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Exploring the effect of yoga and diet counseling on dietary intake of college-going females

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Abstract
Yoga and diet counseling have long been considered to have beneficial effects on health. The objective of the present study was to examine the short term impact of a brief lifestyle intervention based on the cumulative beneficial effects of yoga and diet counseling on dietary and nutritional parameters, which are important components of health, in 60 young college-going females enrolled at one of the constituent colleges of the University of Delhi. The dietary variables were measured at baseline and at end of the 3-month intervention using a pre-post intervention design. The intake of cereals and millets, pulses, roots and tubers, green leafy vegetables, visible fats and oils, and sugar was significantly lower among the post-intervention group as compared to the pre-intervention group. The intake of vitamin C was above the recommended dietary allowances in the pre-intervention group but got significantly reduced in the post-intervention group. The intake of dietary folate significantly increased in the post-intervention group as compared to the pre-intervention group. Overall, consumption of both food and nutrient intake was not sufficient among the subjects in comparison with the recommendations after the 3-month intervention period. The observations suggest that a short term lifestyle modification based on yoga and diet counseling has a few important beneficial effects on dietary and nutritional parameters in college-going females, however, a longer duration intervention may yield a better overall improved dietary intake.

Keywords: Yoga, diet counseling, RDA, Surya-namaskar, Asanas

1. Introduction
Yoga, a comprehensive system of practices for health and well-being includes physical postures, conscious breathing and meditation [1]. At the time this study was conceived, data from several observational and experimental studies suggested that yoga, either alone, or as part of a more comprehensive lifestyle program including dietary counseling, may promote significant changes in eating behaviors, like a reduction in dietary fat intake and increments in that of fresh vegetables, whole grains and soy-based products, which in turn may reduce the risk for various diseases. Cross-sectional studies show that yoga practitioners have better dietary patterns than their sedentary counterparts [2]. Palasuwan *et al*. [3] when evaluating dietary intake and cardiovascular risk factors in pre and postmenopausal Thai women who practice Yoga versus Tai Chi practitioners or sedentary women, found that yoga practitioners have lower intakes of fats and body mass index (BMI). Ross *et al* [4]. Postulate that the frequency of yoga practice at home favorably predicted (P<0.001) mindfulness, subjective well-being, healthy BMI, fruit and vegetable consumption, vegetarian status and vigor. Moreover, specific components of yoga practice (e.g., physical poses, breath work, meditation, and study of yoga philosophy) improve health behaviors or lifestyle-related health conditions. Persons with chronic obesity have shown that 12 weeks of Hatha Yoga practice reduces compulsive eating (binge eating), lengthens meal times and improves food quality [5].
Whereas diet counseling/ nutritional knowledge is positively associated with education, household income, vitamin/mineral supplementation and regular physical activity but inversely related to total cholesterol [6]. Previous researchers showed that subjects who participated in regular exercise had higher nutritional knowledge scores [7-9] and those who took supplements were more highly educated, similar to findings by other investigators [10-11]. Nutritional knowledge demonstrated a significant inverse association to total cholesterol and a positive relationship to supplementary calcium intake; suggesting that nutritional knowledge had a direct impact on health and health maintenance. In certain high risk populations,

acquired nutritional knowledge encouraged a positive attitude and practice with concomitant reduction in risk of developing chronic conditions [12-14].

However, there are still important questions about the relationship between dietary intake and lifestyle modifications such as yoga and diet counseling, particularly on how a practice of yoga modifies dietary intake and specific aspects of the diet e.g., antioxidant intake. This study hoped to provide an insight into the cumulative effect of diet counseling and yoga on dietary parameters of young college going females.

2. Materials and Methods

This study examined the cumulative effect of Yoga and diet counseling on various dietary parameters.

2.1 Sample

All undergraduate students enrolled at one of the constituent colleges of the University of Delhi were informed about the study and invited to participate in it. Written consent was obtained from the students who agreed to participate in the study. Students suffering from major illnesses were excluded from the study sample. Total students initially recruited in the study were 100 and the final sample that completed full intervention were 60 in number.

2.2 Intervention

An intervention package comprising sessions on yoga and diet counseling was planned for young college-going females. The type of Yoga practiced in the present study was *Surya-namaskar*/Sun salutation which was easy to perform and suitable for all ages and levels of fitness. It consists of a set of 12 powerful yoga asanas (postures). Intervention group (60 students) in the present study was divided into two smaller groups, each consisting of 25-30 participants. Each group met six days a week for 60 minutes at the Yoga centre to practice yoga with a yoga instructor. Six diet and nutrition counseling sessions were designed for the participants focusing on different dietary guidelines for Indians and other important diet and nutrition-related issues such as overweight/ obesity and physical activity, eating disorders, concept of balanced diet, etc. These sessions were conducted once in a fortnight in small groups of 25-30 students each. The duration of each session was 1 hour. Power point presentations, role play and discussions were carried out to make the sessions highly interactive and interesting. At the end of each session, some suitable printed material such as leaflet, folder, bookmark etc. focusing on the day's theme was distributed as a take-home message.

2.3 Dietary intake

This was assessed using a one day 24-hour diet recall method which is a most widely used re-collective technique where the interviewer questions the subjects to recall their exact food and beverages intake during the previous 24 hours at each meal and in between meals. The interviewer records detailed descriptions of all foods and beverages consumed. In order to obtain accurate and reliable data on the quantity of food consumed and for accurate nutrient calculations, information on standardized recipes was used. The ingredients and their approximate amounts used in the various preparations consumed during the period of dietary survey were obtained from the respondents, wherever possible. Those were then translated into raw weight, and the total food group and nutrient intake were calculated for all the subjects with the help of the DietCal software – 2014 version, which used the food composition tables of Indian Council of Medical Research (ICMR, 1989) [15]. The mean intake of different food groups by the subjects was compared with the intake recommendations for adult females for the same food groups given by ICMR (2011) [16]. The mean intakes of energy, protein, carbohydrates, fat, calcium, iron, vitamin A, vitamin C, thiamin, riboflavin, niacin, dietary folate and vitamin B_{12} were calculated for the subjects in the study group and compared with the RDA for the same for adult females doing sedentary activity (ICMR, 2010) [17]. Dietary intake was assessed at baseline and after 3 months of intervention in college going female students.

2.4 Statistical Analysis

The data obtained were subjected to quantitative and qualitative analysis using suitable statistical formulae and tests. The frequency and percentages were calculated for the general profile and dietary practices of the subjects. Mean and standard deviations were calculated for food and nutrient intakes. Pre- and post-intervention changes in dietary parameters were assessed using the 't' test. The software SPSS (Statistical Package for Social Sciences) version 20.0 was used for the analysis of data.

3. Results

The results on general profile, dietary practices and the effect of the 3-month intervention package of yoga training and diet counseling on the dietary parameters (food and nutrient intake) of the subjects has been presented as follows:

3.1 General Profile

The general profile of the subjects has been presented in Table 1. The highest number of subjects were between 19 – 20 years of age and the monthly family income of about 60% subjects ranged between Rs. 25,000/- to 50,000/-. Maximum subjects (63.3%) reported to be spending Rs. 500/- per month on purchasing food items. More than three-fourths of the sample perceived their health status as 'good' and nearly half of the total subjects perceived themselves as having a 'normal' weight status. None of the subjects smoked cigarettes while only one subject reported consumption of alcohol in the present study.

Table 1: General Profile of the Subjects

Parameter	Category	Number	Percentage
Age	17 - 18	17	28.3
	19 - 20	37	61.7
	21 - 22	6	10.0
Monthly Family Income (Rs.)	<25,000	12	20.0
	25,000 - <50,000	24	40.0
	50,000 - <1,00,000	15	25.0
	≥1,00,000	9	15.0
Monthly Pocket Money (Rs.)	<500	15	25.0

	501 - <1000	12	20.0
	1001 - <1500	5	8.3
	≥1500	28	46.7
Pocket money spent on food per month (Rs.)	<500	38	63.3
	501 - <1000	15	25.0
	1001 - <1500	4	6.7
	≥1500	3	5.0
Self-perception about health status	Poor	9	15.0
	Good	46	76.7
	Excellent	5	8.3
Self-perception about weight status	Obese	5	8.3
	Overweight	16	26.7
	Normal	31	51.7
	Underweight	8	13.3
Type of activity performed	Sedentary	10	16.6
	Moderately active	46	76.8
	Very active	4	6.6
Smoked cigarettes	Yes	0	0
	No	60	100.0
Consumed alcohol	Yes	1	1.7
	No	59	98.3

3.2 Dietary Practices

The data on dietary practices of the subjects has been presented in Table 2. Nearly 50% subjects were vegetarians, consumed 3 – 4 meals per day and 'sometimes' maintained regular meal timings. More than 60% subjects also skipped meals but did not observe 'fasts'. Majority of the subjects reported that they did not go on a diet and also consumed fruits. About 75% subjects consumed snacks in between main meals. The frequency of eating out daily or weekly was reported by about 45% subjects.

Table 2: Dietary Practices of the Subjects

Parameter	Category	Number	Percentage
Type of food consumed	Vegetarian	29	48.3
	Non-vegetarian	19	31.7
	Ovo-vegetarian	12	20.0
Number of meals consumed per day	1 - 2	8	13.3
	3 - 4	50	83.3
	5	2	3.4
Maintained regular meal timings	Always	17	28.3
	Sometimes	34	56.7
	Never	9	15.0
Skipped meals	Yes	38	63.3
	No	22	36.7
Kept fasts	Yes	22	36.7
	No	38	63.3
Went on a diet	Yes	5	8.3
	No	55	91.7
Consumed snacks in between main meals	Yes	45	75.0
	No	15	25.0
Frequency of eating out	Daily	9	15.0
	Weekly	18	30.0
	Fortnightly	2	3.3
	Monthly	10	16.7
	Occasionally	12	20.0
	Rarely	9	15.0
Consumed fruits	Yes	58	96.7
	No	2	3.3

3.3 Effect on Food Intake

As depicted in Table 3, the intake of all food groups except visible fats and oils was extremely low among the subjects as compared to the recommended intakes (ICMR, 2011)[16] in both pre- and post-intervention groups. Further, the intake of cereals and millets, pulses, roots and tubers, green leafy vegetables, visible fats and oils, and sugar was significantly lower among the post-intervention group as compared to the pre-intervention group.

Table 3: Mean daily intake of different food groups by subjects in pre- and post-intervention groups

Food Group	Recommended Intake∞ (g/ml)	Pre-intervention Intake Mean±SD (g/ml)	Post-intervention Intake Mean±SD (g/ml)	t-value (pre- and post-intervention)	p-value
Cereals and millets	270	161.7±64.7 (60-330)	107.3±90.6 (0-305)	3.27**	0.002
Pulses	60	28.6±21.0 (0-70)	16.7±21.9 (0-90)	2.96**	0.005
Meat/ fish/ eggs/ poultry	50	4.4±17.9 (0-100)	2.4±11.5 (0-55)	0.62	0.541
Milk and milk products	300	194.9±198.1 (0-860)	260.7±451.1 (0-1520)	-0.935	0.355
Roots and tubers	200	103.6±66.6 (0-320)	55.9±53.5 (0-180)	4.63***	0.00
Green Leafy Vegetables	100	7.1±18.3 (0-80)	1.1±4.4 (0-20)	2.33*	0.024
Other vegetables	200	24.4±30.0 (0-120)	20.7±37.4 (0-150)	0.58	0.564
Fruits	100	65.1±83.5 (0-310)	40.3±62.4 (0-340)	1.90	0.064
Visible fats and oils	20	27.5±15.3 (7.5-69.0)	18.9±15.3 (0-45)	2.76**	0.008
Sugar	20	11.9±9.9 (0-40)	7.4±8.4 (0-35)	2.46*	0.018

Figures in parentheses denote range

∞ Recommended intake as per balanced diet for adult woman involved in sedentary activity (ICMR, 2011)

For non-vegetarians, one portion of pulse (30g) is substituted with one portion of egg/ meat/ chicken/ fish (50g)

*Significant at p≤0.05, **Significant at p≤0.01, ***Significant at p≤0.001 as tested by paired t-test

3.4 Effect on Nutrient Intake

The data on nutrient intake of the subjects has been given in Table 4. The intake of energy and nutrients such as protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and folate was lower than the recommended dietary allowances (RDA) given by ICMR (2010)[17] in both pre-intervention and post-intervention groups. Total fat and carbohydrate intakes among the subjects were appropriate as per the RDAs. The intake of vitamin C was above the RDA in the pre-intervention group but got significantly reduced in the post-intervention group (Figure 1). The intake of dietary folate significantly increased in the post-intervention group as compared to the pre-intervention group (Figure 2).

Table 4: Mean nutrient intake of nutrients by the subjects

Nutrient	Recommended Intake∞	Pre-intervention Intake	Post-intervention Intake	t-value	p-value
Energy (Kcal)	1900	1163±414 (898-2511)	1192±289 (610-1809)	-0.440	0.662
Protein (g)	55	32.6±12.9 (9.6-73.5)	34.0±12.3 (13.5-74.3)	-0.564	0.576
Total Fat (g)	30 en%	39.0±19.3 (10.4-106.7)	44.2±14.6 (15.5-91.3)	-1.681	0.100
Carbohydrates (g)	60 en%	169.9±54.6 (70.6-314.9)	164.1±41.6 (69.9-266.1)	0.618	0.540
Calcium (mg)	600	382.1±266.1 (90.3-1352.2)	474.4±352.3 (75.2-2287.5)	-1.623	0.112
Iron (mg)	21	9.3±3.9 (2.3-20.9)	8.5±2.8 (2.2-16.1)	1.137	0.262
Vitamin A (µg)	600	202.2±151.3 (30-693)	191.7±109.1 (6.2-542.0)	0.173	0.863
Vitamin C (mg)	40	49.1±33.1 (4.9-148.6)	33.5±23.6 (5.1-111.7)	3.232**	0.002
Thiamin (mg)	1.0	0.92±0.34 (0.38-2.13)	0.85±0.29 (0.08-1.56)	1.228	0.226
Riboflavin (mg)	1.1	0.67±0.39 (0.20-2.14)	0.78±0.46 (0.19-2.68)	-1.447	0.155
Niacin (mg)	12	7.77±2.62 (3.29-14.64)	7.17±2.02 (2.03-12.77)	1.273	0.210
Dietary Folate (µg)	200	87.11±35.39 (35.27-299.63)	98.04±45.45 (26.54-225.8)	3.232**	0.002
Vitamin B_{12} (µg)	1.0	0.37±0.37 (0-1.8)	1.46±0.39 (0-2.0)	-1.114	0.273

Figures in parentheses denote range

∞Recommended dietary allowances for sedentary adult woman (ICMR, 2010)

**Significant at p≤0.01as tested by paired t-test

Overall, consumption of both food and nutrient intake was not sufficient among the subjects in comparison with the recommendations after the 3-month intervention period and more persistent long term efforts were required to improve their dietary intake.

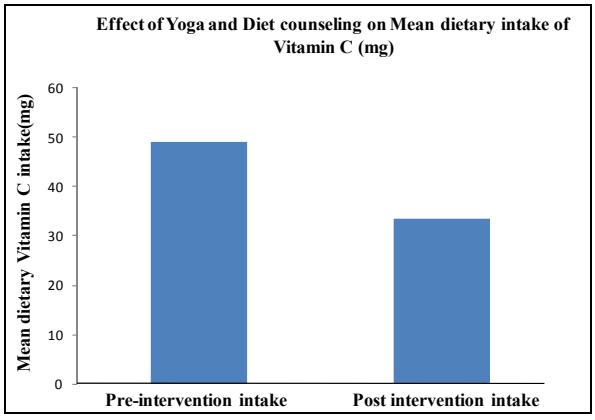

Fig 1: Depicts that mean dietary intake of vitamin C shows statistically significant variation in Pre-exposure versus post yoga exposure groups at 3month

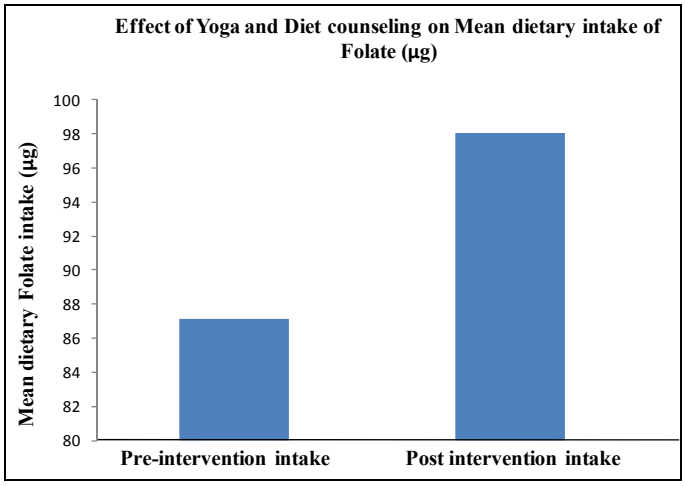

Fig 2: Depicts that mean dietary intake of folate shows statistically significant variation in Pre-exposure versus post yoga exposure groups at 3month

4. Discussion

There is scientific evidence that diet counseling improves nutritional status [18], however there is scant evidence that yoga improves dietary intake. Therefore, the cumulative efficacy of yoga and diet counseling to influence eating behaviors and patterns, or other lifestyle factors, merits further investigation. In our study, the intake of cereals and millets, pulses, roots and tubers, green leafy vegetables, visible fats and oils, and sugar was significantly lower among the post-intervention group as compared to the pre-intervention group. Some of our results are in consonance with studies suggesting that yoga practice is associated with improved nutrient/dietary intake [3, 5, 19]. The intake of vitamin C was above the RDA in the pre-intervention group but got significantly reduced in the post-intervention group. This may be due to seasonal factors. In many developing countries, limitations in the supply of vitamin C are often determined by seasonal factors (i.e., the availability of water, time, and labour for the management of household gardens and the short harvesting season of many fruits). For example, mean monthly ascorbate intakes ranged from 0 to 115 mg/day in one Gambian community in which peak intakes coincided with the seasonal duration of the mango crop and to a lesser extent with orange and grapefruit harvests [20]. This may also be explained as body's oxidative stress and vitamin C requirement is reduced in post yoga intervention group. It is in line with research which suggests that exercise training can be viewed as an effective antioxidant therapy [21]. The evaluation of antioxidant status demonstrated significant increase in serum vitamin C by 9.89% in yoga practitioners [22]. An increased level of serum vitamin C in yoga practitioners may be due to lowering rate of utilization of vitamin C (as yoga is acting as antioxidant) by the body and thereby requiring reduced vitamin intake. This yoga induced achievement in antioxidant capacity may help to cope with deleterious effects of oxidative stress and prevents further damage to tissue. In our study the intake of dietary folate significantly increased in the post-intervention group as compared to the pre-intervention group. This can be explained as yoga intervention may be effective in lowering serum homocysteine levels after an intervention period of 8 weeks [23]. Folate is essential to the metabolic conversion of homocysteine to either cystathionine or methionine [24]. Not surprisingly, epidemiologic evidence from both experimental and observational studies in adult populations showed inverse relations of homocysteine concentrations with nutrient intake and serum concentrations of folate [25-27]. Therefore increase in dietary folate intake in our study may be due to decrease in homocysteine level post yoga intervention. Micronutrient density of vitamin C and folate in diet showed significant change post-intervention, which is in line with the beneficial effects of yoga and dietary counseling on health and wellbeing. Therefore, the present study suggests that the cumulative effect of yoga and diet counseling improves food and nutrient intake, which can raise the health status of college going girls. However, for an overall adequate dietary intake, this intervention package should be imparted for a longer duration and included in the college curriculum.

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