Genetic, dietary, and other lifestyle determinants of serum homocysteine levels in young adults in Costa Rica

Ileana Holst-Schumacher, 1 Rafael Monge-Rojas, 2 Priscilla Cambronero-Gutiérrez, 1 and Gilbert Brenes 3

ABSTRACT

Objective. Elevated serum total homocysteine (tHcy) is considered an independent risk factor for cardiovascular disease. The objective of this study was to develop the first-ever information on the prevalence of hyperhomocysteinemia and its determinants in a population in Costa Rica.

Methods. A cross-sectional study was conducted to determine serum levels of tHcy, vitamin B 12, folate, and creatinine, as well as the presence of the genotype TT for the methylenetetrahydrofolate reductase (MTHFR) enzyme. Additionally, dietary vitamin intakes and other lifestyle risk factors were assessed. A total of 399 Costa Rican adults from the central valley of the country (where the capital city, San José, is located), aged 20 to 40 years, participated in this study in the year 2000. Analyses of variance were performed for continuous variables, and the chi-square test was used for categorical data. Spearman correlation tests were calculated to determine associations between variables. Three linear regression analyses and one binary logistic model were developed in order to determine the predictors for homocysteine levels in the population studied.

Results. The overall prevalence of hyperhomocysteinemia (> 15 μmol/L) in the population was 6%, 31% of the population were in the range of 10 to 15 μmol/L, and 29% had the genotype TT for the enzyme MTHFR. 18% presented a vitamin B 12 deficiency (< 165 μmol/L), and none of the persons had low serum folate levels (< 7.0 nmol/L). No significant associations were found between tHcy and age, smoking, consuming alcohol, or dietary vitamin intake.

Conclusions. Only serum vitamin B 12 levels and the genotype TT of the enzyme MTHFR were considered significant predictors of high serum tHcy levels in the Costa Rica population studied.

Key words Cardiovascular diseases, homocysteine, life style, risk factors, Costa Rica.

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Since 1970, researchers have linked hyperhomocysteinemia to cardiovascular disease (CVD), and hyperhomocysteinemia is now considered a CVD risk factor (1). Low serum concentrations of folate, vitamin B₁₂, vitamin B₉, and vitamin B₆ have been identified as risk factors for hyperhomocysteinemia (2). Folate is considered the micro- nutrient with the greatest impact on homocysteine metabolism (2).

Several genetic defects in the enzymes participating in the homocysteine metabolic cycle have also been associated with hyperhomocysteinemia (3). Frostell et al. (4) identified a common point mutation (C677T) in the methylenetetrahydrofolate reductase (MTHFR) gene that correlated with reduced MTHFR activity. Homozygotes for this enzyme variant have significantly elevated total homocysteine (tHcy) levels, suggesting that this mutant gene may be a risk factor for developing hyperhomocysteinemia (3, 4).

Moderate hyperhomocysteinemia is equivalent to hypercholesterolemia as a cardiovascular risk factor. Given that, some researchers have pointed to the importance of knowing and reducing the tHcy concentrations in a population in order to lower CVD mortality (5). This is important in Costa Rica, where CVDs constitute the leading cause of death among adults, with a mortality rate of 80.4/10 000 in 2001, and where approximately 2.5% of those deaths occurred among relatively young persons, that is, under 40 years of age (6). Some researchers have studied the traditional CVD risk factors among adults in Costa Rica (7), but there are no data available on the prevalence of hyperhomocysteinemia and its determinants in the country. This is the first study that describes the distribution of tHcy and its determinants among Costa Rican adults.

MATERIALS AND METHODS

Subject selection

A sample of 399 Costa Rican volunteers aged 20 to 40 years participated in this study, which was conducted in the year 2000. Subjects were asked to participate in this study through a written circular sent home with 700 randomly selected boys and girls from 20 representative rural and urban schools located in the central valley of the country, where the capital of the country, San José, is located. A total of 490 adults offered to collaborate with the investigation, but only 399 of them fulfilled all the inclusion and exclusion criteria.

The final sample consisted of 186 men and 213 women. Written informed consent was obtained from all the participants, and all the procedures that were followed had been approved in accordance with the guidelines of the bioethics committees of the University of Costa Rica and the Costa Rican Institute for Research and Education on Nutrition and Health. Inclusion criteria included being of Costa Rican nationality and being between 20 and 40 years old. The exclusion criteria included a serum creatinine concentration > 133 μmol/L and conditions such as thyroid disease, cancer, pregnancy, and exposure to nitrous oxide. Also excluded were people taking vitamin supplements, anticonvulsants, or antidepressants, as well as women using estrogen therapy.

Study variables

The study data were collected through validated instruments in face-to-face interviews. The information included age, gender, and the consumption of vitamin supplements or any doctor-prescribed drug. We excluded from this study all persons who said that they were taking vitamin supplements. We also registered the presence or absence of cigarette smoking, coffee consumption, and alcohol/beverage consumption.

Dietary intake was determined by semiquantitative 24-hour recall. Portion size was estimated using a series of photographs of food typically consumed in Costa Rica, along with three-dimensional food models. The Food Processor nutrition analysis software, version 6.0 for Windows (ESHA Research, Salem, Oregon, United States), was used to perform nutrient calculations from the dietary data (8). A comparison with the United States Dietary Reference Intakes (DRIs) for folate, vitamin B₁₂, and vitamin B₉, was made to evaluate micronutrient intake. Two-thirds or less of a DRI was used as the criterion for inadequate dietary intake of a micronutrient (9).

Blood measurements included tHcy, folate, vitamin B₁₂, and creatinine. After 8 to 12 hours of fasting, a venous blood sample was collected from each subject, following National Committee for Clinical Laboratory Standards procedures (10). A plain Vacutainer tube (Becton, Dickinson and Company, Rutherford, New Jersey, United States) was used to obtain serum, and another tube with ethylenediaminetetraacetate (EDTA) was used for DNA extraction. Serum was separated immediately from the blood cells and refrigerated (6 °C ± 2 °C) until further processing. Ascorbic acid (5 000 mg/L) was added to the serum aliquot that was reserved for folate analysis in order to preserve the reduced state and stability of the vitamin, as suggested by Henry et al. (11). Samples were subsequently stored at −20 °C until analyzed.

Biochemical and genetic analysis

The serum tHcy level was measured using fluorescence polarization immunoassay, and serum folate and vitamin B₁₂ levels were determined with microparticle immunoassays in a fully automated IMX (Abbott Laboratories, Diagnostics Division, Abbott Park, Illinois, United States) (12). Total homocysteine serum levels were categorized as normal (< 10 μmol/L), risky (10 to 15 μmol/L), or high (> 15 μmol/L) (12, 13). Creatinine was analyzed by kinetic reactions in a dry chemistry automated VITROS 250 (Johnson & Johnson, Ortho-Clinical Diagnostics, Rochester, New York, United States) (14). The assays' intra-assay coefficients of variation were 8% for tHcy, 12% for folate, < 6% for vitamin B₁₂.
and < 3% for creatinine. Genomic DNA was isolated from blood leukocytes using the method of Miller et al. (15). Identification of the C to T substitution at nucleotide 677 of the MTHFR gene was assayed using the method of Frostat et al. (4). Thirty-five cycles at 95°C for 60 s, 55°C for 60 s, and 72°C for 90 s were used to amplify 198-base pair (bp) products. The restriction enzyme Hint I (Promega Corporation, Madison, Wisconsin, United States) digested the 198-bp fragment into 175-bp and 23-bp fragments, and the analysis was conducted in 3% agarose (Sigma-Aldrich Corporation, St. Louis, Missouri, United States) electrophoresis. Genetic analyses were performed for only a subset of the population studied (215 of 399) because of the high costs of these techniques. The genetic analyses were done according to the tHcy levels of those persons (102 with tHcy < 9.80 μmol/L, and 113 with tHcy > 10.20 μmol/L).

Data analysis

Statistical analysis was performed using SPSS software, version 9.1 for Windows (SPSS Inc., Chicago, Illinois, United States). Continuous variables are summarized using means ± standard deviation, and categorical variables are presented as frequency distributions. Analysis of variance was performed for continuous variables, and chi-square tests were performed for categorical data. Spearman correlation coefficients were calculated to determine associations between variables. Mann-Whitney nonparametric tests were computed to compare mean levels of serum biochemical indicators among homozygous normal (CC) genotype and heterozygous (CT) genotype, and between TT and non-TT subjects, since the distribution of these variables was skewed. Significance was defined as P < 0.05. The serum tHcy concentration (the dependent variable) was positively skewed, so the analyses were performed using natural logarithmic transformations. Inverse transformations were done to provide geometric means of tHcy, with 95% confidence intervals, adjusted by age and gender. Continuous variables were also categorized, using their quartiles as cutoff points. Three multiple linear regression models were developed to determine the best predictors of homocysteine levels. Additionally, a binary logistic model was developed, using serum tHcy concentration < 10 μmol/L or ≥ 10 μmol/L as the dependent variable.

### RESULTS

**General characteristics of the population**

The study sample consisted of 399 adults (186 men and 213 women), with a mean age of 32.5 y (± 5.6 y) (range 20 to 40 y) (Table 1). A smoking habit was reported by 18% of the adults (27% of the men vs. 10% of the women, P < 0.001), and 38% reported consuming alcoholic beverages. In contrast, 77% of the participants were coffee drinkers.

**Biochemical parameters of the population**

Women showed higher mean serum folate levels than men did (27.6 and 25.4 nmol/L, respectively; P < 0.001), but men had higher mean serum levels of tHcy and creatinine than did women (P < 0.001) (Table 1). No significant differences were found by gender in the mean serum vitamin B₁₂ concentrations.

The prevalence of hyperhomocysteinemia (> 15 μmol/L) in the total population was 6% (22 of 399), with the prevalence in men (19 of 186, or 10%), being much higher than that in women (3 of 213, or 1%) (P < 0.001). In terms of ranges, 31% of the adults had...
TABLE 2. Distribution (%) of the population in study of determinants of serum total homocysteine concentrations, according to the total homocysteine concentration categories and cutoff values of serum folate and vitamin B\textsubscript{12}, Costa Rica, 2000

<table>
<thead>
<tr>
<th>Total homocysteine</th>
<th>Folate (nmol/L)</th>
<th>Vitamin B\textsubscript{12} (pmol/L)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 7.0 (n = 0)</td>
<td>≥ 7.0 (n = 399)</td>
<td>&lt; 165 (n = 70)</td>
</tr>
<tr>
<td>&lt; 10 μmol/L</td>
<td>0.0</td>
<td>62.9</td>
<td>42.8</td>
</tr>
<tr>
<td>10–15 μmol/L</td>
<td>0.0</td>
<td>30.6</td>
<td>48.6</td>
</tr>
<tr>
<td>&gt; 15 μmol/L</td>
<td>0.0</td>
<td>15.5</td>
<td>8.8</td>
</tr>
<tr>
<td>Total</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* P value according to chi-square test.

tHcy concentrations ranging between 10 and 15 μmol/L (50% of the men vs. 14% of the women, P < 0.001), and 64% showed normal tHcy levels (< 10 μmol/L) (85% of the women vs. 40% of the men, P < 0.001). The prevalence of hyperhomocysteinemia was 5% among those 20–29 years old, and 6% among those 30–40 years old.

None of the adults in this study presented low serum concentrations of folate (< 7.0 nmol/L) (Table 2). In contrast, 70 of the 399 adults (18%) showed deficient levels of serum vitamin B\textsubscript{12} (< 165 pmol/L), 34 of 70 (49%) of the adults with low serum levels of vitamin B\textsubscript{12} showed risky serum levels of tHcy (10–15 μmol/L, P < 0.001), and 6 of 70 (9%) had hyperhomocysteinemia. Serum creatinine showed a strong direct correlation with tHcy (r = 0.472), while folate and vitamin B\textsubscript{12} presented an inverse relationship with it (r = -0.267 and r = -0.309, respectively).

Methylenetetrahydrofolate reductase genotypes

The proportion of persons in the study with the homoyzygous normal (CC) genotype for MTHFR was 32% (69 of 215); heterozygous (CT) genotype, 39% (84 of 215); and homozygous mutant (TT) genotype, 29% (62 of 215) (Table 3). The frequencies of the alleles 677C and 677T were 52% (111 of 215) and 48% (104 of 215), respectively. The mean serum tHcy concentration in the adults with the TT genotype was higher (12.30 μmol/L) than in the subjects with non-TT genotypes (CC +CT) (9.89 μmol/L) (P < 0.001). Lower serum levels of folate were observed in homozygous mutant adults than in non-TT subjects (23.3 nmol/L vs. 26.5 nmol/L, respectively, P < 0.001). A higher proportion of adults with the non-TT genotypes than those with the TT genotype for MTHFR showed tHcy levels < 10 μmol/L (62% and 27%, respectively, P = 0.002) (data not shown). Of the 62 TT carriers, 12 of them (19%) presented hyperhomocysteinemia, versus 5 of the 153 non-TT individuals (3%) (P < 0.001). No significant differences were found in the mean serum concentrations of folate, vitamin B\textsubscript{12}, and tHcy between the subjects with CC genotype and those with the CT genotype.

Dietary vitamin intake

In terms of dietary vitamin intake, 77% of the adults reported an adequate intake of folate, and 82% for vitamin B\textsubscript{12}. Fewer than 0.5% of the subjects consumed less than one-third of the DRI for vitamin B\textsubscript{12} and folate. In contrast, 46% of women and 32% of men did not meet two-thirds of the DRI for vitamin B\textsubscript{12}. In addition, 12% of the adults did not even meet one-third of the DRI for this vitamin.

Geometric means of total homocysteine concentrations

The geometric mean of tHcy concentrations was 27% higher in men (10.43

TABLE 3. Levels of some of the biochemical parameters of a subset (215 persons) of the population in study of determinants of serum homocysteine concentrations, according to their methylenetetrahydrofolate reductase (MTHFR) genotype, Costa Rica, 2000

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Normal (CC) (n = 69)</th>
<th>Heterozygous (CT) (n = 84)</th>
<th>P value*</th>
<th>Homozygous (TT) (n = 62)</th>
<th>Non-TT (CC+CT) (n = 153)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Folate (nmol/L)</td>
<td>27.2 ± 4.3 (26.3-28.3)</td>
<td>26.0 ± 4.3 (25.2-27.1)</td>
<td>0.107</td>
<td>23.3 ± 4.8 (22.2-24.6)</td>
<td>26.5 ± 4.3 (26.0-27.3)</td>
<td>0.001</td>
</tr>
<tr>
<td>Vitamin B\textsubscript{12} (pmol/L)</td>
<td>250 ± 85.0 (229-271)</td>
<td>276 ± 139.0 (246-306)</td>
<td>0.184</td>
<td>254 ± 114.0 (227-285)</td>
<td>264 ± 120.0 (245-284)</td>
<td>0.562</td>
</tr>
<tr>
<td>Total homocysteine (μmol/L)</td>
<td>9.80 ± 2.30 (9.24-10.38)</td>
<td>9.96 ± 2.10 (9.50-10.43)</td>
<td>0.657</td>
<td>12.30 ± 4.80 (11.10-13.50)</td>
<td>9.89 ± 2.20 (9.54-10.25)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

* P value according to Mann-Whitney test.

1 SD = standard deviation.

5% CI = 95% confidence interval.
μmol/L) than in women (8.21 μmol/L) (P < 0.001), and it was 8% higher in the subjects with serum creatinine levels ≥ 88.4 μmol/L (P = 0.011) (Table 4). The tHcy concentrations were similar in the two studied age groups (20–29 y and 30–40 y). After multivariate adjustment for age and gender, the geometric mean tHcy concentration was 17% higher in the lowest quartile of serum vitamin B12 than in the highest quartile (P < 0.001). Similarly, a 16% difference was found between the lowest and the highest quartiles for serum folate (P < 0.001). The geometric mean tHcy concentration in coffee drinkers was 5% higher than in nondrinkers (9.64 μmol/L versus 9.14 μmol/L; P = 0.047). No significant differences were found in the tHcy concentrations between the smokers and nonsmokers, and the alcohol drinkers and nondrinkers, or among the different quartiles of dietary vitamin intake (data not shown).

Linear and logistic regression models

According to the linear regression model (Table 5), the main predictors of the serum levels of tHcy were the serum levels of vitamin B12 and folate, gender, and the presence of the TT mutation in the MTHFR gene. This model explained 34% of the variance of the tHcy concentrations in the population. Excluding the nonsignificant variables (age, dietary vitamin intake, coffee drinking, and smoking), a second model (Table 6) established that the tHcy levels were 14.5% higher in men than in women, and 13.6% higher in subjects with the TT genotype than in the non-TT adults. Additionally, this model indicated that 1% reduction in the serum levels of vitamin B12 and folate increased the tHcy levels 20.1% and 35.4%, respectively, keeping the rest of the variables constant.

The inclusion of the natural logarithm of folate, vitamin B6, and vitamin B12 intakes in a third linear regression model (not shown) explained an additional 3% of the variance of tHcy compared to the second model (R² = 0.307 for the third model vs. R² = 0.282 for the second model).

The binary logistic regression model (Table 7) established that the risk of having hyperhomocysteinemia was 3.13 times as high in the TT subjects as in the non-TT ones. The risk of having high tHcy decreases 3% for each 10-pmol increase in serum vitamin B12. Serum folate levels and gender were not significant predictors of high tHcy concentrations in the population.

DISCUSSION

The prevalence of hyperhomocysteinemia (that is, >15 μmol/L) in the Costa Rican population studied (6%) is similar to the one estimated for the general population of the United States (5%) (16). In young Asian-Indian residents in the United State this prevalence is 26% for men and women (17), and the prevalence is 77% for men and women in the country of India (18). There are few studies from around the world that have been done on young healthy adults (20–40 y) and their serum tHcy concentrations, thus making comparisons difficult. Nevertheless, the geometric means of tHcy concentrations for the Costa Ricans in our study were slightly higher than the ones reported in the few works done on subjects less than 40 years old (19, 20).

Contrary to other studies (19, 21), in our study in Costa Rica no relationship was found between age and tHcy concentrations. That was probably because the selected population was relatively young (20 to 40 y). Increases of 1 μmol/L in the tHcy concentration
have been observed for each decade between 40 and 70 years (22). Furthermore, it has been suggested that high tHcy concentrations in older subjects could be related to an age-associated decrease in the activity of the enzymes involved in homocysteine metabolism or in renal function (23).

The higher serum tHcy concentrations in men than in women that we found in Costa Rica are consistent with the results of other research, suggesting that sex hormones could have an important role in tHcy metabolism (23). High levels of tHcy have been reported in menopausal women who are not undergoing estrogen replacement therapy, while those treated with these hormones have lower serum tHcy concentrations (24). In addition, other research (25) has found an association between creatinine levels and high tHcy concentrations in men, but not in women. This has been explained in terms of body composition, since men have higher muscle mass than women do.

Several lifestyle variables have been associated with hyperhomocysteinemia. In the cohort work with the descendants of the Framingham Study (20) and of the Hordaland Study (21), a positive association was observed between smoking and the serum tHcy concentrations. Likewise, several studies have reported a positive association between alcohol consumption and serum tHcy concentrations (2). In our Costa Rica study the serum tHcy concentrations were found to be associated with coffee consumption, in accord with previous reports (20, 21, 26). No significant relationship was observed between tHcy concentrations and other lifestyle variables.

In our study the intake of folate and of vitamin B₁₂ both showed weak positive correlations (r < 0.2) with serum tHcy concentrations; however, the associations disappeared after multivariate adjustment for age and gender. In contrast, Saw et al. (26) and de Bree et al. (2) have reported a strong inverse association between folate ingestion and tHcy concentrations. Although 24-hour recall has demonstrated a good correlation with other dietary assessment methods in nutritional epidemiology (20), in our study it was unable to adequately assess the daily intake of folate, vitamin B₁₂, and vitamin B₁₉. Nevertheless, the intake data for these three vitamins together explained around 3% of the variance in the serum tHcy levels, according to our third linear regression model.

In both our work in Costa Rica and in other epidemiologic studies (20, 22, 23) an inverse correlation between the serum concentrations of some vitamins (especially folate and B₁₂) and tHcy was found. Data from the Framingham Study (23) indicated that 67% of the subjects with suboptimal levels...
of one or more of these vitamins presented high Hcy levels. Folate, in the form of 5-methyltetrahydrofolate, has been considered the most important dietetic determinant of serum Hcy concentrations (2). Multiple intervention and fortification assays (27) have established that folic acid is the most effective vitamin of the B complex for lowering high levels of homocysteine in apparently healthy subjects, using doses as small as 100-400 μg/day. A food fortification program was started by the Ministry of Health of Costa Rica in 1997. In 1996, Kim et al. (28) carried out a study in which they found that 98% of the subjects had folate intakes that were less than the recommended 400 μg/day. In women, the mean plasma folate level was 7.9 (± 2.2) nmol/L, and 36% of them had concentrations of less than 6.8 nmol/L, a clear indicator of folate deficiency. In 1997 the Ministry of Health made the enrichment of wheat flour with folic acid obligatory (29). This was extended to corn flour in 1999, milk in 2001, and rice in 2002. Although the purpose of this supplementation was to reduce the number of children born with neural tube defects (anecephaly, spina bifida), this fortification program probably had an important collateral effect on CVD. Since all the adults in our study were characterized by serum folates of one or more of these vitamins presented high Hcy levels. Folate, in the form of 5-methyltetrahydrofolate, has been considered the most important dietetic determinant of serum Hcy concentrations (2). Multiple intervention and fortification assays (27) have established that folic acid is the most effective vitamin of the B complex for lowering high levels of homocysteine in apparently healthy subjects, using doses as small as 100-400 μg/day. A food fortification program was started by the Ministry of Health of Costa Rica in 1997. In 1996, Kim et al. (28) carried out a study in which they found that 98% of the subjects had folate intakes that were less than the recommended 400 μg/day. In women, the mean plasma folate level was 7.9 (± 2.2) nmol/L, and 36% of them had concentrations of less than 6.8 nmol/L, a clear indicator of folate deficiency. In 1997 the Ministry of Health made the enrichment of wheat flour with folic acid obligatory (29). This was extended to corn flour in 1999, milk in 2001, and rice in 2002. Although the purpose of this supplementation was to reduce the number of children born with neural tube defects (anecephaly, spina bifida), this fortification program probably had an important collateral effect on CVD. Since all the adults in our study were characterized by serum folate deficiency, measuring their serum folate levels was not as useful in predicting elevated Hcy concentrations as would be true in countries that do not fortify food with folic acid (21-23).

The presence of the TT mutation in the gene that codes for the MTHFR enzyme had the highest predictive value for high levels of tHcy in our Costa Rica study population. The prevalence of this genotype was higher (29%) than the level reported in various other countries (2.5% - 16%) (3, 18, 26, 30). Only Caucasians (36%) and Asians (40%) have higher prevalences of this homocysteine mutation than did the persons in our Costa Rica study (31). It’s easy to explain the high prevalence of the TT mutation in the MTHFR gene that we found, given that present-day Costa Ricans represent an ancestral gene combination of some 10-15% African, 30% Amerindian, and 50-60% Caucasian origin. The frequency of both alleles (C and T) is practically the same, so the probability that this point mutation in nucleotide 677 is inherited in a homozygous way is high.

Even though this TT mutation is considered a nonmodifiable factor for homozygoteinemia, it’s important to diagnose the individuals with the TT genotype in the population in order to identify the people who could most benefit from nutrition interventions.

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RESUMEN

Factores genéticos y ambientales y otros aspectos del estilo de vida que determinan las concentraciones séricas de homocisteína en adultos jóvenes en Costa Rica

Objetivo. La elevación de las concentraciones séricas de homocisteína total (thHC) se considera un factor que influye de forma independiente en el riesgo de sufrir trastornos cardiovasculares. El objetivo del presente estudio ha sido analizar los factores que aportan datos que jamás se han reunido acerca de la prevalencia de hiperhomocisteínergia y sus factores determinantes en una población costarricense.

Métodos. Se llevó a cabo un estudio transversal a fin de determinar las concentraciones séricas de thHC, vitamina B12, folato y creatinina, así como la presencia del genotipo TT respecto de la enzima reducida del metilentetrahidrolalolato (RMTHF). También se examinaron la ingestión de vitaminas y otros factores de riesgo relacionados con el estilo de vida. Participaron en el estudio, que se realizó en 2000, 399 adultos costarricenses de 20 a 40 años de edad del valle central del país (donde está San José, la capital). Se realizó análisis de la varianza en el caso de las variables continuas, y se aplicó la prueba de ji al cuadrado en el caso de datos categóricos. Se efectuaron pruebas de correlación de Spearman para determinar la asociación entre distintas variables. Se llevaron a cabo tres análisis de regresión lineal y un modelo logístico para datos binarios a fin de determinar qué factores servían para pronosticar las concentraciones de homocisteína en la población estudiada.

Resultados. La prevalencia general de hiperhomocisteínergia (≥15 μmol/L) en la población fue de 6%; en 31% de la muestra se detectaron concentraciones entre 10 y 15 μmol/L; en 29% se halló el genotipo TT respecto de la enzima RMTHF; 18% tuvieron deficiencia de vitamina B12 (<165 μmol/L), y nadie tuvo bajas concentraciones séricas de folato (<2,0 μmol/L). No se hallaron asociaciones significativas entre thHC en el suero, edad, hábitos tabáquicos, el consumo de alcohol o la ingesta de vitaminas.

Conclusiones. Sólo la concentración sérica de vitamina B12 y el genotipo TT respecto de la enzima RMTHF mostraron tener valor pronóstico con respecto a las concentraciones séricas de thHC en la población costarricense, aquí estudiada.

Palabras clave

Enfermedades cardiovasculares, homocisteína, estilo de vida, factores de riesgo, Costa Rica.