Letter to the Editor

Chocolate Consumption and Incidence of Hypertension

To the Editor:

Results from the well-conducted randomized trial by Grassi et al. underline the positive effect of flavanols on blood pressure and endothelial function. However, this study and others 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. 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. 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, 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.

Alvaro Alonso
Department of Preventive Medicine and Public Health
School of Medicine
University of Navarra
Pamplona, Spain

and
Department of Epidemiology
Harvard School of Public Health
Boston, MA

Carmen de la Fuente
Juan José Beunza
Department of Preventive Medicine and Public Health
School of Medicine
University of Navarra
Pamplona, Spain

Almudena Sánchez-Villegas
Department of Preventive Medicine and Public Health
School of Medicine
University of Navarra
Pamplona, Spain

and
Department of Clinical Sciences
University of Las Palmas de Gran Canaria
Las Palmas de Gran Canaria, Spain

Miguel Ángel Martínez-González
Department of Preventive Medicine and Public Health
School of Medicine
University of Navarra
Pamplona, Spain

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

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

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).
Consume cocoa and present with low blood pressure and it is interesting to note the native Kuna of Panama habitually consume cocoa and present with low blood pressure and are normotensive subjects consuming a flavonoid-rich chocolate for 14 days. Although longer-term studies have not been performed, 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 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.

**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 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.

**Davide Grassi**

Department of Internal Medicine and Public Health
University of L’Aquila
L’Aquila, Italy

**Jeffrey B. Blumberg**

Jean Mayer US Department of Agriculture Human Nutrition Research Center on Aging Tufts University
Boston, Massachusetts

**Claudio Ferri**

Department of Internal Medicine and Public Health University of L’Aquila
L’Aquila, Italy
Chocolate Consumption and Incidence of Hypertension
Alvaro Alonso, Carmen de la Fuente, Juan José Beunza, Almudena Sánchez-Villegas, Miguel Ángel Martínez-González, Alvaro Alonso and Almudena Sánchez-Villegas

Hypertension. 2005;46:e21-e22; originally published online November 14, 2005;
doi: 10.1161/01.HYP.0000190583.88379.69

Hypertension is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2005 American Heart Association, Inc. All rights reserved.
Print ISSN: 0194-911X. Online ISSN: 1524-4563

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://hyper.ahajournals.org/content/46/6/e21

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Hypertension can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Hypertension is online at:
http://hyper.ahajournals.org//subscriptions/