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ORIGINAL ARTICLE

Prevalence of erectile dysfunction in Spanish primary care setting and its association with cardiovascular risk factors and cardiovascular diseases. SIMETAP-ED study

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Abbreviations: ACR, albumin/creatinine ratio; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BMI, body mass index; BMSFI, Brief Male Sexual Function Inventory; CHD, coronary heart disease; CI, 95% confidence interval; CKD, chronic kidney disease; CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident or disease, stroke; CVD, cardiovascular disease; CVR, cardiovascular risk; CVRF, cardiovascular risk factors; DBP, diastolic blood pressure; DM, diabetes mellitus; ED, erectile dysfunction; eGFR, estimated glomerular filtration rate (CKD-EPI); FPG, fasting plasma glucose; GGT, gamma-glutamyl transferase; HbA1c, glycated hemoglobin A1c; HDL-C, high-density lipoprotein cholesterol; ICD-9, International Classification of Diseases; ICPC-2, International Classification of Primary Care; IIEF, International Index of Erectile Function; INE, Instituto Nacional de Estadística (Spanish Statistics Institute); IQR, interquartile range; MetS, metabolic syndrome; NIH, National Institutes of Health, Consensus Development Panel on Impotence; Non-HDL-C, non high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; OR, odds-ratio; PAD, peripheral arterial disease; SBP, systolic blood pressure; SD, standard deviation; SERMAS, Madrid Region Health Service; TC, total cholesterol; TG, blood triglycerides; UAE, urinary albumin excretion; VLDL-C, very low-density lipoprotein cholesterol.

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◊ See Annex.

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KEYWORDS
Cardiovascular disease;
Erectile dysfunction;
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Abstract
Introduction: Few studies conducted in primary care setting report about age-adjusted prevalence rates of erectile dysfunction (ED). Aims of SIMETAP-ED study were to determine crude and age-adjusted prevalence rates of ED diagnosis, to compare these rates with other similar studies, and to compare prevalence rates of cardiovascular risk factors (CVRF), cardiovascular diseases (CVD), metabolic diseases and chronic kidney disease (CKD) between populations with and without ED.
Methods: Cross-sectional observational study conducted in primary care setting. Population-based random sample: 2934 adult men. Response rate: 66%. A clinical interview was conducted to diagnose ED using a question derived from ED definition. The medical records of patients were reviewed to identify their CVRF and diseases associated with ED. The age-adjustments were standardized to Spanish population.
Results: The prevalence rates of metabolic diseases, CVD, CVRF, and CKD in population with ED were higher than population without ED, highlighting the CVD.

The crude prevalence of ED was 17.2% (95% confidence interval: 15.8–18.6). The age-adjusted prevalence rates of ED were 0.71% in men under 40 years, 12.4% in men over 18 years, 10.8% in men aged 40–69 years, 18.9% in men over 40 years, and 48.6% in men over 70 years.
Conclusions: SIMETAP-ED study showed association of ED with metabolic diseases, CKD, CVRF, and highlighting CVD.

The age-adjusted prevalence of ED was 12.4% in adult men, 19% in men over 40 years, and almost 50% in men over 70 years.
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PALABRAS CLAVE
Enfermedad cardiovascular;
Disfunción eréctil;
Prevalencia

Prevalencia de la disfunción eréctil en el ámbito de la atención primaria española y su asociación con factores de riesgo cardiovasculares y enfermedades cardiovasculares. Estudio SIMETAP-ED

Resumen
Introducción: Existen pocos estudios realizados en atención primaria sobre prevalencias ajustadas por edad de la disfunción eréctil (ED, por sus siglas en inglés). Los objetivos del estudio SIMETAP-ED fueron determinar las prevalencias crudas y ajustadas por edad del diagnóstico de la ED, comparar estas tasas con otros estudios similares, y comparar las prevalencias de factores de riesgo cardiovasculares (FRCV), enfermedades cardiovasculares (ECV), enfermedades metabólicas y enfermedad renal crónica (ERC) entre las poblaciones con y sin ED.

Métodos: Estudio observacional transversal realizado en atención primaria. Muestra aleatoria base poblacional: 2.934 varones adultos. Tasa de respuesta: 66%. Se realizó una entrevista clínica para diagnosticar ED mediante una pregunta derivada de la definición de ED. Se revisaron las historias clínicas de los pacientes para identificar sus FRCV y enfermedades asociadas con la ED. Los ajustes de tasas se estandarizaron con respecto a la población española.
Resultados: Las prevalencias de enfermedades metabólicas, ECV, FRCV y ERC en la población con ED fueron más altas que en la población sin ED, destacando las ECV.

La prevalencia cruda de la ED fue del 17,21% (intervalo de confianza del 95%: 15,86-18,63). Las tasas de prevalencia ajustadas por edad de la ED fueron del 0,71% en menores de 40 años, del 12,4% en mayores de 18 años, del 10,8% en varones entre 40 y 69 años, del 18,9% en mayores de 40 años y del 48,6% en mayores de 70 años.
Conclusiones: El estudio SIMETAP-ED mostró asociación de la ED con las enfermedades metabólicas, ERC, FRCV y, sobre todo, con ECV.

La prevalencia ajustada por edad de la ED fue del 12,4% en varones adultos, del 19% en mayores de 40 años y casi del 50% en mayores de 70 años.
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Introduction

The erectile dysfunction (ED) is defined as the inability to achieve or maintain an erection sufficient for satisfactory sexual performance according to National Institutes of Health Consensus Development Panel on Impotence (NIH).[1] The ED is associated with cardiovascular risk factors (CVRF), increases risk of coronary heart disease (CHD), stroke (CVA) and all-cause mortality, and may be an early manifestation of cardiovascular disease (CVD).[2–4] The ED is a common disorder worldwide with higher prevalence in men over 40 years old (yr). Furthermore, ED is an important disorder in any stage of life due to unsatisfactory sex life, and psychological problems affecting quality of life and relationship with their partners.[2]

Many scales, single questions or self-administered questionnaires are used to diagnose ED, even though there is a main definition of ED.[1] Some examples of assessment tools of ED are following: Brief Male Sexual Function Inventory (BMSFI)[5] questionnaire about erectile function; Keed questionnaire,[6] with 18-item for evaluation of ED, six of them for assessing erectile and orgasmic function; Boxmeer definition[7] based on a positive answer on the question about problems getting an erection; Krimpen definition[8] based on a questionnaire, rigidity of erections and clinical relevant. The International Index of Erectile Function (IIEF)[9] is the best known. The IIEF questionnaire[9] is a psychometric tool designed to assess sexual function but it has also been used as diagnostic tool for ED. It includes the erectile function domain (EF-IIEF), and the abridged 5-item version (IIEF-5),[10] suitable for basic assessment work-up in patients with ED.[2] Question number 15 of IIEF questionnaire[9] is also used in some studies to assess confidence on getting an erection. This variability of the criteria for ED diagnoses may also increase the variability of the prevalence rates. Epidemiologic studies conducted in the same country could report different prevalence rates using different assessment tools. The variability of ED prevalence may also be explained by factors that depend on study population such as comorbidities, pharmacological treatments, ethnic groups, educational level, or socioeconomic status. Finally, the following design factors dependent on researchers may have a great influence on the variability of prevalence rates: age range of study population, type of sampling (based-population, telephone or household surveys, patients attended in medical or urologic practices), biased samples, and assessment tools (single questions, questionnaires, interviewers election surveys filled at home, by phone calling or medical consultation).

The aims of SIMETAP-ED study were to determine, in a Spanish primary care setting, the crude and age-adjusted prevalence rates of the ED diagnosis in male population aged 18 or order, to compare these rates with those of other similar studies conducted to date, and to compare the prevalence of metabolic diseases, CVRF, CVD, and chronic kidney disease (CKD) between population with and without ED.

Methods

The SIMETAP-ED study was a cross-sectional study conducted by 121 family physicians selected from 64 primary care centers of Madrid Region Health Service (SERMAS), competitively selected until reaching the necessary sample size designed by the study. SIMETAP-ED study was included in SIMETAP study, which was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki), was approved by Research Commission of the Adjunct Management of Planning and Quality, Primary Care Management of SERMAS. All study subjects granted the informed consent. Material and methods (design, ethical aspects, sampling, recruitment, inclusion and exclusion criteria of study subjects, and data collection) were previously reported in this journal.[11]

For the purposes of this study, ED was considered according to the definition of the NIH Consensus Conference[1] as inability to achieve or maintain an erection sufficient for satisfactory sexual performance. The diagnosis of ED was determined by the physician after asking the patient the following question derived from the NIH definition[1]: Do you usually have inability to achieve or maintain an erection sufficient for satisfactory sexual performance? The researchers diagnosed ED if the patients answered that they did suffer from the aforementioned inability. The definitions of the comorbidities assessed were also previously reported in this journal.[11] It was considered that patients had the comorbidities assessed if these diseases or their related codes of International Classification of Primary Care – 2nd edition (ICPC-2)[12] or International Classification of Diseases – 9th revision, clinical modification (ICD-9)[13] were registered in their medical records.

The population attached to SERMAS was 5,144,860 adults (99.0% of census), whose health care was performed in 260 primary care centers. A population-based sample (4462 men) was obtained from all male population aged 18 and older with no upper age limit assigned to family physicians (85,871 men). From this finite population, sample size was calculated for the 95% confidence level, 0.035 for confidence interval width (margin of error 1.75%), $P = 0.5$ for expected proportion, and considering 35% for non-responding, losses and dropouts.

Statistical analysis was performed with Statistical Package for the Social Sciences program (IBM® SPSS® Statistical release 20.0, Armonk, NY, USA). Continuous variables were analyzed with mean and standard deviation (±SD), range, median, and interquartile range Q1–Q3 (IQR). Qualitative variables, crude and age-specific prevalence estimates were calculated and presented with lower and upper limits of 95% confidence interval (CI). The Student *t* test or analysis of variance (ANOVA) was used for between-group comparisons for continuous variables, and the chi-square test was used for categorical variables. The multivariate logistic regression analysis with the enter method was the applied model to assess the effect on ED (dependent variable) of those CVRF and comorbidities (independent variables) that the previously performed bivariate analysis showed a statistically significant association with the dependent variable. The variables metabolic syndrome (MetS) and CVD were not included in the multivariate analysis because these entities encompass other variables already included in the analysis. All tests were considered statistically significant if two-tailed *P*-value was <0.05.

The prevalence rates were reported as crude and age-adjusted rates. The age-adjusted prevalence rates were calculated by the direct method,[14] standardized to Spanish male adult population. The age distribution of Spanish population was obtained from the database of the Spanish Statistics Institute (INE)[15] dated January 2015.

The Medline, PubMed, Embase, Google Scholar, and Web of Science databases of studies published from January 2000 to date were reviewed to compare the prevalence rates. The search strategy included the terms prevalence, erectile dysfunction, population-base, and primary care; and excluded the terms incidence, lower urinary tract symptoms, male infertility and sexual dysfunction.

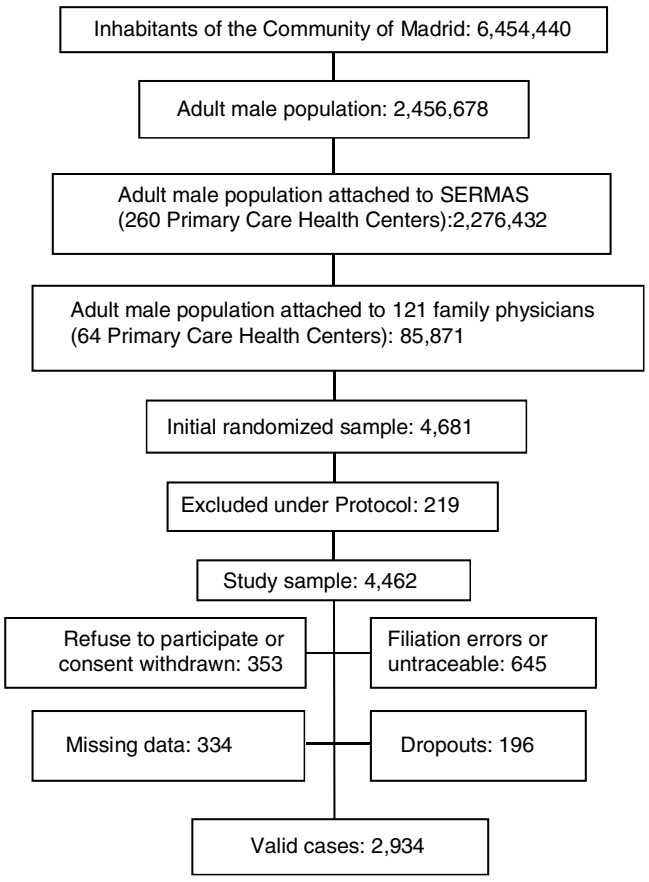

Figure 1 Flow chart the sampling process of the SIMETAP-ED study.

Results

The Spanish adult male population was 18,526,109 men and the adult male inhabitants from Madrid Region were 2,456,378 men.[11] A sample with 4462 adult men from Madrid Region was obtained after excluding 4.7% per protocol (terminal patients, institutionalized patients, or with cognitive impairment). Response rate was 65.8%. Rejected participation in study or consent withdrawn was 7.6% of initial sample; 13.8% had filiation errors or were untraceable after an active search. Study subjects with missing data or with medical records without relevant clinical information were 7.1%. Losses and dropouts who did not meet the clinical interview were 4.2%. The study population was 2934 men aged 18.01–102.12 yr (Fig. 1).

The median age of study population was 54.75 (IQR: 42.01–67.35) yr, and its average age was 55.06 (SD: ±16.90) yr. The range age of the population with ED was 26.06–102.12 yr, and its median age was 73.28 (IQR: 62.82–81.77) yr. The range age of the population without ED was 18.01–88.73 yr, and its median age was 51.26 (IQR: 39.98–63.36) yr.

The distribution of age-specific prevalence rates of ED increases with the age according to a natural exponential function ($y = 0.0061e^{0.831x}$) (Fig. 2). The crude and age-adjusted prevalence rates of ED of study population are outlined in Table 1.

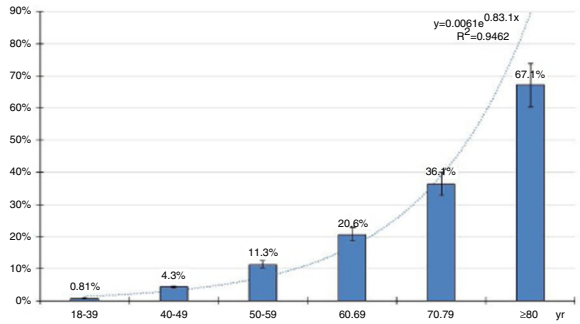

Figure 2 Distribution of age-specific prevalence rates of ED.

Table 1 Prevalence rates of ED in study population.

Age	Crude[a]	Age-adjusted[b]
Under 40 yr	0.81 (0.26–1.89)	0.71 (0.70–0.72)
40–69 yr	12.1 (10.6–13.7)	10.8 (10.7–10.8)
40–79 yr	16.3 (12.5–20.6)	14.5 (14.4–14.5)
Over 40 yr	21.6 (19.9–23.3)	18.9 (18.9–18.9)
Over 70 yr	48.7 (44.6–52.8)	48.6 (48.5–48.6)
18–102 yr	17.2 (15.9–18.6)	12.4 (12.4–12.4)

ED: erectile dysfunction; yr: years old.
[a] Crude prevalence rates % (95% confidence interval).
[b] Age-adjusted prevalence rates % (95% confidence interval).

The clinical characteristics of the study population and differences between populations with and without ED are outlined in Table 2. The values of age, systolic blood pressure (SBP), fasting plasma glucose (FPG), glycated hemoglobin A1c (HbA1c), creatinine, urinary albumin excretion (UAE), and albumin-to-creatinine ratio (ACR) were significantly higher ($P < 0.001$) in population with ED than in population without ED. The values of diastolic blood pressure (DBP), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), non-high-density lipoprotein cholesterol (non-HDL-C), alanine-aminotransferase (ALT) and estimate glomerular filtration rate (eGFR) according to CKD-EPI (Chronic Kidney Disease EPIdemiology Collaboration) were significantly lower ($P < 0.001$) in population with ED than in population without ED.

The CVRF and comorbidities of the populations with and without ED are outlined in Table 3. The differences between both populations of the percentages of all variables were significant, except alcohol consumption, physical inactivity, hypertriglyceridemia and high cardiovascular risk (CVR). The prevalence rates of the variables current smoker, low CVR and moderate CVR were significantly lower in the population with ED. The result of the multivariate analysis of the CVRF and comorbidities associated with ED is outlined in Table 4.

Table 2 Clinical characteristics of the study population.

	With ED		Without ED		Mean difference (%)	*P*-value
	N	Mean (SD)[a]	*N*	Mean (SD)[a]		
Age (years)	505	71.9 (12.9)	2429	51.6 (15.5)	20.4	<0.001
BMI (kg/m^2)	505	28.3 (4.1)	2429	27.8 (4.6)	0.5	0.029
SBP (mmHg)	505	126.8 (15.1)	2429	123.5 (13.8)	3.3	<0.001
DBP (mmHg)	505	73.5 (9.6)	2429	75.2 (9.4)	−1.7	<0.001
FPG (mg/dL)[b]	504	111.0 (35.4)	2400	97.4 (26.2)	13.6	<0.001
HbA1c (%)[c]	465	6.2 (1.1)	1891	5.6 (0.9)	0.6	<0.001
TC (mg/dL)[d]	504	175.1 (38.4)	2400	191.0 (38.6)	−15.9	<0.001
HDL-C (mg/dL)[d]	504	49.0 (13.2)	2400	49.3 (12.5)	−0.3	0.662
LDL-C (mg/dL)[d]	494	100.5 (34.0)	2366	115.1 (33.9)	−14.6	<0.001
Non-HDL-C (mg/dL)[d]	504	125.8 (38.0)	2400	140.0 (41.2)	−14.2	<0.001
TG (mg/dL)[e]	504	131.3 (86.5)	2400	136.6 (103.3)	−5.3	0.277
AST (U/L)	385	23.2 (32.7)	1726	26.2 (49.8)	−3.0	0.248
ALT (U/L)	494	25.8 (15.5)	2341	29.9 (19.8)	−4.1	<0.001
GGT (U/L)	475	45.1 (55.2)	2198	41.6 (67.0)	3.5	0.282
Creatinine (mg/dL)	504	1.06 (0.43)	2400	0.94 (0.25)	0.12	<0.001
eGFR (CKD-EPI) (ml/min/1.73 m^2)	504	74.4 (19.8)	2400	93.1 (18.2)	−18.7	<0.001
UAE (mg/dL)	436	33.3 (107.6)	1575	15.6 (72.0)	16.7	<0.001
ACR (mg/g)	436	30.9 (76.3)	1575	14.3 (63.8)	16.6	<0.001

ED: erectile dysfunction; *N*: cases number; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; FPG: fasting plasma glucose; HbA1c: glycated hemoglobin A1c; TC: total cholesterol; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; TG: blood triglycerides; AST: aspartate-aminotransferase; ALT: alanine-aminotransferase; GGT: gamma-glutamyl transferase; eGFR: estimate glomerular filtration rate; UAE: urinary albumin excretion; ACR: albumin-to-creatinine ratio.
[a] Mean (± standard deviation).
[b] To convert from mg/dL to mmol/L, multiply by 0.05556.
[c] To convert from % to mmol/mol, multiply by 0.09148 and add 2.152.
[d] To convert from mg/dL to mmol/L, multiply by 0.02586.
[e] To convert from mg/dL to mmol/L, multiply by 0.01129.

Table 3 Comorbidity and CVRF in the populations with and without ED.

	With ED		Without ED		*P*[c]	OR[d]
	Crude[a]	Age-adjusted[b]	Crude[a]	Age-adjusted[b]		
Current smoker	106 (21.0)	41.8	650 (26.8)	27.8	0.007	0.7 (0.6–0.9)
COPD	88 (17.4)	8.2	94 (3.9)	3.5	<0.001	5.2 (3.9–7.1)
Alcohol consumption	93 (18.4)	31.1	410 (16.9)	16.3	0.404	1.1 (0.9–1.4)
Physical inactivity	214 (42.4)	47.5	1045 (43.0)	42.4	0.792	1.0 (0.8–1.2)
Obesity	165 (32.7)	24.6	669 (27.5)	25.7	0.020	1.3 (1.0–1.6)
Abdominal obesity	232 (45.9)	31.4	874 (36.0)	33.6	<0.001	1.5 (1.3–1.8)
Hypercholesterolemia	385 (76.2)	68.1	1415 (58.3)	54.4	<0.001	2.3 (1.8–2.9)
Low HDL-C	177 (35.1)	41.7	662 (27.3)	26.3	<0.001	1.4 (1.2–1.8)
Hypertriglyceridemia	202 (40.0)	41.4	861 (35.5)	33.3	0.053	1.2 (1.0–1.5)
Hypertension	363 (71.9)	39.9	860 (35.4)	31.3	<0.001	4.7 (3.8–5.8)
Diabetes	211 (41.8)	22.2	357 (14.7)	12.5	<0.001	4.2 (3.4–5.1)
MetS	368 (72.9)	53.5	988 (40.7)	36.7	<0.001	3.9 (3.2–4.8)
CVD	215 (42.6)	27.5	154 (6.3)	5.5	<0.001	11.0 (9.6–13.9)
CHD	124 (24.6)	17.8	86 (3.5)	3.1	<0.001	8.9 (6.6–11.9)
CVA	71 (14.1)	5.9	57 (2.4)	2.0	<0.001	6.8 (4.7–9.8)
PAD	69 (13.7)	7.2	25 (1.0)	0.9	<0.001	15.2 (9.5–24.3)
Heart failure	57 (11.3)	2.7	23 (1.0)	0.8	<0.001	13.3 (8.1–21.8)
Low eGFR	117 (23.2)	6.6	98 (4.2)	4.2	<0.001	7.0 (5.2–9.3)
Albuminuria	91 (20.9)	9.5	115 (7.4)	6.5	<0.001	3.3 (2.5–4.5)
CKD	157 (31.2)	12.4	178 (7.5)	7.3	<0.001	5.6 (4.4–7.1)
Low CVR	7 (1.4)	24.8	770 (31.7)	37.1	<0.001	0.03 (0.01–0.06)
Moderate CVR	17 (3.4)	5.9	618 (25.4)	22.1	<0.001	0.10 (0.06–0.17)
High CVR	74 (14.7)	24.4	414 (17.0)	14.8	0.189	0.84 (0.64–1.09)
Very high CVR	407 (80.6)	44.9	679 (28.0)	24.1	<0.001	10.7 (8.4–13.6)
Hypoglycemic drugs	168 (33.3)	18.5	291 (12.0)	10.2	<0.001	3.7 (2.9–4.6)
Antihypertensive drugs	358 (70.9)	38.1	779 (32.1)	28.1	<0.001	5.2 (4.2–6.4)
Lipid-lowering drugs	295 (58.4)	39.8	633 (26.1)	22.9	<0.001	4.0 (3.3–4.9)

ED: erectile dysfunction; CVRF: cardiovascular risk factors; COPD: chronic obstructive pulmonary disease. Alcohol consumption: more of two drinks per day. Obesity: body mass index >30 kg/m^2. Abdominal obesity: waist circumference >102 cm. Hypercholesterolemia: total cholesterol >200 mg/dL. Low HDL-C: high-density lipoprotein cholesterol <40 mg/dL. Hypertriglyceridemia: triglycerides >150 mg/dL. MetS: metabolic syndrome; CVD: cardiovascular disease; CHD: coronary heart disease; CVA: cerebrovascular accident or disease, stroke; PAD: peripheral arterial disease. Low eGFR: estimated glomerular filtration rate <60 mL/min/1.73 m^2. Albuminuria: albumin to creatinine ratio >30 mg/g. CKD: chronic kidney disease (low eGFR and/or albuminuria); CVR: cardiovascular risk.

[a] Crude prevalence rate: cases number (%).

[b] Age-adjusted prevalence rate: % (95% confidence interval <0.02).

[c] *P*: *P*-value of differences of crude prevalence rates.

[d] OR: odds ratio (95% confidence interval) (crude prevalence rates).

Discussion

The higher levels of FPG and HbA1c in the population with ED (Table 2) and the higher prevalence rates of treatment with hypoglycaemic drugs versus the population without ED (OR: 3.7 [CI: 2.9–4.6]) (Table 3) could be explained because the DM was strongly associated with the population with ED (OR: 4.2 [CI: 3.4–5.1]). In the multivariate analysis, the risk of developing DM in the population with ED was 2.4 (CI: 1.8–3.0) times more likely (Table 4). Likewise, the higher prevalence rates of treatment with antihypertensive drugs in the population with ED versus without ED (OR: 5.2 [4.2–6.4]) could be justified because the hypertension had a greater association with the population with ED (OR: 4.7 (CI: 3.8–5.8]) (Table 3). In the multivariate analysis, the risk of suffering from hypertension in the population with ED was 2.0 (CI: 1.5–2.5) times more likely (Table 4). Likewise, the higher prevalence rates of treatment with lipid-lowering drugs in population with ED versus without ED (OR: 4.0 [3.3–4.9]) could be justified because hypercholesterolemia and hypertriglyceridemia had a greater association with the population with ED (OR: 2.3 and 1.2 respectively) (Table 3). The lower levels of TC, LDL-C, and non-HDL-C in population with ED (Table 1) could be explained by the higher prevalence of treatment with lipid-lowering drugs in this population (Table 3). All the comorbidities outlined in Table 4 were associated with ED, highlighting the risks of suffering from peripheral arterial disease (PAD) (OR: 7.6 [CI: 4.4–12.9]), CHD (OR: 4.1 [CI: 2.9–5.7]), and CVA (3.8 [CI: 2.5–5.9]). These results support the messages that ED is considered as an independent risk factor for CVD, and that ED and CVD could be considered as manifestations of the same systemic disorder.[2–4]

The higher prevalence rates of MetS in population with ED versus without ED (OR: 3.9 [CI: 3.2–4.8]) could be justified because the variables abdominal obesity,

Table 4 Multivariate analysis of the comorbidities and CVRF associated to ED.

	β[a]	Wald[b]	P[c]	OR Exp(β)[d]
PAD	2.02 (2.27)	54.28	<0.001	7.55 (4.41–12.93)
CHD	1.40 (0.18)	62.77	<0.001	4.06 (2.87–5.73)
CVA	1.33 (0.22)	36.55	<0.001	3.79 (2.46–5.85)
Low eGFR	1.29 (0.18)	53.09	<0.001	3.63 (2.57–5.13)
Heart failure	1.20 (0.31)	15.14	<0.001	3.33 (1.82–6.10)
COPD	1.05 (0.19)	30.62	<0.001	2.85 (1.97–4.13)
Diabetes	0.86 (0.13)	45.85	<0.001	2.37 (1.85–3.04)
Hypertension	0.67 (0.13)	28.27	<0.001	1.96 (1.53–2.51)
Intersection	−16.89 (1.05)	258.49	<0.001	NA[e]

CVRF: cardiovascular risk factors; ED: erectile dysfunction; PAD: peripheral arterial disease; CHD: coronary heart disease; CVA: cerebrovascular accident or disease, stroke; Low eGFR: estimated glomerular filtration rate <60 mL/min/1.73 m^2; COPD: chronic obstructive pulmonary disease.

[a] β coefficient ($\pm$ standard deviation of the maximum likelihood estimate of β).

[b] z-value of Wald-statistic.

[c] P: P-value of Wald test on one degree of freedom.

[d] Odds-ratio parameter Exp(β) (95% confidence interval).

[e] NA: not applicable.

hypertriglyceridemia, low HDL-C, hypertension and DM had a greater association with the population with ED (Table 2).

The higher levels of creatinine, UAE and ACR, and the lower levels of eGFR in population with ED versus without ED (Table 2) could be explained by the greater association of CKD with the population with ED (OR: 5.6 [CI: 4.4–7.1]) (Table 3). In the multivariate analysis, the risk of having low eGFR in the population with ED was 3.6 (CI: 2.6–5.1) times more likely (Table 4).

The higher prevalence rates of the very high CVR in the population with ED versus without ED (OR: 10.7 [CI: 8.4–13.6]) could be explained by the greater association of CVRF, CVD, heart failure, hypertension, DM, MetS,[16] and CKD with the population with ED (Table 3).

In the other hand, the prevalence of chronic obstructive pulmonary disease (COPD) was higher in population with ED than population without ED (OR: 5.2 [3.9–7.1]) (Table 3). In multivariate analysis, the risk of suffering from COPD was 2.9 (CI: 2.0–4.1) times more likely in the population with ED, despite the fact that smoking (current smokers) was not significantly associated with ED (Table 4).

All the crude prevalence rates of the CVRF, CVD, and CKD were higher than their age-adjusted prevalence rates. This could be explained because the average and median age of the population with ED are greater than Spanish population used for the age-adjustment. Most studies agree that the prevalence of ED increases with age, and this is confirmed in the present study (Fig. 2). However, the studies included below report a high variability of prevalence rates, probably due to the different types of sampling, response rates, age ranges evaluated, and especially due to the many scales, single questions, self-administered questionnaires or criteria[1,5–10] used to diagnose ED.

The crude prevalence of ED in men under 40 yr was 0.8% in present study, slightly lower than crude prevalence rates reported by studies conducted in Italy[17] (2%), The Netherlands[18] (2.5%), Australia[19] (3.5%), or Spain[20] (4%).

The crude prevalence of ED in men aged 40–69 yr was 12% in present study, lower than prevalence rates reported by studies conducted in Spain[20] (18%), The Netherlands[18] (22%), Australia[19] (34%), Boston[21] (35%), Brazil[22] (46%), or Germany[23] (59%). In this population, the age-adjusted prevalence of the present study (11%) was lower than prevalence rates reported by studies conducted in Brazil[24] (16%), Italy[24] (17%), Malaysia[24] (22%), Japan[24] (35%), Singapore[25] (24%), Belgium[26] (35%), New Zealand[27] (38%), or Portugal[28] (48%).

The age-adjusted prevalence of ED in men aged 40–79 yr was 14.5% in present study, similar to prevalence rates reported by studies conducted in The Netherlands[7] (13%) or Denmark[29] (16%). In this population, the crude prevalence of the present study (16%) was lower than prevalence rates reported by studies conducted in Taiwan[30] (18%), Germany[6] (19%), Boston[31] (21%), Australia[32] (23%), The Netherlands[18] (24%), Boston[5] (25%), Jordan[33] (32%), Malaysia[34] (36%), or Germany[23] (50%).

The crude prevalence of ED in men over 40 yr with no upper limit was 22% in the present study, similar to prevalence rates reported by studies conducted in Taiwan[30] (18%), Germany[6] (19%), United States[35] (22%), Australia[32] (23%), The Netherlands[18] (24%), Boston[5] (25%), or Singapore[25] (25%), and lower than prevalence rates reported by studies conducted in France[36] (32%), Canada[37] (34%), Boston[21] (35%), or Malaysia[34] (36%).

The prevalence of ED in men over 70 yr was 49% in the present study, similar to prevalence rates of studies conducted in Italy[17] (48%), or Germany[6] (53%), higher than prevalence rates of Taiwan[30] (34%) or The Netherlands[18] (42%), and lower than prevalence rates reported by studies conducted in United States[35] (55%), Australia[19] (58%), or Malaysia[34] (74%).

The crude prevalence of ED in men over 18 yr with no upper limit was 17% in the present study, lower to prevalence rates reported by studies conducted in Singapore[25] (28%), Australia[19] (32%), Jordan[33] (32%), Austria[38] (32%), or Germany[23] (35%). In this population, the age-adjusted

prevalence of the present study (12.4%) was similar to prevalence rates reported by studies that also used a single question related with NIH definition[1] to diagnose ED, as those conducted in The Netherlands[18] (11%), Spain[20] (12%), and Italy[17] (13%).

Although both crude and age-adjusted prevalence rates of ED were similar in population under 40 yr (0.8%) and in population over 70 yr (49%), the age-adjusted prevalence of ED in entire adult male population was almost five percentage points lower than its crude prevalence, and almost three percentage points lower in men over 40 yr. These differences justified the need to standardize prevalence rates due to the differences between the population structure of the sample and the Spanish population.

The main limitation of present study was that the ED degrees were not assessed. The IIEF questionnarie[9] has been used to assess the efficacy of sildenafil, to identify patients at risk for ED, and to detect the severity of ED in heterosexual men with well-established partnerships. The study populations could be limited if the single men, homosexual men, divorced, and widowed were not included. On the other hand, an insufficient erection for a satisfactory sexual performance would allow to diagnose ED without the obligation to assess different degrees of erection. Others limitations included the inability of cross-sectional data to determine causation, and the possibility that men with ED did not respond or deny it.

The main strengths of present study were the population-based random selection, a large sample that included men aged 18–102 yr, and the assessment of other diseases, CVRF and CVD associated with ED.

The determination of the prevalence of ED is very important to optimize the available health resources and to improve health care and quality of life for patients. The ED is strongly influenced by age, so its prevalence should always be reported with age-adjusted rates to facilitate comparison with those in other populations. Improving knowledge of the prevalence could be achieved by conducting more epidemiological studies with similar methodologies aimed at the entire population. We hope that present study will contribute to a better understanding of the ED prevalence.

Conclusions

The SIMETAP-ED study provides the most current information about the ED prevalence in a Spanish primary care setting. The metabolic diseases, CKD, CVRF, and CVD were associated with ED, highlighting especially the CVD.

This study agrees that ED is rare in men under 40 yr and that about 50% of the population over 70 yr suffers from ED. The age-adjusted prevalence of ED in men over 18 yr with no upper limit was 12.4%, similar to prevalence rates reported by other studies conducted in Europe. There are many studies reporting prevalence of ED in men over 40 yr, however the prevalence rates are very different from each other. The age-adjusted prevalence of ED in men over 40 yr was 19% in present study, and close to 11% in men aged 40–69 yr. Further studies with age-adjusted rates are required to accurately determine prevalence of ED.

Declarations

This scientific work is original and has not been submitted or published nor is it being considered for publication in any other medium or publication.

I declare that all the authors of this scientific work agree to send it to be presented in the Journal of Clinical Research in Arteriosclerosis.

Research ethics committee

Comisión de Investigación de la Gerencia Adjunta de Planificación y Calidad.

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Conflicts of interest

The authors have no conflicts of interest for this publication.

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