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THE IMPACT OF NUTRITIONAL INTAKE ON OSTEOARTHRITIS SYMPTOMS AND PHYSICAL FUNCTION: A CROSS-SECTIONAL STUDY

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ABSTRACT

Osteoarthritis (OA), a chronic degenerative joint condition, is closely linked to nutritional status and dietary habits. This study aimed to assess the macronutrient and micronutrient intake and physical function of OA patients using the Western Ontario and McMaster Universities Arthritis Index (WOMAC). A stratified random sample of 50 participants (11 males, 39 females) was evaluated for demographic factors such as gender, age, and Body Mass Index (BMI). Dietary patterns were analyzed using a Food Frequency Questionnaire (FFQ) and a 3-day food recall. The findings revealed a significant association between higher BMI and increased OA risk and severity. Nutritional assessment indicated excessive consumption of protein, fat, and carbohydrates beyond the Recommended Dietary Allowance (RDA), which was associated with aggravated OA symptoms. Furthermore, the analysis of FFQ and WOMAC scores demonstrated a positive correlation between the consumption of fried foods, dairy products, refined carbohydrates, and sugar-sweetened beverages and the progression of OA symptoms. This study emphasizes the critical role of dietary management in mitigating OA symptoms. It underscores the need for adopting balanced diets, limiting the intake of specific food categories, and incorporating lifestyle changes such as regular moderate exercise to improve physical function and overall quality of life in OA patients. These findings highlight the importance of personalized dietary interventions as part of a comprehensive approach to OA management.

KEYWORDS: Osteoarthritis, Macronutrient Intake, Micronutrient Intake, BMI, WOMAC Index, Dietary Assessment, Healthy Lifestyle**.**

INTRODUCTION

Osteoarthritis (OA) is a prevalent musculoskeletal disorder that significantly impacts global health, affecting mobility, quality of life, and healthcare systems. With projections estimating that nearly 1 billion individuals will be affected by OA by 2050, understanding its multifaceted risk factors—including age, sex, obesity, genetics, diet, and lifestyle—is crucial. Among various forms of OA, knee osteoarthritis is particularly concerning due to its high prevalence, earlier onset in women, and strong associations with obesity and dietary habits. Nutritional factors, including calcium-phosphorus balance, vitamin intake, and dietary patterns, have been identified as potential influencers of OA risk and progression. Emerging evidence highlights the role of diet in modulating inflammation and joint health, underscoring the need for targeted dietary interventions. This study aims to explore the relationship between dietary patterns and OA severity using validated assessment tools such as the Food Frequency Questionnaire (FFQ) and the Western Ontario and McMaster Universities (WOMAC) index. By identifying distinct dietary patterns among OA patients and their association with disease severity, the findings may contribute to developing evidence-based nutritional recommendations for OA management and inform future research into dietary strategies for mitigating OA progression.

METHODOLOGY

Research Methodology

This study investigates the impact of dietary patterns on osteoarthritis (OA) progression and symptom management. Given that pharmacological interventions

provide only symptomatic relief and may pose adverse effects, the research focuses on identifying dietary factors that may alleviate OA symptoms. The study aims to determine whether specific foods, nutrients, and dietary habits influence OA severity, inflammation, and disease progression, potentially leading to improved dietary recommendations for OA management.

A quantitative research design was employed, utilizing a stratified random sampling method. The sample comprised 50 individuals diagnosed with OA, recruited from The Arthritis and Rheumatism Care Center, Ashok Nagar. Participants were stratified by gender to analyze differences in dietary influence. Inclusion criteria encompassed individuals aged 30–80 years with a confirmed OA diagnosis through clinical examinations, imaging (CT, MRI, X-ray), and willingness to participate. Exclusion criteria included individuals above 80 years, pregnant or lactating women, individuals with language barriers, and those with a history of alcohol or smoking.

Data collection involved both primary and secondary sources. Primary data were obtained through a structured interview schedule, while secondary data were derived from journals, articles, and books. The interview schedule included demographic details, anthropometric measurements (height, weight, BMI), lifestyle patterns, medical history, dietary habits, food frequency data, and a three-day dietary recall. The **Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)** was utilized to assess OA severity, evaluating pain, stiffness, and physical function.

Anthropometric data were recorded to determine participants' nutritional status. Height was measured using a standard measuring tape, with subjects standing erect without footwear, while weight was assessed using a digital weighing scale. BMI was calculated. Medical history was documented to identify any additional chronic conditions or medications that might influence OA progression.

The dietary assessment incorporated a **Food Frequency Questionnaire (FFQ)**, categorizing consumption patterns into daily, weekly, monthly, rarely, or never. A **three-day dietary recall** was also conducted to assess actual nutrient intake. Nutrition education was provided to participants, emphasizing the role of balanced diets in joint health. Participants received educational materials in Tamil and English, focusing on reducing inflammatory food intake and promoting nutrient-dense choices using models like the food pyramid and food plate.

For statistical analysis, **descriptive analysis** was used to summarize and interpret dietary patterns, anthropometric data, and OA severity indicators. The **chi-square test** was applied to test hypotheses regarding associations between dietary components, BMI, and OA symptoms. This methodology ensures a comprehensive understanding of dietary influences on OA and provides a basis for developing evidence-based dietary recommendations.

RESULTS AND DISCUSSION

Anthropometric Parameters

Table 1.

HEIGHT							
Gender	**Mean Height (cm)**	**SD Height (cm)**		**Max Height(cm)**		**Min Height (cm)**	
Male	165	9.45		180		156	
Female	155.83	6.43		167		140	
WEIGHT							
Gender	MeanWeight(kg)	SD Weight(kg)		Max Weight(kg)		MinWeight(kg)	
Male	70.22	19.91		107		52	
Female	71.77	13.75		97.3		34.3	
Variable	**BMI CATEGORY**						
	Underweight	Normal	Overweight	Obese I	Obese II	Obese III	p-value
GENDER							
Male	0(0)	6(54.5)	2(18.2)	2(18.2)	0(0)	1(9.1)	
Female	1(2.6)	3(7.7)	14(35.9)	15(38.5)	4(10.3)	2(5.1)	**0.016***

The study analyzed the anthropometric measurements of male and female participants. The mean height for males was **165 cm (±9.45)**, while females had a mean height of **155.83 cm (±6.43)**. In terms of weight, males had a mean weight of **70.22 kg (±19.91)**, whereas females had a mean weight of **71.77 kg (±13.75)**.

The distribution of BMI categories among males and females revealed notable differences. Among males, **0%** were underweight, **54.5%** had a normal weight, 18.2% were overweight**,** 18.2% were classified as Obese I**, and** 9.1% as Obese III**.** In contrast, among females, **2.6%** were underweight**,** 7.7% had a normal weight**,** 35.9% were overweight**,** 38.5% were classified **as Obese I**, **10.3% as Obese II**, and **5.1% as Obese III**. A **p-value of 0.016** indicated a statistically significant association between BMI and OA severity among female participants.

These findings align with previous research by **Grotle et al. (2008)**, which established a correlation between increased BMI and the prevalence of knee osteoarthritis. The results suggest that obesity, particularly among females, may contribute to the progression and severity of osteoarthritis symptoms.

MACRONUTRIENT INTAKE

Table 2.

ENERGY (N= 50)				
Gender	**Mean Intake**	**Nutritional status (excess intake)**	**RDA**	**p - value**
Male	2179.6	69.6	2110kcals	
Female	2044.4	444.4	1600 kcals	0.13
PROTEIN (N= 50)				
Male	68.8	14.8	54g	
Female	60.2	14.2	46g	0.04
FAT(N=50)				
Male	63.1g	4.5	58.6g	
Female	57.5g	13.1	44.4g	0.04
CARBOHYDRATES(N=50)				
Male	302.6g	12.6	290	
Female	278.9g	58.9	220	0.0001

The analysis of nutrient intake based on a **3-day dietary recall** was conducted for both male and female participants, comparing their consumption levels with the **Recommended Dietary Allowance (RDA)** as per **ICMR guidelines**. The evaluation assessed nutrient excesses and deficits in relation to established standards.

For **males**, the mean energy intake was **2179.6 kcal**, which was **3.3% above** the RDA of **2110 kcal**. In **females**, the mean energy intake was **2044.4 kcal**, exceeding the RDA of **1600 kcal** by **27.8%**. However, this difference was not statistically significant.

The mean **protein intake** in males was **68.8 g**, which was **27.4% higher** than the RDA of **54 g**. In females, the mean protein intake was **60.2 g**, **30.4% above** the RDA of **46 g**. This excess was statistically significant for females, with a **p-value of 0.04**.

Regarding **fat intake**, males had a mean intake of **63.1 g**, exceeding the RDA of **58.6 g** by **7.7%**. Females had a mean fat intake of **57.5 g**, **29.4% above** the RDA of **44.4 g**. This excess was statistically significant in females (**p = 0.04**).

The mean **carbohydrate intake** for males was **302.6 g**, which was **4.3% higher** than the RDA of **290 g**. In females, the mean carbohydrate intake was **278.9 g**, exceeding the RDA of **220 g** by **26.5%**. This deviation was highly statistically significant (**p = 0.0001**) among females, indicating a significant departure from the recommended carbohydrate intake.

These findings align with the study by **Peng et al. (2023)**, which suggested that **higher energy and dietary fat intake were associated with an increased risk of osteoarthritis**. The results of the present study corroborate these previous findings, highlighting the potential impact of dietary factors on osteoarthritis progression.

The results emphasize the need for **dietary modifications** in osteoarthritis patients, particularly in **reducing excess energy, fat, and carbohydrate intake** to mitigate disease risk and progression.

MICRONUTRIENT INTAKE

Table -3.

CALCIUM (N= 50)				
Gender	**Mean Intake**	**Nutritional status (deficit)**	**RDA**	**p - value**
Male	522.6	477.4 mg	1000 mg	
Female	538.1	461.9mg	1000 mg	0.0001
MAGNESIUM (N= 50)				
Male	293.8	146.2 mg		
Female	285.5	154.5 mg	440 mg	0.0001
PHOSPHOROUS (N= 50)				
Male	357.3	242.7 mg		
Female	348.1	251.9 mg	600 mg	0.0001

The analysis of calcium intake revealed that males had a mean intake of 522.6 mg, resulting in a deficit of 477.4 mg compared to the Recommended Dietary Allowance (RDA) of 1000 mg. In females, the mean intake was slightly higher at 538.1 mg, yet still resulted in a deficit of 461.9 mg. The statistical analysis indicated a highly significant difference in calcium intake between males and females (p = 0.0001).

Similarly, for magnesium intake, males had a mean intake of 293.8 mg, leading to a deficit of 146.2 mg against the RDA of 440 mg. Females exhibited a slightly lower mean intake of 285.5 mg, with a corresponding deficit of 154.5 mg. The difference in magnesium intake between the two genders was also statistically significant (p = 0.0001).

For phosphorus, the mean intake for males was 357.3 mg, which resulted in a deficit of 242.7 mg compared to the RDA of 600 mg. Females had a mean intake of 348.1 mg, leading to a greater deficit of 251.9 mg. The statistical analysis again revealed a highly significant difference in phosphorus intake between males and females (p = 0.0001).

These findings align with previous studies on mineral deficiencies and their implications for bone health. Fujita (1998) highlighted that calcium deficiency can trigger secondary hyperparathyroidism, causing calcium mobilization from bones and its subsequent accumulation in soft tissues such as blood vessels, the brain, and intracellular compartments. This process is linked to conditions like osteoporosis and degenerative joint diseases.

Further, Li et al. (2017) established an association between dietary and serum magnesium levels with serum high-sensitivity C-reactive protein in patients with early radiographic knee osteoarthritis, underscoring the importance of adequate magnesium intake.

Takeda et al. (2012) also emphasized that insufficient dietary phosphorus can lead to bone demineralization, negatively affecting bone health and overall quality of life. The findings of the present study corroborate these earlier studies, reinforcing the need for monitoring and optimizing calcium, magnesium, and phosphorus intake to mitigate potential health risks associated with mineral deficiencies.

Table -4
WOMAC INDEX IN RELATION WITH HEALTH CONDITION

WOMAC (N = 50)				
Condition	**Gender**	**Frequency**	**Percentage**	**p - value**
Better (0-500)	Male	3	27.30	
	Female	8	20.50	0.03
Poor (50-1000)	Male	8	72.70	
	Female	31	79.50	0.05

The table 3 analyzed WOMAC scores for males and females, categorizing them into Better condition(0-50%)andPoorcondition(50-100%). 27.3% of male sand 20.5%offemaleswerein better condition with ap-value of 0.03 indicated a statistical significance for females. While72.7% of males and 79.5% of females were in poor condition. The p-value of 0.05 reflected a statistical significance for females who experienced pain for the daily activities when compared with males.

WOMAC IN RELATION WITH FOOD
Table 5.

FRIED FOODS				
Gender	**Better(0-500)**	**Poor(50-1000)**	**Total**	**p - value**
Male	2(4.00)	9(18.0)	11(1000)	
Female	12(24.00)	27(54.00)	39(1000)	0.001
SUGAR SWEETENED BEVERAGES				
Male	2(8.00)	9(18.00)	11(1000)	
Female	8(16.0)	31(62.00)	39(1000)	<0.001
REFINED CARBOHYDRATES				
Male	3(6.00)	8(16.00)	11(1000)	
Female	10(20.00)	29(78.00)	39(1000)	<0.001
MILK AND IT'S PRODUCTS				
Male	2(4.00)	9(18.00)	11(1000)	
Female	8(16.00)	31(62.00)	39(1000)	0.001

Table 4.13 presents the analysis of dietary patterns and their association with WOMAC scores among males and females.

For fried food consumption, 4.0% of males were classified in the better condition category (0–50%), while 18.0% were in the poor condition category (50–100%).

Among females, 24.0% were in better condition, whereas 54.0% were in poor condition. A p-value of 0.001 indicates a statistically significant difference in fried food consumption between genders.

Regarding sugar-sweetened beverages, 8.0% of males were in the better condition category, while 18.0% were in the poor condition category. Among females, 16.0% were in the better condition category, and 62.0% were in the poor condition category. A p-value of <0.001 suggests a highly significant difference in sugar-sweetened beverage consumption between males and females.

For refined carbohydrate consumption, 6.0% of males were classified in the better condition category, whereas 16.0% were in the poor condition category. Among females, 20.0% were in better condition, and 78.0% were in poor condition. A p-value of <0.001 indicates a highly significant difference in refined carbohydrate consumption between genders.

In terms of milk and dairy product consumption, 4.0% of males were in better condition, while 18.0% were in poor condition. Among females, 16.0% were in the better condition category, and 62.0% were in the poor condition category. A p-value of 0.001 suggests a statistically significant difference in milk and dairy product consumption between males and females.

These findings align with previous research. Movassagh et al. (2017) reported that a Western dietary pattern—characterized by high consumption of soft drinks, fried foods, processed meats, sweets, desserts, and refined grains—was inversely associated with bone mineral density (BMD). High fat intake may interfere with intestinal calcium absorption, while excessive fat accumulation and obesity, often resulting from a diet rich in fat and refined carbohydrates, may inhibit osteoblast differentiation and bone formation. The present study corroborates these findings.

Similarly, Xu et al. (2021) found that adherence to a Western diet was associated with an increased risk of knee osteoarthritis, likely due to elevated production of inflammatory cytokines. The findings of the present study are consistent with these prior observations, further supporting the detrimental impact of a Western dietary pattern on musculoskeletal health.

CONCLUSION

The present study aimed to examine the dietary patterns of osteoarthritis patients, with a specific focus on BMI, macronutrient and micronutrient intake, and the consumption of foods that may exacerbate osteoarthritis symptoms. The findings revealed a significant association between obesity and osteoarthritis. Higher intake of macronutrients, including protein, fat, and carbohydrates, was highly significant, while inadequate intake of essential micronutrients such as calcium, magnesium, and phosphorus was particularly evident among females, further aggravating osteoarthritis symptoms.

Additionally, the study highlighted that the consumption of fried foods, dairy products, sugar-sweetened beverages, and refined carbohydrates was linked to osteoarthritis, emphasizing the role of diet in disease progression. A well-balanced diet is crucial for managing osteoarthritis, and patients should focus on maintaining proper nutrition by ensuring sufficient intake of essential micronutrients while limiting foods that may worsen their condition, such as fried foods and sugar-sweetened beverages.

Implementing nutrition education programs through awareness campaigns, informational pamphlets, audiovisual materials, and visual food guides can play a vital role in reducing the incidence of osteoarthritis. Providing patients with evidence-based dietary guidance can help alleviate pain, improve disease management, and ultimately enhance their overall quality of life.

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Conflict of interest

No conflict of interest was declared by the authors.

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