Assessment of Anthropometric, Clinical and Analytical Parameters in Cardiovascular Apparently Healthy Workers: Relationship with Sociodemographic Variables and Healthy Habits

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ABSTRACT

Background: Cardiovascular apparently healthy workers are those who claim not to suffer or to be diagnosed of pathology related to cardiovascular risk.

Objectives: To determine the prevalence of elevated values of different parameters related to CVR in cardiovascular apparently healthy workers

Methods: A descriptive study on 55,063 Spanish Mediterranean area workers was performed. Anthropometric (body mass index, waist to weight ratio), clinical (hypertension) and analytical (lipids, glycaemia) variables are determined along with its relationship with socio demographic variables (sex, age, social class, education) and healthy habits (tobacco, physical exercise and feeding).

Results: 15.3% of apparently healthy workers have obesity (12.7% in women and 17.3% in men), 14.5% hypertension (7.5% in women and 19.9% in men), 11.4% high cholesterol (9.6% in women and 12.7% in men), 14.4% high LDL-c (13.7% in women and 14.9% in men), 7.2% high triglycerides (2.2% in women and 11.1% in men) and 1.2% high glycemia (0.7% in women and 1.6% in men).

Sex, age, tobacco, physical exercise and feeding are the most related variables to these pathologies.

Conclusions: An important percentage of cardiovascular apparently healthy workers present pathologies related to cardiovascular risk.

Keywords: Cardiovascular Risk Factors; Obesity; Hypertension; Hypercholesterolemia; Diabetes

BACKGROUND

Cardiovascular Diseases (CVD) are the leading cause of death in Spain and have a significant socioeconomic impact [1,2]. In the Balearic Islands, they represent the leading cause of death and were responsible for 27% of deaths in 2008 due to ischemic heart disease and 7% of overall mortality due to cerebrovascular disease [3].

High blood pressure, dyslipidemia and smoking are the three modifiable risk factors that are most commonly associated with coronary disease [4,5]. Diabetes is considered a high risk factor for macrovascular disease [6,7], and is related to early death by CVD [8].

The ERICE study [9], shows that in the Balearic Islands, cardiovascular risk factors have a higher prevalence than that observed in the rest of the Spain (47.8% for hypertension, 24.2% for hypercholesterolemia, 11.7% for diabetes and 27% for obesity) which represents a high risk profile for its population [10].

The DARIOS study of 2011 shows that the Balearic Islands is one of the Spanish regions with the highest prevalence of hypertension and smoking in men [11]. According to the latest Balearic Health Survey (ESIB) [12], of 2007, 83.5% of the population had visited a health professional in the last year. In adults the main reason for consultation was for diseases perceived by the patient (41.4%). These data suggest that, in the case of asymptomatic health problems such as hypertension, diabetes or dyslipidemia, the young and active population with altered cardiovascular risk factors and, therefore, with elevated cardiovascular risk, does not consult their physician of primary care so it does not access treatment programs or preventive recommendations for cardiovascular diseases.

Finding high rates of under diagnosis of cardiovascular risk factors would imply the need to implement strategies for the prevention of cardiovascular diseases and the promotion of healthy lifestyles, alternatives to those currently existing for active young working people.

The definition of “apparently healthy workers” refers to those who state that they do not suffer from or are not diagnosed with cardiovascular disease (hypertension, diabetes, dyslipidemia) or previous cardiovascular pathologies (stroke, ischemic heart disease...) [13].

In Spain, studies have been carried out on the prevalence of cardiovascular risk factors in the working population [14]. But always including the total population, both workers already diagnosed of high risk factors or cardiovascular diseases themselves, as well as individual workers without a previous diagnosis of high cardiovascular risk. Therefore, existing studies have not focused on those who ignore if they present any factors related to cardiovascular risk.

In other countries, studies have not been performed in apparently healthy labour people but in the general population [15].

OBJECTIVES

The purpose of our study is to estimate the prevalence of altered anthropometric, clinical and analytical parameters in apparently healthy workers, as well as to determine the existing relationship with sociodemographic variables and healthy habits.

METHODS

Study Design and Subjects

A descriptive and cross-sectional study was carried out on 55,063 workers (24,176 women and 30,887 men) from the regions of Balearic Islands and Valencia, in the period between January 2015 and December 2016. Workers were selected from those who attended the obligatory regular medical examinations. The Safety and Health committees of the different companies were notified; and informed consent was requested to every subject who entered the study in order to obey the current legislation.

Inclusion/Exclusion Criteria

As criteria for inclusion were considered: acceptance to participate in the study, being an active worker between 18 and 70 years and not having a previous diagnosis of hypertension, diabetes or dyslipidemia. Each participant was asked explicitly if they had previously informed health personnel that their blood pressure, lipid profile, or blood glucose levels were high or if they were in pharmacological treatment for these pathologies.

Exclusion criteria included: Not accepting to be included in the study, not having performed the blood test, not belonging to any of the participating companies and being diagnosed with any CVD or related pathologies (diabetes, hypertension, dyslipidemia).
In the mentioned period 61,227 medical examinations were carried out and 6,164 workers were discarded (85 for not allowing their data to be used, 112 for not being extracted for blood sample, 232 for not being in the age bracket considered in the study and 5,735 for suffering some of the diseases).

**Determination of Variables**

An anamnesis with a complete clinical history was performed, including: personal and family history, previous treatments, smoking, food, physical activity, anthropometric data - weight, height, Body Mass Index (BMI), waist circumference, blood pressure and sociodemographic data (age, level of education and social class).

The different anthropometric and clinical measurements and the extractions for the analytics were performed by the health personnel of the different occupational health units involved in the study. Blood tests were performed in two laboratories, one in each region to avoid interlaboratory bias.

The international recommendations were followed to determine the different anthropometric parameters.

The height and weight were determined by an approved scale-heightometer. The Spanish Society for the Study of Obesity (SEEDO) [16], criteria were used, considering obesity when the BMI was equal to or greater than 30 kg/m². The abdominal waist circumference was calculated with a tape measure placed parallel to the floor at the level of the last floating rib, that is, the contour of the natural waist taken between the upper part of the hip bone (iliac crests) and the lower rib, measured during normal breathing with the subject standing and with a relaxed abdomen. Waist-To-Height Ratio (WHtR) was calculated by dividing WC by height in cm.

Cholesterol and triglycerides were determined by automated enzymatic methods, C-HDL was determined by precipitation with Cl2Mg dextran sulphate, Low Density Lipoprotein Cholesterol (LDL-C) was calculated using the Friedwald formula (provided the triglycerides were <400 mg/dl). Borderline values were considered when cholesterol was between 200 and 239 mg/dl, LDL-c between 130-159 mg/dl and triglycerides between 150 and 199 mg/dl; and high values when cholesterol was equal to or greater than 240 mg/dl, LDL-c was equal to or greater than 160 mg/dl and triglycerides equal to or greater than 200 mg/dl.

Glucose was determined by an enzymatic method and was considered Impaired Fasting Glucose (IFG) at values between 100 and 125 mg/dl and hyperglycemia when the values were equal to or greater than 126 mg/dl repeated at least twice.

Blood sampling was performed in the same session and in the same place, after a 12-hour night fast. The samples were sent to the reference laboratory and processed for a maximum of 72 hours, preserving them at a temperature of -20°C.

Blood pressure was determined using a calibrated OMRON M3 automatic sphygmomanometer, after a rest period of 10 minutes in supine position, with three measurements taken at intervals of 1 minute between them, and the mean of the three measurements being calculated. Hypertension was considered when values were equal to or greater than 140/90 mmHg. Hypertension is classified according to the seventh report of the Joint National Committee (JNC-7) criteria: Hypertension 1: Systolic blood pressure 140-159 mmHg or diastolic blood pressure 90-99 mmHg Hypertension 2: Systolic blood pressure ≥160 mmHg or diastolic blood pressure ≥100 mmHg.

Tobacco use, feeding and physical exercise were determined by structured clinical interview and performed during medical examination. A person who smoked regularly at least one cigarette a day in the last month and an ex-smoker who had been smoking for at least 12 months was considered a smoker. According to the American College of Sport Medicine and the American Heart Association, heart-healthy physical activity is considered when the person habitually performs 30 minutes of moderate physical activity at least 5 days a week or 20 minutes of vigorous activity three days a week [17]. The frequency of consumption of fruit (three or more pieces) and vegetables or vegetables (at least two servings) was questioned, and it was considered correct if this consumption was daily.

Concerning education degrees, three categories were established: primary (elementary or uneducated), secondary and university.

Age is classified into four categories: from 20 to 29 years, 30 to 39 years, 40 to 49 years and ≥50 years. Social class was determined from the national classification of occupations of the year 2011 (CNO-2011) and taking into account the classification established by the Spanish Society of Epidemiology [18]. The abbreviated classification is used in three categories: class I (directors, managers and university professionals), class II (intermediate occupations and self-employed) and class III (manual workers).

**Statistic Analysis**

When the variable is continuous, the means are compared using the Student’s t-test if the variable follows a normal distribution, or with the non-parametric Mann-Whitney U test if the normality principle is not met. If the variable is qualitative, the proportions are compared using the Pearson chi-square test. For the multivariate analysis logistic regression is used with the calculation of odds ratios. A p value of less than 0.05 was accepted as significance level in all analysis.

**RESULTS**

The characteristics of the sample in terms of anthropometric, clinical and analytical parameters as well as healthy habits are shown in Table 1.

The prevalence of elevated values of the different parameters analysed in this study (obesity, hypertension, dyslipidemia and hyperglycaemia) is presented in Table 2.

In Tables 3, we present how the different clinical and analytical anthropometric parameters are broken down according to the analyzed socio-demographic variables (age, social class and level of studies).

In both sexes, all altered parameters increase their prevalence as age increases. If we consider social class, in women all altered parameters -except for elevated glycaemia- are less prevalent in social class I; and get worse going down the social class In men, this same situation is not observed since although in most cases the lowest prevalence of altered parameters are seen in class I, an important part of these low prevalence are also seen in class III.

A similar situation to that observed in social class is appreciated when analyzing the academic level. In both sexes, the altered parameters are much more frequent in those who do not regularly perform physical activity or who do not have heart-healthy feeding, while tobacco consumption does not always imply worse parameters as shown in Table 4.
DISCUSSION

A significant proportion of cardiovascular apparently healthy workers who came for medical examinations at work have Cardiovascular Risk Factors (CVR factors). The prevalence of CVR is higher in men and increases with age. In our study, the low prevalence of CVR factors found could be related to previously discarding workers with pathology and the important percentage of subjects less than 35 years (32.7%) included in the study.

The gradual increase in all parameters associated to the age that we have found in our study coincides with that observed by other authors [19,20]. Another aspect in which we also agree with almost all authors [10,20], is that the prevalence of CVR factors is greater in men, and it is also very noticeable. One factor that could explain, at least in part, these differences is that, according to the 2007 ESPID, women do more frequent medical appointments and, therefore, have better controlled parameters than men [12].

The prevalence of hypertension, hypercholesterolemia and hyperglycaemia found in our study was lower than that from other studies conducted in the general population, both Spanish [11] and Balearic [10], although in both studies the mean age of participants was about 10 years higher than in our study. The age of our workers also are lower than that of a study carried out on Spanish working population [14], also in this case, workers with previously known pathology had not had been eliminated. The prevalence of altered values found in our study is similar to those found in others when the younger population is included [20].

Tobacco consumption, as in the previous research of other authors, is more frequent in young people and in men and tends to decrease significantly with age [21-25] - in our study this decrease in consumption occurs from the 55 years - Unlike what was found in other studies [10,26], the prevalence of obesity in our sample was higher in males.

We have not found much research evaluating CVR factors in apparently healthy population; although a study carried out in the Mexican population [15] and another in Nigeria [27], in the general population and with similar ages to our study, but not excluding those who followed treatments, showed higher prevalence in obesity, hypercholesterolemia, hyperglycaemia and hypertension than in our population. A previous study conducted by our group in a different and smaller sample and following the same methodology showed results similar to those found in this study [13].

The lack of standardization of the age groups included in the different studies, as well as the risk factors that were studied and the limits considered as pathological for each factor of CVR in each of them, also made it difficult to directly compare our results with other studies.

Although our study evaluates the prevalence of CVR factors in a working population in the Spanish Mediterranean area, a possible limitation of the study is the impossibility of extrapolating our results at the total Spanish labour population.

The main objective of our study was to show the percentage of apparently healthy workers with CVR factors. Given the study design and the variables analyzed, we cannot establish the real causes of the high percentage of any of these factors although the data suggest that a possible explanation could be the previous misuse of health services as shown by the Health survey of the Balearics 2007 [12]. This survey shows that the visits of people of working age mainly focus on the diagnosis and treatments of the pathologies perceived by the patient; but are not used to assess preventive health status.

The main contribution of this study is twofold: firstly, it shows the role of occupational health units in the early detection of CVR factors through labor medical examinations, and, secondly, it highlights the

<table>
<thead>
<tr>
<th>Table 1: Anthropometric, clinical and analytical characteristics of participants in the study</th>
</tr>
</thead>
<tbody>
<tr>
<td>women n=24176</td>
</tr>
<tr>
<td>men n=30887</td>
</tr>
<tr>
<td>mean (SD) CI 95%</td>
</tr>
<tr>
<td>mean (SD) CI 95%</td>
</tr>
<tr>
<td>p-value</td>
</tr>
<tr>
<td>age 38.6 (8.6) 38.5-38.7 39.1 (10.0) 39.0-39.2  &lt; 0.0001</td>
</tr>
<tr>
<td>BMI 24.7 (4.7) 24.7-24.8 26.5 (4.1) 26.5-26.6 &lt; 0.0001</td>
</tr>
<tr>
<td>Waist 75.1 (9.7) 74.9-75.2 88.3 (9.5) 88.2-88.4 &lt; 0.0001</td>
</tr>
<tr>
<td>BP systolic 113.6 (14.3) 113.4-113.8 124.1 (14.9) 123.9-124.3 &lt; 0.0001</td>
</tr>
<tr>
<td>BP diastolic 69.8 (10.1) 69.7-70.0 75.3 (10.6) 75.2-75.4 &lt; 0.0001</td>
</tr>
<tr>
<td>Cholesterol 191.7 (36.2) 191.2-192.1 196.3 (38.9) 195.9-196.7 &lt; 0.0001</td>
</tr>
<tr>
<td>HDL-c 55.2 (9.2) 55.1-55.3 50.9 (7.5) 50.8-51.0 &lt; 0.0001</td>
</tr>
<tr>
<td>LDL-c 119.4 (36.8) 118.9-119.9 121.5 (37.6) 121.1-121.9 &lt; 0.0001</td>
</tr>
<tr>
<td>triglycerides 85.5 (43.8) 84.9-86.0 121.4 (85.0) 120.5-122.4 &lt; 0.0001</td>
</tr>
<tr>
<td>glycemia 84.2 (12.7) 84.1-84.4 88.5 (16.1) 88.3-88.7 &lt; 0.0001</td>
</tr>
<tr>
<td>smokers % 33.1 37.5 &lt; 0.0001</td>
</tr>
<tr>
<td>no exercise % 45.2 53.0 &lt; 0.0001</td>
</tr>
<tr>
<td>no feeding % 47.1 57.2 &lt; 0.0001</td>
</tr>
</tbody>
</table>

The multivariate analysis using logistic regression establishes the most disadvantaged group as the reference group: male sex, age 50 and older, social class III, primary education, smoking, non-regular physical activity, and poor diet in fruit and vegetables. The odds ratios (OR) are established with their confidence intervals and it is seen that for obesity they affect all factors except the educational level, being the highest odds ratio for physical activity. In index waist to height ratio ≥0.50 all variables influence and especially male sex and no physical activity. In index waist to height ratio ≥0.50 all variables influence high blood glucose or low HDL-c while social class only shows that the visits of people of working age mainly focus on the diagnosis and treatments of the pathologies perceived by the patient; but are not used to assess preventive health status.

Another aspect in which we also agree with almost all authors [10,20], is that the prevalence of CVR factors is greater in men, and it is also very noticeable. One factor that could explain, at least in part, these differences is that, according to the 2007 ESPID, women do more frequent medical appointments and, therefore, have better controlled parameters than men [12].

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The main contribution of this study is twofold: firstly, it shows the role of occupational health units in the early detection of CVR factors through labor medical examinations, and, secondly, it highlights the
### Table 3: Prevalence of high anthropometric, clinical and analytical parameters according to sociodemographic variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>20-29 years</th>
<th>30-39 years</th>
<th>40-49 years</th>
<th>≥ 50 years</th>
<th>p-value</th>
<th>Social class I</th>
<th>Social class II</th>
<th>Social class III</th>
<th>p-value</th>
<th>Primary education</th>
<th>Secondary education</th>
<th>University</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>overweight</td>
<td>17.9</td>
<td>21.6</td>
<td>30.2</td>
<td>38.5</td>
<td>&lt;0.0001</td>
<td>18.0</td>
<td>23.6</td>
<td>29.8</td>
<td>&lt;0.0001</td>
<td>30.4</td>
<td>23.9</td>
<td>17.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>obesity</td>
<td>9.0</td>
<td>11.7</td>
<td>13.9</td>
<td>17.1</td>
<td>&lt;0.0001</td>
<td>6.7</td>
<td>9.4</td>
<td>16.4</td>
<td></td>
<td>16.4</td>
<td>10.6</td>
<td>6.1</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>WHtR ≥ 0.5</td>
<td>12.2</td>
<td>17.3</td>
<td>25.3</td>
<td>31.9</td>
<td>&lt;0.0001</td>
<td>13.6</td>
<td>22.9</td>
<td>21.7</td>
<td>&lt;0.0001</td>
<td>25.0</td>
<td>18.4</td>
<td>13.9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Pre Hypertension</td>
<td>26.5</td>
<td>28.9</td>
<td>39.3</td>
<td>46.4</td>
<td>&lt;0.0001</td>
<td>25.6</td>
<td>33.0</td>
<td>37.4</td>
<td>&lt;0.0001</td>
<td>38.9</td>
<td>32.0</td>
<td>24.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hypertension 1</td>
<td>1.8</td>
<td>3.0</td>
<td>7.2</td>
<td>15.0</td>
<td>&lt;0.0001</td>
<td>2.1</td>
<td>5.4</td>
<td>7.2</td>
<td></td>
<td>7.7</td>
<td>4.9</td>
<td>2.1</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hypertension 2</td>
<td>0.3</td>
<td>0.9</td>
<td>2.2</td>
<td>4.2</td>
<td>&lt;0.0001</td>
<td>0.6</td>
<td>1.3</td>
<td>2.2</td>
<td></td>
<td>2.3</td>
<td>1.3</td>
<td>0.5</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>cholesterol borderline</td>
<td>17.3</td>
<td>24.4</td>
<td>35.9</td>
<td>45.7</td>
<td>&lt;0.0001</td>
<td>24.8</td>
<td>30.0</td>
<td>30.8</td>
<td>&lt;0.0001</td>
<td>31.8</td>
<td>28.9</td>
<td>24.2</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>cholesterol high</td>
<td>3.4</td>
<td>5.2</td>
<td>10.7</td>
<td>25.5</td>
<td>&lt;0.0001</td>
<td>6.4</td>
<td>9.5</td>
<td>10.5</td>
<td></td>
<td>10.7</td>
<td>9.4</td>
<td>6.2</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>HDL-c low</td>
<td>1.8</td>
<td>3.4</td>
<td>3.9</td>
<td>5.5</td>
<td>&lt;0.0001</td>
<td>2.4</td>
<td>4.0</td>
<td>3.5</td>
<td>0.001</td>
<td>3.7</td>
<td>3.7</td>
<td>2.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>LDL-c borderline</td>
<td>13.7</td>
<td>19.8</td>
<td>28.8</td>
<td>34.7</td>
<td>&lt;0.0001</td>
<td>18.2</td>
<td>24.1</td>
<td>24.6</td>
<td></td>
<td>25.5</td>
<td>23.1</td>
<td>17.7</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>LDL-c high</td>
<td>4.7</td>
<td>8.6</td>
<td>15.7</td>
<td>33.5</td>
<td>&lt;0.0001</td>
<td>9.3</td>
<td>13.3</td>
<td>15.2</td>
<td></td>
<td>15.6</td>
<td>13.1</td>
<td>9.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>triglycerid borderline</td>
<td>2.9</td>
<td>3.3</td>
<td>4.4</td>
<td>6.4</td>
<td>&lt;0.0001</td>
<td>2.5</td>
<td>4.2</td>
<td>4.3</td>
<td>&lt;0.0001</td>
<td>4.7</td>
<td>3.7</td>
<td>2.5</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Triglycerid high</td>
<td>1.4</td>
<td>1.6</td>
<td>2.4</td>
<td>4.2</td>
<td>&lt;0.0001</td>
<td>1.4</td>
<td>2.0</td>
<td>2.5</td>
<td></td>
<td>2.5</td>
<td>2.1</td>
<td>1.2</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>IFG</td>
<td>2.6</td>
<td>4.3</td>
<td>7.9</td>
<td>12.7</td>
<td>&lt;0.0001</td>
<td>4.2</td>
<td>5.6</td>
<td>7.3</td>
<td>&lt;0.0001</td>
<td>7.8</td>
<td>5.2</td>
<td>4.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>diabetes</td>
<td>0.3</td>
<td>0.4</td>
<td>0.9</td>
<td>1.6</td>
<td></td>
<td>0.8</td>
<td>0.4</td>
<td>0.8</td>
<td></td>
<td>0.5</td>
<td>0.9</td>
<td>0.9</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

### Table 4: Prevalence of high anthropometric, clinical and analytical parameters according to healthy habits.

<table>
<thead>
<tr>
<th>Variable</th>
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<th>p-value</th>
<th>no exercise</th>
<th>yes exercise</th>
<th>p-value</th>
<th>no feeding</th>
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<tr>
<td>overweight</td>
<td>23.8</td>
<td>27.1</td>
<td>&lt;0.0001</td>
<td>42.9</td>
<td>12.0</td>
<td>&lt;0.0001</td>
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<td>14.8</td>
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<tr>
<td>obesity</td>
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<td>13.6</td>
<td>&lt;0.0001</td>
<td>28.0</td>
<td>0.0</td>
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<td>26.9</td>
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<td>&lt;0.0001</td>
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<tr>
<td>WHtR &gt; 0.5</td>
<td>18.8</td>
<td>21.9</td>
<td>&lt;0.0001</td>
<td>40.5</td>
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<td>4.5</td>
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<tr>
<td>Pre Hypertension</td>
<td>32.8</td>
<td>34.8</td>
<td>0.001</td>
<td>42.5</td>
<td>27.3</td>
<td>&lt;0.0001</td>
<td>41.5</td>
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<td>&lt;0.0001</td>
</tr>
<tr>
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<td>6.0</td>
<td>&lt;0.0001</td>
<td>9.6</td>
<td>2.7</td>
<td>&lt;0.0001</td>
<td>9.3</td>
<td>2.7</td>
<td>&lt;0.0001</td>
</tr>
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</table>
need for further studies to respond to the unresolved hypotheses and to explain why these workers have not been previously evaluated. These studies could also give us information on the frequency of use of the health services and their accessibility. Once these data are known we could fully analyze the reason we obtained such rates of under diagnosed CVR factors.

REFERENCES


