RESEARCH COMMUNICATION

Role of Dietary Intake and Biomarkers in Risk of Breast Cancer: A Case Control Study

Dinavahi V Bala[1], Devendra D Patel[1], Stephen W Duffy[2], Susan Cherman[3], Prabudas S Patel[4], Jignasa Trivedi[1], Patel Pinaki[1], Priti Pandey[1], Ronak Patel[1]

Abstract

Reproductive factors are not considered to play a significant role in the aetiology of breast cancer in low incidence regions like Gujarat, although it is well established that they exert a major influence on such tumours in the western developed world. Women in the western Indian region have a very low prevalence of smoking, alcohol consumption but a high prevalence of vegetarianism. Noting the changes in the life style practices with increasing affluence is likely to yield several interesting findings in such a population. Physical activity and dietary factors have emerged as important parameters and their lack may contribute significantly to the risk of breast cancers. The breast cancer risk significantly increased with higher consumption of total fat (>25% of total calories), frequent intake of fried foods and sweets. A significant protection was offered by frequent consumption of green yellow leafy vegetables, foods rich in β-carotene and isoflavinoids. The present study demonstrated a good protective effect of dietary intake of antioxidant vitamins. The breast cancer risk increases with elevation of circulating lipid components except HDL-Cholesterol.

Key words: Risk factors - Breast cancer - Diet - Serum lipids

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Introduction

The incidence of breast cancer is steadily increasing over the last few years round the globe. An increase of 10% has been noted in Ahmedabad with a 32% rise in the breast cancer referrals at our Institute. The Age Adjusted Rate of breast cancer is 21.2 per 100,000 per year (Annual Report, 1997) Rapid industrialization and urbanization in the State in the last few decades has contributed significantly to changes in the life style of women. The well established risk factors that contribute to breast cancer as reported in women from the western world are: late age at first pregnancy, nulliparity, lack of breast feeding and family history of breast cancer. These risk factors are of less utility for women of Gujarat. Judging by these risk factors only they have a low risk life style, as marriage, child bearing and long breast-feeding are almost universal and occur at a relatively early age during the reproductive life. Strict vegetarianism (similar to veganism, but allowing consumption of some milk products) is widespread in the women of this region. It was, therefore, interesting to investigate the special risk factors related to their life style in order to deduce the aetiology of the increase of breast cancers in this region. The work performed for this report was funded by Gunnar Nilsson Cancer Research Trust Fund, U.K.

The objective of the present study, therefore, was to identify and, wherever possible, quantify the important modifiable risk factors attributable to breast cancers. The influence of dietary micronutrients and the plasma levels of the antioxidant vitamins and lipid components are also evaluated.

Materials and Methods

Patients

A total of 250 newly diagnosed and histologically confirmed breast cancer patients were included in the study.

Controls

Age (frequency matched to 5 year age group) and place of residence (urban or rural) matched healthy women from the community were selected as controls. Since there are considerable differences in the life styles between the urban and rural women, this factor was considered as an

[1]Department of Community Oncology , The Gujarat Cancer & Research Institute GCRI, Ahmedabad 380 016, India, Tel +91-79-2881451, fax +91-79-2125490, Email gcri@ad1.vsnl.net.in [2]Dept. of Mathematics, Statistics and Epidemiology, Imperial Cancer Research Fund (ICRF), P.O. Box 123, Lincoln's Inn Fields, London, WC2A 3PX (U.K). [3]MRC - BSU, Institute of Public Health, Cambridge CB2 2SR (U.K), [4]Biochemistry Research Division, GCRI.

Table 1. Comparative Risk of Breast Cancer and Various Socio-demographic Factors

	Criteria	Number of Cases/Controls	OR	95 % C.I.	χ^2	p value
Area of residence	Rural	117/131	1.00	-	1.57	0.21
	Urban	133/119	1.25	(0.87,1.81)		NS
Marital Status	Never	8/1	1.00	-	4.07	0.04*
	Ever	242/249	0.12	(0.01,0.96)		
Education	Lower	185/118	1.00	-	37.60	0.0001**
	Higher	65/132	0.31	(0.21,0.47)		
Occupation	House-Hold	130/143	1.00	-	1.36	0.2429
	Employed	120/107	1.23	(0.85,1.78)		NS
Physical activity[2]	Sedentary	155/100	1.00	-	15.42	0.0001**
	Moderate	56/99	0.36	(0.24,0.56)		
	Strenuous	39/51	0.49	(0.29,0.83)		

Statistically significant with * $p < 0.05$, ** $p < 0.0001$ levels of significance;
NS – Statistically non-significant; OR – Odds Ratio

independent variable. Blood samples were drawn from all the patients and controls.

Questionnaire

All patients and controls were subjected to a validated questionnaire with a detailed dietary history of their usual diet in a day one year prior to the development of the disease for patients or and a similar interval for controls. A list of food items (120 different items) regularly consumed by majority of women (from both controls and patients) was prepared. Frequency of consumption of these foods was also noted and counterchecked with one-day recall method. Exact quantities of food consumed by the subjects is assessed by ISI standard measures of cups and spoons and standardization of the interviewing the subjects was done between the investigators by repeating the questionnaire of the same subject by each interviewer. Nutrient intakes are computed from the 24-hour diet (Gopalan C et al.,1989).

Estimation of plasma levels of nutrients

Estimation of B carotene and antioxidant vitamins viz. Vitamin A, Vitamin C and Vitamin E from the plasma of all the individuals was done by spectrophotometric method (Varley H, Gowenlock) AH. Lipids were estimated by enzymatic kits using the manufacturer's protocol.

Analysis

For each study variable Odds ratio (O.R), 95% Confidence interval (C.I.), χ^2 value for trend and their corresponding p value were computed (Santos Silva E., 1999).

Results

The mean age of breast cancer patients was 46.2±11.3 years while the controls were selected in the same age range (45.2±12.3 years). Socio-demographic factors and physical activity of the patients and controls are shown in Table 1. As compared to rural area, urban area has 25% increased risk of breast cancer. Incidence of disease was significantly lower in women with education below primary level as compared to women with higher educational level. Employed women exhibited a 23% higher risk of breast cancer than the women managing their house hold only. The differences however, were not statistically significant. Married women showed a significantly lower risk of breast cancer as compared to unmarried women (p=0.04). This difference reflects the role of hormonal milieu of the unmarried women. With respect to sedentary physical activity, moderate and strenuous physical activities (Gopalan C et al.,1989) significantly lowered the risk of breast cancers. Thus the increased physical activity seems to be protective.

Table 2. Reproductive and Menstrual Factors of Breast Cancer Cases and Controls

Factors	(Mean ± S.D) Cases	Controls	Z value	p value
Age at Menarche (Years)	14.53 ± 1.37	14.53 ± 1.37	0.32	0.38 *
Age at Menopause (Years)	45.70 ± 4.92	45.57 ± 3.90	0.20	0.42 *
Reproductive Span (Years)	31.04 ± 5.07	31.54 ± 3.95	0.76	0.22 *
Age at 1st Child Birth (Years)	21.33 ± 3.51	21.38 ± 3.26	0.15	0.44 *
Full Term Pregnancies (in numbers)	2.87 ± 1.77	3.07 ± 1.43	0.52	0.30 *
Duration of Lactation (Months)	42.44 ± 29.83	43.13 ± 34.42	0.24	0.41 *

* Not significant. $p > 0.05$

Table 3. Risk of Breast Cancer in Relation to Frequency of Intake of Various Foods

Food Items	Criteria	Number of Cases/Controls	O.R.	95 % C.I.	χ^2	p value
Milk						
a. Whole milk	Never	98/134	1.00	-	11.67	0.0006***
	<= Daily Once	28/28	1.37	(0.73,2.56)		
	> Daily Once	124/88	1.93	(1.30,2.86)		
b. Toned milk	Never	183/128	1.00	-	26.30	0.0001****
	<= Daily Once	18/25	0.50	(0.25,1.01)		
	> Daily Once	49/97	0.35	(0.23,0.54)		
Sweets[33]						
a. High Fats	Never	119/152	1.00	-	8.77	0.0031**
	Any time	131/98	1.71	(1.18,2.47)		
b. Medium Fats	Never	77/106	1.00	-	7.25	0.0071**
	Any time	173/144	1.65	(1.13,2.43)		
c. Low Fats	Never	211/228	1.00	-	5.40	0.0202*
	Any time	39/22	1.92	(1.06,3.46)		
Nuts	Never	73/128	1.00	-	27.59	0.0000****
	>0 to <= W1	93/77	2.12	(1.37,3.29)		
	>W1	84/45	3.27	(2.01,5.34)		
Deep Fried	Never	51/85	1.00	-	11.99	0.0012**
Foods	>0 to <= W1	190/160	1.98	(1.29,3.03)		
	>W1	9/5	3.00	(0.86,10.99)		
Fried Foods	Never	121/161	1.00	-	11.28	0.0008***
	>0 to <= W1	85/60	1.88	(1.23,2.89)		
	>W1	44/29	2.02	(1.16,3.53)		

<= W1: Less than or equal to once a week, > W1: More than once a week
Statistically significant with * p < 0.05, ** p < 0.01, *** p < 0.001, **** p < 0.0001 levels of significance

Data with regard to menstrual and reproductive factors of patients and controls are shown in Table 2. The figures indicate the mean ±standard deviation (SD) values of breast cancer patients and controls for different events in the life cycle of the woman. All these values were no different in breast cancer patients and healthy controls. Thus none of these factors related to reproductive life of women demonstrated any significant role in the etiology of breast cancer in our population. Therefore, it would appear to be imperative to investigate other life style related factors, mainly the diet.

Food Habit

Consumption of eggs and meat containing products of animal o(rigin is regarded as non-vegetarianism in this part of the country. In the present study with respect to strict vegetarianism (taken as a baseline value) egg consumption was associated with an increased risk (OR = 1.14, 95% C.I. = 0.35, 3.70), but it Non vegetarianism significantly increased the risk (OR = 2.29, 95% C.I. = 1.35, 3.89)

Dietary Intake

Frequency of dietary intake of various foods is shown in

Table 4. Risk of Breast Cancer in Relation to Frequency of Intake of Vegetables and Fruits

Food Category	Criteria	Number of Cases/Controls	O.R.	95 % C.I.	χ^2	p value
G.Y.L.V.	<= W1	32/9	1.00	-	14.05	0.0002**
	> W1	218/241	0.25	(0.11,0.57)		
b-Carotene sources	<= W1	60/20	1.00	-	23.81	0.0001***
	> W1	190/230	0.28	(0.15,0.49)		
Citrus fruits	<= W1	165/119	1.00	-	17.25	0.0001***
	> W1	85/131	0.47	(0.32,0.68)		
Isoflavinoid sources	<= W1	33/19	1.00	-	4.21	0.0403*
	> W1	217/231	0.54	(0.29,1.02)		

G.Y.L.V. – Green Yellow Leafy Vegetables
<= W1 : Less than or equal to once a week , > W1 : More than once a week
Statistically significant with * p < 0.05, ** p < 0.01, *** p < 0.001 levels of significance

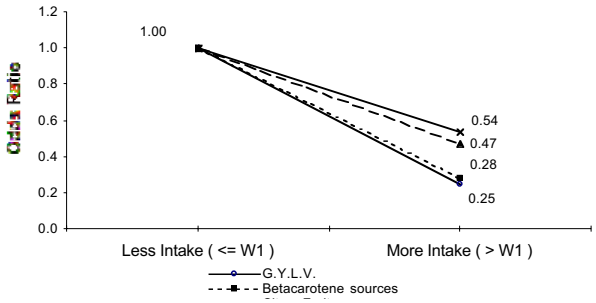

Figure 1. Protective Effect of Intake of Various Foods

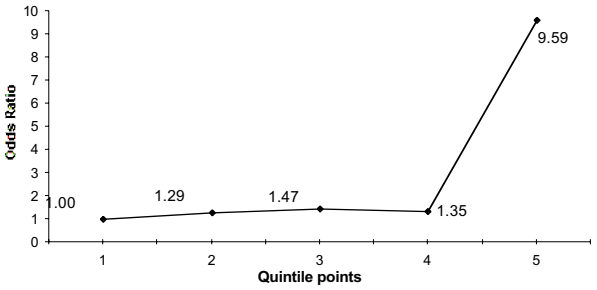

Figure 2. Risk of Breast Cancer and Quintile Distribution of Total Fat Intake

Table 3. With respect to no intake at all, any intake or frequent intake of nuts, fried foods; different types of sweets and full fat milk or whole (containing 6.5% to 7% fat) significantly elevated the risk of breast cancer. In contrast, consumption of dairy toned milk (containing 2.5% to 3% fat) decreases the risk. Table 4 shows the frequency of intake of green yellow leafy vegetables (GYLV), citrus fruits, foods rich in β-carotene and isoflavinoids. Frequent intake of all these food categories (> once a week) are significantly associated with reduced risk and hence may be regarded as protective foods. Figure 1 demonstrates the risk ratios of these foods and their protective effect.

Nutrient Intake

Various nutrients obtained from the food consumed in 24 hours are shown in different quintiles in Table 5(A). Total energy intake in cases was 1590±573.98 and that of controls was 1454±386.91 kilocalories. The first quintile (20th percentile) of respective nutrient intake of controls is considered as baseline value and Odds ratio (O.R) with 95% Confidence Interval (C.I) are computed for all quintiles. Increasing proportion of intake of carbohydrates, carotene and vitamin C (Table 5(B) are independently and inversely associated with breast cancer risk (significant at $p < 0.02$), even though total energy per se has no significant effect on the risk. In contrast, increasing consumption of fat over 25% of total calories significantly increased the risk of breast cancer (O.R.= 18.41, 95% C.I. = 8.22, 42.14). Oil (unsaturated fats) intake of 500 to 750 grams per capita per month also poses a risk (O.R.= 1.89, 95% C.I. = 1.24, 2.87). Intake of oil over 750 grams per month further increases the risk (O.R.= 5.14, 95% C.I. = 2.66, 10.06). Similarly, ghee (saturated fats) intake of more than 500 grams per capita per month also is associated with an elevated risk (O.R.= 1.76, 95% C.I. = 0.89, 3.47). Figure 2 shows the risk ratios of proportion of total fat consumption in different quintiles.

Plasma Antioxidant vitamins and Lipids

Plasma levels of β-carotene, Vitamin A, Vitamin C and Vitamin E are shown in Table 5 (B) and Fig. 3. Their increasing values with increasing quintiles have a significantly inverse association with breast cancer and, therefore, they may be regarded as protective. The protective effect of both (-carotene and Vitamin E is highly significant ($p < 0.0001$)

Vitamin C levels in plasma are significantly protective in the highest quintile only. This could be due to its thermolability. Its consumption in smaller amounts may not cause any significant difference. Risk ratios for breast cancer with increasing plasma values of these antioxidant vitamins is shown in Figure 3.

Figure 4 shows an elevated relative risk of breast cancer with higher quintiles (4th and 5th) of lipid components except in HDL-cholesterol. Higher quintiles of triglycerides, Total cholesterol, LDL-cholesterol and VLDL-cholesterol showed a significant increase in the risk of the disease ($p < 0.05$).

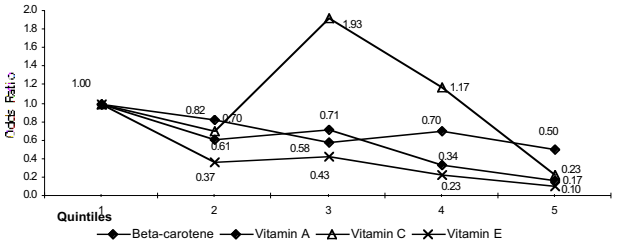

Figure 3. Risk of Breast Cancer and Quintile Distribution of Circulating Levels of Antioxidant Vitamins

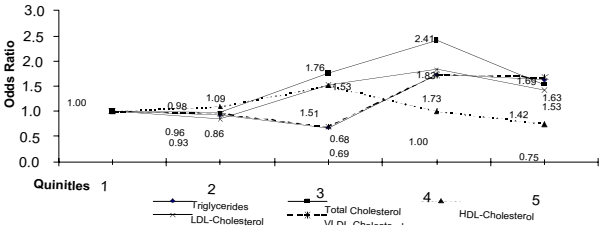

Figure 4. Risk of Breast Cancer and Quintile Distribution of Circulating Levels of Lipid Components

Table 5. Risk of Breast Cancer In Relation to (A) Nutrient Intake (B) Circulating Antioxidant Vitamin Levels (C) Different Lipid Components

Quintiles →	1 Cs/Cnt	2 Cs/Cnt	3 Cs/Cnt	4 Cs/Cnt	5 Cs/Cnt	χ^2	p value
(A)							
Energy(kcal)	54/50	42/50	29/51	39/49	86/50	3.39	0.0657
O.R.	1.00	0.78	0.53	0.74	1.59		NS
95 % C.I.	-	(0.43,1.42)	(0.28,1.00)	(0.40,1.36)	0.92,2.77)		
Carbohydrate intake	137/50	38/51	34/49	29/50	12/50	64.57	<0.0001
O.R.	1.00	0.27	0.25	0.21	0.09		****
95 % C.I.	-	(0.15,0.48)	(0.14,0.45)	(0.12,0.38)	(0.04,0.19)		
Fat (%energy)	17/50	22/50	25/50	23/50	163/50	78.37	<0.0001
O.R.	1.00	1.29	1.47	1.35	9.59		****
95 % C.I.	-	(0.58,2.91)	(0.67,3.26)	(0.61,3.03)	(4.87,19.07)		
Carotene intake (mg)	69/50	59/50	41/50	44/50	37/50	6.14	0.0132
O.R.	1.00	0.89	0.59	0.64	0.54		*
95 % C.I.	-	(0.49,1.49)	(0.33,1.07)	(0.36,1.14)	(0.29,0.97)		
Vitamin C intake (mg)	62/50	65/52	54/48	43/50	26/50	8.95	0.0028
O.R.	1.00	1.01	0.91	0.69	0.42		**
95 % C.I.	-	(0.58,1.76)	(0.51,1.61)	(0.38,1.25)	(0.22,0.80)		
(B)							
β-carotene (mg/Lt)	90/54	47/46	59/50	28/50	14/50	31.17	0.0000
O.R.	1.00	0.61	0.71	0.34	0.17		****
95 % C.I.	-	(0.35,1.08)	(0.41,1.21)	(0.18,0.62)	(0.08,0.35)		
Vitamin A (mg/Lt)	66/51	57/50	37/49	47/52	31/48	5.72	0.0168
O.R.	1.00	0.82	0.58	0.70	0.50		*
95 % C.I.	-	(0.46,1.44)	(0.32,1.06)	(0.39,1.24)	(0.27,0.93)		
Vitamin C (mg/Lt)	48/50	33/49	89/48	55/49	11/49	3.20	0.0738
O.R.	1.00	0.70	1.93	1.17	0.23		NS
95 % C.I.	-	(0.37,1.32)	(1.10,3.40)	(0.65,2.11)	(0.10,0.53)		
Vitamin E (mg/Lt)	107/44	41/45	47/45	25/45	11/44	47.11	0.0000
O.R.	1.00	0.37	0.43	0.23	0.10		****
95 % C.I.	-	(0.21,0.67)	(0.24,0.76)	(0.12,0.43)	(0.05,0.23)		
(C)							
Triglycerides (mg/Lt)	40/49	37/49	27/49	69/49	65/49	6.89	0.0087
O.R.	1.00	0.93	0.68	1.73	1.63		**
95 % C.I.	-	(0.45,1.76)	(0.34,1.33)	(0.95,3.13)	(0.89,2.95)		
Total Cholesterol (mg/Lt)	32/50	30/48	54/48	77/50	47/48	7.02	0.0081
O.R.	1.00	0.98	1.76	2.41	1.53		**
95 % C.I.	-	(0.49,1.94)	(0.93,3.31)	(1.31,4.43)	(0.80,2.91)		
HDL Cholesterol (mg/Lt)	44/49	49/50	65/48	44/49	33/49	0.79	0.3734
O.R.	1.00	1.09	1.51	1.00	0.75		NS
95 % C.I.	-	(0.60,2.00)	(0.84,2.72)	(0.52,1.85)	(0.39,1.43)		
LDL Cholesterol (mg/Lt)	36/49	31/49	55/49	66/49	51/49	4.67	0.0308
O.R.	1.00	0.86	1.53	1.83	1.42		*
95 % C.I.	-	(0.44,1.68)	(0.82,2.84)	(1.00,3.37)	(0.76,2.65)		
VLDL Cholesterol (mg/Lt)	40/50	37/48	27/49	69/50	65/48	7.22	0.0072
O.R.	1.00	0.96	0.69	1.73	1.69		**
95 % C.I.	-	(0.51,1.83)	(0.35,1.35)	(0.96,3.12)	(0.93,3.08)		

OR – Odds Ratio; CI – Confidence Interval; Cs/Cnt: Cases/Controls; NS – Not significant ;Statistically significant with * $p < 0.05$, ** $p < 0.01$, **** $p < 0.0001$ levels of significance

(# Quintiles are four in number and they divide the whole distribution into five equal parts. The first quintile is 20th percentile and has 20% of observations falling to it's left and 80% to it's right.)

However, HDL-cholesterol poses an increased risk in lower quintiles but has a protective effect with higher values and highest quintile (5th). Its overall effect, however, remains insignificant.

Discussion

A significant reduction in risk of breast cancer with moderate and strenuous physical activity is observed in this

study. Carpenter CL et al.(1999) also observed that strenuous exercise reduces the risk in postmenopausal women.

Even though women, who have born children had a lower risk of the disease, total number of children was not significant in this study. McCredic et al.(1998) have reported the lowest risk of breast cancer in women with at least 4 children. Hu et al.(1997) have shown that the risk of breast cancer decreases with increasing number of pregnancies with 3 births or more. Chen and others have demonstrated that the women having more than 3 full term pregnancies had a decreased risk of breast cancer.

Duration of lactation has not emerged as a significant protective factor in this study. As lactation is universal in this community, total duration of lactation has not emerged as a significant protective factor in this study (Furberg et al.(1999) reported that breastfeeding regardless of any duration is associated with a slight reduction in the breast cancer risk. This protective effect was especially seen in postmenopausal women (Enger SM et al., 1998).

Consumption of meat etc. was associated with significant risk in this study. Toniolo et al.(1994) observed an increased risk with higher consumption of meat but no apparent association with fish Jarvinen et al.(1997) showed that a higher consumption of fried meat was associated with increased risk of breast cancer. The meta-analysis of 19 studies showed higher risk of meat consumption for breast cancer (Boyd NF et al., 1993).

Frequent consumption of whole milk (6.5% to 7% fat) was associated with increased risk as compared to toned milk (2.5 to 3% fat) in this study. Toniolo et al.(1994) demonstrated that the breast cancer risk increased with consumption of three or more liters of low fat milk per week R.R = 1.36 (1.03,2.33). Increased consumption of dairy products like whole milk and cheese are also known factors to increase the risk of breast cancer (Toniolo P et al., 1994).

This study showed that the increased risk of breast cancer is solely dependent on total fat intake of the diet. Fat intake of > 20% of total calories is directly associated with increased risk, but it attains significance only when fat is increased to 25% of calories or more. Consumption of either saturated or unsaturated fats over 500 grams per capita per month was associated with an elevated risk. In a meta-analysis of studies of dietary fat and breast cancer risk, (Boyd NF et al., 1993), reported the summary relative risk for all 24 estimates which was weekly positive (Relative Risk = 1.21, 95% C.I. = 1.04 - 1.21) for total fat. Three studies showed significant increased risk with saturated fat intake (Toniolo et al. (1994) (RR = 1.9,P < 0.001); Richardson et al.(1991), (OR = 1.9, 95% C.I. = 1.3 - 2.6); Ronco et al.(1999),1996, (OR = 3.38, 95% C.I. = 1.30 - 4.33).

Our study results highlight a highly statistically significant protection against breast cancer with frequent intake of green yellow leafy vegetables (Odds Ratio = 0.25, 95% C.I. = 0.10 - 0.58) and p = 0.0002. The study also showed an inverse association between frequent intake of β-carotene rich foods and the breast cancer risk, but it was significant only in rural area. (p < 0.0001). Higher intake of β-carotene foods daily or more than once a week showed higher protection against breast cancer in women. Significant protection with frequent intake of foods rich in isoflavinoids was observed in rural women with (p < 0.04) but it did not make any difference in urban women. In meta-analysis of 26 studies, Gandini, (2000) reported a relative risk of 0.74 (95% C.I. = 0.6 - 0.84) for the consumption of vegetables greater than one portion per day versus less than three to four portions per week. Similar results are reported for consumption of fruits, a relative risk of 0.91 (95% C.I. = 0.79 - 1.05). They also reported a relative risk of 0.79 (95% C.I.= 0.71 - 0.89) for the high consumption of β-carotene.

The overall odds ratio for citrus foods intake either daily or more than weekly once showed highly significant protection with p < 0.0001. Trichopoulou et al.(1995) observed that increased vegetable and fruit consumptions were independently associated with a significant reduction of breast cancer risk (a reduction of 12% and 8% respectively, per quintile increase in consumption of vegetables and fruits). Of six case control studies reported as yet, three (Landa MC et al.,1994; Freudenheim JL et al.,1996; Ronco A et al.,1999) studies report an inverse association of total fruit intake with breast cancer risk whereas three studies (Rohan TE et al.,1988; Negri E et al.,1996; Potischman N et al.,1999) suggested no protection for breast cancer .

Average intake of carotene and vitamin C (computed from 24 hour diet) was 2082.41μg micrograms and 110.51mg per day, respectively, in controls. They were 1765.33μg and 82.30 mg respectively in patients. Hunter et al.(1993) reported a relative risk of 0.8 (95% C.I. 0.68-0.95) for the highest quintile of retinol intake. He also reported a relative risk of 0.84 (95% C.I. 0.71-0.98) for vitamin A. Both these were statistically significant. A data analysis of 8 case-control studies by Howe et al.(1990) reported an odds ratio of 0.85 (p=0.007) for the highest versus lowest quintile of β-carotene intake. The authors reported an odds ratio of 0.69 (p<0.0001) for the highest quintile of Vitamin C intake in an analysis of 12 case-control studies (Enger SM et al.,1998). A meta-analysis of 16 studies, Gandini et al.(2000) reported the Relative Risk =0.78 (95% C.I.=0.66-0.93) for the high consumption versus low consumption of vitamin C.

Increasing values of β-carotene and vitamin A showed a significant protective effect (p < 0.0001) in our study. Nunez-Martin C et al.(1995) reported significantly lower level of retinol (p< 0.05) in the cancer group. A case-control study Potischman et al.(1999) demonstrated that low plasma β-carotene was associated with an increased risk of breast cancer. Wald et al.(1984) observed an inverse association of β-carotene and risk of breast cancer in a prospective study. The effect, however, was less strong and less consistent.

In our study, vitamin C showed a protective effect, but the effect was significant only in the highest quintile. We have also observed that higher vitamin E levels (with increasing quintiles) were inversely associated with the disease risk and hence significantly protective. One case-control study by Torun et al.(1995) reported significantly lower level of vitamin E in patients than controls (p < 0.05).

Another prospective study by Wald NJ.(1984) showed a clear association of low level of plasma vitamin E with a higher risk of breast cancer (Wald NJ., 1984).

Significantly higher values of triglycerides and total cholesterol were seen in patients as compared to controls in our study. Alexopoulos et al.(1987) reported an association of breast cancer with increased serum triglycerides. Agurs-Collins et al.(1998) observed significantly higher levels of triglycerides in patients compared to controls ($p <= 0.001$) and a significant correlation between high levels of triglycerides and breast cancer risk (O.R. = 5.12). In our study, we observed a higher LDL-cholesterol and a lower HDL-cholesterol in patients as compared to controls. Thus, higher LDL-cholesterol plays an important role as a risk factor for breast cancer while HDL-cholesterol has no significant role. Qi-XY et al.(1994) reported that elevated level of total serum cholesterol and LDL-cholesterol with lower levels of HDL-cholesterol are associated with increased risk of breast cancer. Only one study Alexopoulos et al.(1987) reported an association of breast cancer with increased serum LDL-cholesterol. Another study by Agurs-Collins et al.(1998) reported no significant difference of LDL-cholesterol levels between patients and controls. Borrelli et al.(1993) also observed no difference in the serum concentration of total lipids.

Summary and Conclusions

Reproductive factors do not play a significant role in the aetiology of breast cancer in this community. Higher risk is associated with urban area and non-vegetarianism. Significant increased risk is observed with over 25% of total fat from calories. Fried foods, nuts and whole milk show a significant elevated risk. A lower risk is offered by increased physical activity and strict vegetarianism. A significant protective effect is observed with frequent intake of green leafy vegetables, citrous foods, and foods rich in β-carotene and isoflavinoids. While significantly lower risk of breast cancer is observed with increasing levels of β-carotene, vitamins A, C and E in plasma, a significantly higher risk is seen with all lipid components except HDL-cholesterol.

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