Milk Consumption, Calcium Intake, and Decreased Hypertension in Puerto Rico
Puerto Rico Heart Health Program Study

MARIO R. GARCIA-PALMIERI, M.D., RAUL COSTAS, JR., M.D.,
MERCEDES CRUZ-VIDAL, M.D., PAUL D. SORLIE, M.S., JEANNE TILLOTSON, M.A.,
AND RICHARD J. HAVLIK, M.D.

SUMMARY The baseline observations in the Puerto Rico Heart Health Program during 1965-1968 involved blood pressure determinations, other measurements, and a 24-hour dietary recall in 7932 men aged 45-64 years. This extensive data base provided an opportunity to test the hypothesis that low calcium intake is related to increased blood pressure level. Among men without baseline coronary heart disease and not taking antihypertensive medication, there was an inverse relationship between milk consumption and definite hypertension in urban Puerto Rican men and older rural men. When data from all age and area groups had been averaged, a twofold increase in hypertension was found in subgroups who drank no milk compared to those who consumed over 1 quart of milk a day. Similar trends were found when an estimate of total calcium intake from food, principally from milk, was used. With multivariate analysis while known correlates of blood pressure were simultaneously considered, an independent effect persisted between milk consumption and blood pressure. These results appeared to confirm an inverse association between calcium and hypertension. It was still not possible to ascribe a causal relationship between calcium and blood pressure, however, due to the intricate network of covarying food intakes, the factors related to absorption or lack of absorption of calcium, and the possible role that unmeasured social and cultural factors may play in the observed relations. (Hypertension 6: 322-328, 1984)

KEY WORDS • epidemiology • nutrition • blood pressure

RECENT reports have suggested that hypertensive individuals consume less calcium in their diets, especially in the form of cheese, and have lower ionized serum calcium levels when compared to control subjects. Consistent with such findings is the observation that certain countries with diets traditionally high in calcium have a low incidence of hypertension with pregnancy. In addition, among a cohort of 8000 Japanese-American men in Hawaii, milk intake was inversely associated with high systolic and diastolic blood pressure. Analysis of dietary calcium intake and blood pressure in the first National Health and Nutrition Examination Survey revealed a significant inverse correlation, but this correlation was of a low order of magnitude. A separate investigation of the same data set found no relationship between blood pressure and intake of dairy food, and a positive relationship between total serum calcium and high blood pressure. Another inconsistent report in Belgium Army personnel involved a positive relationship between 24-hour urinary calcium, total serum calcium, and blood pressure. In a clinically ill patient, a relationship has been reported between hypercalcemia and hypertension, with reversibility of hypertension on lowering of calcium. Because of the availability of extensive dietary and cardiovascular information on a large population of urban and rural Puerto Rican men, it was possible to test the reported hypothesis that dairy products or dietary calcium potentially may have a relationship to hypertension.
Methods

Population and Baseline Characteristics

The Puerto Rico Heart Health Program examined men from four rural and three urban areas during the years 1965–1968. Rural areas were defined as enumeration districts containing fewer than 25 dwelling units in a cluster, and urban areas as enumeration districts with 25 or more dwelling units in a cluster. A house-to-house census of these enumeration districts was made by the personnel who regularly conducted the decennial census. All men between 45 and 64 years of age were invited to participate in the study, and their ages were verified at the time of the initial visit. The response rate was 79.9% in the urban and 82.4% in the rural areas, so that the proportion of urban/rural population in the study was approximately the same as in the general population. No other method of selection was used. Thus, the study population consisted of men aged 45 to 64 years at baseline who were initially free of coronary heart disease and not taking any antihypertensive medication. The first blood pressure measurements were made by a physician with the patient seated; diastolic pressure was designated by the Phase V Korotkoff sound. Normal blood pressure was defined as a systolic level lower than 140 mm Hg and a diastolic level lower than 90 mm Hg. Hypertension was defined as a systolic blood pressure over 160 mm Hg and a diastolic pressure over 95 mm Hg. All other combinations of values were considered borderline. After requiring subjects to successfully complete a 24-hour diet recall, the study had a final population of 7932 men, 30% of whom were from the rural area. Relative weight was determined as a ratio of the observed weight at baseline to a standard weight for height from the Metropolitan Life Insurance tables. Education level was determined by highest grade completed in school and analyzed by grouping into six categories. Standard methodology for the 24-hour recall was utilized. Most interviews were done during one of the regular 5 work days, so that most diet information referred to Sundays through Thursdays. However, some interviews were performed on Saturdays, so there was information on Friday diets as well. No interviews were done on Sundays. In all cases, the day of the week for which the data were taken was identified as Monday-through-Thursday, Friday, Sunday, or holiday. It was necessary to devise a relatively simple system for dietary data collection and computation that could be administered equally to rural and urban men of varying degrees of sophistication and that also could be processed easily using local resources. For this reason, most "basic" foods (milk, cheese, eggs, meat, and so forth) reported eaten during the 24-hour recall interview were tallied for entry into the computer in terms of standard portions; nutrient intake from these items was determined by computation using a nutrient data base appropriate to the area. Mixed dishes (involving recipe calculation) and less frequently eaten basic foods were hand-calculated by the dietitian-interviewers, and nutrients consumed from these sources were entered into the system in order to obtain each subject's total 24-hour nutrient intake. Subjects on special diets were not excluded from analysis.

Because of the current interest in calcium-containing foods, the original food composition table was supplemented for this investigation by the addition of dietary calcium values based on standard American and Latin American reference sources. This allowed an estimate of daily calcium intake to be made for each study participant. While it was possible to add calcium figures for the basic commonly eaten foods to the original nutrient data base retrospectively, it was not possible to estimate dietary calcium intake from the recipe items eaten. Although approximately 40% of the diet recalls included foods from recipe sources, the amount of extra food from the sources was small. On the average, only 10% of the total kilocalories consumed were from recipe foods. Thus, for this report, calcium intake from these foods was omitted.

Statistical Methods

Stratification by age and area of residence was maintained during analysis. Relationships between blood pressure and baseline characteristics were estimated by product moment correlation coefficients and multiple linear regression analysis. The statistical analysis system (SAS) was used to calculate these statistics.

Results

The average daily intake of milk for both urban and rural subjects was about 16 oz per day (Table 1). Milk was most frequently taken with coffee (a usual proportion would be 1 oz of Puerto Rican coffee to 2 oz of evaporated milk, equivalent to 4 oz of whole milk). Relatively small intakes of other dairy products such as

<table>
<thead>
<tr>
<th>Table 1. Prevalence Rates of Hypertension by Quantity of Milk Consumed by Puerto Rican Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural men</td>
</tr>
<tr>
<td>45–54 yrs</td>
</tr>
<tr>
<td>Milk consumption: 24-hour recall</td>
</tr>
<tr>
<td>Rate (%)</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>4 or 8 oz</td>
</tr>
<tr>
<td>12 or 16 oz</td>
</tr>
<tr>
<td>20 or 24 oz</td>
</tr>
<tr>
<td>28 or 32 oz</td>
</tr>
<tr>
<td>&gt;32 oz</td>
</tr>
<tr>
<td>Population number</td>
</tr>
<tr>
<td>Average consumption (oz/day)</td>
</tr>
</tbody>
</table>

Data from Examination 1, Puerto Rico Heart Health Program, of men free of coronary heart disease and not taking antihypertensive medication. Milk consumption was recorded in 4 oz units/day.
cheese and ice cream were reported, with the lowest intakes reported by rural men. The average calcium intake from whole or evaporated milk was 587 mg for rural and 573 mg for urban men, with the next largest nondairy calcium source being legumes.

Individuals who consumed more milk had a lower prevalence of hypertension than those who consumed less milk. This relationship was observed in all area and age groups except in the younger rural group (Table 1). The relationship was strongest in urban men aged 45 to 54 years, where 20% of those who consumed no milk were hypertensive and only 4% of those who consumed more than four glasses a day were hypertensive.

The relationship between milk consumption and systolic blood pressure can be expressed as a correlation coefficient (Table 2). The magnitude of this correlation ranged from —0.05 to —0.12, depending on age and geographic area. Correlations with diastolic blood pressure were similar. Milk consumption was highly correlated with total protein, fats, and carbohydrates, largely because milk contributed to the overall levels of these nutrients. Milk consumption was also positively correlated with coffee drinking since coffee was usually drunk with milk, and inversely correlated with alcohol use. There was a small positive association of milk use with higher education and the greater number of cigarettes smoked. Correlations between systolic blood pressure and these variables were generally weak except for the known associations of blood glucose, relative weight, and heart rate.

To correct simultaneously for interrelationships among milk, other variables, and blood pressure, multivariate regression analysis was used (Table 3). A significant inverse relationship between milk consumption and systolic blood pressure persisted in three of the four subgroups. By using the unstandardized regression coefficients, it was possible, for example, to estimate that an increment of 16 oz of milk would theoretically be equivalent to a 2 mm Hg decrease in systolic blood pressure.

The results of the multiple linear regression model in Table 3 show the inability of measured characteristics

### Table 2. Correlation Coefficients between Milk Consumption and Other Specified Characteristics for a Population Free of CHD, Not on Antihypertensive Medications, and with Known Values of All Measurements at Examination 1; The Puerto Rico Heart Health Program

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Rural men</th>
<th>Urban men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45–54 yrs</td>
<td>55–64 yrs</td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>-0.05</td>
<td>-0.12</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>-0.02</td>
<td>-0.12</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>0.39</td>
<td>0.37</td>
</tr>
<tr>
<td>Fats (g)</td>
<td>0.36</td>
<td>0.29</td>
</tr>
<tr>
<td>Carbohydrates (g)</td>
<td>0.31</td>
<td>0.27</td>
</tr>
<tr>
<td>Coffee (g)</td>
<td>0.14</td>
<td>0.23</td>
</tr>
<tr>
<td>Alcohol (g)</td>
<td>-0.11</td>
<td>-0.14</td>
</tr>
<tr>
<td>Education (levels)</td>
<td>0.13</td>
<td>0.04</td>
</tr>
<tr>
<td>Blood glucose (mg/dl)</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Relative weight (%)</td>
<td>0.03</td>
<td>-0.08</td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>0.00</td>
<td>-0.03</td>
</tr>
<tr>
<td>Cigarettes smoked (no./day)</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Population number</td>
<td>1209</td>
<td>1133</td>
</tr>
</tbody>
</table>

Minimum correlation statistically significant at $p < 0.05$ ±0.06 ±0.06 ±0.04 ±0.05

Data from Examination 1, Puerto Rico Heart Health Program, of men free of coronary heart disease and not taking antihypertensive medication. Milk consumption was recorded in 4 oz units/day. 

### Table 3. Multivariate Regression Coefficients of Systolic Blood Pressure (mm Hg) on Specific Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rural men</th>
<th>Urban men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45–54 yrs</td>
<td>55–64 yrs</td>
</tr>
<tr>
<td>Milk consumption (4 oz units/day)</td>
<td>-0.350</td>
<td>-0.522*</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>0.015</td>
<td>0.012</td>
</tr>
<tr>
<td>Fats (g)</td>
<td>-0.019</td>
<td>0.019</td>
</tr>
<tr>
<td>Carbohydrates (g)</td>
<td>-0.002</td>
<td>-0.009</td>
</tr>
<tr>
<td>Coffee (g)</td>
<td>-0.311</td>
<td>-0.581</td>
</tr>
<tr>
<td>Alcohol (g)</td>
<td>0.018</td>
<td>0.028</td>
</tr>
<tr>
<td>Education (levels)</td>
<td>0.003</td>
<td>0.200</td>
</tr>
<tr>
<td>Blood glucose (mg/dl)</td>
<td>0.096†</td>
<td>0.087†</td>
</tr>
<tr>
<td>Relative weight (%)</td>
<td>0.282†</td>
<td>0.310†</td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>0.314†</td>
<td>0.387†</td>
</tr>
<tr>
<td>Cigarettes smoked (no./day)</td>
<td>-0.005</td>
<td>-0.066</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>0.532†</td>
<td>0.704†</td>
</tr>
<tr>
<td>($R^2$)</td>
<td>(0.157)</td>
<td>(0.136)</td>
</tr>
</tbody>
</table>

* $p < 0.05$.
† $p < 0.01$. 

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TABLE 4. Comparison of Standardized Multiple Regression Coefficients of Milk in Models Containing Systolic and Diastolic Blood Pressure Measurements

<table>
<thead>
<tr>
<th>Age group (yrs)</th>
<th>Rural men</th>
<th>Urban men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Std coeff of milk</td>
<td>t</td>
</tr>
<tr>
<td>45-54 SBP</td>
<td>-0.0200</td>
<td>-1.66</td>
</tr>
<tr>
<td>55-64 SBP</td>
<td>-0.0247</td>
<td>-2.05</td>
</tr>
<tr>
<td>45-54 DBP</td>
<td>-0.0038</td>
<td>-0.31</td>
</tr>
<tr>
<td>55-64 DBP</td>
<td>-0.0200</td>
<td>-1.66</td>
</tr>
</tbody>
</table>

*SBP model: systolic blood pressure (dependent variable); milk, protein, fats, carbohydrates, coffee, alcohol, education, blood glucose, relative weight, heart rates, cigarettes smoked, age (independent variables). DBP model: diastolic blood pressure (dependent variable); same independent variables as above.
†Coefficient of milk standardized by dividing by standard deviation of SBP or DBP.

The results of the regression analysis were nearly the same when diastolic blood pressure was used in the model. The results are compared in Table 4 where the regression coefficient for milk has been standardized so that its magnitude is roughly comparable in the models with systolic and diastolic blood pressure. The magnitude of the effect of milk on diastolic blood pressure was slightly less than on systolic blood pressure, and in the older age group it did not reach statistical significance.

The possible effect of coffee use as a confounder was more carefully investigated. The relationship between coffee and milk consumption, as measured by a correlation coefficient of about 0.2, could have been an important confounding factor since coffee has an inverse relationship with blood pressure (Table 3). There was, however, a considerable range of milk use at each level of coffee consumption. The prevalence rates of hypertension by increasing milk use were stratified by coffee consumption (Table 5). When we controlled for coffee consumption by stratifying according to ounces of coffee consumed, we found a decreasing prevalence of hypertension with increasing milk use. Thus, the results are consistent with those from the multivariate analysis. A similar analysis stratifying by alcohol consumption showed an inverse association between systolic blood pressure and milk in both drinkers and teetotalers (Table 5).

To investigate a possible confounding or interactive effect of weight, prevalence rates of hypertension by milk levels were calculated in the leaner group (relative weight less than 110) and in the heavier group (greater than 110). A relative weight index of 100 means a weight equivalent to the ideal weight stan-

TABLE 5. Age-Adjusted Prevalence of Hypertension by Milk Consumption and Alcohol Use, Coffee Use, and Relative Weight

<table>
<thead>
<tr>
<th>Milk consumption</th>
<th>Alcohol use</th>
<th>Coffee use</th>
<th>Relative weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td>0-3 oz</td>
</tr>
<tr>
<td>Rural men</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>10.0</td>
<td>9.6</td>
<td>8.2</td>
</tr>
<tr>
<td>4 or 8 oz</td>
<td>11.3</td>
<td>9.9</td>
<td>11.5</td>
</tr>
<tr>
<td>12 or 16 oz</td>
<td>7.7</td>
<td>12.7</td>
<td>11.2</td>
</tr>
<tr>
<td>20 or 24 oz</td>
<td>6.9</td>
<td>8.6</td>
<td>8.0</td>
</tr>
<tr>
<td>28 or more oz</td>
<td>8.3</td>
<td>10.8</td>
<td>8.7</td>
</tr>
<tr>
<td>Total</td>
<td>8.6</td>
<td>10.6</td>
<td>10.0</td>
</tr>
<tr>
<td>No. with known values</td>
<td>1883</td>
<td>483</td>
<td>1456</td>
</tr>
</tbody>
</table>

| Urban men        |    |    |        |       |      |      |
| None             | 22.9 | 22.0 | 23.9 | 19.9 | 19.4 | 25.6 |
| 4 or 8 oz        | 16.7 | 19.8 | 18.6 | 12.3 | 11.9 | 20.9 |
| 12 or 16 oz      | 12.9 | 18.7 | 14.9 | 11.6 | 10.0 | 16.5 |
| 20 or 24 oz      | 12.0 | 13.1 | 12.1 | 12.2 | 6.1 | 16.1 |
| 28 or more oz    | 10.0 | 13.6 | 11.4 | 9.4 | 8.0 | 12.3 |
| Total            | 13.6 | 17.8 | 15.7 | 11.7 | 10.0 | 17.5 |
| No. with known values | 4127 | 1439 | 4099 | 1463 | 2060 | 3502 |
standards published by the Metropolitan Life Insurance Company in 1959. An inverse trend was seen in the urban area for both relative weight groups, which was also suggested in the leaner rural group (Table 5).

While milk contributes several unique factors to the diet, such as lactose, tryptophan, and riboflavin, it is also the main contributor of calcium. Milk provides slightly more than 60% of all calcium intake, with peas and beans contributing the next largest percentage (around 10%). However, when the amount of calcium of the specified food groups was correlated with systolic blood pressure, calcium from milk showed the largest correlation.

An alternative method of displaying the results is to present mean values of calcium intake by classes of hypertensive, borderline, and normal. Figure 1 shows that the mean intakes of calcium from nondairy sources were nearly identical for all of the blood pressure groups for each age and area. There was also little difference in the mean values of calcium from dairy sources other than milk, such as cheese and ice cream. The mean value of calcium from milk was less in the hypertensive individuals.

A further possible confounder in this analysis is that the urban population was approximately 15% black. The ethnic classification of black or white in this study was based on skin color determination, and thus the groups were subsequently described as dark- or light-skinned. In Puerto Rico, the dark-skinned population has slightly higher blood pressure and generally a greater degree of lactose intolerance. When our analysis of the urban area was stratified by skin color, the correlation between blood pressure and milk consumption was stronger in dark-skinned than light-skinned individuals (Table 6). Also, the multiple regression

![Figure 1](http://hyper.ahajournals.org/)

**Table 6. Prevalence of Hypertension by Milk Consumption: Correlation and Regression of Milk Consumption and Blood Pressure in Those with Light and Dark Skin, Urban Area Only**

<table>
<thead>
<tr>
<th>Milk consumption</th>
<th>45-54 yrs</th>
<th>55-64 yrs</th>
<th>Hypertension prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>18.0</td>
<td>27.1</td>
<td>25.0</td>
</tr>
<tr>
<td>4 or 8 oz</td>
<td>13.9</td>
<td>18.0</td>
<td>21.6</td>
</tr>
<tr>
<td>12 or 16 oz</td>
<td>9.4</td>
<td>14.6</td>
<td>12.9</td>
</tr>
<tr>
<td>20 or 24 oz</td>
<td>8.8</td>
<td>14.4</td>
<td>8.6</td>
</tr>
<tr>
<td>28 or 32 oz</td>
<td>8.8</td>
<td>14.9</td>
<td>9.5</td>
</tr>
<tr>
<td>&gt;32 oz</td>
<td>3.1</td>
<td>12.4</td>
<td>16.7</td>
</tr>
<tr>
<td>Total</td>
<td>10.4</td>
<td>15.9</td>
<td>16.0</td>
</tr>
</tbody>
</table>

Correlation of milk with

<table>
<thead>
<tr>
<th></th>
<th>Light skinned</th>
<th>Dark skinned</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td>-0.12</td>
<td>-0.07</td>
</tr>
<tr>
<td>DBP</td>
<td>-0.13</td>
<td>-0.05</td>
</tr>
</tbody>
</table>

Multiple regression

<table>
<thead>
<tr>
<th></th>
<th>Light skinned</th>
<th>Dark skinned</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP model b</td>
<td>-0.033</td>
<td>-0.001</td>
</tr>
<tr>
<td>t</td>
<td>-3.55</td>
<td>-2.15</td>
</tr>
<tr>
<td>DBP model b</td>
<td>-0.030</td>
<td>0.006</td>
</tr>
<tr>
<td>t</td>
<td>-3.28</td>
<td>0.49</td>
</tr>
</tbody>
</table>

*Standardized by dividing by the standard deviation of SBP or DBP.
coefficients for milk were larger in dark-skinned than light-skinned Puerto Ricans. An inconsistent finding in Table 6 is that the multiple regression coefficient in urban light-skinned men aged 55 to 64 years was not statistically significant, although for those aged 45 to 54 years it was strongly significant.

Discussion

The average daily intake of milk of 16 oz per day reported in our study is comparable to that reported by Fernandez and coworkers\textsuperscript{15} from an island wide nutrition survey carried out in 1966 on a representative sample of the entire Puerto Rico population. In that survey rural adults reported consuming an average of 1.8 cups of milk per day and urban averages averaged 2.2 cups per day, usually with coffee.

Although Puerto Rico has a coronary heart disease rate approximately half that of the U.S. mainland, hypertension is prevalent and is the most important predictor of subsequent cardiovascular disease.\textsuperscript{16} Thus, the identification of potential additional blood pressure correlates has public health implications for this population. The Puerto Rico Heart Health Program has collected an extensive data set on a large group of middle-aged Puerto Rican men. Because of the availability of these 24-hour diet recall data collected in a standardized manner, it was possible to explore, by other methodology, the conclusion in a case-control study report of an inverse relationship between dietary calcium and hypertension.

The initial analysis of the data, using correlation coefficients, suggested a modest inverse association of milk consumption and blood pressure. From this investigation we cannot be certain if this weak association indicates a true relationship or merely a poorly measured one. The latter situation is possible since it is unlikely that a single 24-hour diet recall is adequate to characterize an individual’s usual intake of dairy products or calcium. Unfortunately, multiple 24-hour recall data on the same individual, which would give a better estimate of usual intake, are not available in this population.

Further analyses indicated that those drinking no milk had twice the prevalence of hypertension as those who drank a quart or more per day. An intensive search for confounding variables among nutritional and non-nutritional factors was attempted, but with multivariate analysis the relationship persisted in three of four age/area subgroups. Possible confounding with coffee and alcohol was explored. The same inverse relationship persisted in separate groups of beverage drinkers and nondrinkers.

Since the average cheese consumption in this study was small, a satisfactory comparison with one of the previously reported studies was not possible.\textsuperscript{1} However, there was not a major trend toward a lower frequency of hypertension with increasing calcium from non-milk dairy sources (Figure 1). Most of the difference appeared to be from calcium in milk. It was not surprising that when the various sources of calcium were combined and participants were classified by hypertensive status, a similar inverse trend was found in three of the four groups. Generally, the borderline hypertensive subjects had an intermediary calcium intake. No satisfactory explanation exists for the inconsistent findings in the young rural group.

An important issue that could be addressed somewhat in this particular population was the possibility that a subgroup with significantly higher blood pressure and a potential lactase deficiency by virtue of darker skin color might, because of the unpleasant side effects of milk ingestion, avoid dairy products. Skin color had previously been assessed in urban men in this population.\textsuperscript{17} Although the milk/blood pressure relationship was slightly less consistent in the light- than in the dark-skinned individuals, this explanation does not account for the blood pressure/milk relationship. It is not possible in Puerto Rico to identify subgroups exactly comparable to the designation on the mainland of black or white.\textsuperscript{17}

Since the mechanism for an association between milk consumption per se or dietary calcium from milk and blood pressure is uncertain, the relationship must be investigated further in diverse populations as well as in laboratory situations. It will be necessary to determine whether a covariable of milk that affects blood pressure could be operating. There could be cultural or social factors associated with milk drinking that have an unmeasured impact on blood pressure. Other foods consumed with milk products could be affecting absorption of calcium.\textsuperscript{18} It is also possible that a high milk-containing diet might decrease absorption of trace metals, such as cadmium and lead, which have been implicated in the pathogenesis of hypertension.\textsuperscript{19} Some other substances in milk, such as tryptophan,\textsuperscript{20} lactose, riboflavin, or fortification with Vitamin D, could also be important factors.

Although the chain of causation has been postulated to involve decreased dietary calcium intake leading to lower ionized serum calcium which in turn results in higher blood pressure,\textsuperscript{2} the inconsistent findings from Kesteloot and Geboers\textsuperscript{3} that increased total serum calcium and urinary calcium are related positively to blood pressure means resolution. The known hypotensive effects of calcium-channel blocking drugs must be considered as well.

Even if a causal relationship is accepted, the public health implications of the findings must be carefully considered. Since this is a very large population, statistical significance does not directly translate into a practical program for individuals. For example, from the multivariate regression coefficients in Table 3, which relate milk intake to systolic blood pressure, one would predict that drinking two glasses of milk (16 oz) per day would be associated with a decrease in systolic blood pressure of only about 2 mm Hg, as compared to a nondrinker. Of course, even this modest relationship is only theoretical and would require a clinical investigation to confirm. In the Puerto Rico population, the estimated mean intake of calcium is already approxi-
mately 900 mg per day. This is a value well within the range of the recommended daily dietary allowances for calcium for adult men established by the Food and Nutrition Board of the National Academy of Sciences — National Research Council.21

In addition, while milk consumption is associated with blood pressure in a beneficial way, milk also contributes a large amount of saturated fatty acids to the diet. In this study, the correlation between milk consumption and total saturated fatty acids in the diet was about 0.50. Dietary studies generally show low but positive correlations between saturated fatty acid intake and serum cholesterol. In the Puerto Rico study, this translates into a small but consistently positive correlation between milk consumption and serum cholesterol that is between 0.02 and 0.05 depending upon age group and geographic area.

The possible implications for the development of coronary heart disease must be considered. Of course, skim milk or calcium supplementation might be an alternative for increasing calcium intake while maintaining a low saturated fat intake. Before major dietary changes can be recommended, further studies are necessary to clarify the etiological nature of the relationship as well as to define the risks and benefits of any recommended changes.

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