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Original Article

Prevalence of Prediabetes and Associated Factors in the Oldest Old. A Cross Sectional Study in the Octabaix Cohort☆

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SUMMARY

Background: The leading high-risk state for diabetes mellitus (DM) – prediabetes – is increasing; however, a lack of information exists in oldest old subjects. The objective of this study is to describe the rate of prediabetes and the associated factors among community-dwelling 85-year-olds.

Methods: A cross-sectional survey including data from 321 subjects on cardiovascular risk factors, functional status, comorbidities and laboratory tests was conducted. Participants were divided in three groups: normoglycemic (fasting plasma glucose (FPG) < 5.6 mmol/L), prediabetes (FPG 5.6–6.9 mmol/L) and DM (FPG ≥ 7 mmol/L, or DM diagnostic, or antidiabetics use). Comparative analysis was performed between the 3 groups.

Results: One hundred seventy-nine (55.8%) participants were classified as normoglycemic, 86 (26.8%) as DM and 56 (17.4%) as prediabetic. Multinomial logistic regression model found no association of explanatory variables with normoglycemia in front of prediabetes, while there was significant association with DM (rather than prediabetes) and Angiotensin converting enzyme (ACE) treatment (OR: 7.04 95% CI 2.52–19.61), diuretics (OR: 2.46, 95% CI 1.04–5.78) and Charlson Index (OR: 2.67, 95% CI 1.77 –4.02), with higher odds of being in DM than in prediabetic group.

Conclusion: Prevalence of prediabetes is high among the 85-year-old population studied. The comparison between prediabetic and DM groups revealed that the major clinical differences were the higher Charlson comorbidity Index scores, diuretics and ACE drugs in the DM group.

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1. Introduction

Diabetes mellitus (DM) represents one of the most serious challenges for health care systems worldwide. Approximately one-third of the elderly have DM, more than 60% of those patients with DM die due to vascular disease complications and an even greater percentage of the very old population develop other geriatric syndromes related to DM[1,2]. In the elderly, DM is clinically heterogeneous and its leading high-risk state, prediabetes—intermediate state of hyperglycemia—, is increasing. Currently, 50% of US adults older than 65 years have prediabetes and around 5–10% of them become diabetic every year[3,4]. Clinical improvements, lifestyle modifications, and pharmacotherapy interventions in prediabetic individuals have shown benefits for conversion back to normoglycemia and to diminish the incidence of diabetes. This is particularly significant in the older population[5]. In accordance, the European Diabetes Working Party for Older People

☆ Conflicts of interest: All contributing authors declare that they have no conflicts of interest.

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and the International Task Force of Experts in Diabetes[6,7] have led a major international movement toward large scale diabetes prevention efforts and for targeting those aged patients with diabetes.

The aim of this study was to evaluate the prediabetic status and its associated factors in a community-dwelling of 85-year-old subjects (Octabaix study).

2. Materials and methods

2.1. Study subjects

The Octabaix study is a prospective population-based investigation of 328 subjects, born in 1924 (aged 85 at the time of enrollment in 2009) described in detail elsewhere[8]. All participants were registered in one of the seven primary healthcare centers belonging to the Catalan Institute of Health. All primary care teams were placed in the South Metropolitan Area of Barcelona, Catalonia, Spain, and served a population of approximately 210,000 inhabitants, being the Hospital Universitari de Bellvitge the referral hospital. In brief, of a total of 696 potential participants, 487 were considered eligible to be included in the Octabaix study. Exclusion criteria were to live in a nursing home or the impossibility to contact at the time of enrollment. Compromised health status was not considered among the exclusion criteria. The study was approved by the institutional ethics committee of the Jordi Gol Institute for Primary Care Research. All patients or caregivers of those cognitively impaired subjects gave their written informed consent prior to the study enrollment.

All data were collected by personal interview and on the basis of a review of electronic medical data. A total of 321 participants (67.5%) were finally included in the present study. All participants were examined—in their place of residence or in the primary healthcare center—by a physician-nurse primary care team with long and trained experience attending elderly people.

2.2. Measures

Collected variables included: social and demographic information, geriatric assessment, hypertension, diabetes, dyslipidemia, other chronic conditions, laboratory and drug prescription data.

2.3. Geriatric assessment

Functional status measured using Barthel Index (BI)[9] for basic activities of daily living (ADL) and Lawton Index (LI)[10] for instrumental activities of daily living (IADL). Cognitive status was evaluated with the adapted and validated Spanish version of Minimental State Examination (MEC)[11]. Nutritional status was assessed using Mini Nutritional Assessment (MNA)[12]. Quality of life (QoL) was assessed using EuroQol 5-Dimension 3L[13] with the visual analog scale of perceived health (EQ-EVA).

2.4. Clinical data

Comorbidity was measured with Charlson comorbidity Index[14] and information regarding written diagnosis of the most common chronic conditions as stroke, heart failure, vasculopathy, ischemic cardiopathy and renal failure[15] was also recorded.

2.5. Laboratory data

It included total leukocytes (WBC), hemoglobin, platelets, fasting plasma glucose (FPG), creatinine, estimated glomerular filtration rate (eGFR) using the Modification Diet in Renal Disease formula MDRD-4, total cholesterol, high (HDL-C) and low (LDL-C) density lipoprotein cholesterol.

2.6. Procedure

For the present study, we analyzed participants who at baseline had undergone a blood test to assess FPG. Participants were defined as having DM according to self-report, clinical reports, use of antidiabetic agents and FPG ($\geq$7 mmol/L). Hemoglobin A1c (HbA1c) was not included as a criteria because the Octabaix study was planned and the data compiled in 2009, and it was not until 2010 when the American Diabetes Association clearly recommended the HbA1c in DM definition[16]. Non DM participants were divided into normoglycemic or prediabetic group as follows: FPG < 5.6 mmol/L, (normoglycemic) or FPG 5.6–6.9 mmol/L (prediabetes).

2.7. Statistical analyses

Descriptive categorical variables were given as absolute and relative frequencies [n (%)]. Continuous variables were presented in terms of means and Standard Deviations (SD) or median and interquartile range (IQR) depending on normality of variables (tested with the Kolmogorov–Smirnov test). In the bivariate analysis, Fisher's exact test was used for the comparison of categorical variables while parametric Student's T test, or the non-parametric Kruskal–Wallis or Mann–Whitney U test were applied to compare continuous variables. In order to evaluate the adjusted association of aforementioned factors on being normoglycemic or diabetic in relation to the prediabetes group, a multinomial logistic regression model was fit, in which the categorical dependent variable was “normoglycemia”, “prediabetes” or “DM” (with “prediabetes” as the reference category), and significant variables in bivariate analyses were included as explanatory variables. Despite of the ordinal nature of the dependent variable, ordered logistic regression was not adjusted because the aim of the study was not the association of factors with a latent degree of diabetes but the differential profile of prediabetes in front of normoglicemia and diabetes. As all the participants were the same age, adjusting for age was not applied.

The adjusted odds ratio (OR) with a 95% confidence interval (CI) was calculated and results were considered significant when $p < 0.05$. All statistical analyses were performed by using R 2.14.2 software.

3. Results

Of the 321 inhabitants analyzed, 197 were women (61.4%). Comorbidity measured by Charlson Index revealed a mean of 1.5 (±1.6 SD). Hypertension had been previously diagnosed in 245 (76.3%) participants, dyslipidemia in 163 (50.8%), stroke in 49 (15.3%), heart failure in 42 (13.1%), chronic kidney disease in 23 (7.2%) and ischemic cardiopathy in 20 (6.2%). Regarding geriatric assessment, the mean for BI was 87.6 (±19.3 SD) and 5.4 (±2.6 SD) for LI. When evaluating cognitive status, the mean MEC score was 26.7 (±6.9 SD) and when assessing nutritional status, the median MNA score was 25.0 [IQR 22.5–27.5]. The mean EQ-5D EVA was 62.4 (±21.3 SD). In detail, 113 (35.2%) subjects were on hypolipemic therapy, 184 (57.3%) were using angiotensin converting enzyme (ACE) drugs (which included 122 (38.0%) ACE inhibitors and 62 (19.3%) angiotensin receptor blockers), 41 (12.8%) b-blockers and 142 (44.2%) were on diuretic treatment, with a median of 6 [IQR 4–8] chronically prescribed drugs. Blood measurements revealed the following values: WBC 6.6 $\times$ 10^3 cells/μL [IQR 5.4–7.8], hemoglobin 13.3 g/dL [IQR 12.2–14.3], creatinine 89.8 μmol/L (±30.2 SD), total cholesterol

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