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Laboratory values in a Spanish population of older adults: A comparison with reference values from younger adults

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ABSTRACT

Objective: To examine the laboratory indices in a population aged 65 years or more and compare them with the reference values used for young adults.
Study design: Distribution patterns of frequently used biochemical and hematological indices were examined in a sample ($N = 600$) of non-institutionalized adults aged over 65.
Outcome measures: The obtained values were compared with the reference intervals for young adults.
Results: On some of the indices analyzed, large proportions of the participants had values above the upper limit of the reference interval: glucose, 25.0%; urea, 26.6%; creatinine, 27.2% of males; total cholesterol, 54.6%; and low-density lipoprotein cholesterol, 35.8%. Of the participants who met the World Health Organization's diagnostic criteria for diabetes, 31.8% said they had not been previously diagnosed. Similarly, 74.9% of subjects with total cholesterol values above the reference value indicated in the European guidelines on cardiovascular disease said they had not been diagnosed with dyslipidemia, as did 75.5% of those with low-density lipoprotein cholesterol values above the European reference value. The proportion of participants who were not aware that they might be suffering from those disorders was significantly higher among those who reported not having visited their doctor within the last 6 months.
Conclusion: Further studies should examine whether the use of adapted, more appropriate reference values for elderly populations will help physicians to make early and correct diagnoses and to decide when medical intervention is required.

1. Introduction

Laboratory tests are used to detect pathology and confirm diagnoses. To interpret the results of these tests, it is necessary to compare them with reference values drawn from a healthy population. Unfortunately, the reference population often largely comprises young adults, and this may make the reference values inappropriate for an elderly patient. For example, significant age-related changes have been observed in hematological profile [1]. Since the use of inappropriate reference values may impede the detection of pathologies in older adults, it would be useful to establish age-specific reference values.

Few papers have included reference values for adults aged over 65 and some even of these studies have included younger subjects [1,2]. A further problem is that where age-appropriate reference intervals have indeed been based wholly on samples of healthy older subjects [2–6], the criteria used to determine their 'healthy' status have varied across studies.

Most research done with elderly adults not suffering severe disorders has shown that their biochemical parameters are in fact within the conventional reference values for young adults [3,4]. Nevertheless, some biochemical and hematological indices have shown wider normal (healthy) reference intervals for older adults than for young adults [7].

A likely reason for the lack of reference values specific to an elderly population is that older adults have a relatively high prevalence of chronic pathologies such as diabetes, dyslipidemia, dementia, renal disease and anemia [8–11], as well as high comorbidity [12], which makes it difficult to find an appropriate healthy reference sample. Furthermore, a large proportion of older subjects regularly take medication [13] and many of them are dependent in activities of daily living (ADL) and instrumental activities of daily living (IADL) [14]. Again, the use of a strict health criterion is likely to result in a small and unrepresentative sample of the elderly population [5].

In this study we determined biochemical and hematological indices for a representative sample of adults aged over 65 years and

Abbreviations: ALAT, alanine aminotransferase; AST, aspartate aminotransferase; ESR, erythrocyte sedimentation rate; GGT, gamma glutamyl transpeptidase; HCT, hematocrit; Hb, hemoglobin; HDL-cholesterol, high-density lipoprotein cholesterol; LDL-cholesterol, low-density lipoprotein cholesterol; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; MCV, mean corpuscular volume; TSH, thyroid-stimulating hormone.

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compared them with the reference values derived from a younger general adult population.

2. Methods

2.1. Subjects

A cross-sectional descriptive study was carried out on a representative sample of 600 people (257 men, 343 women) aged 65 years or more (75.1 ± 7.5, range 65–101), randomly selected from the Narón municipal register (A Coruña, Spain). The level of confidence was 95%, accuracy ± 4%, and estimation for data losses 10%.

Participants were individually assessed in a health center. Before data collection, all participants were informed about the study and signed the corresponding informed consent form. The study protocol was approved by the Ethics Committee at the University of A Coruña and conformed to the principles embodied in the Declaration of Helsinki.

2.2. Diabetes and dyslipidemia

Medical histories were given by the patients or their relatives and their medical records were consulted. The Older Americans Resources and Services (OARS) standardized questionnaire [15] was used to elicit information regarding pathologies and any visits to the doctor within the last 6 months.

Locally derived and used reference intervals were used for evaluation of all the indices (see below). In addition, the World Health Organization (WHO) reference values for diabetes were consulted [16], as were values cited in the 'European guidelines on cardiovascular disease' [17] for high total cholesterol and high low-density lipoprotein cholesterol (dyslipidemia).

2.3. Blood collection

Distribution patterns of the biochemical and hematological indices commonly analyzed in clinical chemistry were explored. The specific biochemical indices analyzed were glucose, urea, creatinine, uric acid, aspartate aminotransferase (AST), alanine aminotransferase (ALAT), gamma glutamyl transpeptidase (GGT), total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-cholesterol), low-density lipoprotein cholesterol (LDL-cholesterol), phosphorus, calcium and thyroid-stimulating hormone (TSH). The specific hematological indices analyzed were leucocyte count, erythrocyte count, hemoglobin (Hb), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), platelet count and erythrocyte sedimentation rate (ESR).

Blood samples were collected at a primary health care center. For all participants, samples were drawn in the morning, after an overnight fast. Samples for the biochemical indices were collected into SST-gel tubes and those for the hematological indices into EDTA tubes. For determination of the biochemical and hematological indices, analyses were done using 4 ml Vacutainer tubes (Becton Dickinson); Seditainer tubes were used for the ESR determination. Biochemistry tubes were centrifugated at room temperature at 3000 rpm. The biochemical indices were determined using an Advia analyzer (Bayer Diagnostics) and the hematological indices were determined using a Beckman-Coulter analyzer. All measurements were reported in SI units.

All analyses were performed in the laboratories of the Complejo Hospitalario Universitario (CHUAC) in A Coruña city on the day of sample collection.

2.4. Statistical analysis

A descriptive analysis of the biochemical and hematological indices was carried out; the mean (standard deviation) and median values, maximum and minimum values and the 2.5th and 97.5th percentiles were calculated for each parameter. These values were compared with the CHUAC reference intervals used by the Galician Health Service (SERGAS). Gender-specific intervals were used where appropriate. The number and percentage of sample results that were higher or lower than the CHUAC reference intervals were identified. Results that were more than 5% above the upper end of the reference interval or 5% below the lower value were considered to be significantly different from a population perspective.

For any indices on which more than 25% of participants returned values above those of the reference intervals, further exploration was done. This applied to glucose and cholesterol. The number and percentage of subjects with had glucose levels above the reference interval who reported having been diagnosed with diabetes were noted, as were the number and percentage of subjects with levels of cholesterol above the reference value who reported having been diagnosed with dyslipidemia. Finally, a chi-square test was performed to determine whether awareness of a diagnosis of dyslipidemia and diabetes was related to having visited a doctor within the last 6 months.

Statistical analysis was performed using SPPS software version 16.0.2 [18].

3. Results

Table 1 summarizes the results for each biochemical and hematological index for the whole sample.

Table 2 shows the reference intervals for the biochemical and hematological indices, and the number and frequency of values from the study sample that fell below and above those intervals.

3.1. Biochemical indices (see Tables 1 and 2)

The mean glucose concentration in the study sample was 5.5 ± 1.4 mmol/l, and 25.0% of the subjects had glucose values above the CHUAC reference interval. The mean urea concentration was 7.6 ± 2.5 mmol/l, and 26.6% of participants had values above the reference interval. Among women, the mean creatinine level was 89 ± 18 μmol/l and among men it was 106 ± 27 μmol/l; 13.0% of the women and 27.2% of the men had values above the reference interval. The mean concentration of uric acid was 300 ± 72 μmol/l in women and 377 ± 90 μmol/l in men; 24.5% of women and 22.9% of men had values above the reference interval.

If we refer to transaminases, the mean AST value was 0.37 ± 0.27 μkat/l, and 97% of participants were within the reference range. The mean ALAT value was 0.43 ± 0.54 μkat/l in women and 0.45 ± 0.25 μkat/l in men; 6.3% of women and 8.1% of men had ALAT levels above the reference interval. The mean GGT value was 22 ± 29 U/l and it was found that 10.1% of all participants had GGT levels above the reference interval.

As regards cholesterol, mean values were 5.8 ± 1.1 mmol/l for total cholesterol, 1.5 ± 0.4 mmol/l for HDL-cholesterol and 3.6 ± 0.9 mmol/l for LDL-cholesterol; 54.6% of the sample had levels of total cholesterol above the reference value, and 35.8% had levels of LDL-cholesterol above the reference value.

The mean concentration of triglycerides was 1.8 ± 1.1 μmol/l, and 12.9% of participants had levels above the reference interval. The mean concentration of phosphorus was 1.0 ± 0.2 mmol/l, and 8.6% of the subjects had levels below the reference interval. The mean calcium concentration was 2.3 ± 0.1 mmol/l, and 99.0% of participants were within the reference range. The TSH mean value