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Assessment of Usual Fruit, Vegetable and Vitamin C Intakes in a Sample of Egyptian Children: Pilot Study

Laila Hussein*, Nehad Hassan, Mahmoud Mohamad, Sahar Abdel Aziz

Department of Nutrition, National Research Center, Giza, Egypt
Email: *dr.lailahussein@yahoo.com, nehadhassan@yahoo.com, ama1mahmoud@yahoo.com, saharabdelaziz15@yahoo.com

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Abstract

The objective was to create an Egyptian database on the contributors of fruit and vegetables in the diets of preschool children and to estimate the usual daily intakes of fruits, vegetables and vitamin C. A total of 59 healthy boys and girls aged 2.5 - 6 years attending day care centers in urban Giza governorate completed the study by interviewing their mothers on 6x non-consecutive days using the 24 h dietary recall. Participants were classified according to age, gender and socioeconomic class. Prevalence of daily consumptions of fruits and vegetables amounted to 22% and 54%, respectively of the total children. The daily intakes of fruits and vegetables averaged 117.5 and 56.4 g, respectively. The consumption of different types of fruits and vegetables was unevenly distributed by different personal and social variables. Estimated daily vitamin C supply from the diet was 38 mg per child, which satisfied the respective recommended nutrient intake (RNI) of 30 mg for the first six years of life. However, the diet of 15% of the children covered less than 75% of RNI. Top fruits contributing to vitamin C were oranges, guava, watermelon, pears and grapes. Extra foods such as chipsy was consumed by 81% of the children, contributed 18% to daily vitamin C supply and also 58.6 mg sodium. A multilevel intervention strategy is warranted for promoting daily fruit and vegetable intake and healthy eating in early childhood.

Keywords

Children Aged 2.5 - 6 Years, Fruit & Vegetable Intakes, Vitamin C Intake, Health Problems & Vit C Deficiency

*Corresponding author.

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1. Introduction

A number of international recommendations and population targets defined the desirable level of consumption of fruit and vegetables for children [1]. Dietary guidelines convey the importance of consuming 400 grams of total fruits-vegetables at all age groups [2] and limiting salty or sweet snack foods. The daily consumption of at least one portion of fruit and one portion of vegetables was considered to be an absolute minimum in children and there is inconsistency about including or excluding potatoes, fruit juice, vegetable soup and tubers. When using 400 grams as a cut-off; 6% - 24% of the European children 11 years old had an intake of ≥400 g/day; Austrian children with 175 g per day were highest, while Icelander children with 80 g per day were the lowest [1].

Dietary vitamin C (AA) is present exclusively in fruits and vegetables and the consumption of vegetables [3] and dietary intake of vitamin C has attained great importance from the point of view of prevention of disease and therapy [4]. Vitamin C is in the form of the reduced form L-ascorbic (AA) and the dike to L-dehydro-ascorbic acid (DHAA); both forms are biologically active to humans. The DHAA content of fresh fruits and vegetables is on the order of 5% - 10% of total vitamin C [5] whereas storage and/or processing may increase the proportion to 30 % or greater [5] [6].

The functions of A are based primarily on its properties as a reversible biologic reductant and it efficiently scavenges hydroxyl and superoxide radicals [4]. Vitamin C deficiency causes oxidative damage to lipids and proteins in the brain, which may end up with neurodegenerative diseases. Vitamin C improves the apparent iron absorption in individuals with low iron stores [7]. The antiscorbutic function of AA is attributed to hydroxylation of peptide bound proline during the biosynthesis of collagen; an important structural component of blood vessels, tendons, ligaments and bone [8].

Reactivity of radical oxygen species (ROS) with anantioxidant molecule such as vitamins C, leading to neutralised or greatly reduced reactivity [9]. After this process, the antioxidant properties of AA are lost and the vitamin must be constantly replenished or recycled.

Vitamin C accumulates in the central nervous system and the highest concentrations of ascorbate in the body are found in the brain and the neurons. Today ascorbate is proposed as a neuromodulator of glutamatergic, dopaminergic, cholinergic, and GABAergic transmission and related behaviors [10].

Vitamin C deficiency may be due to limited dietary supply or due to losses during the processing of foods as it is water soluble, easily oxidized and attacked by enzymes. The variations of ascorbic acid in fresh and thermally processing led to pronounced loss in the ascorbic acid content in all crops studied [5].

The promotion of daily fruit and vegetable consumption in childhood is important, since young children can learn to accept a greater variety of foods and flavours through repeated exposure [11] and may, to a certain extent, track into adolescence and adulthood. Food choice was thought to be influenced by a number of environmental and individual factors. Environmental factors may include food pricing [12]. Cost of food was negatively associated with dietary quality, low cost diets tending to have increased energy density and poor nutrient adequacy [13] [14].

The aim of the present study is to assess the usual intake of fruits and vegetables derived from repeated follow up dietary recalls performed among representative preschool children. The vitamin C supply with fruits and vegetables and percentage of children not satisfying the recommended vitamin C intake was also investigated.

2. Materials and Methods

2.1. Participating Children

Fifty nine boys and girls aged 2.5 - 6 years were recruited from four daycare- centers located in El-Haram, Giza Governorate. Data related to the age of each child was obtained from birth certificate. Mothers of the children were interviewed after the nature of the study was explained to them and the mothers gave their written consent.

Socio economic characteristic The socioeconomic status (SES) was measured by a composite score of completed educational level of the heads of the household (in years). Education has been used as a common indicator because it is easy to measure and is the most stable measure of socioeconomic status. Household income per capita (in Egyptian pounds) and parental occupation. The SES index score was predicted from the following equation [15]. Socioeconomic status = 2.259 + 1.016 (C1) + 0.886 (C2) + 0.622 (C3) + 0.013 (C4), whereby C1 = Average income of the household per month in Egyptian pounds; C2: Score of the father's occupation (score 5 - 50); C3: Score of the father's education (0 - 15 years); C4: Score of the mother's occupation. The socioeconomic levels were categorized as low with score (48 - 96); medium (97 - 144) and high (145 - 192).

2.1.1. Dietary Assessment

A face-to-face six-pass 24-hour dietary recall was used to collect dietary information. Three recalls were collected during the month of December and three 24-h dietary recalls were collected during the month of August. The mothers reported the intake for their childrenand the interviews were conducted in the respondent's home. The familiar environment encouraged participation, improved the recall of foods consumed and facilitated calibration of local household utensils by the interviewer [16]. The mothers were given instructions tolist the actual amounts and forms of all foods consumed at breakfast, lunch, dinner and snacks at home and away from home during the last 24-hour dietary recalls. These included both simple foods such as fresh vegetables, fruits, juices and complex foods such as cooked recipes.

2.1.2. Sampling Protocol

To convert food intake into vitamin C equivalent, duplicate portions were transported to the laboratory for vitamin C determinations and 106 food items were identified. The purchase of the majority of the food cores was completed by experienced dietitians. Ready to eat dishes and commercial products such as chipsy and pickles were purchased from food stands or restaurants. At least three generous servings of each sample were collected directly from the serving lines, placed in plastic containers and packed in a portable thermo-container for transport. Dishes that required preparation or that were ingredients for mixed dishes were home-made by experienced dieticians using tradition Egyptian cooking practices approximated those used in homes.

In the laboratory, inedible portions were removed and only edible parts of vegetables and fruits were used. Portions from two to six major brands of each product were prepared for analysis.

Food description systems followed the recommended published reports [17] [18]. These included important descriptors consisting of food source, scientific name, part of the plant, major cultivars; preservation state; food processing; heat treatments; added ingredients, packaging type or storage conditions. Identifying the major commercial products was also recorded and an approximation of their sales ranking was reported.

2.2. Laboratory Investigations

Moisture determination The fresh edible portions were weighed, dehydrated by freeze-drying and final dry weight of each food sample was recorded and the percentage moisture was calculated.

The vitamin C was determined by the microfluorometric technique [19].

Food portions (0.5 - 5 g) was weighed with approximate vitamin C content between 2 and 100 mg and blended in a Waring blender with 3% meta-phosphoric acid dissolved in 8% glacial acetic acid (mP-A-W). Juices were homogenized with mP-A-W at a ratio of 1:3 (v/v). Foodstuffs rich in basic compounds (roots; tubers and fresh leafy vegetables) were extracted with acidic solution (15 g metaphosphoric acid—40 ml glacial acetic and 200 ml of diluted sulfuric acid, 0.3 N) (mP-A-S). Further dilution was carried out with (mP-A-W), sothat the vitamin C concentration ranged between 1 - 5 mg/100ml.

The pH was checked and adjusted to around 1.2 and the volume was brought to constant volume. After filtration, aliquots (25 ml) were treated with norit (2 grams) for the conversion of ascorbic acid (AA) into its oxidized derivative dehydro ascorbic acid (DHAA). Aliquots of the norit treated filtrate (5 ml) were transferred into two separate 100 ml volumetric flasks. The first flask contained 5 ml aqueous sodium acetate solution (50%) and the volume was completed to the mark with distilled water; whereas, the second flask contained 5 ml boric acid (3% dissolved in 50 % sodium acetate); which converted the ascorbic acid into borate—dehydroascorbic acid complex and this served as blank. It was treated in an identical manner as the first flask. Two milliliters aliquots were taken from each flask and mixed with 0.02% aqueous ortho-phenylenediamine to form the fluorescent chinoxalin derivative. The fluorescence was measured within 30 minutes at excitation and emitting wavelengths of 350 and 430 nm, respectively. A reagent blank was run in parallel.

Pure ascorbic acid (5 mg/dl) (Merck) was used throughout the present work as an external standard for calibration. The working solutions were prepared by dilution from the stock with (mP-A-W) to contain between 1 - 50 µg per ml. Aliquots were taken and treated in an identical manner as the test samples. The whole analytical process was carried out in dim light and care was given to avoid excess oxygen and temperature increase.

Quality control: A Standard Reference Material (SRM 1846) consisting of an Infant formulae was obtained from the National Institute of Standards and Technology (NIST; Gaithersburg, Maryland, USA) and was treated in a similar manner to the unknown samples. The analysis of the SRM 1846 by the present analytical method gave mean level of 11.3 mg vitamin C/100g equivalent to 103.6% of the certified value (10.9 mg/100g) reported by the NIST.

Calculation: The external standard procedure was adopted throughout the course of the vitamin C analysis. Based on the concentration and the respective fluorescent reading of the standard ascorbic acid solutions, linear regression equation were derived and the regression factors a, b were used for calculating the ascorbic acid in the test samples.

2.3. Estimation of the Daily Nutrient Intakes

Six 24 hour food intake measurements for each child were the basis for estimating the usual fruits and vegetable intakes. The mean intake of the completed records was taken for each fruit and vegetable and expressed in g/d. To obtain the amount of vitamin C consumed, the amount of fruit or vegetable consumed in grams/d was multiplied by the vitamin C content in the fruit or vegetable.

The probability of adequacy was determined by dividing the dietary vitamin C supply by the recommended nutrient intake (RNI) of vitamin C, which is 30 mg for the age group 2 - 6 years [20].

3. Statistical Analysis

The fruit and vegetable frequency questions were categorized into response category 1 - 6 and accordingly, the children were distributed according to the frequency of consumption per 6 days. Percentages, means and standard errors were calculated to describe frequency of fruit and vegetable characteristics. Mean and median estimated daily intake of fruits, vegetables and vitamin C among the whole study group or according to specific categories are calculated. Significant differences were assessed by using students' t test or the non-parametric Chi square test. Differences with $P \leq 0.05$ were considered significant.

4. Results

Table 1 presents number of times fruits and vegetables were reported by the children during the 6-day repeated recall period. In the total sample, 22% of the children reported to eat fruit every day, 54.2% reported to eat vegetables every day. Percentage of children who report consuming fruits less than one time daily and vegetables less than one time daily was quite high amounting to 78 and 46%, respectively.

The overall daily fruit intake averaged 117.5 ± 4.6 g and daily vegetable intake averaged 55 g (**Table 2**).

Table 3 presents the vitamin C content of selected fruits, vegetables and juices determined by the fluorometric assay. Citrus fruits and guava are the richest fruit sources in vitamin C. Paprica is the richest vegetable source in vitamin C. Chipsy is also good source of vitamin C, yet its sodium content is quite high.

The dietary supply of vitamin C averaged 38.7 ± 2.3 mg per day among the total participants (**Table 4**). The % children with dietary vitamin C less than 75% of the RNI were 15.2% % among the whole study group. Fruits contributed 72% of the total dietary vitamin C; juices contributed 10 % of the dietary vitamin C; whereby vegetables contributed 18%. Citrus fruits (oranges, mandarine and lemon), guava, watermelon, pear and grapes were the five top fruit contributors to vitamin C in the diets of the children (**Figure 1**). Potatoes including chipsy (6%), tomatoes (4%), fruiting vegetables (2.5%) and dark green leafy vegetables (1.16%) were the top vegetable contributors of vitamin C.

5. Discussion

It had been repeatedly reported that increasing the number of measurement days minimizes within-subject variation [21]. The general results on contributions of numbers of days on the accuracy of mean intake estimates showed that the benefits fall off after six days [22]. Accordingly, our study was designed using six repeated 24 h dietary recall on non consecutive days to assure that the released data represents usual food intakes.

The daily consumption of at least one portion of fruit and one portion of vegetables has been considered a minimum in children [1]. A survey carried out on nine European countries reported that 43.2% of the 11-year-old children ate fruit every day; whereas, 46% ate vegetables every day [23]. Percent Australian children 2 - 16 years consuming fruits and vegetables every day amounted to 69.3% and 69.1%, respectively [24]. In Brazil, 66.2% and 48.6% of the adolescents consumed fruits and vegetables every day [25].

Table 1. Distribution of the children according to frequency of fruits and vegetables intake per 6 days.

Category	Frequency fruit intakes per 6 days							
	Number	Age, mo	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
				Fruits				
All children	59	54.2 ± 1.5		10.2	23.7	23.7	20.3	22.0
Age group < 4 years	13	37.7 ± 1.3		23.1	38.5	23.1	15.4	0.0
Age group ≥ 4 years	46	58.8 ± 1.2		6.5	19.6	23.9	21.7	28.3
Boys	34	54 ± 1.9		2.9	26.5	20.6	26.5	23.5
Girls	25	54.4 ± 2.5		20	20	28	12	20
SES (1)	15	61.8 ± 2.4		13.3	13.3	40.0	13.3	20.0
SES (2)	21	52.9 ± 2.5		14.3	19.0	14.3	38.1	14.3
SES (3)	23	51.2 ± 2.5		4.3	34.8	21.7	8.7	30.4
				Vegetables				
All children	59	54.2 ± 1.5	1.7	1.7	0.0	11.9	30.5	54.2
Age group < 4 years	13	37.7 ± 1.3		7.7	0.0	23.1	38.5	30.8
Age group ≥ 4 years	46	58.8 ± 1.2	2.2	0.0	0.0	8.7	28.3	60.9
Boys	34	54 ± 1.9	0.0	0.0	0.0	8.8	35.3	55.9
Girls	25	54.4 ± 2.5	4.0	4.0	0.0	16.0	24.0	52.0
SES (1)	15	61.8 ± 2.4	6.7	0.0	0.0	26.7	13.3	53.3
SES (2)	21	52.9 ± 2.5				4.8	38.1	52.4
SES (3)	23	51.2 ± 2.5	0.0	4.3	0.0	8.7	34.8	52.2

Table 2. Distribution of the children according to daily fruit and vegetables intake in grams.

Category	Estimated	Median
	Average (X ± SE)	(g/d)
	Fruit	
All children	117.5 ± 4.6	113
Age group < 48 mo	109.1 ± 11.2	93
Age group ≥ 48 mo	119.9 ± 5.0	120
Boys	130.7 ± 6.6	135.5
Girls	107.8 ± 5.8	98
SES, Low	130.6 ± 9.5	131
SES, Medium	111.6 ± 6.1	96.5
SES, High	114.4 ± 8.2	117.2
	Vegetables	
All children	56.4 ± 2.3	55.9
Age group < 48 mo	55.4 ± 6.2	50.7
Age group ≥ 48 mo	56.6 ± 2.4	55.9
Boys	57 ± 3.2	54.9
Girls	55.5 ± 3.4	56.8
SES, Low	62.6 ± 4.3	66.8
SES, Medium	57.0 ± 4.0	54.3
SES, High	51.6 ± 2.6	50.7

Table 3. Mean vitamin C and moisture contents in fruits and vegetables commonly consumed in Egypt.

Item	Eaten	Edible proportion	Processing	Moisture % as eaten	Energy Kcal/100g	Vitamin C mg/100g
Cabbage	Leaves	0.71	Boiled	92.8459		5.76
Carrots	Root	0.86	Raw	92.1	28.1	4.87
Carrots	Root	0.82	Boiled	92.5	28.3	2.99
Carrots	Root	1	Pickles	90.4	29.3	1.8
Cauliflower	Flower	0.75	Boiled	94.3	20.5	9.32
Cauliflower	Flower	0.75	Recipe	86.7	55.0	7.9
Cauliflower	Flower	0.78	Fried	68.7	181.2	12.64
Cauliflower	Leaves		Fried, w eggs	59.7	199.2	6.75
Celery	Leaves	0.64	Raw	93.2	7.0	5.13
Coriander	Leaves	0.46	Raw	91.5		116.6
Cucumber	Fruit	0.87	Raw	96.1	12.9	22
Dill	Leaves	0.7	Raw			48.98
Eggplant purple color	Fruit	0.84	Boiled	93.9	23.8	3.12
Eggplant white colour	Fruit	0.88	Boiled	93.6	23.8	1.1
Eggplant white colour	Fruit	0.88	Pickles	76.7	89.5	1.48
Eggplants	Fruit	0.88	Fried	76.2	159.2	16.2
Eggplants	Fruit	0.88	Fried, pickled	79.2	76.1	2.235
Eggplants	Fruit	0.8	Recipe	69.5	179.7	28.37
Garden rocket	Leaves	0.55	Raw	92.7	21.2	98.12
Garlic	Fruit	0.22	Raw	69.4		3.97
Grape leaves	Leaves	0.82	Raw	74.7	108.4	76.2
Grape leaves	Leaves	0.83	Recipe w rice	87.1	55.4	13.58
Green beans	Pods	0.73	Recipe	89.1	144.6	5.7
Jews mallow	Leaves	1	Raw, Sun dehydration, ground	9.5	342.9	14.5
Jews mallow	Leaves	0.25	Recipe	92.1	29.8	1.68
Leeks	Leaves	0.87	Raw	93.2		18.26
Lemon	Fruit	0.56	Pickles	83.1	69.5	5.76
Salad	Green	0.8	Raw	93.4		8.97
Green mallow	Leaves	0.8	Boiled	90.4	38.7	6.92
Green mallow	Leaves	0.8	Recipe	81.8	80.7	1.49
Okra	Fruit	0.88	Raw, Sun dehydration, ground	51.0	176.0	24.03
Okra	Fruit	0.8	Recipe	87.1	52.8	9.94
Okra	Fruit	0.8	Recipe w tomato	83.9	79.9	8.9
Onion	White Bulb-leaves		Raw	90.2	34.7	4.2
Onion	White Bulb-leaves		Boiled	85.7	51.9	7.74
Onion	Red Bulb-leaves		Raw	87.8	43.7	3.65
Parsley	Leaves	0.62	Raw	85.7	48.6	114.2

Continued

Parsley	Leaves	0.62	Boiled	92.4	26.8	53.2
Peas	Seeds	0.48	Boiled	76.2	90.8	4.77
Peas	Seeds	0.5	Recipe w carrots-tomato	80.2	91.9	3.1
Peas	Seds	0.5	Recipe w tomato	81.0	72.3	4.2
Pepper bell green	Fruit	0.82	Raw	92.6	26.5	68
Pepper hot green	Fruit	0.97	Raw	91.7	30.4	75.9
Pepper hot green	Fruit	0.95	Boiled	92.1	30.1	47
Pepper bell green	Fruit	0.8	Boiled	88.6	60.3	152.9
Pepper bell green	Fruit	0.82	Recipe, w rice fillings	75.3		44.4
Pepper hot	Fruit		Pickles	84.5	70.7	18.13
Potato	Tuber	1	Boiled ;peeled	81.5	67.1	18.9
Potato	Tuber	0.81	Boiled w peel	79.2	76.9	9.95
Potato	Tuber	0.81	Stewed; oil added	73.8	126.2	13.8
Potato	Portion	0.81	Pommes frittes	24.4	28.8	7.8
Potato	Serving dish	0.83	Cooked w tomato	78.2	76.9	7.3
Raddish	Root-Leaves	0.59	Raw	91.9	35.7	64.1
Spinach	Leaves	0.45	Boiled	87.4	40.9	8.2
Spinach	Serving dish	0.5	Cooked w tomato	87.0	60.8	7.3
Squash	Fruit	0.83	Boiled	89.1	34.2	5.6
Squash	Serving dish		Cooked w tomato	87.2	40.4	5.3
Sweet potato	Tuber	0.9	Boiled	71.8	270.6	10.54
Sweet potato	Tuber	0.9	Baked	71.7	269.1	34.05
Taro	Tuber	0.84	Boiled	80.9	64.6	4.1
Taro	Serving dish		Recipe w tomato	80.7	82.5	4.1
Taro	Serving dish	0.8	Recipe w celery	82.0	63.6	5.2
Tomatoes	Fruit		Raw	83.9	84.1	18.6
Tomatoes	Fruit	0.98	Boiled	93.8	23.3	10.7
Tomatoes	Fruit		Tomato salad	77.4	72.7	6.47
Carrots	Mixed	1	Pickles	87.6	21.5	0.8
White beans	Seeds	1	Boiled	60.5	152.7	2.875
White beans		1	Recipe w tomato	72.0	113.5	3.3
Fruits						
Apple	Fruit	0.9	Raw local	87.0	48.0	3.2
Apple American golden	Fruit	0.94	Raw imported	85.1	55.2	5.58
Apple American red	Fruit	0.93	Raw imported	86.1	51.2	3.9
Apple Syrian golden	Fruit	0.92	Raw imported	82.7	64.2	3.2
Pommegranate	Fruit	0.5	Raw local	80.4	72.8	11.54
Apricots	Fruit	0.93	Raw local	85.9	50.2	7.8
Banana	Fruit	0.7	Raw local	84.7	55.0	5.65

Continued

Banana	Fruit	0.75	Raw, imported	81.7	66.7	6.78
Cantalope	Fruit	0.61	Raw	91.9	28.2	29.9
Dates dehydrated	Fruit	0.85	Raw, dehydrated	45.4	199.0	7.18
Dates Zaghloul red	Fruit	0.85	Raw, fresh	62.6	136.5	8.62
Dates Samaniyellow	Fruit		Raw, fresh	60.7	147.3	5.79
Figs	Fruit	0.9	Raw, fresh	82.2	66.1	10.9
Grapes purple	Fruit	0.98	Raw, local	84.7	55.2	4.2
Grapes seedless	Fruit	0.95	Raw, local	82.8	62.0	4.06
Grape fruits	Fruit	0.88	Raw, local	90.1	35.4	45.4
Guave	Fruit	0.97	Raw, local	86.8	50.1	102.3
Mandarine	Fruit	0.75	Raw, local	86.9	48.3	39.9
Mango	Fruit	0.51	Raw, local	83.9	60.0	32.9
Melon	Fruit	0.8	Raw, local	93.4	22.8	20.2
Mulberry	Fruit	0.98	Raw, local	83.2	64.6	17.49
Mulberry purple	Fruit	0.97	Raw, local	84.9	56.8	21.49
Oranges baladi	Fruit	0.77	Raw, local	86.4	50.7	53.16
Oranges besorra	Fruit	0.75	Raw, local	86.0	52.9	49.95
Oranges sokkari	Fruit	0.74	Raw, local	87.4	47.8	48.2
Oranges summer	Fruit	0.81	Raw, local	86.8	49.9	44.2
Peaches	Fruit	0.8	Raw, local	85.6	53.6	9.38
Pears	Fruit	0.96	Raw, local	84.8	57.1	17.81
Plums golden	Fruit	0.88	Raw, local	84.2	58.3	5.05
Prickly pear	Fruit	0.85	Raw, local	85.0	54.1	13.12
Water melon	Fruit	0.56	Raw, local	90.7	33.7	7.9
Juices						
Carrots	Juice	1	Proc, local	93.0	29.8	3.39
Cocktail	Juice	1	Proc, local	81.4	73.5	15.47
Guava	Juice	1	Proc, local	84.9	33.0	32.6
Mango	Juice	1	Proc, local	81.3	72.6	5
Milk-banana	Beverage	1	Fresh	76.3	90.5	2
Milk-mango	Beverage	1	Fresh	80.6	81.2	0.14
Milk-strawberries	Beverage	1	Fresh	80.8	81.4	6.51
Orange	Juice	1	Proc, local	91.3	32.5	35.37
Orange carrots	Juice	1	Proc, local	90.0	37.0	29.7
Orange peaches	Juice	1	Proc, local	85.9	53.2	22.2
Pine apple	Beverage	1	Proc, local	86.6	50.6	11.31
Straw berry	Beverage	1	Proc, local	80.4	60.7	28.5

Table 4. Mean and median dietary vitamin C supply and % children below the recommended nutrient intake.

	Dietary vit C supply, mg (Mean ± SE)	Dietary vit C supply, mg Median	% children < 75% RNI*	Chi square test
All children	**38.7 ± 2.3**	**35.5**	15.25	
Age group < 48 mo	**34.2 ± 4.4**	**29.1**	18.18	
Age group ≥ 48 mo	**40.8 ± 2.7**	**41**	15.2	
Boys	**41.8 ± 3.1**	**39.5**	8.8	
Girls	**34.5 ± 3.4**	**33.1**	24	2.57#
SES, Low	**35.9 ± 3.9**	**40.4**	26.7	2.03
SES, Medium	**38.7 ± 3.5**	**30.8**	9.5	
SES, High	**40.6 ± 4.5**	**35.5**	13	

*The age groups 2.5 - 6 years; #P < 0.05.

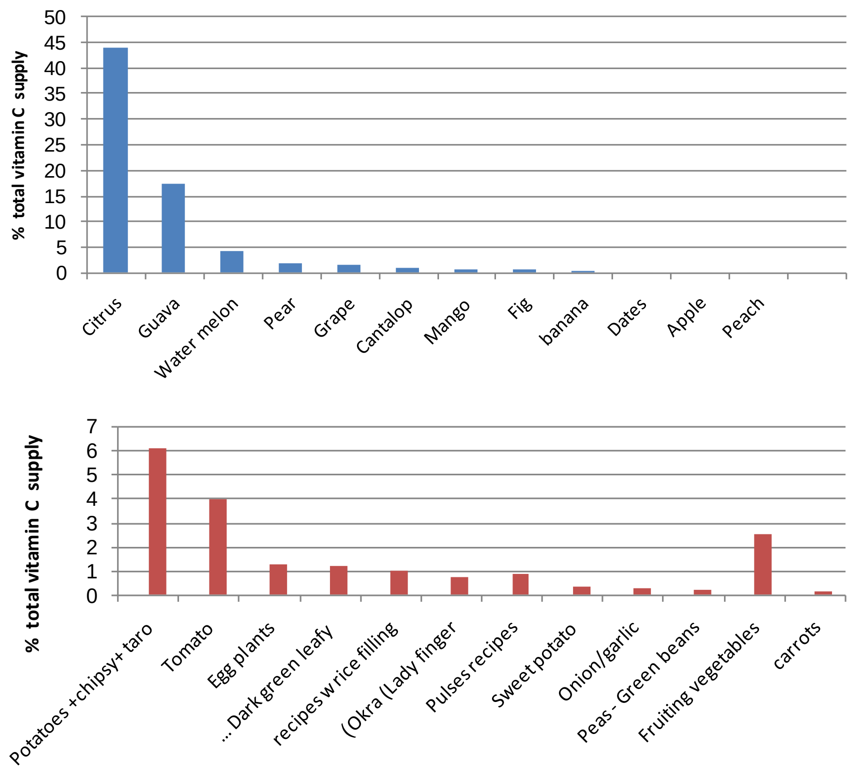

Figure 1. Legend to figures % total vitamin C supply.

In the present study, 54 % of the children ate vegetables every day, which is overlapping with the above mentioned reports. However, only 22% of the children ate fruits every day, which is far below the guideline of daily fruit consumption. In agreement with earlier reports, the consumption of different types of fruits and vegetables was unevenly distributed by different personal and social variables [26].

The median vegetable consumption decreased from 64.6, to 55.5 to 45.6 g among children from households with low, medium and high socioeconomic class, respectively.

Estimated fruit supply in the diet of our children 2.5 - 6 years is 58% the respective intakes of figures of Australian children. Estimated total fruit intakes of 179 and 177 gram had been reported for Australian children in the age groups 2 - 3 and 4 - 8, respectively [24].

The dietary fruit and vegetable supplies in the diet of our children is still better than those reported for Indian children. Mean daily intakes of 26, 35, 12.5 and 14.6 grams fruits were reported for boys and girls (2 - 4 years) and (4 - 6 years) respectively. Respective mean daily intakes of vegetables were 64.0, 59.91, 71.28, 71.92, 12.46, 14.56 71.3, 59.1 and 55.7 and 71.92 [27]. The authors considered these amounts significantly low and wouldn't satisfy the RNI.

In the United Kingdom, a survey reported mean daily fruit intake of 148 g/d for children 8 years of age in families never eating meal together at a table, which increased to 229 in families always eating together. The respective vegetable supply was 66 and 113 g/d [28].

The vitamin [C] composition data of new forms of vegetables and fruits appearing in the market and the important commercially prepared foods are generally unavailable. The formulations of such food commodities are nonexistent and are frequently different from home-prepared products so that their vitamin [C] composition should be determined by analysis [6]. Food analysis is costly and laborious, analytical data are frequently borrowed from tables of developed countries and incorporated in tables of developing countries.

For the generation of accurate analytical food composition table vitamin C was analyzed based on nationally based sampling and actual chemical analyses for foods. We took advantage of this table to gain an insight into the adequacy of this practice by estimating the vitamin C content in the diets of Egyptian preschool children

Dietary supply of vitamin C among children from European and American populations is much superior compared to those estimated in the present study and in reports for African and Asian children.

Dietary intake surveys estimate US per capita vitamin C intakes at approximately 83 mg/day for children age 1 to 5 years [29]. Approximately 90% of the vitamin C comes from fruits and vegetables, with citrus fruits being main contributors [6]. Furthermore, high mean intakes of vitamin C equivalent to 202 and 166% of the Recommended Dietary Allowances were reported for children from food sufficient and insufficient households, respectively [30]. Dietary vitamin C supply averaged 90.5 and 53.5 mg for American and Russian children, respectively [31]. Respective mean, median estimated vitamin C intakes of 30.6 and 24 mg/day and 80% prevalence of adequacy were reported among children from Bangladesh 2 - 4 years [32]. The authors attributed the low intakes primarily due to low diversity of foods. In South Africa, estimated vitamin C intakes of 29 and 52 mg/day were reported for children 2 - 5 years of age, when the 24 d recall was conducted during the months of February and November, respectively [33].

In rural Zambia, the roots and tubers contributed to the intake of vitamin C by 16% in the diet of Zambian children two years of age; while respective contribution of fruits and vegetables amounted to 28% [34]. In the present study, tubers and potatoes were also the top vegetable contributors to vitamin dietary vitamin C supply. Chipsy and fried potatoes were consumed by 81% of the children with weighted daily intake of 8.4 g contributing 3.2% of the daily vitamin C supply.

Unfortunately, the consumption of chipsy was associated with 50 mg increase in the daily intake of sodium. Respective amounts of chipsy and fried potatoes consumed by Australian children 2 - 3 and 4 - 8 years were 32 and 47 grams, respectively [24]. In the US, chips, crackers, popcorn and pretzels consumed by children 2 - 18 years contributed higher daily sodium intake of 192.6 mg [29]. Childhood is a sensitive period with respect to effects of sodium on future blood pressure [35]. The majority of children exceeded recommendation levels of sodium intake at 2 - 6 years and interventions to reduce sodium in childhood should be considered.

Vitamin C is the important single nutritional factor viewed as essential for healthy life across the lifespan. Its deficiency probably increases morbidity and mortality in children, emphasizing the public health importance of this disorder. Some sources now suggest that recommended dietary allowance (RDA) of vitamin C should be as much as double the currently advised per day depending on age and gender [36].

Results obtained from the present survey serves as baseline measurement to track consumption of fruits and vegetables over time to monitor progress towards increased F&V consumption, a key recommendation of the Dietary Guidelines for World Health organization.

Promoting healthier eating patterns among children is crucial for optimal growth and development. Because children's eating patterns are influenced by such a range of characteristics of the social and physical environment, it is important to develop interventions that target the different levels at which these influences occur.

Busy families rely on convenient foods which often come from fast food establishments, other restaurants, and the pre-packaged food sections of the grocery store [37]. Hurried families no longer have time to sit down to eat meals together, even though eating together has been associated with greater intake of foods from the basic food groups contributing to less than optimal eating patterns [28]. There is still more work to be done to promote healthier eating patterns using a multi-faceted approach targeting children, parents, families and schools. Attempting to increase F&V consumption should include strategies to improve access and establish policies that make it easier to target child care centers, as children are spending more of their time in these settings. These interventions could focus on making fruit and vegetables as healthful food choices. The state can support increased fruit and vegetable consumption by ensuring that their child care regulations closely align with national standards for serving fruits and vegetables.

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