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Impact of Food Intake on Bone Mineral Density and Uric Acid Level of Patients Suffering from Arthritis

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Abstract- Arthritis is a chronic disease that can affect people at any stage of life. Osteoarthritis (OA) is known as degenerative joint disease. It is the most common form of arthritis. Women usually develop osteoarthritis after age 40. To study the impact of food intake on Bone mineral density and uric acid level of patients suffering from arthritis 60 female patients suffering from osteoarthritis in the age group of 40-60 years were selected from two hospitals of Ludhiana city. The subjects were divided into two groups *viz*. experimental (E) and control (C) group. General information, family history and dietary pattern of the subjects was recorded by interview schedule. In group E, nutrition counseling was imparted for a period of three months at 15 days interval by individual and group contacts. After nutrition counseling significant improvement was seen in food habits and dietary pattern of the subjects in group E. The mean daily intake of cereals (66.70 to 75%), other vegetables (31.33 to 47.66%), fruits (53.33 to 118.88%) and milk and milk product (90 to 161.3%) was significantly increased and mean daily intake of pulses (74.16 to 69.88%), green leafy vegetable (25.28 to 20.38%) and roots and tubers (55 to 23%) was significantly decreased in the subjects of group E. It was found that improvement in bone mineral density and significant improvement in uric acid level in the subjects of group E. The percentage of subject having T-score between -1.0 and -2.5 decreased from 70 to 53.3 percent and subjects having T-scores more than -1.0 increased from 20 to 36.7 percent where as subjects having T-score less than -2.5 did not show any improvement in group E. Significant decrease in the percentage (63 to 36.7%) decreased of subjects having more than 6 mg/dl uric acid level was observed in group E after nutrition counseling. Therefore, it can be reported from the results that nutrition counseling significantly improved the food intake, bone mineral density and uric acid level of the patients suffering from osteoarthritis.

Index Terms- Bone mineral density, food intake, nutritional counseling, Osteoarthritis, uric acid

I. INTRODUCTION

Arthritis is a term that includes a group of disorders that affect the joints and muscles. Its symptoms include joint pain, inflammation and limited movement of joints. When a joint is inflamed it may be swollen, tender, warm to the touch or red. Surrounding each joint is a protective capsule holding a lubricating fluid to aid in motion. Cartilage, a slippery smooth substance, covers most joints to assure an even fluid motion of the joint. With arthritis, the cartilage may be damaged, narrowed and lost by a degenerative process or by inflammation making movement painful (Mahan and Stump 2000).

Osteoarthritis (OA) is more common in older people, younger people can develop it - usually as the result of a joint injury, a joint malformation, or a genetic defect in joint cartilage. Both men and women are equally prone before the age of 45, more men than women has osteoarthritis; after the age of 45, it is more common in women. Osteoarthritis is a truly universal disorder. Everyone will get it somewhere if they live long enough. Though others may show minor changes; a common variant is the generalized osteoarthritis of postmenopausal women affecting the terminal joints of the fingers as well as the knees.

In late life, i.e. after the menopause in women and a decade or so later in men, imbalances in the remodeling of the skeleton results in more rapid bone losses, so that reduction in bone mineral content (BMC) and bone mineral density (BMD) occur. The first 5-10 years following the menopause, e.g., from 50-60 years of age, women undergo a high rate of bone loss, i.e., approximately 2% per year. The loss of estrogens is so powerful that adding extra quantities of nutrients, such as calcium and vitamin D supplements, to the diet has little effect on the retention of calcium, as indicated by measurements of bone mass or density (Zacas and Wolinsky 2003).

Keeping in view importance of nutrition counseling in the management of arthritis the present study was designed to study the impact of nutrition counseling on Bone Mineral Density and Uric acid level of patients suffering from arthritis.

II. MATERIALS AND METHODS

A. Selection of the subjects

A statistically adequate sample of 60 females suffering from arthritis in the age group of 40-60 years were selected and divided into two groups viz. Experimental (E) and Control (C). Nutrition counseling was imparted to group E, while group C was not be given any nutrition counseling.

B. Collection of data

Data pertaining general information, anthropometric parameters, and dietary survey was carried out to collect the information regarding dietary pattern and dietary intake for 3 consecutive days by using "24 hour recall cum weighment method.

C. Dietary survey

Information pertaining to food preferences, food avoidances was recorded. Dietary intake of subjects was recorded for three consecutive days by using "24 hour recall method" using standardized containers before and after nutrition counseling. The average daily nutrient intake was calculated using Michigan State University (MSU) Nutriguide Computer Programme (Song et al (1992). The average raw amounts in grams of each and every item of food consumed for three consecutive days for each subjects was fed in the software and nutritive value of the diets was recorded. The food intake was compared with RDA by ICMR (2003) and percent adequacy of the various foods was calculated before and after nutrition counseling.

D. Bone mineral density (BMD)

BMD is determined by using DEXA. Principle: Dual-energy X-ray absorptiometry (DEXA) is a method developed originally for the measurement of bone density and mass. The method is based on the attenuation characteristics of tissues exposed to X-rays at two peak energies. A typically whole body scan takes approximately 30 minutes and exposes the subject to~ 1 mrem radiation. The method provides the first accurate and practical means of measuring bone mineral mass and offers a new opportunity to study appendicular muscle mass.

E. Uric acid level

Reagents: 0.66N H_2SO_4, 10% sodium tungstate, Uric acid reagent, 14% Na_2CO_3, Stock standard solution, working standard. The uric acid level was determined by using method of Folin (1934).

Procedure: To 1ml of urine add 8ml distilled water and add 0.5ml of 0.66N H_2SO_4, and 0.5ml of 10% sod. tungstate to deproteinise it.

Allow to stand for flocculation of proteins, centrifuge and take 4ml of supernatant in a test tube for uric acid determination. Add 1ml of sodium carbonate and 1ml uric acid reagent and mix well. Read the colour after 15min at 680nm.

Prepare standard curve using 4-20 ug uric acid and calculate the concentration of the unknown using standard curve.

F. Nutrition counseling

Nutrition counseling was imparted to the selected subjects for the period of 3 months at 15 days interval regarding arthritis, its types and dietary management. In dietary management knowledge regarding foods to be taken and avoided for the management of arthritis. Counseling was carried out through lectures and demonstrations. A booklet containing all the information regarding arthritis and its dietary management and a sample menu of 7 days were distributed to the subjects.

G. Statistical analysis

The data on food and nutrient intake, anthropometric measurements, bone mineral density and uric acid level was analyzed statistically The mean, standard-error, percentages, paired t-test and their statistical significance was ascertained using a computer programme package (Cheema and Sidhu 2007).

III. RESULTS AND DISCUSSION

The study was conducted on 60 females aged between 40-60 years suffering from osteoarthritis were selected randomly and divided equally into two groups viz. experimental (E) and control (C). It was observed that 26.7 & 40 percent of the subjects were in the age group of 40-50 years, while 73.3 & 60 percent of the subjects were in the age group of 50-60 years in group E and C respectively, majority of subjects belonged to Sikh. Percentage of subjects who belonged to joint families was 46.6 and 16.7 percent in group E and C respectively. It was observed that majority of the subjects i.e. 43.4 and 53.4 percent had per capita income more than ₹ 3500, 23.3 and 13.3 percent of the subjects had per capita income of ₹1500 - 2500 and 33.3 and 33.3 percent had per capita income of ₹2500-3500 in group E and C respectively (Table 1). It was reported that per capita income of Indians grew by 17.3 per cent to ₹ 54,527 in 2010-11 from ₹ 46,492 in the 2009-10, as per the revised data released by the Government of India. However, the increase in per capita income would be only 6.7 per cent in 2010-11 (Anonymous 2011a). However, the per capita income of Punjab is estimated to ₹ 70072 in 2010-11 showing an increase of 12.74% (Anonymous 2011b).

Food intake of the subjects

The data revealed that the mean daily cereal intake of the subjects was increased from 66.70 to 69 percent in the subjects of group E could be due to effect of nutrition counseling about the ill effects consumptions of refined cereals. Most commonly consumed pulses were green gram, Bengal gram, lentil and black gram dal. The mean daily consumption of pulses was 74.16 & 75.83 and 69.88 & 75 percent before and after nutrition counseling in group E & C respectively. The most common green leafy vegetables consumed by the subjects were mustard, fenugreek, spinach, asparagus and coriander leaves as they increase uric acid level. The percent adequacy of intake of green leafy vegetables in group E and C was only 25.8 & 24.45 and 20.38 & 22.03 percent before and after nutrition counseling. The data depicted that there was non significant decrease in the intake of green leafy vegetables by the subjects in group E and C after nutrition counseling was observed. Krishnaswami et al (1997) reported inadequate intake of grren leafy vegetable among adult women. Sodhi (2000) and Goyal (2003) also reported lesser intake of green leafy and other vegetables by Punjabi women. The consumption of roots and tubers was 55.16 and 23.40 percent before and after nutrition counseling in group E; it could be due to decreased consumption of potato, carrot, radish and other tubers because higher intake of potatoes decreased bone mineralization, whereas no change was found in group C. Onions were taken as salad and vegetables. The percent adequacy of intake of other vegetables in group E and C was 31.33 & 30.77 and 47.66 & 29.60 percent before and after nutrition counseling in both the groups respectively. During nutrition counseling sessions the subjects were advised to increased the intake of other vegetables like pumpkin, turnip, and beans etc which are high in fiber and provide more satiety. Agrahar and Pal (2004) also reported inadequate consumption of other vegetables among the subjects. The fruits commonly consumed by the subjects were apple, banana, orange, papaya, and tomato etc. The daily intake of fruits by the subjects was 53.33 & 54.94 and 118.88 &

57.83 percent before and after nutrition counseling in group E & C respectively. Madhura (2009) also recommended fresh fruits and vegetables for pain relief of patients suffering from arthritis. The consumption of milk & milk products by the subjects was in the form of curd, tea and cheese. The mean daily intake of milk & milk products was 90 & 93 per cent and 161.3 & 93.6 per cent by the subjects in group E & C before and after nutrition counseling respectively. Zacas and Wolinsky (2003) suggested that calcium, vitamin D and other bone related nutrients need to be consumed in sufficient amounts, as recommended. An important role for additional calcium, as a supplement, is that the serum calcium has an inhibitory effect on the secretion of parathyroid hormone by the parathyroid gland. Fats & oils were consumed by the subjects in the form of vanaspati, refined oil, butter & butter oil. It was observed that the percent adequacy of fats & oils was 88.5 & 90 and 60 & 95 percent before and after nutrition counseling by the subjects in group E & C respectively. The intake of fats and oils in group E was significantly decreased after nutrition counseling as the subjects were taught to reduce fat intake because high fat diet have been linked to arthritis.

Table 1: General information of the subjects

Parameters	Group E (n=30)	Group C (n=30)
Age		
40-50	8 (26.7)	12(40)
50-60	22 (73.3)	18 (60)
Mean ±S.E	53.37±6.38	50.90±7.40
Religion		
Hindu	13 (43)	15 (50)
Sikh	17 (57)	15 (50)
Family type		
Nuclear	16 (53.4)	25 (83.3)
Joint	14 (46.6)	5 (16.7)
Family size		
2-4	12 (40)	17 (56.6)
4-8	14 (46.7)	11 (36.7)
>8	4 (13.3)	2 (6.7)
Family income		
Per month (₹)	6(20.0)	6 (20)
<10,000	8(26.7)	8(26.7)
10,000-20,000	12(40.0)	9(30)
20,000-30,000	6(20.0)	7 (23.3)
>30,000		
Mean ±S.E	18033±10502.82	14250±6268.07
Per capita income		
Per month (₹)	7(23.3)	4 (13.3)
1500-2500	10(33.3)	10 (33.3)
2500-3500	13(43.4)	16 (53.4)
>3500		
Mean ±S.E	3869±2307.49	2710±1027.12

Figures in parenthesis indicate percentages
n = number of subjects in each group

Table 2: Mean daily food intake of the subjects before and after nutrition counseling (Mean ±SE)

Food group	Group E (n=30)			Group C (n=30)			Suggested intake (g) #
	Before	After	Paired t- value	Before	After	Paired t-value	
Cereals (g)	200.83±10.67	225±10.67	2.89*	207.66±12.78	205.30±12.43	-	300
Pulses (g)	44.50±7.77	41.93±6.77	1.71**	45.50±10.31	45.00±10.19	0.67^{NS}	60
GLV 's (g)	25.28±8.13	20.38±7.35	1.69 ^{NS}	24.45±7.62	22.03±9.83	1.30 ^{NS}	100
Roots and tubers (g)	55.16±3.59	23.40±12.28	4.66*	54.83±5.71	54.94±6.57	-	100
Other vegetables (g)	31.33±10.33	47.66±6.12	2.21**	30.77±10.97	29.60±7.65	0.11 ^{NS}	100
Fruits (g)	53.33±13.43	118.88±12.44	5.45*	54.94±17.21	57.83±16.86	0.72 ^{NS}	100
Milk and milk products (ml)	270.57±24.36	484.69±27.44	5.62*	279.38±25.69	281.72±20.38	0.31 ^{NS}	300
Fats and oils (g)	17.72±3.75	12.02±2.01	6.56*	18.00±4.86	19.08±5.27	0.45 ^{NS}	20
Sugar and jaggery (g)	23.66±3.69	12.37±2.01	7.26*	22.55±3.90	22.83±3.86	-	20

#: ICMR (2003) *: Significant at 1%

NS: Non significant **: Significant at 5%

Smith (2008) reported that high cholesterol and high fat diets have been shown to increase the chances of developing arthritis and for patients suffering from arthritis, they can have a devasting effect on their level of pain and suffering. The sugar was mainly consumed in the form of biscuits, sweets and by addition in milk, tea, coffee etc. Statistically significant decrease in the consumption of sugar & jaggery was observed in the group E whereas a non significant decrease was reported in the group C. Skupeika (2007) reported that people who have arthritis, it is better to avoided sugar, as sugar does not absorb nutrients and calcium.

In the frequency of food consumption pattern of the subjects, it was seen that majority of the subjects in group E and C consumed cereals i.e. 70 and 63.3 percent at least thrice a day, 30 and 36.7 percent at least twice a day. After nutrition counseling the consumption of cereals increased significantly ($P \leq 0.01$) by the subjects in group E. The percentage of subjects consuming of pulses/legumes twice a day was 20 and 26.6 percent, once a day was 80 and 86.6 percent respectively before nutrition counseling in group E and C respectively. After nutrition counseling the corresponding figures were 6.7 percent twice a day and 93.3 percent once a day in group E. Similarly it was seen that there was a significant decreased in the consumption frequency of green leafy vegetables and roots & tubers by the subjects of group E. After nutrition counseling the consumption frequency of fruits and milk & milk products were significantly increased by the subjects in group E i.e. 93.3 and 100 percent.

Bone mineral density

The results of the present study revealed that 10 & 3.3 and 10 & 10 percent of the subjects were having T-score less than-2.5, 70 & 80 and 53.3 & 70 percent of the subjects were having T-score in the range of -1.0 to -2.5 whereas 20 & 16.7 and 36.7 & 20 percent of the subjects fall in the range of more than -1.0 before and after nutrition counseling in group E and C respectively. There was non-significant reduction was observed in group E after nutrition counseling. Zhang et al (2000) reported relations of bone mineral density and change in BMD to risk of incident and progressive radiographic knee osteoarthritis.

Uric acid level

Uric acid levels of the subjects were recorded before and after nutrition counseling. Table 4.2 depicted that 6.7 & 10and 3.3 & 6.7 percent of the subjects having uric acid level less than 1.5 mg/dl, 13.3 & 10 and 26.6 & 16.70 percent of the subjects having uric acid level 1-3 mg/dl, 16.70 & 10 per cent and 33.3 & 13.3 percent of the subjects having uric acid level 3-6 mg/dl whereas 63.3 & 70 and 36.7 & 63.3 percent of the subjects were having uric acid level more than 6.0 before and after nutrition counseling in group E and C respectively . A significant ($P \leq 0.05$)

reduction in the uric acid level of the subjects was found after nutrition counseling in group E while non-significant reduction in group C respectively.

Table 3: BMD of the subjects before and after nutrition counseling

BMD(T-score)	Group E (n=30)			Group C (n=30)		
	Before	After	Paired t-value	Before	After	Paired t-value
< -2.5	3(10)	3(10)		1(3.3)	3(10)	
-1.0 - -2.5	21(70)	16(53.3)	1.55^{NS}	24(80)	21(70)	0.38^{NS}
> -1.0	6(20)	11(36.7)		5(16.7)	6(20)	

Figures in parenthesis indicate percentages *: Significant at 1% **: Significant at 5% ^{NS}: Non significant

Table 4: Uric acid level of the subjects before and after nutrition counseling

Uric acid (mg/dl)	Group E (n=30)			Group C (n=30)		
	Before	After	Paired t-test	Before	After	Paired t-test
<1.5	2(6.7)	1(3.3)		3(10)	2(6.7)	
1-3	4(13.3)	8(26.6)	1.72**	3(10)	5(16.70)	1.05^{NS}
3-6	5(16.70)	10(33.3)		3(10)	4(13.3)	
>6.0	19(63.3)	11(36.7)		21(70)	19(63.3)	

Figures in parenthesis indicate percentages *: Significant at 1% **: Significant at 5%
NS: Non significant

IV. CONCLUSION

The investigations of present study revealed that average intake of cereals of the subjects was less before nutritional counseling and it was increased after nutritional counseling whereas in case of pulses and green leafy vegetables it got decreased after nutritional counseling, but still it was less than RDA'S and intake of fruits and milk & milk products by the subjects was increased. It showed a positive effect on the Bone Mineral Density level of the subjects. There was a significant decrease in the uric acid level of the subjects after nutrition counseling.

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