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VEGETABLE AND FRUIT DIVERSITY IN AN INDIAN COMMUNITY

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ABSTRACT

Purpose: diversity particularly in vegetables and fruits has been associated with better nutritional profile, reduction in overall risk of cancer risk, diabetes and cardiovascular disease. Vegetable and fruit diversity was thus studied in 513 subjects belonging to a single community belonging to higher socio-economic strata in the city of Mumbai.

Method: diversity of consumption of 68 vegetables and fruits was examined over a week's period. The reasons for non-consumption of vegetables and fruits were also studied.

Results: more than 90% of subjects had lowest mean percent diversity for leafy vegetables, vegetables and roots, due to dislike for vegetables. Significant differences in the distribution of mean percent diversity was observed for other vegetables (p 5 0.000) and for fruits (p 5 0.000).

Value: the study has brought forth a very important and significant issue of poor vegetable diversity, thus emphasising the need for nutrition education programmes focusing on diversity.

Keywords: Vegetable diversity; Vegetable variety; Indian community ; Vegetable consumption; Fruit diversity; Fruit variety.

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1 INTRODUCTION

Dietary diversity has been long recognised by nutritionists as a key element of high quality diets. Increasing the variety of foods across and within food groups is recommended in most dietary guidelines, in India (National Institute of Nutrition, 2011) as well as internationally (Ruel, 2003) because it is thought to ensure adequate intake of essential nutrients and to promote good health. Additionally, with the current recognition that dietary factors are associated with increased risks of chronic diseases, as indicated by Ruel (2003), dietary recommendations promote increased dietary diversity along with reducing intake of selected nutrients such as fat, refined sugars and salt.

It has been reported by Royo-Bordonada et al. (2003) that among the various food groups, diversity particularly in vegetables and fruits was associated with better nutritional profile, with respect to the plasma levels of alpha and beta-carotene, lycopene, retinol, alpha-tocopherol and vitamin E in Spanish children. The study of Ledikwe et al. (2006) on adults reported that Vitamins A, C and B-6, folate, iron, calcium, and potassium levels was positively associated with diversity in vegetable and fruit consumption. The study carried out by Bernstein et al. (2002) indicated that fruit and vegetable variety score were positively associated with intake of many nutrients in frail, elderly adults The researchers further reported that men's fruit and vegetable variety score were associated with high-density lipoprotein and very-low-density of lipoprotein and triglycerol. In women, the score was associated with higher blood folate levels. Ye et al. (2012) suggested that variety of fruit and vegetable intake may offer cognitive protection in middle aged and older adults.

Further, studies carried out by Thompson et al. (1999, 2006) indicated that consumption of a diet that significantly increased vegetable and fruit intake from a diverse number of botanical families resulted in significant reductions in markers of oxidative cellular damage to DNA and lipids. It has been proposed by Thompson et al. (2006) that botanical diversity plays a role in determining the bioactivity of high-vegetable and fruit diets and that smaller amount of many phytochemicals may have greater beneficial effects than larger amounts of fewer phytochemicals.

The beneficial effect of consumption of diverse vegetables and fruits on overall cancer risk reduction has been reported by Jansen et al. (1994). Diversity in vegetable intake was reported by Wright et al. (2003) to lower the risk of lung cancer in smoking and nonsmoking women while Büchner et al. (2010) reported that diversity in both vegetables and fruit consumption was associated with lower risk of squamous cell carcinoma in smokers. Similar findings were reported by Garavello et al. (2008) for oral and pharyngeal cancer while Lucenteforte et al. (2008) have reported for squameous cell esophageal cancer. It has been suggested by Garavello et al. (2009) that diversity in vegetable and fruit consumption is associated with the reduced risk of laryngeal cancer and by Suwanrungruang et al. (2008) for stomach cancer. As suggested by Masala et al. (2012) a clear protective role of increasing vegetables, mainly leafy and fruiting vegetable consumption on breast cancer risk in Mediterranean population has been emerged. High intake of fruits and vegetables has been associated with reduced risk of diabetes is reported by Yu et al. (2011). It has been suggested by Cooper et al. (2012) that diversity in fruit and vegetable consumption along with greater quantity is also thought to reduce the risk of type II diabetes. The study carried out by Bhupathiraju and Tucker (2011) indicated that consumption of variety of vegetables and fruits were associated with low level of C-reactive protein, an inflammation marker, which in turn would lower the risk of cardiovascular disease.

In view of the beneficial effects of vegetable and fruit diversity, the present study was conducted to examine the extent of vegetable and fruit diversity in the city of Mumbai.

2 METHOD

The present study was conducted from (July 2008 to February 2009), for a period of 7 months to study various vegetables and fruits consumed by families belonging to Maharashtrian community. Families from higher socioeconomic strata were selected for the study as indicated by being tax payers in the city of Mumbai. The study was approved by the Research Committee of the S.N.D.T Women's University.

Five hundred and thirteen subjects were recruited through various ladies organisations and personal contacts. House wives or the members of the family who were involved in food selection and/or preparation for the family were selected as

subjects. An informed consent was obtained from all the subjects prior to the data collection.

A questionnaire was prepared which included general information about the subject and her family. A food frequency questionnaire consisting of 68 foods comprising of 17 types of leafy vegetables, 8 types of roots and tubers 23 varieties of other vegetables and 20 types of fruits was prepared based on foods listed in "Nutritive Value of Indian Foods" (Gopalan et al., 1989). The foods selected in present questionnaire were easily available in all parts of the city. Frequency of consumption of the families over a week was studied (Ruel, 2003). Questionnaire consisted of two sections- section A: frequency of consumption of food item over a week's period and section B: reasons for non-consumption of a particular food item. Reasons for non-consumption were listed and the responses were collected from the subjects. Any other response besides those that were listed was recorded. The data was collected using face-to-face interviews. The amount or quantity of consumption of these food items by the respondents was also noted in terms of the standardised household measurements. Portion sizes of consumed foods were then converted to grams. For computation of dietary diversity the portion size of 100 gm for fruits and vegetables as given in dietary guidelines was considered. The consumption of foods less than recommended was not considered. (National Institute of Nutrition, 2011).

The reliability of diversity questionnaire was tested in June 2008 by carrying out pilot testing of the questionnaire on 50 subjects. The reliability statistic is as follows: Cronbach's alpha test: 0.757, Spearman-Brown Coefficient unequal length: 0.660 and Guttman Split-Half Coefficient: 0.647.

Computation of dietary diversity: the frequency of consumption was noted as: almost daily, 4 to 5 times a week, 2 to 3 times a week, and once a week. The scores were given as: Score of 1 for almost daily, 2. for 4–5 days in a week, 3 for 2–3 days in a week and 4 for once a week.

$$\text{Percent Dietary Diversity} = \frac{\text{Total Score} \times 100}{\text{(as 4 is the highest score)}\ \text{Number of items} \times 4}$$

The mean dietary diversity was classified into quartiles – (0–25 mean % diversity), (26–50 mean % diversity), (51–75 mean % diversity) and (75–100 mean % diversity).

Data entry and statistical analysis were done using Microsoft Excel and SPSS package of 17.0 for windows respectively. Frequency distribution and descriptive statistics was calculated from the data. Chi-Square test was performed using SPSS version 6 and 10 for Windows. The p value$=$or $<$ than 0.05 was considered as significant.

3 RESULTS

The mean diversity for leafy vegetables was the lowest and that of fruits was the highest (Table 1).

The distribution of subjects according to the quartile distribution for all types of vegetables and fruits is presented in Table 2.

Table 2 indicates that more than 90% of subjects had the lowest mean percent diversity for leafy vegetables and roots. The mean percent diversity for leafy vegetables did not extend beyond 50% and the mean percent diversity of a small percent of subjects (1.0%) was in the range of 25 to 50%. Among all four food groups, the fruits were the most diverse. 62(12.1%) subjects had mean percent diversity in highest quartile that is in the range of 75–100%. Significant differences in the distribution of mean percent diversity was observed for other vegetables ($\chi=20.109$, $p=0.000$) and for the distribution of mean percent diversity for fruits ($\chi=98.480$, $p=0.000$).

Table 1 Vegetable and fruit diversity

Food group	*Mean % diversity ± SD*	*Minimum % diversity*	*Maximum % diversity*
Leafy Vegetables	0.49 ± 4.62	0.00	48.53
Roots	2.58 ± 12.91	0.00	86.11
Other Vegetables	3.13 ± 12.84	0.00	95.65
Fruits	26.84 ± 33.70	0.00	100.00

Table 2 Distribution of subjects by quartiles

Food group	*Mean % diversity*			
	0–25%	*25–50%*	*50–75%*	*75–100%*
Leafy Vegetables (n=513)	508 (99.0%)	5 (1.0%)	–	–
Roots (n=513)	491 (95.7%)	8 (1.6%)	4 (0.8%)	10 (1.9%)
Other Vegetables* (n=513)	485 (94.5%)	13 (2.5%)	12 (2.3%)	3 (0.6%)
Fruits** (n=513)	305 (59.5%)	70 (13.6%)	76 (14.8%)	62 (12.1%)

*χ=*20.109*, p=0.000)
**χ=*98.480*, p=0.000

Table 3A Reasons for non-consumption of leafy vegetables

Food stuff	*Do not know*	*Don't know how to prepare*	*Not liked by family members*	*Too tedious to make/ chop/cut*	*Taboos*	*Allergy*	*No time to cook*	*Any other*
Amaranthus gangeticus (Amaranth) (n=189) (36.8%)	66 (12.9%)	16 (3.1%)	107 (20.9%)	–	–	–	–	
Rumex vesicarius (Ambat chukka) (n=300) (58.5%)	68 (13.3%)	19 (3.7%)	211 (41.1%)	0.2 (0.4%)	–	–	–	
Chenopodium album (Bathua leaves) (n=418) (81.5%)	217 (42.3%)	55 (10.7%)	144 (28.1%)	–	–	–	–	
Brassica oleracea var: capitata (Cabbage) (n=18) (3.5%)	–	–	17 (3.3%)	–	–	0.1 (0.2%)	–	
Brassica oleracea var: botrytis Cauliflower greens (n=203) (39.6%)	60 (11.7%)	57 (11.1%)	78 (15.2%)	0.2 (0.4%)	–	–	0.6 (1.2%)	
Colocassia anti-quorum (Colocassia leaves) (n=52) (10.1%)	–	0.7 (1.4%)	39 (7.6%)	0.1 (0.2%)	–	0.1 (0.2%)	0.4 (0.8%)	
Vigna catjang (Cow pea leaves) (n=77) (15.0%)	0.9 (1.8%)	0.1 (0.2%)	65 (12.7%)	0.1 (0.2%)	–	–	0.1 (0.2%)	
Moringa oleifera (Drumstick leaves) (n=232) (45.2%)	50 (9.7%)	37 (7.2%)	144 (28.1%)	1 (0.2%)	–	–	–	
Trigonella foenum graecum (Fenugreek leaves) (n=28) (5.5%)	–	–	28 (5.5%)	–	–	–	–	
Hibiscus cannabinus (Gogu) (n=263) (51.3%)	22 (4.3%)	11 (2.1%)	221 (43.1%)	0.9 (1.8%)	–	–	–	
Brassica oleracea var: caulorapa (Knol- khol greens) (n=374) (72.9%)	95 (18.5%)	75 (14.6%)	203 (39.6%)	0.1 (0.2%)	–	–	–	
Lactuca sativa (Lettuce) (n=313) (61.0%)	46 (9.0%)	54 (10.5%)	211 (41.1%)	0.2 (0.4%)	–	–	–	
Brassica campestris var: sarason Mustard leaves (n=429) (83.6%)	44 (8.6%)	90 (17.5%)	289 (56.3%)	0.6 (1.2)%	–	–	–	

Table 3B Reasons for non-consumption of leafy vegetables

Food stuff	*Do not know*	*Don't know how to prepare*	*Not liked by family members*	*Too tedious to make/ chop/cut*	*Taboos*	*Allergy*	*No time to cook*	*Any other*
Raphanus sativus (Radish leaves) (*n*=113) (22.0%)	0.3 (0.6%)	0.8 (1.6%)	96 (18.7%)	0.6 (1.2%)	–	–	–	
Carthamus tinctorius (Safflower leaves) (*n*=370) (72.1%)	49 (9.6%)	72 (14.0%)	239 (46.6%)	1.0 (1.9%)	–	–	-	
Peucedanum graveolens (Shepu) (*n*=218) (42.1%)	11 (2.1%)	16 (3.1%)	177 (34.5%)	–	–	14 (2.7%)	–	
Spinacia oleracea (Spinach) (*n*=23) (4.5%)	–	–	23 (4.5%)	–	–	–	–	

Table 4 Reason for non-consumption of roots and tubers

Food stuff	*Do not know*	*Don't know how to prepare*	*Not liked by family members*	*Too tedious to make/ chop/cut*	*Taboos*	*Allergy*	*No time to cook*	*Any other*
Beta vulgaris (Beet root) (*n*=42) (8.2%)	10 (1.9%)	–	32 (6.2%)	–	–	–	–	
Daucus carota (Carrot) (*n*=06) (1.2%)	–	-	0.6 (1.2%)	–	–	–	–	
Colocasia antiquorum (Colocasia) (*n*=278) (54.2%)	76 (14.8%)	65 (12.7%)	119 (23.2%)	0.5 (1.0%)	–	0.1 (0.2%)	12 (2.3%)	
Allium cepa (Onion) (*n*=0.6) (1.2%)	–	–	0.6 (1.2%)	–	–	–	–	
Solaneum tuberosum (Potato) (*n*=11) (2.1%)	–	–	11 (2.1%)	–	–	–	–	
Raphanus sativus (Radish) (*n*=63) (12.3%)	–	–	63 (12.3%)	–	–	–	–	
Ipomoes batatas (Sweet Potato) (*n*=56) (10.9%)	–	0.6 (1.2%)	47 (9.2%)	0.1 (0.2%)	–	-	0.2 (0.4%)	
Amorphophallus campanulatus (Yam elephant) (*n*=129) (25.1%)	0.6 (1.2%)	0.3 (0.6%)	113 (22.0%)	0.6 (1.2%)	–	0.1 (0.2%)	–	

The results of non-consumption of leafy vegetables are presented in the Table 3A and B.

Among the various reported reasons, by the majority of family members, for non-consumption of leafy vegetables is not being liked Bathua leaves (Chenopodium album) was an exception, in which they mentioned they were not familiar with. Similar responses were reported for roots and tubers.

Table 4 shows that Colocasia and yam were the two tubers for which maximum subjects (23% and 22%) gave a response of not liking these tubers.

The reasons for non-consumption of other vegetables are listed below in Table 5A and 5B.

It can be observed from the tables that the highest percent of respondents reported dislike for vegetables as the main reason for non-consumption.

Table 5A Reason for non-consumption of other vegetables

Food stuff	*Do not know*	*Don't know how to prepare*	*Not liked by family members*	*Too tedious to make/ chop/cut*	*Taboos*	*Allergy*	*No time to cook*	*Any other*
Benincasa hispida (Ash gourd) (n=330) (64.3%)	51 (9.9%)	41 (8.0%)	228 (44.4%)	0.2 (0.4%)	0.6 (1.2%)	–	0.2 (0.4%)	
Momordica charantia (Bitter gourd) (n=123) (24%)	–	0.6 (1.2%)	110 (21.4%)	0.6 (1.2%)	0.1 (0.2%)	–	–	
Lagenaria vulgaris Bottle gourd (n=52) (10.1%)	–	–	40 (7.8%)	12 (2.3%)	–	–	–	
Solaneum melongena (Brinjal) (n=22) (4.3%)	–	–	22 (4.3%)	–	–	–	–	
Capsicum annuum var: grossa (Capsicum) (n=18) (3.5%)	–	–	18 (3.5%)	–	–	–	–	
Brassica oeracea var: botrytis (Cauliflower) (n=22) (4.3%)	–	–	21 (4.1%)	0.1 (0.2%)	–	–	–	
Cyamopsis tetragonolobs (Cluster beans) (n=24) (4.7 %)	0.2 (0.4%)	–	15 (2.9%)	0.1 (0.2%)	–	-	0.6 (1.2%)	
Cucumis sativus (Cucumber) (n=11) (2.1%)	–	–	0.5 (1.0%)	–	–	0.6 (1.2%)	–	
Faba vulgaris (Double beans) (n=122) (23.8%)	14 (2.7%)	0.2 (0.4%)	106 (20.7%)	–	–	–	–	
Moringa oleifera (Drumstick) (n=5) (8.8%)	0.7 (1.4%)	–	38 (7.4%)	–	–	–	–	
Dolichos lablab (Field beans) (n=187) (36.5%)	48 (9.4%)	38 (7.4%)	101 (19.7%)	–	–	–	–	
Phaselous vulgaris (French beans) (n=22) (4.3%)	0.6 (1.2%)	–	16 (3.1%)	–	–	–	–	
Luffa cylindrica (Ghosala) (n=175) (34.1%)	27 (5.3%)	24 (4.7%)	123 (24.0%)	1 (0.2%)	–	–	–	

The reasons for non-consumption of fruits are presented in Table 6A and B.

For all fruits the highest percentages of respondents stated that the main reason for non-consumption is dislike. Also a small percentage (1%) of respondents reported 'taboos' as a reason for non-consumption for 10 out of 19 fruits.

4 DISCUSSION

Our study has brought forth a very important and significant issue of poor diversity in vegetable and fruit consumption in an Indian community. Comparison between fruit and vegetable group revealed diversity of fruits was higher than vegetables, leafy vegetable being least diverse.We have made an attempt to understand the reasons of poor diversity. The highest percentage of subjects responded about dislike for fruits and vegetables of all categories. However, compared to different types of vegetables and roots and tubers the percentage of respondents reporting 'dislike for the fruit' was less. Although we did not make any further attempt to understand which

Table 5B Reason for non-consumption of other vegetables

Food stuff	*Do not know*	*Don't know how to prepare*	*Not liked by family members*	*Too tedious to make/ chop/cut*	*Taboos*	*Allergy*	*No time to cook*	*Any other*
Artocarpus heterophyllus (Jack fruit, tender) (*n*=216) (42.1%)	0.6 (1.2%)	25 (4.9%)	152 (29.6%)	23 (4.5%)	—	–	10 (1.9%)	
Coccinia cordifolia Kovai (*n*=46) (9.0%)	0.8 (1.6%)	0.1 (0.2%)	37 (7.2%)	–	–	–	–	
Brassica oleracea var: caulorapa (Knol-khol) (*n*=260) (50.7%)	37 (7.2%)	25 (4.9%)	198 (38.6%)	–	–	–	–	
Abelmoschus esculentus (Ladies fingers) (*n*=14) (2.8%)	0.5 (1.0%)	–	0.9 (1.8%)	–	–	–	–	
Allium cepa (Onion stalks) (*n*=58) (11.3%)	19 (3.4%)	–	38 (7.4%)	–	–	–	0.1 (0.2%)	
Trichosanthes diocia (Parwar) (*n*=224) (43.7%)	33 (6.4%)	19 (3.7%)	17 (33.1%)	–	–	0.2 (0.4%)	–	
Musa sapentium (Plantain flower) (*n*=311) (60.6%)	15 (2.9%)	40 (7.8%)	218 (42.5%)	30 (5.8%)	–	0.2 (0.4%)	0.6 (1.2%)	
Cucurbita maxima (Pumpkin fruit) (*n*=97) (18.9%)	0.7 (1.4%)	0.4 (0.8%)	85 (16.6%)	0.1 (0.2%)	–	–	–	
Lufta acutangula (Ridge gourd) (*n*=154) (30.0%)	22 (4.3%)	10 (1.9%)	122 (23.8%)	–	–	–	–	
Trichosanthes anguina (Snake gourd) (*n*=86) (16.8%)	11 (2.1%)	0.1 (0.2%)	74 (14.4%)	–	–	–	–	

of the attributes like taste and texture of various vegetables and fruits that they dislike, it can be presumed that taste of these foods must be a barrier. In a study reported by Heimendinger and Van Duyn (1995) consumers had consistently reported taste as the most important factor that positively influence fruit and vegetable selection and consumption. Study undertaken by Schatzer et al. (2009) also reported similar finding that a majority of the respondents choose to consume fruit and vegetables because of the taste. Sensory and physical attributes of fruit and vegetables was an important determinant in fruit and vegetable consumption of children as suggested by Krølner et al. (2011). The researchers' further report that taste was the main reason for not liking fruit and vegetables – especially vegetables with children and adolescents. Also it was observed that children who liked a broad variety of fruit and vegetables appeared to be more likely to eat ample amount of these foods.

It has been indicated by Pollard et al. (2002) that food choices also depend on economic status and availability. A recent study carried out in Delhi by Finzer et al. (2013) reported that affordability was the main barrier in increasing fruit and vegetable intake. However, in present study subjects belonged to higher socioeconomic strata so affordability was not a barrier against the consumption. Also, in a city like Mumbai, almost all vegetables and fruits are available in all areas. Besides, cost of fruits and vegetables or the availability of these foods as barrier in consumption was not mentioned by any of the subjects.

The study thus reports that taste of vegetables and fruits is the barrier for poor diversity that is, when taste is a limitation it restricts the subject's selection and contributes to poor diversity.

Imparting culinary skills, modifying the diets are the strategies that have been reported by Nicklas et al. (1998) which aimed at improving vegetable and fruit intake in children, youth and adults.

Table 6A Reason for non- consumption of fruits

Food stuff	*Do not know*	*Don't know how to prepare*	*Not liked by family members*	*Too tedious to make/ chop/cut*	*Taboos*	*Allergy*	*No time to cook*
Embilica officinalis (Amla) (*n*=114) (22.2%)	–	0.6 (1.2%)	106 (20.7%)	2 (0.4%)	–	–	–
Malus sylvestris (Apple) (*n*=20) (3.9%)	–	–	20 (3.9%)	–	–	–	–
Musa paradisiaca (Banana ripe) (*n*= 4) (6.7%)	–	–	29 (5.7%)	–	1.0 (1.0%)	–	–
Phoenix dactylifera (Dates) (*n*=32) 6.3(%)	–	–	27 (5.3%)	–	0.5 (1.0%)	–	–
Ficus carica (Figs) (*n*=63) (12.3%)	–	–	58 (11.3%)	–	0.5 (1.0%)	–	–
Vitis vinifera (Grapes) (*n*=32) (6.2%)	–	–	24 (4.7%)	–	0.5 (1.0%)	0.3 (0.6%)	–
Psidium guajava (Guava) (*n*=45) (8.8%)	–	–	40 (7.8%)	–	0.5 (1.0%)	–	–
Artocarpus heterophyllus (Jack fruit) (*n*=81) (15.8%)	–	–	74 (14.4%)	0.1 (0.2%)	0.5 (1.0%)	0.1 (0.2%)	–
Syzgium cumini (Jambu fruit) (*n*=90) (17.5%)	–	–	84 (16.4%)	–	0.5 (1.0%)	0.1 (0.2%)	–
Nephelium litchi (Lichi) (*n*=96) (18.7%)	0.3 (0.6%)	–	86 (16.8%)	–	–	0.7 (1.4%)	–
(Citrus aurantifolia) (Lime sweet) (*n*=52) (10.1%)	—	—	52 (10.1%)	—	—	—	—
Magnifera indica (Mango) (*n*=25) (4.9%)	–	–	25 (4.9%)	–	–	–	–
Citrus aurantium (Orange) (*n*=86) (7.0%)	–	–	86 (7.0%)	–	–	–	–
Carcia papaya (Papaya, ripe) (*n*=63) (12.3%)	–	–	52 (10.1%)	–	0.5 (1.0%)	0.6 (1.2%)	–

Table 6B Reason for non-consumption of fruits

Food stuff	*Do not know*	*Don't know how to prepare*	*Not liked by family members*	*Too tedious to make/ chop/cut*	*Taboos*	*Allergy*	*No time to cook*
(Prunus persica) Pears (*n*=48) (9.4%)	0.1 (0.2%)	–	47 (9.2%)	–	–	–	–
Ananas comosus (Pineapple) (*n*=52) (10.2%)	–	–	41 (8.0%)	0.6 (1.2%)	0.5 (1.0%)	–	
Prunus domestica (Plum) (*n*=129) (25.1%)	17 (3.3%)	–	105 (20.5%)	–	–	0.7 (1.4%)	–
Punica granatum (Pomegranate) (*n*=58) (11.3%)	0.8 (1.6%)	–	44 (8.6%)	0.6 (1.2%)	–	–	–
Achras sapota (Sapota) (*n*=43) (8.4%)	–	–	38 (7.4%)	–	0.5 (1.0%)	–	–
Fragaria vesca (Strawberry) (*n*=111) (21.6%)	0.3 (0.6%)	–	108 (21.1%)	–	-	–	–
Citrullus vulgaris (Watermelon) (*n*=28) (5.5%)	–	–	28 (5.5%)	–	–	–	–

The researchers have reported that 'Gimme 5' – An intervention comprising of a media campaign, classroom workshops, school meal modification and parental support – significantly improves fruit and vegetable consumption of high school children. Thus, this study demonstrates that the intervention of 'Gimme 5' provides a suitable model to illustrate that dietary habits of high school students can be influenced by positive media messages relative to that age group, increased exposure to a variety of tasty products, and minimal classroom activity. The study of Brown and Hermann (2005) indicated that using fruit and vegetable cooking classes as an educational approach was effective in significantly increasing fruit and vegetable intake and improving food safety behaviours in youth and adults. A recent study on school age children by Johnston et al. (2011) also demonstrated that the pairing of vegetables with a preferred taste, such as peanut butter, may be an effective technique in increasing consumption, especially in children who report being resistant to eating vegetables.

Improvement in vegetable and fruit intake, with implementation of certain strategies, at lunchtime at the work place is reported by Lassen et al. (2004). This Danish study demonstrated a large potential for work-site canteens to increase customer's intake of fruits and vegetables at lunch and suggests a broad spectrum of strategies to compose meals that are both rich in fruits and vegetables and attractive to customers. Among the spectrum of various strategies one was aimed at providing training session for canteen staff. Emphasis was placed on the taste and flavour of fruits and vegetables and on practical skill-building, including new and more effective ways of cutting vegetables and how to prepare a delicious buffet with lots of fruits and vegetables.

Besides, studies that focus on incorporation of vegetables in diet are on increasing consumption of target vegetables and its effect on nutritional status have been reported. The study carried out by Seshadri et al. (1997) indicated that dehydrated drumstick leaves incorporated in recipes were acceptable among preschoolers and thus can be a valuable source of beta-carotene. Sood et al. (2001) have reported that feeding of 100 g/day of cauliflower leaves powder in recipes for four months improved hemoglobin and serum retinol levels and nutritional status of school children. A recent study on rural women by Rao et al. (2013) indicated that intervention programme aimed at modifying dietary habits significantly reduced iron deficiency anemia and improved hemoglobin status. The researchers further reported that significant gain in hemoglobin was observed in women who repeated >50% of the recipes at home.

These various studies reported earlier have indicated that incorporating vegetables in the recipes or preparations has resulted in the improved intake and these later studies have reported on increased intake that gets reflected in improvement of selected indicators of nutritional status. The improved intake is definitely an outcome of better palatability. This strategy can be extended to emphasise on incorporation of diverse vegetables and fruits. The study of Snee et al. (2011) which included incorporation of bitter foods like bitter melon or bitter gourd in commonly consumed food dishes demonstrated that such incorporation can mask bitter taste of this vegetable. A recent study conducted by Cox et al. (2012) reported that sensory perception tended to predict liking and intentions to consume Brassica vegetables. In this case to increase the popularity of Brassica vegetables addressing the taste dimension is more important than promoting heath information.

5 STUDY LIMITATIONS

The present study is a preliminary study, done on a single community and in one city. The results of the present study cannot be extrapolated to other communities and to other cities. Studies with similar design will bring forth the extent of diversity. Such studies will help to evolve culture specific and region specific strategies to tackle the issue of low diversity in vegetable and fruit consumption.

This study has important implications for public health. According to the World Health Report of 2002 (FAO/WHO, 2004). (this is reference number 15) low fruit and vegetable intake is estimated to cause about 31% of ischaemic heart disease and 11% of stroke worldwide. Overall it is estimated that up to 2.7 million lives could potentially be saved each year if fruit and vegetable consumption was increased. The amount of diversity in vegetables and fruits is also important. There are studies that have addressed the benefits of diverse consumption of vegetables and fruits in relation to micronutrient adequacy and reduced risk of non-communicable diseases like cancers, cardiovascular disease and diabetes. In view of these findings, the research results of poor vegetable and fruit

diversity emphasise the need to focus on the significance of diversity in public health and/or nutrition messages/campaigns.

Strategies that emphasise on including variety of vegetables and fruits in the diets, besides the amounts needed to be incorporated in nutrition education programmes developed for the communities. This can include creating awareness among the community about the beneficial effects of incorporating variety of vegetables and fruits in their diets, encouraging inclusion of locally grown vegetables and fruits and developing preparations that will improve acceptability. Development of a variety of recipes with diverse vegetables along with incorporating various other foods that will complement the taste of vegetables can be a method of improving the taste of vegetables. Such strategy may improve acceptability and thus consumption. Alternatively, a variety of spices can be used to improve the flavour of such preparations. Nutrition education programmes need to be developed with use of region specific diverse vegetables and fruits along with culture specific combination of ingredients and methods of cooking. Enhancing culinary skills of the homemaker will ensure vegetable and fruit diversity in the diets of people. Such strategies will enable people to choose variety of vegetable and fruits for consumption.

6 CONCLUSION

The poor vegetable and fruit diversity observed in the present study focuses on the need to spread the message of beneficial effects of diverse consumption of vegetables and fruits in maintaining good health and thus reducing the risk of non-communicable diseases.

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