

Original

Consumption of fruits and vegetables and C - reactive protein in women undergoing cosmetic surgery

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Abstract

Low-grade inflammation adversely influences metabolism and cardiovascular prognosis, nevertheless increased intake of fruits and vegetables has rarely been studied in this context.

Objective: In a prospective controlled study, the effect on C-reactive protein (CRP) levels was assessed.

Methodology: Sixty consecutive women undergoing cosmetic abdominal surgery were instructed to consume six servings each of fruits and vegetables during the first postoperative month. Detailed 24h interviewer-administered dietary recall was conducted at baseline and at the end of the study, with weekly returns to monitor unscheduled dietary changes and compliance with the protocol. Variance (ANOVA) and covariance (ANCOVA) were evaluated to confirm significance and minimize confounding variables.

Results: No differences concerning age (42.2 ± 5.3 vs 41.1 ± 6.0 years) or BMI (25.5 ± 3.1 vs 25.0 ± 3.0 kg/m²) occurred. Ingestion of fruits increased to approximately 5.2 vs 3.9 and of vegetables 5.9 vs 3.4 servings/ day, respectively. CRP decreased more conspicuously in the treated group ($P=0.028$), and correlation between vitamin C input and CRP in supplemented participants was demonstrated ($P=0.014$).

Conclusions: Higher intake of antioxidant foods was feasible, and an antiinflammatory effect occurred. Further studies with longer administration and follow-up period are recommended.

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Key words: Nutritional intervention. Fruits. Vegetables. C-Reactive Protein. Cosmetic surgery. Subclinical inflammation.

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CONSUMO DE FRUTAS Y VEGETALES, Y PROTEÍNA C-REACTIVA EN MUJERES SOMETIDAS A CIRUGIA COSMÉTICA

Resumen

Inflamación subclínica influencia adversamente el metabolismo y el pronóstico cardiovascular, pero ingestión elevada de vegetales y frutas há sido pocas veces investigada en este contexto.

Objetivo: En un estudio prospectivo y controlado, el impacto sobre la proteína C-reactiva fue determinado.

Metodología: Sesenta pacientes consecutivas sometidas a cirugía cosmética abdominal fueron instruidas a consumir seis porciones diarias de frutas y seis de vegetales, en el primero mes de postoperatorio. Un recordatorio alimentar detallado registrado por dietista fue conducido inicialmente y al cabo del estudio, con retornos semanales para monitorar adherencia y cambios eventuales de la dieta. Análisis de variância (ANOVA) y covariância (ANCOVA) fueron realizadas para evaluar resultados y minimizar variables de confusión.

Conclusiones: Un consumo mas alto de alimentos antioxidantes fue posible, y una respuesta antiinflamatoria fue documentada. Estudios adicionales com sumministrazione y seguimiento mas prolongados son recomendados.

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Palabras clave: Intervención nutricional. Frutas. Vegetales. Proteína C reactiva. Cirugía cosmética. Inflamación subclínica.

Introduction

Most strategies for a healthy diet and for management of acute and chronic diseases including cancer recommend daily consumption of five or more servings of fruits and vegetables¹⁻⁴. Although epidemiological and experimental evidence in favor of such dietary components is compelling, encompassing reduction of C-reactive protein⁵, trials with prospective food supplementation are comparatively scant, and not all of them are conclusive⁶⁻¹¹.

The present study aimed to change dietary profile of comparatively young, uncomplicated patients submitted to cosmetic surgery. The hypothesis was that if by means of additional intake of fruits and vegetables a reduction of C-reactive protein could be achieved, supplementation in more challenging proinflammatory environments could be worthwhile, including diabetes, obesity and atherosclerosis which feature persistent albeit mild increases of inflammatory biomolecules.

Methods

This was a prospective randomized partially blinded clinical study. Patients were aware of the differences in their diet, however the dietitian who performed 24h recall and the statistician didn't know the results of randomization. It targeted 60 consecutive females admitted for elective cosmetic abdominal surgery who met the following criteria: Age 25-60 years and body mass index (BMI) <30 kg/m². Exclusions encompassed sepsis, shock, tissue necrosis, organ failures, thromboembolic complications, smoking or substance addiction, metabolic diseases (diabetes mellitus, dyslipidemia, gout), cardiovascular troubles (myocardial infarction, stroke, peripheral arterial disease), postmenopausal hormone replacement, use of other food or vitamin supplements, and refusal to participate in the protocol.

Subjects were interviewed on the first postoperative day, started the diet on the third day, and were followed for four weeks afterwards. Six servings each of fruits and vegetables, reflecting a diet rich in such foodstuffs, were advised. Seven easy and convenient recipes were developed by the team with the objective of improving palatability and intake¹².

Anthropometric measurements and calculations included weight, height and BMI, documented in the morning with minimal clothing by an experienced dietitian. An interviewer-administered 24h recall questionnaire, based on the multiple-pass method, was applied at initial and final interview¹³⁻¹⁴. Two interim interviews respectively on the second and third week, were scheduled to rule out eventual changes in dietary habits, and to reinforce compliance with the regimen. Each subject was shown depictions of foods and serving sizes in order to assist in reporting meals and portions, including ingredients and preparation methods.

Once the recall was complete the interviewer read the list back aiming at forgotten items, till final confirmation. High-sensitivity CRP assay relied on an immunonephelometric method using the BN II analyzer (Dade Behring, Wilmington, Delaware, USA) (16). Statistical tests included analysis of variance (ANOVA), when necessary after logarithmic conversion, followed by Bonferroni correction, Student's t test, Hotelling T2 distribution, Pearson linear regression, and analysis of covariance (ANCOVA). Values are presented as mean \pm SEM, and $P < 0.05$ was considered significant. Calculations were done with the SPSS 14.0 statistical package (SPSS Inc., Chicago, III, USA)

Results

With the exception of four recruited participants who dropped out and were replaced (two in each group, no difference), there were no exclusions, all patients successfully finished the study and no dietetic side effects were registered. Surgical complications were limited to serous effusion and/or hematoma in the wound area, without discrepancies (9/30 *versus* 8/30, $P = 0.841$).

More substantial fruit consumption was achieved in supplemented participants (5.2 *versus* 3.9 servings, approximately 310 and 230 grams respectively), and an even larger difference, though not statistically significant ($P = 0.07$), was demonstrated for vegetables (5.9 *versus* 3.4 servings, about 350 and 200 grams respectively). BMI remained stable despite somewhat reduced intake of calories and lipids in the supplemented group. Fiber intake of controls tended to exceed that of treated subjects, although no statistical difference occurred. C reactive protein diminished in both populations, but a more expressive decrease could be demonstrated for the high fruit and vegetable participants. Final ingestion of vitamin C and beta-carotene also increased, and Vitamin C values correlated with CRP in treated patients ($r = 0.450$, $P = 0.014$) (Table I).

Current outcome is displayed in the light of other interventional as well as epidemiological protocols^{5-9,11,13,17-23} (Table II).

Discussion

There is much evidence that a diet high in fruits and vegetables is associated with reduced plasma CRP concentrations. Nevertheless, each center adopts different procedures and correlations, ranging from a complete "healthy diet" to selected items such as carotenoids or flavonoids only. In other circumstances, epidemiological approaches have been applied, with the purpose of demonstrating association between diets rich in antioxidant nutrients, and asymptomatic inflammation (Table II).

Fibers have not been identified as a factor for CRP decrease in postmenopausal women²³, nevertheless opposite results can be encountered²⁴. In the present

experience, no impact on CRP was observed for total, soluble or insoluble fiber (results not shown), only for vitamin C. Antioxidants such as ascorbic acid have been proved relevant in multiple studies, probably because of their modulatory abilities concerning NF(nuclear factor) kappa beta and other transcription factors²⁵.

However one should not overlook the meaning of ascorbic acid, at least of its plasma concentration, as an excellent biomarker of general intake of fruits, especially citric fruits, along with vegetables²⁶.

Asymptomatic microinflammation is an ubiquitous but not innocent phenomenon, as in almost all situations where it was examined, increased long-term cardiovascular damage was unveiled, including the Framingham cohort study^{27,28}.

Fruits and vegetables are attractive tools for the combat of inflammation because of their rich endowment of anti-inflammatory vitamins, trace elements, magnesium, soluble fibers, flavonoids, carotenoids and other phytochemicals. By replacing pro-inflammatory energy sources especially omega-6 fatty acids, and improving omega 6/omega 3 ratio, they could further pursue this objective²⁷⁻³⁰.

Dietary adherence cannot be overemphasized, and in this regard previous selection of the population and the incentive represented by scheduled interviews was rewarding. The six targeted servings/day for the two food categories were met for vegetables, and very nearly for fruits as well (Table I). That represented a hefty 310g of fruits and 350g of vegetables.

Table I
Dietary, nutritional and biochemical outcome

Variable	Time	Experimental	Control	Between groups	P#	
					Initial	Final
CRP (mg/dl)	Initial	4.5±4.4	4.2±4.5	0.57	0.00*	
	Final	0.2±0.1**	0.4±0.5			
Age (years)		41.1 ± 6.0	42.2 ± 5.3	0.67		
BMI (kg/m ²)	Initial	25.5±3.1	25.0±3.0	0.19	0.85	
	Final	24.6±2.6	24.7±2.7			
Fruits (Servings)	Initial	3.7±2.7	2.9±4.6	0.01*	0.01*	
	Final	5.2±2.9	3.9±3.1			
Vegetables (Servings)	Initial	4.2±4.1	2.6±1.6	0.03*	0.07	
	Final	5.9±8.3	3.4±2.1			
Calories (Kcal)	Initial	2020.9±665.9	2069.6±1034.5	0.66	0.01*	
	Final	1621.0±528.2	1751.8±494.4			
Carbohydrates (g)	Initial	278.3±93.6	230.3±99.8	0.30	0.98	
	Final	248.0±83.6	261.5±84.6			
Proteins (g)	Initial	95.0±42.2	93.7±38.3	0.97	0.84	
	Final	91.4±32.4	91.2±28.4			
Lipids (g)	Initial	55.8±27.1	60.1±34.4	0.20	0.31	
	Final	49.3±29.6	58.8±36.0			
Total fibers (g)	Initial	17.4±8.6	16.8±11.4	0.77	0.06	
	Final	18.6±7.7	20.6±11.9			
Soluble fibers (g)	Initial	4.7±2.5	5.0±4.3	0.96	0.26	
	Final	5.2±2.8	5.6±3.3			
Insoluble fibers (g)	Initial	6.9±4.2	6.6±5.5	0.61	0.26	
	Final	7.1±4.1	7.5±4.6			
Vitamin C (mg)	Initial	144.1±114.5	197.1±284.1	0.97	0.05	
	Final	212.5±137.4**	189.2±247.8			
Vitamin E (mg)	Initial	9.6±5.0	10.7±7.4	0.50	0.38	
	Final	10.3±5.6	11.4±7.6			
Beta-carotene (mcg)	Initial	3054± 3467	1915± 1898	0.06	0.21	
	Final	4072± 4049***	1897± 2099			
Zinc (mg)	Initial	12.3±11.1	9.3±5.7	0.22	0.63	
	Final	10.2±5.3	11.1±7.1			
Selenium (mcg)	Initial	2.2±10.8	3.7±12.1	0.13	0.55	
	Final	0.2±0.2	2.5±7.8			

Obs: Data were analyzed by the Brazilian DietWin Nutritional Analysis software, encompassing both national and international food databanks TACO, IBGE, TBCA- USP, USDA, CENEXA, German, and General Table of Foods [18].

No interactions for significant results observed with ANCOVA;

Initial findings were different for Vegetables (P=0.01) and Fruits (P=0.03) (Student's t test);

*Significant, two-way ANOVA with Bonferroni correction;

** P<=0.028, Student's t-test;

*** P=0.023, Student's t-test;

This heavy load was conceived in the light of a rapid response within a difficult setting, namely of recently operated patients. For longer supplementation and more stable cohorts, probably smaller amounts will be appropriate.

The principal advantage of employing fruits and vegetables is that synergism of multiple components might conduct to optimal clinical response, in contrast to single vitamins or antioxidants. Their safety and tolerability record is of course outstanding, and depending on the country they could also be more available and inexpensive than industrialized supplements.

These early findings should be expanded to longer periods of supplementation and follow-up, especially involving high-risk groups suffering from diabetes, atherosclerosis and other microinflammatory diseases.

Conclusions

On the basis of this study, increased fruit and vegetable intake can be recommended as a feasible strategy for reducing moderately elevated C-reactive protein in adults. With the help of convenient recipes, good compliance and an improved antiinflammatory profile were reached. Future studies should focus additional inflammatory markers, different disease contexts, and longer administration periods.

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Conflict of interest statement

This study received no financial Grant, and the authors have no conflict of interest to declare.

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Table II
Recently published results

Population	Supplement	CRP
60 postoperative females (Current study)	6 servings/day fruits and vegetables (28 days)	Significant decrease
20 non-obese male smokers [17]	Single fruit (Camu-camu) (7 days)	Significant decrease
48 adults peripheral arterial disease [18]	Fruit juice (7 days)	11% decrease
33 healthy adults [19]	High antioxidant diet (14 days)	Significant decrease
24 healthy adults [20]	Tomato juice (14 days)	Significant decrease
24 healthy adults [13]	8 servings /day fruits and vegetables (56 days)	Significant decrease
119 Filipino schoolchildren [11]	High-vegetable diet (63 days)	No change
15 healthy adults [7]	Grapes and raisins (28 days)	No change
7208 adult Japanese [6]	vegetables, fruit, soy products, fish *	Significant association
8335 US adults [8]	Dietary flavonoids *	Significant association
4077 Australian adults [9]	Dietary fruits, potatoes etc *	Significant association
974 Dutch adults [21]	Dairy and fruit intake *	Significant association
2895 postmenopausal women [22]	Dietary carotenoids *	Significant association
88,517 female nurses [5]	DASH style diet *	Significant association
1958 postmenopausal women [23]	Dietary fiber *	No association

(*) Epidemiological study

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