RESULTS AND DISCUSSION

RESULTS AND DISCUSSIONS

The major objective of the present study was to assess the role of antioxidants in health and disease during aging process. Adult and elderly subjects from the free living population of Vadodara city were selected for the present study. Subjects suffering from cardiovascular diseases (CVD) and oral cancer were also enrolled for the study. The other objectives were to collect information on these subjects with respect to socio-demography, diet, nutrition and lifestyle related factors. The antioxidants profile, of all the subjects, was studied in diet as well as in serum/plasma. The study also involved assessment of knowledge and practices (KaP) of the caregivers of the elderly with respect to importance of antioxidants rich foods in the diet of old people.

To achieve the above objectives, specially designed tools and techniques were used as discussed in the previous chapter. The results for each of the sections have been presented used various heads mentioned in the following sections:

I. EVALUATION OF SOCIO-DEMOGRAPHIC PROFILE, NUTRITIONAL STATUS, DIETARY PATTERN, LIFESTYLE FACTORS AND ANTIOXIDANTS PROFILE IN FREELIVING SUBJECTS (AGED 45 YEARS AND ABOVE).

II. ASSESSMENT OF SOCIO- DEMOGRAPHIC PROFILE, NUTRITIONAL STATUS, DIETARY PATTERN, LIFESTYLE FACTORS, DISEASE PROFILE, CLINICAL AND ANTIOXIDANTS PROFILE IN SUBJECTS SUFFERING FROM CARDIO VASCULAR DISEASES (45 YEARS AND ABOVE).

III. COLLECTION OF DATA ON SOCIO- DEMOGRAPHIC PROFILE, NUTRITIONAL STATUS, DIETARY PATTERN, LIFESTYLE FACTORS, DISEASE PROFILE, CLINICAL AND ANTIOXIDANTS PROFILE AND ORAL HYGIENE PRACTICES IN SUBJECTS WITH ORAL CANCER (45 YEARS AND ABOVE).

IV. ASSESSMENT OF KNOWLEDGE AND PRACTICES OF THE CAREGIVERS REGARDING IMPORTANCE OF ANTIOXIDANTS IN THE DIET OF THE ELDERLY.

SECTION I

EVALUATION OF SOCIO-DEMOGRAPHIC PROFILE, NUTRITIONAL STATUS, DIETARY PATTERN, LIFESTYLE FACTORS AND ANTIOXIDANTS PROFILE IN FREELIVING SUBJECTS (AGED 45 YEARS AND ABOVE).

RESULTS

This section reports the findings of the baseline information of the subjects from the free living population of urban Vadodara. Baseline data included socio - demographic profile, nutrition, diet and lifestyle factors like addiction pattern and activity pattern and disease profile. Assessment of antioxidants profile was done in diet as well as from blood.

The results are discussed in accordance with the objectives of the present section under the following heads :

A) SOCIO-DEMOGRAPHIC PROFILE

B) NUTRITIONAL STATUS

C) DIETARY INTAKE

D) ACTIVITY PATTERN

E) ADDICTION PATTERN

F) OTHER FACTORS

G) DISEASE PROFILE

A) SOCIO - DEMOGRAPHIC PROFILE

Pre- tested questionnaire was used to obtain socio - demographic profile of the selected subjects. The subjects aged 45 years and above were selected from the free living population of urban Vadodara (table 1a)

As seen from the table, total 166 men and 70 women were selected from the free living population aged 45 years and for the study. The mean age of men selected in the present study was 62 years. All the men from the free living population were married and majority of them were Hindus (95%). More than three fourth of the men belonged to gujarati ethnic group (82%). The education level of the men revealed that majority of the subjects had school level education (55%) followed by 40% of men who completed their college education. Compared to those

living in nuclear families, almost double the number of men (63%), were residing in joint families. Almost three fourth of the total subjects (72%) were from middle income groups.

Table 1a : Socio demographic information of the subjects (aged 45 years and above) from the free living population.

Characteristics	Men (N=166)	Women (N=70)
Age (years)		
45 - 59	45.18 (75)	34.28 (24)
≥ 60	54.81 (91)	65.71 (46)
Mean ± SD	61.98 ± 9.44	64.70 ± 10.25
Religion (%)		
Hindu	95.78 (159)	95.71 (67)
Muslim	2.41 (4)	2.86 (2)
Jain	1.81 (3)	1.43 (1)
Ethnic group (%)		
Gujarati	81.93 (136)	67.14 (47)
Non – gujarati	18.07 (30)	32.86 (23)
Education level (%)		
Illiterate	5.42 (9)	5.71 (4)
School education	54.82 (91)	57.14 (40)
College education	39.76 (66)	37.14 (26)
Family type (%)		
Nuclear	37.35 (62)	57.14 (40)
Joint	62.65 (104)	42.86 (30)
Economic status (%)		
Middle	72.29 (120)	85.71 (60)
Lower	27.71 (46)	14.29 (10)

(Figures in parenthesis indicate number of subjects)

From the socio demographic profile of the women, as seen from the above table, the mean age of women comes out to be 64 years. All the women were married and with the majority of them being Hindus (97 %). The percentage of women from the gujarati community (67%) was double compared to non gujaratis. The education level of the women from the free living

population was better than that from men. Fifty seven percent of women had school education followed by 37 % of women having college level education. Larger number of women (57 %) resided in nuclear families. Majority of the women (86 %) were from middle income group as compared to 14 % of women who were from low income group.

B) NUTRITIONAL STATUS

Nutritional status of men and women from the free living population was assessed in terms of anthropometric measurements.

I) ANTHROPOMETRIC MEASUREMENTS

Table 2a shows the results of the anthropometric measurements of men and women from the free living population of urban Vadodara.

Table 2a: Mean anthropometric measurements of the subjects (aged 45 years and above) from the free living population.

Parameters	Men (N=166)		Women (N=70)		Total (N=236)
	45-59 years (N=75)	>= 60 years (N=91)	45-59 years (N=24)	≥ 60 years (N=46)	
Height (cm)	160.45 ± 5.59	161.46 ± 4.06	153.54 ± 3.44	152.30 ± 5.58	156.94 ±4.67
Weight (kg)	60.28 ± 7.86	60.95 ± 7.83	62.73 ± 9.91	55.01 ± 12.07	59.74 ± 9.42
BMI (Kg/M^2)*	23.47 ± 3.17	23.43 ± 3.14	24.58 ± 4.74	23.79 ± 3.95	23.79 ± 3.95
< 18.5 (Underweight)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
18.5-24.9 (Normal)	69.33 (52)	68.13 (62)	29.17 (14)	78.69 (27)	65.68 (155)
25.0-29.9 (Overweight)	24.74 (19)	29.67 (27)	58.33 (7)	30.43 (14)	28.39 (67)
> 30 (Obese)	5.33 (4)	2.19 (2)	12.5 (3)	10.87 (5)	5.93 (14)

(Figures in parenthesis indicate number of subjects)

** Source : World Health Organisation. Physical Status : The use and interpretation of anthropometry. Geneva, Switzerland: World Health Organisation 1995. WHO Technical Report Series.*

As can be seen from the above table, the mean BMI of men (45-59 years) was found to be 23 kg/m^2. Body mass index of the subjects was also categorised according to the cutoffs given by the WHO. The results revealed that majority of the younger men (69 %) had a normal BMI between 18.5 - 24.9 kg/m^2 followed by around $1/4^{th}$ of the men falling into the overweight category. Five percent of these men were obese with BMI > 30 kg/m^2 as seen from figure 1(a).

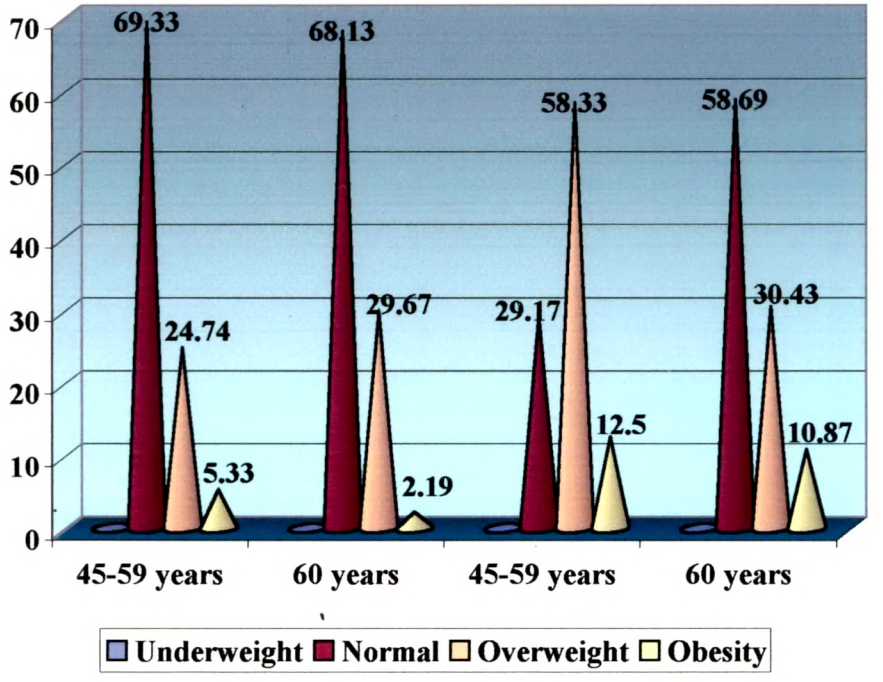
The results of anthropometric measurements of elderly men (60 years and above) revealed that the mean BMI was 23 kg/m^2 . These men, when categorised under various categories of BMI, indicted that more than $2/3^{rd}$ of them had normal BMI as seen from the above table. Twenty nine percent of the men above 60 years were found to be overweight. Obesity was found to be prevalent in 2 % of the elderly men.

In case of women (45-59 years), the mean BMI was found to be 24 kg/m^2 which was slightly higher than men. The data on BMI cutoffs revealed that more than 50 % of the younger women were overweight. Only 29 % of the women (45-59 years) had a normal BMI as seen from the above table. Obesity was found to be present in $1/8^{th}$ of the younger subjects.

The BMI of the elderly women (aged 60 years and above) revealed that more than $2/3^{rd}$ of the elderly women had normal BMI. Thirty percent of these women were found to be falling under the overweight category. Obesity was prevalent in slightly more than $1/10^{th}$ of the elderly women.

Thus the anthropometric measurement data of men and women (aged 45 years and above) revealed that more than 60% of the subjects had a normal BMI. Less than $1/3^{rd}$ subjects were found to be overweight. Obesity was prevalent in only 5% of the subjects.

FIGURE 1a : Percent distribution of weight in men and women (aged 45 years and above) with respect to BMI



C) DIETARY INTAKE

The dietary intake was assessed in terms of changes made in food consumption, dietary pattern, types of oil and fats consumed, mean nutrient intake and food frequency.

I) CHANGES IN FOOD CONSUMPTION PATTERN

Self reported changes made in food habits, over a period of 5 - 10 years by the subjects was studied. Most of the subjects did not report any changes in their dietary pattern. Few changes that were made, attributed mainly to one or the other minor health problems. Reduction in food consumption was mainly reported because of digestion problems occurring with advancing age and due to chewing problems.

II) DIET PATTERN

The habitual dietary pattern in terms of consuming vegetarian, non-vegetarian, or ovo-vegetarian diets was also studied as given in table 3a.

Table 3a: Percentage of subjects (45 years and above) from the free living population habituated to the type of dietary pattern.

Food type	Men (N=166)		Women (N=70)		
	45-59 years (N=75)	≥ 60 years (N=91)	45-59 years (N=24)	≥ 60 years (N=46)	Total (N=236)
Vegeterian	88.00 (66)	92.31 (84)	79.17 (19)	91.30 (42)	89.41 (211)
Non – vegetarian	9.33 (7)	4.39 (4)	8.33 (2)	4.35 (2)	6.35 (15)
Ovolactovegetarian	2.67 (2)	3.30 (3)	12.50 (3)	4.35 (2)	4.24 (10)

(Figures in parenthesis indicate number of subjects)

The above table reveals that more than 80% of the younger men as compared to 92% of the elderly men were vegetarians. Non-vegetarian diets were followed by double the younger men 9% against 4% of their elderly counterparts.

Similar observations were noted for the women between the two age groups. Majority of the women followed vegetarian diets habitually. Higher percentage of the younger women (45-59 years) reported consumed non-vegetarian (8%) and ovalactoveg (2.50%) foods as compared to

the elderly women (4% each).Thus it can be said that majority of the subjects (89%) were vegetarian.

III) TYPES OF OIL AND FAT CONSUMED

Consumption of different types of oil is commonly found in Gujarat. In some cases, 2 or 3 oils are also blended and used in combination. Hence, the oil consumption pattern of the subjects selected for the present study, was studied. Table 4a shows types of oil consumed by these subjects.

Table 4a: Types of oil and fat consumed by the subjects (45 years and above) from the free-living population.

Types of oil / fat	Men (N=166)	Women (N=70)	Total (N=236)
Cottonseed	57.83 (96)	30 (21)	49.57 (117)
Groundnut	36.74 (61)	44.28 (31)	38.98 (92)
Sunflower	2.41 (4)	2.85 (2)	2.54 (6)
Mustard	0.6 (1)	7.14 (5)	2.54 (6)
Combination *	2.41 (4)	22.86 (16)	8.47 (20)
Dalda	34.94 (58)	17.14 (12)	29.66 (70)
Ghee (clarified butter)	76.51 (127)	82.86 (58)	78.38 (185)

(Figures in parenthesis indicate number of subjects)
** combination of oils included groundnut+cottonseed, cottonseed+ mustard, mustard+sesame oil.*

Consumption of cottonseed oil was reported by 58 % of men followed by 37 % of men reporting consumption of groundnut oil as seen from the above table.

In contrast, consumption of groundnut oil was found to be higher than cottonseed oil as it was in case of men. Forty four percent of women reported consumption of groundnut oil followed by 30 % of women consuming cottonseed oil. A combination of 2 or 3 types of oil, mainly cottonseed and groundnut or mustard oil, was reported by 23 % of women. However, oils were not blended but different oils were used for different food preparation which required seasoning, shallow frying, deep frying or as addition topping.

Data on commonly consumed fat like dalda (vanaspati) and clarified butter (ghee) by the subjects from the free living population was also collected. As observed from table 4, majority

of men (65 %) and women (83 %) consumed clarified butter (ghee) for various ghee based preparations as well as for additional fat topping on various foods. Consumption of dalda or vanaspati was found to be 35 % in men and 17 % in women.

As observed from the above table, the consumption pattern of different oils and fats by all the subjects selected for the present phase indicated use of cottonseed oil by half of the subjects. Groundnut oil was second common oil after cottonseed oil consumed by almost 39 % of the subjects. Combination of 2 - 3 oils used for various purposes was also reported by a small percent of subjects (8 %).

Consumption of ghee was highly practised by more than 3/4th of the total population as can be seen from the above table. Less than 1/3rd of the total subjects used vanaspati for fat based food items.

IV) FAT TOPPING

Addition of fat or oil, as a topping, on some food items, is a common practice followed in this part of the country. Hence, data on the consumption of fat topping was also collected (table 5a).

As noted from the following table, though 90 - 97 % of men (45-59 years) did not report using fat topping on either rice, handwa or dhokla, additional fat was used on other frequently prepared food items. Fat topping was found to be highest on khichadi (73 %) followed by roti (58 %). Other infrequently prepared food items such as vedmi or khichu were consumed with additional fat by only 24 % of the younger men.

Data on fat topping by elderly men revealed that majority of the subjects consumed khichadi with additional fat (63 %). More than 50 % of the elderly men were also found to be using fat topping on daily prepared roti. Majority of the elderly men (80 %) did not use fat topping on either rice (13 %), dhokla (15 %) and handwa (15 %). Less than 1/3rd of the men (aged 60 years and above) reportedly consumed other non-frequently prepared food items with additional fat as a topping.

Table 5a: Percentage of subjects (aged 45 years and above) from the free living population consuming additional fat / oil as a topping.

Food Items	Men (N=166)		Women (N=70)		Total (N=236)
	45-59 years (N=75)	≥ 60 years (N=91)	45-59 years (N=24)	≥ 60 years (N=46)	
Rice					
Yes	9.33 (7)	9.89 (9)	4.17 (1)	13.04 (6)	9.75 (23)
No	90.67 (68)	90.10 (82)	95.83 (23)	86.96 (40)	90.25 (213)
Roti					
Yes	58.67 (44)	54.94 (50)	70.83 (17)	71.74 (33)	61.02 (144)
No	41.33 (31)	45.05 (41)	29.17 (7)	28.26 (13)	38.98 (92)
Khichadi					
Yes	73.33 (54)	63.73 (58)	50.00 (12)	52.17 (24)	63.14 (149)
No	26.67 (21)	36.26 (33)	50.00 (12)	47.83 (22)	36.86 (87)
Handwa					
Yes	6.67 (5)	13.18 (12)	33.33 (8)	15.22 (7)	13.56 (32)
No	93.33 (70)	86.81 (79)	66.67 (16)	84.78 (39)	86.44 (204)
Dhokla					
Yes	2.67 (2)	7.69 (7)	16.67 (4)	15.22 (7)	8.47 (20)
No	97.33 (73)	92.31 (84)	83.33 (20)	84.78 (39)	91.53 ((216)
Any other					
Yes	24 (18)	28.57 (26)	45.83 (11)	47.83 (22)	32.63 (77)
No	76 (57)	71.43 (65)	54.17 (13)	52.17 (24)	67.37 (159)

(Figures in parenthesis indicate number of subjects)

Frequent consumption of certain foods with fat topping by women (45-59 years), indicated that majority of the subjects did not use additional fat on either rice (95 %), dhokla (83 %). More than 70 % of the younger women reported daily consumption of roti with extra fat as topping followed by half of the women consuming khichadi with additional fat (50 %). One third of the women also reported consuming handwa with fat topping. Intake of other infrequently prepared food items with fat topping was reported by less than half of the total women (45 %).

Use of fat topping on food items like rice, handwa or dhokla was not reported by more than 80 % of the women above 60 years. Highest use of fat topping was noted on frequently consumed roti (71 %) followed by khichadi (52 %). Forty seven percentage of elderly women also reported consuming other non-frequently prepared food items with additional fat topping as seen from the above table.

Thus, the overall picture of fat topping indicated that more than 60 % of the subjects consumed roti and khichadi with extra fat as a topping. One third of the subjects consumed other non-frequently prepared food items with fat topping. However, more than 3/4th of the subjects did not report using fat on either rice, handwa or dhokla.

V) NUTRIENT INTAKE

The subjects' dietary intake of one normal routine day was noted from which their nutrient intake per day was calculated in terms of energy, protein, fat, fibre, calcium, iron along with antioxidants vitamins such as β-carotene and vitamin C. Since the subjects were aged 45 years and above, two different RDAs for energy were used for men between 45-59 years and those above 60 years to compare their mean nutrient intake as seen from the following table. The mean intake of energy of the elderly subjects (aged 60 years and above) were compared with the RDAs given by the ICMR (2002) for adults as well as those given by Natarajan (1991). These RDAs for energy are the suggested intakes and not the actually recommended.

a. NUTRIENT INTAKE OF MEN

The mean nutrients intake of men (aged 45 years and above) were assessed as given in table 6a. The nutrient intake data was further analysed with respect to percentage of RDA met by the younger (45-59 years) as well as the elderly men (≥ 60 years) as shown in table 7a and 8a.

Mean nutrient intake of men aged 45-59 years, as depicted from table 6a, revealed slightly more than half the consumption of energy and proteins as compared to the recommended allowance. However, consumption of fat was found to be one and half times of the daily recommendations. As against this, the mean intake of fibre by men (45-59 years) was found to be 1/4th of the recommended allowances.

Consumption of micro-nutrients like minerals and vitamins was also calculated. A satisfactory calcium intake by the younger men was observed. However, consumption of iron was only about half the recommendation.

Table 6a: Mean consumption of various nutrients by men (45 years and above) from the free-living population.

Nutrients	RDA* (45-59 years)	Men (N=75)	RDA** (≥ 60 years)	Men (N=91)
Energy (kcal)	2425	1362 ± 479	1750	1445 ± 492
Proteins (gm)	60	31.34 ± 15.52	60	35.42 ± 15.41
Fats (gm)	20	32.44 ± 14.30	20	35.57 ± 14.77
Fibre (gm)	20	5.16 ± 4.33	20	4.96 ± 2.65
Calcium (mg)	400	466 ± 336	400	551 ± 366
Iron (gm)	28	10.10 ± 5.07	28	10.51 ± 4.92
β - carotene (μg)	2400	1349 ± 1247	2400	1461 ± 1515
Vitamin C (mg)	40	46.08 ± 45.82	40	55.73 ± 49.71

* *Nutrient Requirements and Recommended Dietary Allowances for Indians, ICMR(2002)*
** *Natarajan (1991)*

Intakes of anti-oxidants rich foods like those rich in β-carotene and vitamin C were also assessed. As seen from the above table, men between 45-59 years met more than slightly half of the recommended allowance for β-carotene (1349 vs 2400 μg). In contrast, consumption of vitamin C was found to be slightly higher (51 gm) as against the recommended allowance of 40 gm per day.

Data on mean nutrient intake of elderly men (aged 60 years and above) revealed almost similar results that were obtained for the younger group. Energy intake was found to be more than 3/4th of the recommended allowances, which has been suggested by Natarajan as can be seen from the above table. However on comparison with the recommendation given by ICMR (2002) for adults, it was noted that its energy intake was less than 2/3rd of the RDA. Consumption of protein by the elderly men was only half of the recommended amount. As against this, fat intake was observed to be one and half times the RDA by this group. Very low fibre intake was reported by the elderly men. Only 1/4th of the daily requirement for fibre was met by this group.

Intakes of minerals were found to be satisfactory as far as only calcium consumption was concerned. A higher calcium intake was observed by the elderly men as compared to the recommendation. However, these men could not meet even half of the recommended iron intakes as seen from the above table.

Consumption of foods rich in antioxidants nutrients such as β-carotene and vitamin C were also assessed. More than half the recommended allowances for β-carotene was met by the elderly men. However, the intake of vitamin C was higher than the daily requirements (55 vs 40 mg).

NUTRIENT INTAKE BY MEN AS PERCENTAGE OF RDA

Data on mean nutrient intake by the men selected for the study, was further analysed in detail. Percentage of men, aged 45-59 years and 60 years and above, consuming different nutrients at various levels of percent RDA thereby showing either deficient or excess intake was calculated as seen in table 7a and 8a respectively.

Table 7a: Percentage consumption of different nutrients at various levels of percent RDA by men (45-59 years)

Nutrients	Men (N=75)				
	<25 %	**> 25-50 %**	**> 50-75 %**	**>75-100 %**	**>100 %**
Energy (kcal)	4.00 (3)	34.67 (26)	46.67 (35)	12.00 (9)	2.67 (2)
Proteins (gm)	21.33 (16)	22.67 (17)	34.67 (26)	20.00 (15)	1.33 (1)
Fats (gm)	2.67 (2)	1.33 (1)	8.00 (6)	12.00 (9)	76.00 (57)
Fibre (gm)	54.67 (41)	42.67 (32)	0	0	2.67 (2)
Calcium (mg)	4.00 (3)	33.33 (25)	6.67 (5)	4.00 (3)	52.00 (39)
Iron (gm)	20.00 (15)	61.33 (46)	17.33 (13)	1.33 (1)	0
β - carotene (μg)	17.33 (13)	45.33 (34)	17.33 (13)	10.67 (8)	9.33 (7)
Vitamin C (mg)	14.67 (11)	21.33 (16)	9.33 (7)	7.93 (7)	45.33 (34)

(Figures in parenthesis indicate number of subjects)

As seen from the above table, consumption of energy and protein was found to be between 50-75 % of the RDA by men aged 45-59 years (46 % and 34 % respectively). However, 3/4th of the younger men met more than 100 % of the fat requirements through their daily diets. As against this, more than 1/2 of the men met < 25 % of the RDA for fibre. More than 50 % of the men

(45-59 years) consumed > 100 % requirements of calcium whereas around 60 % of them could meet only 25-50 % of daily iron requirements through their diets.

Consumption of antioxidants rich nutrients such as β-carotene and vitamin C revealed that 45 % of the men could meet only 1/4th - 1/2 of the β-carotene requirements whereas similar percentage of men could meet more than 100 % requirements for vitamin C through their daily diets (Figure 2a).

Table 8a: Percentage consumption of different nutrients at various levels of percent RDA by men (60 years and above)

Nutrients	Men (N=91)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	2.20 (2) 2.19 (2)*	4.39 (4) 29.67 (27)*	32.97 (30) 52.74 (48)*	37.36 (34) 10.98 (10)*	23.07 (21) 4.39 (4)*
Proteins (gm)	9.89 (9)	18.68 (17)	48.35 (44)	19.78 (18)	3.29 (3)
Fats (gm)	1.10 (1)	0	3.29 (3)	10.98 (10)	84.61 (77)
Fibre (gm)	54.94 (50)	41.76 (38)	3.29 (3)	0	0
Calcium (mg)	7.69 (7)	16.48 (15)	6.59 (6)	6.59 (6)	62.64 (57)
Iron (gm)	16.48 (15)	64.83 (59)	13.18 (12)	4.39 (4)	1.10 (1)
β - carotene (μg)	15.38 (14)	49.45 (45)	14.28 (13)	7.69 (7)	13.18 (12)
Vitamin C (mg)	12.08 (11)	18.68 (17)	8.79 (8)	6.59 (6)	53.84 (49)

(Figures in parenthesis indicate percentages)
** ICMR (2002)*

Percent consumption of different nutrients at various levels of percent RDA by men (60 years and above) was also found out. Around 37 % of the elderly men could meet 75-100 % of the energy requirements suggested by Natrajan. However on comparison with the RDA by ICMR for adults more than 50% of the men could meet only 50-75% of the energy intake. Similarly, protein intake was also found to be around 1/2 to 3/4th of the recommended allowances by almost half of the elderly men as seen from the above table. However, consumption of fat was more than 100 % of the RDA by over 80 % of the elderly men. As against this, fibre intake was found to be less than satisfactory by majority of the men. More than 50 % of the men could meet less than 25 % of the fibre intake that is recommended at their age. However, calcium intake was better as around 60 % of the elderly men could meet their calcium requirements.

On contrary, almost similar percentage of met had less than 25 % of the recommended allowances for iron.

Consumption of antioxidants vitamins like β-carotene and vitamin C were also assessed (Figure 3a). Half of the elderly men above 60 years could meet only 25-50 % of the RDA for β-carotene. However, more than 50 % of this group consumed vitamin C rich foods meeting more than 100 % of their daily requirements.

Thus, from the tables 7a and 8a it can be noted that majority of the men (aged 45 years and above) from the free living population could meet only 50-75 % of their energy and protein requirements. As against this, more than 80 % of these men met more than 100 % of the recommended allowances for fat. On the other hand, around 50 % of the total men consumed less than 25 % of the RDA for fibre. Calcium intake was found to be somewhat satisfactory in these subjects as more men from both the age groups could meet their calcium requirements. However, iron intake was found to be poor in these subjects as majority of the men (62 %) could meet only 25-50 % of the RDA for iron. As far as consumption of antioxidants vitamins are concerned, less than half (47 %) of men from both the age groups could meet only $1/4^{th}$ to 1/2 the recommendations for β-carotene. As against this, 49 % of them could meet more than 100 % requirements for vitamin C through their daily diets.

Figure 2a : Number of men (45-59 years) consuming β-Carotene and Vitamin C at various levels of percent RDA

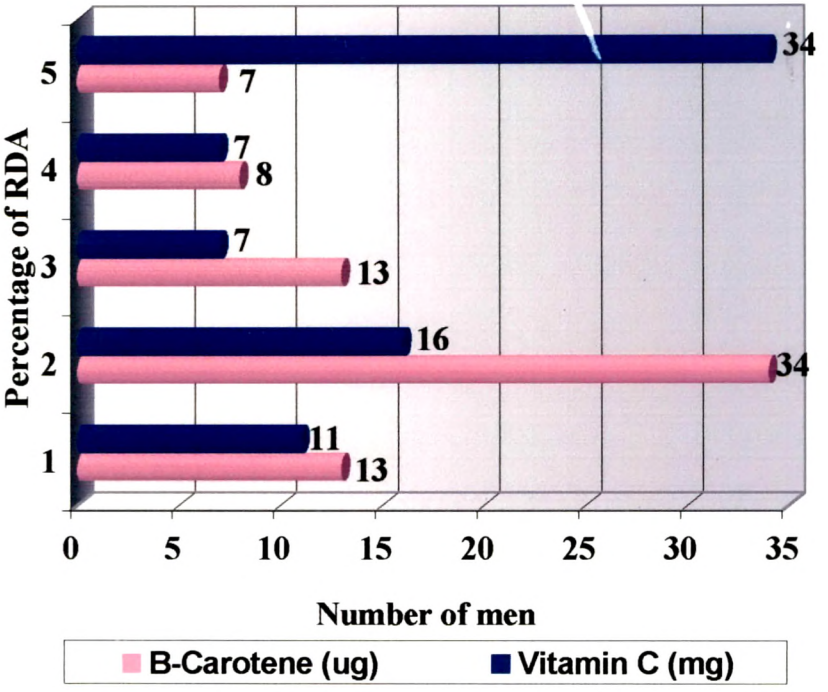
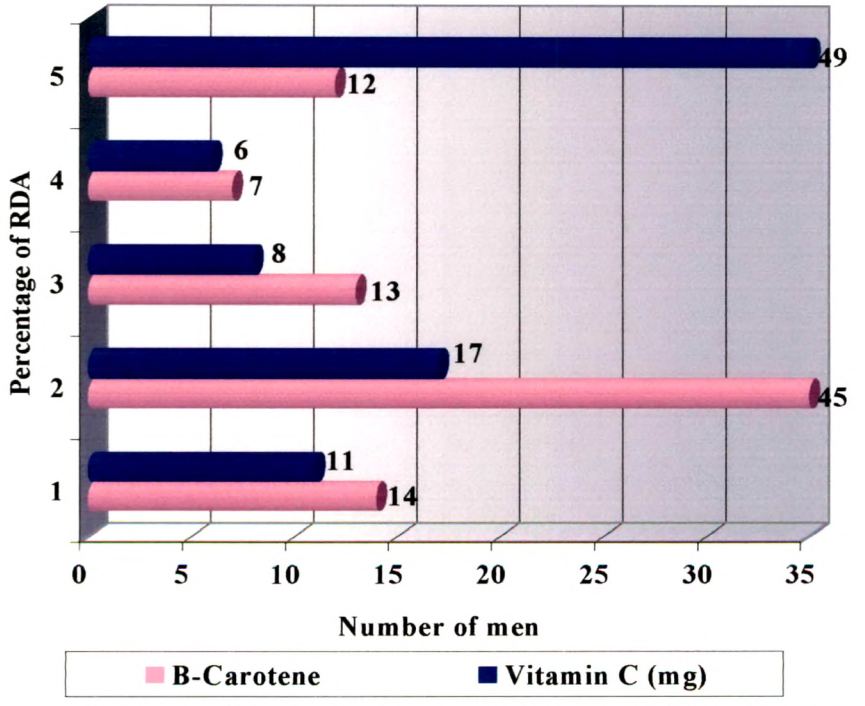


Figure 3a : Number of men (60 years and above) consuming β-Carotene and Vitamin C at various levels of RDA



1 = < 25 % , 2 = 25 - 50 % , 3 = 50 - 75 % , 4 = 75 - 100 % , 5 = > 100 %

b. NUTRIENT INTAKE OF WOMEN

The mean nutrients intakes of women (aged 45 years and above) were assessed as given in table 9a. The nutrient intake data was further analysed with respect to percentage of RDA met by the younger (45-59 years) as well as the elderly women (60 years and above) as shown in table 10a and 11a.

Table 9a: Mean nutrient intake of women (45 years and above) from free-living population

Nutrients	RDA* (45-59 years)	Women (N=24)	RDA** (≥ 60 years)	Women (N=46)
Energy (kcal)	1875	1299 ± 253	1350	1402 ± 429
Proteins (gm)	50	35.21 ± 9.95	50	36.63 ± 13.49
Fats (gm)	20	36.77 ± 11.60	20	37.59 ± 17.31
Fibre (gm)	20	6.70 ± 1.79	20	6.93 ± 3.04
Calcium (mg)	400	531 ± 160	400	715 ± 346
Iron (gm)	30	10.31 ± 1.32	30	11.36 ± 5.22
β - carotene (μg)	2400	1083 ± 577	2400	1616 ± 1329
Vitamin C (mg)	40	66.18 ± 62.82	40	64.53 ± 56.23

* *Nutrient Requirements and Recommended Dietary Allowances for Indians, ICMR(2002)*
** *Natarajan (1991)*

Consumption of various nutrients through routine diet of women aged 45-59 years, as seen in table 9a, reveals deficient energy intake by around 576 kcal. Protein intake was found to be just above 2/3rd of the recommended daily allowance by these women. Consumption of fat was found one and half times more than the recommended amount of 20 gm per day. Only around 1/4th of the fibre intake was reported by the younger women as can be seen from the table.

Consumption of micro-nutrients like minerals and vitamins was also calculated. As indicated in the table, daily intake of calcium by women was found higher than the recommended intakes. However, consumption of iron was only 1/3rd of the recommended levels.

Data on dietary intake of antioxidants by the women aged 45-59 years revealed that the consumption of β-carotene through diet was even less than half of the recommended daily allowances. As against this, vitamin C intake was reportedly consumed at levels far exceeding the recommendation (66 vs 40 mg).

Mean nutrient intake data on women aged 60 years and above was also noted down as given in the above table. Energy intake was found to be satisfactory as it showed a deficit of only 52 kcal when compared to the suggested RDA given by Natarajan (1991). However, the energy intake was found to be 3/4th of the recommendation given by ICMR (2002) for adult women. Protein intake was slightly less than 3/4th of its recommended allowances. As against this, fat intake was found to be quite high (37 gms) as compared to 20 g recommendation. On contrary, just above 1/4th of the fibre requirements were found to be met by the elderly women. Calcium intake was found to be less than double the recommendations as can be seen from the above table. However, iron intake was just above 1/3rd of the recommendations.

Data on consumption of antioxidants vitamins like β-carotene and vitamin C revealed that the mean intake of β-carotene by the elderly women was above 2/3rd of the recommended allowances. Intake of vitamin C was found to be more than one and half times of the RDA by the women aged 60 years and above.

NUTRIENT INTAKE AS PERCENTAGE OF RDA OF WOMEN

Data on mean nutrient intake by the women was further analysed in terms of percentage of RDA met by these subjects as given in table 10a and 11a.

Table 10a: Percentage consumption of different nutrients at various levels of percent RDA by women (aged 45-59 years)

Nutrients	Women (N=24)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	0	8.33 (2)	54.16 (13)	37.5 (9)	0
Proteins (gm)	8.33 (2)	4.16 (1)	41.67 (10)	45.83 (11)	0
Fats (gm)	0	4.16 (1)	4.16 (1)	4.16 (1)	87.50 (21)
Fibre (gm)	16.67 (4)	83.33 (20)	0	0	0
Calcium (mg)	0	0	4.16 (1)	16.67 (4)	79.17 (19)
Iron (gm)	0	100.00 (24)	0	0	0
β - carotene (μg)	20.83 (5)	50.00 (12)	20.83 (5)	4.16 (1)	4.16 (1)
Vitamin C (mg)	4.16 (1)	25.00 (6)	4.16 (1)	12.50 (3)	54.17 (13)

(Figures in parenthesis indicate number of subjects)

Data on percentage of women aged 45-59 years consuming different nutrients at various levels of RDA, as shown in table 9, indicated that majority of women (54 %) met only 50 - 75 % of the daily energy requirement. Similar findings were observed for protein intake, though 45 % of women could meet 75 % of the requirement also. More than 100 % of the daily recommended allowance for fat was met by more than 80 % of the women. As against this, majority of the women (83 %) consumed 25 - 50 % of the RDA for fibre.

Consumption of minerals, in terms of calcium, was found to be satisfactory by majority of the women. More than 3/4th of the women could meet more than 100 % of the daily calcium requirements. In contrast to this, all of younger group women consumed less than 50 % of the recommended iron levels.

Dietary levels of antioxidants vitamins such as β-carotene and vitamin C by the subjects were also analysed at various levels of their RDA. As seen from the above table, half of the women between 45-59 years could meet only 25 - 50 % of the RDA for β-carotene. However, equal percentage of the women also reportedly consumed 50-75 % of the recommended β-carotene allowances. As against this, 54 % of these women met more than 100 % of vitamin C level through their daily diets (Figure 4a).

Table 11a: Percentage consumption of different nutrients at various levels of percent RDA by women (60 years and above) from free living population

Nutrients	Women (N=46)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	0	4.35 (2)	19.56 (9)	23.91 (11)	52.17 (24)
Proteins (gm)	2.17 (1)	17.39 (8)	32.61 (15)	28.26 (13)	19.56 (9)
Fats (gm)	0	2.17 (1)	10.87 (5)	6.52 (3)	80.43 (37)
Fibre (gm)	30.43 (14)	54.34 (25)	13.04 (6)	2.17 (1)	0
Calcium (mg)	0	0	0	8.69 (4)	91.30 (42)
Iron (gm)	19.56 (9)	63.04 (29)	15.22 (7)	0	2.17 (1)
β - carotene (μg)	21.73 (10)	32.61 (15)	15.22 (7)	8.69 (4)	21.74 (10)
Vitamin C (mg)	8.69 (4)	15.23 (7)	4.35 (2)	8.69 (4)	63.04 (29)

(Figures in parenthesis indicate number of subjects)

Data on percentage consumption of different nutrients at various levels of percent RDA women aged 60 years and above was also assessed as given in table 11a. It was surprising to find that more than half of the elderly women met more than 100 % of the requirements for energy according to suggested RDA by Natrajan (1991). However on comparison of energy intake with ICMR recommendations (2002), majority of women (41%) meet only 50-75% of the RDA. Consumption of protein was found to be 50-75 % of the RDA by 32 % of the women. As against this, fat intake was exceeding the daily recommendation by 80 % of the aged women. On contrary, only 54 % of the women met 25-50 % of the fibre requirements through their daily diets.

Intake of minerals like calcium and iron were also evaluated. Calcium consumption was noted to be more than satisfactory as 91 % of the elderly women reportedly consumed more than 100 % of the requirements for calcium. As against this, a majority of these women (63 %) could meet only 25-50 % of the iron requirements.

Data on antioxidants consumption revealed that only 32 % of the women aged 60 years and above could meet 25-50 % of the β-carotene requirements although 21 % could also meet more than 100 % of its RDA as can be seen from the above table. As against this, vitamin C intake was exceeding its requirements in 63 % of the elderly women (Figure 5a).

Thus, overall the data on nutrient intake as percentage of RDA as given in table 9 and 10 suggested that equal percentage of women aged 45 years and above could meet 50-75 % and also more than 100 % of the RDA for energy. Similarly, equal percentage of women (36 %) met protein requirements between 50-75 % of the daily recommendations as can be observed from the above tables. More than 80 % of the women from both the age groups reportedly consumed more than 100 % of the fat requirements. As against this, fibre intake was on 25-50 % of the RDA in majority of the women (68 %). In women from both the age groups, calcium intake was found to be satisfactory as more than 80 % of the women met the RDA for calcium. However, iron intake was only $1/4^{th}$ - 1/2 of the recommended amounts in more than 80 % of the women. Consumption of antioxidants rich vitamins such as β-carotene and vitamin C revealed that only 25-50 % of the β-carotene requirements were met by majority of the women (41 %). As against this, consumption of antioxidants vitamin C was reportedly more than 100 % of the recommended allowances by more than half of the total women subjects selected for this phase of the study.

Figure 4a : Number of women (45-59 years) consuming β-Carotene and Vitamin C at various levels of percent RDA

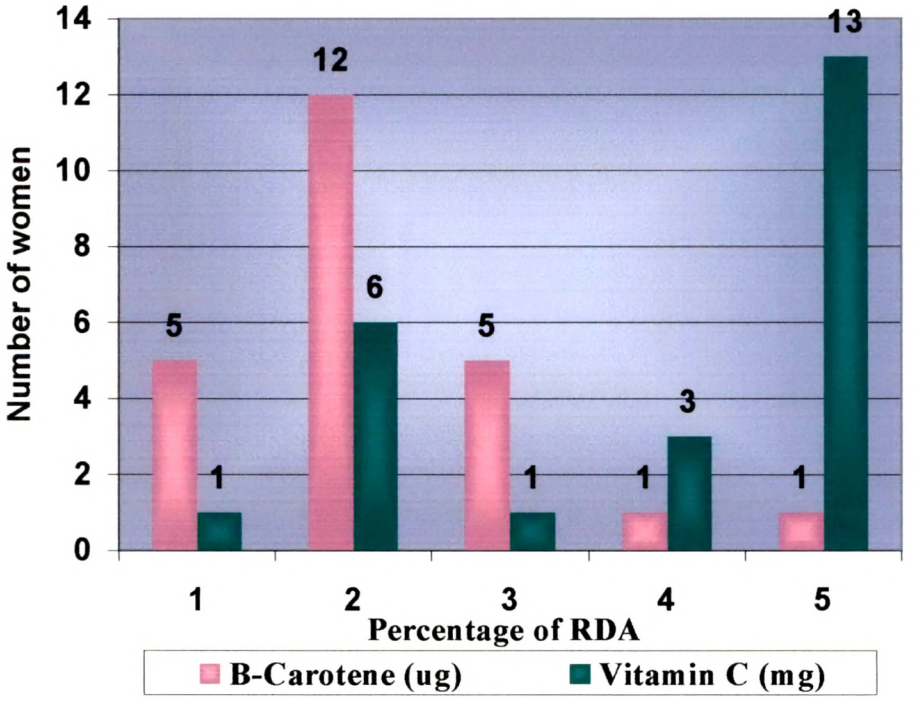
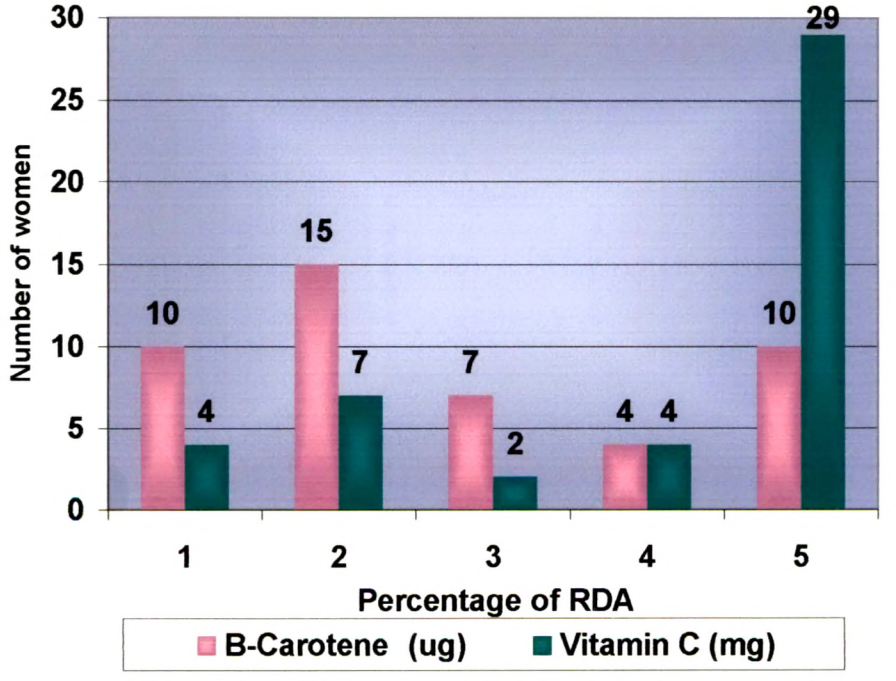


Figure 5a : Number of women (60 years and above) consuming β-Carotene and Vitamin C at various levels of percent RDA



1 = < 25 % , 2 = 25 - 50 % , 3 = 50 - 75 % , 4 = 75 - 100 % , 5 = > 100 %

C. MEAN INTAKE OF GREEN LEAFY VEGETABLES (GLVS) AND FRUITS

Data on mean food intake of men and women (aged 45 years and above) were also assessed from the 24 hour dietary recall as given in table 12a.

Table 12a : Mean food intake of men and women (aged 45 years and above)

Food Group	Food Intake					
	Suggested RDA*	Men (N=166)		Suggested RDA*	Women (N=70)	
		45-59 years (N=75)	>=60 years (N=91)		45-59 years (N=24)	>=60 years (N=46)
Cereals (gm)	350	226	248	225	196	216
Pulses (gm)	50	61	58	40	56	42
GLVs (gm)	50	182	194	50	175	211
Fruits (gm)	100	94	87	150	86	73
Milk & milk products (ml)	300	374	462	300	406	432
Sugars (gm)	20	32	35	20	38	37
Fats (gm)	25	51	48	20	57	52

** Pasricha and Thimmayamma (1992)*

The consumption of various food groups of men and women (aged 45 years and above) has been shown in the above table. The intake of cereals by men was around 22 gm less in younger subjects as compared to their elderly subjects. However, in case of pulses, the consumption was slightly more in men aged 45-59 years than those above 60 years.

Less than 200 gms of green leafy vegetables (GLVs) were reported to be consumed by both younger and elderly subjects. Fruit consumption was also found to be very low in men from both the age groups. Less than 100 gm of fruits was reported by these men as observed from the figure 6a.

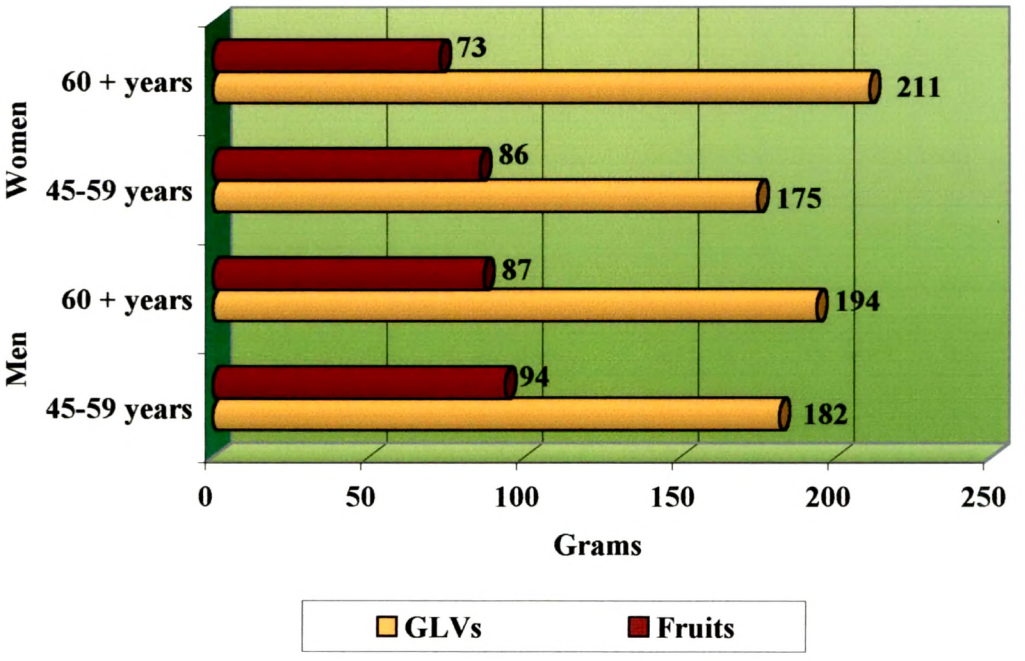
Consumption of milk and milk products was noted to be higher in the elderly group men as compared to their younger counterparts (374 vs 462 ml). Sugars/jaggery intake in the form of sweets and sugar used in beverages was more than 30 gm per day by both the subjects. On an average, 51 gm of fat consumption was reported my men (aged 45-59 years) and 48 gm by elderly men.

Data on food intake by women (aged 45 years and above) was also assessed as seen from table 12a. The consumption of cereals was higher in the elderly women (216 gm) as compared to the younger women (196 gm). However, intake of pulses was found to be more in younger group women as against their elderly counterparts.

Green leafy vegetables consumption was less than 200 gm in women (aged 45-59 years) whereas it was more than 200 gm in women (aged 60 years and above). Consumption of fruits was found to be very low in women subjects. Elderly women consumed less fruits (73 gm) as compared to their younger counterparts (86 gm) as observed from figure 6a.

More than 400 ml of milk and milk products were reportedly consumed by all the women subjects selected for this phase of the study. Consumption of sugars was noted to be more than 35 gm per day in women from both the age groups as observed from the above table. Similarly, fat intake was found to be very high in both the age groups women. More than 50 gm of fat was reported to be consumed per day by the women (aged 45 years and above).

Figure 6a : Amount of GLVs and fruits consumed by men and women from the freeliving population



d. ANTIOXIDANTS INTAKE IN RELATION TO THE EDUCATIONAL STATUS

Data on consumption of antioxidants rich vitamins such as β-carotene and vitamin C by the subjects selected for the present section of the study was also assessed in relation to the educational status of these subjects (table 13a).

Table 13a: Mean dietary antioxidants intake of subjects (aged 45 years and above) from the free-living population in relation to the educational status.

Antioxidants	School level (N=110)	University level (N=47)
Men (N=166)		
β - carotene (μg)	1485 ± 1635	2138 ± 1585
Vitamin C (mg)	50.77 ± 39.41	61.97 ± 52.92
Women (N=70)		
	(N=40)	(N=26)
β - carotene (μg)	1340 ± 1134	1400 ± 1165
Vitamin C (mg)	65.24 ± 62.09	68.19 ± 55.23

As seen from the above table, a direct relationship was observed between the education level of men and consumption of antioxidants vitamins such as β-carotene and vitamin C. Lowest intake of both the antioxidants was noted in men who did not have any kind of education (Figure 7a)

Effect of educational level in case of women (aged 45 years and above) showed a distinct difference in the intake of foods rich in β-carotene and vitamin C as can be seen from the above table. With increase in education level, an increase in the intake of both the antioxidants rich foods was observed (Figure 8a).

Figure 7a: Consumption of B-carotene by men and women (45years and above) in relation to the educational status

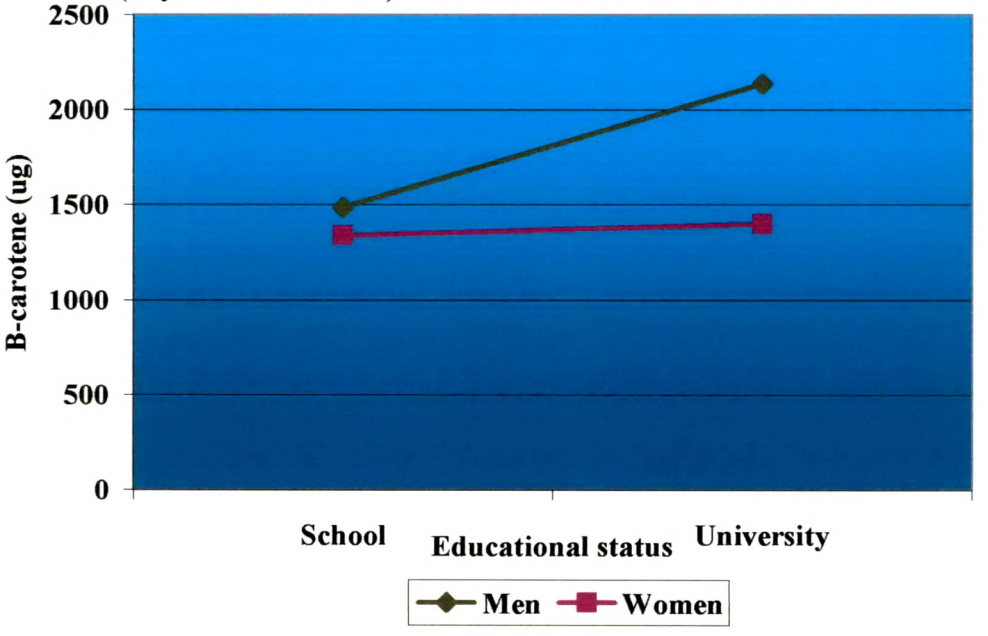
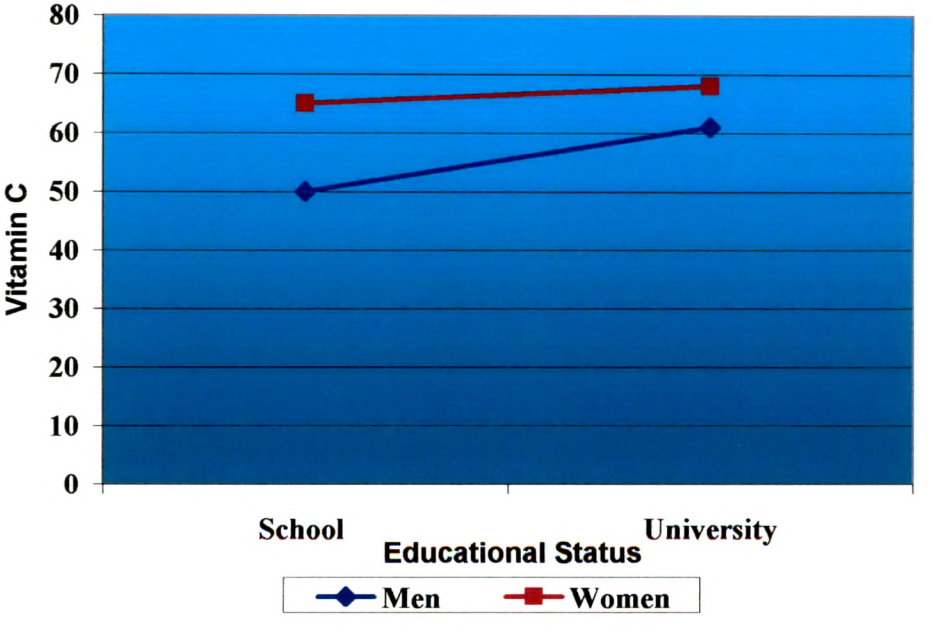


Figure 8a : consumption of vitamin C by men and women (aged 45 years and above) in relation to the educational status



VI) FOOD FREQUENCY

Data regarding food frequency was collected from the subjects using an exhaustive list of food items rich in antioxidants vitamins such as vitamin C, vitamin E and β-carotene along with foods rich in fats.

Table 14a: Percentage of subjects (45 years and above) from the free living population reporting frequent consumption of various foods.

Food Item	Men (N=166)		Women (N=70)		Total (N=236)
	45-59 years (N=75)	≥ 60 years (N=91)	45-59 years (N=24)	≥ 60 years (N=46)	
Cereals					
Frequent	80 (60)	82.42 (75)	79.17 (19)	60.87 (28)	77.12 (182)
Non frequent	20 (15)	17.58 (16)	20.83 (5)	39.13 (18)	22.88 (56)
Pulses					
Frequent	33.33 (25)	32.97 (30)	45.83 (11)	39.13 (18)	35.6 (84)
Non frequent	66.67 (50)	67.03 (61)	54.17 (13)	60.87 (28)	64.4 (152)
Green leafy vegetables					
Frequent	48.00 (36)	79.12 (72)	54.17 (13)	50.00 (23)	61.01 (144)
Non frequent	52.00 (39)	20.87 (19)	45.83 (11)	50.00 (23)	38.98 (92)
Veg. rich in β-carotene					
Frequent	36.00 (27)	67.03 (61)	45.83 (11)	36.96 (17)	49.15 (116)
Non frequent	64.00 (48)	32.96 (30)	54.17 (13)	63.04 (29)	50.85 (120)
Veg. rich in isoflavonoids					
Frequent	74.67 (56)	73.62 (67)	75.00 (18)	69.57 (32)	73.30 (173)
Non frequent	25.33 (19)	26.37 (24)	25.00 (6)	30.43 (14)	26.70 (63)
Other vegetables					
Frequent	42.67 (32)	45.05 (41)	75.00 (18)	45.65 (21)	47.46 (112)
Non frequent	57.33 (43)	54.94 (50)	25.00 (6)	54.35 (25)	52.54 (124)
Fruits rich in β-carotene					
Frequent	65.33 (49)	73.62 (67)	37.50 (9)	26.09 (12)	58.05 (137)
Non frequent	34.67 (26)	26.37 (24)	62.50 (15)	73.91 (34)	41.95 (99)

Contd..

Fruits rich in vitamin C					
Frequent	29.33 (22)	31.86 (29)	70.83 (17)	56.52 (26)	39.83 (94)
Non frequent	70.67 (53)	68.13 (62)	29.16 (7)	42.48 (20)	60.17 (142)
Non vegeterian foods					
Frequent	9.33 (7)	4.39 (4)	8.33 (2)	2.17 (1)	5.93 (14)
Non frequent	90.67 (68)	95.60 (87)	91.67 (22)	97.83 (45)	94.07 (222)
Milk and Milk products					
Frequent	40 (30)	56.04 (51)	45.83 (11)	54.35 (25)	49.58 (117)
Non frequent	60 (45)	43.95 (40)	54.17 (13)	45.65 (21)	50.42 (119)
Milk based sweets					
Frequent	20.00 (15)	9.89 (9)	33.33 (8)	23.91 (11)	18.22 (43)
Non frequent	80.00 (60)	90.11 (82)	66.67 (16)	76.09 (35)	81.78 (193)
Khoa based sweets					
Frequent	5.33 (4)	1.09 (1)	25.00 (6)	19.57 (9)	8.47 (20)
Non frequent	94.67 (71)	98.90 (90)	75.00 (18)	30.43 (37)	91.53 (216)
Ghee based sweets					
Frequent	2.67 (2)	1.09 (1)	20.83 (5)	15.22 (7)	6.35 (15)
Non frequent	97.33 (73)	98.90 (90)	79.17 (19)	84.78 (39)	93.65 (221)
Deep fried snacks					
Frequent	22.67 (17)	32.97 (30)	29.17 (7)	36.96 (17)	30.08 (71)
Non frequent	77.33 (58)	67.03 (61)	70.83 (17)	63.04 (29)	69.92 (165)
Shallow fried snacks					
Frequent	5.33 (4)	5.49 (5)	87.5 (21)	30.43 (37)	28.39 (67)
Non frequent	94.67 (71)	94.51 (86)	12.50 (3)	19.57 (9)	71.61 (169)
Dry snacks					
Frequent	18.67 (14)	30.77 (28)	75.00 (18)	71.74 (33)	39.40 (93)
Non frequent	81.33 (61)	69.23 (63)	25.00 (6)	28.26 (13)	60.60 (143)

(Figures in parenthesis indicate number of subjects)

Frequent consumption of various foods by the subjects (aged 45 years and above) from the free living population was assessed. Cereal (bajra) intake was found to be frequent by majority of men from the younger group (45-59 years) as well as by the elderly men (82 %). However, 67 % of men from both the age groups reported non-frequent consumption of pulses.

Consumption pattern of vegetables such as green leafy vegetables (GLVs), vegetables rich in β-carotene and isoflavonoids and other vegetables were also assessed. Intake of GLVs by men (45-59 years) was found to be non-frequent in slightly higher percentage of men (52 %). As against this, majority of the men (60 years and above) consumed GLVs frequently.

Non frequent intake of vegetables rich in β-carotene was noted in double the percentages of younger men (64 %). However, in case of the elderly men, similar percentage of men reportedly consumed these vegetables frequently.

Consumption of vegetables rich in isoflavonoids was reported by more than 70 % of the men from both the age groups as revealed from the above table.

Non frequent intake of other vegetables was noted in slightly higher percentage of younger men (57 %) and elderly men (55 %).

Data on frequent consumption of fruits rich in β-carotene and vitamin C were also noted down. Around 2/3rd of men (45-59 years) and 3/4th of the elderly men (60 years and above) were found to be consuming β-carotene rich fruits frequently. As against this, almost equal number of men from both the age groups had non frequent intake of citrous fruits rich in vitamin C.

Frequent consumption of non-vegetarian foods was reported by only 9 % of men (45-59 years) and 4 % of the elderly men (60 years and above).

Milk and milk products consumption was found to be non frequent in 60 % percent of the younger men as compared to 56 % of the elderly men who reported frequent intake of these products.

Information on frequent / non-frequent intake of milk based, khoa based and ghee based sweets by men was also collected. Though, majority of men from both the age groups had non-frequent intake of all the types of sweets (80-100 %), frequent consumption of milk based sweets was reported by 20 % of the younger men and 9 % of the elderly men.

Data on frequent consumption of snacks using oil in various ways was also noted. Though, non frequent consumption of deep fried, shallow fried and dry snacks were reported by more than 3/4th of the men from both the age groups, around 1/4th of the younger men and 1/3rd of the elderly men consumed shallow fried and dry snacks frequently.

Data on frequent / non frequent consumption of various foods by women (aged 45 years and above) was also assessed as given in the table 14a.

Cereal intake was found to be higher in the younger women (79 %) as compared to the elderly women (60 %).

Non frequent consumption of pulses was reported by majority of women aged 45 years and above. However, between groups, 45 % of the women (45-59 years) reported frequent intake of pulses as compared to 39 % of the elderly women.

Consumption of GLVs by the women from both the age groups observed in our study, pinpointed at frequent intake of these vegetables. However, as compared to the younger women (54 %), higher percentage of the elderly women (58 %) reportedly consumed GLVs frequently.

Non frequent consumption of vegetables rich in β-carotene was indicated by majority of the younger women (54 %) as well as the elderly women (63 %). However, between the two age groups, 45 % of the younger women as compared to 36 % of the elderly women reportedly consumed these vegetables frequently.

Three fourth of the women (45-59 years) were found to be having frequent intake of isoflavonoids rich vegetables as compared to almost $2/3^{rd}$ of their elderly counterparts.

Similarly, $3/4^{th}$ of the younger women reported frequent intake of other vegetables as against 45 % of the elderly women (60 years and above).

Results of the data on frequent / non frequent intake of fruits rich in β-carotene revealed that majority of the women from both the younger (62 %) as well as the elderly (73 %) groups had non frequent intake of these fruits. However, between the groups, slightly more than $1/3^{rd}$ of the younger women reported frequent consumption of β-carotene rich fruits as compared to only 26 % of the elderly women. As against this, frequent intake of vitamin C rich fruits was reported by higher percentage of women from both the age groups. $2/3^{rd}$ of the younger women had frequent consumption of these fruits as compared to 56 % of the elderly women.

Majority of the younger women (91 %) as well as the elderly women (97 %) did not report consumption of non vegetarian foods as can be seen from the above table.

On the contrary, consumption of milk and milk products was found to be frequent in higher percentage of the elderly women (54 %) as compared to their younger counterparts (45 %).

Though, non frequent consumption of milk based, khoa based and ghee based sweets was reported by almost 3/4 of the younger women, however 20-33 % of these group did report frequent consumption of these sweets. Similarly, only 15-23 % of the elderly women reported frequent intake of these sweets. However, between the women from two age groups, consumption of sweets was frequent in more younger women as compared to the elderly group.

Thus data on frequent consumption of various foods by men and women (aged 45 years and above) revealed that more than 3/4th of the subjects had frequent consumption of cereals. However, non-frequent consumption of pulses was reported by 64% of the total subjects.

Amongst the vegetables, frequent consumption of GLVs and vegetables rich in isoflavanoids was reported by majority of the subjects (62% and 73% respectively). Intake of vegetables was found to be non frequent in more than half the total subjects selected for the present section.

Data on consumption of fruits by the subjects (aged 45 years and above) revealed that higher percentage of the subjects reported frequent intake of fruits rich in beta-carotene (58%). However, almost similar percentage of subjects had a non frequent intake of vitamin C rich fruits (Figure 9a and 10a)

Consumption of non-vegetarian foods was found to be non-frequent by 94% of the subjects. Almost equal percentage of subjects reported frequent/non-frequent intake of milk and milk products.

Non frequent consumption of milk based, khoa based and ghee based sweets was reported by majority (80-94%) of the subjects. However, amongst these sweets, milk based sweets were more frequently consumed by the subjects (18%) from the free living population.

Similar observations were made for consumption of deep fried, shallow fried and dry snacks. However, around 30% of the subject did report frequent consumption of deep fried and shallow fried snacks and more than 1/3rd reported consumption of dry snacks frequently.

Figure 9a : Frequent consumption of antioxidants rich vegetables and fruits by men from the free living population

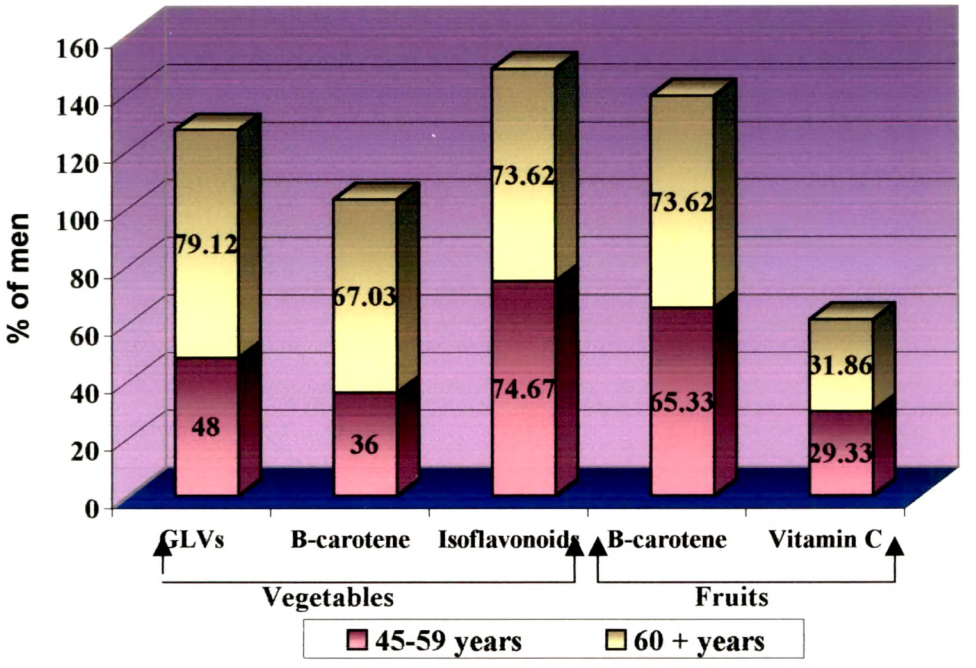
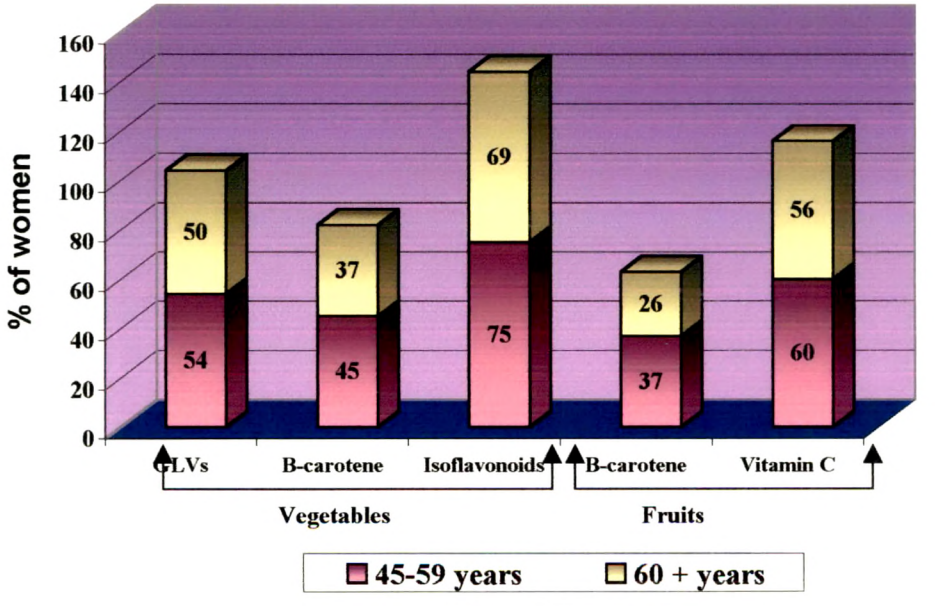


Figure 10a : Frequent consumption of antioxidants rich vegetables and fruits by women from the free living population



D) ACTIVITY PATTERN

Activity pattern of the men and women from the free living population was assessed by collecting information of total hours spent in work related and leisure time activities along with time spent in sleep as seen in table 15a.

Table 15a: Activity pattern of the subjects (aged 45 years and above) from the free living population.

Activities	Men (N=166)		Women (N=70)		Total (N=236)
	45-59 years (N=75)	≥ 60 years (N=91)	45-59 years (N=24)	≥ 60 years (N=46)	
Work related (hours)					
< 5	66.67 (50)	67.03 (61)	12.50 (3)	58.70 (27)	59.74(141)
5 - 8	17.33 (13)	27.47 (25)	66.67 (16)	34.78 (16)	29.66 (70)
> 8	16.00 (12)	5.49 (5)	20.83 (5)	6.52 (3)	10.60 (25)
Leisure (hours)					
< 5	0	0	0	0	0
5 - 8	6.67 (5)	3.30 (3)	20.83 (5)	8.70 (4)	7.20 (17)
> 8	93.33 (70)	96.70 (88)	79.17 (19)	91.30 (42)	92.80 (219)
Sleep (hours)					
< 5	0	0	0	0	0
5 - 8	21.33 (16)	13.19 (12)	37.50 (9)	23.91 (11)	19.91 (48)
> 8	78.67 (59)	86.81 (79)	62.50 (15)	76.09 (35)	79.66 (188)

(Figures in parenthesis indicate number of subjects)

As indicated, 2/3rd of the men from both the age groups were engaged in less than 5 hours of work related activities. As against this, more than 90 % of the younger and the elderly men spent more than 8 hours daily in leisure activities such as watching television, reading newspaper, listening to music and other routine activities. Five to eight hours were spent daily in sleep by 78 % of men (45-59 years) and 86 % of the elderly men (60 years and above).

The activity pattern of the women selected for the present study revealed that 2/3rd of the women (45-59 years) spent 5-8 hours daily in work related activities as observed in the above table. However, majority of the elderly women (58 %) were engaged in less than 5 hours of work related activities. More than 3/4th of the younger women and 91 % of the elderly women

spent more than 8 hours in leisure time activities like watching television, reading newspaper, listening to music and other routine activities. Like men, more than 8 hours of sleep daily was reported by 62 % of the women (45-59 years) and the 76 % of the elderly women (60 years and above). Thus it was indicated that around 60% of the subjects spent less than 5 hours in work related activities whereas more than 90% of them were engaged in more than 8 hours of leisure acitivities. More than 2/3rd of the subjects spent more than 8 hours of everyday in sleeping. Hence it can be reasonable concluded that majority of the subjects had a sedentary life style.

E) ADDICTION PATTERN

Data on various types of addiction such as smoking, alcohol drinking, chewing tobacco or betel quid by both men and women were also collected as shown in table 16a.

Table 16a: Addiction pattern reported by the subjects from the free living population.

Addictions	Men (N=166)		Women (N=70)		Total (N=236)
	45-59 years (N=75)	>= 60 years (N=91)	45-59 years (N=24)	>= 60 years (N=46)	
Pan					
Yes	0 (0)	1.10 (1)	0 (0)	4.35 (2)	1.27 (3)
No	100 (75)	98.90 (90)	100 (24)	95.65 (44)	98.73(233)
Ghutka					
Yes	0 (0)	0 (0)	0 (0)	0 (0)	0(0)
No	100 (75)	100 (91)	100 (24)	100 (46)	100 (236)
Supari					
Yes	0 (0)	0 (0)	4.19 (1)	2.17 (1)	0.84 (2)
No	100 (75)	100 (91)	95.83 (23)	97.83 (45)	99.15 (234)
Cigarette					
Yes	40 (30)	18.68 (17)	0 (0)	0 (0)	19.91 (47)
No	60 (45)	81.32 (74)	100 (24)	100 (46)	80.08 (189)
Bidi					
Yes	2.67 (2)	7.69 (7)	4.17 (1)	0 (0)	4.24 (10)
No	97.33 (73)	92.31 (84)	95.83 (23)	100 (46)	95.76 (226)

Contd...

Tobacco					
Yes	29.33 (22)	18.68 (17)	4.17 (1)	8.70 (4)	18.64 (44)
No	70.67 (53)	81.32 (74)	95.83 (23)	91.30 (42)	81.36 (192)
Alcohol					
Yes	34.67 (26)	12.09 (11)	0 (0)	2.17 (1)	16.10 (38)
No	65.33 (49)	87.91 (80)	100 (24)	97.83 (45)	83.90 (198)

(Figures in parenthesis indicate number of subjects)

Though majority of men from both the age groups did not report any addiction as can be seen from the above table, around 40 % of the men (45-59 years) reportedly had addiction to cigarette followed by alcohol addiction (34 %) and tobacco addiction (29 %). Addiction pattern of the elderly men (60 years and above) revealed that majority of the men did not report any kind of addiction. However, 18 % of the elderly men were addicted to cigarettes and tobacco followed by 12 % of the elderly men being addicted to alcohol.

Similarly among women subjects, though majority of the women did not have any addiction, 4 % of the younger women (45-59 years) was addicted to supari consumption, bidi smoking and tobacco chewing. As against this, higher percentage of the elderly women (8 %) reported addiction to tobacco chewing as can be seen from the above table followed by pan (betel quid) addiction in 4 % of the elderly women and 2 % reporting addictions to supari.

Thus it can be noted that the majority (95-100%) of the subjects did not report any kind of addiction to pan, supari and gutkha. However $1/5^{th}$ to $1/6^{th}$ of the subject specially men had addiction to smoking bidi, alcohal consumption and tobacco chewing.

Since addiction pattern was found to be less prevalent among women, further detailed data on the same has been given on men.

I) ADDICTION TO SMOKING

Data on addiction to smoking was assessed in terms of total years of smoking either cigarette or bidi and duration i.e number of cigarettes and bidis smoked per day as given in table 17a.

Table 17a: Duration and frequency of cigarette and bidi smoking in men (45 years and above) from the free living population.

Total years	Cigarette		Bidi		Total (N=332)
	45-59 years (N=75)	≥ 60 years (N=91)	45-59 years (N=75)	≥ 60 years (N=91)	
< 10	10.67 (8)	0 (0)	0 (0)	0 (0)	2.41 (8)
10 - 20	21.33 (16)	5.49 (5)	1.33 (1)	2.20 (2)	7.23 (24)
20 - 30	8.00 (6)	10.99 (10)	1.33 (1)	4.39 (4)	6.32 (21)
30 - 40	0 (0)	1.10 (1)	0 (0)	1.10 (1)	0.60 (2)
> 40	0 (0)	1.10 (1)	0 (0)	0 (0)	0.30 (1)
Number / d					
< 10	18.66 (14)	16.48 (15)	0 (0)	4.39 (4)	9.93 (33)
10 – 15	16.00 (12)	2.19 (2)	2.67 (2)	3.30 (3)	6.92 (19)
15 – 20	2.67 (2)	0 (0)	0 (0)	0 (0)	0.60 (2)
> 20	2.67 (2)	0 (0)	0 (0)	0 (0)	0.60 (2)
Never	***60 (45)***	***81.32 (74)***	***97.33 (73)***	***92.31 (84)***	***83.13 (276)***

(Figures in parenthesis indicate number of subjects)

It can be observed from the above table that though 60 % of the men (45-59 years) did not smoke cigarettes (94 %), around 21 % of those who smoked were addicted to cigarettes since 10-20 years. Ten percentage of the younger men addicted to cigarettes since less than 10 years followed by 8 % addicted since 20-30 years. As against this, higher percentage of the elderly men (60 years and above) as compared to the younger men did not report cigarette smoking. However, 10 % the elderly men who smoked cigarettes were addicted since last 20-30 years followed by 5 % of these men having addiction since 10-20 years.

Though more than 90 % of the men from both the age groups did not report addiction to bidi smoking, it was noted that higher number of elderly men as compared to their younger counterparts were addicted to bidi. Four percent of the elderly group were addicted to bidi since 20-30 years followed by 2 % of the elderly men having addiction to bidi since 10-20 years.

Thus it can be said that more than 80% of the men (aged 45 years and above) were not addicted to smoking either cigarette or bidi. Total years of smoking was found to be 10-20 years by 7% of the subjects.

Eighteen percent of men (45-59 years) smoked less than 10 cigarettes / day as can be noted from the above table followed by 16 % of the younger men reportedly smoking 10 - 15 cigarettes per day. The number of cigarettes smoked per day by the elderly men (60 years and above) revealed that 16 % of the men smoked less than 10 cigarettes per day followed by 2 % of the elderly men smoking 10-15 cigarettes per day.

The overall results of number of cigarettes/bidi smoked per day revealed that less than 10 cigarette/bidi were smoked by 9% of the smokers. More than 80% of the men did not report smoking.

II) ALCOHOL CONSUMPTION

Data on alcohol consumption was collected in terms of total years of alcohol drinking and frequency and amount of alcohol taken per day.

Table 18a: Duration and frequency of alcohol consumption by men from the free living population.

Years	45-59 years (N=75)	≥ 60 years (N=91)	Total (N=166)
< 5	0 (0)	0 (0)	0 (0)
5 – 15	9.33 (7)	4.39 (4)	6.63 (11)
15 – 25	17.33 (13)	5.49 (5)	10.84 (18)
25 – 35	8.00 (6)	0 (0)	3.61 (6)
> 35	0 (0)	2.20 (2)	1.21 (2)
Alcohol per day (ml)			
< 50	0 (0)	0 (0)	0 (0)
50 – 100	20.00 (15)	6.59 (6)	12.65 (21)
> 100	14.67 (11)	5.49 (5)	9.64 (16)
Never	***65.33 (49)***	***87.91 (80)***	***77.71 (129)***

(Figures in parenthesis indicate number of subjects)

Alcohol consumption was found to be practiced in 17 % of men (45-59 years) against 5 % of the elderly men (60 years and above) since 15 - 25 years as seen from the above table. Compared to the younger men (65 %), higher percentage of the elderly men (87 %) did not report alcohol addiction.

Thus the overall picture of alcohol consumption revealed that less than 1/4th of the total subjects who were addicted to alcohol since 15-25 years.

Alcohol intake was found to be between 50 - 100 ml / day by majority of alcohol drinkers between 45-59 years (20 %). Fourteen percent of the younger men also reported drinking more than 100 ml of alcohol per day as observed from the above table. Though, majority of the elderly men did not report alcohol addiction, 6 % of those who were addicted, consumed 50-100 ml of alcohol per day followed by 5 % having more than 100 ml alcohol per day.

Total frequency of alcohol consumption, thus indicated that though more than 3/4th of the men did not consume alcohol, around 1/5th of the men consumed between 50 and 100 ml of alcohol per day while only 1/6th of the men only consumed more than 100 ml of alcohol per day.

III) ADDICTION TO TOBACCO

Tobacco addiction as reported by the subjects was assessed in terms of total years of tobacco chewing along with amount consumed per day (table 19a)

Table 19a: Duration and frequency of tobacco consumption by men from the free living population.

Years	45-59 years (N=75)	≥ 60 years (N=91)	Total (N=166)
< 5	0 (0)	0 (0)	0 (0)
5 – 15	29.33 (22)	14.28 (13)	21.08 (35)
15 - 25	0 (0)	2.20 (2)	1.20 (2)
25 - 35	0 (0)	1.10 (1)	0.06 (1)
> 35	0 (0)	1.10 (1)	0.06 (1)
Tobacco per day (gm)			
< 2.5	0 (0)	1.10 (1)	0.06(1)
2.5 - 5.0	16.00 (12)	9.89 (9)	12.65 (21)
> 5.0	13.33 (10)	7.69 (7)	10.24 (17)
Never	*70.67 (53)*	*81.32 (74)*	*76.51 (127)*

(Figures in parenthesis indicate number of subjects)

As seen from table 19a, more than 70 of the younger men (45-59 years) and 81 % of the elderly men (60 years and above) did not report tobacco addiction. However, 29 % of the younger men against 14 % of the elderly men who were consuming tobacco in one form or the other, were addicted since past 5 - 15 years.

Addiction to tobacco was thus reported by around more than $1/5^{th}$ of the men since 5 –15 years. More than $3/4^{th}$ of the men had no addiction to tobacco.

The above table indicates that though majority of men from both the age groups were not addicted to tobacco in any form, 16 % of younger men as compared to the 9 % of the elderly men who were addicted consumed 2.5 - 5.0 gm of tobacco per day. Thirteen percent of the men (45-59 years) also reportedly chew more than 5 gm of tobacco per day against 7 % of the elderly men. Tobacco chewing was found to be more common in the younger group as compared to the elderly men.

Thus, more than $3/4^{th}$ of the men were not addicted to tobacco. However 12% of those addicted, consumed 2.5-5.0 grams of tobacco per day.

F) OTHER FACTORS

Data on other factors such as personality traits was also collected in terms of experiencing stress and anxiety in day to day life along with short temperedness (table 20a).

Table 20a: Percentage of men and women (aged 45 years and above) reporting stress, anxiety and angry temperament

Traits	Men (N=166)		Women (N=70)		Total (N=236)
	45-59 years (N=75)	≥ 60 years (N=91)	45-59 years (N=24)	≥ 60 years (N=46)	
Stress					
Yes	66.67 (50)	25 27 (23)	37.50 (9)	28.26 (13)	40.25 (95)
No	33.33 (25)	74.73 (68)	62.50 (15)	71.74 (33)	59.74 (141)
Anxiety					
Yes	46.67 (35)	27.47 (25)	37.50 (9)	28.26 (13)	34.74 (82)
No	53.33 (40)	74.73 (68)	62.50 (15)	71.74 (33)	66.10 (156)

Angry temperament					
Yes	58.67 (44)	24.17 (22)	25.00 (6)	15.22 (7)	33.47 (79)
No	41.33 (31)	75.82 (69)	75.00 (18)	84.78 (39)	66.53 (157)

(Figures in parenthesis indicate number of subjects)

Data on personality traits which are known to affect human health, of men and women (aged 45 years and above) are given in the above table. Higher number of the younger men (45-59 years) were found to be experiencing stress in their normal day to day life as compared to their elderly counterparts (66 % vs 25 %).

Though less than 50% of the younger men reported this but was still higher than those reported by the elderly men (27%). More than twice the percentage of younger men (58%) reported of being short tempered as compared to their elderly counterparts (24%).

Personality traits of women pin pointed at the fact that higher percentage of women (45-59 years) experienced stress (37%), anxiety (37%) and were short tempered (25%) as compared to the elderly women.

G) DISEASE PROFILE

Data on disease profile was assessed with respect to the age group using a check list. The results are given in the following table.

Table 21a : Percentage of subjects (aged 45 years and above) reporting different health problems.

Types of health problems	Men (N=166)		Women (N=70)	
	45-59 years (N=75)	≥ 60 years (N=91)	45-59 years (N=24)	≥ 60 years (N=46)
Oral cavity	16.00 (12)	80.22 (73)	45.83 (11)	82.61 (38)
Gastrointestinal	74.67 (56)	87.91 (80)	33.33 (8)	60.87 (28)
Hepatic	-	-	-	-
Respiratory	10.67 (8)	23.07 (21)	50.00 (12)	28.26 (13)
Cardiovascular	-	-	-	-
Genitourinary	-	-	-	-
Locomotor	4.00 (3)	28.57 (26)	33.33 (8)	65.22 (30)

Nervous	64.00 (48)	50.55 (46)	62.5 (15)	39.13 (18)
Endocrine	-	-	-	-
Miscellaneous	9.33 (7)	12.08 (11)	21.07 (7)	19.56 (9)

(Figures in parenthesis indicate number of subjects)

As seen from the above table, 75 % of men aged 45 - 59 years complained about gastrointestinal problems such as missing teeth or use of dentures. Problems related to the nervous system such as tension headaches, sleeplessness was reported by 64 % of the younger men. Sixteen percent of these men also reported oral cavity problems which were related to tooth ache only. Respiratory tract and other miscellenous problems were reported by very few of the younger men (9-10 %).

Gastrointestinal problems were rated highest among the elderly men. Eighty eight percent of the elderly men reported gastrointestinal tract problems such as constipation, flatulence and acidity. Oral cavity problems with respect to missing teeth, wearing denture and difficulty in chewing was reported by 80 % of the elderly men. Half of the elderly men complained nervous problems like tension headaches and sleeplessness. Locomotor problems related to bone and joint were reported by more than $1/4^{th}$ of the elderly men. Almost same number of men also experienced problems related to the respiratory tract.

Thus, the disease profile of the men aged 45 years and above indicated distinct differences in the types of diseases experience by the younger and the older subjects. Majority of men from both the age groups reported gastrointestinal tract problems. This was followed by nervous problems in younger men and oral cavity complaints in the elderly group. Locomotor problems were higher in elderly men as compared to their younger counterparts. Very few men from both the age groups reported respiratory tract problems as can be observed from the above table.

Disease profile of the women selected for the present study was also assessed as seen from table 21a. More than 60 % of the women (45-59 years) complained of problems related to the nervous system which included tension headaches and sleeplessness. Respiratory problems in terms of frequent cough and cold were reported by half of the younger women. Forty five percent of the women had complaints regarding oral cavity in terms of tooth ache. Very few women (33 %) reported problems related to GI tract and locomotor.

In case of elderly women, majority of them (82 %) reported oral cavity problems with respect to missing teeth, use of dentures, difficulty in chewing. Bone and joint disorders like presence of osteoporosis and osteoarthritis was found in 65 % of the elderly women. Gastrointestinal problems in terms of constipation and flatulence were reported by 60 % of women above 60 years.

A prominent difference in the disease profile of the women from both the age groups was thus observed. Double the number of elderly women complained of oral cavity problems as compared to the younger group. Similar observations were noted for the gastrointestinal tract problems and locomotor problems. However, complaints related to the nervous system and the respiratory system were prevalent in higher number of younger women as compared to their elderly counterparts.

DISCUSSION

Despite consistent increase in the life expectancy, attaining completely healthy life free from morbidity and disability is very difficult. The health of the aged individual is determined by several factors affecting his health during adulthood. Socio-demographic factors such as gender, economic status, marital status, living standards influence health during old age. Moreover, social support especially from the family members also determines the quality of life of the elderly and their overall nutritional status.

The results of anthropometric measurements in our study indicated that majority of the subjects had BMI < 24 kg/m^2. The low BMI observed in our study may be attributed to the socio-economic status of majority of the subjects selected for this phase belonged to the middle income group and few subjects were from low income strata. These findings are in line with the results obtained by Mehta and Shringarpure (2001) which revealed the mean BMI of men to be < 24 kg/m^2 and <25 kg/m^2 in case of women from the middle income groups. This results are also supported by the study carried out by Ritchie et al (1997) on 370 elderly subjects aged 65 years and above. Twenty nine percent of women and 63 % of men had a body mass index (BMI) less than 24 kg/m^2

Advancing age brings about various changes in the dietary pattern of the individual. These changes may be due to various health reasons or decrease in the digestive capactiy. In the present study, though only few changes were reported, the main reason for a change in consumption pattern was due to digestion problems leading to deficiency in various nutrients. Similar survey was carried out on 303 institutionalised elderly over 65 years by Brown (1976). He reported that almost 2/3 rd of them had changed their diets within past five years. Many of these changes resulted in subjects eating less or restricting their food intake due to decrease in sensory specific satiety.

In 1992, Wurtman et al distinguished effects of aging from life style changes by examining intakes of young and elderly subjects living in a clinical research center where they offered identical foods. The elderly subjects consumed significantly fewer calories carbohydrates and fats than the younger subjects. Different patterns of eating were also seen in the two groups. Younger subjects ate more of their calories from snacks than the elderly. Thus aging seems to be markedly affect the food and dietary intakes.

Present study also reported a shift in dietary pattern in terms of reduced food intake especially hard to chew foods. This finding is supported by finding of Ritchie et al (1997) who reported significant association between oral health problems (difficulty in chewing) with lower food intake in turn resulting in lower BMI in 370 elderly aged 65 years and above. He also reported that there was an increase in BMI because of increased food intake due to denture wear in few of the elderly. High prevalence of undernutrition was thus found in this study.

These findings of changes in food consumption indicate that there is some impact of onset and appearance of health disorders on consumption pattern. This may further restrict the overall intake of essential nutrients in with advancing age.

The nutritional status of an individual along with other lifestyle factors, is also dependent on the habitual dietary pattern followed throughout the life. In our study, we found out that majority of the subjects were vegetarians since most of them belonged to hindu religion. However, very few studies have been conducted on the nutritional status of elderly vegetarians. In general, though being vegeterianism forms a part of a "healthy" lifestyle, reducing the susceptibility to chronic diseases, deficiencies in certain nutrients have also been documented (Helman and Hill 1987; Reddy and Sander 1990).

A study was carried out with an aim of assessing the nutritional status of 25 men and 25 women elderly (aged 60 years and above) belonging to the Hindu religion and residing in urban Vadodara by Mehta and Mehta (2003). Significantly lower intake of energy and protein ($p \leq 0.05$) as compared to the RDA was observed in the elderly men and women. Iron intake was less than 50 % of the RDA in 62 % of the subjects whereas 60 % of them could meet only 50-75 % of the β-carotene requirements daily.

To assess the nutritional status of elderly vegetarians, a study was conducted by Woo et al on 131 elderly Chinese aged above 65 years. Lower frequency of Ischemic heart disease was reported in vegeterians as compared to omnivores elderly. Intake of energy, fat, protein, thiamine, riboflavin, niacin, iron and folic acid were lower in vegetarians whereas carbohydrates, calcium, potassium, retinol equivalent and ascorbic acid intake were higher. Deficiency of B_{12}, iron and folate accounted for 64 % of anemia in vegetarians as compared to 30 % in omnivares. Anthropometric indices in terms of total body fat was also found to be lower in vegetarians than their non-vegetarian counterparts. It was thus concluded that in elderly Chinese people, vegetarian diets may be beneficial in terms of reducing the risk of

coronary heart disease, but it is deficient in many B vitamins, thus causing anemia. This finding supports the results of anthropometric measurements with respect to BMI < 24 kg/m^2 noted in our study.

Use of fats and oils for various food items are common in Indian diets. Preferences for specific oils differ with the region, traditional practices and health reasons eg mustard oil is commonly used in north India whereas use of coconut oil is more in southern India. Irrespective of the type of oils, plant fats and oils are major sources of mono - and polyunsaturated fatty acids as well as vitamin E, the major fat soluble antioxidants in human nutrition.

Use of cottonseed oil was found to be preferred over other oils by majority of subjects in the present study. Cottonseed oil having good amount of linoleic acid is shown to have some health implications. Previous research has also demonstrated that cottonseed oil in the diets of growing male rats resulted in a lowering of the total cholesterol (TC) concentration in the serum. Another study was thus undertaken on similar lines to assess the effect of diets containing corn oil (CO), cottonseed oil (CSO) and a mixture of corn and cottonseed oil (OM) (1:1 w/w) on the serum and liver lipids in rats (Radcliff et al 2001). There was no difference between CO and OM groups for TC, HDL-C, non-HDL-C or the TC/HDL-C ratio. However, TC was significantly lower ($p \leq 0.05$) for the CSO group than the CO group (110 vs 125 mg/dl, respectively) as was HDL-C (71 vs 82 mg/dl, respectively). Diet had no effect on serum triglycerides (TG) or the total liver content of either cholesterol or TGs. Thus, partial (50 %) replacement of CO with CSO was without effect on any of these serum indices of cholesterol status, but total replacement resulted in lower TC, HDL-C without affecting non-HDL-C and the TC/HDL-C ratio. This findings can be encouraging considering the use of cottonseed by majority of local people in this part of the country.

The various deficiencies and morbidities found in the old age can partly be the result of the faulty dietary practices and inadequate nutrient intake during the adulthood. Dietary habits, nutrient intakes and aging processes are interrelated and are of particular importance among the elderly. Poor or marginal nutritional status is linked to increased morbidity and mortality in both free living as well as hospitalised population.

Energy and protein intake were found to be 50-75 % of the RDA whereas fat intake was found to be > 100 % of the RDA by the younger and elderly subjects in our study. As against this, fibre and iron consumption were $1/4^{th}$ of the RDA by these subjects. These findings are in

accordance with the series of studies carried out by Mehta (1999) on local elderly. It was reported that the calorie intake was 70 % of the RDA and protein consumption was 61 % of the recommendation in the elderly men and women. Consumption of fat was found to be higher than the recommended allowances in these studies. In line of these studies, our study also reported higher calcium intake by the elderly men and women. Iron intake was found to be < 25-50 % of the RDA by majority of the subjects in our study. The low iron intake observed in our study may be primarily because of the vegetarian diets consumed by majority of the subjects in our study. About 40 % of the iron in meat, poultry and fish is heme whereas rest is the non-heme iron. Heme iron is generally much better absorbed (15-35 %) than the non-heme iron (2-20 %) (Craig, 1991). The diet of the subjects selected for our study mainly constituted of cereals, legumes, dairy products and some amount of green leafy vegetables. However, polyphenols present in some vegetables and phytates present in whole grain cereals, legumes and green leafy vegetables can bind non-heme iron and greatly reduce its absorption. A high calcium intake noted in the present study can also inhibit iron absorption. Among all these inhibitors, ascorbic acid acts as a powerful promoter of non-heme iron absorption. Though very high consumption of vitamin C was reported by the subjects from the present study, cooking losses of vitamin C cannot be ruled out. A significant higher intake of vitamin C was also reported by Murgai (1999) in a study carried out on 50 elderly men aged 60 years and above from rural Punjab.

Another study was undertaken by Groot et al (1999) to evaluate the energy and micronutrient intake in elderly European participating in SENECA study. The data was collected on 486 men and 519 women (74 - 79 years) out of 13 centers selected from 12 European countries. The micro nutrients that were studied were iron, thiamine, riboflavin and pyridoxin. The relationship of these micronutrients were studied with respect to the energy intake. Nineteen percent of men and 26 % of women had an inadequate micronutrient intake. The prevalence of inadequate intake of iron and riboflavin was very high in most of the people. Results revealed a decrease in the prevalence of an inadequate nutrient intake with higher energy intakes in elderly people.

The nutrient / energy intakes of elderly (60 - 103 years) were also assessed with respect to their income status and ethnic group (Protho and Rosenbloom 1999). Only 6 % of the sample had adequate energy intake. Fifty three percent had marginal deficiency whereas 41 % had submarginal deficiency of energy and nutrient intakes. Diets of men were better than those of women ($p < 0.05$). Calcium ($p < 0.05$) and potassium ($p < 0.05$) were higher in diets of female

elders above the poverty line than those below. A trend was observed for higher intakes of fatty components (total fat, cholesterol, % fat calories) for both men and women in the below poverty than in above poverty group.

In another cross - sectional study of 66 men and 279 women from North Carolina, nutrient intake in correlation to individual characteristics (age, race, education, income, marital status and living arrangements) and health related factors (physical, psychological, meal pattern and current nutritional health status) was evaluated (Sharkey et al 2002). The subjects did not meet the recommended dietary allowances - adequate intake (RDA-AI) for energy and 7 micro nutrients (Vitamin D, E, B_6, folate, calcium, magnesium and zinc). Diets of women (compared to men) met a significantly lower percent of RDA - AI for vitamin D, E and B_{12}, folate, calcium, iron, phosphorous, riboflavin and selenium. For both men and women, the nutrients for which the largest proportion of subjects had inadequate intakes were vitamin E (94 %), magnesium (81 %) and zinc (51 %). The results also suggested that the nutrient intakes of a sizable proportion of subjects were inadequate for multiple nutrients ; 27 % for ≥ 6 nutrients, 40 % for 3 - 5 nutrients, 29 % for 1 or 2 nutrients. The study thus revealed that regardless of health related factors, women, blacks and those with low income and limited education were the most vulnerable for low nutrients intakes. Women had significantly lower intakes of total energy, protein and 15 of 16 vitamins and minerals as compared to men.

Present study also revealed differences in the nutrient intakes between men and women. Similar findings were observed by Marshall et al (2001) to assess the dietary habits and nutrient intakes of an elderly population aged 65 years and above (n = 420) from Iowa. The energy intake of men was found to be higher than women (6775 kcal vs 6140 kcal). However, intake of protein (60 g vs 54 g), fat (57 g vs 51 g) and fiber (16 g vs 15 g) did not differ much between the genders. The findings of our study support the results obtained from the above mentioned study.

Addition of fat and oil on various food items is commonly practiced in this part of the country. However, data on fat toppings is very scarce. Use of fat and / or oil was reported on khichadi and roti by men and women selected for the present phase in our study. Since majority of the subjects were gujaratis, roti constituted the main item of their diet along with khichadi which is frequently prepared in their households, fat topping on these two frequently consumed item was reported. Similar findings were observed by Iyer (2000) in a study carried out on 60 elderly men aged 70 years and above.

Food intakes in terms of various food groups assessed in our study revealed decreased intake of cereals by both men and women as compared to the suggested RDA. Consumption of other food groups were higher than the suggested recommendation in these subjects. this findings supports the findings on a study carried out by Murgai (1999) on 50 elderly from rural Punjab. A reduced intake of cereals with advancing age was reported in her study. However, along with cereals, consumption of other food groups such as pulses, roots and tubers, other vegetables and fruits were also found to be less than the suggested RDA. This finding contradicts the findings of our study as far as other food groups are concerned. The reduced consumption of green leafy vegetables and other vegetables were less in the younger men and women in our study as compared to their elderly counterparts. This may be attributed to the less preferences of vegetables in their diets. However, higher intake of fruits was found to be higher in the younger group than the elderly. This may be because of the general perception among elderly that fruits are more important for the children and younger people. Hence, they have self imposed restriction on themselves as far as fruits consumption is concerned.

A similar study on fruit consumption pattern was carried out by Shah (2003) on 130 men, 184 women (aged 18 years and above) and 51 children (aged 1 - 17 years) from the free living population of Urban Vadodara. The results revealed that the average fruit consumption of adults was 100 g / week and that of children was 135 g / week which was below recommended intake. Data on dietary intake was also assessed in terms of frequent consumption of cereals, pulses, vegetables, fruits and fat rich food items like sweets and snacks. Frequent consumption of cereals by men and women observed in our study was maybe due to cereal based diets consumed by majority of the subjects. Moreover, cereal 'bajra' was also reported consumed frequently during winter season by these subjects in various forms.

A linear relationship has been observed between higher education level and increased intake of antioxidants like β-carotene and vitamin C by the subjects in our study. This results indicate awareness about beneficial role of consumption of antioxidants vitamins in subjects with higher educational level. A survey was carried out on 2213 Dutch elderly men and 3193 elderly women (55 years and above) from the district of Rottendam to assess the education and nutrient intake (Rossum et al 2000). Lower educated men and women had higher intake of almost all macronutrients compared with higher educated subjects. The total energy intake of men/women with lowest education vs highest education was 9.60/7.54 vs 8.94/7.17 MJ/day. Also intake of

visible fat (46/37 vs 44/34 g/day) and meat consumption (130/100 vs 116/86 g/day) was higher in lower educated subjects as compared to the higher educated men and women. The higher educated used relatively more lean mean and low fat milk products. On the contrary, fibre intake was intake was lower in lower educated (1.88/2.17 vs 2.03/2.29 g/day). However, this study did not find difference in the intake antioxidants vitamins from food between educational groups. This finding contradicts the findings observed in our study regarding the relationship between educational status and antioxidants vitamin consumption from foods.

Consumption of pulses was found to be non-frequent by almost 2/3rd of the men and women in our study. This may be because majority of the subjects complained of gastrointestinal problems like flatulence and heaviness in stomach after consumption of pulses and legumes.

The role of dietary factors, particularly micronutrient vitamins, in the prevention of the major chronic diseases has been the focus of an ever - growing body of scientific investigations. Mounting evidence from laboratory and human studies points to the action of free radicals species in the pathogenesis and to the potential efficacy of vitamin C, vitamin E and β-carotene in reducing the risk of cardiovascular diseases, cancer and degenerative eye disorders. Epidemiologic data support the association between high intake of vegetables and fruits and low risk of chronic diseases. There were several biologically plausible reasons why consumption of vegetables and fruits might slow or prevent the onset of chronic diseases. Vegetables and fruits are rich sources of a variety of nutrients including antioxidants vitamins (A and C), trace minerals, dietary fibres and many other classes of biologically active compounds.

In our study frequent consumption of green leafy vegetables and vegetables rich in isoflavonoids was reported by higher number of men and women. However, consumption of vegetables rich in β-carotene was found to be non-frequent by majority of the subjects. Data on consumption of fruits revealed frequent intake of β-carotene rich fruits but non-frequent intake of vitamin C rich citrous fruits by majority of the subjects. These findings can have implications on the health of the subjects considering that a diet rich in vegetables and fruits may provide protection against CVD (Ness and Powles 1997) and several common cancers (Steinmetz and Potter 1996) and other chronic diseases. However, certain dietary or lifestyle pattern, rather than an individual constituent, plays a role in disease prevention.

Available evidence indicates that persons who consume more fruits and vegetables often have lower prevalence of important risk factors for CVD, including hypertension, obesity and type 2 diabetes mellitus. Recent large, prospective studies also show a direct inverse association between fruits and vegetable intake and development of CVD incidents such as coronary heart disease and stroke (Bazzano et al 2003).

John et al (2002) in their on study on 690 healthy participants (25-64 years) assessed the effect of an intervention of increased fruits and vegetables consumption on plasma concentration of antioxidants vitamins, daily fruits and vegetable intake and blood pressure. Intervention was in terms of encouraging the subjects to increase the consumption of fruits and vegetables to at least five portions per day. Findings revealed that the plasma concentration of α-carotene, β-carotene, lutein, β-cryptoxanthin and ascorbic acid increased by more in the intervention group than in the controls (from p=0.032 to 0.002). Self reported fruit and vegetable intake increased by 1.4 ± 1.7 portions in the intervention group and by 0.1 ± 1.3 portion in the control group. Systolic blood pressure fell more in the intervention group than in the controls (difference = 4.0 mmHg, $p < 0.001$), as did diastolic blood pressure (1.5 mmHg, $p < 0.02$). The study thus concluded that intervention of fruits and vegetables consumption would be expected to reduce cardiovascular diseases in the general population.

A review on fruits and vegetables and cardiovascular diseases was done by Ness and Powles (1997). All the ecological, case-control, cohort and unconfounded studies carried out from 1966-1995 in humans were included. For coronary heart disease nine of ten ecological studies, two of three case-control studies and six of 16 cohort studies found a significant protective association with consumption of fruit and vegetables. For stroke three of five ecological studies, none (of one) case-control study and six of eight cohort studies found a significant protective association with consumption of fruit and vegetables. The results of all these studies thus show a protective effect on stroke and coronary heart diseases.

Our study revealed difference in the consumption of fruits and vegetables by men and women. Less preference for vegetables by men and fruits by women was revealed. A similar survey was carrried out by Baker and Wardle (2003) on sex differences in fruit and vegetable intake in 1024 older adults across UK. Men were found to be consuming fewer servings of fruits and

vegetables daily than women (2.52 vs 3.47, $p < 0.01$). Women rated their liking for vegetables but not fruit.

Many nutrient vitamins such as vitamin C, E and β-carotene along with phytochemicals present in fruits and vegetables could be independently or jointly responsible for the apparent reduction in various disorders or significantly delay the development of various pathologic processes. These vitamins and phytochemicals present in the foods are involved in the antioxidants defense of cells. Vegetable oils, nuts and oilseeds are the main dietary sources of vitamin E whereas fruits and vegetables are the primary source of vitamin C, β-carotene and phytochemicals.

Epidemiologic evidence of a protective effect of vitamin C for non-hormone dependent cancers is strong. Of the 46 such studies in which a dietary vitamin C index was calculated, 33 found statistically significant protection with high intake conferring approximately a two fold protective effect compared with low intake. For cancers of esophagus, larynx, oral cavity and pancrease, evidence for a protective effect of vitamin C is strong and consistent (Block 1991).

A multicenter study on 190 men and women from United States, evaluated the association between diet and incidence of oral and pharyngeal cancer among black Americans. A lower risk of these cancer was associated with an increased intake of fiber, carotene, and vitamin C and E in men and of vitamin C and fiber in women (Gridley et al 1992).

In the Harvard based 8 year study of 87245 healthy nurses in the United States, the women in the top fifth vitamin E intake had a 34 % lower relative risk of major coronary disease than women in the lowest fifth, after adjustments for age and smoking (Stampher et al 1993). The same author reported reduced risk of coronary artery disease with high intake of β-carotene along with the plasma level.

Similarly, the Basal Prospective Study on 2974 healthy male volunteers revealed that after 12 years of follow up, low plasma concentrations of vitamin C and β-carotene increased the risk of coronary heart disease (Grey 1993). Also, a significantly lower mean carotene levels for all cancer ($p < 0.01$) was observed in the same study (Stehelin et al 1991).

The present study also reported higher consumption of flavonoids rich vegetables. These phenolic "Bioactive compounds" are the extranutritional constituents that typically occur in

small quantities in fruits, vegetables and beverages like tea and wine. These compounds have been shown to have antioxidants properties and also shown to be inversely correlated with mortality due to coronary heart diseases. The Zutphen Elderly Study (Hertog 1993) showed inverse association of flavonoid intake with coronary heart disease. The study revealed that when the flavonoid intake was less tha 19 mg/day, the coronary heart disease mortality rate was 18.5/1000 person per year which decreased significantly to 7.8/1000 person per year, when the flavonoid intake was increased to more than 30 mg/day.

These results can be more encouraging for the subjects from the free living population as high intake of vitamin C and β-carotene along with flavonoids was observed through their daily diets. Also considering the fact that the incidences of cardio vascular diseases and cancers are increasing at an alarming rate, higher consumption of antioxidants vitamins from the diet should be encouraged.

A sedentary activity pattern of all the subjects was indicated in the present study. These findings are consistent with the observations made my Mehta et al (1998) who reported sedentary activity pattern of pre-geriatric and geriatric men and women from the free living population of Urban Vadodara. However, it should also be kept in mind that a sedentary lifestyle may predispose the healthy subjects to various health disorders in future.

The addiction pattern of the subjects selected for the present study indicated addiction to smoking cigarette/bidi, alcohol drinking and tobacco chewing by $1/5^{th}$ of the subjects. However, the number of years of addiction along with the frequency of addiction per day, of these subjects was less.

Smoking along with alcohol and tobacco addiction is a major risk factor for CVD, respiratory diseases and cancers. It has been postulated that the increased risk for these diseases among those who smoke compared with those who do not smoke may be due in part to differences in other lifestyle behaviors, including dietary habits.

In the second National Health and Nutrition Examination Survey (NHANES II), people who smoke reported lower intakes of Vitamin C, folate, fiber and vitamin A than those who do not smoke (Subar et al 1990). People who report smoking also tend to have higher intakes of saturated fatty acids and lower intakes of polyunsaturated fat, iron, β-carotene and vitamin E compared with people who do not smoke (Troisi et al 1991; Nuttens et al 1992). In addition to a

poorer diet consisting of low intakes of fruits and vegetables that are rich in antioxidants, people who smoke are more likely to be susceptible to oxidative damage caused by free radicals, produced by cigarette smoke. However, such data on nutritional adequacy and variability in nutrient intake among people who smoke, could not be assessed in the present phase of the study as only few subjects reported addiction to smoking.

Moderate alcohol consumption (1 or 2 drinks) have been shown to beneficially affect the life expectancy notably through a protective effect on coronary artery disease, mediated by an increase in HDL concentration (Thun et al 1997). However, with higher alcohol intake, a change in the diet, have been shown. Kesse et al (2001) reported that with increasing alcohol consumption, higher intake of animal products, cheese, potatoes, oil, bread and breakfast cereals and lower consumption of vegetables and dairy products was found. Such differences in the dietary pattern and nutritional intakes, however, could not be evaluated in the present section of the study due to limited number of alcohol drinkers observed in our study.

A variety of tobacco habits are also prevalent in India and they differ from region to region. Tobacco use measured in form of duration of chewing, frequency of chewing per day, period of time chewed and retention of chewing betel quid with tobacco overnight while asleep has been shown as a major risk factor for cancers of oral cavity (Sankarnarayanan et al 1989). A cheap alternate of tobacco in form of ghutka is also very common in India especially in this part of the country. In the present study, $1/4^{th}$ of the men reported tobacco addiction since 5 - 15 years, the average amount chewed being 2.5 - 5.0 gm per day. The retention time of tobacco in mouth was though not more than 1 - 2 minutes in these subjects. However, even this fact of small subjects reporting tobacco chewing should not be neglected as the use of tobacco in any form increases the risk of oral cancer.

Along with the dietary and non-dietary factors, an attempt was also made to assess self reported personality traits such as presence of stress, anxiety and angry temperament which are known to affect human health, in the present study. These traits were reported by higher number of younger men and women (45-59 years) as compared to their elderly counterparts (60 years and above) in our study. Such personality traits may play an important part along with other modifiable and non-modifiable factors in making the adult population at increased risk for cardiac events and other health disorders in future. However, since these traits were self reported responses of the subjects and a proper validated standardised scale to measure level

and frequency of stress, anxiety and angry temperament, was not used, a strong conclusion regarding the affect of these traits on the overall health and nutritional status of the subjects could not be assessed in the present study.

The disease profile of the subjects selected in our study indicated complaints of oral cavity and gastrointestinal tract (GIT) problems by higher percentage of elderly men and women. Oral cavity problems may be attributed to loss of teeth resulting in difficulty in chewing in the elderly thereby leading to reduced intake of fiber rich foods. This also predisposed an individual to various GIT problems like constipation, flatulence and decrease in digestive capacity. The younger subjects in the present reported nervous problems which shows in the personality traits of these subjects assessed in the present study. Locomotor problems were also found to be more prevalent in elderly group especially women, selected in the present study. Similar observations have been made by other workers (Mehta et al 1999). The vicious cycle of reduced food intake with various health ailments in elderly is common as physiological changes associated with age, including slower gastric emptying, altered hormonal responses, decreased basal metabolic rate, and altered taste, smell as well as mastication may contribute to decreased food intake. Present study also reported nervous problems prevalent in more number of younger men and women as compared to their elderly counterparts. This may thus be found to be reflected on the personality traits of the younger subjects who reported more stress, anxiety and angry temperament than their elders.

Thus, following are the highlights of section I

HIGHLIGHTS

- *Majority of the subjects had BMI within the normal range indicating low prevalence of obesity in elderly.*
- *Increase in the educational level was found to have a direct relationship with the intake of antioxidants rich vitamins like β-carotene and vitamin C.*
- *Frequent consumption of fruits and vegetables was reported by majority of the men and women from both the age groups.*
- *Lower addiction pattern was prevalent in the elderly men.*
- *Personality traits such as stress, anxiety and hot temperament were reported by higher number of younger men and women as compared to their elderly counterparts.*
- *There seems to be an increase in the disorders of oral cavity, gastro intestinal tract and locomotor systems with the advancing age.*

SECTION II

ASSESSMENT OF SOCIO-DEMOGRAPHIC PROFILE, NUTRITIONAL STATUS, DIETARY PATTERN, LIFESTYLE FACTORS AND ANTIOXIDANTS PROFILE IN SUBJECTS SUFFERING FROM CARDIO VASCULAR DISEASES (45 YEARS AND ABOVE).

RESULTS

This section reports the findings of the baseline information of the subjects suffering from cardio vascular diseases. Baseline data included socio-demographic profile, nutrition, diet, and lifestyle factors such as addiction pattern and activity pattern and disease profile. Assessment of antioxidants profile was done in diet as well as from blood. Subjects for this section were selected from the Jivraj Mehta Hospital, Ahmedabad.

This section also reports similar findings on controls i.e subject without any cardiovascular diseases. These controls were selected from the free living population after matching for age (± 2 years) and economic status.

The results are discussed in accordance with the objectives of the present section under the following heads:

A. TYPES OF CARDIOVASCULAR DISEASES (CVD) AMONG THE CASES

B. SOCIO-DEMOGRAPHIC PROFILE

C. NUTRITIONAL STATUS

D. DIETARY INTAKE

E. ACTIVITY PATTERN

F. ADDICTION PATTERN

G. OTHER FACTORS

H. DISEASE PROFILE

I. BIOCHEMICAL PARAMETERS

J. STRAITIFIED ANALYSIS OF VARIOUS FACTORS ACCORDING TO AGE AND SEX.

A) TYPES OF CARDIO VASCULAR DISEASES (CVD) DIAGNOSED AMONG THE CASES

Freshly diagnosed men and women (aged 45 years and above) with any of the CVDs, by a physician, were enrolled for this phase from the year 2000-2001 from the Jivraj Mehta hospital, Ahmedabad and were categoried according to the types of the disease as seen in table 1(b).

Table 1(b) : Types of CVD diagnosed among the subjects (aged 45 years and above)

Diagnosis	Men (N = 63)	Women (N = 38)	Total (N=101)
Ischemic Heart Disease (IHD)	38 (24)	29 (11)	34.65 (35)
Myocardial Infraction (MI)	62 (39)	71 (27)	65.34 (66)

As seen from the above table, majority of men (62 %) and women (71 %) were suffering from MI followed by IHD (Men - 38 % ; Women - 29 %). Among various types of CVD, myocardial infraction was found to be common in more than 65 % of the subjects.

B) SOCIO - DEMOGRAPHIC PROFILE

The data on socio-demographic profile of the cases as well as controls were acquired using a pre-tested questionnaire. Following table reveals the baseline characteristics of men and women with and without CVD.

The socio-demographic profile of men as seem from the table indicated that the mean age of occurrence of CVD in men was 60 years. Marital status showed that majority of men (98 %) with and without CVD were married. More than 90 % of men were Hindus and belonged to gujarati ethnic group. A difference in the level of education was observed in men with and without CVD. Forty one percent of the cases had only school level education as compared to 43 % of the controls who had university education. Fifty six percent of the cases resided in joint families as against 3/4th of the controls who stayed in nuclear families. The economic status of the subjects revealed that majority (80 %) of the cases belonged to the middle income group.

Table 2(b) : Socio demographic information of men and women (aged 45 years and above) with and without CVD.

Characteristics	Men		*Women*	
	Cases (N = 63)	Controls (N = 63)	Cases (N = 38)	Controls (N = 38)
Age (years)				
45 - 59	49.20 (31)	49.20 (31)	34.21 (13)	34.21 (13)
≥ 60	50.79 (32)	50.79 (32)	65.78 (25)	65.78 (25)
Mean ± SD	**60.46 ± 9.73**	**61.63 ± 10.21**	**65.95 ± 10.17**	**66.02 ± 10.64**
Marital status				
Married	98.41 (62)	100 (63)	100 (38)	100 (38)
Single	1.59 (1)	-	-	-
Religion				
Hindu	92.06 (58)	92.06 (58)	78.95 (30)	78.95 (30)
Muslim	3.17 (2)	3.17 (2)	7.89 (3)	7.89 (3)
Jain	3.17 (2)	3.17 (2)	7.89 (3)	7.89 (3)
Others	1.59 (1)	1.59 (1)	5.26 (2)	5.26 (2)
Ethnic group				
Gujarati	85.71 (54)	88.89 (56)	76.32 (29)	65.79 (25)
Non - gujarati	14.29 (9)	11.11 (7)	23.68 (9)	34.21 (13)
Education level				
Illiterate	1.59 (1)	0	23.68 (9)	7.89 (3)
School	65.08 (41)	31.75 (20)	68.42 (26)	55.26 (21)
University	33.33 (21)	68.25 (43)	7.89 (3)	36.84 (14)
Family type				
Nuclear	44.44 (28)	47 (74.60)	14 (36.84)	17 (44.74)
Joint	55.56 (35)	16 (25.40)	24 (63.16)	21 (55.26)
Economic status				
Upper	9.52 (6)	9.52 (6)	2.63 (1)	2.63 (1)
Middle	80.95 (51)	80.95 (51)	81.58 (31)	81.58 (31)
Lower	9.52 (6)	9.52 (6)	15.79 (6)	15.79 (6)

(Figure in parenthesis indicate number of subjects)

The socio-demographic profile of women with and without CVD, as seen from above table, indicated that the mean age of the occurrence of CVD in women was 66 years. All the women were married and more than 3/4th of the subjects were Hindus. Higher number of cases (76 %) were gujarati than controls (66 %). The educational level of the women revealed that 26 % of the cases had school education as against 15 % of the controls who had higher education till university level. The economic status of the women revealed that more than 80 % of the subjects belonged to the middle income group.

C) NUTRITIONAL STATUS

Nutritional status of men and women with and without CVD was assessed using anthropometric measurements in terms of height, weight and body mass index (BMI).

I) ANTHROPOMETRIC MEASUREMENT

The data on anthropometric measurements of men and women was assessed in terms of height, weight and body mass index (BMI) as given in table 3(b).

Table 3(b) : Mean anthropometric measurements and BMI cutoffs of men and women (aged 45 years and above) with and without CVD

Parameters	Men		't' value	Women		't' value
	Cases (N = 63)	Controls (N = 63)		Cases (N = 38)	Controls (N = 38)	
Height (cm)	155.39 ± 2.78	161.03 ± 5.26	5.41*	151.50 ± 1.94	151.98 ± 5.92	0.23
Weight (kg)	64.16 ± 11.86	64.44 ± 9.26	0.15	55.21 ± 11.54	58.68 ± 12.66	1.25
BMI (Ht / m^2)**	26.68 ± 4.76	24.91 ± 3.63	1.77	24.07 ± 5.04	25.26 ± 4.77	1.06
<18.5 (Underweight)	4.76 (3)	0 (0)		7.89 (3)	0 (0)	
18.5-24.9 (Normal)	31.74 (20)	42.86 (27)		34.21 (13)	52.63 (20)	
25.0-29.9 (Overweight)	46.03 (29)	52.38 (33)		42.11 (16)	36.84 (14)	
>30 (Obese)	17.46 (11)	4.76 (3)		15.79 (6)	7.89 (3)	

(Figure in parenthesis indicate number of subjects)

*$p \leq 0.001$

** *Source : World Health Organisation. Physical Status : The use and interpretation of anthropometry. Geneva, Switzerland: World Health Organisation 1995. WHO Technical Report Series.*

The anthropometric indices of men showed no difference in the measurements of weight and BMI. However, significant difference was observed in height, which was higher in the cases as compared to the controls.

No significant difference was observed in any of the anthropometric measurements of women with and without CVD as seen from the above table.

Prevalence of obesity was found to be 17 % in men with CVD as compared to 4 % of their healthy counterparts.

Similar observations were noted for women with and without CVD as given in figure 1b (15 % vs 7 % respectively).

D) DIETARY INTAKE

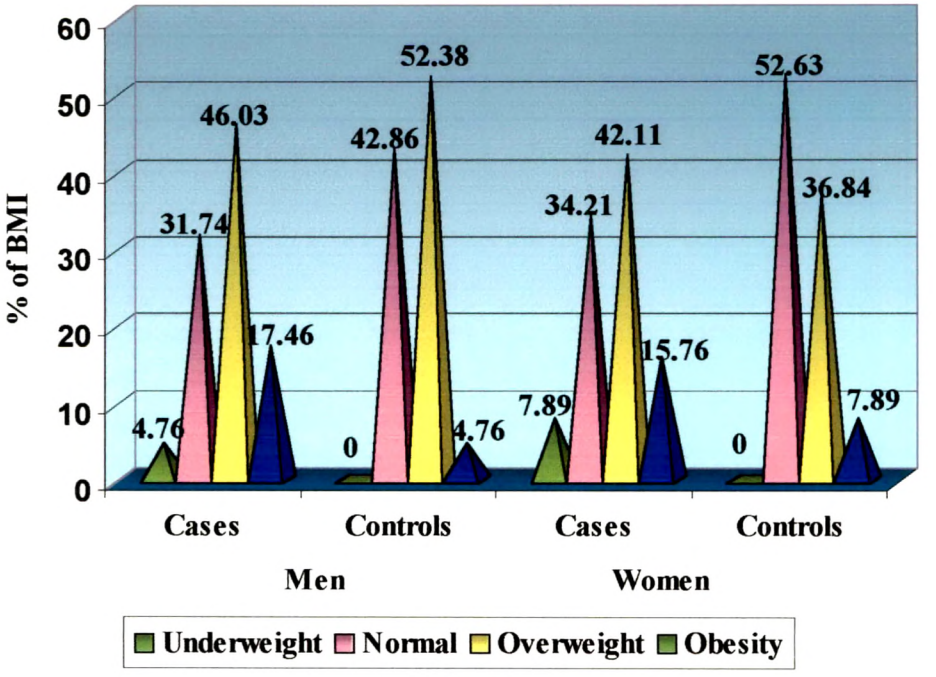
The dietary intake was assessed in terms of changes made in food consumption, dietary pattern, types of oil and fats consumed, fat topping, mean nutrients intake and food frequency.

I) CHANGES IN FOOD CONSUMPTION PATTERN

Self reported changes made by subjects over a period of 5 - 10 years were studied. No major change in food consumption was reported by men with and without CVD. Few changes that were made mainly attributed to general well being in case of controls. These changes were in terms of reduction in consumption of fats and oils based food. However, increase in fruits and vegetables were not reported by either cases or controls.

In case of women, no change in food consumption pattern was observed. However, reduced consumption of overall diet was reported by elderly women mainly because of decrease in their digestive capacity.

Figure 1b : Percentage distribution of weight in men and women (aged 45 years and above) with and without CVD with respect to BMI



II) DIETARY PATTERN

Consumption of vegetarian, non-vegetarian and ovo-vegetarian diets by men and women with and without CVD were also assessed as shown in table 4b.

Table 4b : Percentage of men and women (aged 45 years and above) with and without CVD habituated to the type of dietary pattern

Food type	*Men*		Women	
	Cases (N = 63)	Controls (N = 63)	Cases (N = 38)	Controls (N = 38)
Vegeterian	85.71 (54)	84.13 (53)	78.95 (30)	97.37 (37)
Non - vegetarian	7.94 (5)	11.11 (7)	10.53 (4)	0
Ovo-vegetarian	6.35 (4)	4.76 (3)	10.53 (4)	2.63 (1)

(Figure in parenthesis indicate number of subjects)

Vegetarianism was pre-dominantly reported by more than 80 % of men with and without CVD as seen from the above table.

The habitual diet consumed by majority of women with and without CVD was also vegetarian as was also reported by men.

Very few percentages of men and women with and without CVD were found to be consuming non-vegetarian and ovo-vegetarian diets as seen from the above table.

III) TYPES OF OIL AND FAT CONSUMED

Various types of oils are consumed in Gujarat. In some households, 2 or 3 oils are also blended and used in combination for various preparations. Therefore, the oil consumption pattern of the subjects selected for the present phase was noted as shown in table 5b.

Consumption of groundnut oil was around 60 % by men with and without CVD followed by consumption of cottonseed oil. Use of other oils like sunflower or mustard or blend of 2 oils was reported by very few subjects.

Use of fat in form of dalda (vanaspati) or ghee (clarified butter) is also very common in Indian diets. Majority of men with and without CVD reported more consumption of ghee over dalda (Cases - 66 % ; Controls - 81 %).

Table 5b : Types of oil and fat consumed by men and women (aged 45 years and above) with and without CVD

Type of oil	Men		Women	
	Cases (N = 63)	Controls (N = 63)	Cases (N = 38)	Controls (N = 38)
Cottonseed	22.22 (14)	28.57 (18)	42.11 (16)	31.58 (12)
Groundnut	66.67 (42)	57.14 (36)	50.00 (19)	34.21 (13)
Sunflower	9.52 (6)	6.35 (4)	5.26 (2)	5.26 (2)
Mustard	1.59 (1)	1.59 (1)	2.63 (1)	5.26 (2)
Combination *	4.76 (3)	6.35 (4)	0	23.68 (9)
Type of fat				
Dalda	17.46 (11)	9.52 (6)	26.31 (10)	15.79 (6)
Ghee (clarified butter)	66.66 (42)	80.95 (51)	57.89 (22)	73.68 (28)
Never	15.87 (10)	9.52 (6)	15.78 (6)	10.53 (4)

(Figure in parenthesis indicate number of subjects)
* *cottonseed + groundnut, cottonseed + mustard, mustard + sesame oil*

Data on type of oil used by women subjects pinpointed at almost equal consumption of both cottonseed and groundnut oil as can be seen from the above table. The consumption of both these oils was around 50 % in cases and around 30 % in controls. A combination of 2 oils mainly cottonseed and groundnut was also reported by 24 % of the controls. However, these oils were not blended for consumption but were used separately for different food preparations which required seasoning, shallow frying, deep frying, making pickles or as additional topping on various recipes.

Information on commonly consumed fat like dalda and clarified butter by women with and without CVD was also collected. The consumption of ghee (clarified butter) was reported by half of the cases and 3/4th of the control subjects as observed in above table.

IV) FAT TOPPING

Use of extra raw fat or oil as a topping on various frequently and non-frequently prepared food items, is a common practice in gujarat. The amount of fat, thus used as a topping, adds to the total fat intake from the diet and increases the risk of developing CVD in the population. Hence, information on fat topping by the subjects was also collected (table 6b).

Table 6b : Percentage of the men and women (aged 45 years and above) with and without CVD consuming additional fat / oil as a topping.

Food Items	Men		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Rice				
Yes	7.94 (5)	3.17 (2)	13.16 (5)	7.89 (3)
No	92.06 (58)	96.83 (61)	86.84 (33)	92.11 (35)
OR (95 % CI)	**2.63 (0.41-28.43)**		**1.77 (0.31-2.20)**	
$\chi 2$ (p value)	**$\chi 2 = 1.36$ (0.24)**		**$\chi^2 = 0.56$ (0.45)**	
Roti				
Yes	84.13 (53)	65.08 (41)	71.05 (27)	52.63 (20)
No	15.87 (10)	34.92 (22)	28.95 (11)	47.37 (18)
OR (95 % CI)	**2.84 (1.13-7.29)**		**2.21 (0.78-6.37)**	
$\chi 2$ (p value)	**$\chi^2 = 6.03$ (0.01*)**		**$\chi^2 = 2.73$ (0.09)**	
Khichadi				
Yes	68.25 (43)	61.90 (39)	52.63 (20)	47.37 (18)
No	31.75 (20)	38.10 (24)	47.37 (18)	52.63 (20)
OR (95 % CI)	**1.32 (0.60-2.95)**		**1.23 (0.46-3.36)**	
$\chi 2$ (p value)	**$\chi^2 = 0.56$ (0.45)**		**$\chi^2 = 0.21$ (0.64)**	
Handwa				
Yes	25.40 (16)	25.40 (16)	31.58 (12)	21.05 (8)
No	74.60 (47)	74.60 (47)	68.42 (26)	78.95 (30)
OR (95 % CI)	**1.00 (0.42 - 2.40)**		**1.73 (0.55-5.55)**	
$\chi 2$ (p value)	**$\chi^2 = 0.00$ (1.00)**		**$\chi^2 = 1.09$ (0.29)**	
Dhokla				
Yes	20.63 (13)	14.29 (9)	26.32 (10)	28.95 (11)
No	79.37 (50)	85.71 (54)	73.68 (28)	71.05 (27)
OR (95 % CI)	**1.56 (0.56-4.38)**		**0.88 (0.29-2.69)**	
$\chi 2$ (p value)	**$\chi^2 = 0.88$ (0.34)**		**$\chi^2 = 0.07$ (0.79)**	
Any other				
Yes	11.11 (7)	41.27 (26)	57.89 (22)	15.79 (6)
No	88.89 (56)	58.73 (37)	42.11 (16)	84.21 (32)
OR (95 % CI)	**0.18 (0.06 - 0.49)**		**7.33 (2.22-25.33)**	
$\chi 2$ (p value)	**$\chi^2 = 14.82$ (0.00**)**		**$\chi^2 = 14.48$ (0.00**)**	

(Figure in parenthesis indicate number of subjects)
*$p < 0.05$, **$p < 0.01$

Consumption of roti with extra fat as a topping was significantly associated (OR=2.84, $\chi 2$=6.03) with the occurrence of CVD followed by intake of rice, dhokla and khichadi in case of men as shown in the above table.

Similar finding were obtained for consumption of roti (OR=2.21) with added fat or oil by women. Intake of other non-frequently prepared food items such as vedmi or khichu were also found to be positively associated with the occurrence of CVD in case of women (OR=7.71). Consumption of other food items like rice and handwa were associated to a lesser extent with the occurrence of CVD as seen from the above table.

V) NUTRIENT INTAKE

The dietary intake of one normal routine day by the subjects' was noted using tools and techniques same as 24 hour dietary recall method. From this data, nutrient intake per day was calculated in terms of energy, proteins, fats, fibre, calcium, iron, along with antioxidants vitamins such as β-carotene and vitamin C as given in following tables

A. NUTRIENT INTAKE OF MEN

The mean nutrients intake of men (aged 45 years and above) were assessed as given in table 7b. The nutrient intake data was further analysed with respect to percentage of RDA met by the younger (45-59 years) as well as the elderly men (≥ 60 years) as shown in table 8b and 9b.

As seen from table 7b, younger men with CVD met more than 3/4th of the energy and protein requirements as compared to their controls who could meet just over half of the daily requirements for energy and 2/3rd of the RDA for protein. However, a significant difference ($p \leq 0.001$) was found in the consumption of fat which was higher in younger men with CVD as compared to their controls. Similar observations were noted for the fibre intake which was significantly higher ($p \leq 0.05$) in the younger men without CVD as against their diseased counterparts. Calcium requirements exceeded the recommended allowances in the younger men with and without CVD, however, there were no significant differences between the two. Similar findings were obtained for iron intake in both the cases and controls who met less than half of the RDA for iron. A significantly higher intake ($p \leq 0.01$) of dietary β-carotene was observed in the younger men controls who met more than 3/4th of its requirement as compared to the cases who could not meet even the 2/5th of the β-carotene requirements. Consumption of vitamin C

by the control men (45-59 years) was significantly higher ($p \leq 0.001$) in the younger men without CVD as compared to the cases. The intake of vitamin C by the younger men without CVD was more than double the recommended intakes whereas men with CVD could just meet the daily requirements for vitamin C as can be seen from the table.

Table 7b : Mean consumption of various nutrients by the men (aged 45 years and above) with and without CVD

Nutrients	RDA#	Men (45-59 years)		t value	Men (60 years+)		t Value
		Cases (N=31)	Controls (N=31)		Cases (N=32)	Controls (N=32)	
Energy (kcal)	2425/ 1750##	1635 ± 539	1393 ±517	1.08	1466 ±552	1410 ±517	0.42
Proteins (gm)	60	47.87 ± 18.38	43.20 ±10.52	1.23	42.56 ±14.39	46.92 ±13.22	1.26
Fats (gm)	20	61.71 ± 25.22	40.69 ±13.33	4.10*	54.14 ±12.42	44.80 ±14.93	2.72**
Fibre (gm)	20	5.51 ± 1.81	7.84 ±5.42	2.27 ***	4.29 ±1.85	6.27 ±2.80	3.34**
Calcium (mg)	400	607 ± 240	678 ±222	1.21	674 ±308	747 ±328	0.92
Iron (gm)	28	12.75 ± 4.88	11.58 ±4.42	0.98	11.86 ±7.07	11.70 ±5.84	0.09
β - carotene (μg)	2400	944 ± 918	2270 ±2105	3.22**	908 ±553	1595 ±1531	2.38 ***
Vitamin C (mg)	40	39.00 ± 32.13	88.36 ± 51.21	4.55*	35.22 ±34.35	88.57 ±56.69	4.55*

 # Nutrient Requirements and Recommended Dietary Allowances for Indians, ICMR(2002)
For elderly subjects : source - Natarajan (1991)
** $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$*

The nutrient intake data of the elderly men (60 years and above) with and without CVD was also assessed as given in the above table. The elderly men cases could meet more than $3/5^{th}$ of the requirements for energy as against their healthy controls who met less than $3/5^{th}$ of the energy requirements when compared to the recommendations given by the ICMR (2002).

However, on comparison with the suggested RDA given by Natarajan (1991), both the cases and controls fared better, meeting more than 3/4th of the RDA for energy. Similar observations were obtained for protein intake. However, no significant difference was observed for energy and proteins between the cases and controls. Consumption of fat, which was exceeding the RDA in both cases and the controls, was noted to be significantly higher ($p \leq 0.01$) in the elderly men with CVD than their counterparts. Similar findings were observed for fiber intake which was significantly higher ($p \leq 0.001$) in controls than in the cases (60 years and above). Though, the elderly men with and without CVD had satisfactory calcium intake above the recommended allowances, there was no significant difference observed between the two groups. Similarly, no significant difference was indicated in the iron intake of the cases and controls, who did not meet even half of the recommended levels for iron. β-carotene ($p \leq 0.05$) and vitamin C consumption was reported to be significantly higher ($p \leq 0.001$) in the elderly men without CVD as against their diseases counterpart as seen from the above table.

NUTRIENT INTAKE AS PERCENTAGE OF RDA BY MEN

The nutrients intake by the younger men (45-59 years) expressed at various levels of percentage of the RDA as given in table 8b revealed that majority of the younger men with CVD, met 50-75 % of the RDA for energy as compared to 45 % of their healthy elderly counterparts who could meet only 1/4th - 1/2 of the requirements for energy. Protein intake was noted to be 75-100 % of the RDA by 45 % of the cases whereas 54 % of the controls met only 50-75 % of the protein requirements. As against this, consumption of fat was found to be exceeding the recommended allowances by all the younger men with CVD as against 93 % of their controls. However, majority of the cases (61 %) and controls (64 %) reported 25-50 % of the fibre recommendations.

Intake of minerals such as calcium and iron were also evaluated. Calcium consumption was found to be satisfactory as 90 % of the cases as well as the controls met more than 100 % of the calcium requirements through their daily diets. On the contrary, only 25-50 % of the iron requirements were reportedly met by 58 % of the cases and 64 % of the controls.

Data on consumption of antioxidants vitamins indicated higher percentage of the younger controls (25 %) having more than 100 % of the recommended allowances for β-carotene. As against this, 45 % of the cases could meet only 1/4th to 1/2 of the β-carotene requirements

through their diets. Similarly, more than 80 % of the younger men without CVD reportedly consumed more than 100 % of the vitamin C requirements as compared to 35 % of their diseased counterparts as seen from the table 8a.

Consumption of nutrients at various levels of percentage of RDA by elderly men (60 years and above) is depicted in table 9b. Energy intake was found to be 50-75 % of the recommended allowances by 40 % of the cases as against 53 % of the controls who met 1/2 to $1/4^{th}$ of the energy requirements when compared the RDA given by the ICMR (2002). However, on comparison with the suggested RDA given by Natarajan (1991), 34 % of the cases could meet more than 100 % of the RDA against 40 % of the controls could meet 75-100 % of the RDA for energy. Protein intake was noted to be 50-75 % of the RDA by 40 % of the cases whereas 68 % of the controls met 75-100 % of the protein requirements. More than 95 % of the elderly men with and without CVD exceeded their fat intake from their diets. Fibre intake was less than $1/4^{th}$ of the recommendations in majority of the cases (68 %) whereas around half of the controls met $1/4^{th}$- 1/2 of the requirements for fibre.

Mineral intake data pinpointed at a satisfactory calcium intake, which exceeded the requirements in 90 % of the elderly men with and without CVD. As against this, more than half of the total elderly cases and controls met only $1/4^{th}$ - 1/2 of the requirements for iron.

Consumption of antioxidants vitamins such as β-carotene and vitamin C at various levels of RDA were also assessed. β-carotene intake was found to be 25-50 % of the RDA by $2/5^{th}$ of the elderly men with and without cardiovascular diseases. On the contrary, higher percentages of the elderly controls (78 %) met more than100 % requirements for vitamin C as against $1/4^{th}$ of their elderly diseased counterparts as seen from table 9b.

Table 8b: Percentage consumption of different nutrients at various levels of percent RDA by the men (45-59 years) with and without CVD

Nutrients	Cases (N=31)					Controls (N=31)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	3.22 (1)	16.13 (5)	51.61 (16)	19.35 (6)	9.67 (3)	0 (0)	45.16 (14)	32.26 (10)	16.13 (5)	6.45 (2)
Proteins (gm)	3.22 (1)	6.45 (2)	32.28 (10)	45.16 (14)	12.90 (4)	3.22 (1)	0 (0)	54.84 (17)	35.48 (11)	6.45 (2)
Fats (gm)	0 (0)	0 (0)	0 (0)	0 (0)	100 (31)	0	0 (0)	0 (0)	6.44 (2)	93.55 (29)
Fibre (gm)	38.71 (12)	61.29 (19)	0 (0)	0 (0)	0 (0)	19.35 (6)	74.19 (23)	0 (0)	0 (0)	6.45 (2)
Calcium (mg)	3.22 (1)	0 (0)	0 (0)	6.45 (2)	90.32 (28)	0 (0)	0 (0)	0 (0)	9.67 (3)	90.32 (28)
Iron (gm)	9.68 (3)	58.06 (18)	25.81 (8)	6.45 (2)	0 (0)	6.45 (2)	64.51 (20)	22.58 (7)	6.45 (2)	0 (0)
β - carotene (μg)	38.71 (12)	45.16 (14)	3.22 (1)	9.67 (3)	3.22 (1)	12.90 (4)	22.58 (7)	19.35 (6)	19.35 (6)	25.80 (8)
Vitamin C (mg)	12.9 (4)	12.90 (4)	3.22 (1)	6.45 (2)	35.48 (11)	3.22 (1)	0 (0)	6.44 (2)	6.45 (2)	83.87 (26)

(Figure in parenthesis indicate number of subjects)

Table 9b: Percentage consumption of different nutrients at various levels of percent RDA by the men (60 years and above) with and without CVD

Nutrients	Cases (N=32)					Controls (N=32)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	3.12 (1) / 3.12 (1)*	25.00 (8) / 12.5 (4)*	40.62 (13) / 28.12 (9)*	12.5 (4) /21.87 (7)*	18.75(6) /34.37(11)*	0 / 0*	34.37(11) /18.75(6)*	53.12(17) /21.87(7)*	3.12(1) /40.62(13)*	9.37(3) /18.75(6)*
Proteins (gm)	3.12 (1)	18.75 (6)	40.62 (13)	28.12 (9)	9.37 (3)	0 (0)	3.12 (1)	18.75 (6)	68.75 (22)	9.37 (3)
Fats (gm)	0 (0)	0 (0)	0 (0)	3.12 (1)	96.87 (31)	0 (0)	0 (0)	0 (0)	3.12 (1)	96.87 (31)
Fibre (gm)	68.75 (22)	31.25 (10)	0 (0)	0 (0)	0 (0)	37.5 (12)	53.12 (17)	9.37 (3)	0 (0)	0 (0)
Calcium (mg)	0 (0)	3.12 (1)	3.12 (1)	3.12 (1)	90.62(29)	0 (0)	6.25 (2)	0 (0)	15.62 (5)	78.12 (25)
Iron (gm)	21.87 (7)	56.25 (18)	9.37 (3)	6.25 (2)	6.25 (2)	21.87 (7)	50 (16)	18.75 (6)	6.25 (2)	3.12 (1)
β - carotene (μg)	31.25 (10)	40.62 (13)	21.87 (7)	3.12 (1)	3.12 (1)	15.62 (5)	43.75 (14)	15.62 (5)	6.25 (2)	18.75 (6)
Vitamin C (mg)	18.75 (6)	25.00 (8)	21.87 (7)	21.87 (7)	12.50 (4)	3.12 (1)	9.37 (3)	3.12 (1)	6.25 (2)	78.12 (25)

(Figure in parenthesis indicate number of subjects)

* Energy requirement for elderly - *Source* : Natarajan (1991)

A. NUTRIENT INTAKE OF WOMEN

The mean nutrients intakes of women (aged 45 years and above) were assessed as given in table 10b. The nutrient intake data was further analysed with respect to percentage of RDA met by the younger (45-59 years) as well as the elderly women (60 years and above) as shown in table 11b and 12b.

Table 10b : Mean consumption of various nutrients by the women (aged 45 years and above) with and without CVD

Nutrients	RDA#	Women (45-59 years)		t value	Women (60 years +)		t value
		Cases (N=13)	Controls (N=13)		Cases (N=25)	Controls (N=25)	
Energy (kcal)	1875/ 1350##	1278 ± 273	1374 ± 191	1.04	1313 ± 504	1309 ± 411	1.51
Proteins (gm)	60	37.78 ± 7.40	41.40 ± 5.79	1.38	38.92 ± 16.04	47.41 ± 14.28	1.98
Fats (gm)	20	48.15 ± 6.03	39.55 ± 7.55	3.21*	46.22 ± 15.39	42.97 ± 14.77	0.76
Fibre (gm)	20	4.58 ±1.56	7.44 ± 2.70	3.31*	4.06 ± 2.07	6.17 ± 2.65	3.14*
Calcium (mg)	400	555 ± 184	514 ± 90	0.72	653 ± 285	818 ± 423	1.62
Iron (gm)	30	9.36 ± 2.38	10.45 ± 1.32	1.45	10.02 ± 5.80	12.72 ± 6.09	1.61
β - carotene (μg)	2400	1021 ± 647	1315 ± 1226	0.76	799 ± 407	2164 ± 2272	2.96*
Vitamin C (mg)	40	42.96 ± 32.69	69.98 ± 37.30	1.96	40.69 ± 37.92	86.36 ± 64.41	3.05*

 # Nutrient Requirements and Recommended Dietary Allowances for Indians, ICMR(2002)
For elderly subjects : source - Natarajan (1991)
** $p \leq 0.01$,*

The above table reveals the mean consumption of various nutrients by women (45 years and above) with and without CVD. Consumption of macro-nutrients like energy and proteins were found to be higher in the younger controls than the cases. Though, both the younger cases and controls met more than 3/4th of the requirements for energy and protein, no significant

difference was observed between the subjects. However, the intake of fat, which exceeded the daily recommendations by the women with and without CVD, was significantly higher in the cases ($p \leq 0.01$) as compared to the controls. Significantly higher intake ($p \leq 0.01$) were observed in controls with respect to fibre, even though both the cases and controls could meet around $1/4^{th}$ of the fibre requirements. A higher calcium intake than the RDA was revealed in the cases as well as the controls. Though, the calcium consumption was found to be higher in cases than in controls, no significant difference was observed between the two groups. Similar findings were observed for iron intake which was higher in the controls than in the cases. Consumption of antioxidants rich vitamins like β-carotene and vitamin C, though higher in the younger women without CVD, did not reveal any significant difference when compared with the cases as can be seen from the above table.

The mean nutrient intake of the elderly women with and without CVD indicated that the consumption of energy was more than $2/3^{rd}$ of the recommended allowances given by the ICMR (2002) in both the cases as well as the controls. However, on comparison with the suggested RDA by Natarajan (1991), the elderly women subjects could almost meet the complete recommendations as seen from the table 10. Consumption of protein, though higher in the controls than the cases, could meet around $3/4^{th}$ of the RDA by both the groups. No significant difference was observed for fat intake between the cases and the controls, though both the groups exceeded their daily requirements for fat. Significant difference ($p \leq 0.01$) was observed in the fibre consumption, which was higher in controls. However, both the cases and the controls could meet around $1/4^{th}$ and $1/3^{rd}$ of the fibre requirements daily. Calcium and iron intake, though higher in control elderly women did not indicate any significant difference with the cases. Calcium intake was exceeding the RDA whereas iron intake was less than half of the daily recommendations by both the cases and the controls (aged 60 years and above). Significantly higher consumption ($p \leq 0.01$) of antioxidants rich vitamins like β-carotene and vitamin C was observed in controls as compared to the cases. The cases could meet $1/3^{rd}$ of the RDA for β-carotene against the controls who met more than 2000 μg of β-carotene requirements daily. The intake of vitamin C was above the recommended allowances in the elderly women with and without CVD as can be observed from the above table.

NUTRIENT INTAKE AS PERCENTAGE OF RDA BY WOMEN

The data on the nutrient intake by the women (45-59 years) and those aged 60 years and above, was further analysed at various levels of percentage of the RDA met, as given in table 11a and 12b, thereby showing either the deficit or excess of particular nutrients.

As seen from table 11a, 46 % of the younger women with CVD could meet 50-75 % of the RDA for energy and proteins as against half of the controls who could meet more than 100 % of the recommendations for energy. Protein intake was found to be 75-100 % of the recommended allowances by 69 % of the elderly controls. As against this, all the cases as well as the controls consumed fats at level more than the recommendations. Higher percentage of the younger women without CVD could meet atleast $1/4^{th}$ to 1/2 of the recommendations for fibre as against 61 % of the controls who consumed less than $1/4^{th}$ of their fibre requirements.

Minerals such as calcium and iron intake assessment revealed a satisfactory calcium consumption by higher percentages of women with out CVD (92 %) as compared to the cases (84 %). Similar percentages of the cases, however, met 25-50 % of the iron requirements against all the controls.

Consumption of antioxidants vitamins like β-carotene and vitamin C was also assessed. Though, 38 % of the cases and the controls met around 1/2 of the β-carotene requirements through their daily diets, against 15 % of the younger women without CVD, only 7 % of the cases met more than 100 % of the RDA for β-carotene. Intake of vitamin C was found to be exceeding in higher percentages of the younger controls (69 %) as compared to 38 % of their diseased counterparts as seen from the table 11b.

Table 11b : Percentage consumption of different nutrients at various levels of percent RDA by the women (45-59 years) with and without CVD

Nutrients	Cases (N=13)					Controls (N=13)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	0	15.38 (12)	46.15 (6)	38.46 (5)	0	0	0	0	46.15 (6)	53.85 (7)
Proteins (gm)	0	0	46.15 (6)	38.46 (5)	15.38 (2)	0	0	23.07 (3)	69.23 (9)	7.69 (1)
Fats (gm)	0	0	0	0	100 (13)	0	0	0	0	100 (13)
Fibre (gm)	61.54 (8)	38.46 (5)	0	0	0	7.69 (1)	84.61 (11)	0	7.69 (1)	0
Calcium (mg)	0	0	15.38 (2)	0	84.62 (11)	0	0	0	7.69 (1)	92.31 (12)
Iron (gm)	15.38 (2)	84.62 (11)	0	0	0	0	100 (13)	0	0	0
β - carotene (μg)	38.46 (5)	38.46 (5)	15.38 (2)	0	7.69 (1)	30.77 (4)	38.46 (5)	7.69 (1)	7.69 (1)	15.38 (2)
Vitamin C (mg)	15.38 (2)	15.38 (2)	23.07 (3)	7.69 (1)	38.46 (5)	0	7.69 (1)	0	23.07 (3)	69.23 (9)

(Figure in parenthesis indicate number of subjects)

The data of nutrient intakes expressed as percentage of RDA by the elderly women (60 years and above) has been given in table 12b. As seen from the above table, the energy intake was found to be between 25-50 % of the RDA by 32 % of the elderly women with CVD against 40 % of their respective controls who met 50-75 % of the energy when compared to the RDA given by the ICMR (2002). However, on comparing the energy intake with the suggested RDA given by Natarajan (1991), it was found that 44 % of the cases and 60 % of the controls could meet more than 100 % of the energy requirement. Consumption of protein was found to be between 75-100 % of the RDA by 32 % of the cases as compared to 40 % of the controls who met more than 100 % of the protein requirement. All the elderly women with CVD and 96 % of the controls exceeded their fat requirements. However, similar percentages of the cases and 92 % of the controls had fibre intake less than 50 % of the RDA.

As far as mineral intake through diets was concerned, 80 % of the cases and controls exceeded the daily recommendations of calcium. However, in contrast, the iron intake was less than half of the recommended allowances by 76 % of the cases and 100 % of the controls.

Data on consumption of antioxidants vitamins such as β-carotene and vitamin C by the elderly women with and without CVD were also assessed. Fifty six percent of the cases against 32 % of the controls met 25-50 % of the β-carotene requirements. Thirty two percent of the elderly women without CVD were found to be exceeding the β-carotene requirements against none of the cases. Only 20 % of the cases against $3/4^{th}$ of the controls could meet more than 100 % of the RDA for vitamin C as can be seen from the table 12b.

Table 12b : Percentage consumption of different nutrients at various levels of percent RDA by the women (60 years and above) with and without CVD

Nutrients	Cases (N=25)					Controls (N=25)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	0 / 0*	32 (8) / 8 (2)*	8 (2) /32 (8)	28 (7) / 32 (8)*	16 (4) / 44(11)*	0 / 0*	8 (2) / 4 (1)*	40 (10) / 4 (1)*	28 (7) / 32 (8)*	24 (16) / 60 (15)*
Proteins (gm)	4 (1)	12 (3)	28 (7)	32 (8)	24 (6)	0	4 (1)	28 (7)	28 (7)	40 (10)
Fats (gm)	0	0	0	0	100 (25)	0	0	0	4 (1)	96 (24)
Fibre (gm)	60 (15)	40 (10)	0	0	0	40 (10)	52 (13)	8 (2)	0	0
Calcium (mg)	0	0	12 (3)	8 (2)	80 (20)	0	0	0	12 (3)	88 (22)
Iron (gm)	44 (11)	32 (8)	20 (5)	4 (1)	0	20 (5)	80 (20)	0	0	0
β - carotene (μg)	20 (5)	56 (14)	16 (4)	8 (2)	0	12 (3)	32 (8)	16 (4)	8 (2)	32 (8)
Vitamin C (mg)	20 (5)	8 (2)	36 (9)	16 (4)	20 (5)	0	8 (2)	4 (1)	12 (3)	76 (19)

(Figure in parenthesis indicate number of subjects)

** For elderly subjects : source - Natarajan (1991)*

C. MEAN INTAKE OF GREEN LEAFY VEGETABLES (GLVS) AND FRUITS

Data on mean food intake of men and women (aged 45 years and above) with and without CVD were also assessed from the 24 hour dietary recall as given in table 13b and 14b.

Table 13b : Mean intake of GLVs and fruits by men (aged 45 years and above) with and without CVD

Food Group	Men (45-59 years)		Men (60 years and above)	
	Cases (N=31)	Controls (N=31)	Cases (N=32)	Controls (N=32)
GLVs (gm)	175	196	180	215
Fruits (gm)	121	130	98	109

The consumption of GLVs was found to be low in the younger men with CVD as compared to their healthy counterparts. Similar observations were noted for GLVs consumption by elderly male cases and controls. However, within group comparison revealed that the consumption of GLVs was low in younger cases and controls as compared to their respective counterparts.

Intake of fruits was found to be low in the younger and elderly men with CVD as against their respective controls. However, within group comparison of fruit intake revealed low consumption of fruits by the elderly men with and without CVD as compared to the younger cases and controls(Figure 2b)

Table 14b: Mean intake of GLVs and fruits by women (aged 45 years and above) with and without CVD

Food Group	Women (45-59 years)		Women (60 years and above)	
	Cases (N=13)	Controls (N=13)	Cases (N=25)	Controls (N=25)
GLVs (gm)	190	220	206	230
Fruits (gm)	120	128	80	90

The mean intake of GLVs by younger women with CVD was found to be less as compared to their respective controls (190g vs 220g). Low consumption of GLVs was also observed in case of elderly women with and without CVD as seen from the above table. Between the

cases and controls, elderly women without CVD were found to be consuming higher amounts of green leafy vegetables as compared to the cases.

Fruits consumption was noted to be slightly higher in women without CVD (45-59 years) compared to their respective cases as seen from the above table. Similar findings were also observed in case of the elderly women with and without CVD though the difference in the consumption pattern between the cases and controls was not very vast(Figure 3b).

Figure 2b : Amount of GLVs and fruits consumed by men with and without CVD

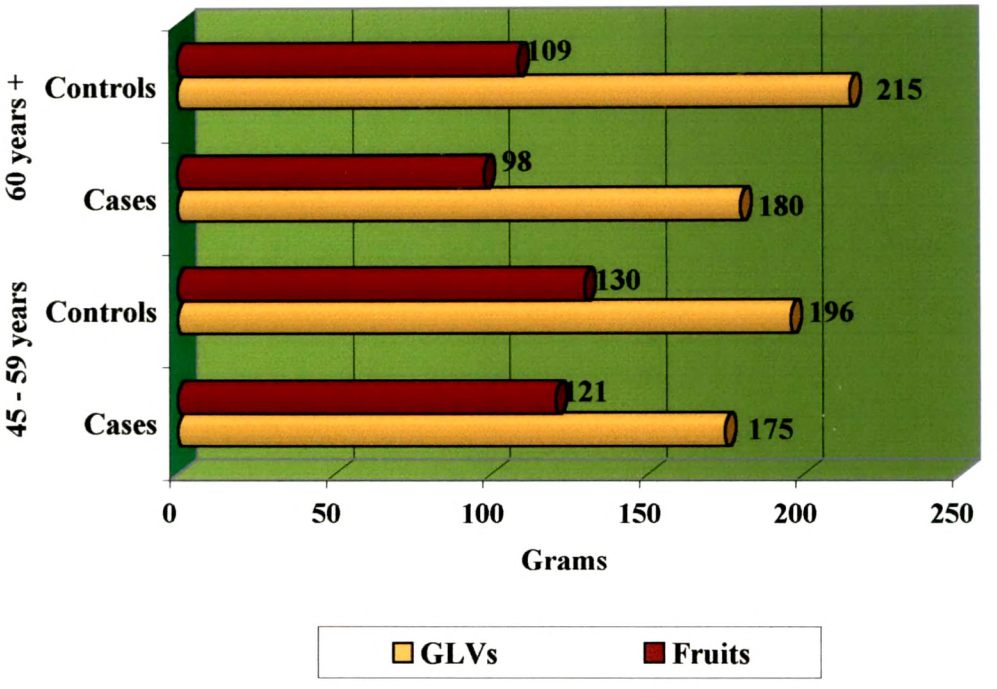
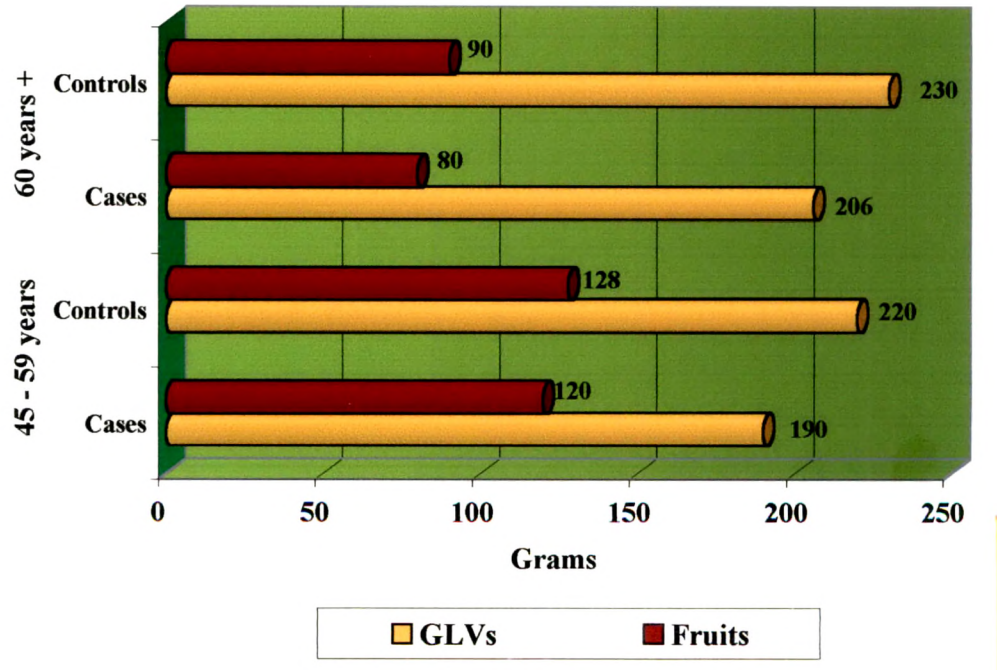


Figure 3b : Amount of GLVs and fruits consumed by women with and without CVD



d. ANTIOXIDANTS INTAKE IN RELATION TO CVD RISK IN THE CASES

The antioxidants intake were further analysed in relation to CVD risk in all the subjects. For this purpose, the intakes of the cases were distributed in quartiles for determining the risk. These quartiles were based on the distribution of values among four quarters of 100 percentage. The first quartile of the controls was taken as the baseline value (table 15b)

Table 15b : Antioxidants intake in relation to CVD risk in men and women (aged 45 years and above)

Quartiles	1 Cs / Cnt	2 Cs / Cnt	3 Cs / Cnt	4 Cs / Cnt	χ^2	P - value
Men						
β - carotene (μg)	22/9	27/22	8/11	6/21	14.58	0.000*
O.R	1.00	0.50	0.30	0.12		
95 % C.I	-	0.17-1.43	0.07-1.15	0.03-0.44		
Vitamin C (mg)	10/2	11/3	17/3	25/55	22.600	0.000*
O.R	1.00	0.73	1.13	0.09		
95 % C.I	-	0.05-7.96	0.06-5.25	0.01-0.50		
Women						
β - carotene (μg)	11/7	19/13	6/5	2/13	7.518	0.00611*
O.R	1.00	0.93	0.76	0.10		*
95 % C.I	-	0.24-3.54	0.13-4.50	0.01-0.68		
Vitamin C (mg)	7/3	5/3	12/6	14/34	3.32	0.0683
O.R	1.00	0.71	0.86	0.30		
95 % C.I	-	0.07-7.93	0.11-5.32	0.04-1.65		

*$p < 0.001$, **$p < 0.01$,

As seen from the table 15a, increasing intakes of antioxidants vitamins such as β-carotene and vitamin C showed highly protective effect in the fourth quartile (OR=0.12 and OR=0.09 respectively) thereby showing a significant $\chi 2$ for trend for both the vitamins ($p<0.001$) in men with CVD(Figure 4b)

A significant association (OR=0.10) was observed with highest intake of β-carotene in the fourth quartile as against the third and the second quartiles in case of women. The trend of this association was found to be significant ($p<0.01$). However, a decreasing trend in the second and the fourth quartile was observed in case of vitamin C intake, the association was not found to be significant(Figure 5b)

FIGURE 4b : ANTIOXIDANTS INTAKE IN RELATION TO CVD RISK IN MEN

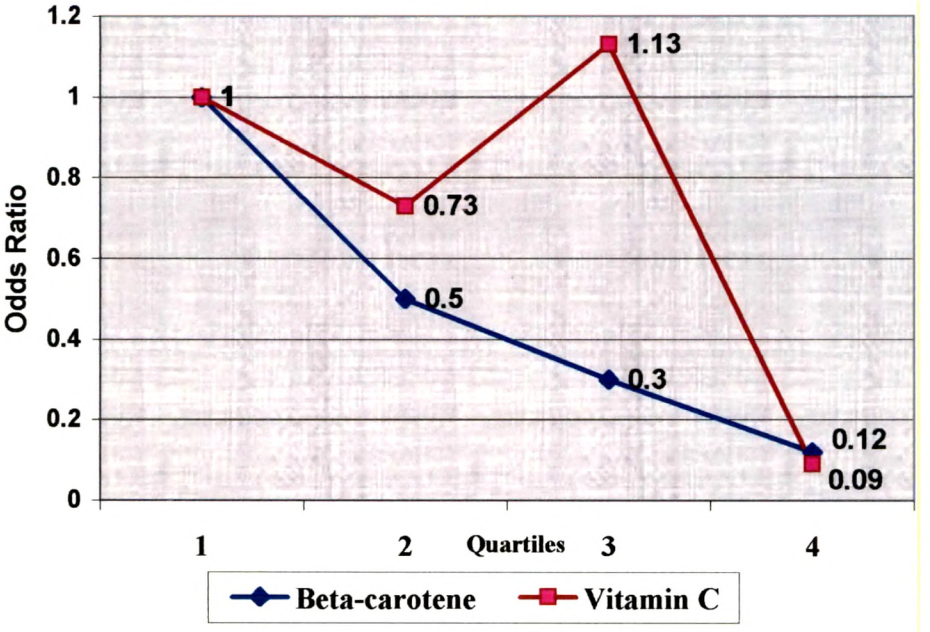
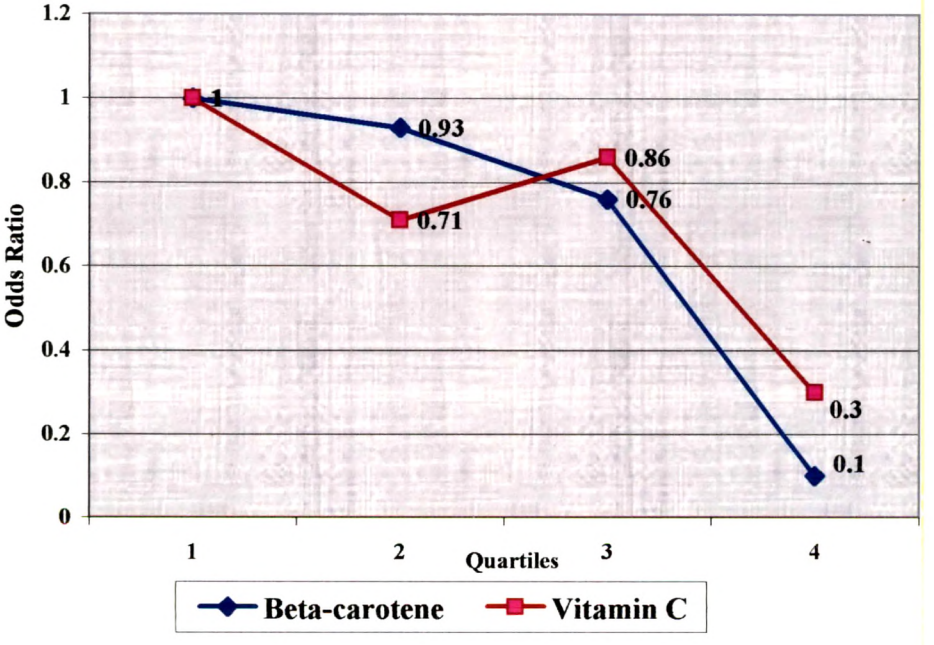


FIGURE 5b: ANTIOXIDANTS INTAKE IN RELATION TO CVD RISK IN WOMEN



VI) FOOD FREQUENCY

Data regarding food frequency was collected from the men and women (aged 45 years and above) with and without cardiovascular diseases. An exhaustive list of food items such as fruits and vegetables rich in vitamin C, vitamin E and β-carotene along with foods rich in fats was used to elicit information on frequent consumption of antioxidants vitamins and fats in the diet of the men (table 16b) and women (table 17b).

Table 16b : Percentages of men (45 years and above) with and without CVD reporting frequent consumption of various foods.

Food Items	Men		Odds ratio	C.I 95 % χ^2 and p value
	Cases (N=63)	Controls (N=63)		
Cereals				0.45-2.24
Frequent	66.67 (42)	66.67 (42)	1.00	$\chi^2 = 0.00$
Non frequent	33.33 (21)	33.33 (21)		P = 1.00
Pulses				0.37-1.99
Frequent	26.98 (17)	30.16 (19)	0.86	$\chi^2 = 0.16$
Non frequent	73.01 (46)	69.84 (44)		P = 0.69
GLVs				0.20-0.93
Frequent	34.92 (22)	55.55 (35)	0.43	$\chi^2 = 5.41$
Non frequent	65.08 (41)	44.44 (28)		P =0.01*
Veg rich in β-carotene				0.06-0.37
Frequent	19.05 (12)	60.31 (38)	0.15	$\chi^2 = 22.41$
Non frequent	80.95 (51)	39.68 (25)		P = 0.0000***
Veg rich in isoflavonoids				0.11-0.62
Frequent	52.38 (33)	80.95 (51)	0.26	$\chi^2 = 11.57$
Non frequent	47.62 (30)	19.04 (12)		P = 0.0006**
Other vegetables				0.21-1.00
Frequent	34.92 (22)	53.96 (34)	0.46	$\chi^2 = 4.63$
Non frequent	65.08 (41)	46.03 (29)		P=0.0314*
Fruits rich in β-carotene				0.11-0.62
Frequent	34.92 (22)	84.12 (53)	0.26	$\chi^2 = 11.57$
Non frequent	65.08 (41)	15.87 (10)		P=0.0000***

Fruits rich in vitamin C				0.05-0.40
Frequent	11.11 (7)	46.03 (29)	0.15	$\chi^2 = 18.82$
Non frequent	88.89 (56)	53.96 (34)		P = 0.0000**
Non vegetarian + poultry				0.75-4.56
Frequent	30.16 (19)	19.04 (12)	1.84	$\chi^2 = 2.10$
Non frequent	69.84 (44)	80.95 (51)		P = 0.1476
Milk and Milk products				0.28-1.29
Frequent	47.61 (30)	60.31 (38)	0.60	$\chi^2 = 2.04$
Non frequent	52.38 (33)	39.68 (25)		P = 0.1527
Milk based sweets				2.28-12.57
Frequent	60.32 (38)	22.22 (14)	5.32	$\chi^2 = 18.86$
Non frequent	39.68 (25)	77.77 (49)		P = 0.000**
Khoa based sweets				2.58-35.72
Frequent	36.51 (23)	6.34 (4)	8.48	$\chi^2 = 17.02$
Non frequent	63.49 (40)	93.65 (59)		P = 0.000***
Ghee based sweets				1.11-6.78
Frequent	36.51 (23)	17.46 (11)	2.72	$\chi^2 = 5.80$
Non frequent	63.49 (40)	82.53 (52)		P = 0.01*
Deep fried snacks				3.09-33.06
Frequent	44.44 (28)	7.94 (5)	9.28	$\chi^2 = 21.72$
Non frequent	55.56 (35)	92.06 (58)		P = 0.0000***
Shallow fried snacks				0.40-1.92
Frequent	61.90 (39)	65.08 (41)	0.87	$\chi^2 = 0.14$
Non frequent	38.09 (24)	34.92 (22)		P = 0.711
Dry snacks				0.68-3.35
Frequent	68.25 (43)	58.73 (37)	1.51	$\chi^2 = 1.23$
Non frequent	31.75 (20)	41.27 (26)		P = 0.2669

(Figure in parenthesis indicate number of subjects)

Frequent = intake ≥ 4 times a week, Non-frequent = intake < 4 times a week

**p ≤ 0.05, **p ≤ 0.001, ***p ≤ 0.0001*

The food frequency data on men with and without CVD as given in table 16 indicates no association frequent consumption of cereals with the occurrence of the disease. An insignificant negative association (OR=0.86) was observed with the frequent intake of pulses in the controls.

A strong protective effect was revealed with the frequent consumption of green leafy vegetables (OR=0.43), vegetables rich in β-carotene (OR=0.15), vegetables rich in isoflavonoids (OR=0.26) and other vegetables (OR=0.46) in men. The trend of these associations with the occurrence of CVD was highly significant at 0.05, 0.001 and 0.0001 levels(Figure 6b).

Frequent consumption of fruits rich in β-carotene and vitamin C was also found to be negatively associated (P<0.0001) with the occurrence of cardiovascular diseases (OR=0.10, OR=0.15 respectively).

Fat intake which was higher in cases, was found to increase the risk factor by 1.84 times in the development of heart diseases, though the association was not statistically significant.

A non-significant association was also obtained with frequent intake of milk and milk products (OR=0.60) which was slightly higher in men without CVD as compared to their diseased counterparts.

Information on frequent / non-frequent intake of milk based, khoa based and ghee based sweets by the cases and the controls were also evaluated. A highly significant positive association was observed with the frequent consumption of these sweets (OR=5.32, OR=8.48 and OR=3.05 respectively) in men with CVD.

Similar observations were made for frequent consumption of deep fried snacks (OR=9.28) which was significantly higher in cases as compared to the controls. A non-significant positive effect was also noted with frequent intake of shallow fried (OR=0.87) and dry snacks (OR=1.51) as seen from the above table.

Table 17 b: Percentages of women (45 years and above) with and without CVD reporting frequent consumption of various foods.

Food Items	Women		O.R	C.I 95 %
	Cases (N=38)	Controls (N=38)		
Cereals				0.62-4.85
Frequent	65.79 (25)	52.63 (20)	1.73	$\chi^2 = 1.36$
Non frequent	34.21 (13)	47.37 (18)		P=0.24
Pulses				0.28-2.25
Frequent	34.21 (13)	39.47 (15)	0.80	$\chi^2 = 0.23$
Non frequent	65.79 (25)	60.53 (23)		P = 0.63
GLVS				0.21-1.61
Frequent	39.47 (15)	52.63 (20)	0.59	$\chi^2 = 1.32$
Non frequent	60.53 (23)	47.37 (18)		P = 0.2498
Veg rich in β-carotene				0.08-0.79
Frequent	18.42 (7)	47.37 (18)	0.25	$\chi^2 = 7.21$
Non frequent	81.57 (31)	52.63 (20)		P = 0.00**
Veg rich in isoflavonoids				0.11-1.02
Frequent	52.63 (20)	76.32 (29)	0.34	$\chi^2 = 4.65$
Non frequent	47.37 (18)	23.68 (9)		P = 0.03*
Other vegetables				0.15-1.17
Frequent	36.84 (14)	57.89 (22)	0.42	$\chi^2 = 3.38$
Non frequent	63.16 (24)	42.10 (16)		P = 0.06
Fruits rich in β-carotene				0.11-0.86
Frequent	36.84 (14)	65.79 (25)	0.30	$\chi^2 = 6.37$
Non frequent	63.16 (24)	34.21 (13)		P = 0.01*
Fruits rich in vitamin C				0.07-1.03
Frequent	13.16 (5)	34.21 (13)	0.29	$\chi^2 = 4.66$
Non frequent	86.84 (33)	65.79 (25)		P = 0.03*
Non vegetarian foods				0.24 -170.9
Frequent	7.89 (3)	2.63 (1)	3.17	$\chi^2 = 1.06$
Non frequent	92.10 (35)	97.37 (37)		P = 0.30

Contd..

Milk and Milk products				0.24-1.78
Frequent	47.37 (18)	57.89 (22)	0.65	$\chi^2 = 0.84$
Non frequent	52.63 (20)	42.11 (16)		P = 0.35
Milk based sweets				0.33-4.21
Frequent	21.05 (8)	18.42 (7)	1.18	$\chi^2 = 0.08$
Non frequent	78.95 (30)	81.58 (31)		P = 0.77
Khoa based sweets				0.66-19.55
Frequent	21.05 (8)	7.89 (3)	3.11	$\chi^2 = 2.66$
Non frequent	78.95 (30)	92.11 (35)		P = 0.10
Ghee based sweets				0.66-19.55
Frequent	21.05 (8)	7.89 (3)	3.17	$\chi^2 = 2.66$
Non frequent	78.95 (30)	92.11 (35)		P = 0.10
Deep fried snacks				2.95-32.65
Frequent	68.42 (26)	18.42 (7)	9.60	$\chi^2 = 19.33$
Non frequent	31.58 (12)	81.58 (31)		P = 0.00***
Shallow fried snacks				0.12-0.95
Frequent	42.11 (16)	68.42 (26)	0.34	$\chi^2 = 5.32$
Non frequent	57.89 (22)	31.58 (12)		P = 0.02*
Dry snacks				0.35-2.87
Frequent	65.79 (25)	65.79 (25)	1.00	$\chi^2 = 000$
Non frequent	34.21 (13)	34.21 (13)		P = 1.00

(Figure in parenthesis indicate number of subjects)

Frequent = intake ≥ 4 times a week, Non-frequent = intake < 4 times a week

**p ≤ 0.05, **p ≤ 0.001, ***p ≤ 0.0001*

Table 17b indicates the frequent consumption of various foods by women with and without CVD. Frequent consumption of cereals (OR=1.73) and pulses (OR=0.80) was found to be non-significantly positively associated with the occurrence of the disease in cases.

The data on frequent consumption of vegetables revealed a protective effect of intake of vegetables rich in β-carotene (OR=0.25) at 1 % level. However, a non-significant negative effect was observed with the frequent consumption of GLVs (OR=0.56), vegetables rich in isoflavonoids (OR=0.34) and other vegetables (OR=0.42).

Consumption of fruits rich in β-carotene which was higher in the women without CVD, was found to give a strong protective effect against the occurrence of disease (OR=0.30). However, a non-significant risk was observed with the frequent intake of vitamin C rich citrous fruits (OR=0.29) which was higher in the controls(Figure 7b)

Frequent intake of non-vegetarian foods, which was non frequently consumed by majority of the cases and the controls, was found to increase the risk of developing CVD 3 times (OR=3.17).

Similar observation were made for the consumption of milk and milk products which gave a positive association with the occurrence of CVD (OR= 0.65)

Though consumption of milk based, khoa based and ghee based sweets were non-frequently consumed by majority of the women with and without CVD, a non-significant risk was however observed in small number of cases who reportedly consumed these sweets frequently (OR= 1.18, OR=3.11 and OR 3.11 respectively).

Similar results were obtained for frequent consumption of shallow fried (OR=0.34) and dry snack (OR=1.00) in the cases though the risk was non-significant. However, frequent consumption of deep fried snack which was higher in the cases gave a strong positive association in cases (OR=9.50).

E. ACTIVITY PATTERN

The activity pattern of the men and women with and without CVD were assessed in terms of total hours spent in work related and leisure time activities. Time spent in sleep was also noted down as given in table 18b.

Figure 6b : Frequent consumption of Vegetables and Fruits by men with and without CVD

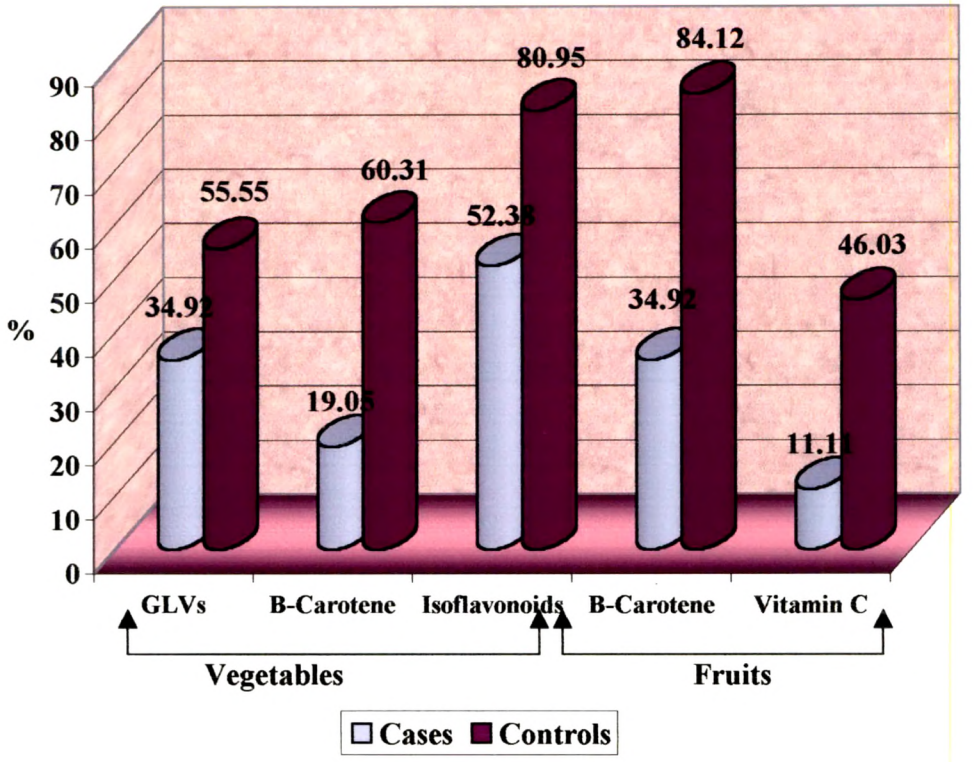


Figure 7b : Frequent consumption of Vegetables and Fruits by women with and without CVD

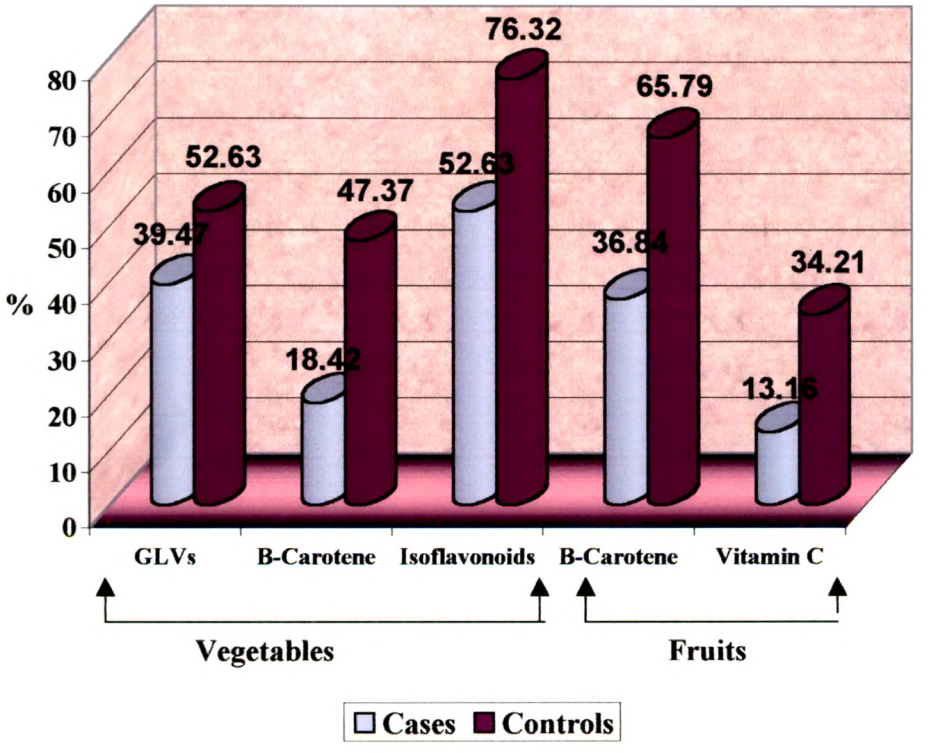


Table 18b : Activity pattern of men and women (aged 45 years and above) with and without CVD.

Activities	*Men*		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Work related (hours)				
< 5	46.03 (29)	53.97 (34)	76.32 (29)	31.58 (12)
5 - 8	47.62 (30)	39.68 (25)	23.68 (9)	57.89 (22)
> 8	6.35 (4)	6.35 (4)	0	10.53 (4)
Leisure (hours)				
< 5	4.76 (3)	0	2.63 (1)	0
5 - 8	9.52 (6)	26.98 (17)	5.26 (2)	39.47 (15)
> 8	85.71 (54)	73.02 (46)	92.11 (35)	60.53 (23)
Sleep (hours)				
< 5	0	0	0	0
5 - 8	69.84 (44)	38.10 (24)	21.05 (8)	57.89 (22)
> 8	30.16 (19)	61.90 (39)	78.95 (30)	42.11 (16)

(Figure in parenthesis indicate number of subjects)

Forty six percent of the men with CVD spent less than 5 hours daily in work related activities as compared to higher percentage of the controls (54 %). More than 3/4th of the men, both cases and controls selected for the present phase spent more than 8 hours in leisure time activities. Total hours spent in 5 - 8 hours in sleep was reported by 70 % of the cases as against 62 % of the controls who slept for more than 8 hours per day.

The activity pattern of the women, as seen from the above table, indicated that higher percentage of the cases (76 %) worked for less than 5 hours daily as compared to more than half of the controls who spent 5-8 hours in work related activities. More than 8 hours of leisure time activities was reported by 92 % of the women with CVD as compared to 61 % of the controls. Higher percentage of women cases also reported more than 8 hours of sleep daily as compared to 58 % of their healthy counterparts.

F) ADDICTION PATTERN

Information on various addictions such as chewing of pan (betel quid), supari, ghutka and tobacco, smoking cigarettes and bidis along with alcohol drinking were collected using a questionnaire (table 19b).

Table 19b : Addiction pattern reported by men and women (aged 45 years and above) with and without CVD.

Addictions	Men		*Women*	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Pan				
Yes	4.76 (3)	1.59 (1)	2.63 (10)	2.63 (10)
No	95.24 (60)	98.41 (62)	97.37 (28)	97.37 (28)
OR (95 % CI)	**3.10 (0.24-165.32)**		**1.0 (0.09-80.59)**	
χ2 (p value)	**χ^2=1.03 (0.30)**		**χ2=0.00 (1.00)**	
Ghutka				
Yes	11.11 (7)	11.11 (7)	0	0
No	88.89 (56)	88.89 (56)	100 (38)	100 (38)
OR (95 % CI)	**3.81 (0.68-27.83)**		**0**	
χ2 (p value)	**χ^2= 2.99 (0.08)**			
Supari				
Yes	11.11 (7)	3.17 (2)	2.63 (10)	2.63 (10)
No	88.89 (56)	96.83 (91)	97.37 (28)	97.37 (28)
OR (95 % CI)	**3.81 (0.68-27.83)**		**1.0 (0.09-80.59)**	
χ2 (p value)	**χ^2= 2.99 (0.08)**		**χ2=0.00 (1.00)**	
Cigarette				
Yes	14.29 (9)	14.29 (9)	0	0
No	85.71 (54)	85.71 (54)	100 (38)	100 (38)
OR (95 % CI)	**1.00 (0.33-3.01)**		**0**	
χ2 (p value)	**χ^2=0.06 (0.79)**			
Bidi				
Yes	30.16 (19)	3.17 (2)	0	0
No	69.84 (44)	96.83 (61)	100 (38)	100 (38)
OR (95 % CI)	**13.17 (2.73-86.48)**		**0**	
χ2 (p value)	**16.51 (0.00*)**			
Tobacco				
Yes	17.46 (11)	6.35 (4)	0	0
No	82.54 (52)	93.65 (59)	100 (38)	100 (38)
OR (95 % CI)	3.12 (0.85-14.14)		0	
χ2 (p value)	χ^2=3.71 (0.05)			
Alcohol				
Yes	17.46 (11)	9.52 (6)	0	0
No	82.54 (52)	90.48 (57)	100 (38)	100 (38)
OR (95 % CI)	**2.01 (0.62-7.07)**		**0**	
χ2 (p value)	**χ^2= 1.70 (0.19)**			

*(Figure in parenthesis indicate number of subjects), * P ≤0.0001*

As indicated from the table, though more than 80 % of the men with and without CVD did not report any kind of addiction, however, more number of cases were found to be still addicted to various vices as compared to the controls. A non - significant association was found between chewing of pan, ghutka and supari and the occurrence of the diseases in cases. No association was found with cigarette smoking and CVD as equal number of the cases and the controls, reported addiction to cigarette smoking. However, addiction to smoking bidis was found to be ten times higher in the cases as compared to their healthy counterparts thereby indicating a strong risk factor with the incidence of cardiovascular diseases at 5 % level. Higher percentage of the men with CVD also reported tobacco chewing (17 %) as against 6 % of the controls giving a weak association with the disease. A positive effect was also observed with alcohol addiction which was reported by almost double the percent of the men with CVD as compared to the controls.

The data on addiction pattern of women, as can be observed from table 19b, revealed that only one subject reported addiction to pan along with supari. Since no other addiction was reported by the women both with and without CVD, further detailed data on the same had been given only on men subjects selected for the present section.

I) ADDICTION TO SMOKING

Data on addiction to smoking was evaluated in terms of total years of smoking either cigarettes or bidi along with frequency of cigarettes and bidis smoked per day (table 20b).

As indicated from table, though 85 % of men with and without CVD did not report addiction to cigarettes, it could be noted that 6 % of the cases were addicted to cigarette smoking since past 30-40 years as against similar percentage of the controls who were addicted since past 10-20 years.

Addiction to bidi was reported by higher percentage of the cases (69 %) as compared to the controls (96 %). Seven percent of the cases were addicted to bidi since 10-20 years as against 3 % controls who were addicted to bidi since 30-40 years.

Table 20b: Duration and frequency of cigarette and bidi smoking by men (aged 45 years and above) with and without CVD.

Total years	Cigarette		Bidi	
	Cases (N = 63)	Controls (N = 63)	Cases (N = 63)	Controls (N = 63)
< 10	0	0	1.59 (1)	0
10 - 20	1.59 (1)	6.35 (4)	7.94 (5)	0
20 - 30	3.17 (2)	1.59 (1)	6.35 (4)	0
30 - 40	6.35 (4)	1.59 (1)	4.76 (3)	3.17 (2)
40 - 50	1.59 (1)	1.59 (1)	6.35 (4)	0
> 50	1.59 (1)	3.17 (2)	3.17 (2)	0
Number of cigarettes and bidis / day				
< 10	0	6.35 (4)	4.76 (3)	3.17 (2)
10 - 15	1.59 (1)	1.59 (1)	4.76 (3)	0
15 - 20	1.59 (1)	3.17 (2)	4.76 (3)	0
20 - 25	6.35 (4)	0	1.59 (1)	0
> 25	4.76 (3)	3.17 (2)	14.29 (9)	0
Never	***85.71 (54)***	***85.71 (54)***	***69.84 (44)***	***96.83***

(Figure in parenthesis indicate number of subjects)

Six percent of cases reporting cigarette addiction, smoked 20-25 cigarettes per day as against none of the controls. Similar percentage of the men without CVD smoked less than 10 cigarettes per day as can be seen from the above table.

More than 25 bidis were reportedly smoked by majority of bidi smokers (14 %) in men with CVD. As against this, only 3 % of the controls smoked less than 10 cigarettes per day.

II) ALCOHOL CONSUMPTION

Information on the alcohol addiction was noted (table 21b) in terms of total years of alcohol drinking along with the frequency and amount of alcohol taken per day.

Table 21b: Duration and frequency of alcohol consumption by men (aged 45 years and above) with and without CVD.

Years	*Cases* (N = 63)	Controls (N = 63)
< 5	0	0
5 - 15	1.59 (1)	0
15 - 25	7.94 (5)	1.59 (1)
25 - 35	4.76 (3)	0
> 35	3.17 (2)	7.94 (5)
Alcohol per day (ml)		
< 50	0	0
50 - 100	3 (4.76)	9.52 (6)
> 100	8 (12.70)	0
Never	***82.54 (52)***	***90.48 (57)***

(Figure in parenthesis indicate number of subjects)

Alcohol drinking was found to be less prevalent among the cases as well as the controls. However, those reporting the consumption, 7 % of the cases were addicted to alcohol since 15-25 years whereas similar percentage of the controls were addicted since more than 35 years.

Alcohol intake was found to be more than 100 ml per day by 12 % of the alcohol drinker men with CVD. As against this, 9 % of the controls reportedly consumed 50 - 100 ml of alcohol per day.

III) ADDICTION TO TOBACCO

Assessment of tobacco addiction by men with and without CVD was carried out in terms of total years of tobacco chewing along with amount of tobacco chewed per day as given in table 22b.

As seen from the table, majority of the cases (84 %) and the controls (93 %) did not report addiction to tobacco chewing. However, among those who did report, 9 % of the men with CVD were addicted to tobacco since 25-35 years as against 3 % of the men without CVD who were addicted since 15-25 years.

Table 22b : Duration and amount of tobacco chewed by men (aged 45 years and above) with and without CVD

Years	Cases (N = 63)	Controls (N = 63)
< 5	0	0
5 - 15	3.17 (2)	0
15 - 25	3.17 (2)	3.17 (2)
25 - 35	9.52 (6)	1.59 (1)
> 35	1.59 (1)	1.59 (1)
Tobacco per day (gm)		
< 0.5	4.76 (3)	4.76 (3)
0.5 - 2.0	3.17 (2)	1.59 (1)
> 2.0	9.52 (6)	0
Never	*82.54 (52)*	*93.65 (59)*

(Figure in parenthesis indicate number of subjects)

Higher percentage of tobacco addicts in cases, chewed more than 2 gm of tobacco per day (7 %) than controls. Four percent of the control men reportedly consumed less than 0.5 gm of tobacco per day as can be seen from the above table.

G. OTHER FACTORS

Information on other risk factors such as personality traits was also collected. These traits included experiencing stress, anxiety and reporting of hot temperament (table 23b)

Information on personality traits of the subjects with and without CVD selected for this present section of the study indicated higher percentage of the cases, both men and women, reporting stress, anxiety and hot temperament. Though more than half of the total men subject did not report these traits, a weak association was observed with occurrence of anxiety (OR=1.21) and hot temperament (OR=1.90) with the occurrence of CVD.

Table 23b : Percentage of men and women (aged 45 years and above) reporting stress, anxiety and angry temperament

Personality Traits	Men		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Stress				
Yes	41.27 (26)	49.21 (31)	23.68 (9)	26.32 (10)
No	58.73 (37)	50.79 (32)	76.32 (29)	73.68 (28)
OR (95 % CI) χ2 (p value)	0.72 (0.34-1.56) χ2=0.80 (0.37)		0.87 (0.27-2.77) χ2=0.07 (0.79)	
Anxiety				
Yes	46.03 (29)	41.27 (26)	23.68 (9)	26.32 (10)
No	53.97 (34)	58.73 (37)	76.32 (29)	73.68 (28)
OR (95 % CI) χ2 (p value)	1.21 (0.50-2.61) χ2=0.29 (0.58)		0.87 (0.27-2.77) χ2=0.07 (0.79)	
Hot temperament				
Yes	41.27 (26)	26.98 (17)	7.89 (3)	7.89 (3)
No	58.73 (37)	73.02 (46)	92.11 (35)	92.11 (35)
OR (95 % CI) χ2 (p value)	0.72 (0.84-4.31) χ2=2.86 (0.09)		1.00 (0.13-7.99) χ2=0.00 (1.00)	

(Figure in parenthesis indicate number of subjects)

The assessment of personality traits in women with and without CVD revealed that slightly higher percentage of women controls reported experiencing stress and anxiety as compared to the cases. However, a non-significant association was found between these two factors and occurrence of CVD (OR=0.87 and OR=0.87 respectively). Equal percentage of the women with and without CVD reported of having hot temperament as can be seen from the above table, thereby showing no association with the disease.

G. DISEASE PROFILE

Data on disease profile was assessed with respect to the age group using a check list. The results are given in the following table.

Table 24b : Percentage of men and women (aged 45 years and above) with and without CVD reporting different health problems.

Types of health problems	Men		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Oral cavity	53.96 (34)	47.62 (30)	55.26 (21)	50.00 (19)
Gastrointestinal	66.67 (42)	69.84 (44)	60.53 (23)	52.63 (20)
Hepatic	-	-	-	-
Respiratory	34.92 (22)	30.16 (19)	28.95 (11)	21.05 (8)
Genitourinary	7.94 (5)	7.94 (5)	18.42 (7)	7.89 (3)
Locomotor	49.21 (31)	47.62 (30)	47.37 (18)	52.63 (20)
Nervous	63.49 (40)	44.44 (28)	52.63 (20)	42.10 (16)
Endocrine	-	-	-	-
Miscellaneous	12.69 (8)	12.69 (8)	15.78 (6)	13.16 (5)

(Figure in parenthesis indicate number of subjects)

As seen from the above table, gastrointestinal problems ranked highest by the men with and without CVD. Forty percent of the cases reported nervous problems as compared to 28 % of the controls. Oral cavity disorders were found to be prevalent in around 30 % of the men with and without CVD. Similar percentage of the subjects also reported locomotor problems. Less than 1/3rd of the subjects reported respiratory problems. Complaints related to the genitourinary system and other miscellaneous problems were reported by 5-8 % of the men with and without CVD.

The disease profile of women with and without CVD is also shown in table 24b Gastrointestinal problems were highest in both the cases as well as the controls (23 % and 20 % respectively). Around 20 % of the women with CVD also reported nervous and oral cavity problems. In case of the women without CVD, locomotor problems followed by oral cavity disorders were reported by almost 20 % of the subject. Eighteen percent of the cases also reported locomotor problems followed by 11 % respiratory problems. Very few subjects reported genitourinary problems and other miscellaneous problems as seen from the above table.

H. BIOCHEMICAL PARAMETERS

A sub sample of 30 elderly men and women (60 years and above) with and without CVD each were selected for the assessment of the biochemical parameters. The parameters were estimated in terms of their lipid profile and antioxidants status (plasma vitamin C, serum α-tocopherol and serum β-carotene) as given in the following tables.

I. LIPID PROFILE OF THE SUBJECTS

The data on lipid profile was assessed on a sub-sample of elderly men and women (aged 60 years and above) with and without CVD. The lipid profile was estimated with respect to triglygerides (TG), total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) and very low density lipoprotein cholesterol (VLDL-C) as given in table 25b.

Table 25b : Mean value of lipid profile of men and women (aged 60 years and above) with and without CVD

Lipid profile	Men		't' value	Women		't' value
	Cases (N=30)	Controls (N=30)		Cases (N=30)	Controls (N=30)	
Triglycerides (mg/dl)	144.51 ± 32.91	137.46 ± 21.95	0.97	135.58 ± 29.74	120.84 ± 31.44	1.86
Total Cholesterol (mg/dl)	220.48 ± 39.32	180.56 ± 25.98	4.64*	210.66 ± 17.52	167.74 ± 17.39	9.52
HDL - C (mg/dl)	31.45 ± 6.47	43.02 ± 8.93	5.74*	34.37 ± 9.23	45.08 ± 9.99	4.31*
LDL - C (mg/dl)	160.50 ± 24.89	109.38 ± 37.93	6.17*	148.18 ± 20.64	98.49 ± 17.82	9.91*
VLDL - C (mg/dl)	29.52 ± 7.62	27.49 ± 4.39	1.26	27.11 ± 5.94	24.17 ± 6.28	1.86

*$p < 0.001$

As seen from the above table, the values of TG, TC, LDL-C and VLDL-C were higher in women with cardiovascular diseases as compared to their healthy counterparts. However, significant difference was observed only with TC and LDL-C ($p < 0.001$). On the contrary, high density lipoprotein fraction was found to be significantly higher in men without CVD.

The data on lipid profile of women with and without CVD suggested higher values for TG, TC, LDL-C and VLDL-C in the cases. However, significant difference was observed only in case of low density lipoprotein fraction. On the other hand, good cholesterol i.e HDL-C was noted to be significantly higher in controls as compared to the cases.

II. ANTIOXIDANTS PROFILE

The antioxidants profile was estimated with respect to serum α-tocopherol, serum β-carotene and plasma vitamin C in elderly sub-sample of men and women with and without CVD as shown in table 26b and figure 8b.

Table 26b : Antioxidants profile of men and women (aged 60 years and above) with and without CVD

Antioxidants Profile	Men		't' value	Women		't' value
	Cases (N = 30)	Controls (N = 30)		Cases (N = 30)	Controls (N = 30)	
S. Vitamin E (mg/lt)	8.23±2.37	11.20±2.24	6.44*	7.77±2.07	10.87 ± 2.04	7.54*
< 9.0	76.67 (23)	6.67 (2)		36.67 (11)	16.67 (5)	
9.0 - 12.0	23.33 (7)	80.00 (24)		63.33 (19)	43.33 (13)	
> 12.0	0	13.33 (4)		0	40.00 (12)	
P. Vitamin C (mg/lt)	7.80±4.47	10.94±5.26	3.22*	6.61±3.48	10.24 ± 4.86	4.29*
< 4.0	23.33 (7)	10.33 (3)		48.33 (14)	20.00 (6)	
4.0 - 18.0	76.67 (23)	89.67 (27)		51.67 (16)	80.00 (24)	
> 18.0	0	0		0	0	
S. β - carotene (mg/lt)	1.36±0.61	1.92±0.68	2.01	1.17±0.60	1.74 ± 1.06	3.31*
< 0.5	6.67 (2)	6.67 (2)		16.67 (5)	13.33 (4)	
0.5 - 2.0	76.67 (23)	50.00 (15)		83.33 (25)	50.00 (15)	
> 2.0	16.67 (5)	43.33 (13)		0	36.67 (11)	

(Figure in parenthesis indicate number of subjects)

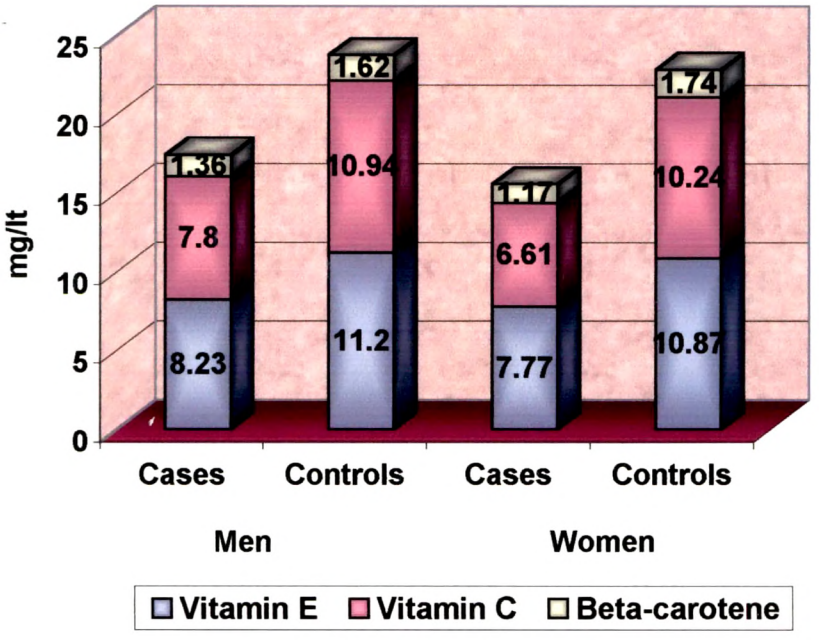
*$p < 0.001$

Table 26b indicates the mean values of antioxidants in the sub sample of men and women with and without CVD. The values of α-tocopherol, and vitamin C were found to be significantly higher ($p<0.001$) in men without CVD as compared to their respective cases. Though serum β-carotene was found to be higher in the healthy men than the cases, the

difference was not statistically significant. When the values for these antioxidants were assessed in terms of below normal, normal and above normal ranges, it can be noted that more than 3/4th of the subjects had α-tocopherol values below 9 mg/lt. Cutoff values for plasma vitamin C revealed that though majority of the subjects (> 3.4th) had normal vitamin C levels, more than 1/5th of the men with CVD had lower vitamin C levels (< 4 mg/lt) as compared to 10 % of the controls. Forty three percent of the healthy men as against 16 % of the cases had serum β-carotene values higher than 2 mg/lt.

The antioxidants profile of women with and without CVD indicated at significantly higher levels of serum α-tocopherol, β-carotene along with plasma vitamin C in healthy women as compared to their respective controls. On further analysis of the antioxidants levels with respect to below and higher than normal level was done as shown in the above table. Forty six percent of the cases had α-tocopherol values less than 9 mg/lt as against almost similar percentage of the controls who had higher than normal values of α-tocopherol values (>12 mg/lt) in serum. Though majority of the cases and the controls had normal plasma vitamin C levels (51 % and 80 % respectively), 48 % of the women with CVD had vitamin C values lower than 4 mg/lt against more than half of the controls. More than 1/3rd of the women without CVD had serum β-carotene values more than 2 mg/lt as against none of the cases. More than 80 % of the cases and 50 % of the controls had normal β-carotene values.

Figure 8b : Mean antioxidant values of men and women with and without CVD



III. MEAN INTAKE OF SELECTED NUTRIENTS IN RELATION TO CVD RISK

The consumption of fat along with vitamin C and β-carotene through was assessed in the sub-sample of men and women on which the lipid profile and antioxidants status in serum/plasma were estimated (table 27b) (Figure 9b and 10b)

Table 27b: Mean intake of selected nutrients in relation to CVD risk in a sub-group of men and women with and without CVD

Dietary Intake	Men		't' value	Women		't' value
	Cases (N = 30)	Controls (N = 30)		Cases (N = 30)	Controls (N = 30)	
Fat (gm)	48.75 ± 13.38	45.17 ± 16.69	3.58***	47.08 ± 12.64	39.31 ± 13.19	2.33*
Vitamin C (mg)	37.08 ± 33.32	83.31 ± 55.46	3.91***	40.33 ± 36.46	79.23 ± 61.28	2.98**
β-Carotene (µg)	926 ± 755	2019 ± 1588	3.40**	876 ± 530	2159 ± 1842	3.66***

*$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$*

As seen from the above table, a significantly higher consumption of dietary fat was observed in men with CVD as compared to their controls ($p \leq 0.001$). However, in contrast, healthy men without CVD reportedly consumed higher amount of vitamin C and β-carotene from their daily diets ($p \leq 0.001$ and $p \leq 0.01$ respectively).

The data on mean intake of dietary fat along with antioxidants vitamin C and β-carotene pinpointed at significantly higher consumption of fat in the sub-sample of women with CVD as compared to their healthy controls ($p \leq 0.05$). However, the consumption of vitamin C ($p \leq 0.01$) and β-carotene ($p \leq 0.001$) was significantly higher in healthy women without CVD than their respective cases.

Figure 9b : Dietary intake of vitamin C in sub-sample of men and women with and without CVD.

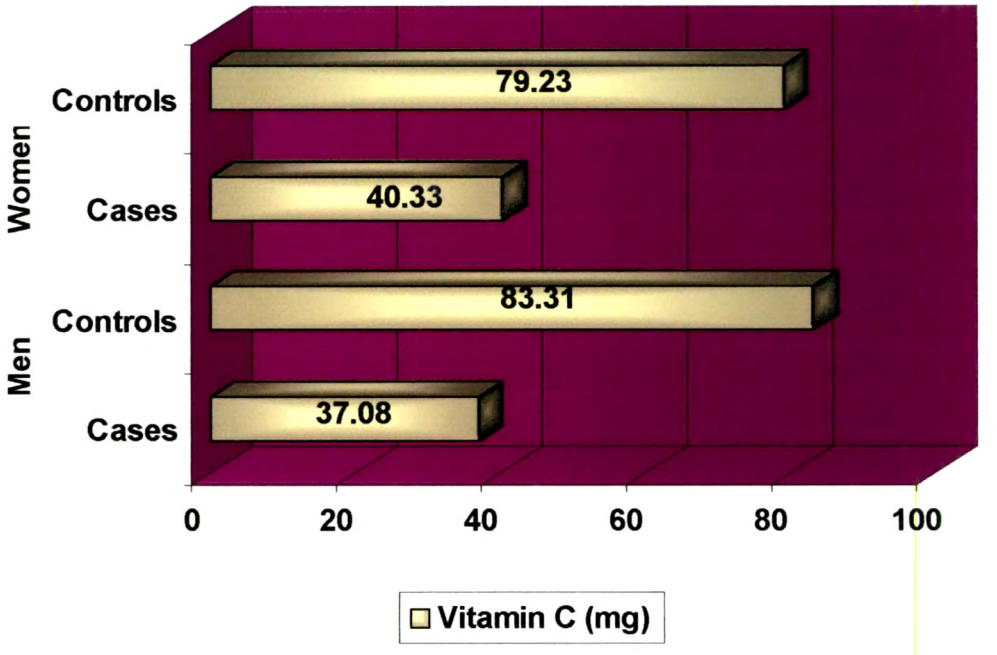
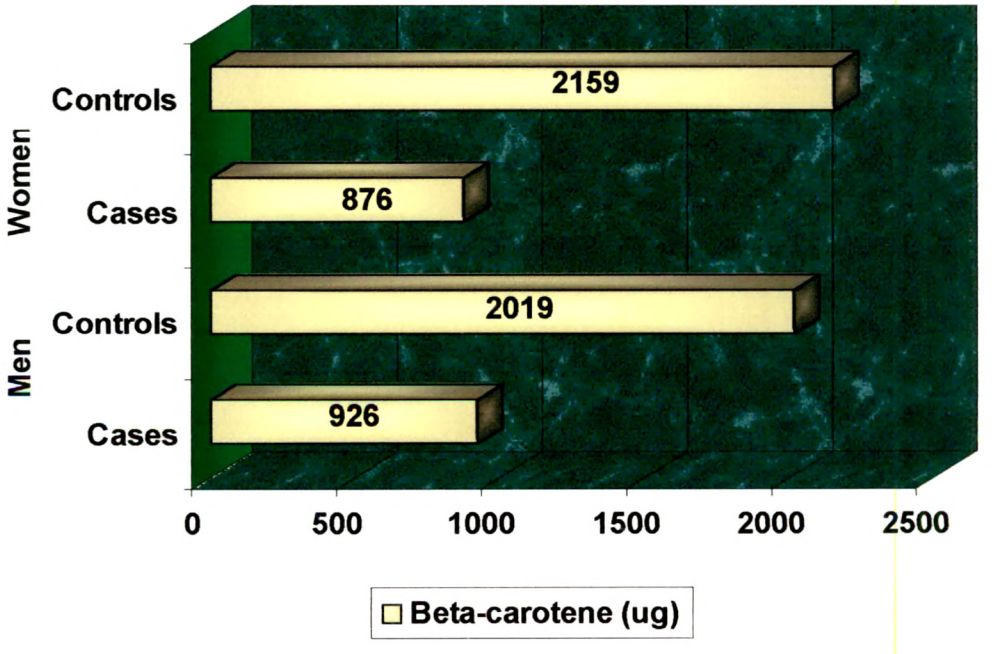


Figure 10b : Dietary intake of β-carotene in sub-sample of men and women with and without CVD.



J. STRAITIFIED ANALYSIS ACCORDING TO VARIOUS FACTORS IN RELATION TO AGE

Straitified analysis was used to further investigate the risk of developing the cardiovascular disease after adjusting for age. For this purpose, the subjects were divided into two categories viz 45 - 59 years and 60 years and above.

I) RELATIONSHIP OF CONSUMPTION OF GREEN LEAFY VEGETABLES (GLVS) WITH CVD

Following table shows the relationship between frequent consumption of GLVs and occurrence of CVD in men and women aged 45 years and above.

Table 28b : Age adjusted association of frequent consumption of GLVs by men and women (aged 45 years and above) with and without CVD

VEGETABLES (GLVs)	Men		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Frequent	34.92 (22)	55.55 (35)	39.47 15)	52.63 (20)
Non-frequent	65.07 (41)	44.44 (28)	60.52 (23)	47.36 (18)
O.R (95 % CI)	0.43 (0.20-0.93)		0.58 (0.21-1.61)	
$\chi 2$ (p value)	5.41 (0.02*)		1.32 (0.24)	
ADJUSTED FOR AGE				
45-59 years	Cases (N=31)	Controls (N=31)	Cases (N=13)	Controls (N=13)
Frequent	35.48 (22)	58.06 (37)	38.46 (14)	53.84 (20)
Non-frequent	64.51 (41)	41.93 (26)	61.53 (24))	46.15 (18)
O.R (95 % CI)	0.40 (0.12-1.24)		0.54 (0.08-3.32)	
$\chi 2$ (p value)	3.17 (0.07)		0.15 (0.69)	
≥ 60 years	Cases (N=32)	Controls (N=32)	Cases (N=25)	Controls (N=25)
Frequent	34.37 (22)	53.12 (33)	40 (15)	52 (20)
Non-frequent	65.62 (41)	46.87 (60)	60 (23)	48 (18)
O.R (95 % CI)	0.46 (0.15-1.42)		0.62 (0.17-2.18)	
$\chi 2$ (p value)	2.29 (0.13)		0.72 (0.39)	

(Figure in parenthesis indicate number of subjects)

* *P<0.05*

Results of frequent consumption of GLVs by men with and without CVD, revealed a significant protective effect at 5 % level. However, after adjusting for age, though consumption of GLVs gave a negative association, the trend of association was not strong in men from both the age groups. Higher number of both the younger as well as the elderly men without CVD reported frequent consumption of the GLVs as compared to their respective counterparts.

The data on frequent consumption of GLVs by the women, after adjustment for age, indicated frequent intake of these vegetables by more than 50 % of the controls from both the age groups as compared to less than 40 % intake by the cases belonging to the younger and elderly age groups. However, like in case of men, a non-significant protective effect was observed between frequent intake of these vegetables and the occurrence of CVD.

II) RELATIONSHIP OF CONSUMPTION OF VEGETABLES RICH IN β-CAROTENE WITH CVD

The relationship of consumption of vegetables rich in β-carotene with occurrence of CVD in men and women was assessed after adjusting for age (table 29b).

Table 29b : Age adjusted association of frequent consumption of vegetables rich in β-carotene by men and women with and without CVD

VEGETABLES (β-carotene)	Men		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Frequent	19.04 (12)	60.31 (28)	18.42 (7)	47.36 (18)
Non-frequent	80.95 (41)	39.68 (35)	81.57 (31)	52.63 (20)
O.R (95 % CI)	0.15 (0.06-0.37)		0.25 (0.08-0.79)	
χ2 (p value)	22.41 (0.00*)		7.21 (0.00*)	
ADJUSTED FOR AGE				
45-59 years	Cases (N=31)	Controls (N=31)	Cases (N=13)	Controls (N=13)
Frequent	19.35 (6)	58.06 (18)	23.07 (3)	46.15 (6)
Non-frequent	80.64 (25)	41.93 (13)	76.92 (10)	53.84 (7)
O.R (95 % CI)	0.17 (0.05-0.62)		0.35 (0.05-2.47)	
χ2 (p value)	9.79 (0.00*)		1.53 (0.21)	

≥ 60 years	Cases (N=32)	Controls (N=32)	Cases (N=25)	Controls (N=25)
Frequent	18.75 (6)	62.5 (20)	16 (4)	48 (12)
Non-frequent	81.25 (26)	37.5 (12)	84 (21)	52 (13)
O.R (95 % CI)	0.14 (0.04-0.49)		0.21 (0.04-0.90)	
$\chi 2$ (p value)	12.70 (0.00*)		5.88 (0.01**)	

(Figure in parenthesis indicate number of subjects)
** P<0.001, **p < 0.05*

Data on frequent consumption of vegetables rich in β-carotene indicated a strong protective effect as seen from the above table. The association was highly significant in both the younger (45-59 years) as well as the elderly men (≥ 60 years) (OR=0.17 and OR=0.14 respectively) with significant trend of association at $p \leq 0.001$ level (χ^2 =9.79 and χ^2 =12.70 respectively).

The consumption pattern of vegetables rich in β-carotene by women with and without CVD pinpointed at a strong negative effect between frequent consumption of these vegetables with the disease (OR=0.25). However, between the two age groups, a significant protective effect was observed in the elderly women at 1 % level as shown in the above table (OR=0.21). A weak association was observed in case of younger women (OR=0.35).

III) RELATIONSHIP OF CONSUMPTION OF VEGETABLES RICH IN ISOFLAVONOIDS WITH CVD

Data on frequent intake of vegetables rich in isoflavonoids in men and women with and without CVD was noted down and its association was evaluated after adjustment for two age categories, as shown in the following table.

Table 30b: Age adjusted association of frequent consumption of vegetables rich in isoflavanoids by men and women with and without CVD

VEGETABLES (Isoflavonoids)	*Men*		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Frequent	52.38 (33)	80.95 (51)	52.63 (20)	76.31 (29)
Non-frequent	47.61 (30)	19.04 (12)	47.36 (18)	23.68 (9)
O.R (95 % CI)	0.26 (0.11-0.62)		0.34 (0.11-1.02)	

χ2 (p value)	11.57 (0.00*)		4.65 (0.03**)	
ADJUSTED FOR AGE				
45-59 years	**Cases (N=31)**	**Controls (N=31)**	**Cases (N=13)**	**Controls (N=13)**
Frequent	54.83 (17)	80.6452	53.84 (7)	84.61 (11)
Non-frequent	45.16 (14)	19.3548	46.15 (6)	15.38 (2)
O.R (95 % CI)	0.29 (0.08-1.03)		0.21 (0.02-1.74)	
χ2 (p value)	4.72 (0.02**)		2.89 (0.08)	
≥ 60 years	**Cases (N=32)**	**Controls (N=32)**	**Cases (N=25)**	**Controls (N=25)**
Frequent	50 (12)	81.25 (26)	52 (13)	72 (18)
Non-frequent	50 (12)	18.75 (16)	48 (12)	28 (7)
O.R (95 % CI)	0.23 (0.06-0.80)		0.42 (0.11-1.58)	
χ2 (p value)	6.93 (0.00*)		2.12 (0.14)	

(Figure in parenthesis indicate number of subjects)
** P<0.001, **p < 0.05*

Consumption of vegetables rich in isoflavonoids was frequent in around 80 % in younger and elderly men without CVD as compared to half of their counterparts. Though, frequent consumption of these vegetables gave protection against the disease, the association was significant only in total men subjects without CVD (OR=0.26). Age adjusted strong protective association was observed only in case of elderly men without CVD (OR=0.23) at $p < 0.001$.

As indicated in the above table, frequent consumption of vegetables rich in isoflavonoids was reported by more than 70 % of women without CVD as compared to around 50 % of the cases. Though, a negative association was observed with the frequent intake of these vegetables with the occurrence of disease, it was not found to be significant after adjustment for age (OR=0.2 and OR=0.42 respectively).

IV) RELATIONSHIP OF CONSUMPTION OF FRUITS RICH IN β-CAROTENE WITH CVD

Following table shows the relationship between the consumption of fruits rich in β-carotene and CVD in men and women after adjusting for age.

Table 31b : Age adjusted association of frequent consumption of fruits rich in β- carotene by men with and without CVD

FRUITS (β-carotene)	Men		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Frequent	34.92 (22)	84.12 (53)	36.84 (14)	65.78 (25)
Non-frequent	65.07 (41)	15.87 (10)	63.15 (24)	34.21 (13)
O.R (95 % CI)	0.26 (0.11-0.62)		0.30 (0.11-0.86)	
$\chi 2$ (p value)	11.57 (0.00*)		6.37 (0.01**)	
ADJUSTED FOR AGE				
45-59 years	**Cases (N=31)**	**Controls (N=31)**	**Cases (N=13)**	**Controls (N=13)**
Frequent	35.48 (11)	80.64 (25)	46.15 (6)	61.53 (8)
Non-frequent	64.51 (20)	19.35 (6)	53.84 (7)	38.46 (5)
O.R (95 % CI)	0.29 (0.08-1.03)		0.54 (0.08-3.32)	
$\chi 2$ (p value)	4.72 (0.02**)		0.62 (0.43)	
≥ 60 years	**Cases (N=32)**	**Controls (N=32)**	**Cases (N=25)**	**Controls (N=25)**
Frequent	34.37 (11)	87.50 (28)	32.00 (8)	68.00 (17)
Non-frequent	65.62 (21)	12.50 (4)	68.00 (17)	32.00 (8)
O.R (95 % CI)	0.23 (0.06-0.80)		0.22 (0.06-0.84)	
$\chi 2$ (p value)	6.93 (0.00*)		6.48 (0.01**)	

(Figure in parenthesis indicate number of subjects)
** $P<0.001$, **$p < 0.05$*

A strong negative association was obtained with frequent consumption of fruits rich in β-carotene in men without CVD (OR=0.26). However, between the two age groups, though frequent intake of β-carotene rich fruits was higher in the controls, a slight weak association was observed with the disease in the younger men (OR=0.29). The trend of association was stronger in case of elderly men without CVD (OR=0.23).

Data on consumption of fruits rich in β-carotene by women with and without CVD has been given in table 31b. A significant protective effect ($p \leq 0.01$) was observed with frequent intake

of β-carotene rich fruits with CVD (OR=0.30). The association, after adjusted for age, was found to be negative in both the younger (OR=0.54), as well as the elderly women (OR=0.22) with and without CVD. However, the trend was significant only in elderly women (χ^2 =6.48) at 1% level.

V) RELATIONSHIP OF CONSUMPTION OF FRUITS RICH IN VITAMIN C WITH CVD

Association between the consumption of fruits rich in β-carotene with the occurrence of CVD was also assessed and the results are given in table 32b.

Table 32b: Age adjusted association of frequent consumption of fruits rich in vitamin C by men with and without CVD

FRUITS (Vitamin C)	Men		Women	
	Cases (N=63)	Controls (N=63)	Cases (N=38)	Controls (N=38)
Frequent	11.11 (7)	46.03 (29)	13.15 (5)	34.21 (13)
Non-frequent	88.88 (56)	53.96 (34)	86.84 (33)	65.78 (25)
O.R (95 % CI)	0.15 (0.05-0.40)		0.29 (0.07-1.03)	
χ2 (p value)	18.82 (0.00*)		4.66 (0.03**)	
ADJUSTED FOR AGE				
45-59 years	**Cases (N=31)**	**Controls (N=31)**	**Cases (N=13)**	**Controls (N=13)**
Frequent	9.67 (3)	48.38 (15)	15.38 (2)	46.15 (6)
Non-frequent	90.32 (28)	51.61 (16)	84.61 (11)	53.84 (7)
O.R (95 % CI)	0.11 (0.02-0.51)		0.21 (0.02-1.76)	
χ2 (p value)	11.27 (0.00*)		2.89 (0.08)	
≥ 60 years	**Cases (N=32)**	**Controls (N=32)**	**Cases (N=25)**	**Controls (N=25)**
Frequent	12.50 (4)	43.75 (14)	12.00 (3)	28.00 (7)
Non-frequent	87.50 (28)	56.25 (18)	88.00 (22)	72.00 (18)
O.R (95 % CI)	0.18 (0.04-0.75)		0.35 (0.06-1.84)	
χ2 (p value)	7.73 (0.00*)		2.00 (0.15)	

*(Figure in parenthesis indicate number of subjects) * P<0.001, **p < 0.05*

A strong protective effect was observed with frequent intake of fruits rich in Vitamin C which was significantly higher in the men without CVD (OR=0.15). A significant negative effect was also observed in men, in both younger as well as elderly age group after

adjustment for age as seen from the above table. Frequent consumption of fruits rich in vitamin C gave a strong protective effect against CVD in women (OR=0.29) at 5% level. A non-significant negative association was observed after adjustment for age in both younger and elderly women (OR=0.21 and OR=.0.35 respectively).

DISCUSSION

Cardiovascular diseases (CVD) is the leading cause of death in the world today. According to the WHO (2002), 17 million people died of CVD of all types, globally. The most important causes were ischemic heart disease (IHD), hypertension and rheumatic heart diseases (RHD). In the present study, however, we found higher occurrence of myocardial infraction (MI) in men and women followed by IHD.

Although cardiovascular disease had been a major cause of death in the developed countries, it is on the increase in developing countries too. The projections made by the Global Burden of Disease study indicates that the developing countries would contribute 13-8 % of the CVD burden (Reddy 1999). It has been shown consistently that socio economic status (SES) is inversely associated with the cardiovascular morbidity and mortality (Woodward et al, 1992 ; Liu et al 1982). In the developed countries, the declining trend in CVD has been more pronounced among individuals in higher socio economic groups, and the differences in the occurrence of CVD between higher and the lower socio economic groups is widening (Kaplan and Keil 1993). In the present study, it was found that 80 % of the men and women with CVD belonged to the middle income group followed by 9 % of the men and 15 % of the women from the low income group. Education level of the subjects in our study indicated that 65 % of the men and women with CVD had school level education.

Similar results were obtained in a study carried out in Tianjin, China on 1615 men and 1592 women aged 25-69 years (Yu et al 2000). Education level ($\leq$ 12 years) seemed to be the most important measure of the four socio economic indicators (education, occupation, income and marital status). People with lower socio economic status had higher levels of cardiovascular risk factors. The association between the socio economic status and cardiovascular risk factors was more consistent among women than men.

The nutritional status and the dietary intakes along with other several inherited and lifestyle factors appear to influence the risk of an individual suffering from this disease. One of the traditional risk factors for the development of CVD is obesity. Obesity is known to have a strong association with coronary risk factors. The NHANES II study has shown that hypertension and diabetes mellitus were 2.9 times higher and hypercholesterolaemia 2.1 times more prevalent in obese subjects (National Institutes of Health Consensus

Development Conference Statement 1985). Although the relationship between obesity per se to CAD is less clear, the Framingham study reported an increasing risk for CAD with increasing levels of obesity, independent of other risk factors (Hubert et al 1983).

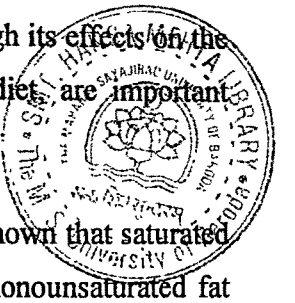
The anthropometric measurements of the subjects in the present study indicated that though majority of the subjects had BMI within normal range, obesity was found to be prevalent in higher number of cases (17 % men and 15 % women) as compared to the controls (4 % men and 7 % women). This may be because of the less sample size.

The dietary habits may influence the risk of an individual developing some form of CHD. In the present phase, more than $3/4^{th}$ of the subjects were followed vegetarian diets. Higher percent of female controls were found to be vegetarians as compared to the cases. Vegetarian diets consumed by these subjects may be responsible for the low occurrence of obesity found in the present section of the study.

Interest in the association between the lifestyle factors and chronic diseases had led to studies of disease occurrence in Seventh-day Adventist (SDA) who are advocated vegetarian diets and are required to abstain from animal foods, alcohol, drugs, tobacco and caffeine containing beverages. In both, the Netherlands (Berkel et al 1983) and Japan (Kuratsuna et al 1985), studies have shown significantly lower mortality of both cancer and cardiovascular disease in the SDAs.

To assess the nutritional status of elderly vegetarians, a study was conducted by Woo et al on 131 elderly Chinese aged above 65 years. Lower frequency of ischemic heart disease was reported in vegeterians as compared to omnivores elderly. Intake of energy, fat, protein, thiamine, riboflavin, niacin, iron and folic acid were lower in vegetarians whereas carbohydrates, calcium, potassium, retinol equivalent and ascorbic acid intake were higher. Deficiency of B_{12}, iron and folate accounted for 64 % of anemia in vegetarians as compared to 30 % in omnivares. Anthropometric indices in terms of total body fat was also found to be lower in vegetarians than their non-vegetarian counterparts. It was thus concluded that in elderly Chinese people, vegetarian diets may be beneficial in terms of reducing the risk of coronary heart disease, but it is deficient in many B vitamins, thus causing anemia.

The fundamental importance of diet in the development of CVD is through its effects on the development of hypercholesterolaemia. Fats and oils, present in the diet, are important component of human diet with several nutritional and health functions.



The classic studies of Keys et al (1965) and Hegsted et al (1965) have shown that saturated fatty acids raise total and LDL cholesterol levels whereas C18:0 and monounsaturated fat (cis C18:1) are neutral when substituted for carbohydrates and n-6 polyunsaturated fatty acids (PUFAs) lower cholesterol. More recent studies have shown that long-chain n-3 fatty acids are hypotriglyceridemic and trans fatty acids are hypercholesterolemic. Epidemiologic studies have shown that saturated fat intake is associated with increased risk of coronary heart disease, the greatest risk reduction is associated with PUFA intake, and a lesser extent of risk reduction is associated with monounsaturated fat. Both n-6 (linoleic acid) and n-3 (linolenic acid) PUFAs are protective (Hu et al 1993). However, in our study, no such relationship was observed as majority of the subjects with and without CVD reportedly consumed groundnut oil which has no linolenic acid content (Rao et al 1991). However, the saturated fat intake was slightly more in the cases as compared to the controls.

Cottonseed oil, a good source of linolenic acid was also found to be commonly consumed in the study sample. However, in a 10 year follow up study of 667 men aged 64-84 years from Zutphen Elderly Study by Oomen et al (2001) revealed that the relative risk of CAD for the highest compared with the lowest tertiles of α-linolenic acid intake was 1.68 (95 % CI: 0.86,3.29) in 98 cases of CAD. α-linolenic acid intake from sources containing trans fatty acids was also non-significantly, yet positively, associated with CAD risk. Thus no beneficial effect of dietary α-linolenic acid intake was observed on the risk of 10 year CAD incidence in the follow up study.

The possible effects of diet on the risk of cardiovascular disease have been of interest for ≥ 40 years. Along with high intakes of energy and fat rich foods, low consumption of antioxidants vitamins like β-carotene and vitamin C have been found to be associated with various chronic diseases. Traditionally, the effects of diet on the coronary heart disease have been attributed to the effect of medium chain fatty acids, soluble fiber and dietary cholesterol on serum low density lipoprotein (LDL) cholesterol concentration. Many dietary substances may affect the risk, often via mechanism not involving LDL-C concentration directly. Such

substances include phytosterols, tocotrienols, arginine and antioxidants vitamins (Fraser 1994).

The nutrient intake data revealed deficient intake of energy, protein, fiber and iron by the younger and elderly men and women with and without CVD in our study. Similar observations were made by Mehta and Sheth (1998) in series of studies carried out on local elderly.

Inadequate nutrient intake were also found to be common in 420 rural community dwelling elderly Iowans, aged 79 years and above (Marshal et al 2001). The percentage of subjects with inadequate intakes of selected nutrients was 75 % for folate, 83 % for vitamin D and 63 % for calcium. Eighty percent of subjects reported inadequate intakes of four or more nutrients. Also intake of protein (60g vs 54g), fat (57g vs 51g) and fiber (16g vs 15 g) did not differ between genders. This finding is in line with the results of nutrient intake of men and women, observed in our study.

A study was carried out by Natarajan et al (1993) on 163 women and 257 men (mean age 65 years) from rural and urban population of TamilNadu. The calorie intake of 93.3 % of the elderly was less than the recommended allowances, the mean daily calorie intake being 1191 kcal in men and 928 kcal in women. Except for calcium, all the nutrients were deficient in their diet.

Similar observation was made by Shahar et al (2000) in a cross sectional nutritional survey carried out on 350 elderly Malays aged 60 years and above from 11 randomly selected villages from east coast of Malaysia. The findings indicated that the mean intakes of energy and of all the nutrients investigated were below the Malaysian Recommended Dietary Allowances, except for protein and vitamin C.

Much information has been disseminated in the past two decades regarding nutrition and cardiovascular disease. A great deal of information has addressed cholesterol and fat intake (saturated vs poly-and-mono-unsaturated fats) and their impact on blood lipids and the development of heart disease. However, the role of micro-nutrients, especially vitamins, minerals, flavonoids are gaining importance for the prevention of major chronic diseases like CVD and cancers.

As expected, in the present study, the consumption of fats was found to be significantly higher in men and women with CVD as compared to their respective counterpart. As against this, the intake of antioxidants vitamins which were significantly higher in men and women without CVD as compared to the cases. One of the limitations of the present study was that, due to unavailability of data on vitamin E values from food stuff and oils commonly consumed in India, we could not assess the exact vitamin E consumption from diet, by the subjects, so as to find its relationship with CVD. However, its levels in plasma was determined, which was significantly higher in control as compared to the cases.

A number of epidemiologic studies have been performed which point towards a connection between dietary vitamin E intake and heart disease.

Stampher et al (1993) reported data from 87245 Nurses' Health Study participants who were followed up for periods of ≤ 8 years. Risk of major coronary disease was lowest in women within the highest compared with those within the lowest quintile of reported vitamin E intake after adjustment for age and smoking status (relative risk - 0.66; 95 % CI: 0.5-0.87). Lower risk was associated with levels of vitamin E intake that were achievable only by supplementation. Subsequent analysis revealed a 43 % lower risk for vitamin E supplement users versus nonusers and an inverse relationship between risk and duration of supplement use.

Rimm et al (1993) described similar benefit for vitamin E on 39910 male participants of the Health Professionals Follow-up Study (aged 40-75 years). He found that men consuming more than 60 IU per day of vitamin E had a relative risk of 0.64 as compared with those consuming less than 7.5 IU per day (a 36 % decreased risk).

In a prospective cohort study in Finland (Knekt et al 1994), 2748 men and 2385 women were followed for a mean of 14 years. During follow-up, 186 men and 58 women died of coronary heart disease. Only 3 % of the study sample took vitamin supplements. Compared with men in the lowest tertile of intake (intake of vitamins through diet and supplements, < 4.5 IU/d), men with the highest intake of vitamin E (mean > 6.0 IU/d) had a non significant relative risk reduction (RRR) of 34 % (CI:11% to 58 %) after adjustment for age, smoking, serum cholesterol levels, hypertension, body mass index and energy intake. Compared with women in the lowest tertile of vitamin E intake (mean < 3.5 IU/d), women in the highest tertile (mean > 4.7 IU/d) had a RRR of 65 % (CI:12 % to 86%).

Rimm et al (1993) also observed a lower risk of major coronary events in men reporting high versus those reporting low intakes of β-carotene, but in the subgroups analysis, this relationship was only significant in current and former smokers. These findings are consistent with several other studies that indicated an inverse association between dietary intake of β-carotene or provitamin A carotenoids and risk of cardiovascular disease, particularly among smokers (Gaziano et al 1995 ; Kritchevsky et al 1998). Our results are in line with these observations as the intake of β-carotene was significantly higher in men and women without CVD as compared to their respective cases, selected for the present section of the study.

The present study also pinpointed at higher consumption of dietary vitamin C by controls. This might possibly have been the reason of occurrence of CVD in the cases. This finding is supported by a study carried out by Enstrom et al (1992) on > 11000 US adults examined in the first National Health and Nutrition Examination Survey (NHANES I). Individuals reporting high intakes of vitamin C exhibited significantly lower risk of death from all causes, particularly from coronary heart disease, over a 10 year follow up period. Among men, multivariate -adjusted relative risk was 0.75 (95% CI:0.53-0.97) in individuals within the highest versus those within the lowest vitamin C intake group (50 mg/d dietary vitamin C plus regular supplements containing vitamin C versus < 50 mg/d dietary vitamin C). Results were not adjusted for the intake of other antioxidants, however.

In the Western Electric Study, dietary vitamin E and vitamin C intake was assessed over a 20 + year span in 1556 men. For the means of the highest vs the lowest quartile of vitamin C intake, patients with the higher intake had a 30 % decreased risk of death from CAD (Pandey et al 1995).

Like vitamin E, the lipid soluble antioxidants β-carotene also associates itself with lipoproteins. Even though the β-carotene content of LDL cholesterol is less than $1/20^{th}$ the amount of vitamin E (Easterbauer et al 1991), it is an equally potent antioxidants .

In the present study, the consumption of β-carotene through daily diet, was found to be significantly higher in men and women without CVD. Also, the association for β-carotene was strongest in the highest quartile of intake (OR=0.10, 95 % CI: 0.01-0.68).

Similar findings were obtained in the Health Professionals Study (Rimm et al 1993), which included more than 39000 men, participants in the highest quintile of carotene intake (mean 19034 IU/d) had a RRR of 29 % (CI 14 % to 47 %) for coronary reveascularization, myocardial infarction, and death from coronary heart disease compared with those in the lowest quintile (mean 3969 IU/d) after adjustment for cardiovascular risk factors and intake of vitamins E and C. Significantly, reduced risk was seen only in the highest quintile compared with the lowest quintile, corresponding to 4.8 fold difference. The benefit was largely confined to current smokers (RRR 70 %), with no benefit seen in nonsmokers (RRR, -9%). This association in smokers could not be assessed in the present study as the number of men reporting smoking were very few.

In the Finnish study of 2748 and 2385 women (Knekt et al 1994), risk for death from coronary heart disease was not significantly reduced in men in the highest tertile of carotene intake (mean > 258 mg) compared with those in the lowest tertile (mean < 147 mg) (RRR, -2 %; CI: -48 % to 30 %) after adjustment for cardiovascular risk factors . A non-significant reduction was seen for women (RRR 38 %; CI - 29 % to 70 %) in the highest tertile (mean 383 mg) compared with those in the lowest tertile (mean < 182 mg). No adjustment was made for vitamin E or C.

In another study of male pharmaucetical employees (Kok et al 1987), mortality from coronary heart disease was non significantly higher in men with low baseline carotene levels (relative risk 1.53; CI: - 29% to 70 %).

In a small prospective study of 1299 elderly nursing home residents (Gaziano et al 1992), risk for death from cardiovascular disease was reduced among residents with a high dietary intake of β-carotene (RRR 46 %; CI 13 % to 66%).

Our study also showed significantly higher consumption of vitamin C by men and women without CVD. Also, a strong positive association for vitamin C intake was observed in the highest quartile as compared to the lowest quartile, in men with CVD (OR 0.09; 95 % CI: 0.01-0.50). However, this trend was not significant in case of women (OR 0.30; 95 % CI: 0.04-1.65).

Similar study was carried by Trout (1991) in a small cohort of 730 elderly persons in the United Kingdom followed for 20 years, stroke among persons in the highest tertile of

vitamin C intake (mean > 45 mg/d) was significantly reduced (RRR 50 %; CI: 20-70 %) compared with the lowest tertile (mean < 28 mg/d). However, in the Nurses' study and Male Health Professional study, persons using vitamin C did not have a significantly lower risk for myocardial infarction or death from coronary heart disease after adjusting for vitamin E intake.

These findings suggest that persons using antioxidants vitamins may have other health and lifestyle behaviours that reduce their risk for cardiovascular diseases. Though, in the present study, higher intakes of β-carotene was observed, a strong conclusion regarding their protective effect in isolation cannot be said unless adjustments for vitamin E and vitamin C intakes are made. Similarly, higher vitamin C intakes noted in our study should also be considered after considering the effects of vitamin E and β-carotene. Also, cooking loss of vitamin C and bioavailability of β-carotene should be kept in mind while drawing conclusions regarding its effect against CVD. Moreover, effect of other antioxidants minerals such as selenium, zinc and non-nutrient , flavonoids should also be taken into consideration to arrive at a concrete conclusion.

Present study also revealed a strong positive association with the frequent intake of roti with extra fat added as a topping in case of men with CVD. Similar findings were obtained for women selected for the present phase. These results are in accordance with the observations noted in the phase I of the present study where consumption of roti with fat topping was reported by majority of men and women from the free living population. This may be because of the habitual diets of the people in this part of the country being cereal based, roti forms the main part of these diets daily. Hence, daily use of fat topping on roti was reported by majority of the subjects.

The food frequency data of men with and without CVD, in the present phase revealed a strong beneficial effect of consumption of GLVs, vegetables rich in β-carotene, vegetables rich in isoflavonoids along with vitamin C and β-carotene rich fruits with was significantly higher in healthy men. On the other hand, a strong positive association was obtained with frequent consumption of sweets and deep fried snacks with the occurrence of the disease. Similarly, frequent intake of fruits and vegetables rich in β-carotene by women without CVD, in the present phase, gave significant protective effect in the controls. A weak negative association was observed with frequent consumption of GLVs, vegetables rich in

flavonoids and vitamin C rich citrous fruits. A non-significant positive association was also noted with frequent intakes of sweets whereas consumption of deep fried foods increased the risk of developing CVD 9 times in the cases.

Understanding the association between fruits and vegetables intake and other health behaviors is important for properly interpreting the rapidly growing number of studies that link low intakes of fruits and vegetables to the risk of cancer and cardiovascular disease.

Johnsen et al (2003) studied the association between intakes of fruits and vegetables and the risk of ischemic stroke in a cohort of 54506 Danish men and women in the Danish Diet, Cancer and Health Study from 1993 to 1997 using a semi quantitative food frequency questionnaire. During 168388 person years of follow up, 266 cases of ischemic stroke involving hospitalisation were identified. After adjustment for potential confounders, persons in the top quintile of fruit and vegetable intake (median 673 g/d) had a risk ratio of ischemic stroke of 0.72 (95 % CI: 0.47, 1.12) relative to persons in the bottom quintile of intake (median 147 g/d) (p for trend = 0.04). When comparing the top quintile with the bottom quintile, an inverse association was most evident for fruit intake (risk ratio: 0.60; 95 % CI: 0.38, 0.95; p for trend = 0.02). Similar risk estimates were seen for most types of fruits and vegetables, although the risks were significant only for citrous fruits. He thus concluded that an increased intake of fruit may reduce the risk of ischemic stroke.

Similar study was carried out by Hung et al (2003) to evaluate the association between fruit and vegetable consumption and peripheral arterial disease. In a cohort of 44059 men initially free of cardiovascular disease and diabetes, 295 cases of peripheral arterial disease were documented during a 12 year follow up. Fruits and vegetable consumption was assessed by food frequency questionnaire. The results revealed that in the age-adjusted model, men in the highest quintile had a relative risk of 0.55 (95 % CI: 0.38-0.80) for overall fruit and vegetable intake, 0.52 (0.36-0.77) for fruit intake and 0.54 (0.36-0.81) for vegetable intake, compared with those in the lowest quintile of intake. However, the associations were greatly weakened after adjustment for smoking and other traditional cardiovascular disease risk factors. Comparing men in the highest quintile versus the lowest quintile, relative risk and 95 % CI were 0.95 (0.62-1.44) for overall fruit and vegetable intake, 0.97 (0.64-1.48) for fruit intake and 0.76 (0.50-1.17) for vegetable intake. Thus this study did not find evidence that

fruit and vegetable consumption protects against peripheral arterial disease, although a modest benefit cannot be excluded.

In the present study, after adjustments for age (45-59 years and 60 years +), a strong protective association was observed with frequent consumption of vegetables rich in β-carotene and isoflavonoids and fruits rich in vitamin C and β-carotene in men from both the age groups. However, due to small size in case of younger women, age adjusted significant protective effect was noted with frequent consumption of vegetables and fruits rich in β-carotene in the elderly women. A non-significant association was observed with frequent intake these fruits and vegetables in younger women along with frequent intake of vegetables rich in isoflavonoids and vitamin C rich fruits after adjusting for age.

In the first NHANES epidemiologic follow up study by Bazzano et al (2002), fruit and vegetable intake was examined in relation to the risk of cardiovascular disease in 9608 US adults aged 25-74 years, using a food frequency questionnaire. Consuming fruit and vegetables ≥ 3 times / d compared with < 1 time/ d was associated with a 27 % lower stroke incidence (RR:0.73; 95 % CI: 0.57, 0.95; *p* for trend=0.01), a 42 % lower stroke mortality (RR:0.58; 95 % CI: 0.33, 1.22; *p* for trend=0.05), a 24 % lower ischemic heart disease mortality (RR:0.76; 95 % CI: 0.56, 1.03; *p* for trend=0.07), a 27 % lower cardiovascular disease mortality (RR:0.73; 95 % CI: 0.58, 0.92; *p* for trend=0.008), and a 15 % lower all cause mortality (RR:0.85; 95 % CI: 0.72, 1.00; *p* for trend=0.02) after adjustment for established cardiovascular disease risk factor. Thus an inverse association of fruit and vegetable intake with the risk of cardiovascular disease and all cause mortality in the general US population was observed.

Similar study was also carried out by Rissanen et al (2003) to assess the association of dietary intake of fruits, berries, vegetables with all cause CVD related and non-CVD-related mortality in Finnish men aged 42-60 years examined in 1984-1989 in the prospective Kuopio Ischemic Heart Disease Risk Factor (KIHD) Study. The risk of all cause mortality and non-CVD-related deaths was studied in 2641 men and the risk of CVD related death in 1980 men who had no history of CVD at baseline. During a mean follow-up time of 12.8 years, cardiovascular as well as non-CVD and all cause mortality were lower among men with highest consumption of fruits, berries and vegetables. After adjustment for the major CVD risk factors, the relative risk for men in the highest fifth of fruit, berry and vegetable

intake for all cause death, CVD-related and non-CVD-related death was 0.66 (95 % CI: 0.50, 0.88), 0.59 (95 % CI:0.33-1.06) and 0.68 (95 % CI:0.46-1.00), respectively, compared with men in the lowest fifth. These data showed that a high fruit, berry and vegetable intake is associated with reduced risk of mortality in middle aged Finnish men.

A prospective study of consumption of carotenoids in fruits and vegetables and decreased cardiovascular mortality in the 1299 elderly Massachusetts was carried out by (Gaziano et al 1995). For total CVD death and fatal myocardial infarction, risks were lower among those residents in the highest quartile for consumption of carotene-containing fruits and vegetables as compared with those in the lowest. For death due to CVD, the relative risk (RR) was 0.54 (95 % CI:0.34-0.86; *p* for trend=0.004). For myocardial infarction, the RR was 0.25 (95 % CI:0.09-0.67; *p* for trend=0.002). These observations are in line with the finding of the present study where in frequent intake of fruits and vegetable rich in β-carotene by the elderly men and women showed a beneficial effect thereby decreasing the risk of CVD. However, confounding cannot be ruled out. These confounding factor can be presence of some other "bioactive compound" in the fruits and vegetables.

Flavonoids, a group of phenolic compounds found in fruits and vegetables, are known to have antioxidants properties. They prevent low density lipoprotein oxidation in vitro and thus may play a role in the prevention of coronary heart disease. In 1986, in a prospective study of 34492 postmenopausal women in Iowa, Kushi et al (1999) examined the association of flavonoid intake with CHD and stroke mortality. Over 10 years of follow-up, 438 deaths from CHD and 131 deaths from stroke were documented. Total flavonoid intake was associated with a decreased risk of CHD dealth after adjusting for age and energy intake (p for trend=0.04). However, decreased risk was seen in each category of intake compared with the lowest. Relative risks and 95 % confidence intervals of CHD death from the lowest to highest intake category were 1.0, 0.67 (95 % CI:0.49-0.92), 0.56 (95 % CI:0.39-0.79), 0.86 (95 % CI:0.63-1.18), and 0.62 (95 % CI:0.44-0.87). There was no association between the total flavonoid intake and stroke mortality (p for trend = 0.83). Of the foods that contributed the most to flavonoid intake in this cohort, only broccoli was strongly associated with reduced risk of CHD death.

Dietary antioxidants flavonoids and risk of coronary heart disease was evaluated in the Zutphen Elderly Study by Hertog et al (1993). The flavonoid intake was assessed on 805

elderly men (65-84 years) in 1985 and were followed up for 5 years. The major sources of intake were tea (61 %), onions (13 %) and apples (10 %). Between 1985 and 1990, 43 men died of coronary heart disease. Flavonoid intake (analysed in tertiles) was significantly inversely associated with mortality from coronary heart disease (p for trend=0.015) and showed an inverse relation with the incidence of myocaridial infarction which was of borderline significance (p for trend=0.08). The relative risk of coronary heart disease mortality in the highest versus the lowest tertile of flavonoid intake was 0.42 (95 % CI:0.20-0.88). After adjustment for age, BMI, smoking, serum total and high density lipoprotein cholesterol, blood pressure, physical activity, coffee consumption and intake of energy, vitamin C, vitamin E, β-carotene, and dietary fibre, the risk was still significant 0.32 (95 % CI:0.15- 0.71). Intakes of tea, onions, and apples were also inversely related to coronary heart disease mortality, but these associations were weaker.

The consumption of flavonoids rich vegetables was found to be high in men and women without CVD in our study giving a significant protective effect against the disease. However, we could not quantify the amount of flavonoids consumed by the subjects due to lack of availability of such database on foods rich in flavonoids. Also, the effect of flavonoids was assessed in isolation and adjustments for another traditional risk factors for CVD such as age, BMI, smoking, serum TC and LDL-C, blood pressure, physical activity was not found. Also confounding effect of other antioxidants vitamins like β-carotene, vitamin C and vitamin E was also not adjusted to see the extent of the beneficial effect of flavonoids.

Present study also evaluated the lipid profile along with levels of antioxidants vitamins in a sub-sample of cases and control selected for the present phase. Total cholesterol and LDL-C was found to be significantly higher in the men and women with CVD as compared to their healthy controls. This may be attributed to the amount of dietary fat and habit of using fat topping on various food items regularly in the meals.

The values of antioxidants vitamins such as serum β-carotene and α-tocopherol along with plasma vitamin C were significantly higher in male and female controls as compared to the cases. This may be attributed to the higher intakes of these vitamins through diets, by these subjects giving them protection against the occurrence of CVD.

In a cross-sectional relation between antioxidants vitamin status and carotid atherosclerosis in a 468 men and women aged 66-75 years living in Sheffield, United Kingdom was

investigated by Gale et al (2001). The results revealed that in the men, after adjustment for age and cardiovascular disease risk factors, a 20 % higher plasma vitamin C concentration was associated with a 0.004 mm smaller intima media thickness; a 20 % higher β-carotene concentration was associated with 0.005 mm smaller intima-media thickness. Compared with men with high blood concentrations of β-carotene or cholesterol adjusted vitamin E, those with low blood concentrations of these vitamins were 2.5 times as likely to have carotid stenosis of > 30 %. Thus it was concluded that a high antioxidants vitamin status may help to prevent initiation and progression of early atherosclerotic lesions in men.

Influence of combined antioxidants nutrient intakes on their plasma concentrations in an elderly population (n=746) aged ≥ 60 years from Boston was analysed by Jacques et al (1995). Intakes of vitamin C and carotenoids and supplemental vitamin E were estimated by using a 3 day diet records. Plasma α-tocopherol concentrations were 18 % greater in individuals consuming ≥ 220 mg vitamin E/d compared with those with intakes < 120 mg/d (*p* for trend , 0.001). Plasma carotenoid concentrations were 13 % higher across increasing categories of vitamin C intake (*p* for trend=0.002). An increasing intake of carotenoids was moderately associated with higher plasma α-tocopherol (*p* for trend=0.008) and unrelated to ascorbic acid status. An increasing intake of supplemental vitamin E was weakly correlated with plasma ascorbic acid (*p* for trend=0.05) and unrelated to carotenoid status. These results provide epidemiologic evidence that increasing intake of either vitamin C, vitamin E or carotenoids is associated with greater plasma concentrations of one or both of the other antioxidants vitamins and not associated with any impairment in antioxidants status.

Sedentary lifestyle is associated with a greater risk of the development of various chronic degenerative disorders. Modest levels of physical activity help to control lipid abnormalities, diabetes and obesity as well as blood pressure lowering effect in certain hypertensive groups. There is a evidence that regular physical exercise increases the concentration of HDL-C (Miller et al 1979) and decreases body weight, lowers arterial pressure, improves glucose intolerance and decreases stress. People who exercise regularly are able to cope up with stress and tension better than those who do not exercise.

Regular exercise plays a vital role in both primary and secondary prevention of CVD. Exercise training increases the cardiovascular functional capacity and decreases the

myocardial oxygen demand. Thus, sedentary lifestyle is associated with a greater risk of development of CHD and physical inactivity may be protective (Superko et al 1995). In our study, we found majority of the subjects engaging in sedentary lifestyle. Due to such an activity pattern it is possible that higher percentage of subjects with and without CVD were found to be overweight in the present study.

A 1990 meta-analysis concluded that physically active individuals had about half the CHD rates of those who were sedentary. However, less than $1/5^{th}$ of the studies in the meta analysis included women. Thus a study was undertaken by Lee et al (2001) to examine the relation between physical activity and CHD among 39372 healthy female health professionals aged 45 years and above enrolled throughout the US between 1992 and 1995 and were followed up in 1999. A total of 244 cases of CHD occurred. Adjusting for potential confounders, the relative risks (RRs) of CHD for less than 200, 200-599, 600-1499, and 1500 or more kcal/wk expended on all activities were 1.00 (referent), 0.79 (95% confidence interval [CI], 0.56-1.12), 0.55 (95% CI, 0.37-0.82), and 0.75 (95% CI, 0.50-1.12), respectively (*P* for linear trend = .03). Vigorous activities were associated with lower risk (RR, 0.63; 95% CI, 0.38-1.04 comparing highest and lowest categories). Walking also predicted lower risk among women without vigorous activities. Among these women, the multivariate RRs for walking 1 to 59 min/wk, 1.0 to 1.5 h/wk, and 2 or more h/wk, compared with no regular walking, were 0.86 (95% CI, 0.57-1.29), 0.49 (95% CI, 0.28-0.86), and 0.48 (95% CI, 0.29-0.78), respectively. For walking paces of less than 3.2 km/h (2.0 mph), 3.2 to 4.7 km/h (2.0-2.9 mph), and 4.8 km/h (3.0 mph) or more, compared with no regular walking, RRs were 0.56 (95% CI, 0.32-0.97); 0.71 (95% CI, 0.47-1.05), and 0.52 (95% CI, 0.30-0.90), respectively. When analyzed simultaneously, time spent walking (*P* for linear trend = .01) but not walking pace (*P* for linear trend = .55) predicted lower risk. The inverse association between physical activity and CHD risk did not differ by weight or cholesterol levels (*P* for interaction = .95 and .71, respectively), but there were significant interactions by smoking and hypertension status. Physical activity was inversely related to risk in current smokers but not hypertensive women (*P* for interaction = .01 and .001, respectively). These data indicate that even light-to-moderate activity is associated with lower CHD rates in women. At least 1 hour of walking per week predicted lower risk. The inverse association with physical activity was also present in women at high risk for CHD, including those who were overweight, had increased cholesterol levels, or were smokers.

Such a relationship could not be found in the present study as only self reported time spent in work related activities, leisure time activities and time spent in sleep were noted. Thus, the present study failed to evaluate the time spent in various exercises to arrive at a conclusion regarding health benefits of physical activity.

One of the other modifiable factor affecting CHD risk are smoking and alcohol consumption. Smoking effects the risk of developing heart disease by several possible mechanisms like carbon monoxide induced atherogenesis, nicotine stimulation of adrenergic drive raising both blood pressure and myocardial oxygen demand and lipid metabolism with fall in 'protective' HDL (Shaper et al 1981).

Cigarette smoking alters the serum lipids and lipoprotein fractions and these changes are related to the duration and amount of smoking (Whig et al 1992). In the Framingham heart study, cardiovascular mortality increased 18 % in men and 31 % in women for each 10 cigarettes smoked per day (Kannel and Higgins 1990). It has been reported that as the number of cigarette smoked per day increased, the serum cholesterol and blood pressure both systolic and diastolic increased and HDL-C decreased ((Deewan and Rowlands 1986).

In the present study, no association was found with cigarette smoked between the cases and the controls with the occurrence of CVD as smoking was reported by very few men. The number of cigarettes smoked per day was less than 10 by the cases as compared to 20-25 by 6 % of the men with CVD. Due to small number of smokers in our study, a strong association between the smoking and occurrence of CVD could not be ascertained.

High alcohol intake is an independent risk factor for cardiovascular diseases. Alcohol in moderation has been associated with decreased coronary risk (Pohorecky 1990) and this protective effect may be mediated by an increase in HDL-C (Gaziano et al 1993).

The risk of CVD increases steeply with higher levels of alcohol consumption. In the Framingham study, positive dose related association between alcohol consumption and lower CHD and higher HDL-C have been found, however when alcohol consumption was greater than 2 drinks per day, a rise in mortality from stroke was observed. Hence it was found that the amount of change in HDL was dependent on the amount of alcohol consumed (Haskell et al 1984).

Studies have also shown that eating habits and nutrient intakes differ according to alcohol consumption (Kesse et al 2001). It was observed in a cross-sectional study of French cohort including 10000 womenaged 40-65 years that marked differences exists in the dietary pattern and nutrient intakes in the alcohol drinkers. After adjustment for energy derived from alcohol, increasing alcohol consumption was associated with a higher total energy intake, a higher percentage of energy intake as protein and lipids and higher intakes of cholesterol, fatty acids, retinol, iron and vitamin E. increasing alcohol consumption was associated with higher consumption of animal products, cheese, potatoes, oil, bread and breakfast cereals and with lower consumption of vegetables and dairy products. However, in the present study, the number of men reporting alcohol consumption were less. Among those who reported alcohol drinking, the consumption was found to be between 50-100 ml per day in men without CVD as compared to 12 % of the cases who consumed more than 100 ml of alcohol per day. Due to less number of alcohol drinkers in the present study, the effect of alcohol on dietary pattern and lipid profile could not be assessed.

Recent evidence suggests that tobacco use is the largest single cause of premature death in the developing countries. Smokeless tobacco is associated with an increased risk for CVD. In a 12 year observational epidemiologic study conducted in men, the age adjusted relative risk for death by CVD was 1.4 in users of smokeless tobacco, 1.8 in smokers of less than 13 cigarettes per day and 1.9 in smokers of 15 or more cigarettes per day compared with subjects who did not use any of the tobacco products (Bolinder et al 1994).

Researches have also shown that the use of tobacco products increases HDL-C. In an epidemiological study, HDL-C was 12 % lower in male smokers and 7 % lower in female smokers than in non smokers (Humphries et al 1992). Hence, smoking tends to adversely affect the HDL metabolism and structure. However, this relationship could not be assessed in our study as the number of tobacco chewers were very less.

Competitive lifestyle and stress i.e type A personality behaviour is associated with restlessness, hostility, competitive drive and a sense of urgency or impatience. Type A individuals are more prone to CHD than the calmer Type B individuals (Jenkins et al 1974).

Stress arises from a number of factors, the biggest of them all being 'lifestyle'. The rush, mobility, urbanisation, rivalry, insatiable needs and a fast and competitive lifestyle, all have a great impact on the mental health of the individual.

Stress is an adaptive response mediated by individual characteristics or psychological processes, that is a consequence of any external action, situation or event that places special phsical or psychological demands upon a person. Stress can get manifested in the behaviour of a person in form of continuos anxiety for small things and an angry temperament.

A study was carried out by Williams et al (2001) to determine the component of an anger prone personality predicting strongly CHD risk on 12990 middle aged men and women from Atherosclerosis Risk in Communities Study from US. Among normotensive persons, a strong, angry temperament (tendency toward quick, minimally provoked, or unprovoked anger) was associated with combined CHD (acute MI/fatal CHD, silent MI or cardiac revascularisation procedure) (multivariate-adjusted hazard ratio=2.10, 95 % CI:1.34,3.29) and with 'hard' events (acute MI/fatal CHD) (multivariate-adjusted hazard ratio=2.28, 95 % CI:1.29,4.02). CHD event-free survival among normotensives who had a strong, angry temperament was not significantly different from that of hypertensives at either level of anger. These data suggested that a strong, angry temperament rather than anger in reaction to criticism, frustration or unfair treatment places normotensive, middle aged persons at increased risk for cardiac events and may confer a CHD risk similar to that of hypertension. In the present study, such relationship could not be evaluated as number of subjects reporting stress, anxiety and hot temperament were more or less same in men and women with and without CVD. However, between the cases and the controls, higher percentage of cases reported of such behaviour as compared to their healthy counterpart. Also, one of the limitations of this study was that a validated standardised scale to measure these personality traits was not used. Instead a behaviour were self reported. Hence, association between these personality traits with the occurrence of CVD could not be found in our study.

The disease profile of the subjects indicated higher percentage of cases reporting nervous problems than the controls. This was also reflected in the cases reporting various personality traits such as stress, anxiety and hot temperament. Gastrointestinal problems were also found to be high among the subjects. This was in terms of mainly constipation. This is also reflected when we consider the fibre content of the diet reported by these subjects through 24 hour dietary recall. Also the consumption of GLVs was found to be less in the cases than the controls. These finding are in line with those reported in phase I of the present study.

Thus to sum up, the highlights of the present phase are :

HIGHLIGHTS

- *Obesity was prevalent in higher percentage of men and women with CVD as compared to the controls.*
- *Consumption of fat was significantly higher in cases than in the controls.*
- *Intake of antioxidants vitamins such as β-carotene and vitamin C were significantly higher in subjects without CVD as compared to the cases.*
- *Frequent consumption of fruits and vegetables gave a strong protective effect against the occurrence of CVD in the subjects without CVD especially elderly, after adjusting for age.*
- *Consumption of sweets and deep fried foods were found to be a risk factor for the occurrence of cardiovascular disease.*
- *Total cholesterol and LDL cholesterol were significantly higher in the cases than the controls.*
- *Serum α-tocopherol, serum β-carotene and plasma vitamin C were significantly higher in the men and women without CVD as compared to their diseased counterparts.*

SECTION III

COLLECTION OF DATA ON SOCIO-DEMOGRAPHIC PROFILE, NUTRITIONAL STATUS, DIETARY PATTERN, LIFESTYLE FACTORS, ORAL HYGIENIC PRACTICES AND CLINICAL AND ANTIOXIDANTS PROFILE IN SUBJECTS WITH ORAL CANCER (45 YEARS AND ABOVE).

RESULTS

This section reports the findings of the baseline information of the subjects suffering from oral cancer. Baseline data included socio-demographic profile, nutrition, diet and lifestyle factors such as addiction pattern and activity pattern, and disease profile. Oral hygienic practices of the subjects were also studied. Assessment of antioxidants profile was done in diet as well as from blood. Subjects for this phase were selected from the Shri Sayaji rao Gaekwad Hospital, Vadodara from the year 2000-2001. The patients that were registered during this time period were males only.

This section also reports similar findings on controls i.e subjects without any oral cancer. These controls were selected from the free living population after matching for age (± 2 years) and economic status.

The results are discussed in accordance with the objectives of the present section under the following heads :

A. SITE OF ORAL CANCER AMONG CASES

B. SOCIO-DEMOGRAPHIC PROFILE

C. NUTRITIONAL STATUS

D. DIETARY INTAKE

E. ACTIVITY PATTERN

F. ADDICTION PATTERN

G. OTHER FACTORS

H. DISEASE PROFILE

I. ORAL HYGIENIC PRACTICES

J. BIOCHEMICAL PARAMETERS

K. STRAITIFIED ANALYSIS OF VARIOUS FACTORS ACCORDING TO AGE AND ECONOMIC STATUS

A) SITE OF ORAL CANCER AMONG CASES

The common site of oral cancer in cases was sides of tongue (60 %) followed by gum (23 %), buccal mucosa (15 %) and lips (2 %)

B) SOCIO-DEMOGRAPHIC PROFILE

The data on socio-demographic profile of the cases as well as the controls was collected using a pre-tested questionnaire. Following table reveals the baseline characteristics of men with and without oral cancer.

Table 1c : Socio demographic information of the men (aged 45 years and above) with and without oral cancer

Characteristics	Cases (N=100)	Controls (N=100)
Age (years)		
45 - 55	33 (33)	33 (33)
55 - 65	33 (33)	33 (33)
65 - 75	34 (34)	34 (34)
Mean ± SD	**57.40 ± 9.42**	**58.01 ± 9.23**
Marital status		
Married	97 (97)	98 (98)
Single	3 (3)	2 (2)
Religion		
Hindu	96 (96)	96 (96)
Muslim	4 (4)	4 (4)
Jain	0 (0)	0 (0)
Ethnic group		
Gujarati	88 (88)	90 (90)
Non - gujarati	12 (12)	10 (10)
Education level		
Illiterate	27 (27)	9 (9)
School	63 (63)	73 (73)
University	10 (10)	18 (18)

Contd...

Family type		
Nuclear	45 (45)	30 (30)
Joint	54 (54)	70 (70)
Staying alone	1 (1)	0 (0)
Economic status		
Middle	54 (54)	56 (56)
Lower	46 (46)	44 (44)

(Figure in parenthesis indicate number of subjects)

The socio-demographic profile of men as seen from the above table, indicated that the mean age of the occurrence of oral cancer in cases was 57 years. The marital status of the men showed that only 2-3 % of men were single. Ninety six percentage of men were Hindus and majority of cases (88 %) and controls (90 %) belonged to gujarati ethnic group. Education level of the subjects revealed that though majority of the cases and the controls had school level education, illiteracy was still as high as 3 times in the cases as compared to the controls. Against 10 % cases, 18 % of the men without CVD had university level education. Less than 50 % of the cases resided in nuclear family against 70 % of the controls staying in joint families. The economic status of the subjects revealed that more than half of the total cases and controls were from middle income group.

B) NUTRITIONAL STATUS

Nutritional status of men with and without oral cancer was assessed using anthropometric measurements in terms of height, weight, and body mass index (BMI).

I) ANTHROPOMETRIC MEASUREMENTS

Following table shows the anthropometric measurements of men with and without oral cancer.

Table 2c : Mean anthropometric measurements and BMI cutoff of cases and controls (aged 45 years and above) with and without oral cancer.

Parameters	Cases (N = 100)	Controls (N = 100)	't' value
Height (cm)	155.01 ± 2.97	160.98 ± 3.70	5.97*
Weight (kg)	51.09 ± 8.59	57.86 ± 5.39	6.77*
BMI (Ht / m^2)	21.23 ± 3.26	22.36 ± 2.21	1.13
< 18.5 (Underweight)	20 (20)	0 (0)	
18.5-24.9 (Normal)	69 (69)	90 (90)	
25.0-29.9 (Overweight)	10 (10)	10 (10)	
> 30 (Obese)	1 (1)	0 (0)	

(Figure in parenthesis indicate number of subjects)

$p \leq 0.05$

The mean anthropometric measurements of the cases and controls, as shown in the above table, pinpointed at a better nutritional status among the men without oral cancer. Height, weight and BMI of the controls were significantly higher in the controls as compared to the cases. The data on BMI cutoffs revealed that though majority of the cases (69 %) and the controls (90 %) had BMI with in the normal range, undernutrition was prevalent in $1/4^{th}$ of the total cases. One tenth of the men with and without oral cancer were found to be overweight. Obesity was reported only in 1% of the cases.

C) DIETARY INTAKE

The information on dietary intake of men with and without oral cancer was collected in terms of changes made in the food consumption pattern in last 5 years, dietary pattern, types of oils and fats consumed, fat topping, mean nutrient intake and food frequency.

I) CHANGES IN FOOD CONSUMPTION PATTERN

Self reported changes in the food consumption pattern over a period of 5 years by men with and without oral cancer were evaluated. The major changes made by the men with oral cancer were in hard to chew foods. This was not, however, not reported by the healthy men. A general reduced food intake was reported by few subjects due to decrease in appetite.

II) DIETARY PATTERN

Habitual consumption of diet in terms of vegetarian, non-vegetarian and ovo-vegetarian diets by men with and without oral cancer were also studied as given in table 3c.

Table 3c : Type of food normally consumed by men (45 years and above) with and without oral cancer.

Food type	Cases (N = 100)	Controls (N = 100)
Vegeterian	47 (47)	84 (84)
Non - vegetarian	22 (22)	3 (3)
Ovo-vegetarian	31 (31)	13 (13)

(Figure in parenthesis indicate number of subjects)

A mixed dietary pattern was observed in male cases, as seen from the above table. Forty seven percent of men with oral cancer were found to be vegetarian against 84 % of their healthy counterparts. Higher percentage of the cases were also found to be consuming non-vegetarian diets (22 %) as compared to the controls (3 %). One third of the men with oral cancer were also found to be following ovolactovegetarian diets against 13 % of the controls.

III) TYPES OF OIL AND FAT CONSUMED

Data on types of oils and fat consumed by men with and without oral cancer were assessed. Information on use of oils in combination in various food based preparations was also collected as given in table 4c.

As can be seen from the table, consumption of groundnut oil was found to be higher by men with oral cancer (48 %) as compared to 22 % of the controls. As against this, more than 3/4th of the men without oral cancer were found to be consuming cottonseed oil in their daily diets as compared to around 1/3rd of the cases.

Table 4c : Types of oil consumed by the men (45 years and above) with and without oral cancer.

Type of oil	Cases (N = 100)	Controls (N = 100)
Cottonseed	34 (34)	78 (78)
Groundnut	48 (48)	22 (22)
Sunflower	2 (2)	0 (0)
Mustard	0 (0)	0 (0)
Combination *	2 (2)	0 (0)
Other	4 (4)	0 (0)
Types of fat		
Dalda	38 (38)	63 (63)
Ghee (clarified butter)	22 (22)	14 (14)
Never	40 (40)	23 (23)

(Figure in parenthesis indicate number of subjects)

** cottonseed + groundnut, cottonseed + mustard, mustard + sesame oil*

Consumption of fat in form of dalda was found to be higher in men without oral cancer (68 %) as compared around 38 % of the cases. More than 1/4th of the cases were found to be consuming ghee (clarified butter) as compared to 14 % of the controls as seen from the above table. Higher percentage of men with oral cancer did not report consumption of fat in any form than their healthy counterparts (40 % vs 23 %).

IV) NUTRIENT INTAKE

The dietary intake of one normal routine day by the subjects was noted using technique similar to 24 hour dietary recall method. From this data, nutrient intake per day, consumed by the cases and controls were calculated in terms of energy, protein, fats, fibre, calcium, iron along with antioxidants vitamins such as β-carotene and vitamin C (table 5). Nutrient intakes were evaluated with respect to two major age categories viz, 45-59 years and 60 years and above as the energy requirement for elderly are different from the younger group.

Table 5c : Mean consumption of various nutrients by the men (aged 45 years and above) with and without oral cancer

Nutrients	RDA*	Men (45-59 years)		t value	Men (60 years+)		t Value
		Cases (N=54)	Controls (N=54)		Cases (N=46)	Controls (N=46)	
Energy (kcal)	2425/ 1750#	1336 ± 313	1056 ± 399	4.05*	1070 ± 434	1058 ± 449	0.13
Proteins (gm)	60	31.19 ± 10.14	24.30 ± 10.18	3.52*	32.67 ± 13.03	27.37 ± 11.44	2.07 ***
Fats (gm)	20	38.54 ± 10.41	32.10 ± 10.10	3.26**	30.20 ± 12.03	28.94 ± 12.96	0.48
Fibre (gm)	20	4.07 ± 1.96	3.55 ± 1.63	1.49	3.49 ± 1.88	3.94 ± 1.77	1.18
Calcium (mg)	400	302 ± 294	526 ± 328	3.73*	337 ± 265	527 ± 301	3.21**
Iron (gm)	28	7.05 ± 4.93	7.39 ± 3.41	0.12	7.91 ± 3.63	9.38 ± 5.06	1.60
β - carotene (μg)	2400	588 ± 215	850 ± 759	2.41 ***	592 ± 208	919 ± 448	4.49*
Vitamin C (mg)	40	24.26 ± 21.29	35.00 ± 25.50	2.38 ***	21.52 ± 17.44	29.32 ± 15.60	2.26 ***

(Figure in parenthesis indicate number of subjects)

** Nutrient Requirements and Recommended Dietary Allowances for Indians, ICMR(2002)*
 # For elderly subjects : source - Natarajan (1991)
** $p \leq 0.001$, ** $p \leq 0.01$, *** $p \leq 0.05$*

The nutrient intake data, of men (aged 45-59 years) with and without oral cancer indicated deficient energy intakes by the cases as well as the controls when compared with the recommended dietary allowances. The energy intake was still significantly higher ($p \leq 0.001$) in men with oral cancer than their controls. Consumption of protein was found to be half of the recommended intakes by the cases as compared to their healthy counterpart, who had significantly lower protein consumption (24 gm; $p \leq 0.001$) than the cases. However, fat intake, which was significantly higher in men with oral cancer, exceeded the daily recommendations by both the cases as well as the controls. Fibre consumption was far

below the RDA meeting only around 1/5th of the recommendations by men with and without oral cancer.

Consumption of mineral like calcium and iron through diet were also assessed. A significant difference ($p \leq 0.001$) was observed in calcium intake between the cases and the controls, as seen from the above table. The calcium requirement was found to be exceeding the recommended allowances by the controls whereas it was deficient by 92 mg in cases. On the other hand, iron intake was found to be around 1/4th of the daily requirements by men with and without oral cancer.

Data on consumption of vitamin rich in antioxidants, such as β-carotene and vitamin C, was also collected. Though β-carotene intake was noted to be significantly higher in men without oral cancer, the amount consumed by the subjects was far below the recommendations. Cases could meet less than 1/4th of the RDA for β-carotene against their healthy counterpart who met just above 1/3rd of the β-carotene requirements through their daily diets. Similarly, intake of vitamin C was found to be below the recommended levels, by the subjects selected for this phase of the study. Though significantly higher intakes of β-carotene was noted in controls ($p \leq 0.05$), men with oral cancer could meet just above half the recommendations for β-carotene against more than 3/4th of the RDA met by their healthy counterparts.

The nutrient intake data, on men (60 years and above) with and without CVD was also evaluated, as shown in table 5c. The energy intake was found to be highly deficient. No difference was observed in the energy intakes between the elderly cases and the controls. Less than half of the recommendations for energy (given by the ICMR 2002) were met by the subjects. However, on comparison with the suggested recommendations given by Natarajan (1991), slightly more than 3/5th of the RDA were met by both the cases as well as the controls. Similar observations were made in case of protein intake which was below the recommended levels in the subjects. However, between the cases and controls, significantly higher protein consumption by men with oral cancer was observed. Against this, the fat consumption was found to exceed the recommended levels by both the cases as well as the controls. Fibre intake was found to be less than 1/4th of the daily requirements by the elderly men with and without oral cancer.

Data on minerals intake in term of calcium and iron, indicated at a deficient calcium intake by the cases, who met 3/4th of the RDA for calcium against controls who exceeded the calcium requirements, thereby showing a significant difference ($p \leq 0.01$).

Intake of antioxidants vitamins such as β-carotene and vitamin C were also assessed in the elderly men with and without oral cancer. A significantly higher β-carotene consumption was reported in the controls as compared to the cases ($p \leq 0.001$). However, on comparison with the recommended allowances, the elderly men with oral cancer could meet just below 1/4th of the RDA for β-carotene against controls who could meet slightly above 2/5th of the β-carotene requirements. Half of the RDA was met for vitamin C by the cases as compared to the controls who met around 3/4th of the vitamin C requirements, thereby giving a significant difference in the intakes between the elderly subjects with and without cancer.

NUTRIENT INTAKE AS PERCENTAGE OF RDA

The nutrients intake by the younger men (45-59 years) and the elderly men (60 years and above) with and without oral cancer were further analysed at various levels of percentage of the RDA as given in table 6c and 7c respectively.

As seen from table 6c, the consumption of energy was found to be 25-50% of the RDA for majority of the younger men with and without oral cancer (59% and 64% respectively). Similar observations were made for protein intake. Around 3/4th of the cases consumed > 100% of the requirement for fat as compared to 55% of their healthy counterparts. Though majority of cases and controls consumed less than 25% of the fibre requirement, one third of the healthy men against 12% of the cases consumed 25-50% of the fiber intake through diet.

Data on consumption of minerals like calcium and iron were also assessed. Half of the total men with oral cancer could meet only 25-50% of the calcium requirements as against 59% of the controls who could meet > 100% of the RDA for calcium. Iron intake was found to be less than 1/2 the recommended allowances by around half of the total subject with and without oral cancer.

Intake of antioxidants vitamins in terms of Beta carotene and vitamin C, indicated a deficient intake by both the cases as well as the control. Consumption of Beta-carotene was 50% of the RDA by all the cases as against 84% of their healthy counterparts. Three percent of the healthy men without oral cancer could meet >100% of the recommendation .

Vitamin C intake was found to be between 25-50% of the RDA by majority of men with and without oral cancer (24% and 35% respectively). However, 1/4th of the healthy men could also meet >100% RDA for vitamin C against 16% of the cases.

Data on consumption of different nutrients at various levels of % RDA by men (60 years and above) was also assessed as given in table 7.c.

Majority of the men with and without oral cancer could meet 25-50% of the RDA for energy when compared with the recommendation given by the ICMR (58% and 43% respectively). However, a shift was observed in the energy consumption pattern when compared to the RDA suggested by Natarajan (1991). Half of the men with oral cancer and 41% of their healthy controls could meet 50-75% of the RDA for energy. 23% of the men without oral cancer could also meet more than 100% of the energy requirement against 6% of the controls. Protein intake was found to be between 25 to 50% of the RDA by more than half of the cases (52%) as compared to 36% of the controls who could meet 50-75% of the recommendations for proteins. More than 100% of the RDA for fat was met by majority of men with and without oral cancer (69% and 53% respectively). Consumption of fibre was found to be less than 1/4th of the recommendations by more than 3/4th of the cases and controls.

The data on mineral intake, indicated that more than half of the men with oral cancer against 1/3rd of their healthy counterparts met more than 100 % requirements for calcium. However, the iron consumption was found to be less than 25 % of the RDA by majority of the cases as well as the controls.

Table 6c: Percentage consumption of different nutrients at various levels of percent RDA by the men (45-59 years) with and without oral cancer

Nutrients	Men									
	Cases (N=54)					Controls (N=54)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	11.11 (6)	59.25 (32)	24.07 (13)	5.55 (3)	0 (0)	7.40 (4)	64.81 (35)	27.77 (15)	0 (0)	0 (0)
Proteins (gm)	1.85 (1)	48.14 (26)	35.18 (19)	11.11 (6)	3.70 (2)	20.37 (11)	48.14 (26)	27.77 (15)	3.70 (2)	0 (0)
Fats (gm)	0 (0)	0 (0)	3.70 (2)	22.22 (12)	74.07 (40)	0 (0)	0 (0)	20.37 (11)	24.07 (13)	55.55 (30)
Fibre (gm)	85.18 (46)	12.96 (7)	1.85 (1)	0 (0)	0 (0)	66.66 (36)	33.33 (18)	0 (0)	0 (0)	0 (0)
Calcium (mg)	3.70 (2)	51.85 (28)	14.81 (8)	9.25 (5)	20.37 (11)	1.85 (1)	11.11 (6)	16.66 (9)	11.11 (6)	59.25 (32)
Iron (gm)	48.14 (26)	48.14 (26)	1.85 (1)	1.85 (1)	0 (0)	44.44 (24)	51.85 (28)	3.70 (2)	0 (0)	0 (0)
β - carotene (μg)	50 (27)	50 (27)	0 (0)	0 (0)	0 (0)	40.74 (22)	44.44 (24)	9.25 (5)	1.85 (1)	3.70 (2)
Vitamin C (mg)	18.51 (10)	24.07 3(13)	22.22 (12)	18.51 (10)	16.66 (9)	24.07 (13)	35.18 (19)	11.11 (6)	3.70 (2)	25.92 (14)

(Figure in parenthesis indicate number of subjects)

Figure 1c: Percentage consumption of β-carotene at various level of percent RDA by men (45-59 years) with and without oral cancer

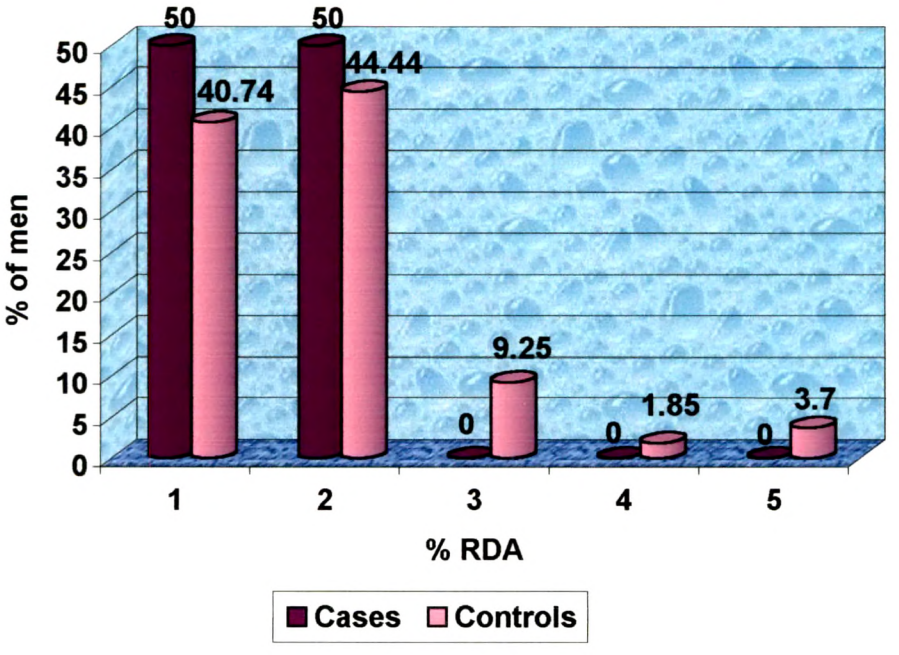
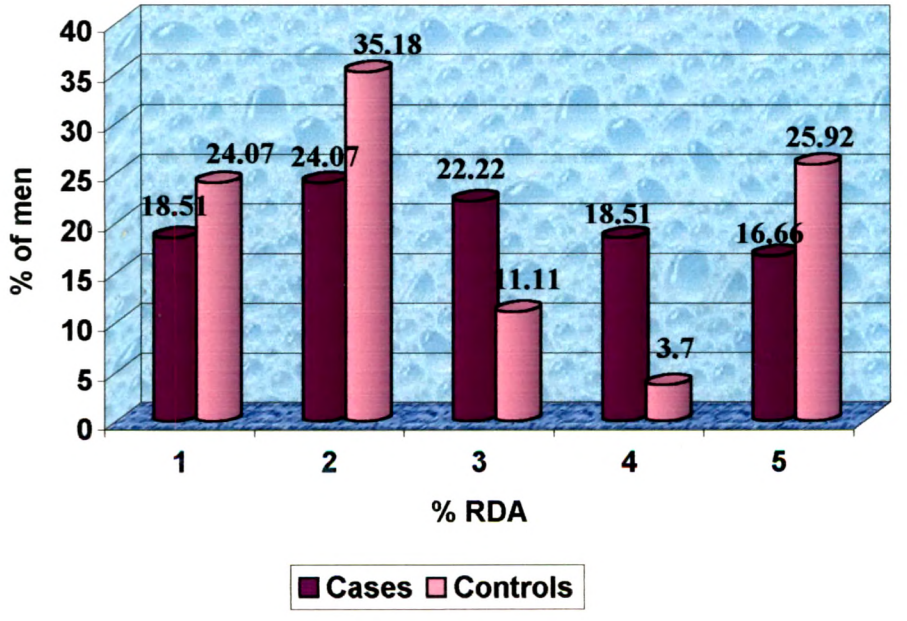


Figure 2c : Percentage consumption of vitamin C at various level of percent RDA by men (45-59 years) with and without oral cancer



1 = < 25 %, 2 = >25-50 %, 3 = > 50-75 %, 4 = > 75-100 %, 5 = > 100 %

Table 7 c: Percentage consumption of different nutrients at various levels of percent RDA by the men (60 years and above) with and without oral cancer

Nutrients	Cases (N=46)					Controls (N=46)				
	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %	<25 %	> 25-50 %	> 50-75 %	>75-100 %	>100 %
Energy (kcal)	10.86 /0	58.69 /34.78	23.91 /50	6.52 /8.69	0 /6.52	0 /0	43.47 /8.69	39.13 /41.30	13.04 /26.08	0 /23.91
Proteins (gm)	0 (0)	52.17 (24)	26.08 (12)	21.73 (10)	0 (0)	23.91 (11))	32.60 (15)	36.95 (17)	6.52 (3)	0 (0)
Fats (gm)	0 (0)	0 (0)	2.17 (1)	21.73 (10)	76.08 (25)	76.08 (35)	23.91 (11)	0 (0)	0 (0)	0 (0)
Fibre (gm)	80.43 (37)	15.21 (7)	4.34 (2)	0 (0)	0 (0)	76.08 (35)	23.91 (11)	0 (0)	0 (0)	0 (0)
Calcium (mg)	2.17 (1)	15.21 (7)	8.69 (4)	19.56 (9)	54.3478 (25)	2.17 (1)	45.65 (21)	10.86 (5)	4.34 (2)	36.95 (17)
Iron (gm)	52.17 (24)	39.13 (18)	8.69 (4)	0 (0)	0 (0)	21.73 (10)	65.21 (30)	10.86 (5)	2.17 (1)	0 (0)
β - carotene (μg)	52.17 (24)	47.82 (22)	0 (0)	0 (0)	0 (0)	21.73 (10)	58.69 (27)	10.86 (5)	8.69 (4)	0 (0)
Vitamin C (mg)	21.73 (10)	23.91 (11)	17.39 (8)	15.21 (7)	21.73 (10)	15.21 (7)	26.08 (12)	19.56 (9)	6.52 (3)	32.60 (15)

(Figure in parenthesis indicate number of subjects)

** Energy requirements for elderly by Natarajan (1991)*

Figure 3c : Percentage consumption of β-carotene at various level of percent RDA by men (60 years and above) with and without oral cancers

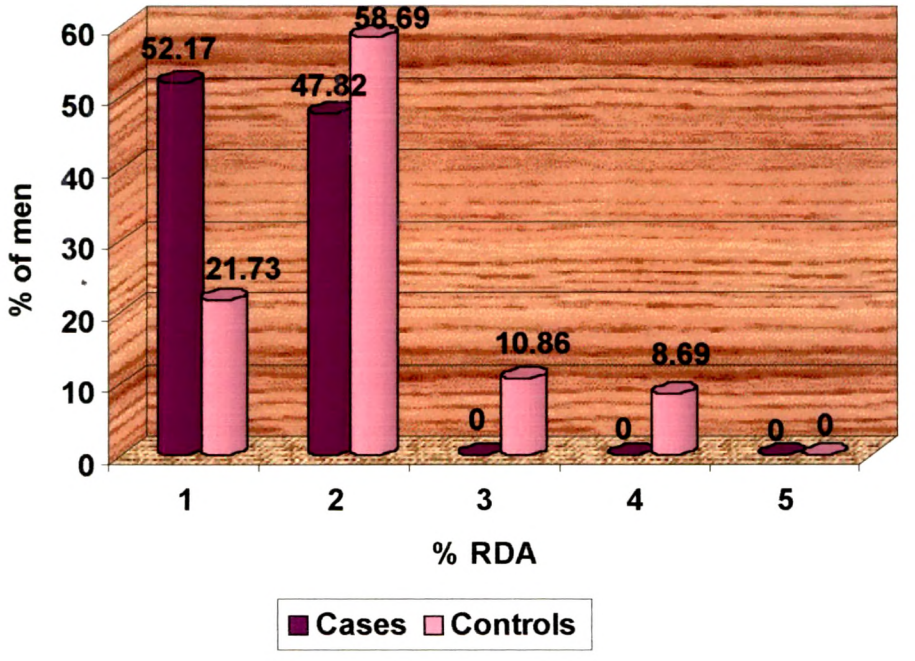
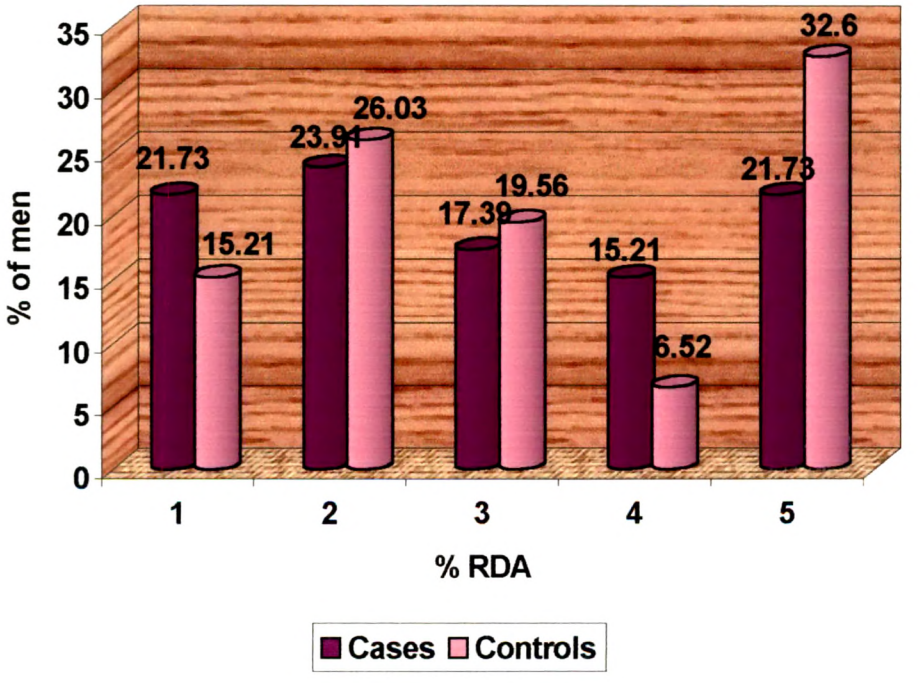


Figure 4c : Percentage consumption of vitamin C at various levels of percentage of RDA by men (60 years and above) with and without oral cancer



C. MEAN INTAKE OF GREEN LEAFY VEGETABLES (GLVS) AND FRUITS

Data on mean food intake of men (aged 45 years and above) with and without oral cancer were also assessed from the 24 hour dietary recall as given in table 8c.

Table 8c : Mean intake of GLVs and fruits by men (aged 45 years and above) with and without oral cancer

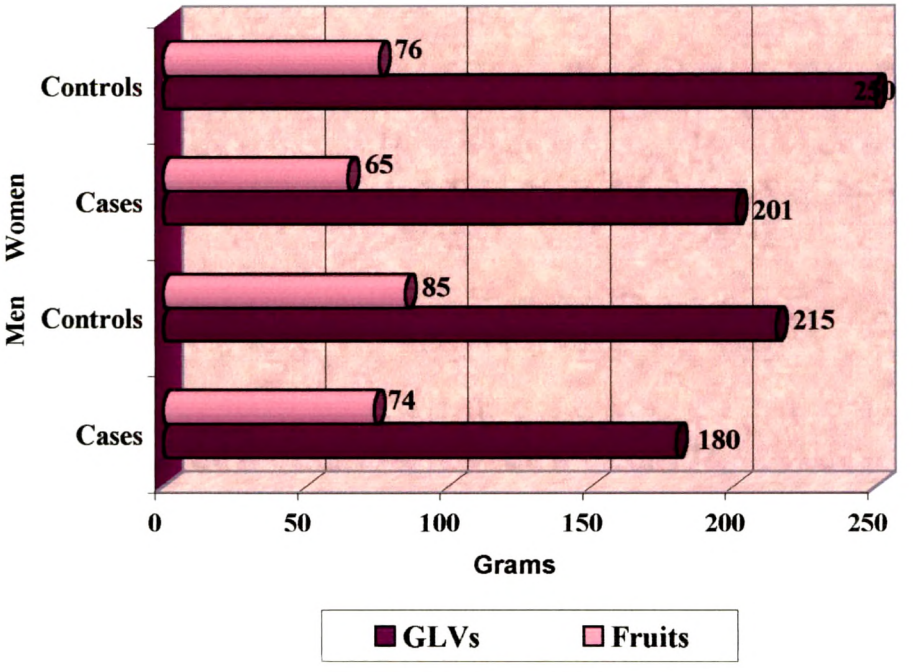
Food Group	Antioxidants Intake			
	Men (45-59 years)		Men (60 years and above)	
	Cases (N=54)	Controls (N=54)	Cases (N=46)	Controls (N=46)
GLVs (gm)	180	215	201	250
Fruits (gm)	74	85	65	76

The consumption of green leafy vegetables (GLVs) was found to be higher in younger men without oral cancer as compared to their diseased counterparts. Similar observations were made for fruit intake, which was noted to be lower in male cases than control. The consumption of fruit was found to be less than 100 gm by all the subjects.

The antioxidants consumption data, in terms of β-carotene and vitamin C, by the elderly men with and without oral cancer was also assessed as given in table 9. Like the consumption pattern observed in younger men subjects, intake of GLVs was found to be lower in elderly men with oral cancer than their healthy counterparts. Similar, elderly male controls reported higher consumption of fruits as compared to the cases. However, the fruit consumption was below 100 gm.

The antioxidants intake between the younger and elderly men with and without oral cancer pin pointed at higher consumption of GLVs by the elderly cases and controls as compared to their respective younger subjects. On the other hand, fruit intake was found to be higher in younger subjects than their elderly counterparts, as seen from the above table.

Figure 5c : Consumption of antioxidants rich GLVs and fruits by men with and without oral cancer



V) FOOD FREQUENCY

Data regarding food frequency was collected from the men (aged 45 years and above) with and without oral cancer. An exhaustive list of food items such as fruits and vegetables rich in vitamin C, vitamin E and β-carotene along with foods rich in fats was used to elicit information on frequent consumption of antioxidants vitamins and fats in the diet of the men (table 9c).

Table 9c : Frequent consumption of various foods by the cases and the controls

Food Items	Cases (N = 100)	Controls (N = 100)	Odds Ratio	Confidence Interval (95%)
Cereals				0.79 - 2.62
Frequent	59 (59)	50 (50)	1.44	$\chi^2 = 1.63$
Non frequent	41 (41)	50 (50)		P = 0.2012
Pulses				0.37 - 1.21
Frequent	40 (40)	50 (50)	0.67	$\chi^2 = 2.02$
Non frequent	60 (60)	50 (50)		P = 0.1552
Green leafy vegetables				0.26 - 0.88
Frequent	37 (37)	56 (56)	0.48	$\chi^2 = 6.50$
Non frequent	63 (63)	44 (44)		P = 0.0107
Veg. rich in β-carotene				0.18 - 0.67
Frequent	22 (22)	45 (45)	0.34	$\chi^2 = 11.87$
Non frequent	78 (78)	55 (55)		P = 0.0005
Veg. rich in isoflavonoids				0.31 - 1.03
Frequent	50 (50)	64 (64)	0.56	$\chi^2 = 11.87$
Non frequent	50 (50)	36 (36)		P = 0.0005
Other vegetables				0.45 - 1.48
Frequent	42 (42)	47 (47)	0.82	$\chi^2 = 0.51$
Non frequent	58 (58)	53 (53)		P = 0.4768
Fruits rich in β-carotene				0.17 - 0.61
Frequent	31 (31)	58 (58)	0.33	$\chi^2 = 14.76$
Non frequent	69 (69)	42 (42)		P = 0.0001

Fruits rich in vitamin C			0.47	0.19 - 1.11
Frequent	10 (10)	21 (21)		$\chi^2 = 3.54$
Non frequent	90 (90)	79 (79)		P = 0.05973
Non vegetarian foods				2.64 - 13.93
Frequent	40 (40)	10 (10)	6.00	$\chi^2 = 24.00$
Non frequent	60 (60)	90 (90)		P = 0.0000
Milk and Milk products				0.65 - 2.12
Frequent	48 (48)	52 (52)	1.17	$\chi^2 = 0.32$
Non frequent	52 (52)	48 (48)		P = 0.5716
Milk based sweets				0.77 - 6.25
Frequent	14 (14)	7 (7)	2.16	$\chi^2 = 2.61$
Non frequent	86 (86)	93 (93)		P = 0.1064
Khoa based sweets				1.51 - 8.30
Frequent	28 (28)	10 (10)	3.50	$\chi^2 = 10.53$
Non frequent	72 (72)	90 (90)		P = 0.0011
Ghee based sweets				1.19 - 13.10
Frequent	16 (16)	5 (5)	3.62	$\chi^2 = 6.44$
Non frequent	84 (84)	95 (95)		P = 0.0111
Deep fried snacks				0.79 - 2.69
Frequent	44 (44)	35 (35)	1.46	$\chi^2 = 1.69$
Non frequent	56 (86)	65 (65)		P = 0.1929
Shallow fried snacks				1.08 - 3.80
Frequent	44 (44)	28 (28)	2.02	$\chi^2 = 5.56$
Non frequent	56 (56)	72 (72)		P = 0.1929
Dry snacks				0.13 - 0.46
Frequent	42 (42)	75 (75)	0.24	$\chi^2 = 22.43$
Non frequent	58 (58)	25 (25)		P = 0.0000

(Figure in parenthesis indicate number of subjects)

Food frequency data, assessed in men with and without oral cancer, is been given in the above table. Frequent consumption of cereal 'bajra' and pulses did not give any significant association with the occurrence of oral cancer (OR=1.44, OR=0.67).

A protective effect was observed with the frequent consumption of GLVs in controls (OR=0.48; *p* for trend=0.01). A strong trend of negative association was also observed with frequent intake of vegetables rich in β-carotene (OR=0.34; *p* for trend=0.0005). Frequent intake of vegetables rich in isoflavonoids also gave a significant protective effect at 5 % level against the disease in men without oral cancer (OR=0.56). A weak negative association was noted with frequent consumption of other vegetables (OR=0.52, *p* for trend=0.47).

Consumption of fruits rich in β-carotene, frequently, gave highly significant protective effect against the occurrence of oral cancer, in the controls (OR=0.33, *p* for trend=0.0001). A non-significant negative association was also observed with frequent intake of vitamin C rich citrous fruits (OR=0.47, *p* for trend=0.06)(Figure 6c) .

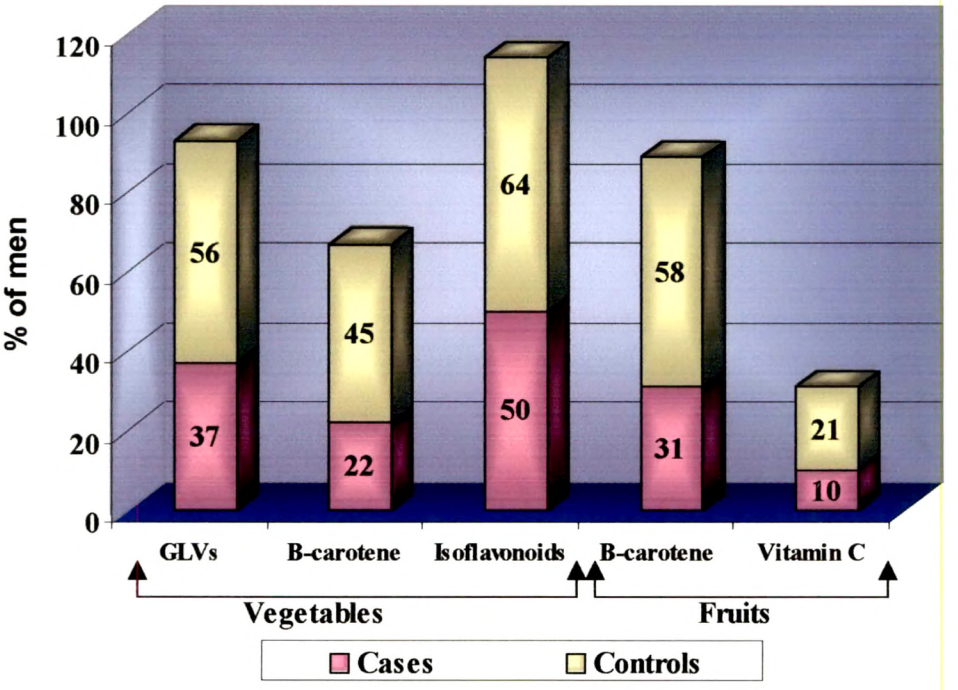
Intake of non-vegetarian foods (including poultry) gave a strong positive association in cases with the occurrence of oral cancer (OR=6.00).

A weak positive association was observed with frequent intake of milk and milk products in men with CVD (OR=1.17)

Data on frequent consumption of milk based, khoa based and ghee based sweets by men with and without oral cancer was also assessed as given in the above table. A non-significant positive association was indicated with frequent intake of milk based sweets (OR=2.16) in cases. However, a strong risk was observed with frequent consumption of khoa and ghee based sweets by men with oral cancer (OR=3.50, *p* for trend=0.001 and OR=3.62, *p* for trend=0.01 respectively).

Consumption of deep fried (OR=1.46) frequently by cases gave a non-significant positive association whereas intake of shallow fried snacks (OR=2.02) was found to be a strong risk factor in the occurrence of oral cancer. Frequent consumption of dry snacks by cases failed to give any positive association with the occurrence of oral cancer (OR=0.24)

Figure 6c : Frequent consumption of antioxidants rich vegetables and fruits by men with and without oral cancer



E) ACTIVITY PATTERN

The data on activity pattern of the men with and without oral cancer was assessed in terms of self reported total hour spent in work related and leisure time activities. Time spent in sleep was also noted down as given in table 10c.

Table 10c : Activity pattern of the cases and the controls (45 years and above) with and without oral cancer

Activities	Cases (N = 100)	Controls (N = 100)
Work related (hours)		
< 5	18 (18)	20 (20)
5 - 8	48 (48)	50 (50)
> 8	34 (34)	30 (30)
Leisure (hours)		
< 5	11 (11)	7 (7)
5 - 8	50 (50)	47 (47)
> 8	38 (38)	46 (46)
Sleep (hours)		
< 5	1 (1)	0 (0)
5 - 8	49 (49)	45 (45)
> 8	50 (50)	55 (55)

(Figure in parenthesis indicate number of subjects)

Majority of men with and without oral cancer (48 % and 50 % respectively) were found to be spending 5-8 hours daily in work related activities followed by around 1/3rd of the subjects spending more than 8 hours in work related activities, as shown in the above table.

Half of the total cases as compared to 47 % of the controls reportedly spent 5-8 hours in leisure activities such as watching television, reading newspaper, socialising and other routine activities,

Total hours spent in sleep were found to be more than 8 hours by half of the men with oral cancer and more than 50 % of their healthy counterparts.

F) ADDICTION PATTERN

Information on various addictions such as chewing of pan (betel quid), supari, ghutka and tobacco, smoking cigarettes and bidis along with alcohol drinking by men with and without oral cancer were collected using a questionnaire (table 11c).

Table 11c : Addiction pattern reported by cases and controls (45 years and above) with and without oral cancer

Addictions	Cases (N = 100)	Controls (N = 100)	Odds Ratio	95 % C I $\chi 2$ and p value
Pan				0.28-162.33
Yes	3 (3)	1 (1)	3.06	1.02
No	97 (97)	99 (99)		0.31
Ghutka				0.65-16.85
Yes	8 (8)	3 (3)	2.81	2.41
No	92 (92)	97 (97)		0.12
Supari				0.10-14.05
Yes	2 (2)	2 (2)	1.00	0.00
No	98 (98)	98 (98)		1.00
Cigarette				0.28-162.33
Yes	3 (3)	1 (1)	3.06	1.02
No	97 (97)	99 (99)		0031
Bidi				1.60-6.99
Yes	85 (85)	63 (63)	3.33	12.58
No	15 (15)	37 (37)		0.00
Tobacco				0.93-5.52
Yes	40 (40)	10 (10)	2.25	3.92
No	60 (60)	90 (90)		0.04
Alcohol				2.12-9.43
Yes	42 (42)	14 (14)	4.45	19.44
No	58 (58)	86 (86)		0.00

(Figure in parenthesis indicate number of subjects)

$p<0.05$, $p<0.001$

As seen from the above table, very few men with and without oral cancer reported addiction to pan (OR=3.06), ghutka (OR=2.81), supari (OR=1.00) and cigarette (OR=3.06) giving a non-significant association with the occurrence of oral cancer. However, more than 80 % of the cases and 63 % of the controls were reportedly addicted to bidi. A strong positive association was thus observed with smoking bidi in cases (OR=3.33, $\chi 2$=12.58, $p < 0.0001$). Similarly, a highly significant positive relationship was also noted for alcohol consumption, which was reported by more than $2/5^{th}$ of the cases and 14 % of the controls, with the occurrence of oral cancer (OR=4.45, $\chi 2$=19.44, $p < 0.0001$). A significant risk in causation of oral cancer was also observed with addiction to tobacco chewing which was reported by $1/5^{th}$ of the cases as compared to $1/10^{th}$ of their healthy counterparts (OR=2.25) at 5 % level (figure 8c).

Figure 7c : Percentage of men with and without oral cancer reporting various addictions

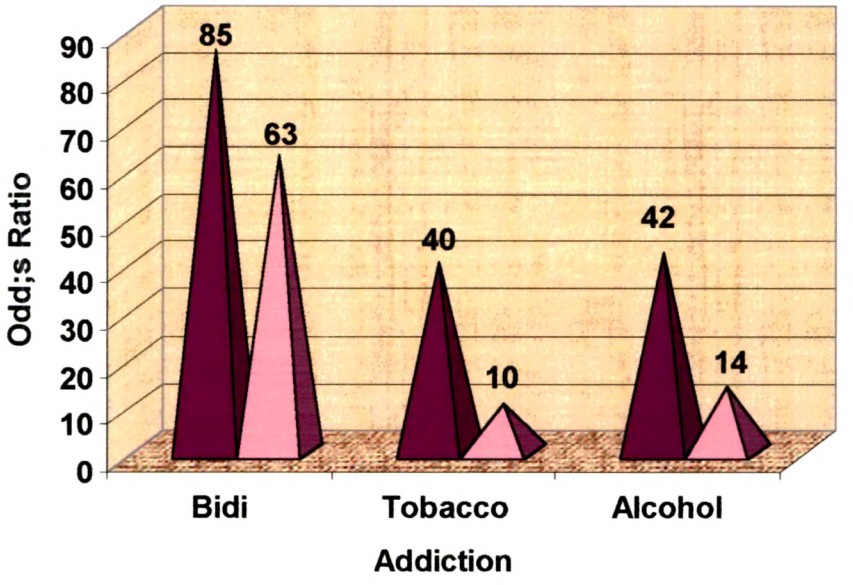
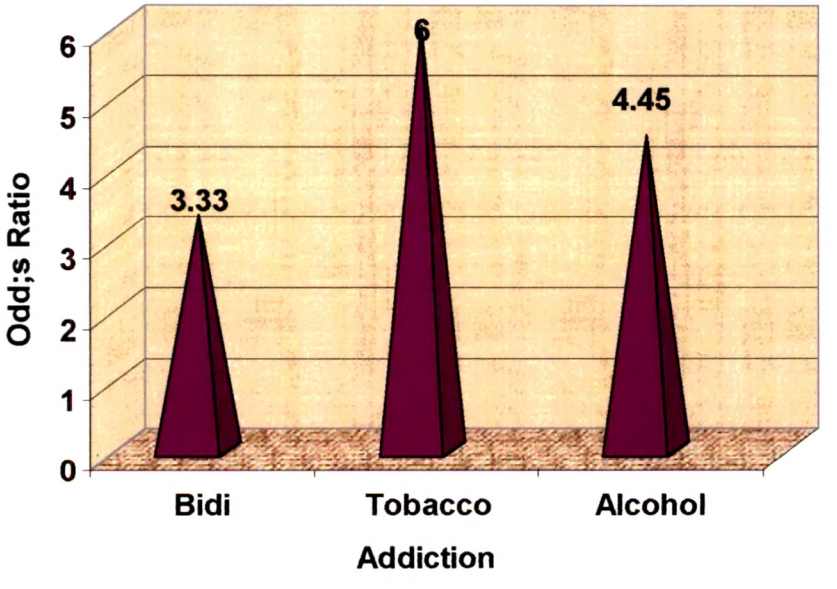


Figure 8 c: Risk of developing oral cancer with various addictions



I) ADDICTION TO SMOKING

Data on addiction to smoking was assessed in terms of total years of smoking bidi along with number of bidis smoked per day (table 12c)

Table 12c : Percentage of men (aged 45 years and above) with and without oral cancer reporting addiction to bidi smoking.

Total years of smoking	Bidi	
	Cases (N = 100)	Controls (N = 100)
< 10	12 (12)	0 (0)
10 - 20	23 (23)	23 (23)
20 - 30	37 (37)	40 (40)
30 - 40	2 (2)	0 (0)
40 - 50	0 (0)	0 (0)
> 50	11 (11)	0 (0)
Number of bidis / day		
< 10	4 (4)	30 (30)
10 - 15	8 (8)	17 (17)
15 - 20	6 (6)	5 (5)
20 - 25	8 (8)	6 (6)
> 25	59 (59)	5 (5)
Never	*15 (15)*	*37 (37)*

(Figure in parenthesis indicate number of subjects)

More than one third of men with oral cancer against 40 % of the controls were found to be addicted to smoking bidis since past 20-30 years followed by 23 % of the cases and controls reporting bidi addiction since 10-20 years, as seen from the above table. Two percent of the cases were addicted to bidis for 30-40 years.

Data on number of bidis smoked per day revealed that though total years of bidi addiction was low in cases as compared to the controls, the frequency of smoking was very high in men with oral cancer. Majority of bidi smokers in cases (59 %) smoked more than 25 bidis per day as compared to only 5 % of their healthy counterparts. Less than 1/3rd of the men without oral cancer were found to be smoking less than 10

bidis per day, as seen from the above table. Seventeen percent of the controls reportedly smoked 10-15 bidis daily as compared to only 8 % of the cases.

II) ALCOHOL CONSUMPTION

Data on alcohol addiction was noted in terms of total years of alcohol drinking along with the amount of alcohol taken per day (table 13c)

Table 13c : Percentage of men (aged 45 years and above) with and without oral cancer reporting alcohol addiction.

Total Years	Cases (N = 100)	Controls (N = 100)
< 5	1 (1)	0 (0)
5 - 15	6 (6)	7 (7)
15 - 25	13 (13)	5 (5)
25 - 35	7 (7)	2 (2)
> 35	15 (15)	0 (0)
Amount / day (ml)		
< 50	4 (4)	10 (10)
50 - 100	12 (12)	3 (3)
> 100	26 (26)	1 (1)
Never	*58 (58)*	*86 (86)*

(Figure in parenthesis indicate number of subjects)

As indicated from the above table, the men reporting alcohol addiction were higher in cases than in controls. Higher percentage of men with oral cancer (13 %) reported addiction to alcohol drinking since 15-25 years against 7 % of their healthy counterparts who were addicted to alcohol since 5-15 years.

The data on amount of alcohol consumed per day was found to be more than 100 ml in more than 1/4th of the men with oral cancer. Majority (10 %) of alcohol drinkers in controls reportedly consumed less than 50 ml per day. Consumption of 50-100 ml of alcohol, which is considered to be moderate amount, was reported by only 12 % of the cases, as can be observed from the above table.

III) ADDICTION TO TOBACCO

Assessment of tobacco addiction by men with and without oral cancer was carried out in terms of total years of tobacco chewing along with amount of tobacco chewed per day as given in table 14c.

Table 14c: Percentage of men (aged 45 years and above) with and without oral cancer reporting addiction to tobacco chewing.

Total Years	Cases (N = 100)	Controls (N = 100)
< 5	0 (0)	0 (0)
5 - 15	5 (5)	3 (3)
15 - 25	4 (4)	7 (7)
25 - 35	14 (14)	0 (0)
> 35	17 (17)	0 (0)
Amount/day (gm)		
< 2.5	11 (11)	5 (5)
2.5 - 5.0	12 (12)	2 (2)
> 5.0	17 (17)	3 (3)
Never	**60 (60)**	**90 (90)**

(Figure in parenthesis indicate number of subjects)

Tobacco addiction was found to be present in 7 % of the men with oral cancer for more than 35 years against 7% of their healthy counterpart also, who were addicted since 15-25 years.

The amount of tobacco chewed per day was found to be more than 5 gm in 17 % of the cases as compared to 3 % of the controls. Five percent of the men without oral cancer reportedly chewed less than 2.5 mg of tobacco per day, as against twice the number of cases, as can be noted from table 14c.

G) OTHER FACTORS

Information on other risk factors, such as personality traits was also noted down. These traits included experiencing stress, anxiety and reporting of hot temperament as given in the following table.

Table 15c: Percentage of men (aged 45 years and above) with and without oral cancer reporting various personality traits.

Traits	Cases (N = 100)	Controls (N = 100)	Odds Ratio	95 % C I $\chi 2$ and p value
Stress				1.67 - 7.28
Yes	38 (38)	15 (15)	3.47	13.58
No	62 (62)	85 (85)		0.0002
Anxiety				0.70 - 2.41
Yes	39 (39)	33 (33)	1.30	0.78
No	61 (61)	67 (67)		0.37
Hot temperament				0.76 - 2.55
Yes	45 (45)	37 (37)	1.39	1.32
No	55 (55)	63 (63)		0.25

(Figure in parenthesis indicate number of subjects)

Data on self reported personality traits by men with and without oral cancer pin-pointed at a experiencing stress to be a strong risk in the causation of oral cancer. A highly significant association was observed in cases reporting stress (OR=3.47, $p < 0.001$) with oral cancer. Anxiety and hot temperament which were reported by higher number of cases than controls, were also found to be positively associated with the occurrence of oral cancer, though the association was not statistically significant (OR=1.30 and OR=1.39 respectively)

H) DISEASE PROFILE

Data on the disease profile was assessed using a check list. The results are given in the table 16c.

Oral cavity problems were highly prevalent in men with oral cancer. More than $3/4^{th}$ of the cases reported various oral cavity problems such as missing teeth, cavities, difficulty in chewing against 45 % of the controls. Problems related to the gastrointestinal tract ranked second in the disease profile list. Sixty percent of the cases and 44 % of the controls reported gastrointestinal problems like constipation and flatulence. Respiratory and nervous problems were reported by around 1/3 or the

cases and around 1/5th or slightly more of the controls. Slightly more than one fifth of the cases and controls reported locomotor problems as seen from the following table.

Table 16c : Percentage of men (aged 45 years and above) with and without oral cancer reporting different health problems.

Types of health Problems	Men	
	Cases (N=100)	Controls (N=100)
Oral cavity	79 (79)	45 (45)
Gastrointestinal	60 (60)	44 (44)
Hepatic	-	-
Respiratory	32 (32)	30 (30)
Genitourinary	-	-
Locomotor	26 (26)	28 (28)
Nervous	38 (38)	25 (25)
Endocrine	-	-
Miscellaneous	12 (12)	10 (10)

(Figure in parenthesis indicate number of subjects)

I) ORAL HYGIENIC PRACTICES

Data on oral hygienic practices was noted down and is presented in table 17c.

Table 17c : Percentage of men with and without oral cancer reporting use of various medium for oral care

	Cases (N=100)	Controls (N=100)
Paste	16 (16)	43 (43)
Datan	42 (42)	56 (46)
Rakh	2 (2)	-
Plain water	34 (34)	-
Coal	3 (3)	-
Tobacco	3 (3)	-
Salt	1 (1)	1 (1)

(Figures in parenthesis indicate number of subjects)

As seen from the above table, men with oral cancer were found to be using carcinogenic materials such as coal , rakh and tobacco for cleaning their teeth. thirty four percent of the cases were also found to be using only plain water for cleaning their teeth. As against this, majority of the controls practiced healthy oral care routine by using either paste or datan to clean their teeth daily.

J) BIOCHEMICAL PARAMETERS

A sub sample of 30 elderly men (60 years and above) with and without oral cancer each were selected for the assessment of the biochemical parameters. The parameters were estimated in terms of their IgM levels, lipid profile and antioxidants status (plasma vitamin C, serum α-tocopherol and serum β-carotene) as given in table 18c and table 19c.

I. IgM LEVELS : The data on IgM levels was obtained from the hospital. The mean values of the cases (1.92 ± 0.33) and those of controls (1.90 ± 0.39) were between the normal ranges.

II. LIPID PROFILE OF THE SUBJECTS

The data on lipid profile was assessed on a sub-sample of elderly men and women (aged 60 years and above) with and without oral cancer. The lipid profile was estimated with respect to triglygerides (TG), total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) and very low density lipoprotein cholesterol (VLDL-C) as given in table 18c.

Table 18c : Mean value of lipid profile of the men (aged 45 years and above) with and without oral cancer

Lipid profile	Cases (N = 30)	Controls (N = 30)	't' value
Triglycerides (mg/dl)	141.10 ± 42.39	137.46 ± 21.95	0.539
Total Cholesterol (mg/dl)	160.46 ± 22.17	166.90 ± 21.74	1.13
HDL - C (mg/dl)	26.26 ± 7.52	33.02 ± 8.93	3.17*
LDL - C (mg/dl)	105.52 ± 21.08	106.39 ± 27.93	0.13
VLDL - C (mg/dl)	28.22 ±8.47	27.49 ± 4.39	0.541

* $p < 0.01$

As seen from the above table, triglycerides, total cholesterol and LDL-C were found to be high in men with oral cancer as compared to their respective controls. However, the difference was not significant. On the other hand, high density lipoprotein (HDL) cholesterol was significantly higher in men without oral cancer than the cases ($p < 0.01$).

II. ANTIOXIDANTS PROFILE

The antioxidants profile was estimated with respect to serum α-tocopherol, serum β-carotene and plasma vitamin C in elderly sub-sample of men and women with and without oral cancer as shown in table 19c and figure 9c.

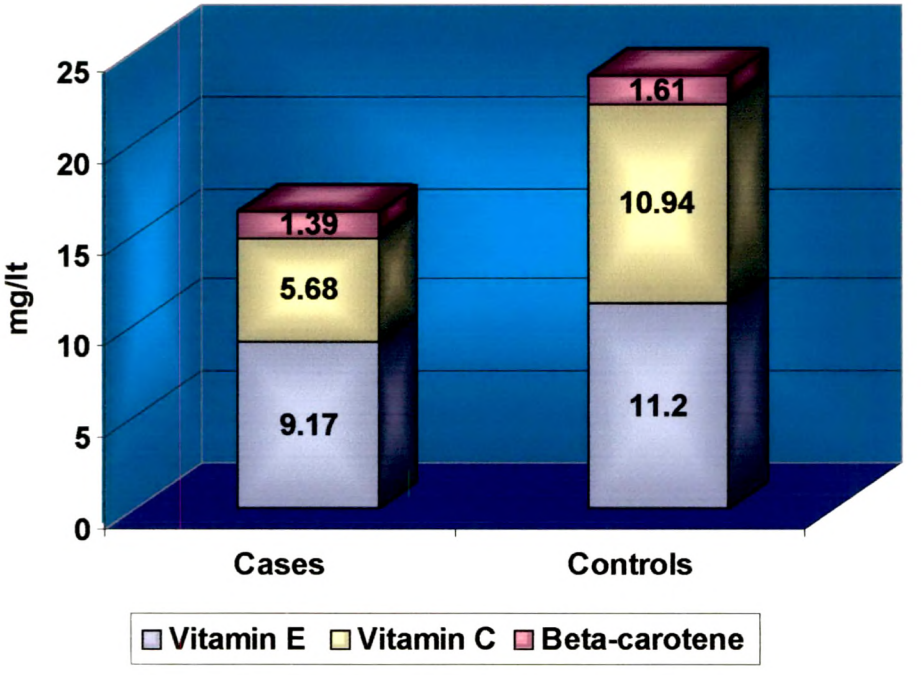
Table 19c : Mean value of antioxidants profile in the men (aged 45 years and above) with and without oral cancer

Antioxidants Profile	Cases (N = 30)	Controls (N = 30)	't' value
Serum α-tocopherol (mg/lt)	9.17 ± 1.81	11.20 ± 2.24	4.984*
Plasma vitamin C (mg/lt)	5.68 ± 3.74	10.94 ± 5.26	5.763*
Serum β - carotene (mg/lt)	1.39 ± 0.75	1.61 ± 0.68	1.537

* $p < 0.001$

Significantly higher values for serum α-tocopherol and plasma vitamin C ($p < 0.001$) were observed in men without oral cancer. Serum β-carotene was found to be higher in controls, however the difference between the case and the controls was not significant as seen from the above table.

Figure 9c : Mean value of antioxidants profile in men with and without oral cancer



K) STRAITIFIED ANALYSIS ACCORDING TO VARIOUS FACTORS IN RELATION TO AGE AND ECONOMIC STATUS

Straitified analysis was used to further investigate the risk of developing oral cancer after adjusting for age. For this purpose, the subjects were divided into two categories viz 45 - 59 years and 60 years and above.

I) RELATIONSHIP OF CONSUMPTION OF GREEN LEAFY VEGETABLES (GLVS) WITH ORAL CANCER

Following table shows the relationship between frequent consumption of GLVs and occurrence of oral cancer after adjusting for age and economic status.

Table 20c : Frequent consumption of GLVs by men (45 years and above) with and without oral cancer

GLVs	**Cases (N=100)**	**Controls (N=100)**	**Odd's Ratio**	0.46
Frequent	37 (37)	56 (56)	**95 % C.I**	0.25 - 0.84
Non-frequent	63 (63)	44 (44)	**Chi square**	7.26
			P value	0.007*
ADJUSTED FOR AGE				
Age (years)	**Cases (N=54)**	**Controls (N=54)**	**Odd's Ratio**	0.40
45-59 years			**95 % C.I**	0.17 - 0.94
Frequent	38.89 (21)	61.11 (33)	**Chi square**	5.33
Non-frequent	61.11 (33)	38.89 (21)	**P value**	0.02**
	Cases (N=46)	**Controls (N=46)**		
60 years and above			**Odd's Ratio**	0.53
Frequent	34.78 (16)	50.00 (23)	**95 % C.I**	0.21 - 1.34
Non-frequent	65.22 (30)	50.00 (23)	**Chi square**	2.18
			P value	0.13

ADJUSTED FOR ECONOMIC STATUS				
Economic status	**Cases (N=51)**	**Controls (N=51)**	**Odd's Ratio**	0.45
MIG			**95 % C.I**	0.19 - 1.07
Frequent	37.04 (20)	60.78 (31)	**Chi square**	3.92
Non-frequent	60.78 (31)	37.04 (20)	**P value**	0.04**
	Cases (N=49)	**Controls (N=49)**		
LIG			**Odd's Ratio**	0.51
Frequent	34.69 (17)	51.02 (25)	**95 % C.I**	0.21 - 1.24
Non-frequent	65.31 (32)	48.98 (24)	**Chi square**	2.67
			P value	0.10

(Figure in parenthesis indicate number of subjects)
** $p < 0.01$, ** $p < 0.05$*

Frequent consumption of GLVs was found to be strongly associated with the occurrence of oral cancer in cases (aged 45 years and above) (OR=0.46, *p* for trend=0.007). This association was still found to be protective in younger men (45-59 years) after adjusting for age (OR=0.40) at 5 % level. A non-significant association was observed in case of elderly men (60 years and above) with frequent consumption of GLVs and oral cancer (OR=0.53).

The relationship of frequent consumption of GLVs with the economic status of men with and without oral cancer indicated at a significant protective effect observed at 5 % level in case of middle income group healthy men. A weak negative association was observed with frequent consumption of GLVs in case of men from LIG.

II) RELATIONSHIP OF CONSUMPTION OF VEGETABLES RICH IN β-CAROTENE WITH ORAL CANCER

The relationship of consumption of vegetables rich in β-carotene with occurrence of oral cancer was assessed after adjusting for age and economic status (table 21c).

Table 21c : Frequent consumption of vegetables rich in β-carotene by men (aged 45 years and above) with and without oral cancer

Vegetables (β-carotene)	Cases (N=100)	Controls (N=100)	Odd's Ratio	0.34
Frequent	22 (22)	45 (45)	95 % C.I	0.18 - 0.67
Non-frequent	78 (78)	55 (55)	Chi square	11.87
			P value	0.0005*
ADJUSTED FOR AGE				
Age (years)	Cases (N=54)	Controls (N=54)	Odd's Ratio	0.45
45-59 years			95 % C.I	0.18 - 1.13
Frequent	22.22 (12)	38.89 (21)	Chi square	3.53
Non-frequent	77.78 (42)	61.11 (33)	P value	0.06
	Cases (N=46)	Controls (N=46)		
60 years and above			Odd's Ratio	0.25
Frequent	21.74 (10)	52.17 (24)	95 % C.I	0.09 - 0.69
Non-frequent	78.26 (36)	47.83 (22)	Chi square	9.14
			P value	0.002**
ADJUSTED FOR ECONOMIC STATUS				
Economic status	Cases (N=51)	Controls (N=51)	Odd's Ratio	0.30
MIG	25.49 (13)	52.94 (27)	95 % C.I	0.12-0.76
Frequent	74.51 (38)	47.05 (24)	Chi square	8.06
Non-frequent			P value	0.004*
	Cases (N=49)	Controls (N=49)		
LIG			Odd's Ratio	0.39
Frequent	18.37 (9)	36.73 (18)	95 % C.I	0.14-1.07
Non-frequent	81.63 (40)	63.26 (31)	Chi square	4.14
			P value	0.04***

(Figure in parenthesis indicate number of subjects)

** $p < 0.001$, ** $p < 0.01$, *** $p < 0.05$*

A highly significant negative association was observed with frequent intake of vegetables rich in β-carotene with the occurrence of oral cancer (OR=0.34, *p* for trend=0.0005). However, after adjusting for age, this association was found to be significantly giving a protective effect in elderly men (60 years and above) against the causation of oral cancer (OR=0.25, *p* for trend=0.002). A weak negative association was noted for the younger men (45-59 years) (OR=0.45, *p* for trend=0.06) as seen from the above table.

Frequent consumption of vegetables rich in β-carotene was found to be strongly associated in men from the middle as well as the low income group (OR=0.30 and OR=0.39 respectively) after adjusting for the economic status.

III) RELATIONSHIP OF CONSUMPTION OF VEGETABLES RICH IN ISOFLAVONOIDS WITH ORAL CANCER

Data on frequent intake of vegetables rich in isoflavonoids in men with and without oral cancer was noted down and its association was evaluated after adjustment for two age categories and economic status, as shown in the following table.

Table 22c : Frequent consumption of vegetables rich in isoflavanoids by men with and without oral cancer

Vegetables (Isoflavonoids)	**Cases (N=100)**	**Controls (N=100)**	**Odd's Ratio**	0.56
Frequent	50 (50)	64 (64)	**95 % C.I**	0.31 - 1.03
Non-frequent	50 (50)	36 (36)	**Chi square**	4.00
			P value	0.04*
ADJUSTED FOR AGE				
Age (years)	**Cases (N=54)**	**Controls (N=54)**	**Odd's Ratio**	0.68
45-59 years			**95 % C.I**	0.29 - 1.58
Frequent	53.70 (29)	62.96 (34)	**Chi square**	0.95
Non-frequent	46.30 (25)	37.03 (20)	**P value**	0.32
	Cases (N=46)	**Controls (N=46)**		
60 years and above			**Odd's Ratio**	0.45
Frequent	46.65 (21)	65.22 (30)	**95 % C.I**	0.18 - 1.12
Non-frequent	54.35 (25)	34.78 (16)	**Chi square**	3.56

			P value	0.05*
ADJUSTED FOR ECONOMIC STATUS				
Economic status	**Cases (N=51)**	**Controls (N=51)**	**Odd's Ratio**	0.57
MIG	58.82 (30)	62.75 (32)	**95 % C.I**	0.25-1.31
Frequent	41.18 (21)	37.25 (19)	**Chi square**	2.07
Non-frequent			**P value**	0.15
	Cases (N=49)	**Controls (N=49)**		
LIG			**Odd's Ratio**	0.37
Frequent	40.82 (20)	65.31 (32)	**95 % C.I**	0.15-0.90
Non-frequent	59.18 (29)	34.69 (17)	**Chi square**	5.90
			P value	0.01*

(Figure in parenthesis indicate number of subjects)

*$p \leq 0.05$

A significant negative association was observed with frequent intake of isoflavonoids rich vegetables by men without oral cancer (OR=0.56, *p* for trend=0.04). Age adjusted intake showed consumption of these vegetables by higher number of controls than cases. However, a weak negative association was observed in elderly men after adjusting for age (OR=0.45, *p* for trend=0.05).

Frequent consumption of vegetables rich in isoflavonoids, after adjusting for the economic status, revealed a significant association in men without oral cancer belonging to the lower income groups at 5 % level (OR=0.37).

IV) RELATIONSHIP OF CONSUMPTION OF FRUITS RICH IN β-CAROTENE WITH ORAL CANCER

Following table shows the relationship between the consumption of fruits rich in β-carotene and oral cancer.

Table 23c : Frequent consumption of fruits rich in β- carotene by men (aged 45 years and above) with and without oral cancer

Fruits (β-carotene)	Cases (N=100)	Controls (N=100)	Odd's Ratio	0.31
Frequent	31(31)	59 (59)	95 % C.I	0.17 - 0.58
Non-frequent	69 (69)	41 (41)	Chi square	15.84
			P value	0.0000*
ADJUSTED FOR AGE				
Age (years)	Cases (N=54)	Controls (N=54)	Odd's Ratio	0.26
45-59 years	27.78 (15)	59.26 (32)	95 % C.I	0.11 - 0.64
Frequent	72.22 (39)	40.74 (22)	Chi square	10.89
Non-frequent			P value	0.000*
	Cases (N=46)	Controls (N=46)		
60 years and above			Odd's Ratio	0.38
Frequent	34.78 (16)	58.69 (27)	95 % C.I	0.15 - 0.95
Non-frequent	65.22 (30)	41.30 (19)	Chi square	5.28
			P value	0.02**
ADJUSTED FOR ECONOMIC STATUS				
Economic status	Cases (N=51)	Controls (N=51)	Odd's Ratio	0.38
MIG	31.37 (16)	54.90 (28)	95 % C.I	0.15-0.91
Frequent	68.63 (35)	45.10 (23)	Chi square	5.76
Non-frequent			P value	0.01**
	Cases (N=49)	Controls (N=49)		
LIG			Odd's Ratio	0.26
Frequent	30.61 (15)	63.26(31)	95 % C.I	0.10-0.64
Non-frequent	69.39 (34)	36.73 (18)	Chi square	10.49
			P value	0.001***

(Figure in parenthesis indicate number of subjects)

*$p < 0.0001$, **$p < 0.05, p < 0.01$

Consumption of β-carotene fruits was found higher in men without oral cancer (aged 45 years and above). A strong protective effect against the occurrence of oral cancer was thus observed with frequent consumption of fruits rich in β-carotene even after adjustment for age. However, the trend of association was found to be more strong in men between the age group of 45-59 years as compared to their elderly counterparts, as seen from the above table.

A highly significant association was observed with frequent intake of fruits rich in β-carotene in men from the middle (OR=0.38) as well as the lower income groups (OR=0.26) at 5 % and 1 % level after adjustment for the economic status.

V) RELATIONSHIP OF CONSUMPTION OF FRUITS RICH IN VITAMIN C WITH ORAL CANCER

Association between the consumption of fruits rich in β-carotene with the occurrence of oral cancer was also assessed and the results are given in table 24c.

Table 24c : Frequent consumption of fruits rich in vitamin C by men (aged 45 years and above) with and without oral cancer

Vegetables (Vitamin C)	**Cases (N=100)**	**Controls (N=100)**	**Odd's ratio**	0.42
Frequent	10 (10)	21(21)	**95 % C.I**	0.17 - 1.00
Non-frequent	90 (90)	79 (79)	**Chi square**	4.62
			P value	0.03*
ADJUSTED FOR AGE				
Age (years)	**Cases (N=54)**	**Controls (N=54)**	**Odd's Ratio**	0.40
45-59 years			**95 % C.I**	0.10 - 1.38
Frequent	9.26 (5)	20.37 (11)	**Chi square**	2.64
Non-frequent	90.74 (49)	79.63 (43)	**P value**	0.10
	Cases (N=46)	**Controls (N=46)**		
60 years and above			**Odd's Ratio**	0.44
Frequent	10.87 (5)	21.74 (10)	**95 % C.I**	0.11 - 1.58
Non-frequent	89.13 (41)	78.26 (36)	**Chi square**	1.99
			P value	1.15

ADJUSTED FOR ECONOMIC STATUS				
Economic status	**Cases (N=51)**	**Controls (N=51)**	**Odd's Ratio**	0.48
MIG			**95 % C.I**	0.14-1.60
Frequent	11.76 (6)	21.57 (11)	**Chi square**	1.76
Non-frequent	88.23 (45)	78.43 (40)	**P value**	0.18
	Cases (N=49)	**Controls (N=49)**		
LIG			**Odd's Ratio**	0.35
Frequent	8.16 (4)	20.41 (10)	**95 % C.I**	0.08-1.34
Non-frequent	91.84 (45)	79.59 (39)	**Chi square**	3.00
			P value	0.08

(Figure in parenthesis indicate number of subjects)

$*p < 0.05$

Consumption of citrous fruits rich in vitamin C, frequently, gave a modest association in men aged 45 years and above at 5 % level (OR=0.42, *p* for trend=0.03). However, age adjusted association with intake of vitamin C rich fruits was not found to be significant in either the younger men (OR=0.40 *p* for trend=0.10) as well as the elderly men (OR=0.44, *p* for trend=1.15).

The data on association between the frequent consumption of fruits rich in vitamin C by men from the middle as well as the lower income groups, failed to give any significant association with the protective effect against the occurrence of oral cancer as can be seen from the above table.

DISCUSSION

Often poorly understood by society in general and frequently ignored in its early stages, when it is most amenable to treatment, oral cancer is increasing in incidence worldwide. Oral carcinoma is the sixth most common cancer in the world. It is an increasing concern in India, and parts of Asia, France, and Brazil where the incidence is particularly high. Smoking, alcohol, and chewing tobacco are major risk factors for oral carcinoma, but dietary factors have also been implicated (Gupta et al 1999). As much as 7 % of all cancer death in males and 4 % in females have been reported to be due to oral cancer. It constitutes nearly half (48.51 %) of all cancer in men and 16.01 of all cancers in women in Gujarat (Gujarat Cancer Registry 1998).

In the present study, during the time of enrollment of cases, the incidence of oral cancer was found predominantly in men. This may probably be due to their higher indulgence in risk factors such as smoking, alcohol and tobacco consumption as compared to the fairer sex. It is also possible that there may be under reporting of such chronic diseases in women. It was also noticed that the prevalence of oral cancer was higher in the lower and lower middle income groups in our study. This seems possible that income status and prevalence of cancers reflect the living conditions or lifestyle of residents in the community and are associated with differential exposure to carcinogens. Also, they suggest that the poor may be less inclined to use the preventive healthcare due to non-financial barriers to access.

Increased incidence of many common cancers was also reported among low socio economic status individuals from Canada and United States. Lower income levels correlated with higher incidences of cancers of the cervix, head and neck region, lung and gastrointestinal tract. In contrast, higher income levels were correlated with higher incidences of breast and prostate cancer (Mackillop et al 2000)

The anthropometric measurements of the subjects in our study showed presence of undernutrition in men with oral cancer. This may be because almost half of the subjects belonged to the lower economic strata. Since these patients were freshly diagnosed, their lower income group can be the attributable factor.

The dietary pattern followed traditionally or habitually determines an individual's risk of developing certain diseases later in the life. Though majority of the controls, from the present study, were vegetarians, non-vegetarian dietary pattern was followed by more than 20 % of the cases. Moreover, it is also possible that the vegetarian diets are thought to be deficient in certain nutrients whereas the non-vegeterian diets can lead to excess of particular nutrients. It would have been interesting to note the differences in the nutrient intakes and the recommendations met for important nutrient by the subjects consuming vegetarian and non-vegetarian diets. However, in the present study this could not be evaluated as the number of healthy subjects reporting consumption of non-vegetarian diets were very few.

A study was carried out by Davey et al (2003) on 65,429 men and women aged 20-97 years, comprising of 33,883 meat eaters, 10,110 fish eaters, 18,840 lacto-ovo vegetarians and 2596 vegans. The results revealed that the nutrient intakes and lifestyle factors differed across the diet groups, with striking differences between meat-eaters and vegans, and fish-eaters and vegetarians usually having intermediate values. Mean fat intake in each diet group was below the UK dietary reference value of 33% of total energy intake. The mean intake of saturated fatty acids in vegans was approximately 5% of energy, less than half the mean intake among meat-eaters (10-11%). Vegans had the highest intakes of fibre, vitamin B1, folate, vitamin C, vitamin E, magnesium and iron, and the lowest intakes of retinol, vitamin B12, vitamin D, calcium and zinc.

One of the major ways in which diet contributes to cancer aetiology is through imbalances in nutrients, deficiency or excess. There are several minor constituents such as micro nutrients which can act as modulators of carcinogenesis. This includes fat soluble vitamins such as vitamin A and vitamin E, water soluble vitamins like vitamin C, minerals and tract elements. Extensive research has been carried out in experimental animals to demonstrate the anticancer activity of retinoids, carotenoids and tocopherol on oral cancer and oral precancerous leukoplakia. The anticancer properties of these micronutrients have been studied in experiments dealing with inhibition of carcinogenesis, prevention of oral cancer development and regression of established oral carcinoma.

In the present study, inadequate intake of macro nutrients like energy, protein and fibre was reported by men with and without oral cancer. The levels of dietary antioxidants vitamins such as β-carotene and vitamin C were also significantly lower in the cases as compared to their healthy controls. this was mainly because of their economic status and family type. Since the cases belonged to the lower and lower middle income group category, the amount of food consumed in a day was inadequate with respect to their age and current nutritional status. Moreover, some of the cases were labourers working on daily wages. So their meager earning per day would be spent on purchasing raw food materials for the whole family. Being in joint families and also having more number of children even in nuclear families, the quantity of meal would be less. As a result, inadequate amount of nutrient dense food and protective vitamins and minerals from the diet along with higher exposure to carcinogens through various addictions, leading to decrease in the immunity, precipitates the events responsible for neoplastic developments.

A similar case-control study of oral cancer was conducted in Beijing, People's Republic of China, to examine the association between dietary nutrient intake and risk of oral cancer, both in terms of estimated intake of nutrients and micro-nutrients, and in terms of specific foods and food groups by (Zheng et al 1993). The study was hospital-based and controls were hospital in-patients matched for age and sex with the cases. Four hundred and four case/control pairs were interviewed. The results suggested that increased protein and fat intake were related to a decreased risk of oral cancer. Carbohydrate intake, however, showed a moderate increased risk for oral cancer. Total carotene intake and carotene intake from fruits and vegetables were inversely associated with risk of oral cancer. A similar pattern was observed for dietary vitamin C intake. Dietary fibre derived from fruits and vegetables showed a strong negative association with oral cancer risk, but fibre derived from other sources did not exhibit any protective effect. At the level of foods and food groups, increased consumption of fresh meat, chicken and liver was significantly associated with a reduction in oral cancer risk: the tests for trend were all statistically significant at the $P < 0.01$ level. The association of fibre was not seen in our study as both the cases and the controls could meet only around $1/5^{th}$ of the fibre recommendations through diets.

The relation between selected micronutrients and oral and pharyngeal cancer risk was also investigated using data from a case-control study conducted between January 1992 and November 1997 in Italy and Switzerland by Negri et al (2000). Cases were 754 incidental, histologically confirmed oral cancers (344 of the oral cavity and 410 of the pharynx) admitted to the major teaching and general hospitals in the study areas. Controls were 1,775 subjects with no history of cancer admitted to hospitals in the same catchment areas for acute, non-neoplastic diseases. Dietary habits were investigated using a validated food-frequency questionnaire. Odds ratios (ORs) were computed after allowance for age, sex, center, education, occupation, body mass index, smoking and drinking habits and non-alcohol energy intake. Micronutrients were analyzed both as continuous variables and in quintiles. ORs for the continuous analysis were 0.95 for retinol, 0.61 for carotene, 0.91 for lycopene, 0.83 for vitamin D, 0.74 for vitamin E, 0.63 for vitamin C, 0.82 for thiamine, 0.87 for riboflavin, 0.59 for vitamin B6, 0.61 for folic acid, 0.62 for niacin, 0.91 for calcium, 0.88 for phosphorus, 0.65 for potassium, 0.82 for iron, 0.67 for non-alcohol iron and 0.89 for zinc; the 95% confidence interval excluded one for carotene, vitamin C and E, thiamine, vitamin B6, folic acid, niacin, potassium and iron. ORs were similar for the 2 sexes and in strata of age. When the combined intake of vitamins C and E and carotene was considered, the protective effect of each nutrient was more marked or restricted to subjects with low intake of the other two. The association with vitamin C and carotene was independent of smoking and drinking habits, while that with vitamin E was less evident in those heavily exposed to alcohol or tobacco. In general, the more a micronutrient was correlated to total vegetable and fruit intake, the stronger was its protective effect against oral cancer.

In our study, when we examined the antioxidants intake of men with and without oral cancer, a significant difference in the higher consumption of β-carotene and vitamin C was observed in the healthy controls. The association between the intakes of β-carotene and vitamin C and occurrence of oral cancer was independent of smoking and drinking habits. This was reflected when we assessed their mean intakes of green leafy vegetables and fruits giving higher amounts of β-carotene and vitamin C in the controls. These findings are in line with the results obtained in the above mentioned study.

Over the past several decades, evidence has accumulated to support the concept that consumption of diets rich in fruits and vegetables is associated with lower risk of cardiovascular diseases and various forms of cancers.

In the present study, nutrient intake data was substantiated with the assessment of frequency of consumption of foods rich in nutrients which are important for our study. The protective effect observed in the controls were further confirmed when we noted higher frequency of GLVs, vegetables rich in β-carotene vegetable rich in isoflavonoid along with fruits rich in β-carotene and vitamin C by men without oral cancer as compared to the cases. However, no single antioxidants from the fruits and vegetables can be isolated and pinpointed at for giving the protective effect as these raw foods are loaded with combination of nutrients and non-nutrients antioxidants and these antioxidants work synergistically to protect against the free radical damage leading to various cancers.

Similarly, in 1998 - 1999, a case-control study was conducted in Uruguay to assess vegetables, fruits, related dietary antioxidants and risk of squamous cell carcinoma of esophagus by Stefani et al (2000). For this purpose, 111 cases with squamous cell carcinoma of the esophagus and 444 controls with conditions unrelated to tobacco smoking, alcohol drinking, or recent changes in the diet were frequency matched on age, gender, residence, and urban/rural status. Vegetables and more markedly fruits were associated with strong reductions in risk. On the other hand, 12 of 15 dietary antioxidants displayed significant inverse associations with esophageal cancer risk. The strongest effect was observed for high intake of beta-cryptoxanthin (OR=0.16, 95 % CI=0.08-0.36). Also, α-carotene, lycopene, and β-sitosterol were associated with significant reductions in risk. Most antioxidants lost their effect when they were further adjusted for a term for all vegetables and fruits. β-carotene showed an increased risk with high intakes. On the other hand, vegetables and fruits remained as significant variables after adjustment for each antioxidant, suggesting that other substances or other mechanisms could explain this effect.

Clinical outcome of unbalanced diet in patients with oral precancerosis and to assess a possible relationship between dietary factors and the development of oral leukoplakia was also assessed, a case-control study by Cianfriglia et al (1998) within

a cohort of 53 subjects treated at Regina Elena Institute for Cancer Research Centre in Rome from October-November 1997. Enrolled subjects and suitable controls underwent a careful interview on their own alimentary habits with a particular interest in retinol and carotenoids as major sources. An individual qualitative and quantitative assessment of retinol-equivalents dietary intake, yielding average values for each group, allowed to compare the cohorts and to relate data also to tobacco use and to the severity of histopathological findings. Case levels were always significantly lower than controls ($P<0.001$), disregarding smoking, whilst no difference resulted between smokers and non smokers within the same groups. No statistical influence seemed to link alimentary vitamin A to the development of oral dysplasia but this work strengthen the epidemiological opinion that specific dietary factors are of great importance in oral oncology. Our findings are in accordance with this study when we consider the differences in consumption of various nutrients by smokers and non-smokers.

A study on same line was carried out to investigate the possible relationship between dietary factors and the development of multiple primary cancer, a nested case-control study was carried out within a cohort of 1,090 oral and pharyngeal cancer patients by Day et al (1994). This patient group, enrolled in 1984-1985 in a population-based case-control study conducted in four areas of the United States, was followed up through June 1989 for the occurrence of second primary cancer. Information on a number of risk factors, including diet, ascertained from interviews conducted at baseline (1984-1985) and at follow-up were compared between 80 patients with histologically confirmed second primary cancers (39% in the upper aerodigestive tract, 32% in the lung, 29% elsewhere) and 189 sex- and survival-matched control patients free of second cancers. Although few significant trends emerged, the results were suggestive of a protective effect provided by higher intake of vegetables. Risk of second primary cancers was 40-60% lower among those with the highest levels of intake for total vegetables and most vegetable subgroups, including dark yellow, cruciferous, and green leafy vegetables and legumes. Risks were also nonsignificantly lower among those with high consumption of vitamin C and carotenoids, with the adverse effects of alcohol being most evident among heavy drinkers with low vitamin C or carotenoid intake. There was also some evidence of an interaction between smoking and vitamin C consumption, but numbers of nonsmokers were small.

Among other dietary factors considered, positive associations were found with increasing consumption of meats, liver, and retinol. The findings suggest that dietary factors contribute along with alcohol and smoking to the excess risks of second primary cancers among patients with oral and pharyngeal cancers.

Cigarette smoking is a strong risk factor for the development of chronic diseases. Smokers can be at risk for anti-/prooxidant imbalances of body tissues because of the plethora of oxidants and free radicals inhaled with cigarette smoke or their inadequate antioxidants defenses due to poor nutrition. Understanding differences in dietary patterns by smoking status is important for nutritionists and health educators involved in helping individuals to make healthy dietary and lifestyle choices.

Smoking of cigarettes or bidi (a crude form of cigarette with about 0.2 g of coarsely ground tobacco wrapped in a specific tree leaf) (Gupta et al 1998) has also been shown to be a risk factor for oral cancer. Bidi smoking shows a higher association with cancer of the tongue, which at least partly explains male predominance since by and large women in India do not smoke. Smoking of bidis was highly reported by cases in our study thereby giving a strong positive association with the occurrence of oral cancer. Smoking of bidis was also reported by large number of healthy men without oral cancer. However, when we compared the smoking habits of the cases with the controls, the duration of smoking and the frequency i.e the number of bidis smoked per day, was comparatively lower in healthy men. Clubbed with this, a higher intake of antioxidants foods like fruits and vegetables rich in β-carotene and vitamin C by the healthy men, observed in our study, may be responsible for no presence of oral cancer in this group. However, possibility of development of oral cancer in future in this group cannot be ruled out especially in younger controls if the exposure to carcinogens through smoking or other addiction or environmental toxins is not reduced. Also the role of passive smoking in non-smokers is also worth considering.

A similar study was conducted by Palaniappan et al (2001) to compare dietary habits of smokers with non smokers in terms of nutrient intake, food groups contributing to nutrient intake, nutritional adequacy and day to day variation in nutrient intake. Non institutionalised adults aged 18-65 years (n=1543) who participated in the Food Habits of Canadians Survey (1997-1998) were studied. Subjects, selected from across

Canada using a multistage, random sampling strategy completed an in home 24 hour dietary recall. Repeat interviews were conducted in a subsample to estimate variability in nutrient intake. Smokers had higher intakes of total and saturated fat, and lower intakes of folate, vitamin C and fiber than non smokers. There were no significant differences in calcium, zinc and vitamin A intakes or day to day variation in nutrient intake by smoking status. Smokers consumed significantly fewer fruits and vegetables than non smokers, leading to lower intakes of folate and vitamin C. Thus it was concluded that smokers have a less healthy diet than non smokers, placing them at higher risk for chronic diseases as a result of both dietary habits and smoking. Diet may act as a confounder in smoking-disease relationship.

Dietary intake in male and female smokers, ex-smokers, and never smokers was assessed by Dyer et al (2003) in the INTERMAP Study. The 4680 participants aged 40-59 years-from 17 population samples in four countries (China, Japan, UK, USA)-provided four 24-h recalls to assess nutrient intakes. Compared to never smokers, current smokers generally consumed more energy from alcohol and saturated fats (SFA), less energy from vegetable protein and carbohydrates, less dietary fibre, vitamin E, beta carotene, vitamin C, thiamine, riboflavin, folate, vitamin B6, calcium, iron, phosphorus, magnesium (Mg), and K per 1000 kcal, excreted less K and urea (marker of dietary protein), had a lower ratio of polyunsaturated fat (PFA) to SFA intake, higher Keys dietary lipid score. There were few differences between smokers and never smokers for total energy intake, energy from total and animal protein, monounsaturated fats, PFA, omega 3 and omega 6 PFA, dietary cholesterol, total vitamin A, retinol, vitamin D, vitamin B12, and urinary and dietary Na. Compared to ex-smokers, smokers generally consumed less energy from vegetable protein, omega 3 PFA, carbohydrates, less dietary fibre, beta carotene, vitamin E, vitamin C, thiamine, riboflavin, folate, vitamin B6, iron, phosphorus, Mg, had lower PFA/SFA. INTERMAP results are consistent with other reports, including our study, indicating that smokers have less healthful diets than nonsmokers. Public health interventions in smokers should focus not only on helping them to quit smoking but also on improving their diets to further reduce cancer and cardiovascular disease risks.

Healthy diet in terms of higher consumption of fruits and vegetables rich in antioxidants nutrients such as β-carotene and vitamin C, may not be the only factors

in giving a protective effect against oral cancer in the controls, selected in our study. It is also important to note that, along with higher duration and frequency of smoking, presence of other addictions such as alcohol consumption and tobacco chewing was also highly prevalent in the cases, in the present study.

It is possible that individuals who smoke, usually drink large quantities of alcohol, thereby producing a synergistic potential for the initiation or promotion of oral cancer. According to the American Cancer Society (1998), alcohol increases the penetration of DNA-damaging chemicals in the lining of oral cavity and oropharynx.

Alcohol consumption and smoking, paired with tobacco use, increases the risk of developing oral cancer. In our study, the number of cases reporting tobacco use were higher in cases as compared to the controls. A site - specific relationship of tobacco was also found in our study. Individuals who kept tobacco between the buccal mucosa and side of tongue and retained it there for a longer period of time, cancer at that site was common. Also few cases in our study reported using tobacco for cleaning their teeth. This habit may also have catalysed the process of development of oral neoplasms, in our study.

Deficiency of antioxidants vitamins such as vitamin A, C and E at the dietary, systemic or mucosal level will interact with tobacco use and increase the risk of oral precancerous lesions. A preliminary study on serum vitamins' status in oral leucoplakias was undertaken by Ramaswamy et al (1996). The objective of this study was to establish the baseline circulating levels of these vitamins in our normal population with and without tobacco use and to compare these levels with the values obtained in cases of oral leucoplakias. Fifty normal controls with 25 each in chewers and non-chewers, matched for age and sex, were selected. Fifty cases of oral leucoplakias (clinically detectable white patches) from the field constituted the study group. Except for serum vitamin E, all the other serum vitamin levels were significantly decreased in oral leucoplakias compared to the controls. Cancer chemopreventive agents acting as inhibitors of both initiation and promotion, as analysed in this population, was promising for further intervention trials.

A recent case-control study conducted in a rural area of India was designed to test the relationship between precancerous changes in the mouth and dietary intake of fruits,

vegetables, and specific dietary nutrients. Researchers decided to use oral precancerous lesions as a marker for oral carcinoma to avoid the potential for measurement bias. This potential for bias is due to the fact that oral carcinoma affects the physical sensation of food, as well as the amount of food consumed, while precancerous lesions have little or no effect on dietary intake.

The relationship of specific nutrients and food items with oral precancerous lesions among tobacco users by Gupta et al (1998) in a population-based case-control study in Palitana taluk of Bhavnagar district, Gujarat, India. Among 5018 male tobacco users, 318 were diagnosed as cases. An equal number of controls matched on age (+/- 5 years), sex, village, and use of tobacco were selected. The results revealed a protective effect of fibre was observed for both oral submucous fibrosis (OSF) and leukoplakia, with 10% reduction in risk per g day-1 ($P < 0.05$). Ascorbic acid appeared to be protective against leukoplakia with the halving of risk in the two highest quartiles of intake (versus the lowest quartile: OR = 0.46 and 0.44, respectively; $P < 0.10$). A protective effect of tomato consumption was observed in leukoplakia and a suggestion of a protective effect of wheat in OSF. Thus it was concluded that in addition to tobacco use, intake of specific nutrients may have a role in the development of oral precancerous lesions.

Macfarlane et al (1995) pooled anaysis of three case-control studies to assess the risk of oral cancer with alcohol, tobacco, diet This combined analysis of data from three large case-control studies of oral cancer confirms the important effect of tobacco in the aetiology of the disease. The studies have been conducted in the United States, Italy and China and results for risks associated with tobacco smoking were generally consistent across centres, while those for alcohol were not; increased risks amongst alcohol drinkers were evident in two centres but not in the study conducted in Turin, Italy. In addition, the combined analysis had large enough numbers to analyse the risk of tobacco consumption in non-drinkers. In females these showed increased risks while in males the effect of tobacco alone was weaker. Given the popularity of tobacco smoking, and its consequent high attributable risk in terms of oral cancer it is reassuring, in terms of public health, that cessation will result in a substantial reduction in risk; a 30% reduction in risk for those stopping smoking between 1 and 9 years, and a 50% reduction for those stopping more than 9 years. Although

encouraging smokers to stop should be the principal aim, decreases in risk for everyone could be achieved by encouraging high fruit and vegetable consumption.

A survey of 5056 tobacco users in Kerala, India, was conducted by Gupta et al (1999), which identified 226 individuals with precancerous lesions. A control group of equal size was gathered and matched to the cases for age, gender, residence, and use of tobacco. Total fruit intake and beta-carotene consumption showed a significant inverse relationship with precancerous lesions even after controlling for tobacco use. Total vegetable intake exhibited a strong but not significant correlation. Associations with certain vitamins and minerals appeared to differ according to gender. A 20% reduction in risk per milligram of zinc consumed per day among men was found, while there was an increased risk of oral precancerous lesions among those women in the lowest quartile of iron and ascorbic acid intake.

In recent years, the production and use of a commercially manufactured smokeless tobacco product called pan masala or gutka, has increased manyfold. Gutka is a generic name for a product that contains tobacco, areca nut and several other substances in powdered or granular form and is sold in small aluminum foil sachets. This mixture, after chewing and sucking for some time, is generally spat out or sometimes swallowed. As a commercial product , gutka was introduced less than three decades ago; today it is a large commercial activity. It is inexpensive and widely available tobacco product that is heavily advertised and is convenient to use with complete social acceptance. As a result, its use has become common even among children and adolescents.

Though only one cases reportedly chewed pan masala, it is also implicated in the occurrence of oral cancer. An antigenotoxic effect of alpha-tocopherol (AT) and ascorbic acid (AA) against the PM/PMT induced genotoxic on Chinese hamster ovary (CHO) cells have been studied using chromosone aberration (CA) assay. AT and AA, per se, had no effect on CA frequency at the concentrations used in the present study. The short-term treatment of AT with aqueous extracts of PM/PMT yielded lower frequencies of CA as compared to the cultures treated with aqueous extracts of PM/PMT alone. However, a statistically significant reduction in CA frequency was observed with continuous treatment only. AA had no statistically significant

protective effect except for continuous treatment with 10 ug/ml AA against the aqueous extract of PMT. The results indicate the possible use of AT to reduce the risk of oral cancer among PM/PMT chewers. (Patel et al 1998).

In addition to the mouth cancer caused by oral use of any tobacco product, gutka causes another serious mouth disease: oral submucous fibrosis. In this disease, fibrous bands develop in the mouth, the mucosa looses its elasticity and the opening of the mouth reduces progressively. In extreme cases, opening may only be just enough for a straw to go through. This might also have implications from nutrition point of view as the food intake would drastically reduce. In our study, few patients did report of this symptom when asked about the first time when they detected something unusual in their oral cavity. This also might mean that there may be under reporting of use of gutka in the subjects and also that the reduced food intake observed in our study, might be because of the above mentioned symptom.

Muscle strength and physical performance in old age might be related to the oxidative damage caused by free radicals. The activity pattern of the subjects revealed that majority of the cases and controls had a sedentary activity lifestyle. A correlation of plasma concentrations and daily dietary intakes of antioxidants with skeletal muscle strength and physical performance in elderly persons were assessed Chianti (InCHIANTI) study, which was conducted in 986 Italians aged > or = 65 y (Cesari et al, 2004). Physical performance was assessed on the basis of walking speed, ability to rise from a chair, and standing balance. Knee extension strength was assessed with a hand-held dynamometer. The European Prospective Investigation into Cancer and Nutrition (EPIC) questionnaire was used to evaluate the daily dietary intakes of vitamin C, vitamin E, beta-carotene, and retinol. Plasma alpha- and gamma-tocopherol concentrations were measured. In adjusted analyses, plasma alpha-tocopherol was significantly correlated with knee extension (beta = 0.566, P = 0.003) and the summary physical performance score (beta = 0.044, P = 0.008). Plasma gamma-tocopherol was associated only with knee extension strength (beta = 0.327, P = 0.04). Of the daily dietary intake measures, vitamin C and beta-carotene were significantly correlated with knee extension strength, and vitamin C was significantly associated with physical performance (beta = 0.029, P = 0.04). Thus, higher dietary

intakes of most antioxidants, especially vitamin C, appear to be associated with higher skeletal muscular strength in elderly persons.

Free radicals in cigarette smoke deplete some plasma antioxidants in vitro and several studies found lower plasma antioxidants concentrations in smokers in vivo. In our study also, a lower plasma antioxidants status with respect to β-carotene, α-tocopherol and vitamin C was observed as compared to the controls. This also suggests that even though the controls were smokers, a strong protection was given because of significantly higher consumption of antioxidants vitamins like β-carotene and vitamin C through fruits and vegetables.

The levels of serum β-carotene and α-tocopherol and plasma vitamin C were also assessed in the present study. The men with oral cancer had significantly lower levels of these micronutrient as compared to their healthy counterparts. This result is in line with a population-based case-control study which was designed by Nagao et al (2000) for the investigation of any association between serum micronutrient levels and oral leukoplakia. Out of a total of 9536 subjects over the age of 40 years who participated in the oral mucosal screening programme in Tokoname city, 48 cases detected with oral leukoplakia (38 male:10 female) were recruited. For each case, four controls matched by age and sex were selected from the same cohort. We examined the fasting serum levels of retinol, alpha-tocopherol, zeaxanthin and lutein, cryptoxanthin, lycopene and carotenoids (alpha-carotene and beta-carotene) by high-performance liquid chromatography. Among males with leukoplakia mean serum lycopene and beta-carotene levels (0.175+/-0.202, 0.357+/-0.295 micromol/l) were significantly lower than those of controls (0.257+/-0.252, 0.555+/-0.408 micromol/l) ($P<0.05$, $P<0.005$). Logistic regression analysis with leukoplakia as the dependent variable showed that high serum levels of beta-carotene were related to low risk of oral leukoplakia (odds ratio 0.160, 95% C.I.: 0.029-0.866, $P<0.05$). There were no significant differences in any of the serum nutrients estimated in female subjects. The results thus suggested that high serum levels of beta-carotene may provide protection against oral precancer for the Japanese male.

Similar study was conducted to investigate the relationship between serum micro-nutrients and the subsequent risk of oral and pharyngeal cancer, a nested case-control

study within a cohort of 25,802 adults in Washington County, MD by Zheng et al (1993). The serum levels of nutrients in 28 individuals who developed oral and pharyngeal cancer during 1975 to 1990 were compared with levels in 112 matched controls. Serum levels of all individual carotenoids, particularly beta-carotene, were lower among subjects who developed oral and pharyngeal cancer. The risks of this malignancy decreased substantially with increasing serum level of each individual carotenoid. Persons in the highest tertile of total carotenoids had about one-third the cancer risk as those in the lowest tertile. High serum levels of alpha-tocopherol also were related to a low oral cancer risk in later years, but the risks were elevated significantly with increasing serum levels of gamma-tocopherol and selenium. The findings from this study are consistent with many previous epidemiological investigations of dietary factors for oral and pharyngeal cancer and provide further evidence for the potential role of carotenoids and alpha-tocopherol in the chemoprevention of these malignancies.

Improper maintenance of dental and oral hygiene i.e irregular brushing, not gargling after having food specially sticky gums or meals or sweets, using other toxic substances such as tobacco, rakh or coal to clean the teeth instead of traditional paste or datan, can also predispose one to oral cancer. In our study, we found that higher percentage of cases reported using rakh, coal, tobacco, and salt for cleaning their teeth as compared none of the controls. This factor, along with other risk factors discussed so far, may be the attributable factor in the causation of oral cancer, found in our study.

The idea that emotions may play a part in malignancy is not new. Observations made of relationship between cancer and less measurable stress factors are increasing. Clinicians and researchers have reported that psychic trauma, especially, the loss of a central relationship, does seem to carry with it a strong cancer correlation. The answer to such a possible relationship to cancer may lie in 2 physiological areas :

- Damage to the thymus gland and the immune system,
- Hormonal effects mediated through the hypothalamus, pitutary gland and adrenal cortex. This "cascade of physiologic events" may provide the neurologic currency that converts anxiety to malignancy (William 1993). Such a stressful state may

An attempt was made in the present study to examine whether stress, anxiety or angry temperament relates to oral cancer. Stress was found to be strongly associated with the occurrence of oral cancer. Stress leading to anxiety and short temperedness were also modestly associated with the disease. This result is worth considering since in the present study, the men with oral cancer were found to have all the known traditional risk factors for oral cancer. In our study, a combined assessment of these factors were positively correlated with the disease. However, how much counfounding variables or how far each risk factor supports the other risk factor in causing the disease should be examined in detail.

Thus, to sum up, the highlights of the present study are :

HIGHLIGHTS

- *Undernutrition was highly prevalent in the cases.*
- *Higher consumption of fruits and vegetables were inversely associated with oral cancer.*
- *A direct linear relationship was found with smoking of bidis and occurrence of oral cancer.*
- *Combination of other addictions like alcohol consumption and tobacco chewing along with decreased fruit and vegetable intake, increased the risk of developing oral cancer.*

SECTION IV

ASSESSMENT OF KNOWLEDGE AND PRACTICES OF THE CAREGIVERS REGARDING ROLE OF ANTIOXIDANTS IN THE DIETS OF THE ELDERLY

RESULTS

This section reports the findings of the information on knowledge and practices of the caregivers of the elderly, who were mainly daughters-in-law, with respect to the importance of proper dietary practices in the elderly. The caregivers were between the age group of 40-45 years belonging to the middle income groups and were graduates. Data was collected in terms of knowledge of the caregivers about various nutritional aspects of elderly using a specially designed questionnaire. Questions were designed in relation to physiological changes taking place in the elderly, their common health complaints and disorders occurring with advancing age and relationship of these disorders with diet. Knowledge regarding the importance of fruits and vegetables, and the sources of nutrients in these fruits and vegetables were also collected. The caregivers were also assessed for their knowledge regarding the changes that should be made in the diets for an elderly person, importance of taking into consideration the various changes taking place with advancing age while planning diets and importance of these changes.

This section also assessed the practices of the caregivers in terms of actual cooking meals for the elderly and making use of their knowledge about the importance of maintaining proper dietary pattern in the elderly.

A) KNOWLEDGE OF THE CAREGIVERS REGARDING THE HEALTH AND NUTRITIONAL STATUS OF ELDERLY

Percentage of the caregivers reporting knowledge regarding various aspects of the importance of the dietary care in an elderly has been presented in the following table 1d and figure 1d .

Table 1d : Percentage of caregivers reporting knowledge regarding health and nutritional status of elderly

Sr. No	Knowledge	Caregivers (N=30)
1.	Physiological changes taking place in an elderly	73
2.	Common health complaints of the elderly	60
3.	Disorders commonly occurring with advancing age	80
4.	Relationship of health complaints and disorders with diet	30
5.	Importance of fruits and vegetables	40
6.	Nutrients present in fruits and vegetables	38
7.	Changes that should be made in the diet of an elderly	57
8.	Considering physiological changes in elderly before planning/preparing their diets	42
9.	Importance of modifying diets with respect to specific disorders for elderly	38

The above table reveals the knowledge of the caregivers with respect to various aspects of health and nutritional status of the elderly. It can be seen that 80 % of the caregivers had knowledge about various disorders commonly occurring with advancing age. The responses were in terms of disorders like diabetes mellitus, hypertension, heart disease and osteoarthritis. Around $3/4^{th}$ of the caregivers could tell about the physiological changes taking place in an elderly. These responses were in terms of loss of teeth, greying of hair, wrinkled skin, diminished vision, reduced mobility and fragile bones. Responses related to the dietary changes with advancing age in terms of reduced appetite, lack of interest in foods, and alteration in certain taste perception, were reported by very few caregivers.

Sixty percent of the caregivers knew about the common health complaints of the elderly. However, these health complaints were only with respect to constipation, and flatulence. Minor complaints like fullness of stomach and acidity were also reported by other groups.

More than 57 % of the caregivers had knowledge regarding the changes to be made in the diets of an elderly. The modifications which was thought necessary by the

caregivers was only in terms of change in consistency of diet followed by amount of spices and salt to be added.

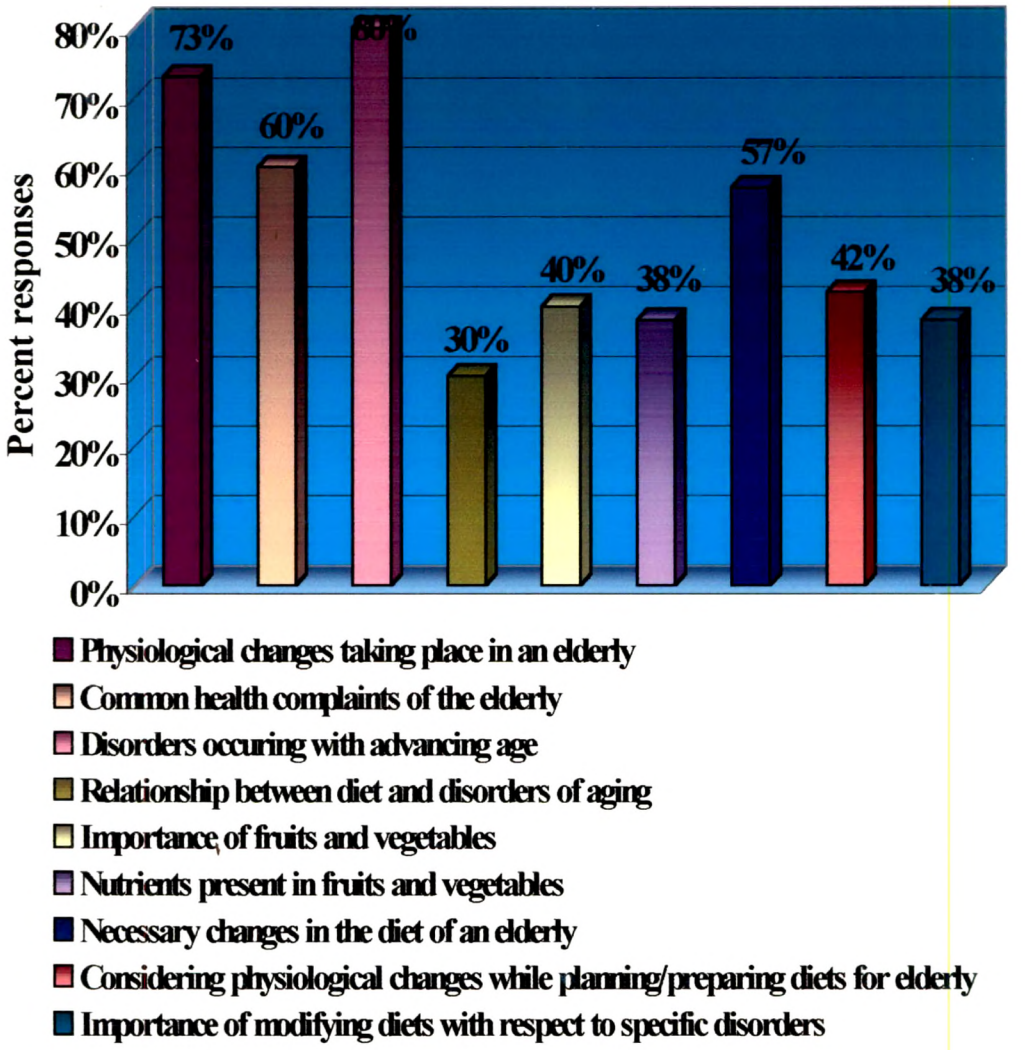
Forty two percent of the daughters-in-law of the elderly felt important to consider various changes taking place with advancing age while planning / preparing meals for the elderly. The responses were in term of change in consistency i.e giving liquid or soups or soft diet when the elderly were sick.

Importance of fruits and vegetables could be told by only 40 % of the caregivers. However, the responses varied from fruits and vegetables being important sources of essential nutrient to they being important for body building and normal functioning of the digestive system. When asked about how fruits and vegetables helped the digestive system, only one caregiver could say that roughage present in these foods helped in proper digestion. Few caregivers also thought that the fruits and vegetables were important to make blood pigments and for improving the heamoglobin status. The protective effects of fruits and vegetables against illnesses was reported by only one caregiver. Caregivers also thought that fruits and vegetables are rich sources of natural salts, provide calories , balances diets, gives variety to the diet and that meal is incomplete without fruits and vegetables. The knowledge regarding fruits and vegetable being rich in vitamins, was reported by only a single daughter-in-law of the elderly.

When asked about the nutrients present in fruits and vegetables, only 38 % of the caregivers had knowledge about vitamins. The responses were in terms of fruits and vegetables being rich in vitamin C, A, and B, minerals like calcium, zinc and iron along with fibre. The daughters-in-law also thought that fruits and vegetables are rich sources of carbohydrates, fats, protein, calories, and sugar. The subjects also felt that these food stuffs are rich in vitamin D and provide RBCs and heamoglobin.

Slightly more than $1/3^{rd}$ of the caregivers had knowledge about the importance of making changes in the diet of an elderly if they are suffering from any disorders. However, the only changes that they thought necessary were with respect to the minor complaints like mastication problems in which case soft or steamed food should be given. Very few subjects could tell about the changes to be made in case of major disorders like diabetes mellitus, hypertension and heart diseases. However, the

Figure 1d : Percentage of caregivers reporting knowledge regarding health and nutritional status of elderly



B) PRACTICES OF THE CAREGIVERS REGARDING THE HEALTH AND NUTRITIONAL STATUS OF ELDERLY

Percentage of the caregivers reporting actual practices regarding various aspects of the importance of the dietary care in an elderly has been presented in table 2d and figure 2d.

Table 2d : Percentage of caregivers reporting actual practices regarding health and nutritional status of elderly

Sr. No	Practices	Caregivers (N=30)
1.	Separate meals for the elderly	23
2.	Dietary guidelines to be kept in mind while preparing meals for the elderly	25
4.	Do you encourage the elderly to consume more than 8 glasses of fluids in a day	12
5.	Forms in which green leafy vegetables are prepared	70
6.	If GLVs not preferred by other member, then do you cook separately for the elders	8
7.	Encourage the elderly to consume fruits	33

As seen from the above table, more than $3/4^{th}$ of the caregivers did not practice preparing separate meals for the elderly. The major reason being lack of time for preparing separate meals followed by the elderly themselves not liking if the caregiver prepares separately for the elderly. Twenty two percent of the caregivers felt that preparing separate meals was very laborious.

Less than $1/5^{th}$ of the daughters-in-law prepared separate meals for the elderly. these separate meals were in terms of bland diets made for the elderly with very little amount of spices and oil added. Modification in terms of texture as a separate meal for elderly was also reported.

Dietary guidelines kept in mind while preparing the meals for elderly were assessed in terms of foods to be included, avoided, restricted and given liberally. Overall, $1/5^{th}$

of the caregivers knew about these dietary guidelines for the elderly. One third of the caregivers knew about foods to be avoided. However, this was only with respect to salt, sugar spices, and oils. Slightly more than $1/5^{th}$ of the subjects practiced restricting some foods in the diets of the elderly. These subjects did not give spicy or sweet foods to the elderly in higher amounts. One third of the caregivers included green leafy vegetables and fruits in the diets of the elderly. However, only 16 % of the caregivers gave these foods liberally to the elderly.

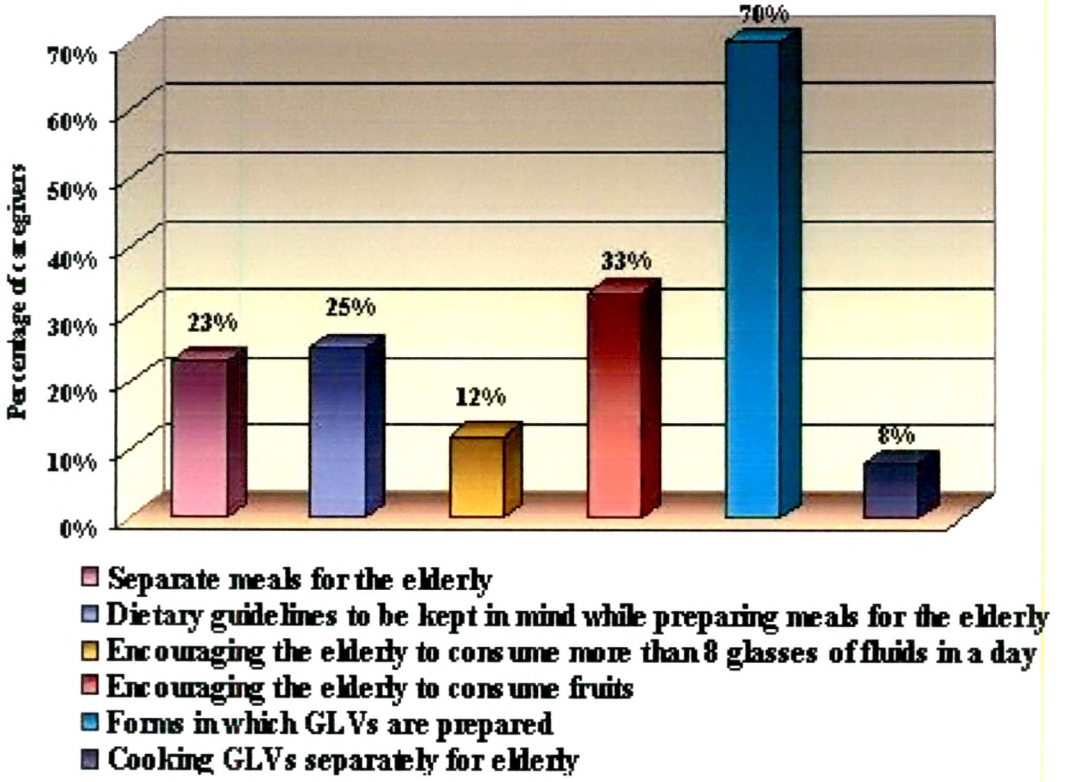
Only 12 % of the caregivers encouraged elderly to consume more than 8 glasses of fluids in a day. The subjects were found to be mainly giving encouragement for increased water consumption. Very few daughters-in-law encouraged the elderly to increase the consumption of vegetable soups and fruit juices.

As seen from the table 2, 70 % of the caregivers prepared green leafy vegetables. However, these vegetables were incorporated in other food preparations such as thepla, muthia or puri and then consumed. Very less subjects prepared GLVs in sabji form either dry or in gravy form. GLVs in form of raw salads and soups was given by still few caregivers to the elderly.

If the GLVs were not preferred by the other family members in sabji form, only 8 % of the caregivers reported cooking these vegetables separately for the elderly. Most of the times these vegetables were incorporated in other food items as reported earlier to make it acceptable to each member of the family.

As seen from the above table, only $1/3^{rd}$ of the caregivers encouraged elderly to consume fruits daily. Large number of the caregivers were not found to be encouraging the elderly to consumed fruits. However, among those who did encourage, it was found that none of the caregivers encouraged to consume more than 5 servings of fruits and vegetables in a day which is considered to be giving protection against various disorders occurring with advancing age.

Figure 2d : Percentage of caregivers reporting practices of the knowledge regarding health and nutritional status of the elderly



DISCUSSION

The aging of populations is a worldwide phenomenon, an ineluctable consequence of decreasing fertility and lengthening life expectancy. The population 60 years and older is enlarging both in relative and in absolute numbers. As the population age structure rectangularizes, intergenerational and intercohort relations need to be re-appraised and altered. The structure and relations of families are being modified by these fertility and mortality changes.

There is growing concern in Asia with how the elderly will be supported and cared for in the twenty-first century. Rapid urbanisation has resulted in breaking up of the traditional joint family system. As a result, the elderly people are left to look after themselves. According to the most National Long-term Care Survey (1994), more than seven million persons are informal caregivers providing unpaid help to older persons who live in the community and have at least one limitation in their activities of daily living. In the family, there is usually one primary caregiver -a role traditionally held by a woman. Seventy to eighty percent of all primary caregivers are women - wives, daughters, daughters-in-law and granddaughters. The typical profile of today's female caregiver is that of a middle-aged individual between the ages of 40 and 60 with "2.3" children who may still be living at home and who also may demand her attention and care.

Advancing age brings about various problems which interferes in the day to day routine activities of the elderly. These problems can be with respect to reduced mobility, diminished vision along with other physical and functional impairments. These, in turn, affect the nutritional status of the family. However, even in joint families, the health and nutritional status of the elderly depends on the caregiver, to a large extent. The existing knowledge of the caregiver with respect to the dietary care and health needs of the elderly determines the awareness regarding various aspects of aging. However, actual practices of the knowledge would be effective in improving the nutritional status of the elderly.

In the present study, we noted that the knowledge of the caregivers with respect to various disorders commonly occurring with advancing age was highest followed by physiological changes taking place in an elderly. The caregivers selected in our study also could tell about minor complaints of the elderly. However, it was noted that caregivers could not differentiate much between these three responses. This suggests that though the caregivers were graduates, the exact knowledge about various physiological changes and minor and major complaints related with advancing age was limited.

A study was carried out by Ryan (1997) to determine the nutritional knowledge of the caregivers of the clients. Seventy-eight caregivers completed the questionnaire. Scores indicated that the caregivers' knowledge of nutrition was minimal, despite the fact that many of the caregivers were educated beyond high school. However, the majority of caregivers did believe their elder received proper nutrition on a daily basis. Data suggest that caregivers' perceptions of proper nutrition may not be based on accurate nutrition knowledge. The study concluded that focus on the education of caregivers regarding nutritional needs of older adults and recognition of signs and symptoms of malnutrition may better maintain nutritional status and quality of life of the elderly adult. This study thus emphasised the importance of nutrition education programs that should be made available to caregivers to increase their knowledge of nutrition.

It was also revealed in our study that the caregivers thought important to plan for a change in diet of an elderly only during any illness. This shows the negligence of the caregivers towards the 'normal' changes taking place in an elderly, that needs dietary modifications.

Misconception regarding the importance of fruits and vegetables was largely observed among the caregivers of the elderly in the present study. The varied responses of fruits and vegetables being important to make blood pigments shows lack of awareness among the caregivers inspite of their higher educational status.

It was however, surprising to note that almost all the caregivers could pinpoint at vitamin A,C and B complex being the main nutrients in fruits and vegetables. The caregivers also thought that these protective foods were also rich sources of energy, proteins, calcium, vitamin D and some mineral 'salts'.

The data on putting the knowledge into action by the caregivers indicated that the actual practices were still more rare than the knowledge. The modifications that were made in the diet of an elderly person, by the caregivers, was only in terms of change in consistency and amount of spices, salt and oil to be used indicating the caregivers' lack of giving importance to the physiological changes taking place in elderly that requires special dietary modifications.
It was also found in our study that the very few caregivers encouraged the elderly to consume more servings of fruits and vegetables which has been shown to protect against various degenerative disorders of aging in the present study itself.

It was also surprising to note that few care-receivers themselves did not like consuming green leafy vegetables, in our study. This issue should be addressed seriously because it suggests that the elderly themselves might not be aware of various diet related disorders and dietary changes that are required in accordance to the changes taking place in their body with advancing age. By identifying these problems, and treating them aggressively, one can help restore the elderly person to as functional, satisfying and healthy a life as possible. If more people were able to recognize and distinguish between diseases that may accompany old age and those changes that are related to the normal aging process, then perhaps they would be less negative about the aging process. It is also seen that both the caregivers as well as the care-receivers depend on their inadequate knowledge and practices they might have been exposed in the past in their own families and still continuing the same practices with each generation.

According to Gettings and Kiernan (2001), a need exists to determine the necessity and focus for education given senior citizens' vulnerability for food-borne illness,. Seniors rely of the distant past for knowledge and identify barriers to altering practices but state that information from educators about the health effects of inappropriate practices will convince them to change. For future food safety education, seniors recommend programs, videotapes, television, newspapers, radio,

church bulletins, and written educational pieces. This will be helpful in the present setup as it will ultimately make the elderly themselves more aware of the various physiological changes taking place with increase in age and thus make them more adaptive with the much required dietary changes.

A need to impart nutrition education to the caregivers is felt necessary from the results obtained in our study. This is also supported by Silver and Wellman (2002) who suggested that nutrition education will reduce the burden on caregiver herself thus assuring healthy life for the elderly.

Scientific evidence increasingly supports that good nutrition is essential to the health, self-sufficiency, and quality of life of older adults. With the elderly population living longer than ever before, the older adult population will be more diverse and heterogeneous in the 21st century. The oldest-old and minority populations will grow more quickly than the young-old and non-Hispanic white populations, respectively. According to the American Dietetic Association (2000), for the current 34 million adults 65 years of age and older living in the United States, there are about 12 million caregivers who provide formal or informal care. A broad array of culturally appropriate food and nutrition services, physical activities, and health and supportive care customized to accommodate the variations within this expanding population of older adults is needed. With changes and lack of coordination in health care and social-support systems, dietetics professionals need to be proactive and collaborate with aging-services and other health c are professionals to improve policies, interventions, and programs that service older adults throughout the continuum of care to ensure nutritional well-being and quality of life. The American Dietetic Association supports both the provision of comprehensive food and nutrition services and the continuation and expansion of research to identify the most effective food and nutrition interventions for older adults over the continuum of care.

A major goal of our public health system should be to maintain health among successful agers and prevent or delay chronic disease morbidity. Major strides should be made in making the caregivers identify the dietary needs of elderly people that are different from those of younger adults. However, nutrition education programs to promote those dietary needs have lagged behind. Thus, there is a need to keep pace with recent findings and develop national and state-sponsored programs that will

provide nutrition education and information transference to older people in the communities as well as their caregivers.

Thus, to sum up, the highlights of the present section are:

HIGHLIGHTS

- ***Inadequate knowledge of the caregivers of the elderly regarding relationship of health complaints and disorders with diet was observed***
- ***Lack of awareness noted among the caregivers with respect to the importance of fruits and vegetables in the diet of an elderly.***
- ***Less practices were followed by the caregivers to keep the necessary dietary modifications in mind while preparing meals for the elderly.***
- ***Very few caregivers encouraged the elderly to increase the consumption of fruits and vegetables in their daily diets.***
- ***Need to impart nutrition health education to the caregivers was felt necessary regarding importance of giving antioxidants rich fruits and vegetables in the diets of elderly.***