continuous scale between two groups (intergroup analysis) on metric parameters.

The Chi-square/Fisher exact test is used to find the significance of study parameters on the categorical scale between two or more groups.

Significant figures are:

*p* value, 0.05 < *p* < 0.10, is suggestive of significance.

*p* value, 0.05 < *p* < 0.05, is moderately significant.

*p* value, 0.05 < *p* < 0.01, is of strong significance.

Statistical software: statistical analysis system 9.2, statistical package for the social sciences (SSPS) 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0, and R environment.

Ver.2.11.1 was used for the analysis of the data, graphs, tables, etc.

## RESULTS

### Age and Gender Distribution

Most of the patients are in the age group of 50–60 years; 104 were female (68%) and 49 were males (32%).<sup>2</sup>

Table 2: Osteophyte associations with gender

	Osteophyte positive	Osteophyte negative	Total
Male	22 (44.89%)	27 (55.11%)	49 (100%)
Female	28(26.93%)	76 (73.07%)	104 (100%)

Table 3: Gender distribution and serum beta carotene

Serum beta carotene (nmol/mL)	Female	Male	Total
<0.7 (low)	23 (59%)	16 (41%)	39
>0.7 (normal)	81 (71%)	33 (29%)	114

### Osteophyte Associations with Gender

The overall osteophyte positivity was noted in 50 (33%) of the 154 patients, 28 of the female patients and 22 male showed osteophyte positivity (Table 2).

### Gender Distribution and Serum Beta Carotene

The normal serum beta carotene values are 0.7–3.72 nmol/mL. Of the 153 patients studied, 39 patients had low beta carotene levels (<0.7 nmol/mL). Out of the 104 female patients, 22% had less than 0.7 nmol/mL beta carotene and 78% had more than 0.7 nmol/mL serum beta carotene. Among the 49 male patients, 32% had less 0.7 nmol/mL and 68% had more than 0.7 nmol/mL (Table 3).

### Association of Beta Carotene and Lumbar Osteophyte

Among 50 osteophyte positive patients, 39 (74%) had serum beta carotene less than 0.7 nmol/mL and 13 (26%) had serum beta carotene more than 0.7 nmol/mL. Out of 103 osteophyte negative patients, 2 (2%) had less than 0.7 nmol/mL and 101 (98%) had more than 0.7 nmol/mL, which is statistically significant with a *p* value of 0.0001 (Table 4).

The correlation between serum beta carotene and lumbar osteophyte was studied. There is a moderate correlation between lumbar osteophyte formation and a serum beta carotene level (*r* = –0.5822), which is statistically significant (*p* < 0.0001).

### Tobacco Consumption and Osteophyte Relation

Among 50 osteophyte positive patients, 44% did not use tobacco and 44% were tobacco consumers. Out of 103 osteophyte negative patients, 87 (84%) do not use tobacco and 16 (16%) were tobacco consumers. These statistics show the strong association between smoking and lumbar osteophyte formation, which is reflected in a significant *p* value of 0.001 (Table 5).

### Association of Alcohol and Osteophyte Formation

Among 103 osteophyte positive patients, 84% were nonalcoholics and 16% were alcoholics. Among the 50 osteophyte positive patients, 38% were alcoholics and 62% were nonalcoholics. Among the alcohol consumers, there was relatively more osteophyte presence with 52% positive and 48% negative for osteophytes. This result is statistically significant with a *p* value of 0.003 (Table 6).

Table 4: Association of beta carotene and lumbar osteophyte

Beta carotene nmol/mL	Osteophyte negative <6 number	Osteophyte positive >6 number
<0.7	2 (2%)	37 (74%)
0.7–2.8	101 (98%)	13 (26%)
Total	103	50

Table 5: Tobacco consumption and osteophyte relation

	Osteophyte negative	Osteophyte positive
Non-tobacco smokers	87 (84%)	28 (56%)
Tobacco smokers	16 (16%)	22 (44%)
Total	103	50

**Table 6:** Association of alcohol and osteophyte formation

	<i>Osteophyte negative</i>	<i>Osteophyte positive</i>
Nonalcoholics	86 (84%)	31 (62%)
Alcoholics	17 (16%)	19 (38%)
Total	103	50

**Table 7:** Serum beta carotene levels in alcoholic and nonalcoholic

	<i>Serum beta carotene (mean + S.D.)</i>
Nonalcoholics	0.835 + 0.57
Alcoholics	1.241 + 0.63
<i>p</i> value	0.0009

**Table 8:** Serum beta carotene levels in tobacco consumers and non-tobacco consumers

	<i>Serum beta carotene (mean + S.D.)</i>
Tobacco smokers	1.039 + 0.65
Non-tobacco smokers	1.184 + 0.63
<i>p</i> value	0.227

Combined smoking and alcohol consumption—a relation with osteophytes:

There is strong association between both alcohol consumption and smoking and lumbar osteophyte formation with a *p* value of 0.0002.

### Serum Beta Carotene Levels in Alcoholics and Nonalcoholics

There is a significant difference in mean, between serum beta carotene levels in alcoholics and nonalcoholics (*p* = 0.0009) (Table 7).

### Serum Beta Carotene Levels in Tobacco Consumers and Non-tobacco Consumers

There is no significant difference in mean serum beta carotene levels, between tobacco consumers and non-tobacco consumers (Table 8).

## DISCUSSION

This study was undertaken to find the association between serum beta carotene levels and the formation of lumbar osteophytes in patients older than 50 years.

The literature on the relation between levels of serum beta carotene and lumbar osteophyte formation is scanty. Only one study in 2005 by Imagama is available.<sup>10</sup> This study included 286 patients who are more than 50 years with a mean age of 68 years. In terms of gender difference, our study showed a similar trend to Imagama et al.'s study with a high incidence in males.

In our study, lower beta carotene was associated with radiological visible degenerative changes in spine; there is a moderate negative correlation between lumbar osteophyte formation and serum beta carotene levels with an *r* value of  $-0.5822$ , which is statistically significant (*p* < 0.0001). This may show that serum beta carotene levels and lumbar osteophyte formation are inversely correlated. Our results were in agreement with the only other study by Imagama.<sup>10</sup>

In spite of the geographical remoteness between the locations of these studies, the average beta carotene levels have almost equal values in osteophyte positive patients. This may show in a common reference

range of this particular factor, which may have the potential to be used as a criterion for preemptive diagnosis of impending degenerative spine disease. It may also be used as a prognostic indicator if specific treatment is initiated targeting this particular pathogenic mechanism. This requires more studies to firmly establish the role of beta carotene and also the usage of supplementation of carotenoids to prevent or arrest the progression of degenerative spine disease.

Nicotine in tobacco by its action of degrading the extracellular matrix and compromising the vascular supply to disk causes increased degeneration of the disc. This disc degeneration leads to abnormal loading of vertebral bodies and causes degeneration of spine.<sup>13</sup> In our study, we found that the association of lumbar osteophyte formation with smoking is stronger when compared to that with alcohol intake. We have also observed that in the study, subjects who consumed both alcohol and tobacco had an 80% incidence of osteophytes. This may show that there might be an additive effect of smoking and alcohol consumption on the formation of osteophytes pointing at the compounded oxidizing stress. Our result was in concordance with the findings of Imagama et al.<sup>10</sup> with respect to the relation among smoking, alcohol intake, and lumbar osteophyte formation.

We have calculated the mean serum beta carotene values in alcohol consuming and nonconsuming patients in the study group and on comparison found that there was a statistically significant difference in the values—alcohol consumers had lower serum levels (*p* = 0.0009).

We have also compared the serum beta carotene values in tobacco consumers and non-consumers and found that there was no significant difference in mean serum beta carotene levels, between tobacco consumers and non-tobacco consumers (*p* = 0.227).

The results of this study suggest that dietary intake of beta carotene<sup>14</sup> may reduce the risk of lumbar osteophyte formation in elderly patients.

We have noticed an association between low serum beta carotene levels and lumbar osteophytosis. Moreover, tobacco and alcohol consumption may add onto lumbar spine degeneration. The exact mechanism of this association is not clear. Probably, the pathology to lumbar spine degeneration is multifactorial and further studies will explain the exact process.

## CONCLUSION

Low serum beta carotene predisposes to lumbar osteophyte formation in elderly patients, and we concluded from our study that dietary supplementation of beta carotene in the form of fruits and vegetables may prevent the progression of lumbar osteophyte formation in elderly patients.

We also conclude that alcohol and tobacco consumption predisposes to lumbar osteophyte formation.

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