



Applied nutritional investigation

Development, validity, and reproducibility of a semiquantitative food frequency questionnaire for the assessment of antioxidant vitamins intake in Lebanon



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ABSTRACT

Objectives: The growing interest in the possible role of antioxidant vitamins in many pathologies makes the methods of evaluating the intakes of these vitamins necessary. The food frequency questionnaire is the most widely used tool in epidemiologic studies and large-scale surveys to assess long-term nutritional exposure and to determine the usual intake of specific foods or nutrients. The aims of this study were to develop and investigate the validity and reproducibility of a semiquantitative food frequency questionnaire (SQFFQ) to evaluate the antioxidant vitamins intake in the Lebanese population and for use in clinical trials.

Methods: An SQFFQ draft was built with the major sources of vitamins with antioxidant properties initially selected from food that have the higher percentages of the daily value of vitamins A, C, and E; listed in the US Department of Agriculture tables. We used food intake data that were available through a 24-h dietary recall (3 weekdays and 1 weekend day) among a subsample of 50 participants to complete the SQFFQ. We sought the major sources of the most frequently reported antioxidant vitamins, portion sizes, and percentages of the daily value of the major sources of these vitamins (developed by the US Department of Agriculture) to build a 34-item SQFFQ. The consumption frequency was coded as daily, weekly, monthly, or occasionally and one to three times or more. Five hundred Lebanese participants (the previous 50 who provided the 24 h dietary recall, along with 450 new participants) completed the questionnaire, whereas only 50 and 42 were accepted to be enrolled in the validity and reproducibility studies, respectively. To assess validity, the questionnaire was compared with the 24-h dietary recall performed on a subsample of 50 participants who already completed the SQFFQ. The reproducibility was assessed by comparing baseline SQFFQ with a second administration of the SQFFQ 3 to 5 wk later at the same dietetic clinic.

Results: The means of daily consumption of vitamins A, C, and E based on the SQFFQ and the 24 h data were as follows:

Vitamin A: $252.5 \pm \text{SD } 958.9$ versus $242.6 \pm \text{SD } 580.5$ mcg of retinol activity equivalents ($\mu\text{g RAE}$),

Vitamin C: $86.5 \pm \text{SD } 59.9$ versus $85.5 \pm \text{SD } 56.2$ μg , and

Vitamin E: $17 \pm \text{SD } 7.2$ versus $17.1 \pm \text{SD } 7.9$ μg .

The Pearson correlation coefficients of the three vitamins between dietary intake estimates derived from the SQFFQ and 24-h data were, respectively, $r = 0.83, 0.98, \text{ and } 0.9$; they were highly significant at $P < 0.001$. One sample t tests and Bland-Altman plots confirmed this validity. The reproducibility of the SQFFQ was assessed using the Cronbach α index that measures reliability between different components (for vitamin A: 0.994, vitamin C: 0.998, and vitamin E: 0.975). The correlation matrix (interitem correlation) showed that all elements were highly correlated ($r > 0.4$) and even close to 1 (for vitamin A = 0.989, vitamin C = 0.995, and vitamin E = 0.95).

Conclusions: In this study, we described the development of an SQFFQ. Based on the results, we found the SQFFQ to be valid and reproducible to assess intake of antioxidant vitamins in Lebanese adults. <END ABSTRACT>

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Introduction

The growing interest in the possible role of antioxidant vitamins in many pathologies such as Alzheimer's disease [1], cancer [2], and cardiovascular disease [3] make the development of methods to evaluate the intake of these vitamins necessary. Different tools exist to evaluate the dietary intakes of an individual or a population, including food frequency questionnaires (FFQs) 24 h dietary recall, and dietary journals [4]. The FFQ is the most commonly used tool in epidemiologic studies and large-scale surveys for assessing long-term nutritional exposure and for determining the usual intake of specific foods or nutrients [5]. A specific semiquantitative (SQ)FFQ is needed to evaluate the consumption of vitamins with antioxidant properties.

According to Young and Woodside [6], the physiological role of antioxidants is to protect the body against oxidative stress. These are generally vitamins (vitamin A, C, and E) and vitamin precursors, minerals (selenium, zinc, copper, and manganese), various phytochemicals (lipoic acid, resveratrol, catechins), and other phenolic compounds (phenols, flavonoids, lycopene, and hydroxytyrosol), with added coenzyme Q10 and α -lipoic acid [7,8].

This study focused on the development, validity, and reproducibility of an SQFFQ to evaluate the food intake of vitamins with antioxidant properties and for use in clinical trials. To our knowledge, this will provide first-time data on the usual frequency of consumption of vitamins with antioxidant properties in the Lebanese population because the creation of this SQFFQ depended on the target population (Lebanese) and their consumption of vitamins with antioxidant properties.

Materials and methods

Participants

Fifty participants were recruited in March 2016 to complete the 24-h dietary recall (3 weekdays and 1 weekend day) to build a food list based on the major sources of antioxidant vitamins that are most frequently reported in the 24-h data collected.

Five hundred participants (the previous 50 who provided the 24-h dietary recall data, along with 450 new participants) completed the SQFFQ. Only 50 and 42 accepted enrollment in the validity and reproducibility studies, respectively. Of the 42 participants in the reproducibility part of the validity study, 8 dropped out to resubmit the SQFFQ in 3 to 5 wk, to study the reproducibility, due to time issues. The included participants agreed to complete the SQFFQ and the 24-h data, allowing us to study the validation at the dietetic clinic on the same day they were asked to enroll in the study. The 4 d of the 24-h dietary recall were retrieved later from the same dietary clinic. The reproducibility was assessed by comparing the baseline SQFFQ with a second administration of the SQFFQ 3 to 5 wk later at the same dietetic clinic. Participants were examined between May and September 2016.

Recruitment was done by a dietitian who summarized the purpose of this study. The same criteria for eligibility were used across the three parts of the study: To be accepted for participation, participants had to be >18 y of age. The exclusion criteria were pregnancy and participation in a weight loss program, including dietary changes and restrictions. The 24-h dietary recall and SQFFQ were administered in person. Similarly, all measurements were carried out in a dietetic clinic by the same dietitian. Three dietetic clinics were included in the database, covering both urban and rural areas. This study was approved by the Ethics Committee of the Department of Human Nutrition and Dietetics of the Faculty of Agronomic and Food Sciences, Holy Spirit University of Kaslik, Lebanon. All participants consented to completing the questionnaires.

Measuring dietary variables

Development of the SQFFQ

According to Lavoie [4] and the Collège des Enseignants de Nutrition [9], different tools exist to evaluate the dietary intake of an individual or a population. These include the FFQ, 24-h dietary recall, and food diaries. Each tool has its own advantages and disadvantages. The FFQ is the most widely used tool in epidemiologic studies and large-scale surveys to assess long-term nutritional exposure and to determine the usual intake of specific foods or nutrients. This tool documents the dietary intake of individuals over a given period and is

therefore likely to be distorted by memory bias [5]. Fortunately, it has several advantages over other methods, specifically low participant burden and low cost. Nevertheless, this method is probably the one that requires the greatest upstream preparation work. An SQFFQ was developed to assess intake of vitamins with antioxidants in a Lebanese population. This was an original SQFFQ and not an adaptation of an existing one.

In general, for a food item to be informative within a frequency questionnaire, it must meet three criteria:

1. Consumed fairly frequently by a significant number of participants.
2. Contain sufficient quantity of nutrients that are being studied.
3. Consumed in quantity (frequency) that varies between individuals.

Accordingly, the choice of food items to be included in the list is crucial for the success of the questionnaire. First, we made an SQFFQ draft. The major sources of vitamins with antioxidant properties were initially selected from foods that have the higher percentages of the daily value (%DV) of vitamins A, C, and E listed in the US Department of Agriculture tables [10]. Then, we used food intake data that were available through 24-h dietary recall data (3 weekdays and 1 weekend day) among a subsample of 50 obese and non-obese participants to help choose the items. If a food was mentioned by at least 25 participants in the 24 h but not in the SQFFQ, it was added to the questionnaire. In the opposite situation, the items were examined by a dietitian and the decision of whether to keep them in the SQFFQ was made. We have built a food list based on the major sources of antioxidant vitamins that are most frequently reported in the 24-h dietary recall data collected. The portion size indicated in the SQFFQ was based on the %DV of the major sources of these vitamins (developed by the US Department of Agriculture) [10].

This list was converted into an SQFFQ format that was field-tested, shortened, and developed into its final form of 34 items to assess food intake over a 1-y period. It should be noted that the variability of the food choices of a group of individuals (e.g., foods, brands, methods of preparation) is very broad and cannot be represented exhaustively in a questionnaire. The frequency of food consumption (over 1 y) is represented in the format from several times per day to never. The dietary frequency was coded as daily ($\geq 1-3/d$), weekly ($\geq 1-3/wk$), monthly ($\geq 1-3/mo$), or occasionally. Participants checked the closest frequency to their usual consumption. The intake of seasonal fruits was asked over a 3-mo period, which is the length of a typical season for most seasonal fruits in Lebanon. The questionnaires were all administered and then reviewed by a dietitian to clarify participant responses and to ensure that no questions were omitted. On average, it took around 15 min to complete the SQFFQ. To complete the questionnaires, participants had at their disposal visual aids, measuring cups (1: 240 mL; 1/2: 120 mL; 1/3: 160 mL; and 1/4: 60 mL), and spoons (1 tablespoon: 15 mL and 1 teaspoon: 5 mL). Data were also collected on cooking methods and type of food (fresh, frozen, canned, prepared, etc.). We specified a standard serving size for each food (e.g., 1/2 cup of orange juice), and portion size estimates were based on household utensils including cups, spoons, and natural units (e.g., small, medium, and large size for fruits). The SQFFQ also included images of actual portion sizes at the end of the questionnaire to help participants accurately estimate their usual intake. Although a number of FFQs have been developed to estimate antioxidant intake; most of them have focused only on a certain vitamin antioxidant such as vitamins A [11], C [12], or E [13] and none of them estimated overall antioxidant vitamins intake. As such, we decided to focus on the antioxidant vitamins because the increasing interest in their possible role in many pathologies makes the methods of evaluating the intake of these vitamins necessary.

Validity

According to Willett [14], the validity of an FFQ corresponds to its ability to measure the food and/or nutrients that are the focus of the questionnaire. Validation is carried out by comparing the FFQ with another method of measuring food consumption (referred to as the reference method), such as the food diary, 24-h dietary recall, biological markers, or even a more complete FFQ that can be used to validate a shorter one [15]. Validation by comparing the test FFQ to an alternative dietary assessment method is also referred to as *relative validation*. The sources of error in the reference method should not be correlated with those of the FFQ, which could distort its validity [14]. Thus, we used the 24-h dietary recall in this study as a source of validation as they are not long-term memory based and are not restricted to a food list in contrast to FFQs [14]. The order of administration of the FFQ and the reference method varies from one study to another. It may be administered before or after 24-h dietary recall. According to Willett [14], the most appropriate sequence of administration would be the reference method preceding the FFQ. This sequence ensures that the questionnaire and the reference method relate to the same time period. Indeed, if the questionnaire is administered after the 24-h dietary recall, participants become aware of their diet, which can improve their responses to the FFQ. However, according to Cantin [5], even if the FFQ is administered after the 24-h dietary recall, it may not exactly cover

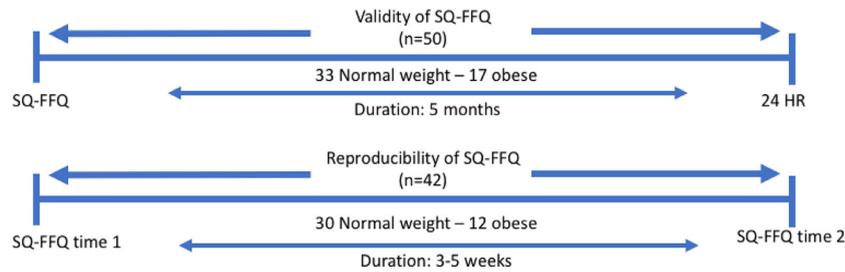


Fig. 1. Design of the development, validity, and reproducibility study of the SQFFQ among Lebanese adults (obese and non-obese). SQFFQ, semiquantitative food frequency questionnaire.

the same time period as the reference method. In this study, the 24-h dietary recall was administered before the SQFFQ, in the developmental phase, to get an idea of which foods to include in the questionnaire list and after the SQFFQ to validate the responses after administering the SQFFQ. To assess validity, the questionnaire was compared to 24-h dietary recall performed on a subsample of 17 obese and 33 non-obese individuals who had already completed the SQFFQ. The 24-h dietary recall consisted of 3 weekdays and 1 weekend day to be representative of the eating habits of the participants. Food models and household measurements were also used by a dietitian to ensure adequacy of portion size reported by the participants in the 24-h dietary recall. Additional questions were asked by the dietitian to refine answers (describe in detail all foods consumed the day before, without omitting cooking details, portions, and so on).

Reproducibility

The reproducibility of an SQFFQ, as defined by Willett [14], refers to the regularity of its measurements when administered to the same participant more than once at different times. It was done by comparing two administrations of the same SQFFQ to the same participant.

In this study, the SQFFQ was administered twice, 3 to 5 wk apart, to assess reproducibility (sample size: 42 participants—30 non-obese and 12 obese). This interval was chosen to reduce bias related to memory as well as real changes in food intake. All questionnaires were self-administered by the participants at the clinics and reviewed by a nutritionist for completeness.

Data were collected from May to September 2016. Each tool in this study was administered by a trained dietitian at dietary clinics. A sample of 50 participants (development study population) was recruited in March 2016 to complete 24-h dietary recall (3 weekdays and 1 weekend day) to build a food list based on the major sources of antioxidant vitamins that are most frequently reported in the data collected over a 24-h period. The 24-h dietary recalls were covered during two interviews, the first asking participants to complete the 24-h dietary recall for 4 d and the second to retrieve them. Five hundred Lebanese participants 18 to 61 y of age (the previous 50 who provided the 24-h dietary recall, along with 450 new participants) completed the SQFFQ, whereas only 50 and 42 agreed to be enrolled in the validity and reproducibility studies, respectively. To assess validity, the questionnaire was compared with the 24-h dietary recall performed on a subsample of 50 participants (33 non-obese and 17 obese) who already completed the SQFFQ. The 42 participants (30 non-obese and 12 obese) in the reproducibility study were also part of the validity study. The reproducibility was assessed by comparing baseline SQFFQ with a second administration of the SQFFQ 3 to 5 wk later at the same dietetic clinic.

Statistical methods

Frequency of dietary intake from the SQFFQ was transformed into daily intake of each food (g/d) and beverage (mL/d) by multiplying the specific portion unit by the frequency of consumption using the following values for reported frequencies:

- 1–3 times/d = 2((1+2+3)/3);
- 1–3 times/wk = 0.28((1/7+2/7+3/7)/3);
- 1–3 times/mo = 0.06((1/30+2/30+3/30)/3);
- Occasionally and never eaten = 0.

The average food intake of the 24-h dietary recall over 4 d was converted into daily intake of each food (g/d) and drink (mL/d).

The validity of the SQFFQ was assessed by comparing the intakes of 34 food items from the SQFFQ with the average intakes from the 24-h data. For each individual in the validation study, the daily intake of foods consumed during each of the 24-h dietary recalls were computed and used to calculate mean daily intakes of foods. The mixed dishes from the 24 h dietary recall were divided into their components and allocated to the appropriate food items of the questionnaire as would routinely be done in the analysis of mixed dishes [16]. Pearson correlation coefficients and Bland-Altman plots (difference plot) were used to measure the strength of the relationship between food intakes estimated by SQFFQ and the 24-h dietary recall. First, we ran a one-sample *t* test on the difference between measures; then we constructed Bland–Altman graphs. The reproducibility of the SQFFQ for foods was assessed by comparing the baseline (SQFFQ time 1) with a second administration of the SQFFQ 3 to 5 wk later (SQFFQ time 2; Fig. 1) using the Cronbach α index that measures reliability between different components. The model used in this study was based on the mean of the interitem correlations. All estimates were analyzed using the statistical software package SPSS version 24 (SPSS Inc., Chicago, IL, USA). Results with *P* < 0.05 was considered statistically significant.

Results

Demographic characteristics

The demographic characteristics of the participants in the SQFFQ evaluation study are presented in Table 1. The means of vitamins A, C, and E from the SQFFQ and the 24-h dietary recall are shown in Table 2.

Table 1
Characteristics of the participants in the development study (N = 500), the validity study (N = 50), and the reproducibility study (N = 42) of the SQFFQ in Lebanon

Characteristics		Development	Validity	Reproducibility
Age (mean ± SE)	Obese	(n = 170) 33.46 ± 0.751	(n = 17) 34.88 ± 2.5	(n = 12) 36.66 ± 2.99
	Non-obese	(n = 330) 33.61 ± 0.579	(n = 33) 36.33 ± 2.13	(n = 30) 37.13 ± 2.19
Male (mean [%])	Obese	(n = 170) 52 (30.5%)	(n = 17) 3 (17.5%)	(n = 12) 2 (16.6)
	Non-obese	(n = 330) 91 (27.6%)	(n = 33) 7 (21.2%)	(n = 30) 7 (23.3)
Female (mean)	Obese	(n = 170) 118 (69.4%)	(n = 17) 14 (83.3%)	(n = 12) 10 (83.33)
	Non-obese	(n = 330) 229 (69.4%)	(n = 33) 26 (78.8%)	(n = 30) 23 (76.6%)

Table 2

Comparison of the mean daily intake of vitamins A, C, and E estimated from the SQFFQ and the 24 HR (validation study) among Lebanese adult

	SQFFQ Mean \pm SD	24 HR Mean \pm SD	<i>t</i> test values	Pearson correlation*
Vitamin A (mg RAE)	252.5 \pm 958.9	242.6 \pm 580.5	0.82	0.83
Vitamin C (mg)	86.5 \pm 59.9	85.5 \pm 56.2	0.29	0.98
Vitamin E (mg)	17 \pm 7.2	17.1 \pm 7.9	0.80	0.90

24 HR, 24-hour dietary recall; RAE, retinol activity equivalents; SQFFQ, semiquantitative food frequency questionnaire

* $P < 0.0001$ for all vitamins

Validity

The mean daily intake of the three vitamins under investigation was overestimated by the SQFFQ when compared with the mean of four 24-h dietary recall (Table 2). The one-sample *t* test was non-significant, indicating that the observed differences in mean intakes between the two methods could not be statistically detected. We found significant ($P < 0.0001$) Pearson correlations between the SQFFQ and the 24-h dietary recall: $r = 0.83$ for vitamin A, $r = 0.98$ for vitamin C, and $r = 0.90$ for vitamin E, respectively (Table 2). Bland–Altman plots for the three vitamins showed a trend between points above and below the mean difference (Fig. 2). This observation confirmed that there was no proportional bias between the two methods. For this reason, we ran a linear regression procedure. The slopes of the regression line (\pm SE) were not significant for the three vitamins (vitamin A 0.05 ± 0.12 , $P = 0.63$; vitamin C 0.05 ± 0.04 , $P = 0.21$; and vitamin E 0.09 ± 0.06 , $P = 0.83$).

Reproducibility

The reproducibility of the SQFFQ was assessed using the Cronbach α index, which measures reliability between different components (for vitamin A: 0.994, vitamin C: 0.998, and vitamin E: 0.975). Satisfactory internal coherence was thus obtained. Also, the correlation matrix (interitem correlation) showed that all elements are

highly correlated ($r > 0.4$) and even close to 1 (for vitamin A = 0.989, vitamin C = 0.995, and vitamin E = 0.95).

Discussion

In this study, we developed an SQFFQ to assess intake of vitamins with antioxidant properties for use in clinical trials of Lebanese individuals and evaluated its relative validity and reproducibility.

The development of an SQFFQ with this scope provided for the first-time data on the frequency of consumption of vitamins with antioxidant properties in the Lebanese population. This is important in future studies that may compare intake between specific groups such as obese and non-obese participants.

As seen in other studies among adults, the FFQ overestimated intake relative to the reference method for most food groups [17,18]. Also, in this study, the mean daily intake of food source of the three vitamins with antioxidant properties was overestimated by the SQFFQ when compared with the mean daily intake estimated from the 24-h data recall. The most frequently used statistical analyses to explore the validity of FFQs is Pearson's correlation coefficients. The Pearson correlation coefficients generally obtained for the validation of an FFQ vary between 0.5 and 0.7 [5] and are considered acceptable [19]. Moreover, Willett speaks of a “ceiling of validity” because correlation coefficients >0.7 are rare in the literature. The correlation coefficients for intakes of all participants of

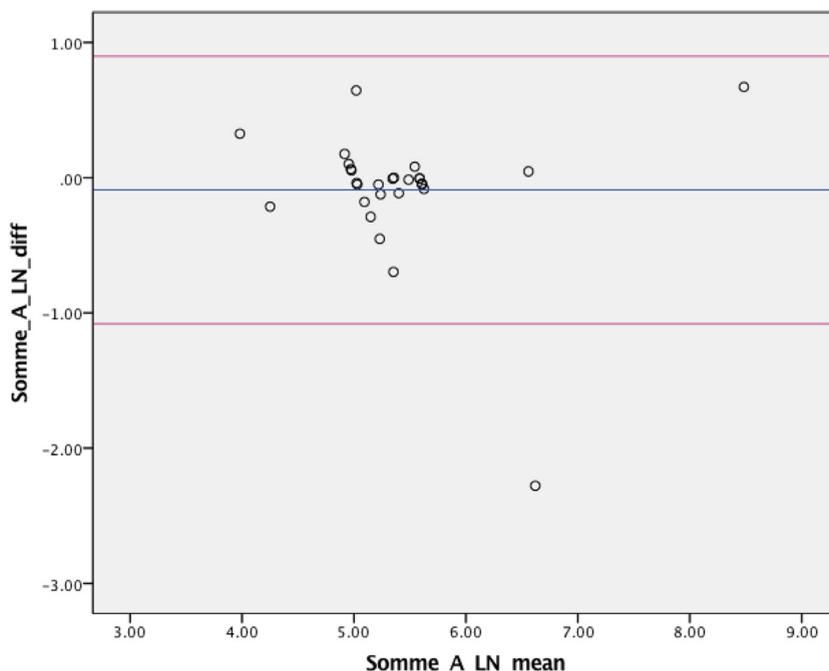


Fig. 2. Bland–Altman plot for means of vitamin A. Blue line represents the mean of the differences between the measures; pink lines represent the lower and upper limits of the confidence interval (95%).

this study ranged between 0.8 and 0.98, which is higher than observed in other validation studies, in other populations [20–22]. This is related to the ability of the SQFFQ to measure food intake because it is limited to a defined list and to the reference method used to validate it, which includes biases [14]. Reference instruments also varied between studies. We used the 24-h dietary recall as the reference method, which unlike FFQ is not representative of long-term food intake. The dietary recall is not long-term memory based and is not restricted to a food list [23]. Previous studies validated FFQ for assessment of antioxidant intake using plasma biomarkers [24], 30-d food records [25,26], and 24-h dietary recall [22] in different countries, but none of them with a Lebanese population, so this country-specific study in relation to the previous FFQs was developed to assess antioxidant vitamins. An FFQ designed for and validated against one population is not valid for other populations. Therefore, FFQs must be appropriately revalidated against new populations [27]. Because different populations consume different sets of foods and beverages, the list of items in an FFQ validated against one population may not cover all the items for another population.

There was a significantly high positive correlation between the means of daily consumption of vitamins A, C, and E from the SQFFQ and the 24-h dietary recall and no statistical significant difference between the two dietary assessment methods. Thus, no proportional bias was observed. Additionally, no trend between the differences and the means of intake was seen (Figs. 2–4). With respect to reproducibility, Cronbach α index values, which measure reliability between different components, were above the acceptable level of 0.7 to 0.8 [28] and interitem correlation coefficients were close to 1. In summary, the results showed an acceptable level of validity and reproducibility of the SQFFQ.

The present study had certain limitations that need to be considered. First, the study covered only vitamins with antioxidant properties without studying other antioxidants (manganese, copper, zinc, selenium lipoic acid, resveratrol, catechins, and other

phenolic compounds). Second, the SQFFQ included individual food products and not mixed dishes. This may have led to underreporting of certain foods (such as fats and vegetable oils) present in mixed dishes even if the dietitian asked the participants in the questionnaires (SQFFQ and 24-h dietary recall) not to omit the method of cooking in their answers.

The present study offered several strengths that are related to the validity of the SQFFQ. Because dietary habits may vary greatly from one population to another, it is generally recognized that FFQs must be validated in the population with which they will be used. The strengths of this study come along with the reference method: The 24-h dietary recall bias is not correlated with SQFFQ recall bias. Also, in a validation study such as this one, the motivation of the participants is crucial. Although the participants did not have to record their dietary intake every day for a certain period, the burden imposed by the 24-h dietary recall was still important. The accuracy of the reported intake was possibly affected. Additionally, the modalities chosen for these recalls provided a good estimate of the participants' usual intake. More frequent and comprehensive recalls would likely have resulted in lower reported intakes given the high burden on participants and may have resulted in higher dropout from the study. Moreover, all days of the week were represented. The strengths of the present study also were related to the control of potential biases related to intraindividual variability in dietary intake. Participants were advised not to change their eating habits during the study. The social desirability bias also was controlled by clearly explaining to the participants that the study was designed to assess the validity of the administered SQFFQ and not their personal eating habits. Additionally, we selected specific food items to cover antioxidant vitamins rather than usual foods consumed, so the usual bias in collection of dietary data with an FFQ was considered as the FFQ may not always represent the usual foods consumed. Moreover, for the 24-h dietary recall, a single administration is unable to account for day-to-day variation; multiple administrations should be considered

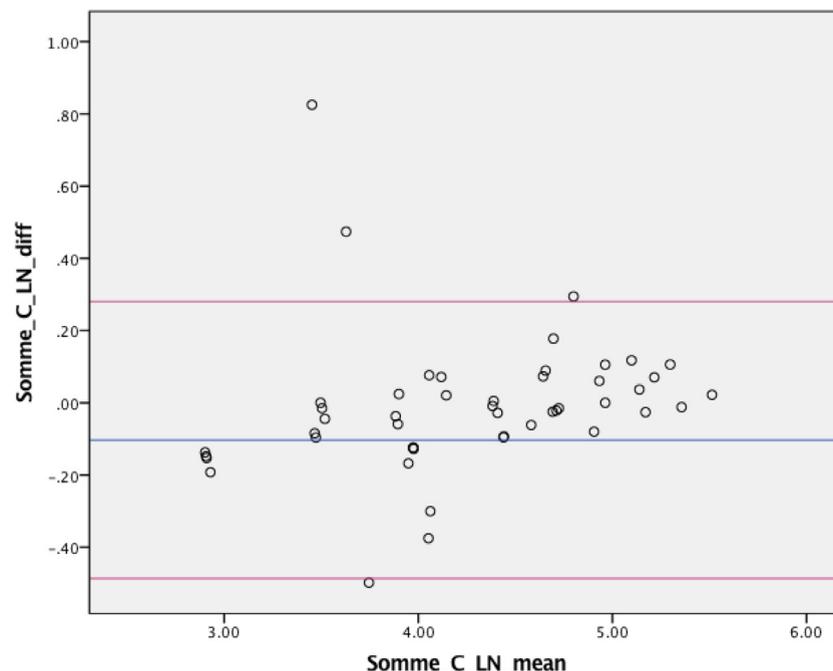


Fig. 3. Bland-Altman plot for means of vitamin C. Blue line represents the mean of the differences between the measures; pink lines represent the lower and upper limits of the confidence interval (95%).

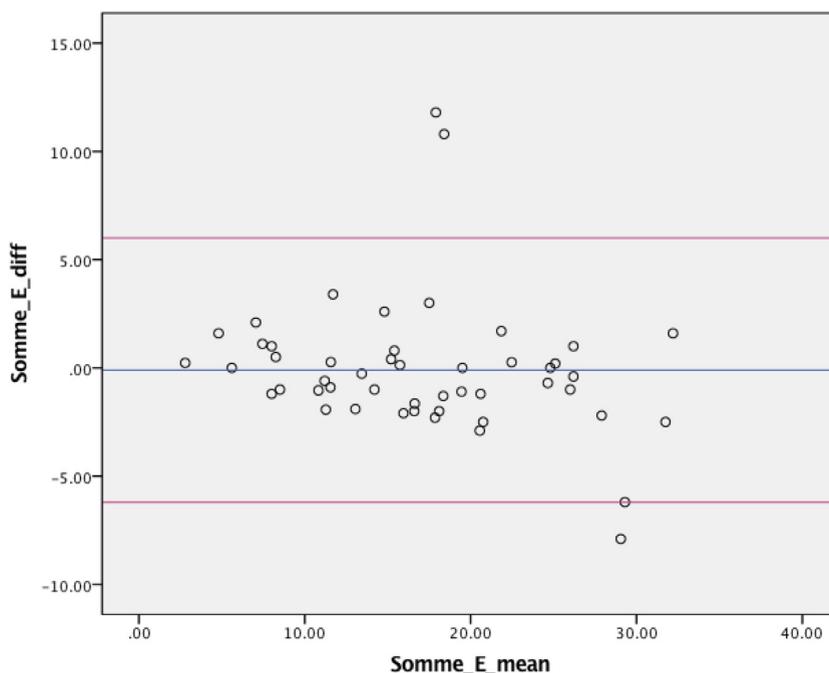


Fig. 4. Bland-Altman plot for means of vitamin E. Blue line represents the mean of the differences between the measures; pink lines represent the lower and upper limits of the confidence interval (95%).

when 24-h dietary recalls are used to examine diet variables [29]. The variability of the food choices of a group of individuals (e.g., food, brands, methods of preparation) is very broad and cannot be represented exhaustively in a frequency questionnaire and also depends on the capacity of the participant to describe his or her diet. For that reason, we performed more than one 24-h dietary recall to capture variation in intake of vitamins with antioxidant properties. Finally, for the validity assessment, the SQFFQ was completed before and after the 24-h dietary recall, which helped to control the bias related to the order of administration of the questionnaire and the reference method. Furthermore, the questionnaire can help participants estimate the correct portions consumed because it is semiquantitative, which is not often the case in the literature. Additionally, this SQFFQ covers a period of 1 y to avoid falling into the seasonal consumption bias of fruits and vegetables, especially as they are a major source of vitamins with antioxidant properties. Furthermore, only one dietitian conducted the 24-h dietary recall to avoid differences between 24-h dietary recall; the clinics covered two major cities in the country (urban and rural).

Conclusion

The recent concerns of the possible role of antioxidant vitamins in many pathologies makes the methods used to evaluate intake of these vitamins essential. This study was able to develop a useful tool for dietary evaluation of antioxidant vitamin intake. Based on the results, use of this SQFFQ is valid for assessing intake of vitamins with antioxidant properties in Lebanese adults. Its reproducibility also was well studied. To our knowledge, this study provided first-time data on the frequency of consumption of vitamins with antioxidant properties in the Lebanese population. The data from the present study can be used in future analysis to evaluate validity in different body mass index groups and to examine dietary intake and the risk for diseases among Lebanese adults. Thus, the present results should be considered exploratory, and further investigations should be undertaken.

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