

Nutrition in Total Knee Arthroplasty and its Functional Outcomes in Vegetarians Population Compared to Non-vegetarians in Indian Scenario – A Prospective Study

Kishore Karumuri¹, Sawankumar Pawar², Kushal Hippalgaonkar¹, Ratnakar Vecham¹, A. V. Gurava Reddy³

¹Consultant, Department of Orthopedics, Sunshine Hospitals, PG Road, Secunderabad, Telangana, India, ²Fellow, Department of Orthopedics, Sunshine Hospitals, PG Road, Secunderabad, Telangana, India, ³Chief and Head, Department of Orthopedics, Sunshine Hospitals, PG Road, Secunderabad, Telangana, India

Abstract

Purpose: The main objective of the study is to compare the functional results in the vegetarian population compared to the non-vegetarian population in patients with total knee Arthroplasty (TKA).

Material and Method: We performed a prospective analytic study between 2017 and 2018 to compare the functional outcome between the vegetarian population and non-vegetarians undergoing TKA at 3-year follow-up, Measurement results include knee society score (KSS) and oxford score.

Results: A total of 200 patients who underwent primary TKA were evaluated, of which 100 were vegetarians (Group A) and 100 were non-vegetarians (Group B). At the time of the latest follow-up (minimum 3 years), KSS score was non-significant between the two groups (pre-operative KSS score 75.59 ± 12.75 in Group A vs. 75.55 ± 12.78 in Group B) and post-operative KSS score 156.51 ± 8.74 in Group A versus 157.50 ± 8.71 in Group B ($P = 0.41$). Functional outcomes were measured in terms of oxford knee score (OKS) for patients undergoing primary TKA. In vegetarians (Group A), OKS was mean 41.27 ± 2.56 and 43.31 ± 1.06 in the non-vegetarian (Group B) population at 3-year post-operative follow-up period. There was a statistically significant difference between the two groups in terms of functional outcome ($P < 0.001$).

Conclusion: The prospective analysis demonstrated that the functional outcomes of primary TKA in a vegetarian population (Group A) post-operative period were lower when compared to that in non-vegetarian.

Key words: Arthroplasty, Diet, Nutrition, Vegetarian

INTRODUCTION

Vegetarians are generally defined as people who do not eat any kind of meat, poultry, or fish.^[1] The popularity of vegetarianism worldwide varies greatly from 0% to 42%, determined by, civilization, outsourcing, and another aspect,^[2,3] but it implies that vegetarian diets are flourishing globally.^[4] In contrast, a large portion (35%) of the Indian

population is vegetarian.^[5] Vegetarians may be at increased risk for deficiencies in Vitamin B12, iron, calcium, Vitamin D, omega-3 fatty acids, eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and protein.^[5,6] Despite some benefits, vegetarians could be at risk for deficiency of essential nutrients, hence, affecting the outcome in patients undergoing primary total knee arthroplasty (TKA). Plant foods contain a negligible quantity of Vitamin B12; so, vegetarians have issues meeting the recommended daily allowance (2.4 µg) and maintaining a concentration of serum B12 adequately.^[7]

While overall iron intake was surprisingly higher in vegetarians than in omnivores, levels of ferritin and an iron storehouse were generally lower in vegetarians. Vegetarians occasionally have much lower Ca levels unless they eat a

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Corresponding Author: Dr. Kishore Karumuri, Department of Orthopedics, Sunshine Hospitals, Secunderabad, Telangana, India.

lot of Ca rich plant foods like dark green vegetables. Many researches have documented decrease consumption of calcium and intake of Vitamin D in vegetarians, but the consequences of a vegetarian food regimen plan on bone health, particularly bone mineral density (BMD), have been varied.^[8] Many studies have proven decrease BMD in vegetarians in comparison with non-vegetarians. Two important fatty acids have to be non-inheritable in the food plan as a human body cannot synthesize them: Linoleic acid (LA) and α -linolenic acid (ALA).^[9] Two other fatty acids which might be lacking in vegetarian diets are EPA and DHA. Plant assets are often considered incomplete sources of protein and lack at least one essential amino acid.

In recent years, the sector of nutrition applied to orthopedics has developed, with the requirement to boost the potency of the treatment path by enhancing the recovery when surgery.^[10] One major aspect of the field is that the undeniable fact that orthopedical surgery (e.g., knee/hip replacement and spine surgery) finds its typical candidate to be an aged individual ordinarily stricken by pathology and cardiac disease. With aging, nutrition plays a big role in maintaining physical and psychological feature skills.^[11,12] Similarly, organic process standing can have a consequence on the surgical outcome of patients undergoing major surgery, particularly the seniors with restricted practical reserves.^[13] Surgery is a stressful event that ends up in a pro-catabolic hormonal secretion and cytokine environment, which significantly impacts the metabolism. This metabolic response is accompanied by the high levels of oxidative stress, hyper inflammation, and immune system impairment, increasing the risk of post-operative complications.^[14] Often as a result of pre-surgery immobilization due to pain, orthopedic patients will suffer muscle disuse atrophy. It is thought that increasing protein consumption in the elderly can maintain lean body mass and function.^[15] According to the reports, vital amino acids can enhance the body and its capacity to synthesize protein and restore muscles. This can provide patients with greater functional reserves to better withstand surgical pressure.

Purpose of Study

The primary objective of the study was the functional outcome in vegetarian and non-vegetarian TKA patients. We hypothesized that the vegetarian diet population has less functional scores and range of motion as compared to the non-vegetarian group population.

MATERIALS AND METHODS

The study design is a prospective and single-center trial adhering to Standard Protocol Items: Recommendation for Interventional Trials (SPIRIT) guidelines. The study

carried out at our tertiary hospital specializing in joint replacement surgery. This study was designed to compare the functional outcome in vegetarian versus non-vegetarian patients undergoing TKA from 2017 to 2018 at our facility. Each patient in the study had to undergo TKA through a unique technique by a single surgeon. This study received Institutional Research Board approval. Inclusion criteria subject with Grade 4 knee osteoarthritis patients with strict vegetarians (Lacto-vegetarian) and not consuming meat and egg product and who had undergone primary TKA that could not be treated conservatively. Subjects also had to have a varus/valgus deformity that matched within 5° of other groups assessed using knee society score (KSS). Exclusion standards – a flexion contracture more than 15°, any extra-articular knee deformities, and with inflammatory arthritis to reduce the bias on outcome. Pre-operative demographic data were recorded for all subjects, including height, weight, age, comorbidities, hemoglobin, serum albumin, Vitamin D3 level, gender, and pre-operative deformity using KSS. Pre-operative radiographs were obtained for all subjects and included a standing full-length anterior-posterior (AP) view that spanned from the hip joint to the ankle joint. Functional evaluation was measured with the oxford knee score (OKS) at time of pre-operative assessment and at 3-year follow-up visit and compared with non-vegetarians patients undergoing TKA during the same period. Both groups were matched to reduce the influence of demographic characteristics on the results of the study. The patients were divided into two groups and willing to follow-up regularly:

- (1) Group A – vegetarians patients undergoing TKA ($n = 100$)
- (2) Group B – Non- vegetarians patients corresponding to Group 1 ($n = 100$)

All data are collected by the research fellow.

Post-operative Care

All patients received the same standardized post-operative multimodal pain protocol, with three doses of 1 g of acetaminophen, two doses of IV antibiotics, and morphine or tramadol for pain exacerbations. All patients underwent the same post-operative rehabilitation program, with full weight-bearing with the use of a walker from the 1st post-operative day and active range of movement exercises. DVT prophylaxis was given in all patients.

Outcome Evaluation

Outcome measures included the OKS, KSS, and the range of movement assessment. The scores were recorded before surgery and postoperatively scores at 3 years of follow-up. The range of motion is recorded through a goniometer.

Statistical Analysis

Data have accumulated with the use of a semi-dependent pre-tested questionnaire, records collected were entered in Microsoft Excel 2013. Data are represented in frequencies

and percentages, charts, and graphs. The mean and standard deviation of quantitative variables are shown. Appropriate statistical assessments have been implemented with the use of the SPSS software program model 21 for analysis. The Chi-square test is used for affiliation and the student's *t*-test is used for evaluation among the study variables. Statistical significance is considered at $P < 0.05$.

RESULTS

In this study, a total of 200 patients who underwent primary TKA were evaluated, of which 100 were vegetarians (Group A) and 100 were non-vegetarians (Group B). Female predominance in each group (83 in Group A vs. 76 in Group B) (Table 1, $P = 0.22$) with the mean age group is 58.37 ± 2.15 (A) and 57.99 ± 2.16 (B), mean BMI of patients in Group A is 22.98 ± 5.67 and Group B is 23.45 ± 4.76 , Charlson comorbidity index is 1.39 in Group A and 1.38 in Group B, pre-operative HB in Group A 12.20 ± 0.86 versus 12.15 ± 0.99 in Group B and post-operative HB 10.40 ± 1.03 in Group A versus 10.44 ± 1.02 in Group B [Table 2] were followed up at the very least 3 years with no statistically significant difference among the two groups ($P > 0.005$). At the end of the final follow-up, implant survivorship was 100% for both groups with no revision surgery performed for any indication. Serum albumin mean was 3.21 ± 0.39 in Group A versus 3.39 ± 0.30 in Group B ($P < 0.001$) significant between two groups, serum Vitamin D3 mean in Group A is 27.65 ± 5.23 versus 42.46 ± 14.44 in Group B ($P < 0.001$) which is significant difference between two groups. KSS score was non-significant between two groups (pre-operative KSS score 75.59 ± 12.75 in Group A vs. 75.55 ± 12.78 in Group B) and post-operative KSS score 156.51 ± 8.74 in Group A versus 157.50 ± 8.71 in Group B ($P = 0.41$). Functional outcomes were measured in terms of OKS for patients undergoing primary TKA. In a vegetarians (Group A), OKS was mean 41.27 ± 2.56 and 43.31 ± 1.06 in non-vegetarian (Group B) population at post-operative 3-year follow-up period. There was a statistical significant difference between two groups in terms of functional outcome ($P < 0.001$) [Table 3].

Complications

There were no reoperations in this study series over the 3-year follow-up span. There were no wound complications further requiring additional oral or intravenous antibiotics. At the 3-year follow-up, there have been no cases of chronic periprosthetic joint infection. Two subjects were asked to manipulate the stiff knee joint under anesthesia. One subject in Group A is a vegetarian and one subject in Group B. is not a vegetarian [Figures 1 and 2].

Table 1: Gender distribution

	Veg	Non-Veg	Total
F	83	76	159
M	17	24	41
Total	100	100	200

Table 2 : Different demographics study parameters comparison in groups

	Group	Mean	Std. deviation	P value
BMI	Veg	22.98	5.67	0.98
	Non-veg	23.45	4.76	
Age	Veg	58.37	2.15	0.21
	Non-veg	57.99	2.16	
Charlson comorbidity index	Veg	1.39	0.78	0.92
	Non-veg	1.38	0.71	
Pre-operative HB	Veg	12.20	0.86	0.69
	Non-veg	12.15	0.99	
Post-operative HB	Veg	10.40	1.03	0.77
	Non-veg	10.44	1.02	
Serum Albumin	Veg	3.21	0.39	<0.001
	Non-veg	3.39	0.30	
Vitamin D	Veg	27.65	5.23	<0.001
	Non-veg	42.46	14.44	

S*: Significant Difference

Table 3: Different study parameters comparison in groups

Group	Mean	Std. deviation	P value
Pre-operative Knee Society Score			
Veg	75.59	12.78	0.98
Non-veg	75.55	12.95	NS
Post-operative Knee Society Score			
Veg	140.91	17.38	0.0001
Non-veg	157.51	8.71	NS
Oxford Knee Score			
Veg	41.27	2.56	<0.001
Non Veg	43.31	1.06	S*

S*: Significant Difference

DISCUSSION

Total knee replacement (TKR), one of the frequently performed orthopedic surgeries, and as the number of procedures increase as population ages, the nutrition should be considered for its role in the management of stress responses during surgery, as the need for early recovery and return to function after surgery increases with the increase in active aging. TKR is a stress stimulus that has profound effects on metabolism from the environment of metabolic hormones and cytokines. This is associated with the high levels of oxidative stress, hyperinflammation, and changes in the immune system, which increase the risk complications after surgery.

Orthopedic patients show severe muscle atrophy due to pre-operative pain-related fixation. Therefore, it has been

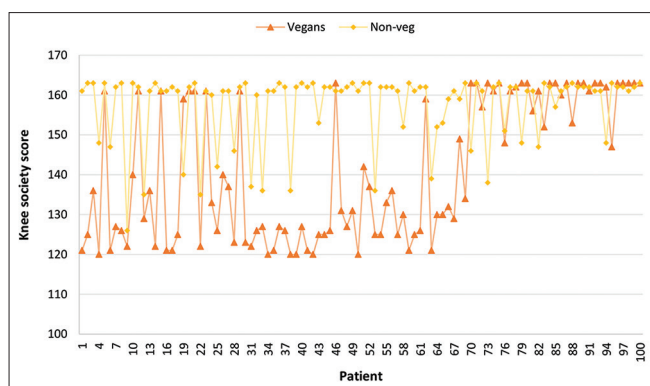


Figure 1: Knee society score

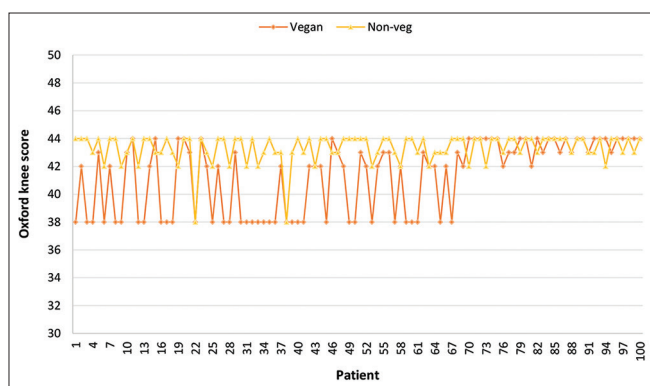


Figure 2: Oxford knee score

suggested that increasing protein intake in the elderly can maintain lean body mass and function.^[15,16] Essential amino acids are recognized to boom the body’s capacity to synthesize proteins and restore muscle tissue.^[17] The richest source of essential amino acids is meat and meat products, which are not consumed by vegetarians and therefore affect their functional outcomes and early mobilization.

Serum cholesterol and blood pressure have a normal range in vegetarians, reducing the risk of cardiovascular disease. BMD, and therefore the risk of fractures, may also be a priority if intake of calcium and Vitamin D is insufficient. In our study, we found that functional OKS outcomes were statistically significant in non-vegetarian patients compared with vegetarian patients at 3 years of follow-up. Likewise, serum albumin and serum Vitamin D levels were statistically significant in the non-vegetarian group compared with the vegetarian group. This could be a confounding factor for the difference in functional outcome between the two groups. Chiu *et al.*^[18] summarized in their study that variable causes bone loss in postmenopausal Taiwanese vegetarians. Fortified food with calcium and Vitamin D should be taken whenever available. Vitamin B12 deficiency can be a potential problem for vegetarians, so it is imperative to take foods or supplements fortified with Vitamin B12. To optimize vegetarian status in n-3

fatty acids, you should regularly consume foods rich in ALA, foods fortified with DHA, or foods fortified with DHA. In general, vegetarians can avoid nutritional health problems by choosing the right food.

Tuckert *et al.*^[19] found that vegetarians may be at increased risk of the lower BMD and fractures, which indirectly affect bone strength and functional outcomes. Lavernia^[20] concluded the impact on post-operative results as vegetarians do not consume a high source of animal protein that indirectly contributes to the body’s production of albumin, which is necessary for the healing process, and thus nutrition for the consequences in arthroplasty. Following the conclusion of Maniar *et al.*,^[21] Vitamin D deficiency adversely affects the functioning of patients with knee osteoarthritis with low Vitamin D content, it also affects post-TKR results.

Post-operative recuperation is multifactorial^[22] and the function of inflammatory/immune responses before and after surgery is a critical element in decreasing rehabilitation, post-operative pain, and malaise. It is important. Therefore, in the case of joint replacement, the predisposition to pre-operative localized myositis at the time of surgery may be an important consideration for post-operative recovery.^[23] Polyunsaturated n3 fatty acids (PUFAs) can help regulate the main inflammatory pathway^[24] and reduce pre-operative inflammatory burden, which can accelerate recovery. The main source of PUFA (EPA and arachidonic acid) is found in animal fats and fish not consumed by vegetarians.

In our research, the functional outcomes of non-vegetarians were relatively good in comparison to the vegetarian population after the primary TKA, and also patients in non-vegetarian group have statistically significant difference in terms of pre-operative serum albumin and serum Vitamin D3 compared to vegetarian group, but more research must be done and longer follow-up is obligatory to judge the outcomes in both groups.

It is recommended that some supplements may play a role in bettering the recovery of patients undergoing TKR. The constraint of study was small sample size, early follow-up, and no consideration was given to the interpretation of albumin and other nutritional parameters. To the best of our knowledge, there is no documented previous study comparing these two groups in knee replacement surgery.

CONCLUSION

Functional results of primary TKA in the vegetarian population are lower to non-vegetarian groups during the post-treatment period (3 years after initiation). Compared

to non-vegetarians, vegetarian candidates appear to have health and nutritional deficiencies, lower Vitamin D storage, and serum albumin/protein levels. TKA in vegetarian patients needs to be provided with cautious nutritional planning and supplementation. Future studies of TKA patients are warranted within side the context of nutritional preferences.

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