

A FOOD FREQUENCY QUESTIONNAIRE TO DETERMINE THE INTAKE OF VITAMIN C: A PILOT VALIDATION STUDY

Holenarasipur Nagesh Santosh , Chaya David

Department of Oral Medicine and Radiology, Dayananda Sagar College of Dental Sciences and Hospital, Bangalore, India

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Abstract


Background and Aims: The aim of this study was to validate a food frequency questionnaire (FFQ) specific to diabetic population wherein the frequency of intake of vitamin C would be examined. **Material and Methods:** The study is registered with Clinical Trial Registry of India (CTRI) with CTRI number CTRI/2016/03/006764. The FFQ was validated against intakes derived from a 24 Hour Dietary Recall (24 DR). 50 subjects were chosen and a FFQ with 24-hour dietary recall was done. The FFQ had a list of commonly used food items. The vitamin C yield from each food item was pre-calculated. **Result and conclusion:** Strong correlations between the FFQ and 24 dietary recall were observed for all vitamin C containing food list (Pearson Correlation Coefficient $r = 0.997$). The p value was significant between the FFQ and 24Hour dietary recall ($p = 0.028$). Cross classification analysis showed uniform classification of the respondents and there was no misclassification into quartiles. This pilot study showed promising validation evidence for the use of this FFQ, which focuses vitamin C intake in patients with type 2 Diabetes Mellitus, as a screening tool in clinical and research settings.

key words: Diabetes Mellitus, Vitamin C, Food Frequency Questionnaire, Validation

Background and aims

Antioxidants have been used to regulate the glycemic control, to reduce the complications due to micro and macro vascular changes in Diabetes [1]. Vitamin C is one such antioxidant which has shown promising results. It is structurally similar to glucose and prevents non-enzymatic glycosylation of proteins. The levels of vitamin C with respect to the glycemic index has been well documented [2]. It is substantially proven that oral supplementation of vitamin C improves the glycemic control in patients on oral

hypoglycemic drugs [3]. But studies till date have not established the singular effect of vitamin C in improving glycemic control. Besides, the studies which have been done using oral supplementation of vitamin C have not excluded the routine dietary intake of vitamin C. The principal source of vitamin C is through diet. The dietary sources of vitamin C are mainly fruits which are taken in restricted quantities. Hence an assessment of dietary intake is crucial. The study objectives, design and resources are to determine the selection of tools to assess the nutrient intake of vitamin C in diabetic

 Kumaraswamy layout, Bangalore 560078, India, Tel: +919448721428, corresponding author e-mail: drhnsantosh29@yahoo.co.in

individuals. A food frequency questionnaire (FFQ) is one such commonly used tool in a clinical screening setting or in epidemiologic studies to assess the dietary intakes [4]. Many randomized controlled trials, cross-sectional, case-control, and cohort studies have incorporated the outcomes of FFQ (assessment of food, food groups, or nutrient intakes) into research protocols [4]. The dietary information derived from FFQs allows researchers to characterize a cohort based on nutrient intake, examine the relationships between diet and disease, and diet and other study outcome measures, such as biochemical and functional measures [5,6]. Validation of FFQ is essential and the questionnaire should be compared to a gold standard diet analysis technique for the specific population under study. The diet analysis should be country-specific, age-specific and include a comprehensive list of food items to capture the study population's eating patterns, food choices and diet variability. The key component in designing a comprehensive FFQ is tabulating a food list. In a situation where the food habits of the population at large are skewed, there has been no initiative to develop and validate a FFQ. Although no one food list is complete, but a simple guideline to include the food items is to match its nutrient yield with the recommended dietary requirement. This study is an attempt to formulate, administer and validate a FFQ to assess the nutrient intake of vitamin C in a representative south Indian population.

Materials and Method

Participant recruitment

Individuals who were a part of the larger study population were approached to participate in the FFQ validation study. This larger study has been provisionally registered with CTRI (Clinical Trial Registry of India) Ref /2016/03/006764. A convenience sample of 50

patients who are diagnosed with Type 2 Diabetes Mellitus were chosen. The study period was from November 1st 2015 to 25th November 2015. In order to be included into the study group, the subjects should be diagnosed cases of Diabetes Mellitus who are on oral anti diabetic drugs and not insulin. The participants should be between age group of 30 years to 60 years and should not be suffering from any other complications arising out of Diabetes.

For the FFQ validation study, the participants were required to fill the FFQ form comprising of the food list, frequency of intake and portion size.

Nutrient analysis

The interviewer administered FFQ contained 29 food items that were found to contain substantial nutrient yield of vitamin C and are commonly used food items in the diet. The food items were arranged into 3 categories namely: fruits, vegetables and milk products. The participants were then asked in what quantity they consumed the food items. The frequency was recorded in terms of per day, per week, per month and never. The nutrient yield of each food item was collected from various studies in the Indian setup.

The quantification of food item was done according to approximate weight. For example, a small banana was supposed to weigh 100g, a medium sized banana was estimated 150g and a large one 200g. The portion size was calculated per gram of the food item taken. For example if a respondent consumed small banana every day, the nutrient intake of vitamin C was calculated as:

Amount of vitamin C / 100g X 100g.
Similarly, if the intake had to be computed for per week, then the formula would be:

(Amount of Vitamin C /100g X 100) divided by 4 as there are 4 weeks in 1 month. And for per month would be:

(Amount of Vitamin C /100g X 100) divided by 30 as there are 30 days in 1 month.

24 Hour Dietary Record

The respondents were administered a FFQ and the same FFQ was administered after 24 hours to check for consistency. All nutrient analysis procedure was conducted by a single investigator. Only completed FFQ were accepted.

Statistical analyses

The mean \pm standard deviation intakes for each food item was calculated the mean intake values derived from the FFQ and 24Hr DR were compared using a paired 2 tailed student t-test. To demonstrate the robustness of the validation technique, statistical tests were done. To determine whether the intakes derived from the FFQ were related to the intakes derived from the 24Hr DR, Pearson correlation coefficient were used. SPSS software (IBM 2103) was used to calculate the statistical results.

Cross classification analysis

In order to determine if the FFQ and 24Hr DR were able to classify the respondents into same or adjacent quartiles, a cross classification analysis was done.

Steps in cross classification analysis:

1. All the means of FFQ and 24Hr DR were arranged in ascending order.

2. Median value was calculated for FFQ and 24Hr DR were calculated separately

3. Values above the median were considered upper half of the quartile and values below the median were considered lower half of the quartile.

4. Median of the upper half was calculated and that is Q2. Median of the lower half of the quartile is Q3.

5. After calculating Q1 Q2 and Q3, the means which were within the quartile ranges were identified and grouped separately for FFQ and 24Hr DR.

The above cross classification analysis shows that all the values of FFQ and 24Hr DR were grouped within the limits of the quartiles and none of the values were misclassified.

Results

The mean intake of Vitamin C in the 24Hr DR was 29.3 ± 8.79 (and 29.2 ± 7.16) for FFQ (Table 1). The 2-tailed student t test revealed statistically significant values ($p = 0.02$ between the intake of food items rich in vitamin C among the two methods- namely FFQ and 24Hr DR (Table 1). There was a strong correlation between FFQ and 24Hr DR (Pearson Correlation Coefficient $r = 0.9997$). The cross classification analysis shows that all values were classified within the range of the quartile values and none of the data was misclassified (Figure 1 and Figure 2).

Table 1. Mean and Standard Deviation between FFQ and 24Hr DR (Dietary Recall).

Method	Mean intake of vitamin C	SD	P (p<0.05)	R (Pearson's Correlation Coefficient)
FFQ	29.2	7.16	0.0289	0.997
24Hr DR	29.3	8.79		

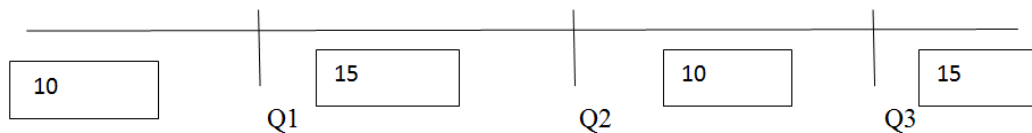


Figure 1. DR Cross classification analysis. Boxes indicate the number of subjects and Q1, Q2 and Q3 represent the quartiles.

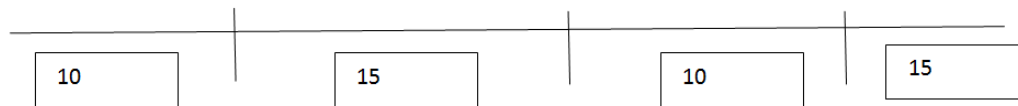


Figure 2. FFQ Cross classification analysis. Boxes indicate the number of subjects and Q1, Q2 and Q3 represent the quartiles.

Discussion

A valid, comprehensive tool to assess the intakes of key nutrients is essential in health research involving humans, such as randomized controlled trials, cohort and case-control studies. FFQ's have to specific to the population. It is difficult to formulate a FFQ which is complete in all respects. Vitamin C specific FFQ for population of Indian ethnicity has not been developed yet.

In the present study, we demonstrated the validity of a FFQ designed to be administered to a cohort of respondents having Type 2 Diabetes Mellitus who are on oral hypoglycaemic agents. The food consumption over a specific period of time is recalled in as much detail as possible. The recall period may vary from one day to weeks, although longer time would result in less accuracy of recall. Unlike diet recordings where the individual records the diet himself, 24-hour recalls are collected via a structured interview. The 24-hour recall pioneered by McHenry, Kruse and Burke is the most widely used method for dietary assessment [7-9].

The success of 24-hour recall depends on the memory, cooperation, and communication ability of the subject and the skill of the interviewer. Multiple 24-hour recalls can provide good estimates of individual dietary intake but require ample time and effort from the

interviewer as well as the respondent. This study utilized a 24Hr dietary recall strategy to assess the average vitamin C intake. The Pearson's correlation coefficient showed a strong positive correlation between the FFQ and 24Hr Dietary recall.

Vitamin C specific food list has not been formulated exclusively for the Indian population. However, our study utilized the expertise of Nagoan et al [10] to re-create an Indian population centric Food list comprising of 29 food items rich in vitamin C. The food list was a representation of the routinely used items which contain vitamin C as per the dietary recommendations of ICMR (Indian Council for Medical Research).

Validation studies for FFQ for the Indian population have been done in the past [11-13]. But the focus has been on total nutrient intake and not on specific nutrients. This study has its focus on Vitamin C specific nutrients. The results of the validation in this study matched with other validation studies done for Indian population specific FFQ [10,11]. In the cross-classification analysis, none of the respondents were misclassified and were within the range of their respective quartiles.

Conclusion

The present study provides a pilot validation evidence for the use of a FFQ that focuses on the

vitamin C intake of patients suffering from Type 2 Diabetes Mellitus. The study also proves that there exists a strong correlation between the FFQ and 24Hr DR. The mean intake of vitamin C measured from the FFQ and 24Hr DR had significant correlation and approximated the

Recommended Dietary Intake (RDI) of Vitamin C for the Indian population i.e. 30 mg. Thus, this FFQ can be used a useful screening tool to identify patients who have adequate intake of Vitamin C.

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