Prevalence of the metabolic syndrome and its correlation with the cardiovascular health status in stroke- and ischemic heart disease-free Ecuadorian natives/mestizos aged ≥40 years living in Atahualpa: A population-based study

Oscar H. Del Brutto a,b,⁎, Mauricio Zambrano b, Ernesto Peñaherrera a,c,d, Martha Montalván a, Freddy Pow-Chon-Long c,d, Daniel Tettamanti a,c,d

⁎ School of Medicine, Universidad Espíritu Santo – Ecuador, Guayaquil, Ecuador
a Department of Neurological Sciences, Hospital-Clínica Kennedy, Guayaquil, Ecuador
b Department of Cardiology, Hospital Luis Vernaza, Guayaquil, Ecuador
c Research Department, Hospital Luis Vernaza, Guayaquil, Ecuador

A R T I C L E   I N F O

Keywords:
Metabolic syndrome
Cardiovascular risk
Cardiovascular health status
Epidemiology
Atahualpa
Ecuador

A B S T R A C T

Aims: Epidemiologic studies assessing cardiovascular risk factors affecting a given population may prove cost-effective to reduce the burden of cardiovascular diseases in the developing world. We evaluated the prevalence of the metabolic syndrome in Atahualpa, a village representative of rural coastal Ecuador.

Methods: Prevalence of the metabolic syndrome and its correlation with the cardiovascular (CVH) status was assessed in a door-to-door survey performed in stroke- and ischemic heart disease-free Ecuadorian native/mestizos aged ≥40 years.

Results: The metabolic syndrome was diagnosed in 288 (55.7%) out of 517 persons. Worst individual components were: increased waist circumference (75%), increased fasting glucose (68.1%) and high blood pressure (56.5%). Prevalence of individual components of this condition varied according to age, gender, education, and alcohol intake. However, no differences were found in the odds for having the metabolic syndrome when persons were stratified according to these parameters. A poor CVH status was found in 80.2% persons with and in 55.9% without the metabolic syndrome (p < 0.0001).

Conclusions: Prevalence of the metabolic syndrome in Atahualpa is high. Most persons with the metabolic syndrome also have a poor CVH status. However, sizable subsets only have either the metabolic syndrome or a poor CVH status. Stratification of cardiovascular risk according to whether the person has both, one, or none of these two sets of risk factors would be of value to evaluate if the metabolic syndrome, a poor CVH status or the combination of both, better predict the occurrence of vascular outcomes in the long-term follow-up.

© 2013 Diabetes India. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Recent evidence suggests that stroke and ischemic heart disease will be the next epidemics of the developing world due to changes in lifestyle and increased life expectancy of the population [1,2]. The World Health Organization has set a global goal of reducing deaths from non-communicable diseases – including stroke and cardiovascular diseases – by 25% by the year 2025 [3]. As the burden of such conditions is directly related to the prevalence of cardiovascular risk factors, regional epidemiologic studies may prove highly cost-effective for developing strategies directed to improve specific risk factors affecting a given population or ethnic group. Such studies will lead to more rational decisions on the prioritization of existing sanitary resources which are limited in many middle- and low-income countries.

The Atahualpa Project (Clinical Trials.gov identifier: NCT01627600) is a population-based study primarily designed to evaluate the cardiovascular health (CVH) status and to determine the prevalence and incidence of stroke and ischemic heart disease in rural coastal Ecuador [4]. That survey used the American Heart Association (AHA) defined set of cardiovascular risk factors – including a number of health behaviors and health factors – to categorize CVH [5]. Data from the Atahualpa Project showed that about 70% of the population has a poor CVH status [6].
which, nevertheless, suggested that CVH status in people living in this rural village of a developing country is better than in U.S. urban centers [7–9]. Indeed, a recent comparative study showed that most of the measured cardiovascular risk factors in Atahualpa residents aged ≥40 years are better than in Caribbean Hispanics living in Northern Manhattan except for fasting glucose levels [10].

Despite this relatively better CVH status, current age-adjusted prevalence rate of stroke in Atahualpa is similar to that reported from the developed world [11]. More worrisome, stroke prevalence in Atahualpa has increased significantly over the past decade; a fact that could be demonstrated after comparing data from two population-based studies using similar designs performed in this village in 2003 and 2012 (from 14.08% in 2003 to 31.15% in 2012, p = 0.03) [11,12].

The metabolic syndrome is a group of interrelated risk factors that, when present, increases the odds for developing vascular diseases (including stroke) and diabetes mellitus type 2 [13]. As some of the cardiovascular risk factors that are evaluated for the diagnosis of the metabolic syndrome are not considered in the set of risk factors defined by the AHA, we evaluated the prevalence of the metabolic syndrome in Atahualpa residents in order to provide more insights in the reasons for the above described paradox (better CVH status/similar stroke prevalence). We also correlated the presence of the metabolic syndrome with the CVH status to settle a complete basal profile of risk factors in our population, which may help to predict (in the long-term follow-up) the occurrence of vascular events.

2. Methods

Atahualpa (2° 18’ S, 80° 46’ W) is a closed village located at the sea level that was selected as it is highly representative of the region. More than 95% of the population belongs to the Ecuadorian native and Mestizo ethnic groups, and their diet is rich in fish and carbohydrates but poor in beef, polyunsaturated fats and dairy products; there are no fast-food restaurants in the village, and most people eat at home. Most men work as carpenters, farmers or laborers, and most women are housewives. Inhabitants mobilize within the village mostly by walking or bicycle riding, as few people own a motor vehicle.

Methodology and ethics considerations of the Atahualpa Project have been detailed elsewhere [4]. In brief, trained field personnel performed a door-to-door survey to detect all Atahualpa residents, and to apply questionnaires designed to evaluate the CVH status of all people aged ≥40 years. CVH status was evaluated according to the AHA criteria [5]. Persons with suspected stroke and ischemic heart disease were detected by the use of validated field questionnaires [14,15] and the diagnosis was further corroborated by certified neurologists and cardiologists.

All Atahualpa residents aged ≥40 years free of stroke and ischemic heart disease were invited to undergo further laboratory examination, and the prevalence of the metabolic syndrome was evaluated in those who signed the informed consent form. According to a recent consensus statement [16], the metabolic syndrome was diagnosed in persons who met at least three of the following five components: (1) waist circumference ≥90 cm in men or >80 cm in women; (2) triglycerides ≥150 mg/dL; (3) high-density lipoprotein (HDl) cholesterol <40 mg/dL in men or <50 mg/dL in women; (4) blood pressure ≥130/85 mmHg; and (5) fasting glucose levels ≥100 mg/dL. Drug treatment with anti-hypertensive, hypo-glycemic, or lipid-lowering drugs was considered as alternate indicators of the latter three components. Waist circumference was measured with persons on the supine position (using only undergarments) at the midpoint between the last rib and the iliac crest, and the values of ≥90 cm for men and ≥80 cm for women were selected on the basis of the International Diabetes Federation (IDF) suggested ethnic-specific cut-off values for Latin American populations [17]. Blood pressure was measured using a well-defined protocol described elsewhere [18]. The blood sample was drawn after an overnight fast, centrifuged at the field, and then transported to the laboratory (International Laboratory Services, S.A., Guayaquil – Ecuador).

We assessed the total number of Atahualpa residents aged ≥40 years (free of stroke or ischemic heart disease) with the metabolic syndrome, as well as the number and the type of individual components of the syndrome per person. We also noted the occurrence of this condition according to the CVH status of the person which, as previously reported, had been classified as ideal, intermediate and poor [6]. Prevalence of the metabolic syndrome was also stratified according to age (40–59 years, and ≥60 years), gender, education (up to primary school, and secondary school or higher), and alcohol intake (none to <50 g/day, and ≥50 g/day).

Descriptive statistics were presented as means with standard deviations for continuous variables and as percentages for categorical variables. Logistic regression models were used to compare the means and proportions across the variables analyzed. All data analyses were carried out using SPSS18 software (SPSS Inc., Chicago, IL, USA). All p-values were 2-sided and a p-value of less than 0.05 was considered statistically significant.

Table 1
Characteristics of 517 Atahualpa residents aged ≥40 years with and without the metabolic syndrome.

<table>
<thead>
<tr>
<th>Total series (n = 517)</th>
<th>Person with the metabolic syndrome (n = 288)</th>
<th>Persons without the metabolic syndrome (n = 229)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD</td>
<td>58.8 ± 12.4</td>
<td>58.8 ± 12.3</td>
<td>58.7 ± 12.5</td>
</tr>
<tr>
<td>Women, %</td>
<td>61.7</td>
<td>62.9</td>
<td>60.3</td>
</tr>
<tr>
<td>Alcohol intake ≥50 g/day, %</td>
<td>66.7</td>
<td>67</td>
<td>66.4</td>
</tr>
<tr>
<td>Systolic BP (mmHg), mean ± SD</td>
<td>177.6 ± 24.6</td>
<td>145.6 ± 24.5</td>
<td>127.7 ± 20.9</td>
</tr>
<tr>
<td>Diastolic BP (mmHg), mean ± SD</td>
<td>77.1 ± 11.8</td>
<td>79.7 ± 11.9</td>
<td>73.7 ± 10.7</td>
</tr>
<tr>
<td>Waist circumference (cm), mean ± SD</td>
<td>90.4 ± 9.9</td>
<td>93.5 ± 8.3</td>
<td>86.3 ± 10.2</td>
</tr>
<tr>
<td>Fasting glucose (mg/dL), mean ± SD</td>
<td>144 ± 91.8</td>
<td>150 ± 95.1</td>
<td>128.8 ± 85.1</td>
</tr>
<tr>
<td>Triglycerides (mg/dL), mean ± SD</td>
<td>151.3 ± 68.8</td>
<td>176.4 ± 74.5</td>
<td>119.6 ± 43.6</td>
</tr>
<tr>
<td>HDL cholesterol (mg/dL), mean ± SD</td>
<td>55.9 ± 15.6</td>
<td>50.6 ± 13.4</td>
<td>62.4 ± 15.6</td>
</tr>
<tr>
<td>Waist circumference ≥90 cm in men or ≥80 cm in women, %</td>
<td>75.1</td>
<td>91.3</td>
<td>55</td>
</tr>
<tr>
<td>Triglycerides ≥150 mg/dL, %</td>
<td>41</td>
<td>62.5</td>
<td>14</td>
</tr>
<tr>
<td>HDL cholesterol &lt;40 mg/dL in men or &lt;50 mg/dL in women, %</td>
<td>25.7</td>
<td>40.3</td>
<td>7.4</td>
</tr>
<tr>
<td>Blood pressure ≥130/85 mmHg, %</td>
<td>56.5</td>
<td>79.2</td>
<td>28</td>
</tr>
<tr>
<td>Fasting glucose levels ≥100 mg/dL, %</td>
<td>68.1</td>
<td>83.7</td>
<td>48.5</td>
</tr>
</tbody>
</table>
3. Results

With the exception of 26 persons who were excluded for a stroke or ischemic heart disease, there were a total of 616 Atahualpa residents aged ≥40 years. All of them were invited to participate in this study, and a drawn of a blood sample was possible in 517 (84%) persons who signed the informed consent. Mean age of these individuals was 58.8 ± 12.4 years, 319 (61.7%) were women, and 345 (66.7%) had only primary school instruction. Sixty-seven persons (13%) admitted alcohol consumption ≥50 g/day. According to AHA criteria [5], the CVH status was classified as poor in 359 (69.4%), intermediate in 147 (28.4%), and ideal in the remaining 11 (2.1%) persons.

Mean values for the diverse measures obtained for the purpose of the present study were: waist circumference 90.4 ± 9.9 cm (90.5 ± 10 cm for men and 90.4 ± 9.8 cm for women), systolic blood pressure 137.6 ± 24.6 mmHg, diastolic blood pressure 77.1 ± 11.8 mmHg, fasting glucose 144 ± 91.8 mg/dL, HDL cholesterol 55.8 ± 15.6 mg/dL (52.5 ± 15.1 mg/dL for men and 57.9 ± 15.5 mg/dL for women), and triglycerides 151.3 ± 68.8 mg/dL. Sixty-eight persons were on antihypertensive, 59 on hypoglycemic and 5 on dyslipidemic drugs (18% of them were taking combinations of these drugs).

A total of 288 (55.7%) persons had the metabolic syndrome. One-hundred fifty-nine of these persons had three, 95 had four, and 34 had the five positive individual components of the syndrome. Of the 229 persons without the metabolic syndrome, 136 had two and 78 had one positive component; the remaining 15 persons had all five negative components. An increased waist circumference was the positive component most frequently found (75.1%), followed by increased fasting glucose (68.1%), high blood pressure (56.5%), increased triglyceride levels (41%), and low HDL cholesterol levels (25.7%). The most common combination in the 136 persons with two positive components was increased waist circumference plus increased fasting glucose (36.5%), followed by increased waist circumference plus high blood pressure, and by increased fasting glucose plus high blood pressure (16.2% each). In the 159 persons with three positive components, increased waist circumference associated with increased fasting glucose and high blood pressure was the most common combination (44.7%), and in the 95 persons with four positive components, the single most common negative component was HDL cholesterol levels below cut-off ranges (47.4%).

Table 1 shows main characteristics of persons with and without the metabolic syndrome. Both groups were similar regarding to age, gender, education, and severity of alcohol intake. In contrast, people with and without the metabolic syndrome differed in the mean values of waist circumference, systolic and diastolic blood pressures, fasting glucose, HDL cholesterol and triglyceride levels, as well as in the prevalence of each of the five individual components of the syndrome. In the univariate analysis, the occurrence of the metabolic syndrome was not modified by age, gender, level of education or severity of alcohol intake. Likewise, no combinations of these factors increased the odds for having the metabolic syndrome in a multivariate analysis.

When the five components of the metabolic syndrome were individually evaluated, we found some significant differences in their prevalence according to age, gender, education and alcohol intake (Table 2). In particular, an increased waist circumference and low values of HDL cholesterol were more common in women. Increased triglyceride levels were more common in persons aged 40–59 years, in men, in those with secondary school education or higher, and in those who ingest ≥50 g/day of alcohol. In addition, blood pressure levels ≥130/85 mmHg as well as fasting glucose levels ≥100 mg/dL were more common in persons aged ≥60 years, in men and in those with up to primary school education.

| Table 2: Prevalence of individual components of the metabolic syndrome in Atahualpa residents ≥40 years stratified by age, gender, education, and alcohol intake. | Alcohol intake | Education | Gender | Age | Total series | <60 years | ≥60 years | p-value | <60 years | ≥60 years | p-value | <60 years | ≥60 years | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Waist circumference ≥90 cm in men or ≥80 cm in women, % | n.s. | n.s. | n.s. | 51.7 | 72 | 72 | <0.001 | 72.5 | 72.5 | n.s. | 72.5 | 72.5 | n.s. | 72.5 | 72.5 | n.s. |
| Triglycerides ≥150 mg/dL, % | 41% | 43% | 43% | <0.05 | 36 | 36 | <0.001 | 36.7 | 36.7 | <0.001 | 36.7 | 36.7 | <0.001 | 36.7 | 36.7 | <0.001 |
| HDL cholesterol ≥40 mg/dL in men, ≥50 mg/dL in women, % | 25.7 | 29.1 | 29.1 | <0.001 | 21.4 | 21.4 | <0.001 | 21.4 | 21.4 | <0.001 | 21.4 | 21.4 | <0.001 | 21.4 | 21.4 | <0.001 |
| Blood pressure ≥130/85 mmHg, % | 41% | 43% | 43% | <0.05 | 36 | 36 | <0.001 | 36.7 | 36.7 | <0.001 | 36.7 | 36.7 | <0.001 | 36.7 | 36.7 | <0.001 |
| Fasting glucose levels ≥100 mg/dL, % | 41% | 43% | 43% | <0.05 | 36 | 36 | <0.001 | 36.7 | 36.7 | <0.001 | 36.7 | 36.7 | <0.001 | 36.7 | 36.7 | <0.001 |
Correlation between the CVH status and the metabolic syndrome showed a poor CVH status in 231 out of 288 persons with, and in 128 of 229 without the metabolic syndrome (80.2% versus 55.9%, p < 0.0001). On the other hand, 231 of 359 persons with a poor CVH and 57 of 158 with ideal/intermediate CVH status had the metabolic syndrome (64.3% versus 36.1%, p < 0.0001).

4. Discussion

The prevalence of the metabolic syndrome varies across populations, in part due to regional-related differences in the individual components required for its diagnosis and in part due to variations in diagnostic definitions [19]. A number of studies have attempted to evaluate the prevalence of this condition in Latin American countries, but many have been restricted to minority groups – postmenopausal women, male workers of an oil company, elders living in marginal areas of large urban centers – that may not be representative of the population at large [20–22]. Other studies have been based on the selection of apparently representative samples of different populations, which may provide more reliable estimates on the prevalence of this condition [21–26]. However, differences in diagnostic criteria used for the metabolic syndrome (including cut-off values for central obesity) or disparities in the socioeconomic status or race/ethnicity of the population sampled may have accounted for some unnotice selection biases.

Reported prevalence of the metabolic syndrome in Latin American populations has ranged widely from 14% to 57%, with additional marked differences between studies in the relative prevalence of each of the individual components of the syndrome [20–26]. In such studies, over- and misdiagnosis of this condition were probably the rule rather than the exception. For example, some comparative studies showed that the Adult Treatment Panel III (ATP-III) definition detect less patients with the metabolic syndrome than the IDF set of criteria and, to our knowledge, no Latin American studies have used the consensus set of criteria using adjusted cut-off values of waist circumference which is more accurate for estimating the actual occurrence of this condition [16].

We found an overall prevalence of 55.7% of the metabolic syndrome in Atahualpa residents aged ≥40 years free of stroke and ischemic heart disease. As noted, all individual components were more prevalent among persons with than those without the metabolic syndrome (Table 1). Worst individual components of the syndrome were an increased waist circumference, increased fasting glucose levels and high blood pressure, in that order. While the relative prevalence of some of these components varied according to the age, gender, education, and severity of alcohol intake, no differences were found in the odds for having the metabolic syndrome when persons were stratified according to these demographic parameters. This finding was probably related to the counterbalance caused by the fact that some of the individual components of the metabolic syndrome were more prevalent in a given strata of the population but not in others and vice versa (Table 2). For example, high blood pressure and fasting glucose levels were more common in men, in persons aged ≥60 years and in those with up to primary school education, while increased waist circumference and high triglyceride levels were more common in women and in those aged 40–59 years. The amount of alcohol ingestion was inversely related to an increased waist circumference, but this finding may be related to the fact that all people with moderate to heavy alcohol intake were men (and men had better waist circumference than women). Of the individual components of the metabolic syndrome in our population, the less frequently abnormal was HDL cholesterol levels, a fact that could be related to a diet that is rich in fish and poor in polyunsaturated fats. Indeed, 97% of all Atahualpa residents ingest ≥two 3.5 oz servings fish/week [10].

This study showed one the highest reported prevalence rate of the metabolic syndrome in a Latin American population which is similar to that found among Caribbean Hispanics living in Northern Manhattan [27]. However, CVH status (according to AHA criteria) across both populations favored Atahualpa versus Northern Manhattan [10]. This paradox may be related to a healthier life-style at a rural level. Indeed, some of the indicators proposed by the AHA to define an ideal CVH status (no smoking status, ingestion of a healthy diet, and physical activity) are not considered in the definition of the metabolic syndrome. These better “health behaviors” are counterbalanced by a probable genetic susceptibility in the Ecuadorian native ethnic group to develop type 2 diabetes mellitus or by the low income of the population that cannot afford the costs related to chronic treatment of arterial hypertension.

Correlation of CVH status – as proposed by the AHA – with the prevalence of the metabolic syndrome in stroke- and ischemic heart disease-free populations has not been reported so far. Here, we noted that most persons with a poor CVH status had the metabolic syndrome. However, there were also sizable subsets of persons who only had the metabolic syndrome associated with an intermediate/ideal CVH status, or a poor CVH status not associated with the metabolic syndrome. Therefore, persons could be classified according to the presence of one, both, or none of these two sets of cardiovascular risk factors. This classification would be of value in further population-based studies to stratify the risk of stroke and ischemic heart disease in the long-term follow-up in order to evaluate which set of risk factors (or the combination of both) is a better predictor for the occurrence of these vascular outcomes.

Conflict of interest

None declared.

Source of funding

This study was partially supported by an unrestricted grant from Universidad EEP. 218–222

References


