

Letter to the Editor

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Chocolate Consumption and Incidence of Hypertension

To the Editor:

Results from the well-conducted randomized trial by Grassi et al¹ underline the positive effect of flavanols on blood pressure and endothelial function. However, this study and others² fail to answer the important questions about the effect of cocoa consumption in a free-living population consuming standard commercial chocolate products. To address this issue, we evaluated the association between chocolate consumption and incidence of hypertension in the Seguimiento Universidad de Navarra Study, a dynamic cohort of university graduates recruited and followed-up biennially through mailed questionnaires.³ The enrollment of participants is permanently open. In this analysis, we have included participants recruited from December 1999 to January 2002. Diet was assessed with a semiquantitative food frequency questionnaire (136 items) validated previously in Spain.⁴ New cases of medically diagnosed hypertension were reported in the 2-year follow-up questionnaire. Participants with cardiovascular disease, cancer, diabetes or hypertension at baseline, and those with missing values in covariates were excluded. Finally, 5880 participants (mean age: 35.8 years, 61.3% female) from the 6686 eligible answered the 2-year follow-up questionnaire (88% retention in the cohort). After 13 526 person-years of follow-up, we identified 180 new cases of hypertension. Overall, chocolate consumption was not associated with the risk of hypertension (Table 1). Adjustment for other dietary variables presumably related to blood pressure levels did not appreciably change the results.

These results can be partly explained by random error in dietary assessment, resulting in a lack of association. Misclassification in the outcome ascertainment and the presence of unmeasured confounding could bias our results as well. Nonetheless, both diet and self-reported hypertension diagnosed have been validated,^{4,5} and our analyses have been adjusted for potential nondietary and dietary confounders.

Differences between the results of short-term trials and our observational study can be explained by several factors. Feeding trials usually use pure dark chocolate, rich in flavanols, whereas the chocolate consumed by the general population has relatively low quantities of cocoa and even lower levels of flavanols. Additionally, individuals do not consume chocolate in isolation, but in a dietary pattern characterized by frequent snacking and high-energy foods that can foster the development of obesity and,

consequently, may counteract any beneficial effect of dark chocolate on blood pressure. In fact, chocolate consumption was associated with snacking (as a dichotomous variable) in our study population ($P < 0.001$ for the lineal trend between chocolate consumption and the habit of between-meal snacking, adjusted for age and sex).

Therefore, to avoid confusion among the general public, caution is needed when sending messages to the general population about this issue. This is especially true when apparent conflicting information can reach the public, creating confusion and, in the end, distrust in sound nutrition research.

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Rate Ratios (95% CIs) of Hypertension by Quintiles of Chocolate Consumption in 5880 Participants in the Seguimiento Universidad de Navarra Cohort

Variable	Quintiles of Chocolate Consumption					P for Trend
	Q1	Q2	Q3	Q4	Q5	
Energy adjusted median consumption (g/day)	0	2	4	6	18	
Incident cases of HT	38	23	36	48	35	
Person-years	2693.3	2719.9	2698.5	2700.3	2714.1	
Age- and sex-adjusted RR	1 (ref.)	0.6 (0.4 to 1.0)	1.0 (0.6 to 1.5)	1.4 (0.9 to 2.2)	1.1 (0.7 to 1.7)	0.25
Multivariate RR*	1 (ref.)	0.6 (0.4 to 1.1)	0.9 (0.5 to 1.5)	1.4 (0.9 to 2.4)	1.1 (0.7 to 1.8)	0.25

Q1 to Q5: successive quintiles of chocolate consumption. HT, hypertension; RR, rate ratios.

*Model-adjusted for age (continuous variable), sex, body mass index (lineal and quadratic term), physical activity (4 categories), alcohol consumption (5 categories), sodium intake (5 categories), total energy intake (continuous variable), smoking (never smokers, former smokers, current smokers), hypercholesterolemia (yes/no), and low-fat dairy consumption (quintiles).

1. Grassi D, Necozione S, Lippi C, Croce G, Valeri L, Pasqualetti P, Desideri G, Blumberg JB, Ferri C. Cocoa reduces blood pressure and insulin resistance and improves endothelium-dependent vasodilation in hypertensives. *Hypertension*. 2005;46:398–405.
2. Grassi D, Lippi C, Necozione S, Desideri G, Ferri C. Short-term administration of dark chocolate is followed by a significant increase in insulin sensitivity and a decrease in blood pressure in healthy persons. *Am J Clin Nutr*. 2005;81:611–614.
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Response:

We welcome the comments by Alonso et al and appreciate their new results from the Seguimiento Universidad de Navarra (SUN) Study. Special care is always necessary when comparing results between observational studies and randomized clinical trials. It is important to note that our study¹ was a controlled dietary intervention in volunteers with essential hypertension and not an examination of the relationship between all chocolate consumption and the incidence of elevated blood pressure in a general population. For example, our patients presented with untreated grade 1 essential hypertension absent other cardiovascular risk factors and comorbidities and, thus, were not comparable to the general population of the SUN cohort. Furthermore, all of our subjects were specifically instructed to reduce their calorie intake during the periods of dark and white chocolate consumption so that no change in weight occurred. Our discussion also emphasized that the dark chocolate used in our trial, although commercially available, differs from the majority of flavonol-poor cocoa-derived products on the market.² These differences may contribute to the apparent lack of agreement between our trial and the relationship between chocolate consumption and the incidence of hypertension observed in the SUN study.

We find it useful to place our study in the context of other reports. For example, Taubert et al³ observed a 5.2 ± 2.4 mm Hg decrease in systolic blood pressure in elderly hypertensive subjects after 15 days of dark chocolate ingestion. Fraga et al⁴ found a 5 mm Hg reduction in mean blood pressure in young normotensive subjects consuming a flavonoid-rich chocolate for 14 days. Although longer-term studies have not been performed, it is interesting to note the native Kuna of Panama habitually consume cocoa and present with low blood pressure and are

absent age-related increases in blood pressure.⁵ From observations in French women followed for 8 years, Mennen et al⁶ found those with the lowest systolic blood pressure and risk for cardiovascular disease in the highest tertile of flavonoid intake with this consumption attributed substantially to tea and chocolate.

Anticipating popular interest in our trial, we specifically cautioned about considering recommendations of energy-dense foods like dark chocolate for patients with cardiovascular disease and were careful to avoid conclusions that might confuse a general audience. We noted the small sample size and short duration of our study, suggested only that a reasonable consumption of dark chocolate might prove to be part of a healthful diet for hypertensive patients, and stated that future investigations in the area were warranted.

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